3rd International Fire Ecology & Management Congress

November 13 - 17, 2006

Town & Country Resort & Convention Center • San Diego, California

PROGRAM

Hosted by:

The Association for Fire Ecology

In cooperation with:

Washington State University
Department of Natural Resource Sciences Extension

Tall Timber Research Station

The Nature Conservancy

Sponsored by:

USDA Forest Service, Pacific Southwest Region

USDA Forest Service Research, Washington Office

USDI Bureau of Land Management, Office of Fire and Aviation

Joint Fire Science Program

National Aeronautics and Space Administration

USDA Forest Service, Pacific Southwest Research Station

University of Chapingo, Mexico

U.S. Geological Survey

USDI National Park Service

ESRI

The Association for Fire Ecology would like to welcome all who have traveled from near and very far to attend the Third International Fire Ecology and Management Congress. This is truly an international event, with over 625 papers and posters being presented by representatives of 22 countries from 6 continents. The interest in fire ecology and its relationship to wildland fire management continues to increase. Compare the interest in this event to the first Tall Timbers Fire Ecology Conference in 1962, with 14 papers and 93 attendees. The growth in this field is also apparent from the amount of student participation in this Fire Congress, both from the Student Association for Fire Ecology, with chapters at 14 U.S. college campuses, and from other universities in this country and abroad.

We are here because we are ecologists and managers who seek to understand how the world works, its natural processes and their interaction with people. We are concerned that wildfires are becoming larger and more severe, despite our best efforts. We are concerned about the effects of these wildfires on natural resources and ecosystems, and their economic and intangible values. And we recognize that these fires have increasing impacts on people. The Congress will explore this apparent alteration in fire regimes in the plenary sessions on Monday, Wednesday and Friday, and in several special and contributed sessions. Other sessions focus on fire effects on ecosystems and their components, management actions to mitigate these changes, fire models and technology, and social responses to fire.

Your attendance shows your willingness to address the challenging issues faced by wildland fire management today, not the least of which is to gain an understanding of how ecosystems interact with and respond to fire – their fire ecology. Responses vary among ecosystems because they are collections of individual species, and soils, each with variations in their ability and means to respond to fire, each with associated fuel complexes, and affected by different fire climates. Yet the principles and processes that govern the interaction of fire with ecosystems and their components are universal. Research can lead to additional understanding of how these principles function. New knowledge, methods for study, models and technology, and management practices can be shared and applied in many different biomes and regions of the globe. We are here to explore different perspectives on wildland fire ecology and management, create new ideas through conversation, build new partnerships, and most of all, to learn.

I would like to thank all who contributed to making this Congress such a success, in particular the Extension Meeting Management and Program Support staff from Washington State University. I would also like to thank the Steering Group and Program Committee who in the last two years built this Congress from an idea. And thank you all for participating. We are only a success because of you.

Melanie Miller, Steering Group Chair,
USDI Bureau of Land Management, Office of Fire and Aviation
Stationed at Rocky Mountain Research Station, Missoula, Montana, USA

Steering Committee

Micah Beierle, Stephen F. Austin State University, Texas
Jan Beyers, USDA Forest Service, California
Anne Bradley, The Nature Conservancy, New Mexico
James Brenner, Division of Forestry, Florida
Wayne Cook, USDA Forest Service, Montana
Susan Conard, USDA Forest Service, Washington, DC
Detlef Decker, Washington State University, Washington
Louisa Evers, USDI Bureau of Land Management, Oregon
Anne Fege, San Diego Natural History Museum, California
Tim Ingalsbee, Firefighters United for Safety and Ethics, Oregon
Ron Masters, Tall Timbers Research Station, Florida
Sarah Otterstrom, Paso Pacifico, California and Nicaragua
Paula Seamon, The Nature Conservancy, Florida
Carrie Shaw, Association for Fire Ecology, California

Program Committee:

Chair: Neil Sugihara, USDA Forest Service, California
Mark Cochrane, South Dakota State University, South Dakota
Tom Dooley, The Nature Conservancy, Oregon
Chris Dicus, California Polytechnic University, California
Jeff Eidenshink, U.S. Geological Survey, South Dakota
Kevin Robertson, Tall Timbers Research Station, Florida

Third International Fire Ecology and Management Congress
San Diego, California USA

Banquet Program

Wednesday November 15, 2006

Masters of Ceremony:
Jan van Wagtendonk and Neil Sugihara

18:00	No host bar and mixer
18:30	Dinner served
19:15	AFE Presidential Address
	Robin Wills, President, Association for Fire Ecology
19:30	Featured Speaker:

Dr. William Bond

Botany Department
University of Cape Town
South Africa

Fitting Fire into Global Ecology

The textbooks tell us that global biome distribution is largely determined by climate with local modification by soils. However large areas of the globe support far too few trees for their climate potential to grow woody biomass. They include some of the most frequently burnt areas on earth. I will discuss recent evidence for fire as a primary determinant of these 'open' ecosystems, their evolutionary origins and conflicting ideas on when, where and why fire became important in terrestrial ecosystems.

20:15 **Award Presentations**

Student Association for Fire Ecology (SAFE) Awards
Micah Beierle presenter

Association for Fire Ecology Lifetime Achievement Awards
Life-time significant contribution to fire ecology and management in the United States. The contribution may be in research, service, or a combination of these areas.

Western United States- The Harold Biswell Award
Scott Stephens presenter

Eastern United States- The Herbert Stoddard Sr. Award
Brian Oswald presenter

Third International Fire Ecology
and Management Congress
San Diego, California USA

Association for Fire Ecology Annual Meeting

Thursday, November 16, 2006
7:00 – 8:30 pm

7:00 Welcome
Robin Wills, President of the Board

7:10 Informal Presentation and Discussion with:

Dr. Stephen Pyne
Regents' Professor
School of Life Sciences
Arizona State University
Tempe, Arizona, USA

The Wrath of Kuhn:
Rethinking the Paradigms of Fire Scholarship

7:45 AFE's Proposed Registered Fire Ecologist Program
Dr. J. Morgan Varner, Humboldt State University
Dr. Andrea Thode, Northern Arizona University

8:10 Discussion of the Draft San Diego Declaration on Climate Change and Fire Management
AFE Board of Directors

8:30 Adjourn

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Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
	Vendor Exhibits & Poster Session Displays					
8:00 AM		*8:00 AM - 12:00 PM Short Courses*	*8:00 AM - 12 Noon Concurrent Sessions Tracks 1-10*	*8:00 AM - 10:00 AM Midweek Plenary Session*	*8:00 AM - 12:00 Noon Concurrent Sessions Tracks 1-10*	*8:00 AM - 10:00 AM Concurrent Sessions Tracks 1-10*
9:00 AM	*9:00 AM - 4:00 PM Field Trips*					
10:00 AM				*10:00 AM - 10:30 AM Break* / *10:30 AM - 12:00 Noon Concurrent Sessions Tracks 1-10 Cont.*		*10:00 AM - 10:30 AM Break* / *10:30 AM - 12:30 PM Closing Plenary Session*
11:00 AM						
12:00 PM			*12 Noon - 1:30 PM Break*	*12 Noon - 1:30 PM Break*	*12 Noon - 1:30 PM Break*	*Congress Adjourned*
1:00 PM		*1:00 PM - 3:00 PM Opening Plenary Session*	*1:30 PM - 5:30 PM Concurrent Sessions Tracks 1-10 Cont.*	*1:30 PM - 6:00 PM Concurrent Sessions Tracks 1-10 Cont.*	*1:30 PM - 6:00 PM Concurrent Sessions Tracks 1-10 Cont.*	*1:00 PM - 5:00 PM Field Trips*
2:00 PM						
3:00 PM		*3:00 PM - 3:30 PM Break* / *3:30 PM - 5:00 PM Opening Plenary Session Cont.*				
4:00 PM						
5:00 PM		*5:30 PM - 8:00 PM Exhibitors Reception*	*5:30 PM - 8:00 PM Poster Session Reception*			
6:00 PM						
Evening		*On your own*	*On your own*	*Congress Banquet hosted by the Association for Fire Ecology*	*Association for Fire Ecology Annual Meeting 19:00 - 20:30*	

Monday, November 13, 2006

OVERVIEW

Time	Room 1	Room 2	Room 3	Room 4	Room 5
8:00 AM 9:00 AM 10:00 AM 11:00 AM	*8:00 AM - 12 Noon* **Environmental Considerations of Fighting Wildland Fires with Chemical Products** *Laila Lienesch, Merrill Saleen, Ed Little, Susan Finger*	*8:00 AM - 12 Noon* **Fire Regime Condition Class: Concepts, Methods, and Applications** *Doug Havlina, Steve Barrett, Dale Hamilton*	*8:00 AM - 12 Noon* **FFI: Fire Ecology Assessment Tool and FIREMON Integration** *Nate Benson, Martha Isbister, Duncan Lutes, Kim Johnson, Austin Streetman, John Caratti, Carter Barnes*	*8:00 AM - 12 Noon* **A Suite of Fuel Management Tools: Fuel Characteristic Classification System, Natural Fuels Photo Series, and Consume 3.0** *Roger D. Ottmar, Cynthia L. Riccardi, Susan J. Prichard, Clint S. Wright, Bob Vihnanek*	*8:00 AM - 12 Noon* **FLAME – FireLine Assessment Method** *Jim Bishop*
12 Noon					

OVERVIEW

Monday, November 13, 2006

Room 6	Room 7	Room 8	Room 9	Room 10	Room 11	Time
	8:00 AM - 12 Noon *Unraveling the Fireshed Code* *Ager, A., Bahro, B., Barber, K., Finney, M.A., McHugh, C., Seli, R,. Sherlock, J., Wright, K., Yasuda, D.*	*8:00 AM - 9:50 AM* Firesafe Buildings and Landscapes: New research and tools for fire prevention *Dr. Greg McPherson, John Kennedy, Dr. Frank Beall, Dr. Jo Ann Fites, Paula Peper, Dr. Mark Dietenberger*	*8:00 AM - 9:50 AM* Help with using the 40 new fire behavior fuel models *Joe H. Scott*	*8:00 AM - 9:50 AM* From start to finish: Creating an effective fire ecology education program for teachers *Christine Denny*	*8:00 AM - 9:50 AM* *Fire and Fuels Extension to the Forest Vegetation Simulator* *Stephanie Rebain*	*8:00* *9:00*
						10:00
		10:10 AM - 12 Noon Firesafe Buildings and Landscapes: New research and tools for fire prevention *Dr. Greg McPherson, John Kennedy, Dr. Frank Beall, Dr. Jo Ann Fites, Paula Peper, Dr. Mark Dietenberger*	*10:10 AM - 12 Noon* Help with using the 40 new fire behavior fuel models *Joe H. Scott*	*10:10 AM - 12 Noon* From start to finish: Creating an effective fire ecology education program for teachers *Christine Denny*	*10:10 AM - 12 Noon* *Fire and Fuels Extension to the Forest Vegetation Simulator* *Stephanie Rebain*	*11:00*
						12:00

OVERVIEW

Tuesday, November 14, 2006

Time	Track 1	Track 2	Track 3	Track 4	Track 5
8:00 AM 9:00 AM 10:00 AM 11:00 AM	*8:00 AM - 12 Noon* Changing Fire Dynamics and Ecosystem Responses in Tropical Vegetation *Mark A. Cochrane*	*8:00 AM - 12 Noon* Contributed Papers - Public Perception and Education - Community Wildfire Management	*8:00 AM - 12 Noon* Fire Effects and Fire/Climate Interactions in Boreal Forests *Susan G. Conard, Douglas McRae*	*8:00 AM - 12 Noon* Contributed Papers - Smoke and Atmospheric Modeling	*8:00 AM - 12 Noon* Wildland Fire Use in the United States: Building the future from 35 years of Learning - History of Wildland Fire Use: What have we learned? *Carol Miller* *Tom Zimmerman*
12 Noon	*12 Noon - 1:30 PM* *Break*				
1:00 PM 2:00 PM 3:00 PM 4:00 PM 5:00 PM	*1:30 PM - 5:00 PM* Changing Fire Dynamics and Ecosystem Responses in Tropical Vegetation - cont. *Mark A. Cochrane*	*1:30 PM - 5:30 PM* Building the support you need: Incorporating education and communications into fire management programs *Maureen Brooks*	*1:30 PM - 4:15 PM* Contributed Papers - Climate Change / Carbon Cycling	*1:30 PM - 5:30 PM* A Roadmap for Improved Weather and Climate Information for Wildland Fire Stakeholders and Decision makers *Bob Dumont* *Samuel Williamson*	*1:30 PM - 5:30 PM* Wildland Fire Use in the United States: Building the future from 35 years of Learning - Future challenges and opportunities *Carol Miller* *Tom Zimmerman*
5:30 PM					
6:00 PM					
Evening					

Track 6	Track 7	Track 8	Track 9	Track 10	Time
8:00 AM - 12 Noon Fire Effects on Fishes/Aquatics *John Rinne*	*8:00 AM - 12 Noon* Contributed Papers - Fuels Management	*8:00 AM - 12 Noon* LANDFIRE: Scientific Foundations for Multi-scale Fire, Fuels and Risk Assessments Across the United States *Kevin Ryan*	*8:00 AM - 12 Noon* The 2003 Southern California Fires: Science Insights Into the Fire Event and Recovery *Jon Keeley*	*8:00 AM - 12 Noon* Contributed Papers - Plant Species & Communities	8:00 9:00 10:00 11:00
		12 Noon - 1:30 PM *Break*			12:00 13:00
1:30 PM - 5:15 PM Fire Effects on Fishes/Aquatics *John Rinne*	*1:30 PM - 5:30 PM* Fire and Dynamics of Arid and Semi-Arid Landscapes *Peter Weisberg* *Ashley Sparrow*	*1:30 PM - 5:30 PM* Do past management activities compound the effects of fire exclusion in western forests? *Anna Sala*	*1:30 PM - 5:00 PM* The 2003 Southern California Fires: Science Insights Into the Fire Event and Recovery *Jon Keeley*	*1:30 PM - 5:15 PM* Contributed Papers - Plant Species & Communities	14:00 15:00 16:00 17:00

Tuesday, November 14, 2006

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Wednesday, November 15, 2006

Time	Track 1	Track 2	Track 3	Track 4	Track 5
8:00 AM – 9:00 AM	*8:00 AM - 10:00 AM* Midweek Plenary Session (all tracks)				
10:00 AM	*10:00 AM - 10:30 AM* Break				
11:00 AM	*10:30 AM - 12 Noon* Contributed Papers - Tropical Ecosystems	*10:30 AM - 12 Noon* Learning and Leading After the 2003 Wildfires in San Diego - Professional and Community Cooperation Created After the October 2003 Wildfires in San Diego *Anne Fege*	*10:30 AM - 12 Noon* Advances in Fire Climatology: Using Modern and Paleofire Data to Understand Long-Term and Broad-Scale Fire Regime Changes in Western North America *Tom Swetnam, Scott Anderson*		
12 Noon	*12 Noon - 1:30* Break				
1:00 PM – 4:00 PM	*1:30 PM - 5:00 PM* California and Australian Aboriginal Burning Practices and Contemporary Fire Management: Restoration of culturally significant habitats *Frank K. Lake*	*1:30 PM - 3:00 PM* Learning and Leading After the 2003 Wildfires in San Diego - Professional and Community Cooperation Created After the October 2003 Wildfires in San Diego *Anne Fege* *3:30 PM - 5:15 PM* The 2003 Southern California Fires: Science Insights Into the Fire Event and Recovery *Anne Fege*	*1:30 PM - 3:00 PM* Advances in Fire Climatology: Using Modern and Paleofire Data to Understand Long-Term and Broad-Scale Fire Regime Changes in Western North America *Tom Swetnam, Scott Anderson*	*1:30 PM - 6:00 PM* Liability, Threatened and Endangered Species, Clean Water, and Cultural Resources: Issues and Challenges *Jim Brenner*	*1:30 PM - 6:00 PM* Fire Ecology and Fuels Management Collaboration: The Good, the Bad, and the Ugly *Paul Reeberg*
5:00 PM					
6:00 PM					
Evening					

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Wednesday, November 15, 2006

Track 6	Track 7	Track 8	Track 9	Track 10
8:00 AM - 10:00 AM *Midweek Plenary Session*				
10:00 AM - 10:30 AM *Break*				
10:30 AM - 12 Noon Contributed Papers - Insects	*10:30 AM - 12 Noon* Contributed Papers - Ecological Restoration	*10:30 AM - 12 Noon* Contributed Papers - Remote Sensing - GIS Applications	*10:30 AM - 12 Noon* Landscape models of fire and vegetation dynamics in research and management -- A strategy for future development *Bob Keane*	*10:30 AM - 12 Noon* Contributed Papers - Fire History/Regimes
12 Noon - 1:30 *Break*				
1:30 PM - 4:30 PM The Interactions of Wildfire and Insect Outbreaks *Daniel Tinker*	*1:30 PM - 5:15 PM* Wildland Fire Decision Support *John Szymoniak*	*1:30 PM - 5:30 PM* Improving Wildfire Observations Through Technology and Science Advancements *Vince Ambrosia*	*1:30 PM - 4:30 PM* Landscape models of fire and vegetation dynamics in research and management -- A strategy for future development *Bob Keane* *Sue Conrad*	*1:30 PM - 5:00 PM* Contributed Papers - Fire History/Regimes
			4:00 PM - 6:00 PM Workshop on landscape modeling: Developing a key for model selection and a strategy for future model development *Bob Keane* *Sue Conrad*	

Time
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
Evening

OVERVIEW

Thursday, November 16, 2006

Time	Track 1	Track 2	Track 3	Track 4	Track 5
8:00 AM	8:00 AM - 12 Noon Fire Regimes and Fire Effects in Mexican Ecosystems *Ronald Myers* *Dante Rodriguez-Trejo*	8:00 AM - 10:00 AM The Public and Fire Management: Understanding social issues of fire management at multiple scales *Sarah McCaffrey*	8:00 AM - 11:30 AM Fire Mediated Changes in the Alaskan Boreal Forest *Amy Lovecraft*	8:00 AM - 12 Noon Air Quality Regulations and Wildland Fire: Issues and Challenges - Federal Air Quality Standards, Regulations, and Policies that may Impact Wildland Fire *Pete Lahm*	8:00 AM - 12 Noon The Effects of Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective. *Scott Stephens* *John Bailey*
9:00 AM					
10:00 AM		10:30 AM - 12 Noon San Diego Wildfires Education Project: From Wildland Fires to School Curriculum *Stephen F. Barnes*			
11:00 AM					
12 Noon			12 Noon - 1:30 PM *Break*		
1:00 PM	1:30 PM - 6:00 PM Fire Regimes and Fire Effects in Mexican Ecosystems - cont. *Ronald Myers* *Dante Rodriguez-Trejo*		1:30 PM - 4:45 PM Changing Spatiotemporal Dynamics of Fire Regimes in the Appalachian Mountains *Charles Lafon*	1:30 PM - 5:30 PM Air Quality Regulations and Wildland Fire: Issues and Challenges - State and Local Air Quality Regulations that may Impact Wildland Fire *Pete Lahm*	1:30 PM - 5:30 PM The Effects of Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective - cont. *Scott Stephens* *John Bailey*
2:00 PM					
3:00 PM					
4:00 PM					
5:00 PM					
6:00 PM					
Evening					

Track 6	Track 7	Track 8	Track 9	Track 10	Time
8:00 AM - 12 Noon Contributed Papers - Ecosystem Process - Soils, Watershed, Aquatic	*8:00 AM - 12 Noon* Contributed Papers - Risk Assessment - Decision Support for Planning & Budgeting	*8:00 AM - 12 Noon* Applications of Remotely Sensed Burned Area and Severity Data *Andrea Thode*	*8:00 AM - 12 Noon* Big Fires: Disaster or diversity? *Dick Williams* *Ross Bradstock*	*8:00 AM - 12 Noon* Fire and Nonnative Invasive Plants *Jane Kapler Smith*	*8:00* *9:00* *10:00* *11:00*
					12:00 *13:00*
1:30 PM - 5:30 PM Contributed Papers - Soil, Watershed, Aquatic - Wildlife and Habitat	*1:30 PM - 5:30 PM* Contributed Papers - Fire and Behavior Modeling	*1:30 PM - 5:30 PM* Contributed Papers - Fire and Burn Severity Mapping - Postfire Rehabilitation & Management	*1:30 PM - 5:00 PM* Big Fires: Disaster or diversity? - cont. *Dick Williams* *Ross Bradstock*	*1:30 PM - 5:30 PM* Fire and Nonnative Invasive Plants - cont. *Jane Kapler Smith*	*14:00* *15:00* *16:00* *17:00*
					18:00
					Evening

Thursday, November 16, 2006

OVERVIEW

Friday, November 16, 2006

OVERVIEW

Time	Track 2	Track 4	Track 5	Track 7	Track 8	Track 10
8:00 AM 9:00 AM	*8:00 AM - 10:00 AM* Contributed Papers - Policy and Programs	*8:00 AM - 10:00 AM* Contributed Papers - Planning and Assessment	*8:00 AM - 10:00 AM* Contributed Papers - Wildland-Urban Interface	*8:00 AM - 10:00 AM* Contributed Papers - Fuels Treatment Effects on Fire Behavior	*8:00 AM -9:45 AM* Contributed Papers - Postfire Rehabilitation & Management	*8:00 AM - 9:45 AM* Contributed Papers - Invasive Plants
10:00 AM	10:00 AM - 10:30 AM Break					
11:00 AM 12 Noon	10:30 AM - 12:30 PM Closing Plenary Session					
	Congress Adjourns					
1:00 PM 2:00 PM 3:00 PM 4:00 PM 5:00 PM	1:00 PM - 5:00 PM Field Trips					

SPEAKERS

Tuesday, November 14, 2006

	Track 1	Track 2	Track 3	Track 4	Track 5
8:00 – 8:15	David Bowman	Stentor Danielson	Susan Conard	Douglas Fox	Bruce Kilgore
8:15 – 8:30		James Absher	Bill De Groot	Janice Coen	Dave Bunnell
8:30 – 8:45		Patricia Winter		Sean Raffuse	Jan van Wagtendonk
8:45 – 9:00	J. Boone Kauffman	Rebecca Montgomery	Douglas McRae	Hyun Cheol Ki	Rich Lasco
9:00 – 9:15		Christine Denny	Douglas McRae	Stephen Reid	Jim Hubbard
9:15 – 9:30	Mark A.. Cochrane	Patricia L. Winter	Steve Baker	Yongqiang Liu	Brandon Collins/ Scott Stephens
9:30 – 9:45		Shelaine Curd-Hetrick	Ron Neilson	Daewon Byun	Zack Holden
9:45 –10:00		Heidi Bigler-Cole	Nadja Tchebakova	Gary Achtemeier	Alisa Keyser
10:30 – 10:45	Jennifer Balch	James Absher	M.R. Turetsky	Robert Mickler	Tom Zimmerman
10:45 – 11:00		Carlu Van der Westhuizen	M.R. Turetsky	Gary Achtemeier	Martha Williamson
11:00 – 11:15	Heidi Asbjornson	Abraham Lincoln Owusu	Edward Berg		John Syzmoniak
11:15 – 11:30		Peter Jacklyn	Edward Berg		Patti Koppenol
11:30 – 11:45	Jos Barlow	Durgadas Mukhopadhyay	Kristen Manies		Carol Miller
11:45 – 12:00					
13:30 – 13:45	Ernesto Alvarado	Maureen Brooks	Matthew Hurteau	Samuel P. Williamson	Katie Knotek
13:45 – 14:00		Ed Smith	Fiona Scarff	Elliot Jacks/Panel	Greg Aplet
14:00 – 14:15	Susan Page		Viatcheslav Kharuk		JoAnn Fites
14:15 – 14:30		Frank Lake	Erica Smithwick		Don McKenzie
14:30 – 14:45	Sarah Otterstrom	Dennis Dupuis	Valerie Trouet		Sandra Haire
14:45 – 15:00		Robin Hanford	Uma Shankar		Carol Miller
15:30 – 15:45	Narendran Kodandapani	Judith Downing	~~Dolors Armenteras~~	Panel/ Allen Riebau	Paula Nasiatka/ Michael DeGrosky
15:45 – 16:00	Tasila Banda		Nancy French		Dave Calkin
16:00 – 16:15	Aaron Petty	Deb Schweizer	Xuexia (Sherry) Chen		Charlie Luce
16:15 – 16:30	Johann Goldammer	John Burwell			Tim Sexton
16:30 – 16:45		Bob Mutch		Eli Jacks , Allen Riebau/ Panel	Carol Miller
16:45 -17:00	Marc A.. Cochrane				
17:00 – 17:15		John Owens			Miller - Panel
17:15 – 17:30			Mary Cairns/ David Andrus/ Robert Dumont		

Track 6	Track 7	Track 8	Track 9	Track 10	
John Rinne	*Alicia Reiner*	*Kevin Ryan*	*Randy Lyle*	*Robert Martin*	8:00 – 8:15
David Propst	*Jonathan Stober*	*Jim Menakis*		*Tasila Banda*	8:15 – 8:30
Stephanie Coleman	*Jennifer Rechel*		*Philip Riggan*	*Shibu Jose*	8:30 – 8:45
Gerald Jacobi	*Clint Wright*	*Don Long*		*David Wester*	8:45 – 9:00
Kara Hilwig	*Jennifer Gibson*	*Matt Rollins*	*Richard W. Halsey*	*Miguel Luna*	9:00 – 9:15
Codey Carter	*Chuck Harrell*			*Thomas Kaye*	9:15 – 9:30
Dennis Miller	*Leda Kobziar*	*Jay R. Kost*	*Max Moritz*	*Neil Burrows*	9:30 – 9:45
John Rinne	*Sharon Hood*	*Matt Reeves*			9:45 –10:00
Don Mitchell	*Jeffrey Kane*	*Doug Haulina*	*Jan Beyers*	*Jah Sah*	10:30 – 10:45
Codey Carter	*Kyle Jacobson*			*Sandra Rideout-Hanzak*	10:45 – 11:00
Jonathan Long	*Malcolm North*	*James L. Smith*	*Peter W. Wohlgemuth*	*Andi Thorstenson*	11:00 – 11:15
John Rinne	*Matt Busse*			*Julie Draper*	11:15 – 11:30
John Rinne	*Eric Just*	*Zhiliang Zhu*	*Janet Franklin*	*Bridget Lair*	11:30 – 11:45
	Peter Cowan			*Mai Hassan*	11:45 – 12:00
Dan Neary	*Ashley Sparrow*	*Pete Fulé*	*Jon Keeley*	*Leigh Lentile*	13:30 – 13:45
Ed Little				*Trent Penman*	13:45 – 14:00
	Matt Brooks	*Jonathan Bakker*	*Robert N. Fisher*	*Peter Kolb*	14:00 – 14:15
Jason Dunham				*Evelyn Hamilton*	14:15 – 14:30
Codey Carter	*Peter Clarke*	*Andre Sanchez Meador*	*Wayne Spencer*	*Jen Hooke*	14:30 – 14:45
Andi Thode				*Paul Hosten*	14:45 – 15:00
Tim Burton	*David Bowman*	*Mike Battaglia*	*Philip Unitt*	*Scott Stephens*	15:30 – 15:45
Clint Sestrich				*Jose Iniguez*	15:45 – 16:00
Alvin Medina	*John Bauer*	*Peter Morrison*	*Hugh Safford*	*Penny Morgan*	16:00 – 16:15
Shaula Hedwall				*Rick Everett*	16:15 – 16:30
Bruce Rieman	*Peter Weisberg*	*Jonathan Thompson*	*Jon Keeley*	*Eric Keeling*	16:30 – 16:45
				Charlotte Reemts	16:45 – 17:00
John Rinne	*Peter Weisberg/ Panel*	*Anna Sala*		*Timothy Paysen*	17:00 – 17:15
					17:15 – 17:30
					17:30 – 17:45

Wednesday, November 15, 2006

	Track 1	Track 2	Track 3	Track 4	Track 5
10:30 – 10:45	Tim Bradley	Anne Fortier	Patrick Bartlein		
10:45 – 11:00	Marco Millones	Valerie Nash	Anthony Westerling		
11:00 – 11:15	Caroline Lehmann	Nancy Owens Renner	Timothy Brown		
11:15 – 11:30	Aaron Petty	Geoffrey Smith	Cathy Whitlock		
11:30 – 11:45	Laura Johnson	Anne Fege	R. Scott Anderson		
11:45 – 12:00	Girraj Amarnath		Jennifer L. Pierce		
13:30 – 13:45	Aaron M. Petty	Bruce Goff	Grant A. Meyer	Tom Buman	Matt Brooks
13:45 – 14:00		Marty Leavitt	Craig Allen	Jeff Stephen	Jon E. Keeley
14:00 – 14:15		Drew Potocki	Thomas T. Veblen	Stephen Bakken	Kevin Greenhalgh
14:15 – 14:30		Thomas Porter	Peter M.Brown	Brenner/Panel	Bruce Fields
14:30 – 14:45	Don Hankins	Pamela Padgett	Amy Hessl	Therese O' Rourke	
14:45 – 15:00		Anne Fege	Alan H. Taylor	Chris Knopp	
15:30 – 15:45	Frank K. Lake	JulianDuval		Laila Lienesch	Jennifer L. Allen
15:45 – 16:00				Brenner/ Panel	Caroline Noble
16:00 – 16:15	Diana Immel	Anne S. Fege		Sherry Hazelburst	Fred Wetzel
16:15 – 16:30		Drew Hubbell		John Greis	Lynn Decker
16:30 – 16:45	Heather Busam	Stephen Quarles		Bruce Sims	Bill Leenhouts
16:45 – 17:00		Ron Montague		Brenner/ Panel	
17:00 – 17:15	Presenters	Anne Fege		Gary Knudsen	Reeberg/Panel
17:15 – 17:30				Julie A. Bell	
17:30 – 17:45				Kathy Foppes	
17:45 – 18:00				Brenner/ Panel	

Track6	Track 7	Track 8	Track 9	Track 10	
Brad Hawkes	*Don Falk*	*John Hom*	*Jimmie Chew*	*Gregory Nowacki*	10:30 – 10:45
Michael Jenkins	*Rebecca Stratton*	*Birgit Petersen*		*Brean W. Duncan*	10:45 – 11:00
Allan York	*Troy Morris*	*Cristobal Rullán*	*Donald McKenzie*	*Dana Cohen*	11:00 – 11:15
Fiona Christie	*Stacy Clark*	*Kelly O'Neal*		*Patricio Pedemera-Alvarez*	11:15 – 11:30
Roy Wittkuhn	*Robert Klein*	*Matt Crawford*	*F. Mouillot*	*Klaus Braun*	11:30 – 11:45
		Dale Hamilton		*Roy Wittkuhn*	11:45 – 12:00
Ken Gibson	*John Szymoniak*	*Everett Hinkley*	*Garry Cook*	*Rand R. Evett*	13:30 – 13:45
William H. Romme				*Russell Parsons*	13:45 – 14:00
Rich A. Fleming	*Bret Butler*	*Marco Trombetti*	*Chao Li*	*David Mladenoff*	14:00 – 14:15
Dominik Kulakowski				*Edward Berg*	14:15 – 14:30
Martin Simard	*Mark Finney*	*Dar A.. Roberts*	*Michael C. Wimberly*	*Andrea Thode*	14:30 – 14:45
Nancy K. Bockino				*Steve Wathen*	14:45 – 15:00
Hugh J. Barclay	*Krista Gebert*	*Diane Davies*	*Robert Scheller*	*Elaine Kennedy Sutherland*	15:30 – 15:45
Barbara Bentz				*Peter M. Brown*	15:45 – 16:00
Kevin C. Ryan	*David Calkin*	*Louis Giglio*	*Robert E. Keane*	*Calvin Farris*	16:00 – 16:15
Diana L. Six				*Tadashi Moody*	16:15 – 16:30
	Richard Stratton	*Brad Quayle*		*Andrew Scroll*	16:30 – 16:45
				Anthony Caprio	16:45 – 17:00
	Richard Szymoniak	*Amber Soja*			17:00 – 17:15
					17:15 – 17:30
					17:30 – 17:45
					17:45 – 18:00

Thursday, November 16, 2006

	Track 1	Track 2	Track 3	Track 4	Track 5
8:00 – 8:15	*Ronald Myers*	*Susan Stewart*	*Sarah Trainor*	*Pete Lahm*	*Jim McIver*
8:15 – 8:30		*David N. Bengston*			*Dylan Schwilk*
8:30 – 8:45	*Ernesto Alvarado*	*Pamela Jakes*	*Jill Johnstone Tessa Hollingsworth*	*Rosalina Rodriguez*	
8:45 – 9:00		*Victoria Sturtevant*			*Tom Waldrop*
9:00 – 9:15	*Jose German Flores Garnica*	*Christine Vogt*	*Sarah Trainor*	*Larry Elmore*	
9:15 – 9:30		*Sarah Mc Caffrey*			*Andrew Youngbood*
9:30 – 9:45	*Juan de Dios Benavides Solorio*	*Sarah McCaffrey/Panel*	*La'ona DeWilde*	*Tom Pace*	
9:45 –10:00					*Leda Kobziar*
10:30 – 10:45	*Richard A. Minnich*	*Stephen F. Barnes*	*Amy Lovecraft*	*Jim Homolya*	*Bruce Hartsouth*
10:45 – 11:00					*Sarah McCaffrey*
11:00 – 11:15	*Peter Z. Fulé*	*Panel/Stephen Barnes, Tracy Albrecht, Ivan Golakoff, Adrienne Marriott, Carol Radford, Nancy Taylor*	*Paul Duffy*	*Jim Brenner*	*D.W. Schwilk*
11:15 – 11:30					
11:30 – 11:45	*Dante Arturo Rodriguez -Trejo*			*Dan Johnson*	*John Bailey*
11:45 – 12:00					
13:30 – 13:45	*Enrique J. Jardel Pelaez*		*Sally Horn*	*Bob Habeck*	*Carl Fiedler*
13:45 – 14:00			*Norman Christensen*		
14:00 – 14:15	*Leonardo Cabrera Garcia*		*Henri Grissino-Mayer*	*Jim Brenner*	*Scott Stephens*
14:15 – 14:30			*Marc Abrams*		
14:30 – 14:45	*Maria de Lourdes Villers Ruiz*		*Patrick Brose*	*Debra Wolfe*	*Ralph Boerner*
14:45 – 15:00			*Ted Gragson*		*Stephen Hart*
15:30 – 15:45	*Rosa Maria Roman Cuesta*		*Charles Lafon*	*Evan Shipp*	*Stephen Hart*
15:45 – 16:00			*Daniel Graybeal*	*Pete Lahm*	*Sarah Converse*
16:00 – 16:15	*Mary Huffman*		*Jim Vose*	*Sarah McCaffrey*	*Kerry Farris*
16:15 – 16:30			*Tom Waldrop*	*Duane Weis*	
16:30 – 16:45	*Heidi Asbjornsen*		*Katherine Elliott*	*Ed Gee*	*Christopher Fettig*
16:45 - 17:00				*Pete Lahm*	
17:00 – 17:15	*Alfredo Nolasco Morales*				*Jim McIver*
17:15 – 17:30					
17:30 – 17:45	*Dante Arturo Rodriguez- Trejo*				

Thursday, November 16, 2006

Track6	Track 7	Track 8	Track 9	Track 10	
Paul Hessburg	Alexandra Syphard	Jose Pereira	Dick Williams	Jane Kapler Smith	8:00 – 8:15
Carl Skinner	Patricio Pedernera-Alvarez		Malcolm Gill	Steve Sutherland	8:15 – 8:30
Kirsten Stephan	Jeffrey Prestemon	Cameron Yates		Matt Brooks	8:30 – 8:45
Anthony Caprio	Armando Rodriguez Montellano		Tania Schoennagel	Peter Rice	8:45 – 9:00
Carlton Britton	Klaus Braun	David Roy		Jane Kapler Smith	9:00 – 9:15
Meg Krawchuk	Davis Weise	Eric S. Kasischke	Patrick Baker	Rob Klinger	9:15 – 9:30
Hal Liechty		Emilio Chuvieco		Steve Radosevich	9:30 – 9:45
Fiona Christie				Anne Marie LaRosa	9:45 –10:00
Luis Outeiro	David Martell	Jeffrey Eidenshink	William Bond	Jane Kapler Smith	10:30 – 10:45
Emily Moghad[illegible]	Keith Reynolds			Kris Zouhar	10:45 – 11:00
Leda Kobziar	Karen Abt	Sally Archibald	Jeremy Russell-Smith	Matt Brooks	11:00 – 11:15
Kevin Robertson				Steve Sutherland	11:15 – 11:30
William Massman		Marc A. Cochrane	Robert E. Keane	Jane Kapler Smith	11:30 – 11:45
Matt Busse		Andrea Thode			11:45 – 12:00
Peter Robichaud	Randell Benson	Crystal Kolden	Phil Burton	Erik Martinson	13:30 – 13:45
Robert Arkle	Brian Sturtevant	Alistair Smith		Molly Hunter	13:45 – 14:00
Alvin Medina	Valeriy Perminoy	John Rogan	Juli Pausas	Paula Fornwalt	14:00 – 14:15
Claud Mellison	Craig Clements	Stephen Howard		Jonathan Freeman	14:15 – 14:30
David Pilliod	Joe Scott	Bill DeGroot	Tom Veblen	Cara Nelson	14:30 – 14:45
Elizabeth Tasker		Karen Murphy		Jon Keeley	14:45 – 15:00
Thalia Partridge	Dominique Morvan	Jay Miller	Ross Bradstock	Kyle Merriam	15:30 – 15:45
Natasha Kotliar	JoAnn Fites	Andrew Hudak		Jane Kapler Smith	15:45 – 16:00
Susan Roberts	Kurt Menning	Tatiana Loboda	Richard J. Williams	Lisa Floyd	16:00 – 16:15
Richard Hutto		Rima Wahab-Twibell		Jeanne Chambers	16:15 – 16:30
Jennifer Potts		Sarah Lewis	Richard J. Williams Ross Bradstock	Allison Ainsworth	16:30 – 16:45
Marc Meyer		Jess Clark		Mick Castillo	16:45 – 17:00
David Wester		Mary Stuever		Panel/Jane Kapler Smith	17:00 – 17:15
		~~Todd Caplan~~		Geneva Chong	17:15 – 17:30

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8:00 – 8:15		*Scott Stephens*			*CJ Fotheringham*
8:15 – 8:30		*Michael Medler*			*Joseph Mitchell*
8:30 – 8:45		*Gordon Friend*			*David Schmidt*
8:45 – 9:00		*Bo Wilmer*			*Wayne Zipperer*
9:00 – 9:15		*Joe Bowersox*			*Chris Dicus*
9:15 – 9:30		*David Ostergren*			*Kevin Fuhriman*
9:30 – 9:45		*Timothy Ingalsbee*			*Mike da Luz*
9:45 –10:00					*Yvonne Everett*

Track6	Track 7	Track 8	Track 9	Track 10	
	Tim Bradley	*Joe Wagenbrenner*			8:00 – 8:15
	Anthony Bova	*Pete Robichaud*			8:15 – 8:30
	Eric Knapp	~~*Todd Caplan*~~			8:30 – 8:45
	Craig D. Kostrzewski	*Troy Wirth*			8:45 – 9:00
	Erin Noonan	*Joe Sabel*			9:00 – 9:15
	Glenn Mason	*Kristine Lee*			9:15 – 9:30
	David A. Schmidt	*James McIver*			9:30 – 9:45
	Reese Lolley				9:45 –10:00

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SPECIAL SESSION

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Track 3	Fire Effects and Fire/Climate Interactions in Boreal Forests *Susan G. Conard, Douglas McRae* 8:00 – 12:00	93
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Track 5	Wildland Fire Use in the United States: Building the Future from 35 Years of Learning *Carol Miller* *Tom Zimmerman* 8:00 – 17:30	117
Track 6	Wildfire Impacts on Fishes, Aquatic Organisms and Their Habitats *John N. Rinne* 8:00 – 17:15	133
Track 7	Fire and Dynamics of Arid and Semi-Arid Landscapes *Peter Weisberg* *Ashley Sparrow* 8:00 – 17:30	147
Track 8	LANDFIRE: Scientific Foundations for Multi-scale Fire, Fuels and Risk Assessments Across the United States *Kevin Ryan* 8:00 – 12:00	163
Track 8	Do Past Management Activities Compound the Effects of Fire Exclusion in Western Forests? *Anna Sala* 13:30 – 17:30	
Track 9	2003 Southern California Fires: Science Insights Into the Fire Event and Recovery *Jon Keeley* 8:00 – 17:00	179

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Track 2	Professional and Community Cooperation Created After the 2003 Wildfires in San Diego *Anne Fege* 10:30 – 15:00	219
Track 2	Engaging Professionals in Reducing Future Risks, After Large Property Losses in 2003 Wildfires in San Diego *Anne Fege* 15:30 – 17:15	
Track 3	Advances in Fire Climatology: Using Modern and Paleofire Data to Understand Long-Term and Broad-Scale Fire Regime Changes in Western North America *Tom Swetnam, Scott Anderson* 10:30 – 15:00	231
Track 4	Liability, Threatened and Endangered Species, Clean Water, and Cultural Resources: Issues and Challenges *Jim Brenner* 13:30 – 18:00	243
Track 5	Fire Ecology and Fuels Management Collaboration: The Good, the Bad, & the Ugly *Paul Reeberg* 10:30 – 17:30	253
Track 6	Interactions of Wildfire and Insect Outbreaks Daniel Tinker 13:30 – 16:30	261
Track 7	Wildland Fire Decision Support *John Szymoniak* 10:30 – 17:15	273
Track 8	Improving Wilfire Observations Through Technology and Science Advancements *Vince Ambrosia* 1:30 – 17:30	283
Track 9	Special Session/Workshop Landscape models of fire and vegetation dynamics in research and management - A strategy for future development *Bob Keane, Sue Conrad* 10:30 – 18:00	295

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Track 2	San Diego Wildfires Education Project: From Wildland Fires to School Curriculum *Stephen F. Barnes* 10:30 – 12:00	
Track 3	Fire Mediated Changes in the Alaskan Boreal Forest *Amy Lovecraft* 8:00 – 11:30	335
Track 3	Changing Spatiotemporal Dynamics of Fire Regimes in the Appalachian Mountains *Charles Lafon* 13:30 – 16:45	
Track 4	Air Quality Regulations and Wildland Fire: Issues and Challenges *Pete Lahm* 8:00 – 17:30	349
Track 5	Effects of Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective *Scott Stephens and John Bailey* 8:00 – 17:30	359
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Track 9	Big Fires: Disaster or Diversity? *Dick Williams* *Ross Bradstock* 8:00 – 17:00	427
Track 10	Fire and Nonnative Invasive Plants *Jane Kapler Smith* 8:00 – 17:30	439

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Track 8	Remote Sensing and GIS Applications 10:30 – 12:00	163
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Track 5	Wildland-Urban Interface 8:00 – 10:00	359
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Track 8	Postfire Rehabilitation and Management 8:00 – 9:45	403
Track 10	Invasive Plants 8:00 – 9:45	439

Featured Speakers


Photo Courtesy of BBC

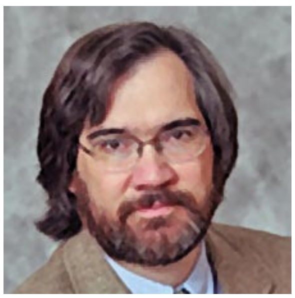
Dr. Richard Alley
The Pennsylvania State University
University Park, Pennsylvania, USA

Dr. Tim Barnett
Scripps Institute of Oceanography
LaJolla, California, USA

Dr. William J. Bond
University of Cape Town
Cape Town, South Africa

Dr. Ross Bradstock
NSW Department of Environment and Conservation
Hurstville, New South Wales, Australia

Featured Speakers



Dr. Mark Cochrane
South Dakota State University
Brookings, South Dakota, USA

Dr. Mike Flannigan
Canadian Forest Service
Sault Ste. Marie, Ontario, Canada

John Gledhill
Tasmania Fire Service
Hobart, Tasmania, Australia

James Hubbard
USDA Forest Service
Washington, DC, USA

Featured Speakers

Dr. Józef Piwnicki
Forest Fire Protection Laboratory
Forest Research Institute
Raszyn, Poland

Dr. Stephen Pyne
Arizona State University
Tempe, Arizona, USA

Brian Stocks
B.J. Stocks Wildfire Investigations
Sault Ste. Marie, Ontario, Canada

Dr. Tom Swetnam
Laboratory of Tree Ring Research
Tucson, Arizona, USA

PLENARY SESSION
OPENING

Monday, November 14, 2006

Welcomes

13:00 – 13:30	Welcomes	*Robin Wills* *President* *Association for Fire Ecology* *Oakland, California, USA* *Ron Masters* *Research Director* *Tall Timber Research Station* *Tallahassee, Florida, USA* *Alfredo Nolasco Morales,* *Mexico Fire Program Coordinator* *The Nature Conservancy* *Mérida, Yucatán, México* *David Baumgartner* *Program Director* *Washington State University Extension* *Pullman, Washington, USA*
13:30 – 13:40	Congress Overview	*Melanie Miller* *Congress Chair* *Bureau of Land Management* *Missoula, Montana, USA*
13:40 – 14:00	Welcome to California	*~~Rubin~~ Grijalva* *Director* *California Department of Forestry and Fire Protection* *Sacramento, California, USA*

Opening Plenary Session

Changing Fire Regimes: Context and Consequences

Moderator: Melanie Miller, USDF Bureau of Land Management, Missoula, Montana, USA

14:00 – 15:00	*Dr. Richard Alley* *Evan Pugh Professor of Geosciences* *The Pennsylvania State University* *University Park, Pennsylvania, USA*	**Back to the Future of Climate Change: Where Surprises Meet Sure Things**
15:30 – 16:30	*Dr. Tim Barnett* *Research Marine Physicist* *Scripps Institute of Oceanography* *LaJolla, California, USA*	**Future Climate of Planet Earth: A Sneak Preview**
16:30 – 17:00	*Robin Wills* *Association for Fire Ecology* *Oakland, California, USA*	**Presentation of San Diego Declaration on Climate Change and Fire Management**

Presentation Title: Back to the Future of Climate Change: Where Surprises Meet Sure Things

Presenter: *Richard Alley*
Evan Pugh Professor of Geosciences
The Pennsylvania State University
University Park, Pennsylvania, USA

Richard Alley is the Evan Pugh Professor of Geosciences at Pennsylvania State. He earned Bachelor's and Master's degrees in Geology from Ohio State University, and earned his Ph.D. in Geology from the University of Wisconsin, Madison. His research focuses on abrupt climate change, glaciers, ice sheet collapse, and sea level change. He interprets the paleoclimatic record found in ice cores -- samples of ice that can be two miles in length collected from Greenland and Antarctica. He has contributed much to our understanding of the stability of these ice sheets. His research has demonstrated that large, abrupt climate changes have occurred many times in the past.

Dr. Alley will discuss climate over the past million years and the importance of various mechanisms that have driven changes in climate. He will provide evidence for a strong relationship between past temperatures and levels of atmospheric carbon dioxide. He will describe rapid changes in climate that have occurred in the last ten thousand years, discuss the response of ice sheets to changing climate, and discuss the future of our climate change based on current knowledge.

Presentation Title: Future Climate of Planet Earth: A Sneak Preview

Presenter: *Tim Barnett*
Research Marine Physicist
Scripps Institute of Oceanography
LaJolla, California, USA

Dr. Tim Barnett has a Bachelor of Science in Physics, Pomona College, and a Masters's and Ph.D, in Physical Oceanography from the Scripps Institute of Oceanography, University of California, San Diego. He investigates the physics of climate change and long-range climate forecasting, focusing his research on greenhouse gases, ocean current effects on climate, and climate forecast model development. He has developed methods for seasonal climate prediction and detection of global warming signals. Past work has included prediction of El Nino and La Nina events, their effects on floods and droughts, and biological consequences, such as effects on fisheries of warmer ocean temperatures. His recent work compares increasing ocean temperatures with predictions from global climate models, showing a compelling relationship with human activity.

Dr. Barnett will discuss the observational and climate modeling evidence that global warming is already having an effect. He will describe the expected impacts of warming in the next few decades on oceans, vegetation distribution, soil moisture, and our supply of fresh water in the western U.S., and generalize these effects to the rest of the planet.

Presentation Title:	Presentation of San Diego Declaration on Climate Change and Fire Management
Presenter:	*Robin Wills, President, Association for Fire Ecology Oakland, California, USA*

PLENARY SESSION
MIDWEEK

Changing Fire Regimes: Perspectives from around the Globe

Moderator: Paula Seamon, The Nature Conservancy, Tallahasee, Florida, USA

8:00- 8:30	*Mark Cochrane* *South Dakota State University* *Brookings, South Dakota, USA*	Changing Fire Regimes: Context and Consequences of Climate Change in Amazonia
8:30 – 9:00	*Tom Swetnam* *Laboratory of Tree Ring Research* *Tucson, Arizona, USA.*	Climate, Forest, and Fire Regime Changes in the Western U.S.
9:00 – 9:30	*Ross Bradstock* *NSW Department of Environment and Conservation,* *Hurstville, New South Wales, Australia*	The fire and climate change prognosis in southern Australia: is Gondwana a goner?
9:30 -10:00	*Mike Flannigan* *Canadian Forest Service* *Sault Ste. Marie, Ontario, Canada*	Fire and Climate Change in Boreal Forests

Presentation Title: Changing Fire Regimes: Context and Consequences of Climate Change in Amazonia

Presenter: *Mark A. Cochrane*
South Dakota State University
Brookings, South Dakota, USA

Abstract: Climate change is synonymous with disturbance, or more specifically a change in disturbance. Two major environmental changes that will influence regional climate change in the tropics are increasing levels of atmospheric CO2 and continued deforestation. While increasing CO2 levels will tend to raise temperatures and precipitation levels, deforestation has the effect of reducing overall precipitation levels. The net effect across the tropics will be a combination of these two disturbances. Model predictions of Amazonian precipitation for a doubling of atmospheric CO2 show an increase of 0.28 mm/day. However, deforestation reduces average precipitation levels by 0.73 mm/day resulting in net increases in surface temperatures and drier hydrological conditions. Global climate change may result in more frequent or severe El Niño events. El Niño does not affect the Amazon in a ubiquitous manner but large regions do become prone to extensive droughts. Droughts indirectly lead to more frequent and devastating forest fires. While forest fires occur every year, multitemporal studies have shown that the largest fires occur in El Niño years, accounting for 90% of all burning. The severe El Niño of 1997-98 resulted in the burning of over 9.2 million hectares throughout Latin America. Land-use and climate change are interacting to create unprecedented stresses on Amazonian forests and the fire situation is expected to worsen under predicted climate change scenarios. Without fundamental changes in land management practices, fire can be expected to degrade and erode forest fragments, impacting vast reaches of tropical forest, and accelerating species extinctions. In terms of total annual area affected, forest fires are quickly overtaking slash-and-burn deforestation as the primary disturbance factor in tropical forests. Climate change may intensify the disturbance regime for forests in many regions to the point where tropical evergreen forests cannot persist.

Presentation Title: Climate, Forest, and Fire Regime Changes in the Western U.S.

Presenter: *Tom Swetnam*
Laboratory of Tree Ring Research
Tucson, Arizona, USA.

Abstract: Increasing numbers of large fires and total area burned in the western U.S. in the past twenty years have been variously attributed to forest structure and fuel changes or climate variability and change. Assessments of recent fire regime changes have been hampered by incomplete and biased fire occurrence records, especially for the first half of the 20th century. Analyses are also complicated by large differences in fire occurrence (fire numbers and area burned) within and between different sub-regions, elevations, and ecosystem types. Nevertheless, recent compilations of comprehensive fire occurrence data for the western U.S. (the 11 western states, 1970-2003), and careful spatio-temporal analyses of these records in combination with hydro-climatic records (e.g., drought indices, temperature, water balance, stream flow and snow pack), reveals that broad-scale trends of increasing frequency of large forest fires (>400 ha) are well-correlated with climate variations. In particular, growing season temperatures (March through August) are strongly positively correlated with frequency of large forests fires (Spearman rank correlation $r = 0.76$, 1970-2003). Moreover, there are coincident and positive trends in temperature, large forest fire occurrence, and lengthening of the fire season (times between first ignitions and last control dates). Although temperature and water balance variables (e.g., water deficits, drought indices, etc.) explain substantial variance in the broad-scale data, there are important fine-scale differences in trends and causal relations. Lower elevation, non-forested landscapes and ecosystems tend to show weaker or statistically non-significant trends in fire occurrence as compared to higher elevations. Some sub-regional time series do not show discernable changes in large fire frequency (e.g., Southern California). Fire occurrence trends and patterns in some sub-regions (e.g., the Southwest) appear to have weaker associations with temperature and concurrent year water balance variables (but stronger one-to-two previous years positive water balance correlations), compared to other regions (e.g., the Northern Rockies). It is likely that well-documented changes in ponderosa pine and some mixed conifer forests caused by past land use practices (e.g., livestock grazing, logging, fire suppression, etc.) have contributed to the surge in large fires and area burned in some areas, so that multiple causes – climate and land use history – are contributing to fire regime changes in some places. In addition to discussion of modern climate, forest and fire regime changes we will describe long-term studies of fire climatology using tree-ring records from throughout the western U.S. Insights from these studies reveal that temperature and drought have partly driven fire regimes for centuries and millennia, with important differences in responses depending on location and ecosystem. Overall, it is apparent from both modern and paleo studies that inter-annual, decadal, and secular changes in climate have important influences on regional fire occurrence. Hence anticipated warming tends and extreme droughts as a consequence of global warming are very likely to exacerbate large, severe fire problems in the western U.S. in coming decades.

Co-Authors: *Anthony L. Westerling, Scripps Institute of Oceanography, University of California, San Diego*

Presentation Title: The fire and climate change prognosis in southern Australia: Is Gondwana a goner?

Presenter: *Ross Bradstock*
University of Wollongong,
Bushfire Co-operative Research Centre
Australian National University
NSW Department of Environment and Conservation
Hurstville, New South Wales, Australia

Abstract: Research on the effects of climate change on landscape fires in Australia began about fifteen years ago, culminating in a series of papers dealing predominantly with predictions about future changes to "fire weather" (i.e. shifts in drought indices and associated fire danger ratings). A recent review (Hennessy et al. 2006) forecasts the potential for a general upward shift in drought and fire danger indices across a range of environments within Australia (e.g. increased general likelihood of days with severe fire weather). Progress on use of future fire weather scenarios to generate scenarios of changes to area burned, fire regimes and vegetation is more fraught, despite the long tradition of relevant fire and ecological research in Australia. In this paper we critically review the research status quo in this regard, highlighting the limitations of existing attempts. We present new research based on the Sydney region of south-eastern Australia - an area of national significance in terms of biodiversity – that contains the largest urban centre on the continent. This work integrates a variety of methodologies (statistical modeling, simulation modeling, gradient analyses of plant functional types) that build on prognoses of future fire weather and human populations as key drivers of fire regimes and resultant ecological responses. These analyses indicate the potential for a significant shift in functional types and species composition that arise from the direct interaction of temperature, moisture and fire regime effects. Mooted shifts in environmental factors (hotter and drier) and fire regimes (more frequent and intense fires) are predicted to have significant negative effects on plant species/functional type diversity, which could provide positive feedback into the fire-cycle. Consequences, in terms of risks to other environmental values and the human population are sketched. The results have general relevance to eucalypt dominated ecosystems across southern Australia at least. They may indicate an impending ultimate triumph of scleromorphic vegetation elements over the remnants of old Gondwana, or else the arrival of a bastard child of new vegetation borne from the cauldron of rapid anthropogenic change in all its manifestations. Deep questions about the ultimate role of fire in shaping the vegetation of this ancient land are prompted by these concerns about the future.

Co-Authors: *Michael Bedward, NSW Department of Environment and Conservation - Geoff Cary, Bushfire Co-operative Research Centre, Australian National University - Janet Cohn, Bushfire Co-operative Research Centre, NSW Department of Environment and Conservation - Ian Davies, Bushfire Co-operative Research Centre, Australian National University - Kate Hammill, Australian National University, NSW Department of Environment and Conservation - Karen King, Bushfire Co-operative Research Centre, Australian National University - Sonya Ku, NSW Department of Environment and Conservation*

Presentation Title: Fire and Climate Change in Boreal Forests

Presenter: *M.D. Flannigan*
Canadian Forest Service
Sault Ste. Marie, Ontario, Canada

Abstract: Fire is the major stand-renewing agent for much of the circumboreal forest, and greatly influences the structure and function of boreal ecosystems from regeneration through mortality. Current estimates are that an average of 5-15 million hectares burn annually in boreal forests, almost exclusively in Siberia, Canada and Alaska. There is a growing global awareness of the importance and vulnerability of the boreal region to projected future climate change. Fire activity is strongly influenced by four factors – weather/climate, vegetation (fuels), natural ignition agents and humans. Climate and weather are strongly linked to fire activity which suggests that the fire regime will respond rapidly to changes in climate. Global atmospheric and oceanic dynamics play a major role in circumboreal fire activity. Recent results suggest that area burned by fire is related to temperature and fuel moisture. The climate of the northern hemisphere has been warming due to an influx of radioactively active gases (carbon dioxide, methane etc.) as a result of human activities. This altered climate, modeled by General Circulation Models (GCMs), indicates a profound impact on fire activity in the circumboreal forest. Recent results using GCMs suggest that in many regions fire weather/fire danger conditions will be more severe, area burned will increase, people-caused and lightningcaused ignitions will increase, fire seasons will be longer and the intensity and severity of fires will increase. Changes in fire activity as a result of climate change could have a greater and more immediate impact on vegetation distribution and abundance as compared to the direct impact of climate change.

PLENARY SESSIONS
CLOSING

Closing Plenary Session

"How will Global Climate Change Influence Fire and Land Management Programs and Policies?"

Moderator:
James Brenner, Florida Division of Forestry, Tallahassee, Florida, USA

10:30 – 10:35	*James Brenner* *Fire Management Administrator* *Florida Division of Forestry* *Tallahassee, Florida, USA*	Introduction of the Panel Discussion: How will Global Climate Change Influence Fire and Land Management Programs and Policies?
10:35 – 11:35	*John Gledhill* *Chief Officer* *Tasmania Fire Service* *Hobart, Tasmania, Australia*	The Influence of Global Climate Change on Fire Management Programs and Policies – An Australian Fire Manager's Perspective
	Józef Piwnicki *Researcher* *Forest Fire Protection Laboratory* *Forest Research Institute* *Raszyn, Poland*	Climate Change and Wildland Fire Policy in Poland
	Brian Stocks *B.J. Stocks Wildfire Investigations Sault Ste. Marie, Ontario, Canada*	Wildland Fire Management in Canada: New Challenges Under a Changing Climate
	James Hubbard *Deputy Chief* *USDA Forest Service* *State and Private Forestry* *Washington, DC, USA*	How Might Changing Climate Affect Fire Management in the United States?
11:35-12:05		Questions, Answers, Discussion
11:55 – 12:25	*Stephen Pyne* *Regents' Professor* *School of Life Sciences* *Arizona State University* *Tempe, Arizona, USA.*	The Big Burn, Then and Now
12:25 – 12:35	*Robin Wills* *President* *Association for Fire Ecology* *Oakland, California, USA*	Congress Closing Remarks

Presentation Title: The Influence of Global Climate Change on Fire Management Programs and Policies – An Australian Fire Manager's Perspective

Presenter: *John Gledhill,*
Chief Officer
Tasmania Fire Service
Hobart, Tasmania, Australia

Abstracts:

Climate change predictions for Australia present significant challenges for Australian fire management agencies. Generally, the predictions are for the climate to become drier and hotter. This is likely to cause a geographical extension of the bushfire prone areas of the Australian south east, east coast and south west. Significant population growth is occurring in some of these areas, increasing the length of the urban interface and placing new inexperienced communities in contact with increasingly flammable bush. Additionally, a greater frequency of days of very high to extreme fire weather is predicted. This will increase the level of bushfire attack on the interface.

There is also potential for increases in the depth of the urban interface at risk. Historically, Australian fire agencies have expected invading interface fires to stop more less when they reach the suburban edge, rarely penetrating much beyond the first row of houses. Political and community pressures are increasing to reduce water use in domestic gardens in response to both urban growth and decreasing rainfall. Water hungry plants and lawns will be replaced by drought resistant, but more flammable, plants and organic mulches enabling fires to spread unchecked through urban gardens. In 2003 in Canberra, invading fires spread well beyond the suburban perimeter fed by drought effected garden fuels and houses. Perhaps this scenario will become the norm.

In the climate changed future, the Australasian Fire Authorities Council's policies of community preparedness and fuel management have heightened relevance and applicability.

Presentation Title: Climate Change and Wildland Fire Policy in Poland

Presenter: *Józef Piwnicki*
Researcher
Forest Fire Protection Laboratory
Forest Research Institute
Raszyn, Poland

Abstract: Forest fires are considered a near natural phenomenon in managed forests and are one of the most important factors damaging the forest environment. A forest fire affects both the whole ecosystem and its particular elements: the forest stand itself, herbaceous vegetation, fauna and soil, depending on the fire's intensity and duration. Fire should be considered as part of the natural environment but it can also be a major disruptive factor able to produce significant and fast environmental changes. During the last twenty years, increases in the number of fires and area burned have been observed in Poland as a consequence of more frequent occurrence of extreme fire weather conditions during the fire season. Weather conditions that were uncommon in earlier years, such as the rapid changes of temperature and windstorm associated with atmospheric fronts are now more common. Moreover, regional climate warming associated with increasing occurrence of relatively warm and snow-less winters have also contributed to a prolonged fire season. Consequently, winter and autumn months are no longer considered free of fire risk. For example, in 1999, September had the maximum number of fires (2106) of any month. Compared with the period 1990-1998, this number is equivalent to a more than tenfold increase of September fires, contributing to more than a quarter of the total number of yearly fires. In 1992, by contrast, atmospheric conditions (long lasting drought associated with inflow of dry air masses) had favoured the emergence of fires at the very start of the season. This situation resulted in an unprecedented occurrence of four disastrous forest fires, each of them affecting several thousand hectares. The largest of these fires burned an area greater than the total area burnt during the most severe years of Poland's post-war fire history (1948 and 1952). This situation spurred the development of a new national strategy for forest fire prevention and suppression. The new strategy adopts legal provisions within the range of forests preparation in the case of fires, improvements in forecasting forest fire risk and rapid detection of fires, and the intensification of silvicultural activities mitigating the results of fires. The strategy foresees an increase in financial support for forest fire protection from both national and European Union sources. Poland, as a member of the EU, is contributing in the collection and analysis of forest related information on climate change, biodiversity and the protective functions of forests.

Presentation Title: Wildland Fire Management in Canada: New Challenges Under a Changing Climate

Presenter: *Brian J. Stocks*
B.J. Stocks Wildfire Investigations Ltd.
Sault Ste. Marie, Ontario, Canada

Abstract: Despite the development of sophisticated forest fire management systems over the past century, large forest fires are ubiquitous across Canada, particularly in the boreal forest zone where natural fire is essential to ecosystem maintenance and structure. On average, ~8000 fires burn over ~2.5 million hectares annually, although the area burned shows high interannual variability. Fire management agencies strive to balance the protection of human life and property, and industrial and recreational interests, with the need for natural fire. This is addressed through a dichotomy in protection approaches - intensive in high-value areas and extensive (or modified) in more remote regions of the country where fires are essentially allowed to burn naturally. Fire management costs in Canada average ~$500 million annually, and recent analysis show that increased fire suppression expenditures lead to decreasing marginal returns in terms of the number of escaped fires and area burned. In addition, Canada is currently dealing with an aging airborne suppression capability, and a projected lack of experienced fire managers. Climate change is already an emerging reality in northern Canada, and recent research indicates that fire occurrence and severity will increase substantially as the climate continues to change. Longer fire seasons, increases in lightning fire activity, and subsequent area burned are projected, resulting in a net terrestrial carbon loss and potential positive feedback to further climate change. Climate change is just one factor contributing to the likelihood of increased vulnerability to future fire in Canada, along with an expanding wildland-urban interface, declining forest health, competition for the land-base, and declining fire management infrastructure. Substantially more fire on the landscape, combined with an inability to sustain current levels of fire suppression success, translates into a new reality in future fire management in Canada. To address this issue a new Canadian Wildland Fire Strategy is currently being developed that will help facilitate adaptation strategies.

Presentation Title: How Might Changing Climate Affect Fire Management in the United States?

Presenter: ***Jim Hubbard***
Deputy Chief, State and Private Forestry
USDA Forest Service
Washington, DC

Abstract: Since the 1980's the United States has experienced a substantial increase in the annual area burned in wildland fires. In some parts of the country, such as the interior Southwest, this has been accompanied by fire behavior that is more extreme than the norm for earlier parts of the 20th century. Associated with these changes, have been increasing concerns for risk to communities and infrastructure in the wildland urban interface. Despite enhanced emphasis on increasing fire safety of communities, several recent fires have resulted in significant structural losses. Severe fires, such as the Hayman Fire in Colorado, can increase erosion, impacting reservoir storage capacity and drinking water quality. Smoke from wildland fires can affect air quality in communities and visibility in Class 1 wilderness areas. The 2006 fire season, thus far, has seen more acres burned than at any time during the past 45 years. Recent research is clarifying the importance of climate variability and change in determining the patterns of fire across wide regions. And models predict that changing climate would bring with it trends toward more and larger fires over large areas of the US. As managers, how do we prepare for the potential effects of climate change on fire regimes? Federal, State, and local agencies in the US are working together to decrease fuel hazard and the likelihood of uncharacteristically severe fires on our wildlands. We are working with communities to support community preparedness: planning, landscaping, and construction that will lessen the likelihood of damage when fires do occur. We are monitoring changes in vegetation condition across the landscape. We are trying to increase the health and resiliency of fire impacted ecosystems. All of these steps will help prepare our wildlands and our fire managers to adapt to changing climate. In the near term, if models are correct, our fire suppression resources will continue to be stretched, leading to the need for new approaches to fire management. We must also consider other steps to take, such as how to incorporate the risks from climate change into long-range planning scenarios, how changing fire regimes might affect carbon storage in forest and other wildlands, and whether new approaches to postfire rehabilitation and restoration can increase the resilience of future forests and rangelands to changing climate.

Presentation Title: The Big Burn, Then and Now

Presenter: ***Stephen J. Pyne***
Regents' Professor
School of Life Sciences
Arizona State University
Tempe, Arizona, USA

Abstract: Most of the fire community thinks it knows what global warming means: it means more fires, more research, more of what exists now. But the real impact may lie elsewhere. Global warming may mean a difference in kind. It may challenge our understanding of what fire management does; challenge our understanding of fire and fire's history; and challenge our understanding of ourselves as fire creatures. Fire management in the field may find that suppression becomes bigger and less effective, that prescribed fire will retreat to nature preserves, and that the struggle to integrate fire practices with national land management will expand to include atmospheric management on a global scale. Climate change, particularly through anthropogenic forcing, will compel us to move fire history beyond public wildlands and include the gamut of fire's appearance on Earth. Fire scholarship must embrace more than fire science because the deep driver of change, industrial fire, or the burning of fossil biomass, can occur only through people. The prevailing physical paradigm of fire is inadequate to this task. A century ago a Big Burn referred to large fires in forests and frontier towns. Our response fell short because such fires were only viewed through the prism of state-sponsored forestry. Our response to the Big Burn of today – industrial combustion – will again fall short unless we conceive of fire more generously and imagine ourselves as inextricably bonded with it.

SHORT COURSES

Monday, November 13, 2006

Short Courses

8:00 - 12.00	*Room: 1* *Environmental Considerations of Fighting Wildland Fires with Chemical Products*
8:00 - 12.00	*Room: 2* *Fire Regime Condition Class: Concepts, Methods, and Applications*
8:00 – 12:00	*Room: 3* *FFI: Fire Ecology Assessment Tool and FIREMON Integration*
8:00 – 12:00	*Room: 4* *A Suite of Fuel Management Tools: Fuel Characteristic Classification System, Natural Fuels Photo Series, and Consume 3.0*
8:00 – 12:00	*Room: 5* *FLAME – FireLine Assessment Method*
8:00 – 12:00	*Room: 7* *Wildfire Risk Assessment and the Design of Fuel Treatment Strategies: Models and Tools for the Practitioner*
8:00 – 9:50 & 10:10 – 12:00	*Room: 9* *Firesafe Buildings and Landscapes: New research and tools for fire prevention*
8:00 – 9:50 & 10:10 – 12:00	*Room: 8* *Help with using the 40 new fire behavior fuel models*
8:00 – 9:50 & 10:10 – 12:00	*Room: 10* *From start to finish: Creating an effective fire ecology education program for teachers.*
8:00 – 9:50 & 10:10 – 12:00	*Room: 11* *Fire and Fuels Extension to the Forest Vegetation Simulator*

Presentation Title: Environmental Considerations of Fighting Wildland Fires with Chemical Products

Presenter: *Laila Lienesch, Merrill Saleen, Ed Little, Susan Finger*

Abstract: Each year thousands of wildfires occur in the United States and, on average, over 25 million gallons of fire chemicals are used in the suppression of these fires. During the early 1990s, the lack of information on potential environmental effects of fire suppression chemicals prompted the National Interagency Fire Center (NIFC) and the US Forest Service to support studies evaluating the ecological risks of wildland fire chemicals. Over a decade of research has provided valuable data on the impacts of fire suppression chemicals to fish, wildlife and their habitat. These data, until now, have not been widely disseminated among natural resource and fire management professionals to aid them in understanding the environmental impacts of fire suppression chemicals and assessing damage when chemicals impact the environment.

What will the Course cover?

- Overview of chemical fire-suppressants and their application
and use in wildland fires
- Toxicity and environmental behavior of fire chemicals
- Ecological risk assessment
- Risk management and fire response planning
- Environmental assessment and response

Presentation Title: Fire Regime Condition Class: Concepts, Methods, and Applications

Title: *Doug Havlina, USDI Bureau of Land Management - Steve Barrett, Consulting Fire Ecologist - Dale Hamilton, Systems for Environmental Management*

Abstract: The Fire Regime Condition Class (FRCC) concept serves as one benchmark of ecological health related to fire regimes and vegetation variables. Since its inception in the late 1990's, it has been applied in multi-scale assessments in many facets of natural resource planning. While initial FRCC mapping depicted national trends (i.e., 1 km^2 resolution), the process has evolved to characterize landscapes, watersheds, and project areas. We first applied state-and-transition modeling to Kuchler vegetation groups, to describe historical vegetation patterns and fire regimes. Outputs from modeling provided reference information related to landscape fire frequency, severity, and seral stage proportions. In order to provide consistency in FRCC evaluation, we then developed quantitative indexing tools based upon similarity to historical vegetation and fire regimes. These techniques allowed field users to consistently assess FRCC for fire management plans, land use plans, and prototype areas. These evaluations involving public and private lands suggest FRCC is a meaningful spatial measure for characterizing watersheds, subbasins, and larger areas such as fire management units. On-going applications of FRCC data include project design, risk assessments, treatment prioritization, fire use decisions, and evaluation of ecosystem sustainability. While not a stand-alone risk or allocation tool, FRCC does represent one important landscape metric which is complimentary with other measures of ecological health and fire regime departure. Eventual LANDFIRE deliverables will include FRCC mapping at 30 m^2 resolution. In this workshop, participants will learn both qualitative and quantitative tools for FRCC evaluation through assessment of an example landscape.

Presentation Title: FFI: Fire Ecology Assessment Tool and FIREMON Integration

Presenter: *Nate Benson, Martha Isbister, Duncan Lutes, Kim Johnson, Austin Streetman, John Caratti, Carter Barnes*
USDI National Park Service

Abstract: Our goals for the San Diego short course are to 1) inform/update people on the progress of FFI and 2) get input so we can make the system more effective for users.FFI is a monitoring tool designed to assist managers with collection, storage and analysis of ecological information. It is being constructed through a complementary integration of the Fire Ecology Assessment Tool (FEAT) and FIREMON. The National Interagency Fuels Coordination Group is the sponsoring group. The National Park Service is the managing partner. The initial release of the software is scheduled for August 2007. FEAT and FIREMON both facilitate fire ecology monitoring and have similar procedural characteristics and database architecture. Their integration results in an enhanced monitoring tool that eases data collection, and supports cooperative, interagency data management and information sharing. FFI supports scalable (site specific to landscape level) monitoring for land management agencies at the field and research level.FFI provides software modules for: data entry, data storage, GIS, summary reports, analysis tools and PDA use. This modular design optimizes the use of computer resources by allowing users to download only the modules they need. The field sampling procedures facilitate data collection. While most sampling procedures are focused on fire effects, FFI incorporates a Protocol Builder. This component lets users define their own sampling protocol, allowing FFI to be used for other natural resource applications including wildlife monitoring. The FFI data migration tool will move FEAT and FIREMON data in to the new system.FFI employs a client-server architecture that is scalable from desktop to server installation supporting simultaneous multiple user access. The system is designed to work on Windows XP® operating systems. Data is stored in a SQL Express database and accessed with SQL and dotNet code. ESRI Arc® products are used for GIS functionality. The system is designed for the varying IT requirements of the USFS, NPS, BLM, BIA and FWS.

Presentation Title: A Suite of Fuel Management Tools: Fuel Characteristic Classification System, Natural Fuels Photo Series, and Consume 3.0

Presenter: ***Roger D. Ottmar, Cynthia L. Riccardi, Susan J. Prichard, Clint S. Wright, and Bob Vihnanek***
USDA Forest Service

Abstract: The Fire and Environmental Research Applications team (FERA) of the Pacific Wildland Fire Sciences Laboratory has developed a suite of three fuel management products that will be demonstrated at this workshop. The products include the Fuel Characteristics Classification System (FCCS), the Natural Fuels Photo Series, and Consume 3.0. These three tools work together and allow users to characterize fuelbeds, assess potential fire hazard, and estimate the amount of fuel consumed and emissions produced if burned during a wildland fire. The FCCS is a software application that enables land managers, regulators, and scientists to create and catalogue fuelbeds, and to classify those fuelbeds for their capacity to support fire and consume fuels. The FCCS contains a set of fuelbeds representing the United States that were compiled from scientific literature, fuels photo series, fuels data sets, and expert opinion. The system enables modification and enhancement of these fuelbeds to represent a particular scale of interest. The FCCS then reports assigned and calculated fuel characteristics for each existing fuelbed stratum including the canopy, shrubs, nonwoody, woody, litter/lichen/moss, and duff. Finally, the system classifies each fuelbed by calculating fire potentials that provide an index of the intrinsic capacity of each fuelbed to support surface fire behavior, support crown fire, and provide fuels for flaming, smoldering, and residual consumption. Photo series are useful tools to quickly and inexpensively evaluate vegetation and fuel conditions in the field. The Natural Fuels Photo Series is a collection of data and photographs that collectively display a range of natural conditions and fuel loadings in a wide variety of ecosystem types throughout the Americas from central Alaska to central Brazil. Fire managers are the primary target audience of the Natural Fuels Photo series, although the data presented will also prove useful for managers, scientists, and researchers in other natural resource and science fields.Consume 3.0 is a user-friendly software application for estimating fuel consumption and emissions produced. Land managers and researchers input fuel characteristics, lighting patterns, fuel conditions, and meteorological attributes; Consume then calculates fuel consumption and emissions by combustion phase. Consume is designed to import data directly from the Fuel Characteristic Classification System (FCCS), and the output is formatted to feed other models and provide usable outputs for burn plan preparation and smoke management requirements. Consume can be used for all forest, shrub and grasslands in North America.

Presentation Title: FLAME – FireLine Assessment Method

Presenter: *Jim Bishop*
California Division of Forestry – Retire

Abstract: FLAME (FireLine Assessment MEthod) is a fireline-practical method, using a simple worksheet and table, for predicting changes in fire behavior—a systematic application of fire-behavior science to support safety and suppression decisions. Unforeseen change is a major contributor to fireline accidents, and to failed control tactics and burn plans. FLAME assesses the two dominant drivers of large, short-term change: effective wind speed and fuel type (and adjusts for fine-fuel moisture). The information is developed in 3 steps, simplest to most complete. Primary output is the ROS-ratio, expressing the degree of change in ROS (rate-of-spread), and the information overall guides implementation of the 'LCES' safety measures. The ROS-ratio can be applied to observed fire-spread times to provide a prediction of future fire-spread times. In four fireline-fatality cases FLAME predictions match reconstructed ROS-ratios with an average error of 9%, and in every case could have foretold the dangerous changes. The presentation will introduce the rationale for and workings of the FLAME system, illustrate its application with examples, and apply it to fireline-fatality cases.

Presentation Title: An introduction to the FuelsTools: products of the Fuels Planning - Science Synthesis and Integration project

Presenter: *Anne E. Black*
Aldo Leopold Wilderness Research Institute

Abstract: This short course will provide an overview of the FuelsTools followed by an additional session during which participants can gain hands-on experience with any or all of the tools. The Fuels Planning: Science Synthesis and Integration Project was a pilot project initiated by the USDA Forest Service to respond to the need for tools and information useful for planning site-specific fuel (vegetation) treatment projects. During the large collaborative effort, scientists from three Forest Service Research Stations and several universities, as well as participants from National Forest Systems, Fire, and DOI synthesized current research information for fire and fuels project managers - specialists, and others involved in project planning in support of the National Fire Plan, the Healthy Forest Restoration Act, and other initiatives. Syntheses of scientific information for dry forest types in the western US were conducted in four key areas:

- Social Science
- Wildland Fire Behavior and Forest Structure
- Environmental Consequences of Treatments
- Financial Analysis and Economic Impacts

Presentation Title: Wildfire Risk Assessment and the Design of Fuel Treatment Strategies : Models and Tools for the Practitioner

Presenter: *A. Ager, A., B. Bahro, B., M.A. Finney – USDA Forest Service*

Abstract:

Fuel reduction activities on Federal lands are generally difficult to plan and implement due to cost, public expectations, and land management regulations. State of the art wildfire modeling is frequently required to demonstrate the benefits of fuels reduction treatments and defend fuels management projects. Proposed treatments must balance multiple and often competing resource objectives and landowner needs. This workshop demonstrates three key analysis tools to streamline project planning for fuel treatments: The Fireshed Assessment process - Landscape fuel treatment planning in a collaborative setting where fuel treatments are modeled and evaluated in a real time setting and multiple resource management objectives are considered in the design and layout of treatments.. The FlamMap fire simulator - FlamMap is used to evaluate the performance of alternative fuel treatment designs. ArcFuels – A library of ArcGIS macros that streamline the design and analysis of fuel treatment projects. The Fireshed Assessment process is used to design spatial treatment patterns such that managers can treat a fraction of the landscape to achieve intended modifications in wildland fire behavior. Treated areas slow the spread and lower the intensity of oncoming fires, reducing damage to both treated and untreated areas and ultimately reducing the size and severity of wildland fires. Treatments are designed to interrupt landscape-scale fire spread as well as modify fire intensity within the treated areas. The process considers multiple resource objectives, such as improving forest health and providing habitats for at-risk species over the long-term. The Fireshed process is conducted in a collaborative setting where the effects of proposed treatments are balanced with multiple and often competing resource objectives and landowner needs. The Fireshed process is increasingly being used as an organizing and operational framework for landscape fuel treatment planning. The Fireshed process was recently adopted nationally by the Forest Service as part of the Stewardship and Fireshed Assessment Pilot Program. Example Fireshed assessments will be provided in the workshop The FlamMap program is used in the Fireshed assessment process for spatial modeling of wildfire behavior. Proposed fuel treatments are analyzed in terms of their effect on wildfire spread rates, burn probability, and wildfire intensity. FlamMap is used to identify and compare minimum wildfire travel times through treated and untreated landscapes, and to find optimal locations of fuel treatments to reduce wildfire spread. The use of FlamMap for wildfire behavior analyses will be demonstrated for example landscapes and outputs from past projects will be displayed. ArcFuels links vegetation and wildfire behavior models and provides for real-time evaluation of proposed fuel treatments within ArcGIS. We will demonstrate the use of ArcFuels to (1) simulate stand-specific silvicultural prescriptions and fuel treatments within ArcMap, including thinning, underburning, and mechanical fuel treatment; (2) generate data plots showing how stand fuel treatments change wildfires in terms of flame length, fire behavior, and stand mortality over time; (3) scale-up of stand-specific treatments and simulation of project-wide changes in vegetation and fuel from proposed management activities; (4) data export from Arc grid data to FlamMap landscape files; and (5) integration of wildfire model outputs to ArcGIS.

Presentation Title: Firesafe Buildings and Landscapes: New research and tools for fire prevention

Presenter: *Greg McPherson, Jo Ann Fites, Mark Dietenberger USDA Forest Service - John Kennedy, Green Building Studio - Steve Quarles University of California*

Abstract:

In the United States 42 million homes are located in the wildland-urban interface. Building construction and landscaping decisions on these properties directly influences the threat of loss in fires. Although federal and state agencies have developed regulations and guidance for improving the fire safety of properties, many remain at risk because modifications may conflict with the desires of an owner for the appearance of the home exterior, use of the land, views, privacy, and wildlife habitat. This special session describes the development and use of ecoSmart-Fire, an interactive, flexible, graphical tool designed to help residents make fire safety choices while considering ways to enhance beauty, retain native vegetation, ensure privacy, conserve water, and save energy.

Presentation Title: Help with using the 40 new fire behavior fuel models

Presenter: *Joe H. Scott*
Systems for Environmental Management

Abstract: A new set of 40 standard fire behavior fuel models was recently made available for use in a variety of fire behavior prediction systems, including: BehavePlus, FARSITE, FFE-FVS, FlamMap, FMAplus, and NEXUS. This workshop describes characteristics of the new fuel model set, its development, and its relationship to the original set of 13 fire behavior fuel models. Workshop participants will learn first whether their specific application might benefit from using the new fuel models, and secondly how to begin using them. We will demonstrate several tools available to assist users transition to using the new fuel models, including (1) a fuel model selection guide, (2) a fuel model crosswalk, (3) an electronic helpfile with standard fire behavior comparisons among fuel models, and (4) a spreadsheet for comparing any original or new standard fire behavior fuel models under standardized fuel conditions. Finally, we will review recent national and regional efforts to implement the new fuel models, and discuss the lessons learned from those projects.

Presentation Title: From start to finish: Creating an effective fire ecology education program for teachers.

Presenter: *Christine Denny*
Pandion Systems, Inc.

Abstract: As more people move into the wildland urban interface, the task of educating the public about fire's natural role becomes of critical importance. By putting fire ecology information and materials into the hands of teachers, land managers can help increase knowledge of fire ecology and support for land management methods such as prescribed burning. This session will outline how to plan, create, and implement a teacher education program from start to finish. There is more to outreach than designing a brochure or some activities, and this session will help participants better understand ways to create an effective education effort. We will discuss how to assess educator needs, design materials, methods for distributing information, and ways to evaluate the efficacy of an education program. Existing fire ecology programs will be used as examples.

Presentation Title: Fire and Fuels Extension to the Forest Vegetation Simulator

Presenter: *Stephanie Rebain*
Forest Management Service Center, Fort Collins

Abstract: The Fire and Fuels Extension (FFE) is a model used throughout the United States to examine potential fire behavior and effects under various management scenarios. Because FFE is linked to the Forest Vegetation Simulator (FVS), an individual tree growth and yield model, it can assess both short and long term effects of fuel treatments and other management activities. Model outputs include estimates of fuel loading, snag levels, and potential fire behavior and effects over time. A variety of management activities can be simulated including thinning, prescribed burning, regeneration harvests, and planting. This workshop will consist of a presentation describing the FFE-FVS model and a demonstration of some of its capabilities.

WORKSHOPS

Workshops

16:00 - 18:00

Bob Keane
USDA Forest Service

Landscape models of fire and vegetation dynamics in research and management - A strategy for future development

This workshop will be conducted in two sections. The first two hours of the workshop will attempt to build a key for managers to use when selecting a landscape model for a specific task, and the second two hours will attempt to develop a set of guidelines that funding agencies can use to support model development into the future. The model selection key development will be accomplished by, first, identifying those issues that land managers are most concerned when selecting models. The most important aspect is the ability of a model to answer the simulation objective, but other issues may include cost, simplicity, ease of use, and degree of complexity. Simulation objectives must be classified into broad groups. Next, we identify those attributes that the modelers feel best describes their models in the context of the identified issues. Then, we will attempt to construct a key that can be used to identify the set of models that can be used for a specific task. The second part of the workshop will be a session that will document what modelers, managers, and administrators feel is important in developing and refining models into the future. These ideas should help funding agencies, project leaders, and other modelers develop integrated models for the right publics and clients. Ideas might include the posting of a model's code to a web site, conducting and publishing extensive sensitivity analyses on developed models, developing a strategy for the transfer of a model to land management. The results of the two parts of this workshop will be written into a report and published in a general technical report.

Workshops

8:00-11:30

Elaine Sutherland
USDA Forest Service

FHAES Demonstration: the Fire History Exploration and Analysis System.

Objective: The most commonly used software tool to analyze fire event data is FHX2, a DOS-based program written by Dr. Henri Grissino-Mayer in the early 1990's. A group of scientists, including Dr. Grissino-Mayer, is collaborating to update this tool and make it freely available on the Internet, more user friendly, and with additional analytical options. The software has been renamed FHAES: the Fire History Analysis and Exploration System. The objective of this workshop is to introduce interested users to the new system, demonstrate its capabilities, help attendees to try it out, and to gain feedback from them.

FIELD TRIPS

Sunday, November 12, 2006

Fieldtrips

9:00 - 16:00

Assemble: 8:45 AM
ATLAS FOYER

San Diego's Chaparral and Forests: Landscape shapoed by Fire

San Diego's biodiversity, fire-adapted landscapes, and rapid rate of development offer unique and unequaled challenges, and this field trip will highlight all three. Start the field trip by driving through miles of suburban sprawl and thousands of chaparral burned on both sides of Interstate 8 during the Cedar Fire in October 2003. The first stop will be along the interstate to discuss fire frequency, the response of chaparral after wildfires in 1970, 2001 and 2003, and the implications of increasing development on fire regimes and natural landscapes. The second stop will be on Pine Creek Road to get an overview of the Tragedy Springs prescribed burn (a joint project with the Cleveland National Forest, California State Parks and Recreation, and California Department of Forestry and Fire Protection) and its effectiveness during the Cedar Fire. Stops at the Cleveland National Forest will show fuels treatments that include repeated underburning in Jeffrey and coulter pine stands over the past 20 years, green-tree thinning, and brush mastication. Lunch will be provided at Horse Heaven Campground. Another stop will be made at Garnet plantation off Sunrise Hwy, consumed in the Cedar Fire of 2003. Dead trees were removed and chipped; snags were removed along highway, 10 acres of Jeffrey pine were replanted; pockets of Coulter pine regenerated naturally; and Black Oak and ceanothus have resprouted. The field trip will traverse Rancho Cuyamaca State Park where 25,000 acres were burned in the Cedar Fire, and stops will highlight post-fire recovery, particularly the regeneration of oaks, limitedrecovery of pines, current conditions and challenges, and planned managementactions by California State Department of Parks and Recreation.

10:00 - 16:00

Assemble: 9:45 AM
ATLAS FOYER

San Diego Wildland Urban Interface

Visit four canyon-urban interface sites that sustained losses in the October 2003 wildfires or have high risks of future property losses. First field trip stop at Mt. Soledad with City of San Diego Fire and Rescue wildfire specialists to view canyon conditions with steep and narrow streets, old water lines and hidden hydrants, heavy ladder fuels, false sense of security from frequent marine layer, high winds that dry vegetation and spread fire, and challenges of managing brush adjacent to 55,000 to 77,000 private land parcels within the city of San Diego. Second field trip stop with Rancho Santa Fe Fire Protection District to discuss strict review of site and building plans that are focused on access, slope setbacks, construction, landscape plans, and education. Third stop with Scripps Ranch FireSafe Council leaders to view Eucalyptus trees, undergrowth, and litter before the October 2003 fires, and recent brush reduction principles, codes, and practices. Last stop with Talmadge FireSafe Council to view homeowner's investments in building code compliance and vegetation reduction, with neighbor's wooden fences, large conifer trees, and wooden deck illustrating dependence on neighbors' awareness and actions. Field trip leader is Anne Fege, Ph.D., retired Forest Supervisor of the Cleveland National Forest and principal investigator on Joint Fire Sciences grant for educating the business sector on reducing wildfire risks.

Friday, November 17, 2006

Fieldtrips

13:00 - 17:00

Assemble: 12:45 PM
ATLAS FOYER

Living with San Diego's Nature and Fire

Fire is a major landscape disturbance shaping southern California ecosystems--and yet, as recent fire storms in 2003 showed, the public and policy makers need a greater understanding of wildfire processes in order to make sound public policy decisions. The field trip will tour San Diego City canyons and view the canyon-development interface, and vegetation reduction to implement city/county codes. The afternoon will end with a visit to the San Diego Natural History Museum to view their award-winning exhibit, "Earth, Wild and Wildfire" (http://www.sdnhm.org/exhibits/fire/index.html). This exhibition is a testimonial to the splendor of nature, the power and inevitability of fire, the responsibility humans have for living with nature and fire, and the inspiration of recovery in nature and the community.

13:00 – 17:00

Assemble: 12:45 PM
ATLAS FOYER

Post- Fire- Rehabilitation

This field tour will look at one of a set of three study catchments (~5 acres each) that evaluates the effectiveness of aerial hydromulch at reducing watershed erosion after the Cedar Fire. The methods, instrumentation, and results to date will be discussed. This is part of a larger monitoring effort looking at the effectiveness of post-fire emergency stabilization treatments throughout the western U.S. We will also visit silt fences that measured the effectiveness of aerial hydromulch on reducing hillslope erosion.

TRACK 1

Tuesday, November 14, 2006

Changing Fire Dynamics and Ecosystem Responses in Tropical Vegetation

Mark A. Cochrane
South Dakota State University
Brookings, South Dakota, USA

8:00 - 8:45	***David Bowman*** ***Charles Darwin University***	The ecological logic of indigenous landscape burning
8:45 – 9:15	***J. Boone Kauffman*** ***USDA Forest Service***	Changing fire dynamics and ecosystem responses of Pacific Islands landscapes
9:15 – 10.00	***Mark A. Cochrane*** ***South Dakota University***	Fire dynamics and human land use in the Brazilian Amazon
10:30 –11:00	***Jennifer Balch*** ***Yale University***	Effects of Recurrent Fire on Transitional Forest Dynamics in the Brazilian Amazon's Wildfire Frontier
11:00 - 11:30	***Heidi Asbjornson*** ***Iowa University***	Changing fire dynamics in tropical montane cloud forests: a global synthesis
11:30 –12:00	***Jos Barlow*** ***University of Anglia***	Wildlife responses to tropical forest fires: Current knowledge and future research priority
13:30 –14:00	***Ernesto Alvarado*** ***University of Washington***	Biomass combustion, emissions of greenhouse gases and fire management in Amazonian tropical forests
14:00 –14:30	***Susan Page*** ***University of Leicester***	Relationships between fire carbon and vegetation dynamics in tropical peat swamp forests
14:30 – 15:00	***Sarah Otterstrom*** ***Paso Pacifico***	Shifts in Neotropical dry forest composition with frequent fires
15:30 – 15:45	***Narendran Kodandapani*** ***Michigan State University***	Spatial, temporal, and ecological compoonents of forest fires in the Western Ghats, India
15:45 –16:00	***Tasila Banda*** ***University of California***	Fire effects on the recruitment success of woody vegetation in the Miombo woodlands
16:00 –16:15	***Aaron Petty*** ***Charles Darwin University***	A LANDSAT and MODIS analysis of contrasting fire patterns in Aboriginal and Park-managed lands in tropical north Australia
16:15 –16:45	***Johann Goldammer*** ***Max Planck Institut für Chemistry***	Revisit of the Freiburg Declaration on Tropical Fires of 1989
16:45- 17:00	***Mark A. Cochrane*** ***South Dakota State University***	Cochrane/Otterstrom Wrap up Discussion - Changing Fire Dynamics and Ecosystem Responses in Tropical Vegetation. Symposium Synthesis and Future Research

Session Title: Changing Fire Dynamics and Ecosystem Responses in Tropical Vegetation

Session Organizer: *Mark A. Cochrane*
South Dakota State University
Brookings, South Dakota, USA

Abstract: Tropical ecosystems are often overlooked despite the fact that, in recent decades, the largest wildfires have occurred in tropical forests and global studies of fire occurrence clearly show that, in terms of sheer numbers, fires in tropical ecosystems dominate. Tropical landscapes are the new frontier for human colonization and human land use patterns are mimicking those experienced in other parts of the globe in previous centuries. Conversion to agriculture, extensive use of natural resources and general management for short term returns. Tropical ecosystems are being stressed by changing fire regimes caused by combinations of altered ignition patterns, fire severity, burn frequency, fire seasonality and changes in vegetation cover, climate, landscape fragmentation, and fuel structure. This symposium will bring together experts in these regions and new scientists at the cutting edge of tropical fire science. The intent is to inform and to shape the emerging subdiscipline of tropical fire ecology.

Presentation Title: The ecological logic of indigenous landscape burning

Presenter: *David Bowman*
Charles Darwin University
Darwin, Northern Territory, Australia

Abstract: The idea that indigenous people intentionally and skillfully modified environments with fire is deeply contested yet has considerable implications for contemporary fire management and anthropological and ecological theory. A multidisciplinary study has been concluded in northern Australia, one of the few remaining places on Earth where it is possible to study indigenous landscape burning. It was found that Aborigines burn small areas, which in aggregate creates open habitats with an abundance of perennial grasses. This burning is concentrated in the second half of the dry season. Isotopic analyses of the diet of kangaroos show that these grazing (grass eating) herbivores increase the proportion of browse (leaves from trees and shrubs) in their diet in the second half of the seven month rain-free dry season. Field surveys of kangaroo scats demonstrated that kangaroos were attracted to small patches burnt by Aborigines because of the presence of nutritious, resprouting perennial grasses. Ethnographic and ethnohistorical findings from throughout Australia have also highlighted the nexus between Aboriginal fire use and the hunting and management of kangaroo habitat. In conclusion, Aboriginal landscape burning has a clear ecological basis and therefore is neither pyromania nor random. Existing literature suggests that these findings can be generalised to other landscape settings around the world – fire, herbivores and humans seem inextricably linked. Thus the long history of indigenous landscape burning can be legitimately used to justify prescribed burning programs. However, in most settings the objectives of contemporary fire management are different from prehistoric practices (for example, fire protection and biodiversity vs. game management) so there is no reason to assume that recreating indigenous landscape burning is the 'answer' for the challenges of modern day fire management.
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Presentation Title: Changing fire dynamics and ecosystem responses of Pacific Islands landscapes

Presenter: *Boone Kauffman*
USDA Forest Service
Hilo, Hawaii, USA

Abstract: Tropical landscapes of the Pacific (Micronesia and Polynesia) are global hotspots of biological diversity due to a unique endemic biota. Although little studied, fires are an increasingly common event in forests, savannas, and grasslands of the Pacific. It is likely that historically fires played an integral role in ecosystem function and structure on high islands of the Pacific, but this role has been dramatically altered due to the widespread influences of humans on these vulnerable landscapes. The greatest influences that have changed fire regimes and the role of fire on Pacific tropical landscapes are deforestation and invasive species. Purposeful deforestation such as land clearing for agricultural production as well as unintentional land cover change (due to logging, grazing, fire, invasive grazers, etc) creates a cycle of increased ignitions, dominance by invasive species, and losses of biological diversity. Breaking the invasive species/wildfire cycle is among the greatest challenges facing land managers and researchers in the Pacific today. When tropical forests undergo land cover change to savanna or grassland, profound changes in the structure, composition and microclimate occur that create a self-perpetuating cycle. Fine fuel layers dominated by grasses and/or ferns dramatically increase. Fine fuel loads of 5 to 40 Mg/ha commonly occur in anthropogenically-created savannas. Microclimates shift to higher temperatures, lower relative humidities, and higher wind speeds. Fuel moisture conditions shift to drier states facilitating the susceptibility of these landscapes to fire. Natural periodic disturbance events, particularly typhoons, which affect forest structure could also interact with invasive species and human disturbances to exacerbate landscape degradation in Pacific Island ecosystems. Downed wood debris in post typhoon forests may be 10-20-fold higher that in undisturbed forests. Forest restoration must focus on overstory regeneration which would reduce fine fuel loads, affect microclimate, and reduce ecosystem flammability. Global change and globalization pose new and significant barriers to breaking wildfire cycles and continued degradation of the biologically rich island landscapes of the Pacific.

Co-Authors: *Alison Ainsworth, Oregon State University - Susan Cordell, USDA Forest Service - Jerrod Thaxton, USDA Forest Service*

Presentation Title: Fire Dynamics and Human Land Use in the Brazilian Amazon

Presenter: *Mark A. Cochrane*
South Dakota State University
Brookings, South Dakota, USA

Abstract: Amazonian land cover is rapidly changing. Road construction in recent decades has provided access for millions of settlers to previously remote and inaccessible forests. Deforestation has necessarily followed. Deforestation fragments the remaining forests. Resultant forest edges are buffeted by wind sand desiccating sunlight. These edge effects lead to structural changes including increased mortality of trees, decreased living biomass and increased fuel loads. These changes predispose these forests to fire. Initial fires in rainforests often progress as slowly creeping ribbons of flame, 10 cm or so in height, burning little besides fallen leaf litter. Despite appearances, these fires kill 23-44% of the trees >10 cm DBH. Fire propagation in tropical forests is largely controlled by variations in ambient relative humidity. Although fire intensity is very low, slow spread rates are deadly for the thin-barked trees characteristic of these forests. Fires in logged or previously burned forests are more severe due to greater fuel loads and lower humidity with more extreme fire behavior capable of killing even the largest and thickest-barked trees. Given the juxtaposition of fire-prone forests and fire-dependent agricultural lands, forest fires are almost inevitable. In new frontier areas with relatively low quantities of cleared land, extensive undamaged forests make large forest fires nearly impossible. However, as fire-prone agricultural land development continues, forests become increasingly fragmented and whole landscapes become conducive to fire propagation. Forest fires are edge-related, moving into forests from deforested lands. These fires significantly alter fire regimes kilometers from forest edges. Fire frequency becomes a function of distance from forest edges and fire severity increases with frequency. Forests will continue to erode, with isolated fragments collapsing, unless future fires can be prevented. Within the Brazilian Amazon, 26 million hectares of forest may currently be undergoing this process, leading to the eventual release of 3.9 Pg C.

Co-Authors: *Carlos M. Souza Jr., Instituto do Homem e Meio Ambiente da Amazonia*

Presentation Title: Effects of Recurrent Fire on Transitional Forest Dynamics in the Brazilian Amazon's Wildfire Frontier

Presenter: *Jennifer Balch*
Yale University
New Haven, Connecticut, USA

Abstract: Along the southern edge of the Amazon basin lies a transitional forest (200,000 km2), between cerrado to the south and more humid rainforest to the north, that is threatened by rapid deforestation and an expanding agricultural frontier. Increasing ignition sources, forest degradation, and a conducive climate are resulting in widespread anthropogenic forest fires at a frequency well beyond that recorded historically. Little is known, however, about how this ecotonal forest will respond to the rapid change it is undergoing. Therefore, we have established a 1-km2 experimental burn in intact transitional forest –one of the largest experimental burns in the tropics – to test the effects of single and repeated fires on tree mortality, fuel dynamics, and future fire susceptibility. By measuring pre- and post-fire forest properties we are able to capture changes directly associated with each fire regime. The fires of the initial burn, set in August 2004, were low intensity, slow-moving surface fires that rarely crowned. Average flame heights were 31 ± 1 cm and the average spread rate was 0.21 ± 0.01 m min-1. Initial mean losses of biomass through combustion were 20.0 Mg/ha (range: 12.2 to 28.7 Mg/ha) and 2.2Mg/ha (range: 1.8 to 2.5 Mg/ha) in downed woody fuels and leaf litter, respectively. One year after the initial fire event overall stem mortality in trees ≥ 10 cm in diameter was 9% in the burned plots versus 4% in the control plot, yet many larger stems are expected to die in the upcoming years. The consequences of repeated fires, set in 2005 and 2006, for stem mortality, fuels, and future fire susceptibility will be addressed. Understanding the implications of increasing fire frequency for forest dynamics is imperative as more severe climatic events are predicted and the agricultural frontier continues to expand.

Co-Authors: *Nepstad, Daniel C., Woods Hole Research Center - Lisa M Curran, Yale University - Paulo M Brando, Instituto de Pesquisa Ambiental da Amazônia - Oswaldo de Carvalho Jr., Instituto de Pesquisa Ambiental da Amazônia*

Presentation Title: Changing fire dynamics in Tropical Montane Cloud Forests: A global synthesis

Presenter: *Heidi Asbjornsen*
Iowa State University
Ames Iowa, USA

Abstract: In recent years, the body of evidence revealing the influence of fire on altering the structure, composition as well as the ecological and hydrological functioning of tropical rainforest environments has grown steadily. In contrast, very little attention has been given to the occurrence and effects of fire in tropical montane cloud forests (TMCF), despite the allegedly high vulnerability to disturbance and climatic warming of these ecosystems, their critical role in providing hydrological services to adjacent lowlands and their function as globally significant storehouses of biodiversity. Our objectives are to synthesize the current knowledge about the temporal and spatial patterns of fire in the world's TMCF son both glacial and decadal timescales and to identify the salient driving forces underlying these patterns. To conduct our analysis, we draw from a diverse literature within the fields of ecology, hydrology, paleoecology, and climate change. Our findings suggest that historically, fires in TMCFs coincided with changing climatic conditions and were accompanied by species migrations that maintained TMCF associations in new locations where environments favored their existence. Results from recent studies suggest that TMCFs are exceptionally vulnerable to accelerated rates of climate change and anthropogenic-driven fire frequencies, as reflected by their slow recovery rates, shifts in ecosystem state, and growing evidence of species extinctions. Thus, it is unlikely that gradual processes of species migrations will be sufficient to maintain TMCFs under current rates of environmental change. We conclude that the growing yet generally unrecognized incidence of fire in TMCFs—propelled by synergistic feedbacks with local and regional land-use activities (deforestation, fragmentation) and climate (rising cloud base, ENSO, global brightening)—may lead to unexpected and irreversible alterations in the ecological and hydrological functioning of these unique mountain regions. Finally, we suggest several directions for future research to better understand and address changingfire dynamics in TMCFs.

Co-Author: *L.A. (Sampurno) Bruijnzeel, Vrije Universiteit*

Presentation Title: Wildlife responses to tropical forest fires: Current knowledge and future research priorities

Presenter: *Jos Barlow*
University of East Anglia
Norwich, England

Abstract: Wildfires in tropical forests erode the value of forests for forest wildlife. I review our current knowledge of their influence, focusing on the short-medium term effects (1-3 yrs after fire events). The effects of fire are then compared with other widespread forms of forest degradation such as logging and fragmentation. The need for more information on the longer-term effects of fires on forest wildlife is highlighted.

Presentation Title: Biomass Combustion, emissions of greenhouse gases and fire management in Amazonian tropical forests

Presenter: *Ernesto Alvarado*
University of Washington
Seattle, Washington, USA

Abstract: Wildfire is one of the main threats to the conservation and sustainability of Amazonian forests. Yet, fire is used persistently as a land management tool throughout the basin and a steady increase of wild fire risk has been detected in the last couple of decades in those tropical ecosystems. Countries within the Amazonian basin have identified fire management as a priority to reduce the negative impact of fire on ecosystems, but also to reduce the environmental and health effects caused by smoke emissions from wildfires and biomass burning at the local and regional levels. Implementation of successful fire management policies requires of quality information specific for the ecosystem type, social and physical conditions on which fire occur. This paper presents results from a joint research between the USFS, UW and Brazilian scientists and the Bolivian Institute of Forest Research. Research in tropica lecosystems on the Brazilian Amazon and Bolivian Chiquitano Forests is conducive to the development of equations and methods to evaluate fueled characteristics, biomass consumption, air pollution, and greenhouse gas emissions from fires across environmental gradients. Flammability, fire severity thresholds, and effects are also being investigated in primary and selectively logged forests. Research has been conducted on experimental fires near Alta Floresta, Brazil since 1997 and since 2004 near Santa Cruz de la Sierra, Bolivia. Results of these fire experiments are intended to support the development of globally consistent decision support systems for fire management in Brazil and Bolivia.The paper presents the progress on the development of flaming/smoldering combustion models fortropical biomass, flammability thresholds for no-wind fire spread in hardwood litter, prediction modelsfor biomass consumption, and estimation of greenhouse gases and particulate matter emissions fro thetwo countries.

Co-Authors: *Carlos Gurgel Veras, Universida de Brasilia - Joao Andrade de Carvalho, Universidade Estadual de Sao Paulo - Carlos Pinto, Universida de Brasilia*

Presentation Title: Relationships between fire, carbon and vegetation dynamics in tropical peat swamp forests

Susan Page
University of Leicester
Leicester, England

Abstract: The status of the world's peatlands is a matter of considerable concern since their degradation can lead to carbon emissions to the atmosphere and loss of carbon sink function. Tropical peatlands, located mostly in SE Asia, are little known ecosystems that make a significant contribution to terrestrial carbon storage, both in terms of their aboveground biomass (peat swamp forest) and thick deposits of peat. They account for only 10-12% of the global peatland resource by area but may contain up to 70Gt (21%) of the peat soil carbon store. Tropical peatlands are, however, being degraded by land-use changes that increase their susceptibility to oxidation and fire. During 1997/98, Page et al. [2002]estimated 0.81-2.57 giga tons of carbon were released into the atmosphere as a result of forest and peatland fires in Indonesia; a study by Langenfelds et al. [2002], using atmospheric measurements, also found Indonesian burning activity made a significant contribution to atmospheric carbon levels. Efforts are now underway to undertake ecological restoration of degraded tropical peatlands, including vegetation restoration. In order for these efforts to be successful at a landscape scale it is necessary to have accurate information on the current status of the vegetation, its recent fire history, and the dynamics of post-fire vegetation succession. To derive this overview, we use a remote sensing approach, including multi-temporal data provided by the ASTER instrument on TERRA and the Disaster Monitoring Constellation (DMC) satellite. Initial results will be presented on the mapping and validation of burnt area and land cover, fire frequency and severity using a time series of satellite observations. Future work will focus on the use of these data for modeling post-fire vegetation dynamics, monitoring ecological restoration and improving fire hazard assessment and fire control.

Co-Authors: *Dr Kevin Tansey, University of Leicester - Agata Hoscilo, University of Leicester*

Presentation Title: Shifts in Neotropical dry forest composition with frequent fires

Presenter: *Sarah Otterstrom*
Paso Pacifico
Modesto, California, USA

Abstract: Throughout Central America, tropical dry forests are severely fragmented and remaining forest areas are subject to frequent human disturbance. Fires ignited during agricultural and subsistence activities enter these forest patches during dry season months. In order to evaluate how past fire-related disturbances have impacted forest composition and structure, we established seven transects totaling a distance of 13 km at the Chococente Wildlife Refuge in southwestern Nicaragua. Additionally, we established transects across recently burned areas to assess the composition of woody regeneration. We compare these field observations with our earlier research of a single experimental fire event, finding that the negative impacts of fire were compounded when combined with other human activities. Our results indicate that in order to predict fire's impacts on Central American dry forests, fires should not be observed in isolation from the human activities driving them. We discuss how fire may have influenced currently observed forest composition and suggest future directions in forests under the present-day disturbance regime. In the interest of dry forest conservation we also explore possible forest restoration and protection actions to mitigate the impacts of frequent fires.

Presentation Title: Spatial, temporal, and ecological components of forest fires in the Western Ghats, India

Presenter: *Narendran Kodandapani*
Michigan State University
East Lansing, Michigan, USA

Abstract: The Western Ghats in India is one of the 25 global hotspots of biodiversity; simultaneously the region is also the hotspot with the highest human densities and hence biotic pressures. Forest fires are almost annual events in deciduous ecosystems and fire-return intervals (FRI) have almost increased 3 fold during the past 100 years. We compare the fire regime and the ecological consequences of these short FRI in three vegetation types. We applied a combination of remote sensing data and GIS techniques to delineate burnt areas in the study site. We also collected information on regeneration and tree species composition, structure, and diversity by enumerating all individuals ³ 10 cm dbh in 35belt transects of 500 m each. The total fuel load in the tropical dry thorn forest is 5.1 Mgha-1, and is three times and five times larger in the tropical dry deciduous and tropical moist deciduous forests respectively. The mean fire size in the tropical moist deciduous forest is 0.1 km2 and is two fold and four fold larger in the tropical dry thorn and tropical dry deciduous forests respectively. Fire severity was pronounced in the tropical moist deciduous and tropical dry deciduous and less important in the tropical dry thorn forests. The grass-fire cycle has significantly altered the fire regime of the landscape. This has resulted in larger and more recurrent fires, leading to increased mortality and reduced regeneration among lower size classes (0-5 cm) dbh class of most tree species in the landscape. Bark characteristics such as thick, pale bark and vegetative reproductive mechanisms could be critical for the survival of species under these short FRI. More than 50% of the total forested area in the Western Ghats is under tropical deciduous forests; managing these forest fires could be vital for the conservation of these ecosystems.

Co-Authors: *Mark A. Cochrane, South Dakota State University - Raman Sukumar, Indian Institute of Science*

Presentation Title: Fire effects on the recruitment success of woody vegetation in the Miombo woodlands

Presenter: *Tasila Banda*
University of California – Davis
Davis, California, USA

Abstract: Fire is an important ecological tool for managing plant species in the tropical savanna ecosystems. Even though fires are believed to have been present in the African subtropical savannas for the past50000 years, archeological evidence shows that intentional ignition of fires has only occurred in the past 2500 years. Primary causes of ignition have been for hunting, preparing land for cultivation, improving the quality of grazing for livestock, and controlling the spread of woody plants. Fires, coupled with increased demand for Pterocarpus angolensis (Fabaceae), a leguminous tree species commonly known as “wild teak” from Miombo region of sub-Saharan Africa, has led to depletion of adult trees in many areas and reduced overall recruitment. We investigated the effects of natural and experimental fire, fire intensity, and seed attributes on germination of Pterocarpus angolensis in the greenhouse. It was necessary for fruits to be burnt in order for the seeds to germinate. Indeed, seeds were less likely to germinate if they were severely burned in the field. Similarly, experimentally burned seeds were less likely to germinate after being exposed to longer burn duration. Generally heavier seeds extracted from heavier fruit had better germination success in comparison to lighter ones. Very few seeds in husks ever germinated. Finally, seeds without husks persisted in the soil and continued to germinate even after 18 months in wet soil, indicating potential long soil longevity. We suspect that burning that occurs earlier in the dry season may augment germination in the field but that late dry season fires kill seeds, resulting in poor rates of recruitment witnessed in the wild.

Co-Authors: *Mark Schwartz, University of California-Davis - Tim Caro,*
Tanzania Wildlife Research Institute

Presentation Title: A LANDSAT and MODIS analysis of contrasting fire patterns in Aboriginal and Park-managed lands in tropical north Australia

Presenter: *Aaron Petty*
Charles Darwin University
Darwin, Australia

Abstract: Extreme seasonal variation in rainfall coupled with robust understory growth create a highly flammable environment in the tropical savannas of northern Australia. Fire return intervals of 1-2 years are common across the high rainfall regions of north Australia, and the institution of management schemes that promote fire-suppression, as has happened in North America and temperate Australia, is neither practical nor ecologically sound. Thus, fire patterns in northern Australia are determined by human decisions about fire management. We present results from an analysis of LANDSAT and MODIS imagery to compare and contrast fire patterns in Aboriginally owned land in central and western Arnhemland with those in neighboring Kakadu and Mary River National Parks. These represent a contrast between two management styles: (1)_Decentralized fire management carried out by small Aboriginal communities widely dispersed across a large landscape. (2)_Centralized fire management carried out by park rangers who are charged with implementing a fire management plan based on a paradigm of hazard reduction burning as well as assumptions of appropriate traditional Aboriginal management. The fire scar patterns which have emerged from these different management schemes show a marked bias towards early dry season burning in the national parks, as well as more comprehensive burning of upland savanna. By contrast Aboriginal lands have a more even distribution of fire throughout the dry season, and less thorough burning of upland savanna. The pattern found under a Park-management regime is likely the result of access to infrastructure such as helicopters which allow more comprehensive burning as well as an institutionalized philosophy of burning savannas as early as possible. However, this pattern may not be indicative of the historical fire regime to which plant and animal species in the Australian tropical savanna have evolved.

Presentation Title: Revisit of the Freiburg Declaration on Tropical Fires of 1989

Presenter: *Johann G. Goldammer*
Max Planck Institut für Chemistry
Mainz, Germany

Abstract:

In response to the accelerating influence of human-made fires on tropical ecosystems in the 1980s an international symposium "Fire in the Tropical Biota" was convened in May 1989 at the Fire Ecology Research Group, Freiburg University, Germany. For the first time the conference developed a pan-tropical view on natural and anthropogenic fires, including land-use fires and the use of prescribed fire in ecosystem management, and summarized the state-of-the-art knowledge on vegetation fire monitoring and impact assessment. Based on an interdisciplinary insight of the global dimension of tropical fires the scientists endorsed and released "The Freiburg Declaration on Tropical Fires". The declaration analyzed the contemporary situation and trends, and called for an action plan for dedicated science and urged the international community to develop appropriate land-use and fire management policies as well as institutional mechanisms to distribute fairly - both within and between nations – the costs and benefits of changes in fire policy. Since the release of the declaration more than 17 years ago, tropical fire science has largely achieved what was expected. The ecological, atmospheric, chemical and climatic impacts of vegetation fires have been investigated in depth. However, the overall decline of tropical vegetation due to excessive use of fire and the feedback mechanisms between land-use change, fire use, increasing vulnerability of ecosystems and climate change have dramatically degraded and destroyed tropical ecosystems, biodiversity and carrying capacity. Progress in science and technology transfer to integrated fire management systems is insufficient. In order to generate public and political interest for developing appropriate fire policies the Global Fire Monitoring Center(GFMC) was established in 1998 and an initiative addressing the reduction of negative impacts of wildland fire on the environment and humanity was launched under the patronage of the United Nations International Strategy for Disaster Reduction (UNISDR).

TRACK 2

Tuesday, November 14, 2006

Public Perception and Education

8:00 – 8:15	*Stentor Danielson* *Clark University*	Discourses About Fire In New Jersey and New South Wales
8:15 – 8:30	*James Absher* *USDA Forest Service*	Perceptions of Wildfire Management Issues by San Diego County's Wildland-Urban Interface Residents
8:30 – 8:45	*Patricia Winter* *USDA Forest Service*	Urban Proximate Wilderness Visitors' Preferences for Fire Management
8:45 – 9:00	*Rebecca Montgomery* *University of Arkansas*	Stakeholder Identification of Emerging Issues Surrounding Use of Prescribed Fire in Arkansas Forests
9:00 – 9:15	*Christine Denny* *Pandion Systems*	Facts about fire - increasing public awareness and support of prescribed burning through the Fire in Florida's Ecosystems Program
9:15 – 9:30	*Patricia L. Winter* *USDA Forest Service*	Improving a National Fire Information Program: A Needs Assessment Approach
9:30 – 9:45	*Shelaine Curd-Hetrick* *National Biological Information Infrastructure*	The Southern Fire Portal: Regional fire information management
9:45 – 10:00	*Heidi Bigler Cole* *USDA Forest Service*	Science delivery: How Fire and Fire Surrogate Study researchers used a scientific approach to develop a plan of action

Community Wildfire Management

10:30 – 10:45	*James Absher* *USDA Forest Service*	Residents' Input on Effective Communication about Wildfire Management
10:45 – 11:00	*Carlu Van der Westhuizen* *Central University of Technology*	Management of veld fires by newly settled farmers and related small-scale business opportunities in South Africa.
11:00 –11:15	*Abraham Lincoln Owusu* *Integrated Ecology Society of Ghana*	Fire Management Strategies in the Upper East Region of Ghana, Case Study
11:15 – 11:30	*Peter Jacklyn* *Charles Darwin University*	Building effective community-based fire management in Australia's tropical savannas: working with diversity and remoteness.
11:30 – 11:45	*Durgadas Mukhopadhyay* *Delhi University*	Issues in Community Based Forest Fire Management in India

Building the Support You Need: Incorporating Education and Communications onto Fire Management

Maureen Brooks
USDA Forest Service
Newton Square, Pennsylvania, USA

13:30 – 13:45	***Maureen Brooks*** ***USDA Forest Service***	Communicate the Role of Fire in Your Fire Management Program (National Interagency Fire Messages)
13:45 – 14:15	***Ed Smith*** ***University of Nevada***	Defensible Space: Fifteen Reasons Why People Don't Do It
14:15 – 14:30	***Frank Lake*** ***Oregon State University***	Collaboration between Private landowners and Native American basket weavers: Fuels reduction and enhancement of basket materials
14:30 – 14:45	~~***Dennis Dupuis***~~ ~~***Bureau of Indian Affairs***~~	~~Integrated Programs provide a Sensible Solution to Treating Hazardous Fuels and Restoring Fire~~
14:45 – 15:00	***Robin Hanford*** ***Nature Conservancy***	Panel Discussion Part 1
15:30 –16:00	***Judith Downing*** ***USDA Forest Service***	Communicating with Communities: Before, During and After Evacuations
16:00 – 16:15	***Deb Schweizer*** ***DOI - National Park Service***	Smoke: Systematic Communication before and during Fire Projects
16:15 – 16:30	***John Burwell*** ***Oklahoma Division of Forestry Services***	The past year in Oklahoma -- Communities and Communication
16:30 –17:00	***Bob Mutch*** ***Fire Management Applications***	Finding the Turning Point: Effective Communications in Fire Management
17:00 – 17:30	***John Owens*** ***Bureau of Land Management***	Discussion: The Importance of Communication

Session Title: Public Perception and Education

Presentation Title: Discourses About Fire In New Jersey and New South Wales

Presenter: *Stentor Danielson*
Clark University
Worcester, Massachusetts, USA

Abstract: With the increasing attention being given to collaborative, participatory, and community-based management of wildfire risks, it is important to understand homeowners' perspectives on fire management. As in any other environmental management issue, the public is home to several different ways of conceptualizing the wildfire issue. This paper presents the results of two case studies: the Pine Barrens of southern New Jersey, USA, and the suburbs of Sydney, Australia. Using Q Methodology, it distinguishes the different discourses -- ways of thinking and talking -- about fire held by stakeholders in each location, considering both their descriptive and normative aspects.

Presentation Title: Perceptions of Wildfire Management Issues by San Diego Wildland county's Wildland-Urban Interface Residents

Presenter: *James Absher*
USDA Forest Service
Riverside, California, USA

Abstract: Working from a social marketing framework, this study provides decision-relevant data for communications aimed at changing attitudes and behaviors among WUI residents with regard to wildland fire management. The first phase of this project is focused on the Wildland Urban Interface (WUI) of San Diego County. A new method was developed to identify and survey only those living in the WUI (roughly defined as ½ mile from the forest boundary). Targeted locations include rural and urbanized areas, such as the Julian or Alpine, and areas with and without a recent major wildland fire. A mailed questionnaire with reminders and follow up mailings is being used. A comprehensive model of WUI residents' wildland fire behaviors was constructed. Results are based on analyses of the key driving concepts, including: a) residents' sense of the area (e.g., their attachment to neighborhood or National Forest, and beliefs or attitudes about wildland fires), b) trust in government to manage the forest in a manner consistent with their values, and c) the manner in which individuals respond to program directives (e.g., fire related communications and regulations) or management practices (e.g., prescribed burning). Other variables included in the study are location specific data (e.g., wildland fire history) and individual behaviors (e.g., homeowner code compliance and defensible space actions) and personal experiences with wildland fire. Never before has all this data been gathered at one time for such a closely targeted population, making this dataset uniquely capable to address complex behavioral and WUI policy questions in a scientifically rigorous way. In addition, the WUI-specific sampling innovation may be repeated by others who wish to focus on WUI issues in other contexts. Thus, this presentation will offer conference participants cutting edge methodological, behavior modeling and issue-driven analyses of important wildland fire social science topics.

Co-Authors: *Jayne Fingerman Johnson, University of Minnesota - Kristen C. Nelson, University of Minnesota - David P. Fan, InfoTrend,*

Presentation Title: Urban Proximate Wilderness Visitors' Preferences for Fire Management

Presenter: *Patricia Winter*
USDA Forest Service
Riverside, California, USA

Abstract: Recreationists' opinions and knowledge about fire management are of great interest, yet, when it comes to issues surrounding fire management, little information is available. The literature suggests that managers' ideas of visitor perceptions may vary quite dramatically from actual visitor values and attitudes (Manning 1999). A recent examination of managers' perceptions of fire's impact on recreational pursuits suggested little to no perceived impact on recreation from visible evidence of wildland fires, trail closures due to fires, or smoke (Bricker, Chavez, Hendricks and Millington 2005). In comparison, studies by Chavez and Hendricks (2003), and by Thapa, Holland and Absher (2003) suggest fire management actions and fire risk influence recreation and tourism choices. Findings from a survey involving 103 urban proximate wilderness visitors in southern California are useful towards increasing our understanding of recreationists' views about fire and fire management. A majority of respondents indicated that they would be bothered by plants and trees charred or burned from a fire, and by smoke from a nearby fire. On the other hand, evidence of clearing to reduce fire risk was viewed as less bothersome. The majority were willing to recreate at other similar sites in cases of closures for severe fire risk, and would travel an average of 20 miles (mode) to get to the alternate site. However, area closures were the least favored among a series of fire management alternatives, and were the focus of several open-ended comments. Approval, effectiveness, personal impact, and trust in the Forest Service to accomplish each management action were assessed and then examined in light of sociodemographics, salient values similarity and general trust, concern, knowledge, and attachment to place. Opportunities for agency communication and education efforts are highlighted and are paired with recommended routes for communication based on trust in information sources.

Presentation Title: Stakeholder Identification of Emerging Issues Surrounding Use of Prescribed Fire in Arkansas Forests

Presenter: *Rebecca Montgomery*
University of Arkansas
Monticello, Arkansas, USA

Abstract: The recognition of the detrimental effects of fire removal has led to the reintroduction of fire to forest ecosystems of Arkansas. Although prescribed fire is critical for restoring and maintaining healthy forests, particulates in smoke can pose a risk to public health and welfare. Recent fires and plans for increased use of fires at National Forests in this region have brought to the surface these inherent conflicts. A better understanding of stakeholder concerns, attitudes, and beliefs relating to prescribed fire is needed to minimize potential disputes among stakeholder groups. The objective of this project is to identify and address the social issues inherent to the use of prescribed fire in the Ozark and Ouachita forests of Arkansas. In order to identify the issues a series of focused discussions were set up at 5 locations across the state. Participating stakeholders came from a variety of backgrounds and included: private industry, organizations (Sierra Club, Lung Association, Nature Conservancy), local business owners, civic services (fire departments, mayors offices), and governmental agencies at the state and local level. Discussions were used to identify emerging issues surrounding the use of prescribed fire in forest management. The three main issues impacting land managers' ability to burn surfaced in these discussions include: risk, public health, and public perception. In addition, several barriers to public acceptance of prescribed fire were identified including limited public understanding of forestry and biological diversity, distrust between the public and governmental agencies, and a lack of information regarding prescribed fires' effects on human health.

Co-Authors: Janean Creighton, University of Arkansas

Presentation Title: Facts about fire- increasing public awareness and support of prescribed burning through the Fire in Florida's Ecosystems Program

Presenter: *Christine Denny*
Pandion Systems, Inc.
Gainesville, Florida, USA

Abstract: Land managers say that a lack of public support for prescribed burning has contributed to the fuel buildup that feeds Florida's wildfires. In addition, recent hurricanes have created an accumulation of fuels that contribute to wildfire dangers. The Fire in Florida's Ecosystems program seeks to raise awareness of the ecological and historic role of fire while building support for prescribed burning among the public by reaching out to educators statewide. Funded by the Florida Division of Forestry, the training and corresponding materials include hands-on activities, field trips, videos, posters, and an interactive CD-ROM. The program has been delivered to over 2300 educators since 2000 and evaluation results show statistically significant improvements in knowledge about and attitudes toward prescribed fire. Participants in the program include teachers and non-formal educators such as state park staff, volunteers, and nature center staff. Follow-up phone surveys indicate that over 90% of educators are adopting the curriculum and over 96% plan to use or continue to use the curriculum and its components in the future. Surveys also show that educators are incorporating fire ecology activities into lesson plans and field trips. The Fire in Florida's Ecosystems program offers educators the information and tools to help students, visitors, and community members gain a better understanding and acceptance of prescribed

Co-Authors: *James Brenner, Florida Division of Forestry*

Presentation Title: Improving a National Fire Information Program: A Needs Assessment Approach

Presenter: *Patricia L. Winter*
USDA Forest Service
Riverside, California, USA

Abstract: A user needs assessment was conducted surrounding National Predictive Services, an interagency program that provides fire related information through websites, emails, and in-person briefings. In this evaluation, the results will be used formatively, that is, they will feed back into further program refinement and development (Quinn Patton 1986). Involving the users of predictive services in this evaluation fits with Fischoff's (1995) recommendation for involving the recipients of risk information in the crafting of the risk message, and Johnson's (2004) research that suggests risk statements should take into account variations in target audiences. In this paper we contrast responses to an online survey of users and potential users of Predictive Services. The respondent population includes individuals from across the U.S. within the Federal (n=1,078) and non-Federal (for example state and county, n=305) sectors. The non-Federal sector respondents completed an abbreviated survey in order to reduce respondent burden. Contrasting those categorized as 'familiar' and 'unfamiliar' with the services being evaluated, we examine perceived quality, satisfaction, and overlap with services provided elsewhere. Trust and confidence in the products and services provided, willingness to rely on the information provided, and likelihood of taking action based on that information are reported. Finally, we examine reported barriers to utilization of products and services. Findings are of value in examining the current products and services and strategies for enhanced communication are highlighted. The importance of investing in innovation diffusion is demonstrated. Implications for evaluations of programs are also offered, including recommendations for sampling approaches and methods for user needs assessments.

Co-Authors: *Heidi Bigler-Cole, USDA Forest Service*

Presentation Title: Southern Fire Portal: Regional Fire Information

Presenter: ***Shelaine Curd-Hetrick***
National Biological Information Infrastructure
Oak Ridge, Tennessee, USA

Abstract: The Southern Fire Portal (SFP), is the gateway for ongoing information and technology transfer between the fire management and research communities, and their publics. The SFP is an Internet-based tool which will allows the abundant, disparate, and often hard-to-find resources of fire science to be accessible from one geo-portal by compiling and synthesizing, packaging, and delivering wildland fire data, information, tools, and technologies efficiently and through http://frames.nbii.gov/southernfire in a user friendly manner that allows increased information access, distribution, comparison and use. The SFP is a subset of FRAMES, the Fire Research And Management Exchange System and is built a software platform that provides customizable website content. Geographically, the SFP encompasses the Southern Area Coordination Center's 13 states. The SFP's objectives are to improve fire science organization and accessibility by integrating and expanding comprehensive and complementary sources of fire information. Currently, the SFP unifies several sources of fire information including: Encyclopedia of Southern Fire Science; Tall Timbers Research Station's E.V. Komarek Fire Ecology Database; Content from Joint Fire Science Program (JFSP) and National Fire Plan (NFP) projects; Information in the U.S. Geological Survey's National Biological Information Infrastructure; and Key products and tools from state agencies, universities, and non-governmental organizations in the southern region. SFP will periodically revise its fire science syntheses, bibliographic databases, and thesaurus to reflect the latest scientific findings. It will incorporate new metadata from JFSP and NFP projects as they become available. In sum, SFP will actively monitor the development of fire resources on all fronts and make all relevant new information available on its website. As a management tool, the SFP will help managers efficiently identify research products, compare these products to similar efforts, and help determine suitability for their particular management application. The goal is to find existing information quickly, efficiently, and for free.

Co-Authors: ***Kevin Robertson, Tall Timbers Research Station - Ronald Masters, Tall Timbers Research Station - Ken Outcalt, Southern Research Station - Mike Rauscher, USDA-Forest Service - Jennifer Pollock, U.S Geological Survey - Greg Gollberg, University of Idaho - Ann M. Bruce, Tall Timbers Research Station - Marylin Naito, Tall Timbers Research Station***

Presentation Title: Science delivery: How Fire and Fire Surrogate Study researchers used a scientific approach to develop a plan of action

Presenter: ***Heidi Bigler Cole***
USDA Forest Service
La Grande, Oregon, USA

Abstract: Declining research budgets are prompting scientists to seek outside research funding. In this era of accountability measures, applied research funding bodies are particularly interested in science delivery. Funding organizations, such as the Joint Fire Sciences Program (JFSP) or the National Research Initiative, want evidence that funded research is useful to practitioners. They also want assurance that research findings will be communicated in a manner that the research is likely to be used. Fire and Fire Surrogate study (FFS) (funded by JFSP) took a scientific approach to the problem. Drawing on social science methods and theories, FFS researchers designed a participatory study that investigated practitioners' science delivery perspectives and preferences. Four regional workshops were conducted in Alabama, California, Montana and North Carolina. Study results address four questions: 1) Who needs fuel reduction information?; 2) What information do they need?; 3) Why do they need it?; and 4) How would they like to receive it? Results suggest that a one-size-fits-all science delivery plan is not appropriate; preferred: communication strategies may vary by audience, by geographic location and by professional vocation. Study results were used to develop a FFS communication plan. Opportunities for improving FFS science delivery through continued participatory research are explored.

Co-Authors: ***Andrew Youngblood, Pacific Northwest Research Station***

Session Title: Community Wildfire Management

Presentation Title: Residents' Input on Effective Communication about Wildfire Management

Presenter: *James Absher*
USDA Forest Service
Riverside, California, USA

Abstract: Providing information to residents of the wildland-urban interface (WUI) about ways to protect their homes from wildland fires (e.g., firewise behaviors) is an important task for local, state, and national land management agencies. While the benefits of creating defensible space around one's home are apparent to most WUI residents, convincing them to engage in these actions is often difficult. Little research exists on how to improve communication success and compliance. Concerns such as what message to provide to whom, and how or when to provide the information complicate the public communication process. Message source (e.g., agencies, media choices) and how agency information is perceived, understood and acted upon by the public are also concerns. The elaboration likelihood model (Petty & Cacioppo 1986) offers a theoretical framework for addressing source credibility and strategies for facilitating behavioral compliance with firewise messages. Residents of WUI in the Front Range Colorado region were sent mail-back questionnaires that (a) assessed the credibility of the US Forest Service, Colorado State Forest Service, and local fire authorities as sources of information; (b) provided information pamphlets about several areas of appropriate firewise behavior; and (c) measured the levels of message clarity, message elaboration, and potential behavior change as a result of the information. Results indicated that perceived credibility of the firewise information source significantly predicted the level of elaboration of a message, and that relationship was mediated by the clarity of the message. Findings are discussed with respect to behavior change, and Firesafe Council and agency communication strategies. Implications include the potential for joint communication efforts among management agencies to enhance the effectiveness of information campaigns designed to influence public behavior.

Presentation Title: Management of veld fires by newly settled farmers and related small-scale business opportunities in South Africa.

Presenter: *Carlu Van der Westhuizen*
Central University of Technology
Free State, Bloemfontein, South Africa

Abstract: The central regions of South Africa experienced an abnormally high precipitation during the first quarter of 2006, in most cases more rain were measured that the average annual rainfall. All farmers must unite in preparing for the unusually high probability of veld fires due to the excessive amounts of fuel/grass available. After the democratic election of 1994 a new policy was developed that ensures that agricultural land in South Africa is evenly distributed to all the inhabitants of the country. In this regard land must be transferred to black people, who in most cases are not trained for the management of a farm. With increased political pressure on policy makers to perform, this process of land redistribution was drastically accelerated during the past few years. This implies that many newly settled black farmers are farming but still need to be trained in various aspects of farm management. Unfortunately, in most cases this did not include environmental management, which among others, implies managing and preparing for veld fires. The Department of Water Affairs and Forestry does not have sufficient funding to cover all these aspects and a regional collaborative plan must therefore be developed. In addition to this, in an attempt to alleviate poverty, many other previously disadvantaged people in South Africa must be assisted in establishing small business enterprises. This paper will highlight the process to be followed to train and coordinate all farmers as well as the business opportunities that is available for small enterprises to remove some of the fuel (grasses and shrubs) in order to reduce the risk and intensity of winter and spring veld fires.

Presentation Title: Fire Management Strategies in the Upper East Region of Ghana, Case Study

Presenter: *Abraham Lincoln Owusu*
Integrated Ecological Society of Ghana
Bolgatanga, Ghana

Abstract: Fire Management in the Upper East region of Ghana is a very new technology that is gaining grounds in the region. The people of the Bazua Zonal Council of the Bawku East District of Ghana have been able to maintain a non-burning strategies since 2003. This has helped boost their crop yield by 60%. The activities and efforts of NGOs and the district assembly's structures have contributed to the success of the technology.

Presentation Title: Building effective community-based fire management in Australia's tropical savannas: working with diversity and remoteness.

Presenter: *Peter Jacklyn*
Charles Darwin University
Darwin, Northern Territories, Australia

Abstract: An ambitious Australian fire management project is building an effective community of fire managers across Australia's 700,000 square mile tropical savannas. This talk describes the research, capacity-building and communication strategies involved. This region has very large bushfires (up to 23,000 square miles in extent); recently changed fire regimes that are having a profound impact on the ecology and economies of north Australia; and a very sparse population. Fire management in the region cannot be undertaken by fire agencies alone and is carried out largely by a diverse range of land managers engaged in grazing, customary indigenous use, defense, mining and conservation. All groups are interested in suppressing wildfire but also use fire as tool for a range of land management goals. To build an effective community of fire managers, the project had to develop strategies that became a number of issues: •_divergent views on fire between the urban majority and the rural fire managers; •_cultural divides between many of the rural fire managers; •_the extreme isolation of many fire managers in remote communities; •_low capacity in ICT and fire management skills. The project is based on a suite of Participative Action Research sub-projects that worked with the whole range of fire anagers. These sub-projects then produced: •_skills and knowledge; •_practical tools; •_a network of relationships including fire agency staff, land managers and researchers in a diverse range of fire management contexts. The network, skills and knowledge produced were then used to create, and continually refine, further integrated tools that spanned the Australian tropical savannas. These included websites that tracked fires through satellite data, now used by many fire managers, and resources for schools, the media and policy-makers that are helping to better inform the urban majority.

Co-Authors: *Jeremy Russell-Smith, Bushfires Council of the Northern Territory - Peter Thompson, Cape York Peninsula Development Association - Brian Lynch, Tropical Savannas Cooperative Research Centre - Natalie Raisbeck-Brown, Ecomap*

Presentation Title: Issues in Community Based Forest Fire Management in India

Presenter: *Durgadas Mukhopadhyay*
University of Delhi
Delhi, India

Abstract: Community based forest fire management is a type of land and forest management in which a locally resident community (with or without the collaboration of other stakeholders) has substantial involvement in deciding the objectives and practices in preventing, controlling and utilising fires. The essential feature of the definition is that it takes seriously the idea of fire management being community-based. It does not include situations where people simply carry out paid work for a fire control agency or another agency outside the community. In this approach to the management of fire in the landscape rests on communities in decision-making roles for the application and control of fire. Forest community responsible for forest fire management can act as guard against man made causes of forest fire where forest fire is used as a means of increasing soil fertility and to get excess fuel and fodder after the harvest season. Based on in-depth interview and participatory research with the community living on the forest resources the data derived suggest remedial strategies in the occurrence of forest fire and management of resources. Community based fire control not only ensures environmental safety and resource management but brings community well-being and healthy society as well. Forest in Uttaranchal in India is degrading day by day with high incidence of `forest fire' and preventing development activity in the local community. Local Self Government (Village Panchayats), community and other stakeholders jointly should shoulder the responsibility of action, planning and managing forest resources creating opportunities and participation of the community Proper incentive and delegation of power and authority may work better in forest fire management. Community based forest fire management would involve- •Planning at village, GP, Block and District levels •Identifying and training key local volunteers •Village level vulnerability and risk mapping Village level preparedness and contingency plan of use of deliberate fires •Disaster Management task force at village level •Skill training and drills in emergency response in case of forest fire The basic strategy for forest and pasture management should have strategic plans for fuel and grazing facility for the local community. Grazing in rural India needs special attention to control pressure of cattle and affecting vegetation growth. The creation and conservation of buffer area that avoid the continuity of forest masses is another strategy to be effective. The joint forest management projects in India tries to develop forest area and plant growth by involving the community as a stakeholder in forest fire management.

Session Title: Building the Support You Need: Incorporating Education and Communications onto Fire Management

Session Organizer: *Maureen Brooks*
USDA Forest Service
Newton Square Pennsylvania, USA

Abstract: Communication plays an integral role in wildland fire management. This session will examine the importance of using communication and fire education as a critical tool for sound wildland fire management, and how to address those special challenges found in today's instant gratification, instant information world. We must all work together to grow public understanding of how fire's long-term ecological role can help land managers reach their ongoing goal of reducing risks and threats to communities while protecting and sustaining natural resources. But communicating the ecological and sociological roles of fire is not an opportunity for agencies alone; it requires the building and maintenance of partnerships.

Presentation Title: Communicate the Role of Fire in you Fire Management Program (National Interagency Fire Messages)

Presenter: *Maureen Brooks*
USDA Forest Service
Newtown Square, PA, USA

Abstract: Communication plays an integral role in wildland fire management. A clear plan can greatly enhance communication efforts – providing a road map to focus on the important issues and ensuring a consistent message and delivery to key audiences.

The cornerstone of any communication program is a set of consistent, compelling messages for use in all proactive and reactive communications. Messages should be actionable messages where appropriate so that, in addition to educating, they will motivate the audiences to act on what they have learned. You may be asking that audiences be informed and supportive of agencies' wildland fire efforts, or that they get involved in local activities. The National Wildfire Coordinating Group (NWCG) Wildland Fire Education Working Team (WFEWT) has developed a set of core messages for agencies to use in communicating the role of wildland fire. These messages have been through an extensive interagency development and review process, and have been approved by the NWCG:

- Wildland fire is an essential, natural process.
- Society's influence has altered historic fire cycles, leading to a dangerous and difficult buildup of vegetation in our wildlands.
- Land management agencies are committed to a balanced fire program that will reduce risks and realize benefits of fire.
- Improving the health of the land and reducing risks to communities requires partnerships among federal and state agencies, tribal governments, fire departments, communities, and landowners.
- Public education is necessary to the success of fire management programs.

Learn about these National Interagency Key Messages and other resources developed by the Wildland Fire Education Working Team to use in your communication, education, information, and prevention efforts.

Presentation Title: Defensible Space: Fifteen Reasons Why People Don't Do It

Presenter: *Ed Smith*
University of Nevada
Minden, Nevada, USA

Abstract: The term defensible space refers to that area between a house and an oncoming wildfire where the vegetation has been modified to reduce the wildfire threat and allow fire fighters to safely operate. Research results clearly demonstrate that defensible space improves the probability of house survival during wildfire. Despite educational efforts by fire fighting agencies, many property owners living in high fire hazard environments have been slow to adopt defensible space practices. Based on the findings of four surveys involving property owners living in high fire hard areas in California and Nevada, fifteen factors were identified that influence decisions to adopt defensible space practices. These factors were: lack of awareness, denial, fatalism, futility, irresponsibility, inability, lack of incentives, insurance, lack of knowledge, aesthetics, unnaturalness, disposal of slash, discomfort, illegality, and lack of ownership. IF THE goal is to have property owners employ defensible space practices, it is important to understand the factors that affect their decisions to take action. Once these factors are understood, resources can be strategically directed to address the real reasons for property owner failure to implement defensible space practices.

Presentation Title: Collaboration between Private landowners and Native American basket weavers: Fuels reduction and enhancement of basket materials

Presenter: *Frank Kanawha Lake*
Oregon State University
Oregon, USA

Abstract: In northwestern California private landowners, agencies, tribes, Fire Safe Councils, and Native American basketweavers are cooperatively working together to reduce fuels within the Wildland Urban Interface (WUI) in rural forested habitats. When conducted appropriately, fuels reduction and prescribed fire can be used to accomplish multiple objectives benefiting the landowners and cultural practitioners. Cross cultural education, communication on the ground, building trust, and aligning expectations around fuel treatments benefited the parties involved. Collaboration was fostered by the willingness of the private landowner to grant access to tribal harvesters. Communication was improved when the parties shared what it was they desire from the fuels treatments. Approaches taken to implementing fuels reduction and the specificity of prescribed fire use were bridged when they exchanged knowledge of historical habitat conditions, fire use, and future desired conditions resulting from prescribed fire. The groups expressed their needs and learned from each other. The process of building community understanding and improving the capacity of others takes innovative private landowners willing to take risks and challenge otherwise stagnate fire management policies and practices. Basketweavers have benefited and increase their cultural capacity to carry on traditions from progressive and culturally considerate private landowners. Fuels reduction and prescribed burning were conducted with collaboration and consultation of tribal practitioners. Projects were able to foster the production of fire induced ecological goods and services. Treatments reduced ladder and ground fuel continuity, maintained canopy closure to regulate habitat microclimates, selected culturally desired trees and shrubs, and integrated modern methods to enhance traditional materials, foods, and medicines benefiting the landowner and tribal practitioners. Specifically, fuel treatments restored at-risk habitats, improved WUI protection, and provided basket materials generally no longer available in other places across the landscape due to access, changes in habitat conditions and lack of sufficient low to moderate severity fires.

Presentation Title: ~~Integrated Programs provide a Sensible Solution to Treating Hazardous Fuels and Restoring Fire in Indian Country~~

Presenter: ~~*Dennis Dupuis*~~
~~*Bureau of Indian Affairs*~~
~~*Boise, Idaho, USA*~~

Abstract: ~~Mechanical fuels treatments are an integral part of hazardous fuel treatment in Indian County. The reintroduction of fire in severely altered ecosystems is possible only when mechanical treatment is used at the outset. Many tribes with forest management programs have a unique advantage which facilitates the achievement of their restoration goals. Bringing all the “players” (programs) to the table provides a sensible solution to restoring ecosystems and achieving goals much earlier than ever thought possible. This presentation illustrates, on a national level, how integrating the hazardous fuels programs with other program opportunities in Indian County is necessary to achieve restoration goals and on a local level, why communication and collaboration between programs is essential for success. Key concepts discussed are fire return intervals, fire regimes, biomass utilization, and policy and procedural processes available to facilitate program integration and collaboration.~~

Presentation Title: Communicating with Communities: Before, During and After Evacuations.

Presenter: *Judith Downing & Dave Olson*
USDA Forest Service
Boise, Idaho, USA

Abstract: Evacuations are increasingly likely during wildfire as the wildland-urban interface expands. Evacuations are one of the most stressful events that a community can face. The residents' experiences during an evacuation will influence relationships between the agencies and communities for decades following the fire. Effective communication can help people cope with evacuation, reducing stress and creating conditions for positive agency-community relationships. Failure to provide effective communication results in strained community relations. That can cause difficulties whenever community collaboration is needed.

When managing fire information on incidents where evacuation is likely, workshop participants will apply the ten recommendations for effective community communications before, during, and following evacuations.
The ten recommendations are for specific, tactical actions that Incident Commanders and Public Information Officers can take to increase the community's ability to cope with the disaster and recover quickly, minimizing losses and creating positive community relationships.

Real time information demands from the public and media have exponentially grown in recent times. Emergency responders must now meet that challenge with the understanding that they, alone, are not the sole providers of information. Strong partnerships, understanding community communication networks, and integration with expanding technical electronic communication infrastructure are the new challenges for communication specialists during emergencies.

Presentation Title: Smoke: Systematic Communication before and during Fire Projects

Presenter: *Deb Schweizer*
USDI National Park Service
Yosemite, California, USA

Abstract: The public, special interest groups, and residents have shown increasing support for project fires in Yosemite (prescribed fire or wildland fire use) as the result of a long-term education strategy. However, their tolerance for the associated smoke event is more problematic. It adversely impacts the tourists (and therefore tourism income), wears on the patience of locals, and well: its smoke. It ranges from annoying to a health issue. Yosemite has developed a smoke communication strategy to best inform interested parties about upcoming or existing smoke events, their expected duration and severity, and possible impacts and solutions for the duration. It has specific triggers for communication outreach that range from posting and distributing updates about fire conditions to Public Service Announcements and using the media when smoke levels become unhealthy for sensitive groups or unhealthy for the general public. The presentation will outline strategy as well as the critical players that need to be part of the collaborative effort (air quality specialists, fuels specialists, ecologists, etc.) Smoke will continue to be controversial by its nature. However, the communication strategy has reduced the number of complaints that come to the park, air pollution control districts, and politicians. This is imperative to continue with a proactive fire management program that reduces hazardous fuels and returns fire to fire adapted ecosystems. The reality is that the Sierra Nevada will burn. These projects help keep it on the park's terms and ultimately reduces the risk of a wildland fire and its associated smoke event.

Presentation Title: The past year in Oklahoma – Communities and Communication

Presenter: *John Burwell*
Oklahoma Division of Forestry Services
Oklahoma City, Oklahoma, USA

Abstract: From November 2005 through May, 2006 Oklahoma experienced an unprecedented fire season. More acres were burned by more fires than at any time in the last hundred years. Of course in this day and age that also meant more communities and more people were threatened by these fires. The fire information staff was stretched to their limits, even with additional resources from the outside, to keep the media and public informed about the situations across the State. Looking back there were some successes, but also some things we could have done better.

Presentation Title: Finding the Turning Point: Effective Communications in Fire Management

Presenter: *Robert Mutch*
Fire Management Applications
Missoula, Montana, USA

Abstract: A primary recommendation that came out of the communication analysis carried out during the southern California Fire Siege of 2003 is that Federal, State, and local agencies have a key responsibility to" inform the network". With a multiplicity of information networks available and implemented in today's world, including even Blogs, it is essential that agencies are fully aware of and responsive to these non-traditional networks. Channeling essential information to these various networks can catalyze the dissemination of required knowledge through the credible assistance of others. The powerful concept of The Tipping Point as described by author Malcolm Gladwell in his recent book The Tipping Point—How Little Things Can Make a Big Difference will be examined. Valuable insights are provided into how small advances can be highly significant in creating a positive epidemic, changing people's behavior and providing for a greater social good.

Information epidemics are characterized by three characteristics:

- Contagiousness
- Little causes can have big effects
- Change happens not gradually but at one dramatic moment

TRACK 3

Tuesday, November 14, 2006

Fire Effects and Fire/Climate Interactions in Boreal Forests

Susan Conard
USDA Forest Service
Arlington, Virginia, USA

8:00 – 8:15	***Susan Conard*** ***USDA Forest Service***	The extent and variability of fires and its impact in boreal zone forests
8:15 – 8:45	***Bill De Groot*** ***Canadian Forest Service***	Modeling fire behavior, fuel consumption and fire emission in Canadian boreal forests
8:45 – 9:15	***Douglas McRae*** ***Canadian Forest Service***	Modeling and predicting interactions between weather, fuel condition, fire behavior, and burn severity
9:15 – 9:30	***Steve Baker*** ***USDA Forest Service***	Effects of fire severity on soil respiration and soil microorganism populations in Siberia pine forests
9:30 – 9:45	***Ron Neilson*** ***USDA Forest Service***	The Role of Fire In Altering Vegetation Distribution Under Future Climate Change
9:45 – 10:00	***Nadja Tchebakova*** ***Sukachev Institute***	Potential climate-induced vegetation change, phytomass loss, and fire danger in the changing climate of Siberia
10:30 – 11:00	***M.R. Turetsky*** ***Michigan State University***	Peatlands and wildfire regimes in boreal North America: implications for pyrogenic emissions of carbon and mercury
11:00 – 11:30	***Edward Berg*** ***US National Wildlife Service***	Landscape drying, spruce bark beetles and fire regimes on the Kenai Peninsula, Alaska
11:30 – 12:00	***Kristen Manies*** ***US Geological Survey***	Differences in short- versus long-term inputs and losses of carbon to boreal ecosystems: are changes in fire severity and carbon cycling occurring today?

Climate Change / Carbon Cycling

13:30 – 13:45	***Matthew Hurteau*** ***University of California***	Forest response to global climate change and atmospheric pollution: Implications for fire management
13:45 – 14:00	***Fiona Scarff*** ***Macquarie University***	Effects of plant functional traits on wildfire behaviour
14:00 – 14:15	***Viatcheslav Kharuk*** ***Sukachev Forest Institute***	Wildfire Dynamics In Central Siberian Taiga
14:15 – 14:30	***Erica Smithwick*** ***University of Wisconsin***	Modeling the effects of changing climate and fire regimes on productivity, carbon storage and nitrogen fluxes in Pinus contorta stands
14:30 – 14:45	***Valerie Trouet*** ***Pennsylvania State University***	Fire-Climate interactions in the northern Sierra Nevada mountains, Lake Tahoe Basin, USA
14:45 – 15:00	***Uma Shankar*** ***University of North Carolina***	The Cyclical Relationships of Climate Change, Forest Biomass, Fire Emissions and Atmospheric Aerosol Loadings: An Integrated Modeling Study
15:30 – 15:45	~~***Dolors Armenteras***~~ ~~***Instituto Alexander von Humboldt***~~	Biomass burning from tropical savannas in Colombia: local to global estimates
15:45 – 16:00	***Nancy French*** ***Altarum Institute***	Mapping Fuel Consumption for Carbon Cycle Studies
16:00 – 16:15	***Xuexia (Sherry) Chen*** ***US Geological Survey***	Modeling forest biomass carbon using LANDFIRE data and FIA field inventory data

Session Title: Fire Effects and Fire/Climate Interactions in Boreal Forests

Session Organizer: *Susan Conard*
USDA Forest Service
Arlington, Virginia, USA

Session Abstract: Future impacts of a changing climate are predicted to be largest in the circum boreal when compared to other global regions. Significant increases in temperatures have already been observed for many boreal regions of North America and Eurasia. With the dominance of fire and fire/insect interactions in these ecosystems, it is critical to understand how fire affects essential ecological processes, interactions of fire with carbon cycling, and how these processes are likely to be affected by a warming climate. This session will address the extent of fire and variability in fire regimes in boreal forests, evidence for recent changes, effects of fire and burn severity on carbon cycling and ecosystem processes, and potential interactions between fire, climate, and insect and disease.

Co-Organizer: *Douglas McRae, Canadian Forest Service*

Presentation Title: The extent and variability of fire and its impacts in boreal zone forests

Presenter: Susan Conard
USDA Forest Service
Arlington, Virginia, USA

Abstract: About 25 percent of the world's forests, and over a third of global terrestrial carbon stocks, are in the boreal zone. Despite relatively low intensity of utilization, the boreal zone forests produce over half of the global roundwood supply. In addition to abundant fiber, these forests provide many other valuable products and resources. While some of these forests have been intensively managed for hundreds of years, most of them are still lightly impacted by human activity relative to other areas of the globe. Nonetheless, human impacts are rapidly increasing. The dynamic processes in boreal zone forests are strongly tied to the patterns of fire across the landscape. Fires burn some10 to 20 million hectares in the boreal zone in a typical year. The areas of high fire activity vary geographically from year to year, depending on regional weather and climate patterns. Fire regimes also vary widely across the boreal zone, from relatively short interval surface fires, to high intensity crown fires, and smoldering ground fires. Forest fire in the boreal is fully as important a process as in the temperate and tropical forests. Much of the carbon storage in the boreal zone is in deep peat deposits; little is known about fire regimes or fire climate interactions for these systems. As we will hear in this session, climate
change--and its interactions with fire, insects, vegetation changes, and other processes--is already having its impacts on the boreal forest zone—and these impacts can be expected to increase in the future. Better understanding of the role of fire in the boreal forest zone will help managers to sustain these critical resources in the face of changing economic, social, and environmental conditions.

Co-Authors: *Ivan Csiszar , University of Maryland*

Presentation Title: Modeling fire behavior, fuel consumption and fire emissions in Canadian and Russian boreal forests

Presenter: *Bill De Groot*
Canadian Forest Service
Edmonton, Canada

Abstract: Wildland fires are estimated to burn between 12 and 20 million ha annually across the circumboreal forest. Boreal fire activity appears to be increasing, as the amount of annual area burned in North America doubled over the last two decades. Wildland fire carbon emission rates are known to be highly variable due to pre-fire fuel conditions and fire behavior. Because the boreal forest is characterized by large fires, there is large spatial variability in carbon emissions as fires burn over a wide range of fuel types under continually changing weather conditions as they spread across the landscape. The Boreal Fire Effects (BORFIRE) Model was used to estimate this variability of North American and Russian carbon emissions from fires. Fire behavior and fuel consumption sub-models in BORFIRE were parameterized using Canadian and Russian data for major fuel types. Recent historical fire weather data was collected and summarized to provide a representative range in burning conditions to calculate component values of the Canadian Forest Fire Weather Index (FWI) System, which are used to drive BORFIRE sub-models. The model was initialized with standard estimated pre-fire fuel loads for major forest fuel types in Canada and Russia. This included live tree biomass (coarse roots, fine roots, stemwood, branchwood, foliage), standing dead tree biomass (stemwood, branchwood), dead and downed woody debris (e.g., medium and course woody debris), and forest floor organic matter (e.g., surface litter, duff). Fuel consumption and carbon emissions from each stand component were calculated and an estimated range of carbon emissions by fuel type was summarized for both continents for recent years.

Co-Authors: *Douglas J. McRae, Canadian Forest Service -*
Galina A. Ivanova, V.N. Sukachev Forest Institute

Presentation Title: Modeling and predicting interactions between weather, fuel condition, fire behavior, and burn severity

Presenter: *Douglas McRae*
Canadian Forest Service
Ontario, Canada

Abstract: In an average year, wildland fires burn about 12-20 million hectares across the circumpolar boreal forest. These fires occur principally in Alaska, Canada, and Russia. In years when extreme burning conditions occur, larger areas can be burned. For example, over 22 million hectares (i.e., the size of the State of Utah) burned just in Russia in 2003. Predictions, using a 2 x CO2 climate scenario, indicate that wildland fire danger will increase across the boreal zone but the highest rate of increase will be in Siberia. Dealing with this increase demands a better understanding of the current interactions between weather, fuel conditions, fire behavior, and burn severity. This will provide important baseline data for current conditions but will also provide a proactive approach for managers to deal with the demands under a changing climate. However, a number of forest or fuel types currently lack adequate fire behavior models to assist in this endeavor. Newer analytical techniques (e.g., Geographic Information Systems) along with improved data acquisition methodology (e.g., infrared monitoring) could vastly improve older models. The development of models for all forest types will be essential in improving our capability for predicting the future consequences of changing fire regimes and their impacts on ecological effects and carbon emission levels. Approaches in conducting this research must involve a multi disciplinary science team, especially when relating the impacts to the correct indicators of burn severity. This need for increased research is occurring at a time when global funding for it is decreasing due to financial cut-backs. Coupled with remote sensing, the construction of reliable burn-severity models will be important in producing daily and annual global-scale estimates to allow for the assessment of carbon emissions and for keeping forest inventories updated.

Co-Authors: *Anatoly I. Sukhinin; V.N. Sukachev Forest Institute - Tim Lynham; Canadian Forest Service*

Presentation Title: Effects of fire severity on soil respiration and soil microorganism populations in Siberia pine forests

Presenter: *Stephen Baker*
USDA Forest Service
Missoula, Montana, USA

Abstract: The influence of fire-induced change is an important consideration in the development of valid estimates of carbon budgets for boreal forests. This study has been conducted on sandy podzolic soils in central taiga Pinus sylvestris stands of central Siberia. On a set of 4 hectare experimental burn plots, covering a range of fire severity, soil respiration has been measured annually for 4 years. For all ages of burns measured, the soil respiration rate showed a high degree of negative correlation with fire severity with $r2 > 0.8$ for linear regressions. The soil respiration rates of the 3 year old burn plots averaged 40 percent of adjacent control plots. On plots where soil respiration was measured immediately before and after burning, the pre-burn soil respiration rate was reduced by an average of seventy percent one day after the fire. For soil micro-organisms the fires reduced the sandy soil invertebrate density and diversity 1.5- 2 times, mainly by eliminating invertebrates found in the organic forest floor and at the mineral soil interface. Changes in the ecological environment after the fires promoted dominance of smaller micro-arthropods, which are resistant to moisture deficit and migrate into the burn area from outside sources. Measurements of these plots will be continued yearly to observe longer term effects of fire severity on soil microorganism populations and soil respiration.

Co-Authors: *I.N. Bezkorovainaya, Sukachev Forest Institute*

Presentation Title: The Role of Fire In Altering Vegetation Distribution Under Future Climate Change

Presenter: *Ron Neilson*
USDA Forest Service
Portland, Oregon, USA

Abstract: A suite of new simulations of vegetation responses to climate change has been created using the latest future climate scenarios and the new Dynamic General Vegetation Model (DGVM) technology. The MC1 DGVM (MAPSS-CENTURY, version 1) simulated potential future vegetation and fire dynamics under 6 future climate scenarios (3 General Circulation Models, GCMs x 2 SRES-IPCC emissions scenarios) as part of the VINCERA Project (Vulnerability and Impacts of North American forests to Climate: Ecosystem Responses and Adaptation). Preliminary results are also available from MC1 simulations over the entire globe using 9 future climate scenarios (3 GCMs x 2 SRESIPCC emissions scenarios). There is, as usual, considerable variation among the scenarios, with the differences appearing to be greatest between the GCMs than between the scenarios within any given GCM. However, certain patterns of vegetation and fire change appear very consistently across nearly all of the scenarios. As the boreal forest shifts north, two processes appear to drive increases in fire over large areas of the forest worldwide. The first is driven by interior continental drying, which causes the interior grasslands to invade north, enhancing the fire regime. Also, within the forest, the waterlimited carrying capacity initially increases, but later decreases as evaporative demand outstrips increases in precipitation and CO_2-induced increases in water use efficiency, thus promoting increases in fire. A similar pattern of initial increased growth followed by temperature-induced drought affects much of the eastern U.S. causing considerable fire under many scenarios. In addition, increased spread of woody and grass vegetation, due to a more favorable moisture regime in the interior western U.S., produces significant increases in fire. These scenarios imply large increases in fire worldwide, which will significantly challenge adaptive responses (including human health), as well as ecosystem and air quality feedbacks to the climate system.

Presentation Title: Potential climate-induced vegetation change, phytomass loss, and fire danger in the changing climate of Siberia

Presenter: *N. M. Tchebakova*
Siberian Branch, Russian Academy of Sciences
Academgorodok, Krasnoyarsk, Russia

Abstract: Climate change impacts are shown to be profound in the boreal zone. Change in the area and phytomass of vegetation zones across Siberia (60-120^{o} E and 50-75^{o} N) in a warming climate are estimated based on our bioclimatic biome and phytomass models correspondingly. The biome model is an envelope-type model that predicts vegetation (tundra, forest-tundra, different taiga forests, forest-steppe, and steppe) from three climatic indices: growing degree days above 5^{o}C; negative degree days below 0^{o}C; annual moisture index; and the depth of seasonal thaw. Zonal phytomass is calculated from regression models based on the same climate indices. Climate indices are calculated from climate data assembled from about 1000 weather stations over the study area. Active layer depth is calculated from the climatic indices described above (r^2 = 0.80). Vegetation change is predicted for 2090 using the Hadley Centre climate change scenarios. Climate index surfaces (1 km grid) are produced for both current and 2090 climates using Hutchinson's thin plate splines. When coupled with climate surfaces and the active layer depth, the biome model predicts Siberian vegetation distribution, and phytomass regression models predict zonal phytomass distribution. Enormous change in the vegetation cover of central Siberia is predicted to occur in the warmer climate of 2090. All vegetation types are predicted to shift northward and the forest area is predicted to decrease two-fold. Grasslands are predicted to occupy 50% of the territory in which they are not currently present. In a warmer climate, major reductions in phytomass of 100-200 t ha^{-1} would result from the predicted replacement of southern and middle taiga by forest-steppe. Warm and dry climatic conditions in the southern and middle taiga by 2090 would result in higher seasonal fire danger. Combined with a large fuel load of vegetation stressed by changing climate this would promote large fires in southern Siberia and stimulate the forests towards equilibrium with the climate.

Co-Author: *Amber Soja, National Institute of Aerospace, NASA Langley Research Center*

Presentation Title: Peatlands and wildfire regimes in boreal North America: implications for pyrogenic emissions of carbon and mercury

Presenter: *Merritt Turetsky*
Michigan State University
East Lansing, Michigan, USA

Abstract: Boreal regions contain large reservoirs of organic matter, mostly in poorly drained areas where peatlands have served as an important reservoir for soil organic matter on a millennial time scale. However, it is not clear whether peatlands will continue to sequester organic matter under future climate regimes, as soil carbon losses (decomposition, fire consumption) will be subjected to regional changes in fire weather and drought. While the thick organic ground-layers present in many boreal permafrost forests and peatlands (litter, mosses, woody debris, organic soil) burns frequently, rates of surface fuel consumption remains one of the greatest uncertainties in modeling carbon cycling in boreal regions. We are using empirical measurements of organic matter combustion, remote sensing of burn severity, and ecosystem- and landscape-level models to investigate fire-related organic matter emissions across the North American boreal region. In addition to exploring spatial and temporal variability in emissions of volatile elements such as carbon and mercury, we also are interested in examining drought and fire weather controls on organic matter consumption across boreal landscapes using the Canadian Fire Weather Index System. Our results to date demonstrate that drought conditions that lower regional water tables and/or increase fire severity in peatlands greatly exacerbate carbon and mercury emissions to the atmosphere. While peatlands in North America have served as a long-term sink for these elements throughout the Holocene period, accelerated losses of organic matter under warmer and/or drier climatic scenarios could cause much of this stored carbon and mercury to be released back to the atmosphere.

Co-Authors: *E. Kasischke, University of Maryland - J. Harden, U.S. Geological Survey - A.D. McGuire, University of Alaska-Fairbanks - Brian Amiro, University of Manitoba - Mike Flannigan, Canadian Forest Service*

Presentation Title: Landscape drying, spruce bark beetles and fire regimes on the Kenai Peninsula, Alaska

Presenter: *Edward Berg*
USDI Fish & Wildlife Service
Kenai National Wildlife Refuge
Soldotna, Alaska, USA

Abstract: Prior to 1977, La Niña cycles brought cool summers and cold winters to the Kenai Peninsula. Warm El Niño summers would initiate spruce bark beetle (SBB) outbreaks, which were soon extinguished returning La Niñas. Since 1977 warm El Niño years have become much more frequent, and even the cool La Niñas are warmer. The warmer summers are drying out the landscape. Peatlands that have been wet Sphagnum fens for 8-13,000 years are for the first time being invaded by woody shrubs and black spruce. In the past these wetlands were fire excellent firebreaks; as the climate dries they are becoming fuel bridges. Longer runs of warm summers have allowed SBB populations to grow exponentially by shortening the 2-year beetle life cycle to 1 year. The 11-year run of warm summers from 1987 to 1997, for example, produced the largest SBB outbreak ever recorded in North America. The outbreak ended only when the beetles had exhausted available host material, not because the summers had cooled. In the past there was no connection between SBB outbreaks and wildfire. Our fire and SBB outbreak history studies indicate that white/Lutz spruce forests burn with a mean fire return interval (MFI) of 400-600 years, whereas the beetles thin the forests every 50 years on average. Black spruce – which is not affected by the SBB - is the dominate fire regime on the Kenai, with an MFI of c.80 years. With a warmer climate we expect that bark beetles will kill white/Lutz spruce before continuous mature conifer forests can be re-established, and that the resulting grasslands and hardwoods will provide a more heterogeneous vegetation cover in upland areas. The absence of conifers will make the upland areas more fire resistant, at least after spring green up. The lowland areas, on the contrary, will become more flammable with increased shrub and black spruce cover.

Presentation Title: Differences in short- versus long-term inputs and losses of carbon to boreal ecosystems: Are changes in fire severity and carbon cycling occurring today?

Presenter: *Kristen Manies*
U.S. Geological Survey
Menlo Park, California, USA

Abstract: It is recognized that the boreal region will be greatly affected by climate change and that these changes will in turn effect the carbon (C) cycle. The balance of these changes, whether positive due to increases in plant growth, or negative due to increases losses to respiration and fire emissions, will ultimately be seen in the soil of these ecosystems. Using the amount of soil which has accumulated since the last fire across stands which vary in post-burn stand age, we estimate long-term inputs and losses for two moderately drained black spruce (Picea mariana), feathermoss dominated ecosystems; one located in northern Manitoba, Canada, the other in interior Alaska. We found that although separated by 2700 km, the long-term input and losses to systems were not different. Next, we compared the long-term estimates for the Manitoba region to recent annual estimates of inputs (net primary production) and losses (heterotrophic respiration, Rh) to determine if changes within the soil system are already apparent. We found that recent annual measurements for both inputs and losseswere higher than decadal estimates, but that these increases tended to balance out when integrated across the chronosequence. However, the older stands appear to be acting as a net sink of C from the atmosphere, implying that stand age locally and regionally greatly affects the net C balance. Therefore, increases in fire frequency will minimize the areas and time spans where these forests are absorbing carbon, thereby possibly exacerbating C release to the atmosphere. The capacity for vegetation to respond to changes in fire frequency, however, has not been explored. If carbon manipulation becomes an important issue for these forests, managing forests for increased C uptake will likely become increasingly difficult in the face of increased fire frequency.

Co-Authors: *Jennifer Harden, U.S. Geological Survey*

Session Title: Climate Change/ Carbon Cycling

Presentation Title: Forest response to global climate change and atmospheric pollution: Implications for fire management

Presenter: *Matthew Hurteau*
University of California-Davis
Flagstaff, California U.S.A

Abstract: Climate change predictions for the west slope of the Sierra Nevada mountain range include increased levels of late winter/early spring precipitation followed by a warmer, longer growing season. Coupled with these climatic changes is an expected increase in nitrogen deposition due to fossil fuel consumption. To determine the affect of these changes on mixed conifer understory plant productivity and diversity in the central and southern Sierra, we have conducted a field experiment which altered the late season snow pack and increased nitrogen levels. Preliminary results indicate that increasing the snow pack, which effectively extends the soil moisture further into the growing season, coupled with increasing nitrogen levels results in increased biomass production, thereby increasing fine fuels. We have utilized the field experiment to parameterize and validate a simulation model to allow fire managers to forecast fine fuel production and the effects of varying prescribed fire frequencies on understory biomass production. The simulation model allows the user to input current shrub and herb biomass measurements, projected changes in precipitation and nitrogen inputs for the specific geographic area and fire frequency. Annual growth estimates, determined from the field experiment, are then utilized to forecast annual growth response to changing precipitation and nitrogen deposition levels. Manipulating the fire frequency within the model allows the user to determine the appropriate fire return interval to maintain understory fuels at desired levels.

Co-Authors: *Malcolm North, USDA Forest Service*

Presentation Title: Effects of plant functional traits on wildfire behavior

Presenter: *Fiona Scarff*
Macquarie University
Sydney, Australia

Abstract: The dependence of wildfire behaviour on fuel load and moisture content have been extensively studied, but the effects of fuel properties such as lignin, phosphate and oil content and leaf size on fine-scale fire behaviour are not well understood. These characteristics are associated with some major dimensions of plant ecological strategy and can be expected to shift over the next century in response to global changes in atmospheric composition. We used bench-scale experiments to estimate the kinetic and heat transfer properties of a range of fuel types. These were used to parameterise a physical model of fire spread, generating predictions of fire intensity and sustainability in fuels with different chemical and structural properties. Increases in steady-state combustion rate were predicted in association with lower lignin, lower phosphate and higher oil contents. The magnitude of these effects is discussed in relation to predicted changes in plant mortality during wildfires, and the penetration of flame fronts into less flammable stands.

Co-Authors: *Mark Westoby, Macquarie University*

Presentation Title: Wildfire Dynamics In Central Siberian Taiga

Presenter: ***Viatcheslav Kharuk***
Sukachev Forest Institute
Academgorodok, Krasnoyarsk, Russia

Abstract: The wildfire events are undergoes natural (climate variables, insect outbreaks) and anthropogenic factors. The long-term wildfire dynamics, including fire return interval (FRI), in Siberian larch and "dark-needle" conifers communities were examined. A wildfire chronology encompassing the 15th through the 20th centuries was developed by analyzing tree stem fire scars. Average FRI determined from stem fire scar dating was 82±7 years. FRI was also found to be dependent on site topography. FRI on north-east facing slopes was 86±11 years. FRI was significantly less on south–west facing slopes at 61±8 years and flat terrain at 68±14 years. For bogs FRI was found to be much longer at 139±17 years. The temporal trend in FRI decreased from 100 years in the 19th century to 65 years in the 20th century. Similarly, for the "dark-needle" conifers communities FRI was found decreased from 95 to 55 yr. An impact of natural and anthropogenic factor on this phenomenon was analyzed. Pest outbreaks in "dark-needle" conifer communities lead to fire frequency increasing. The correlation between extreme fire events and air temperature deviations at the regional (R2= 0.62), sub-continental (R2= 0.46) and global levels (R2= 0.32) was found. Post-fire permafrost thawing depth dynamics was also estimated: after initial melting (>1.0 m) permafrost depth decreased at a rate of ~0.3 cm/yr on average. The double role of fire on the climate-induced species migration was found: (1) burned areas offer a "starting place" for migration of other plant species into the larch dominated zone for "southern species" invasion, since better thermal and soil conditions, enriched biogenic elements content, increased soil thawing depth and drainage; (2) the decrease of FRI may interfere with the "southern species" invasion: it was found that Siberian pine regeneration is more abundant in old burns in comparison with fresh ones.

Co-Authors: ***Kenneth Jon Ranson, NASA***

Presentation Title: Modeling the effects of changing climate and fire regimes on productivity, carbon storage and nitrogen fluxes in Pinus contorta stands

Presenter: ***Erica Smithwick***
University of Wisconsin
Madison, Wisconsin, USA

Abstract: Altered climates and fire regimes affect ecosystem productivity, carbon (C) storage, and nutrient cycling, yet climate-fire interactions are not well studied and may vary with stand structure. We used a process-based model (CENTURY v. 4.5) to predict how climate change and fire regimes may affect C and nitrogen (N) stocks and fluxes in lodgepole pine (Pinus contorta) stands in Yellowstone National Park (Wyoming U.S.A.). Following the 1988 fires, post-fire lodgepole pine regeneration was extensive but highly variable (ranging from 0 to > 500,000 stems ha-1), and we parameterized the model for two different pathways of stand recovery: slow (low density) versus fast (high density). We simulated future climates (as projected by the Hadley and Canadian Climate Center climate models through 2100) with different fire regimes for these two recovery pathways to determine the sensitivity of C and N cycling to disturbance legacies and climate change. Stands that did not experience fire were net C sinks in future climate scenarios (+19 % to +31 %, depending on the climate model selected). Stands that experienced severe fire were initially a net source of C to the atmosphere, but subsequent C sink strength was determined by the recovery pathway. For example, fast regeneration stands were a net C sink (+3 % to +14 %) by 2100, whereas slow regeneration stands remained a net C source (-2 % to -16 %). Stands that regenerated slowly also had lower gross N mineralization and more variable net N mineralization for 80 years following fire. Simulations resulted in two important conclusions for understanding lodgepole pine responses to climate change and fire: (1) net positive effects of climate on C storage were delayed at least a century by a single, severe disturbance event, indicating the importance of disturbance history on future responses to climate, and (2) variation in stand responses to disturbance may ultimately determine net C balance at the landscape scale.

Co-Authors: ***M. Ryan, USDA Forest Service - D.M. Kashian, Colorado State University - W.H. Romme, Colorado State University - D.B.Tinker, University of Wyoming - M.G. Turner, University of Wisconsin University of Wyoming***

Presentation Title: Fire-Climate interactions in the northern Sierra Nevada mountains, Lake Tahoe Basin, USA

Presenter: *Valerie Trouet*
Pennsylvania State University
University Park, Pennsylvania, USA

Abstract: Twentieth century fire exclusion in western United States forest ecosystems has dramatically disrupted existing fire regimes and has had an impact on forest structure and dynamics. Ecosystem management and ecological restoration increasingly include fire reintroduction and depend on information on pre-EuroAmerican settlement reference conditions. Since regional climate variation modulated the temporal variation in fire regimes, understanding pre-settlement fire-climate interactions is essential to the development of reference condition-based management plans. This study aims at assessing the role of interannual and interdecadal regional climatic variation on pre-settlement fire regimes in pine dominated forests in the northern Sierra Nevada mountains. For this purpose, fire-scar based pre-settlement (1700-1900) records of fire frequency and extent were developed for 14 sites in the Lake Tahoe Basin. Individual site records were aggregated to emphasize the regional scale of the studied fire-climate interactions and the fire record was related to proxy climatic records at interannual to interdecadal time-scales. Pre-settlement fire regimes in the Lake Tahoe Basin showed a strong temporal synchronicity, suggesting the occurrence of wide-spread fires, covering large parts of the Basin. This synchronicity also reflects the response of fire occurrence and extent to regional climatic variation. Large fire years were typically associated with drought conditions and were preceded by a wet period. Global circulation patterns (El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO)) modulated fire occurrence and extent on an interdecadal time-scale. The strength of the fire-climate relationships showed strong temporal variability. Both interannual and interdecadal variation in climate effectively influenced pre-settlement pine forest fire regimes in the northern Sierra Nevada, as reflected in the strong synchronicity found in fire records throughout the Lake Tahoe Basin. The temporal variability of these fire climate relationships probably contributed to the structural and compositional diversity of forest ecosystems in the northern Sierra Nevada.

Co-Authors: *A. H. Taylor, The Pennsylvania State University - M.R. Beaty, CSIRO Sustainable Ecosystems*

Presentation Title: The Cyclical Relationships of Climate Change, Forest Biomass, Fire Emissions and Atmospheric Aerosol Loadings: An Integrated Modeling Study

Presenter: *Uma Shankar*
University of North Carolina
Chapel Hill, North Carolina, USA

Abstract: The combustion of forest biomass has important impacts on air quality and the atmospheric aerosol composition from two sources: the fires themselves are a source of particulate black carbon and organic carbon, as well as secondary organic aerosol precursors. In addition, the change in the land cover due to consumption in fires has an impact on the emissions of biogenic aerosol precursors. Biomass combustion also produces significant amounts of SO_2, which forms sulfate aerosol, a strong scatterer of solar radiation, producing a negative forcing on climate. Atmospheric black carbon from fires exerts a positive forcing on climate due to the absorption of solar radiation, while organic aerosol, both directly emitted and secondarily produced from fires can exert a positive or negative forcing, depending on its liquid water content. The response of the climate system to the aerosol radiative forcing, in particular its short-term variability, has been the subject of numerous observational and modeling studies. In turn, the short-term changes in climate variables such as precipitation and temperature affect future forest biomass production, and have a major impact on the fire potential of forests in future years. An integrated modeling approach is needed to better understand these cyclical impacts, and to assess the potential benefits of fire management strategies to forestland. This paper describes such an approach, using the PnET forest growth model, the BlueSky smoke emissions model, and a coupled meteorology-chemistry model for the chemistry, transport and radiative feedbacks of atmospheric aerosol to the climate system. Preliminary results from the modeling system of air quality and aerosol optical properties for a historic period are presented. Model development underway to address the simulation of future-year fires is described.

Presentation Title: ~~Biomass burning from tropical savannas in Colombia: Local to global estimates~~

Presenter: ~~*Dolors Armenteras*~~
~~*Instituto Alexander von Humboldt*~~
~~*Bogota Cundinamarca, Columbia*~~

Abstract: This research outlines the contribution of biomass burning from savannas in Colombia to global warming and assesses the prospects for changes in land use. Fires are one of the most important natural and human factors associated to the expansion of the agriculture frontier in the Llanos orientales of Colombia. Tropical savannas are ecosystems highly threatened by fire driver and this has lead to the transformation and loss of many natural ecosystems and species endemic to this area and to substantial releases of greenhouse gases into the atmosphere. Fire is normally used to control pest, to stimulate the recovery of the vegetation and to clean area for agriculture. Little attention has been paid to this but local estimates of number and size of burned scars point out to important rates of emissions (488,235 ha burned in a four month period of dry season in 2001, Armenteras et al, 2005). The burned area accounts for approximately 5% of the savanna area. This data differs from Global estimates (Tansey et al, 2004) and it will be use to model yearly estimates of greenhouse and atmospheric trace gas emissions from the Colombian savannas. We estimated the emissions of greenhouse gases from human induced biomass burning associated to the different type of physionomies following the IPCC methodology and using consuming fuel in kg/m2 of similar savannas types in Venezuela and Brazil. Preliminary modelling results indicate that vegetation fires in the Llanos could be the largest non-fossil fuel source of CO2 input to the atmosphere from Colombia and needs to be addressed in future strategies of conservation and sustainable ecosystem management.

Co-Authors: *Milton Romero, Gustavo Galindo, Javier Otero, Nelly Rodríguez,*

Presentation Title: Mapping Fuel Consumption for Carbon Cycle Studies

Presenter: *Nancy French*
Altarum Institute
Ann Arbor, Michigan, USA

Abstract: Remote sensing has become an important tool for assessing the within-burn characteristics of fire-disturbed landscapes for several research activities. In addition to the need of fire managers and ecologists to classify burn severity to map vegetation and habitat change, researchers studying carbon emission are interested in knowing the distribution of fuel consumption within fires so the amount of biomass carbon converted to carbon gas during fire can be better quantified. Our study focuses on classification of the within-burn variability associated with fuel consumption. Using multi-spectral imagery from Landsat TM and ETM+, we are developing ways of determining how much landscape is burned at three levels of consumption severity. The goal is to understand how much of the landscape is affected by fires of low, moderate, or severe consumption level within an ecoregion. We will determine this distribution for forested ecoregions of western and northern North America where forest fires are prevalent. Field-based measurements of fuel consumption will be used to associate the remote sensing-based map of consumption level to the amount of fuel consumed (kg-m-2). The paper presents results of our work using remote sensing to map fuel consumption at several sites in the fire effected regions of northern and western North America. Our approach for mapping and measuring fuel consumption using a combination of remote sensing-based land classification and field measurements will be described. Analyses of remote sensing and field data conducted by our group as well as results from other published approaches will be presented and compared.

Co-Authors: *Richard Powell, Luke Spaete, Luz Silverio, Ben Koziol, Altarum Institute*

Presentation Title: Modeling forest biomass carbon using LANDFIRE data and FIA field inventory data

Presenter: *Xuexia (Sherry) Chen*
U.S. Geological Survey
Sioux Falls, South Dakota, USA

Abstract: Science Applications International Corporation (SAIC), USGS Center for Earth Resources Observation and Science (EROS) Abstract Estimation of aboveground forest biomass carbon at a national scale has high relevance to the forest management and fire assessment community. This level of assessment is possible with access to nation-wide data sets. The LANDFIRE project is a nation-wide fire, ecosystem, and fuel assessment project with data available at a resolution of 30 meters. The LANDFIRE data sets are being created and distributed to users for fire managements and fire hazard estimation. In this study regression tree models were used to estimate forest biomass carbon in central Utah. LANDFIRE data used in the modeling process included digital elevation models (DEM), Landsat imagery, and LANDFIRE derived existing vegetation type and vegetation structure (including vegetation height and canopy cover). These data layers were used as independent variables; biomass carbon data derived from Forest Inventory and Analysis (FIA) field plot information were used as the dependent variable in model development. A total of 732 FIA field reference plots were used in the analysis. Of these, ten percent of the plots were held out for model evaluation using stratified sampling. The remaining plots were used as training data for developing regression trees. When using just DEM and Landsat imagery as input layers the correlation coefficient (r value) for the training model was 0.67, and in comparison, the r value for the "hold out" evaluation plots was 0.59. With additional LANDFIRE derived vegetation type and structure data, the r value of the training model improved to 0.74, and the r value of the evaluation data improved to 0.74. These results indicate that LANDFIRE data hold much promise towards improving the nation-wide forest biomass carbon estimates.

Co-Authors: *Shuguang Liu, Science Applications International Corporation - Zhengpeng Li Science Applications International Corporation - James Vogelmann - Science Applications International Corporation - Zhiliang Zhuk, US Geological Survey*

TRACK 4

Tuesday, November 14, 2006

Smoke and Atmospheric Modeling

8:00 - 8:15	***Douglas Fox*** ***Colorado State University***	Evolving Research Approaches to Studying Atmosphere – Fire Linkages
8:15 – 8:30	***Janice Coen*** ***National Center for Atmospheric Research***	Coupled atmosphere - wildland fire modeling and applications
8:30 – 8:45	***Sean Raffuse*** ***Sonoma Technology***	Evaluation of the BlueSky Smoke Prediction Model Using Satellite Data
8:45 – 9:00	***Hyun-Cheol Kim*** ***University of Houston***	Coupling CMAQ with BlueSky and Satellite-Derived Emissions to Assess Fire Impacts on Air Quality
9:00 – 9:15	~~***Stephen Reid***~~ ***Sonoma Technology***	Applications of a GIS-Based Fire Emissions Model
9:15 – 9:30	***Yongqiang Liu*** ***USDA Forest Service***	Regional Air Quality Effects of Brush Creek Burning Simulated with CMAQ-Daysmoke
9:30 – 9:45	***Daewon Byun*** ***University of Houston***	Process Analysis and Mass Budget Analysis of the Effects of Long-Range Transported Forest Fire Plumes on Regional Air Quality
9:45 – 10:00	***Gary Achtemeier*** ***USDA Forest Service***	On the Roles of Prescribed Burn 'Engineering' and Unexpected Environmental Factors on Degraded Air Quality over an Urban Area on 18 March 2006 - Experimental Results with Daysmoke
10:30 – 10:45	***Robert Mickler*** ***Alion Science and Technology***	Development of Smoke Plume, Fire Emissions, and Wildland Fire Fuel Models on Coastal Plain Ecosystems
10:45 – 11:00	***Gary Achtemeier*** ***USDA Forest Service***	Field Validation of a Model to Predict the Movement of Smoke along the Ground at Night

A Roadmap for Improved Weather and Climate Information for Wildland Fire Stakeholders and Decision Makers

Samuel Williamson,
National Oceanic and Atmospheric Administration
Office of the Federal Coordinator for Meteorological Services and Supporting Research

13:30 – 13:45	***Samuel P. Williamson*** ***National Oceanic and Atmospheric Administration***	Introduction - A National Assessment of Weather and Climate Needs and Services to Support Wildland Fire Decision Making
13:45 – 15:00	***Panel Moderator:*** ***Elliott Jacks*** ***NOAA/NWS***	Wildland Fire Weather and Climate Decision Support—the Providers' Perspective - Wildland Fire Weather Data Collection - Wildland Fire R&D - Wildland Fire Modeling - Socioeconomic Impacts of Wildland Fire
15:30 – 16:30	***Panel Moderator:*** ***Allen Riebau*** ***USDA Forest Service***	Wildland Fire Weather and Climate Decision Support—the User/Stakeholder Perspective - Pre-planning - Execution - Post-Analysis - Education
16:30 - 17:15	***Moderators:*** ***Eli Jacks*** ***NOAA/NWS*** ***Allen Riebau*** ***USDA Forest Service***	Discussion Period - Discussion of Questionnaire/Survey - Panel 1 & 2 Questions/Discussion
17:15 - 17:30	***Mary Cairns*** ***David Andrus*** ***Robert Dumont***	Summary and Wrap-up

Session Title: Smoke and Atmospheric Modeling

Presentation Title: Evolving research approaches to studying atmosphere - fire linkages

Presenter: *Douglas Fox*
Colorado State University
Colorado, USA

Abstract: Over the past five years, the capacity of the land management research community to study atmospheric influences on fire has greatly expanded through the development of a group of Fire Consortia for Advanced Modeling of Meteorology & Smoke (FCAMMS). The current status of the national program of the FCAMMS will be reviewed. The FCAMMS simulate regional scale meteorology on a regular and continuing basis utilizing a cooperation paradigm to gather appropriate and timely input data, maintain a complex communications and supercomputer infrastructure, and deliver results via the web. The purposes for doing these simulations are to advance fire weather and fire danger intelligence, provide a platform to study the basic science of fire and its linkage to environmental conditions and to assist in managing smoke. Six years ago the authors completed an assessment of tools needed to support technical smoke management. In that report, we identified the need for FCAMMS like activities as well as a set of additional tools needed for strategic and tactical planning, for operations and for evaluation as well as recommending alternatives for research and development. Here we review what has been accomplished, in Forest Service research as well as through the Joint Fire Sciences Program and in so doing, identify continuing research needs and remaining challenges.

Co-Authors: *Allen R. Riebau, USDA Forest Service*

Presentation Title: Coupled atmosphere - wildland fire modeling and applications

Presenter: *Janice Coen*
National Center for Atmospheric Research
Boulder, Colorado, USA

Abstract: Computer simulations use numerical weather prediction models tied to fire behavior models to simulate the impact of a fire on the atmosphere and the subsequent feedback of these fire-induced winds on fire behavior - i.e. how all fires, to some degree, 'create their own weather'. Although this influence is most dramatic near the fire, model simulations show this influence can change windspeeds by several miles per hour even miles from the fire. This has important implications for understanding and predicting fire behavior, which this work addresses. The methodology involves the use of a numerical weather prediction model capable of modeling fine scale atmospheric flows (under 1 km grid spacing) in steep (slope where the rise over run of terrain may exceed 0.6) terrain. The wildland fire component is based upon the Rothermel surface fire algorithms, a canopy fire model, coupled to the atmospheric model such that low level winds (which may be affected by the fire) drive the spread of the surface fire, which in turn release sensible heat, latent heat, and smoke fluxes into the lower atmosphere. This work describes the latest developments in and applications of this type of modeling :(1) the interaction of fires, which is the basis for assumptions on where and when backfires may be safely and effectively set assuming they will be drawn into the uncontained wildfire for fire suppression, (2) severe weather aspects of intense wildland fires, (3) and steps toward the application and validation of such models as real-time forecasts of fire growth.

Presentation Title: Evaluation of the BlueSky Smoke Prediction Model Using Satellite

Presenter: *Sean Raffuse*
Sonoma Technology
Petaluma, California USA

Abstract: The BlueSky modeling framework predicted cumulative smoke impacts from prescribed burns and wildfires in the western United States for the 2005 fire season. Because fires occur unpredictably in time and space, the model is difficult to evaluate in the traditional manner utilizing data from a planned deployment of air pollution monitors. Furthermore, because there are fewer monitors in areas near where fires occur, coverage is sparse. To assist in a validation analysis of the BlueSky model, satellite-derived data sources were used. Aerosol Optical Depth (AOD) from the Moderate Resolution Imaging Spectroradiometers (MODIS) onboard NASA's Terra and Aqua satellites and analyst-interpreted daily smoke plume extents from the National Petaluma Oceanic and Atmospheric Administration's (NOAA) Hazard Mapping System were used to corroborate the long-range transport pattern of particulate matter less than 2.5 micrometers in diameter (PM2.5) from the BlueSky modeling framework. The unparalleled spatial coverage in remote locations provided by the satellite data sets facilitates a qualitative assessment of the shape of BlueSky's modeled concentration fields. In general, smoke plumes predicted by BlueSky matched well with the satellite data on nearly all days when major smoke plumes originating in the modeling domain w Coupling CMAQ with BlueSky and Satellite-Derived Emissions to Assess Fire Impacts on Air Quality ere predicted and observed.

Co-Authors: *Lyle R. Chinkin, Sonoma Technology -*
Narasimhan K. Larkin, Robert Solomon, Candace Krull, USDA Forest Service

Presentation Title: Coupling CMAQ with BlueSky and Satellite-Derived Emissions to Assess Fire Impacts on Air Quality

Presenter: *Hyun-Cheol Kim*
University of Houston,
Houston, Texas USA

Abstract: The impact of forest fires on regional air quality is studied using the Community Multiscale Air Quality (CMAQ) model coupled with emissions derived from the BlueSky smoke modeling framework and from satellite detections of forest fires. Recent studies have used CMAQ and BlueSky emissions to assess the impact of prescribed fires on regional air quality. Although the combination of CMAQ and BlueSky already has been shown to be a viable method for studying the impact of wildland and prescribed fires on regional air quality, the use of BlueSky emissions for daily regional air-quality forecasting can be problematic because of the limited spatial coverage of BlueSky output and the limited chemical species information contained in the BlueSky emissions inventory. Instead, we propose to utilize satellite-detected fire locations and burn times to estimate fire emissions in nearly real-time for the forecasting operation. We have utilized two data sets for the satellite-based fire detections: (1) the Hazard Mapping System (HMS) fire location data archived by NESDIS and currently made available by the NOAA's Air Resources Laboratory (ARL), and (2) the MODIS fire detection data archived by the National Center for Atmospheric Research (NCAR). Also, we have utilized algorithms developed by NOAA and NCAR to estimate fire emission amounts from satellite measurements for various emission species. These fire emissions are compared with emissions from BlueSky, and their impact on regional air quality is investigated.

Co-Authors: *Daewon W. Byun, Soontae Kim, University of Houston -*
Warren E. Heilman, Joseph J. Charney, Xindi Bian, USDA Forest Service

Presentation Title: Applications of a GIS-Based Fire Emissions Model

Presenter: ***Stephen Reid***
Sonoma Technology
Petaluma, California, USA

Abstract: Sonoma Technology, Inc. has developed a GIS-based fire emission estimation model that is designed to produce emission inventories for wildfires, prescribed burns, and agricultural burning events. The model incorporates fuel loading and emission rate data from the First-Order Fire Effects Model (FOFEM), land cover and vegetation information from the EPA's Biogenic Emissions Landcover Database (BELD), and fuel moisture inputs from a Weather Information Management System (WIMS) database. The model outputs emissions data in either the EPA's National Emissions Inventory Format (NIF) or the Inventory Data Analyzer (IDA) format used by the Sparse Matrix Operator Kernel Emissions (SMOKE) model. STI's fire emissions model was first used to estimate year-2002 emissions from agricultural and prescribed burning in a 9-state region in the midwestern U.S. This work was done on behalf of the Central States Regional Air Planning Association (CENRAP), an agency responsible for researching visibility-related issues in the states of Texas, Oklahoma, Louisiana, Arkansas, Kansas, Missouri, Nebraska, Iowa, and Minnesota. The model estimated total emissions of particulate matter of less than 2.5 micrometers in diameter (PM2.5) to be 317,000 tons, a figure almost 300% higher than existing EPA estimates. The resulting emission inventories were used to assess the impacts of agricultural and prescribed burning on visibility in the CENRAP region. At present, STI's fire emissions model is being used to estimate emissions from wildfires in the Albuquerque, New Mexico region as part of an evaluation of high ozone concentrations in that region that occurred during July, 2003 and July, 2005. Resulting emission estimates will be developed into inputs for the Comprehensive Air Quality Model with extensions (CAMx), a photochemical grid model used to predict ambient air concentrations of ozone and other pollutants.

Co-Authors: ***Dana Sullivan, Sonoma Technology - Bryan Penfold, California***

Presentation Title: Regional Air Quality Effects of Brush Creek Burning Simulated with CMAQ-Daysmoke

Presenter: ***Yongqiang Liu***
USDA Forest Service
Athens, Georgia, USA

Abstract: Prescribed burning is extensively used in the Southeast as a management tool for reducing accumulation of understory debris and maintaining ecosystem health. Emissions from prescribed burning are an important source of air pollutants in the Southeast, a region with some of the highest levels of fine particular matter (PM) and ozone in the nation. This study shows the air quality effects of a prescribed burning case simulated with CMAQ. The burning was implemented at the Brush Creek unit of the Cherokee National Forest near the Tennessee-North Carolina border on March 18, 2006. About 1656 acres were burned. Daysmoke, a dynamical model to simulate movement and deposition of smoke particles, was coupled with CMAQ to provide smoke plume rise and initial vertical distribution of smoke particles. Fire emissions were estimated using a forest fuel and fire modeling scheme. The atmospheric conditions were obtained from an MM5 simulation. The simulation domain had a 12 km horizontal resolution and 21 vertical layers. The simulated smoke plume moves southeastward across the northwestern North Carolina. The ground-layer PM2.5 concentrations reach the point where some people who are sensitive to air pollutants or have other health problems may have experience short-term health problems. The simulated path of the smoke particles is close to that showed in the satellite image. But the magnitude of the ground-layer PM2.5 concentrations is lower in comparison with the measurements at Asheville. Experiments and comparisons with the simulations of the case using other models were made to understand possible causes for the deficiency with the CMAQ-Daysmoke simulation.

Co-Authors: ***Gary L. Achtemeier, Scott L. Goodrick, William A. Jackson, USDA Forest Service***

Presentation Title: Process Analysis and Mass Budget Analysis of the Effects of Long-Range Transported Forest Fire Plumes on Regional Air Quality

Presenter: *Daewon Byun*
University of Houston
Houston, Texas, USA

Abstract: To improve the performance of a regional air quality model, the initial and lateral boundary conditions are provided by linking the model to a global chemistry transport model. The dynamic lateral boundary conditions for trace gas species and particulate matter (PM), resulting from anthropogenic, biogenic, and fire emissions sources, are provided by windowing GEOS-CHEM global model output for the regional air quality modeling domain through appropriate vertical and horizontal interpolation and species mapping. The regional scale fire emissions are specified with NOAA's Hazard Mapping System (HMS) data. The simulation results for the conterminous U.S. (CONUS) and Eastern Texas regional domains for different pollution episodes are evaluated utilizing the EPA's Air Quality System (AQS) repository of ambient air-quality data. Time series and correlation analysis are used to study hourly, daily, and monthly distributions of ozone and particulate matter for each AQS site. The regional distribution and transport of the modeled ozone and PM in both CONUS and Eastern Texas domains are also analyzed and discussed. Process budget and mass budget analyses for the gaseous and particulate species are performed to quantify the trans-boundary contribution compared to the local contributions for each anthropogenic, biogenic, and fire emissions source category.

Co-Authors: *Daewon W. Byun, University of Houston - Hyun-Cheol Kim, University of Houston - Hee-Jin In, University of Houston - Soon-Tae Kim, University of Houston - Chang-Keun Song, University of Houston - Rockjin Park, Harvard University - Warren Heilman, USDA Forest Service*

Presentation Title: On the Roles of Prescribed Burn "Engineering" and Unexpected Environmental Factors on Degraded Air Quality over an Urban Area on 18 March 2006 – Experimental Results with Daysmoke

Presenter: *Gary Achtemeier*
USDA Forest Service
Athens, Georgia, USA

Abstract: Degraded air quality was measured by a PM2.5 sampler located at Asheville, NC, for several hours on 18 March 2006. PM2.5 levels rose from near zero to 106 ug/m3 at 1700 EST and to 130 ug/m3 by 1800 EST. These PM levels could threaten some people who are sensitive to air pollutants to experience short-term health problems. The concentrations fell back to 30 ug/m3 by 2100 EST. The Cherokee National Forest had conducted a prescribed fire on 1840 acres of woodland near the Tennessee/North Carolina state line approximately 30 miles upwind from Asheville, NC. We used the experimental prescribed fire/smoke model, Daysmoke, to investigate possible causes for the unexpected elevated smoke concentrations over Asheville. Results showed late day mixing layer growth, multiple plume updraft cores created by igniting ridge lines, and timing of aerial ignition were contributing to episodes of "plume collapse" miles downwind from the burn. By modeling for these factors, Daysmoke was able to reproduce the magnitude and duration of the Asheville smoke event.

Co-Authors: *Scott L. Goodrick, Yongqiang Liu, William A Jackson, USDA Forest Service*

Presentation Title: Development of Smoke Plume, Fire Emissions, and Wildland Fire Fuel Models on Coastal Plain Ecosystems

Presenter: *Robert Mickler*
Alion Science and Technology
Durham, North Carolina, USA

Abstract: Abstract not available

Co-Authors: *Andrew Bailey, Alion Science and Technology - Miriam Rorig, USDA Forest Service - Chris Geron, US EPA - Gary Achtemier, USDA Forest Service - David Brownlie, USDI Fish and Wildlife Service*

Presentation Title: Field Validation of a Model to Predict the Movement of Smoke along the Ground at Night

Presenter: *Gary Achtemeier*
USDA Forest Service
Athens, Georgia,USA

Abstract: Approximately six million acres of forest and agricultural land are burned each year in the Southern United States. Although the vast majority of these prescribed burns are done without incident, there are occasions when smoke trapped near the ground at night combines with high humidity to form dense fog that poses serious threat to transportation when it drifts across roadways. PB-Piedmont is a numerical smoke model designed to predict near-ground smoke movement over complex terrain (such as that of the Piedmont of the Southeast) at speeds as slow as 0.1 m/sec. Field validation data, mostly in the form of visual observations of smoke at specific locations and times during the nights and early mornings following prescribed burns have been provided by the U.S. Forest Service, the U.S. Fish & Wildlife Service, and the South Carolina Forestry Commission. Results to date show that PB-Piedmont has skill and can be a useful tool for pre-burn planning and post-burn monitoring.

Session Title: A Roadmap for Improved Weather and Climate Information for Wildland Fire Stakeholders and Decision Makers

Session Organizer: *Samuel P. Williamson*
National Oceanic and Atmospheric Administration
Office of the Federal Coordinator for Meteorological Services and Supporting Research
Silverspring, Maryland, USA

Presentation Title: A National Assessment of Weather and Climate Needs and Services to Support Wildland Fire Decision Making

Presenter: *Samuel P. Williamson*
National Oceanic and Atmospheric Administration
Office of the Federal Coordinator for Meteorological Services and Supporting Research
Silverspring, Maryland, USA

Abstract: Wildland fires are now recognized as being both naturally recurrent and healthy in many ecosystems; however, they pose serious threats to safety and the protection of life, property, and public health. To effectively manage fire in the wildland environment, fire and air quality managers need timely, accurate, and detailed fire weather and climate information. In 2005, the Western Governors' Association recommended that the National Oceanic and Atmospheric Administration's (NOAA) Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) complete a national needs assessment report of federal, state, and local fire managers' needs for weather information in their wildfire and prescribed-fire decision-making processes, to include a framework to meet those needs by NOAA's National Weather Service and the federal wildland fire agencies' Predictive Services. The OFCM Joint Action Group for the National Wildland Fire Weather Needs Assessment, a group made up of representatives from many federal departments and agencies, as well as subject-matter experts from state, local, and the academic communities, has begun to conduct their assessment. The primary goals of the assessment are to: (1) conduct a comprehensive review and assessment of weather and climate needs of providers and users in their wildland fire and fuels management activities and (2) assess the capabilities of the provider agencies to ensure that needed weather and climate information is available to fire managers and other users. The assessment will review the

Co-Authors: *Mary M. Cairns, Office of the Federal Coordinator*
for Meteorological Services and Supporting Research -
Allen Riebau,. USDA Forest Service -
Eli Jacks, NOAA National Weather Service

TRACK 5

Tuesday, November 14, 2006

Wildland Fire Use in the United States: Building the Future from 35 Years of Learning

Carol Miller
USDA Forest Service
RMRS Aldo Leopold Wilderness Research Institute

Tom Zimmerman
USDA Forest Service

8:00 - 8:15	***Bruce Kilgore*** ***USDI National Park Service Retired***	Origin and history of Wildland Fire Use in the National Parks and Forest Service
8:15 – 8:30	***Dave Bunnell*** ***Dave Aldrich*** ***USDA Forest Service*** ***retired***	Origin and History of Wildland Fire Use in the USDA Forest Service
8:30 – 8:45	***Jan van Wagtendonk*** ***U.S. Geological Survey***	History and Evolution of Wildland Fire Use
8:45 – 9:00	***Rich Lasko*** ***USDA Forest Service***	Wildland Fire Use and its effects on program opportunities
9:00 – 9:15	***Jim Hubbard*** ***USDA Forest Service***	Programmatic viewpoint-how Wildland Fire Use fits into land management activities
9:15 – 9:30	***Brandon Collins*** ***Scott Stephens*** ***University of California, Berkeley***	Effects of natural fire programs on fire occurrence and stand age structure in Sierra Nevada wilderness areas
9:30 – 9:45	***Zack Holden*** ***University of Idaho***	Twenty-Year Patterns of Burn Severity in the Gila National Forest, New Mexico
9:45 – 10:00	***Alisa Keyser*** ***USDA Forest Service***	Changes in landscape composition in Southwest ponderosa pine forests after 25years of wildland fire use
10:30 – 11:00	***Tom Zimmerman*** ***USDA Forest Service***	Organizational learning from past use of wildland fire
10:45 – 11:00	***Martha Williamson*** ***Anne Black*** ***USDA Forest Service***	Barriers and facilitators to WFU
11:00 –11:15	***John Szymoniak*** ***USDA Forest Service***	Technology and decision making in support of wildland fire use
11:15 – 11:30	***Patti Koppenol*** ***USDA Forest Service***	Management of multiple fires in large areas
11:30 – 12:00	***Carol Miller*** ***USDA Forest Service***	Miller - Question and Answer - History of Wildland Fire Use: What have we learned?

13:30 – 13:45	*Katie Knotek* *USDA Forest Service*	Trends in public attitudes towards the use of wildland fire
13:45 – 14:00	*Greg Aplet* *Wilderness Society*	The potential for restoring fire-adapted ecosystems
14:00 – 14:15	*JoAnn Fites* *USDA Forest Service*	Evaluation of wildland use fires: effects in relation to historic regimes and resource benefits
14:15 – 14:30	*Don McKenzie* *USDA Forest Service*	Wildland Fire Use, climatic change, and air quality in parks and wilderness
14:30 – 14:45	*Sandra Haire* *University of Massachusetts*	Evaluating high severity fire as a possible outcome of Wildland Fire Use across elevational gradients
14:45 – 15:00	*Carol Miller* *USDA Forest Service*	Is Wildland Fire Use enough for wilderness, and if not, then what?
15:30 – 15:45	*Paula Nasiatka* *USDI National Park Service* *Michael DeGrosky* *The Guidance Group*	Organizational tips and tactics for moving forward
15:45 – 16:00	*Dave Calkin* *USDA Forest Service*	Economic analysis to inform AMR in new Wildland Fire Decision Support Systems (WFDSS)
16:00 – 16:15	*Charlie Luce* *USDA Forest Service*	Planning for Sustainable Management and Restoration of Aquatic and Terrestrial Ecosystems
16:15 – 16:30	*Tim Sexton* *USDA Forest Service*	The Future of the Wildland Fire Use Program
16:30 – 17:00	*Carol Miller* *USDA Forest Service*	Miller - Questions and Answers
17:00 – 17:30	*Panelists representing NGOs and other governmental agencies*	Miller - Panel response: Perspectives on Wildland Fire Use

Session Title: Wildland Fire Use in the United States: building the future from 35 years of learning

Organizer: *Carol Miller*
Aldo Leopold Wilderness Research Institute
USDA Forest Service

Abstract: In the early 1970s, federal land management agencies in the United States initiated a "prescribed natural fire" program to allow some lightning-caused fires to burn for resource management objectives. This program has evolved into what is known today as wildland fire use (WFU), which has become an important and viable component of the fire management program. WFU differs from suppression in that fire presence is used to maximize beneficial ecologic effects rather than protection through fire exclusion. Originally reserved for federally designated wilderness or national parks, the WFU program is now being expanded to include lands outside wilderness, presenting a new set of challenges for successful implementation. This session will document the historical program development and the knowledge gained during the past 35 years, describe current implementation procedures and challenges, and explore the future of WFU from a variety of social, political and ecological perspectives.

Co-Organizer: *Tom Zimmerman, Fire and Aviation Management*
USDA Forest Service Southwestern Region

Presentation Title: Origin and history of Wildland Fire Use in the National Parks and Forest Service

Presenter: *Bruce Kilgore*
USDI National Park Service, Retired
Pocatello, Idaho, USA

Abstract: For thousands of years, fire has been an essential process in the conifer, brush and grassland ecosystems found in many national parks in the United States. Since the 1930s and earlier, several Southern scientists pointed out the important role fire played in the life cycle of species like longleaf pine and bobwhite quail. But it was only in the late 1960s and early 1970s that the National Park Service began to accept the role of fire as part of the way such natural ecosystems operate and began to manage such fires as "prescribed natural fires." The most significant document in bringing about such change was the Leopold Report of 1963. Soon after, NPS policy was revised so that, "Fires from natural causes are recognized as natural phenomena and may be allowed to run their course [under certain circumstances] " The first NPS program of allowing lightning fires to burn began in Sequoia-Kings Canyon national parks in 1968. By 1974, nine national park system units had similar plans. These programs were started by managers and researchers who were willing to risk not taking suppression action--based on the best available information--and who, instead, carefully monitored such naturally ignited fires and learned from them. These early resource managers felt, "we must approach the assignment of restoring environmental conditions with humility and great ecologic sensitivity." Over the years, such prescribed natural fire programs evolved and became more sophisticated. Yet managers who were willing to allow some lightning fires to burn have still had to contend with severe philosophical and policy questions. This was particularly true during the large Yellowstone fires of 1988. But similar high-visibility fires in recent years have raised questions about appropriate wildland fire use (WFU) policies for the 21st century.

Presentation Title: Origin and History of Wildland Fire Use in the USDA Forest Service

Presenter:

Dave Bunnell
USDA Forest Service, retired
Charlo, Montana, USA
Dave Aldrich
USDA Forest Service, retired
Scottsdale, Arizona, USA

Abstract:

The Region 1 Forest Service Wilderness Management Conference in 1970 produced a bold new Regional Wilderness Policy, …the management direction will be to let wildfire more nearly play its natural role in Wilderness…" To guide implementation, a nationally sponsored two year study to "develop inventory methods and planning procedures" was undertaken. Starting in 1970, the Bitterroot National Forest hosted the White Cap Wilderness Fire Management Study. In 1972, the Forest Service Manual was revised to allow "exceptions" to the existing fire control policy for areas having a fire management plan approved by the Chief of the Forest Service. The White Cap Study participants included many agency personnel from the "field" and Research. They undertook a wide array of efforts to gain understanding of the role of fire in Wildernesses, the role of fire in ecosystems found in the White Cap area, to engage a wide variety of public (including Forest Service personnel) to share information and to expand the commonly held perception of fire in wildland ecosystems. National Park Service personnel were active participants sharing concepts and ideas. In 1972, Orville Daniels, Bitterroot National Forest Supervisor and Bob Mutch, from the Northern Forest Fire Laboratory, presented the White Cap Wilderness Fire Plan to Forest Service Chief John McGuire and his staff for approval. The first Wilderness Fire Management Plan was approved for implementation. At the conclusion of the presentation, Chief McGuire stated that such planning should be done for all lands, not just Wildernesses, thus supporting the conceptual thoughts of several Forest Service people for "fire management". It also opened the door for a plethora of issues; technical, policy, budgetary, fire reporting, procedural, employee development, political, to list a few, that had to be resolved for implementation of the plan. The first fires in the White Cap area occurred the day following approval of the plan. The Bad Luck Creek Fire was the first free burning fire in Selway-Bitterroot Wilderness for many decades. The learning had just begun. The decade of 1975-1984 was dominated by continuing discussions regarding appropriate planning requirements and NEPA compliance for prescribed natural fire (PNF) in major Wildernesses. Notable among these efforts was the successful collaboration of four National Forests (Flathead, Lewis and Clark, Lolo and Helena) in developing a single PNF Plan for three adjoining Wildernesses (Great Bear, Bob Marshall, and Scapegoat) in 1984. The period 1985-1994 saw the implementation of many plans, but the focus was on the history-making 1988 season in Yellowstone National Park and the Bob Marshall complex where multiple fires and a long, severe fire season with major wind events tested plans and the resolve of individuals and agencies implementing PNF's. The 1995-2005 period was marked by the coordinated Interagency Fire Policy Review which provided a name change from PNF to Wildland Fire Use (WFU), but more importantly, gave equal status to the WFU program within Fire Management for access to resources and funding. The approximately three decades following the initial approval has been marked by significant maturation within the program and cooperating agencies. The future will see further expansion of WFU programs with new challenges within and outside of Wildernesses.

Presentation Title: History and Evolution of Wildland Fire Use

Presenter: *Jan van Wagtendonk*
U.S. Geological Survey
El Portal, California, USA

Abstract: Before the advent of organized fire control, wildland fires ignited by lightning or Native Americans were allowed to burn freely without constraint. Effective fire suppression activities, beginning during the early 1900s, limited the natural role of fire in fire-prone ecosystems. Recognizing that fire exclusion had led to detrimental ecological conditions such as fuel buildup and understory encroachment, the national Park Service and the Forest Service changed their policies to allow naturally caused fires to burn under prescribed conditions in the late 1960s and early 1970s. Progress among the federal agencies in implementing wildland fire use programs has varied. Since 1968, the National Park Service has restored ecological conditions on 791,325 acres with 3,306 fires. The Forest Service began its wildland fire use program in 1972, with 2,899 fires burning 1,237,153 acres. The Bureau of Land Management has treated 954,423 acres since 1995, and the Fish and Wildlife Service has treated 325,479 acres since 2003, both primarily in Alaska. Ironically, the Bureau of Indian affairs, which helps manage tribal lands, has not initiated a wildland fire use program. There remain several challenges for the use of wildland to achieve management and ecological objectives. Included are smoke, endangered and threatened species, and invasive weeds. Even more ominous is the threat of political and bureaucratic resistance, which is manifested in strict implementation guidelines.

Presentation Title: Wildland Fire Use and its Effects on Program Opportunities

Presenter: *Richard Lasko*
USDA Forest Service
Washington, DC, USA

Abstract: Federal Agencies have used wildland fires ignited by lightening since the 1970's. The implementation of this program has provided fire managers increased opportunity and flexibility to utilize unplanned ignitions to manage agency landscapes. Examples and discussion of wildland fire use events from the Selway Bitterroot Wilderness and Bob Marshall/Great Bear/Scapegoat Wilderness will be used to demonstrate the effect of past events on future management activities. These examples will illustrate the potential positive effects from expansion of the wildland fire use program.

Presentation Title: Programmatic Viewpoint - How Wildland Fire Use fits into Land Management Activities

Presenter: *James Hubbard*
USDA Forest Service
Washington, DC, USA

Abstract: Exclusion of fire for nearly a century in areas that historically burned on a regular basis, along with other land-use practices and the proliferation of invasive exotic species, have resulted in heavy fuel accumulations and altered vegetation composition and structure. These conditions are contributing to increased fire intensity, spread, and resistance to control and limiting land managers' ability to accomplish objectives. A compounding factor has been the growth of communities in areas adjacent to open public lands, putting homes and other structures closer to areas where large fires occur. Increased vegetative manipulation and treatment is prerequisite to accomplishing necessary hazardous fuel reduction and ecosystem restoration and maintenance at the appropriate scale. Many of the barriers that limit fuel treatment and restoration activities can be overcome by increasing fuel treatments to reduce hazardous fuels, improving fire preparedness and suppression capability, increasing opportunities for burned area rehabilitation, and making greater use of wildland fire to restore and maintain fire-adapted ecosystems. Wildland fire use is an increasingly important application and can be highly instrumental in accomplishing land management objectives across multiple land use situations, with the exception of the wildland-urban interface areas. Wildland fire use is the primary means of maintaining and restoring fire–adapted ecosystems, creating vegetation mosaics, and reducing intensity of wildfires in wilderness. As the use of this strategy expands outside wilderness, it can have the same effects as in wilderness, as well as accomplishing hazardous fuel reduction, facilitating the use of landscape scale prescribed fire, and secondary benefits of increasing protection capability for communities and wildland-urban interface areas. Wildland fire use is a critically important strategic tool for land managers and has a growing role in successful fire and land management.

Presentation Title: Effects of Natural Fire programs on Fire Occurrence and Stand Age Structure in Sierra Nevada Wilderness Areas

Presenter: *Brandon Collins*
University of California Berkeley
Berkeley, California, USA

Abstract: Managers of wilderness areas are mandated by the Wilderness Act (1964) to "preserve natural conditions." In order to meet management objectives aimed at restoring "natural conditions," structural characteristics, as well as the processes that govern them, must be restored. Fire is among the most influential processes that dictate forest structure from the forest stand to the landscape scale. We use dendrochronological techniques to characterize historical fire occurrence and identify tree initiation dates in two Sierra Nevada wildland fire use (WFU) areas: Illilouette Creek basin in Yosemite National Park, and Sugarloaf Creek basin in Sequoia and Kings Canyon National Park. Both areas have allowed naturally ignited fires to burn with minimal constraint for over 30 years. We assess the effects of fires during the WFU period on stand age structure relative to the fire suppression period (1890-1970) and pre-fire suppression period. Additionally, we investigate the temporal variability in tree initiation and the extent to which species-specific tree initiation is responds to changes in fire occurrence.

Presentation Title: Twenty-Year Patterns of Burn Severity in the Gila National Forest, New Mexico

Presenter: *Zack Holden,*
University of Idaho
Moscow, Idaho, USA

Abstract: Little is known about landscape patterns of burn severity. Hundreds of fires have burned in the Gila Aldo Leopold Wilderness Complex, NM (GALWC) since the Wildland Fire Use program was implemented there in 1975, providing a unique opportunity to evaluate spatial and temporal patterns of naturally burning fires. We used pre and post-fire Landsat TM imagery to create differenced Normalized Burn Ratio (dNBR) images of 114 non-grassland fires greater than 40 hectares from 1984-2004 in the GALWC. 120 field plots collected in 2004 were used to define thresholds between low, moderate and severe post-fire ecological effects. We used Bayesian analysis to compared the observed versus expected distribution of burn severity classes with respect to biophysical setting (aspect, elevation and potential vegetation type). Preliminary analyses show that severe fire patches tend to occur more often on north-facing slopes, mesic forest types and at higher elevations. Fire extent and severe extent have increased during the 20-year period of this analysis. Trends toward increasingly large and severe fires are strongly correlated with corresponding trends in intra-annual precipitation variability (total number of days without rain and maximum rain-free interval). Our results suggest that short-term, localized climate variability rather than climate warming may be contributing to increased extent and severity of recent fires in the Gila NF.

Co-Authors: *Penny Morgan, University of Idaho, Moscow, Idaho, USA - Matthew G. Rollins, USDA Forest Service, Moscow, Idaho, USA*

Presentation Title: Changes in Landscape Composition in Southwest Ponderosa Pine Forests after 25Years of Wildland Fire Use

Presenter: *Alisa Keyser*
USDA Forest Service
Missoula, Montana, USA

Abstract: We used the mechanistic process model FireBGCv2 to determine the effects of 25 years of wildland fire use (WFU) on landscape composition and structure in the Gila/Aldo Leopold Wilderness Complex, NM and the Rincon Mountain Wilderness, AZ. FireBGCv2 models vegetation productivity, succession, and fire dynamics in a spatial domain. We collected stand inventory data to parameterize two mesoscale landscapes, one in each study area. Our simulation design included multiple fire management scenarios: no action (all fires burn), fire suppression (10% burn), low WFU (30% burn), high WFU (60% burn), prescribed burning (25% burn) and WFU (25% burn) combined. We analyzed our results to quantify how landscape composition and structure are affected by fire management decisions. We also evaluated how natural climate variability impacts the effectiveness of various fire management strategies. We will present preliminary results for both landscapes with a focus on vegetation composition/structure and surface and canopy fuel loading.

Co-Authors: *Matt Rollins, USDA Forest Service, Missoula, Montana, USA*

Presentation Title: Organizational Learning From Past Use of Wildland Fire

Presenter: *Thomas Zimmerman*
USDA Forest Service
Albuquerque, New Mexico, USA

Abstract: Since the inception of organized fire suppression in the early 1900's, wildland fire management has dramatically developed in temporal and spatial extent, operational complexity, ecological significance, social, economic, and political magnitude, and seriousness of potential consequences. Fire management has matured from a single dimension program focus of control only to a multi-dimension program focus that utilizes the full spectrum of management responses to accomplish both protection and ecological objectives. Organizational learning has strongly contributed to this steadfast programmatic development and increased management capability. Organizational learning recognizes the importance of consolidating program examination, acquisition of new information, analysis of best procedures, application of knowledge, processes, technology, and proven practices, and archival of overall processes and results and using this information to improve program effectiveness. While organizational learning has affected the entire wildland fire management program, its influence on wildland fire use has been accountable for a steady progression of very definitive positive program changes. Wildland fire use has seen significant advancements in the areas of: expanded knowledge and understanding of fire ecology and the natural role of fire, continual adjustments to the federal wildland fire management policy, increased precision in planning procedures, advanced risk assessment and management knowledge and capabilities, expanded type, direction, and magnitude of operational procedures, increased role of wildland fire use, enlarged temporal and spatial application scales, expanded implementation beyond wilderness and into all fire regimes and vegetation types, improved capability to manage fires across a wider fire behavior range, and use of After Action Reviews to observe, evaluate, and document accomplishments, whether successful or not. Organizational learning is a valued and necessary practice that is markedly contributing to more efficient wildland fire management with particular relevance to wildland fire use.

Co-Authors: *Tim Sexton, USDA Forest Service, Boise, Idaho, USA*

Presentation Title: Barriers and facilitators to Wildland Fire Use

Presenter: *Anne Black*
USDA Forest Service
Missoula, Montana, USA

Abstract: Meeting federal goals to restore fire as a natural process and reduce hazardous fuel accumulations encourages managing natural ignitions to meet resource benefits (called Wildland Fire Use, WFU). Budget constraints and the need for repeated treatments suggest that successful fuel and ecosystem management hinges on expanding the WFU program. In turn, this rests on clearly understanding the multidimensional barriers and facilitators to WFU at all levels of decision-making: National, Region, Forest, and District. Although recent efforts to develop information and tools to support pre-event WFU planning have helped decision-makers quantify resource benefits, there are additional – and arguably more important - influences on the go/no-go decision and decision-maker, some of which appear to create substantial barriers to WFU. These influences are widely recognized by individual managers, but until now have not been objectively measured or prioritized. Organization-wide understanding of these and their underlying basis is the first step to resolving the barriers. We have begun to quantify these barriers and facilitators through 2 recent studies. Another key factor is our ability to manage fire safely and effectively (minimizing escapes and injuries). Consistent success is a facilitator; even a single escape or injury can act as a barrier. Recent efforts by the research and management communities to explore ways to function with higher reliability and to learn from our experiences are providing another important piece of the puzzle. This presentation will review recent findings from a suite of studies and lines of inquiry, summarizing what we know - and don't know - about these barriers and facilitators and how they affect getting fire 'on the ground'.

Co-Authors: *Martha Williamson, USDA Forest Service, Nevada*

Presentation Title: Technology and Decision Making in Support of Wildland Fire Use

Presenter: *John Szymoniak*
USDA Forest Service
Boise, Idaho, USA

Abstract: All aspects of wildland fire management will require the effective use of emerging technologies for decision support. Applications either exist or will exist in the near term to help agency administrators with complex, multiple decisions which occur during the management of any wildland fire. The challenge for wildland fire analysts will be to effectively use these applications to reduce the inherent level of uncertainty surrounding the management of a natural process, which is occurring in an increasingly unnatural landscape. Effective decision support requires the use and application of appropriate tools for the problem at hand. Further, the interpretation and communication of what can be determined, as well as what can not, is critical in the formulation of sound decisions. Ultimately it is the Agency Administrator or Line Officer who has the final say in the decision – providing information to support a good decision based on the developed facts, as opposed to a "desired decision" based on little more than hope, is the challenge. Once a decision is made the work does not often end there, it is seldom a single decision but a series of decisions that must be made over the life of an event or project. Often the community needs to understand the rationale for the decisions that have been made – they need to have the supporting information provided in an honest and understandable manner. Grasping the ecological, social, political, and cultural aspects of wildland fire decisions and how technology can be woven into the process is a key aspect of providing effective wildland fire decision support

Presentation Title: Management of multiple fires in large areas

Presenter: *Patti Koppenol*
USDA Forest Service

Abstract: Abstract not available

Presentation Title: Trends in Public Attitudes Towards the Use of Wildland Fire

Presenter: *Katie Knotek*
USDA Forest Service
Missoula, Montana, USA

Abstract: Management use of wildland fire (wildland fire use and prescribed fire) is a social issue as well as an ecological issue. Ecologically, the use of wildland fire has the potential to reduce hazardous fuels and restore fire as a natural process at a large scale on wilderness and surrounding lands. Socially, the use of wildland fire has the potential to affect (positively and negatively) human uses and relationships associated with the same lands. Thus it is important to consider the social effects of management use of wildland fire, in conjunction with the ecological effects. Following the initial change in federal fire policy allowing the use of wildland fire, there has been a growing body of social science research related to the management of wildland fire. Social scientists have explored public perceptions, beliefs, attitudes and behavioral intentions towards different fire management strategies in a variety of contexts and geographic regions. A minor subset of this literature has focused specifically on public attitudes towards the use of wildland fire in the wilderness context. This paper will summarize such research conducted in the past 35 years, drawing conclusions on trends in public attitudes towards the use of wildland fire in wilderness. In addition, as both the ecological and social importance of management use of wildland fire across the interface of wilderness and non-wilderness lands becomes more widely recognized (i.e., use of prescribed fire inside and along wilderness boundaries and wildland fire use outside wilderness boundaries), there will be a need to understand public attitudes towards the use of wildland fire in this interface area. Thus, this paper will also address future social science research issues concerning the use of wildland fire in the interface between wilderness and non-wilderness lands.

Presentation Title: The Potential for Restoring Fire-Adapted Ecosystems

Presenter: *Gregory Aplet*
The Wilderness Society
Denver, Colorado, USA

Abstract: Historically, the use of prescribed fire has largely been limited to natural areas and Wildland Fire Use to wilderness. Recently, though, recognition of the importance of fire to ecosystems has resulted in policies promoting the restoration of fire to fire-dependent ecosystems. In addition, efforts to expand wildland fire use beyond wilderness boundaries, has opened the possibility for fire restoration across vast landscapes. Still, there are parts of the landscape where WFU is likely never to be considered due to safety concerns, but where fire may be restored through intentional ignition. In this paper, we examine the extent of the U.S. landscape at various distances from human communities and consider those lands that are remote enough that WFU may be considered as a management option. We examine the proportion of the landscape that is currently in wilderness, roadless, and roaded classes and the vegetation thereon. We conclude with an assessment of opportunities for expanded wildland fire use and the restoration of fire to fire-dependent ecosystems.

Co-Authors: *Bo Wilmer, Center for Landscape Analysis, The Wilderness Society*

Presentation Title: Evaluation of Wildland Use Fires: Effects in Relation to Historic Regimes and Resource Benefits

Presenter: *Jo Ann Fites*
USDA Forest Service
Nevada City, California, USA

Abstract: Wildland Fire Use (WFU) fires (previously prescribed natural fires) have been utilized in National Parks in California for a number of years but only recently in National Forests. In the National Forests, the areas where wildland fire use are allowed extend beyond wilderness. This leads to a need to define more closely the resource objectives for wildland fire use beyond one of restoring a natural process. In the absence of defined resource objectives, controversy often emerges over the range of resulting fire effects. We assessed patterns of fire severity and behavior in relation to historic fire for several WFU fires in National Forests in California to develop and evaluate ecologically based resource objectives. We assessed post-fire effects, fire behavior, and historic fire regime patterns. Post one-year fire effects data were collected on three WFU fires on the Sequoia and Stanislaus National Forests. Patches of different severity and vegetation were mapped and quantified along systematically placed transects and random plots. Tree crown and bole scorch, tree mortality, understory scorch and response (e.g. sprouting) by physiognomic layer, surface fuel and soil effects were measured. The highest severities occurred in locations conducive to greater fire behavior such as steeper or wind-prone slopes, or where surface fuel accumulations or densities of intermediate sized trees were greatest. Overstory and understory severity were not always related, suggesting composite indices may mask some of the variation in fire effects. Fire severity was highly variable at a fine-spatial scale—finer than that typically detected with Landsat based severity maps. Comparisons with historic fire regimes suggested that fire behavior and severity were within historic patterns, despite recent increases in fuels. Resource benefits of reduced fuel hazard in old growth forests, late seral wildlife habitat, and a municipal watershed were apparent.

Co-Authors: *Erin Noonan, USDA Forest Service*

Presentation Title: Wildland Fire Use, Climatic Change, and Air Quality in Parks and Wilderness

Presenter: *Don McKenzie*
USDA Forest Service
Seattle, Washington, USA

Abstract: Projected climate warming over the next century is expected to produce longer fire seasons and greater area burned from wildfire across the western United States. Both statistical models that calculate predicted area burned from climate variables and mechanistic models that simulate area burned agree. Simulations of regional air quality by the authors suggest that certain protected areas will be especially affected if regional atmospheric circulation patterns in the future are similar to current ones. The magnitude of decreases in air quality is a function not only of total area burned, however, but also of fire severity, because plume dynamics are sensitive to fire intensity and intense fires can entail positive feedbacks in convective plume rise and the total amount of combustion products delivered to the atmosphere. Conversely, however, in severe fires (i.e., wildfire) the proportion of total combustion in flaming stages may be greater than in low-severity fires (e.g., some prescribed fires), producing proportionally fewer particulates, which are the chief cause of regional haze. Wildland fire management for the future therefore must consider multiple trade-offs just within the air-quality domain, while subsuming these in the larger picture of decisions about WFU such as whether it meet restoration goals, what the hazard is to communities, etc. We suggest that air-quality researchers engage actively in dialogs with fire managers and social scientists to develop alternate realistic scenarios of WFU, increased prescribed fire, and fire suppression, and develop integrated models that consider the cumulative effects over decades of the interactions among these three management strategies.

Co-Authors: *Susan O'Neill, Natural Resources Conservation Service - Sim Larkin, USDA Forest Service - Robert Norheim, University of Washington - Jeremy Littell, University of Washington*

Presentation Title: Evaluating High Severity Fire as a Possible Outcome of WFU across Elevational Gradients

Presenter: *Sandra Haire*
University of Massachusetts
Amherst, Massachusetts., USA

Abstract: In forests of the southwestern US, characteristics of large fires appear to have changed from low, understory burns to mosaics that include relatively high percentages of tree mortality. Recent large fire events that include crown fire, whether they occur as uncontrollable wildfires or in the context of Wildland Fire Use programs, are often assumed to be destructive of ecological function rather than restorative. It is recognized, however, that large disturbances create tremendous landscape heterogeneity in terms of biological legacies and habitat refugia. We investigated how post-fire landscape heterogeneity interacts with topography and other abiotic factors and leads to diverse successional outcomes at particular places and times. Based on our analysis of 2 large, severe fires that occurred decades ago, we provide recommendations regarding the range of conditions resulting from high severity fire that may be compatible with management goals in terms of maintaining species and landscape diversity associated with desired ecological function.

Co-Authors: *Kevin McGarigal, University of Massachusetts*

Presentation Title: Is Wildland Fire Use enough for Wilderness, and if not, then What?

Presenter: *Carol Miller*
Aldo Leopold Wilderness Research Institute
USDA Forest Service

Abstract: Wilderness fire management requires balancing mandates to both preserve natural conditions and minimize the impacts of human activities. Wilderness managers need to know whether wildland fire use (WFU) programs are capable of restoring and maintaining the ecological role of fire to wilderness ecosystems, and if not, when and where to supplement natural ignitions with management ignitions (prescribed fire) or other fuel manipulations. For example, in many areas, current fuel conditions may preclude the management option of WFU because of the potential risks to natural resource values within the wilderness or to social values in the adjacent wildland urban interface. Even the most successful wilderness fire programs are unable to restore and maintain a truly natural fire regime because ignitions outside of these areas that otherwise would immigrate into wilderness are usually suppressed, limiting the amount of natural fire that can occur. In this paper, I provide examples of simulation modeling and GIS analysis that have been used to help assess the feasibility of WFU for restoring wilderness fire regimes and to help identify where management intervention might be justified in wilderness. In one example, I used the landscape simulation model TELSA to evaluate how closely a fire regime under a WFU program can approximate the fire regime that would exist in the absence of modern human influences. TELSA is a spatially explicit, GIS-based landscape-level model for simulating vegetation succession and disturbance dynamics. I varied assumptions about the number of natural ignitions that would be allowed to burn to assess the degree to which WFU can restore and maintain the landscape composition and structure that might occur in the absence of human influence. In two other examples, I describe how a burn probability model (BurnPro) and retrospective fire behavior modeling can be used to identify places on a landscape where prescribed fires may be warranted.

Presentation Title: Organizational Tips and Tactics for Moving Forward

Presenter: *Paula Nasiatka*
USDI National Park Service
Mike DeGrosky
The Guidance Group
Wildland Fire Lessons Learned Center
Tucson, Arizona, USA

Abstract: How can team members in wildland fire use (WFU) programs learn in an organizational environment? How can they to improve in what they know and how they learn? Why is it important to continually educate both the internal and external audiences about WFU? Six specific tasks are critical to organizational learning. By engaging in these tasks WFU programs will significantly improve both their programs and their learning. 1. Continually collect intelligence about the WFU environment. Collect information and regularly incorporate it in your planning and implementation. 2. Learn from the best practices of other organizations. Look at successful processes another WFU program is using and see how you may apply them in your program. 3. Learn from your own experiences and past history. Continually look at what has happened in the past in your program. Use the AAR process to learn from each project. 4. Experiment with new approaches. Try a different approach especially if what you have been doing hasn't worked the way you want. Listen to unit members who have a different perspective. 5. Encourage systematic problem solving. Follow a systematic path while trying to solve a problem by looking at what was planned, what happened, and why it happened. 6. Transfer knowledge throughout the organization. Share your knowledge with your WFU program staff as well as other units. Remember to focus on new staff members but do not forget to share with the long term staff. The Lessons Learned Center is your resource center for sharing what you have learned beyond the scope of your own unit. An organizational learning tool has been recently developed by the Harvard Business School in cooperation with the Lessons Learned Center. Such a tool is designed to measure how your unit is doing with respect to learning. By looking at your learning environment, learning processes and leadership you can measure your WFU program level of learning and improvements over time.

Presentation Title: Economic Analysis to Inform AMR in New Wildland Fire Decision Support Systems

Presenter: *Dave Calkin*
USDA Forest Service
Missoula, Montana, USA

Abstract: A challenge to implementing wildland fire use concepts and promoting confine and contain strategies instead of full control within the Appropriate Management Response (AMR) framework is understanding risks to high valued resources proximate to ongoing fire perimeters. We have developed decision support tools that integrate spatial resource value data with a new fire behavior model (FSPro). FSPro simulates fire behavior in the absence of control for a number of potential future weather patterns and allows for the analysis of likely fire behavior over longer time periods than typically modeled in existing tools such as FARSITE. By rapidly identifying spatial locations of high valued resource, proximity to ongoing fire perimeters, and likelihood of a fire affecting these resource values over a fires life we can provide essential data to inform strategic decision making utilizing the AMR framework. Further, we are developing concepts that will allow us to assess potential non-market value change due to wildland fire and better understand potential benefits of reintroducing fire into fire adapted ecosystems. These tools and data have the potential to reduce suppression expenditures, encourage wildland fire use concepts, and integrate wildland fire use with suppression to apply the AMR framework to all wildland fires.

Presentation Title: Planning for Sustainable Management and Restoration of Aquatic and Terrestrial Ecosystems

Presenter: *Charles Luce*
USDA Forest Service,
Boise, Idaho, USA

Abstract: Striking a balance among competing demands of multiple resource management on public lands can be a daunting task. Balancing management of terrestrial vegetation and aquatic ecological systems, particularly for threatened or sensitive species, for example, poses the problem that vegetation manipulation and the infrastructure required to support it often reduce water quality. At the same time, the threat of severe wildfire, which can also catalyze disruption of aquatic systems through floods and debris flows, might be mitigated by terrestrial restoration. One possible way out of this conundrum is to understand how the terrestrial and aquatic environments coevolved. Paleoclimatologic, and geomorphologic evidence coupled with life-history theory suggest that many aquatic species populations have survived far worse wildfire and hydrologic events than those seen in the last century in the western United States. Geomorphic research has even suggested that wildfire related floods and debris flows can provide important infusions of substrate, wood, and nutrients and increase habitat complexity, creating long term benefits in return for short term disruption. Fish populations that have survived the tumultuous past exhibit variability in life history strategies. Migratory life histories, in particular, may be key to the resilience of populations experiencing catastrophic population reduction. If we can build management strategies that use and reinforce this coevolution of terrestrial and aquatic communities in fire-adapted landscapes, we may find widespread opportunity for more sustainable management. At the very least, the quest for sustainability defines a goal for joint restoration of terrestrial and aquatic ecosystems to be resilient in the face of wildfire, allowing greater use of wildfire itself as an agent to maintain the relevant landscapes and habitat forming processes. We propose that consideration of the physical responses in thermal loading, fine sediment loading, flood and debris flow hazards, and the vulnerability of distinct stream segments supporting a range of ecological values provide a context for evaluation of wildfire and management effects. The relative sensitivity of any stream segment to management or fire can in turn be mapped back to the contributing landscape to indicate areas where 1) maintenance of the natural regimes and the processes shaping both terrestrial and aquatic systems is possible, 2) the joint restoration of both terrestrial and aquatic systems is either mutually beneficial or benign, and 3) places where such restoration is needed but terrestrial management is potentially in conflict with aquatic needs, necessitating more detailed examination of options. Previous work at coarser scales has suggested that the second case is widespread in historically managed landscapes; we are anxious to see if it holds at finer scales as well.

Co-Authors: *Bruce Rieman, USDA Forest Service*

Presentation Title: The Future of the Wildland Fire Use Program

Presenter: *Tim Sexton*
USDA Forest Service
Boise, Idaho, USA

Abstract: Wildland Fire Use (WFU) has demonstrated steady growth over the past thirty years. Starting with the National Park Service in 1968 and US Forest Service in 1972, the careful management of natural ignitions has developed into a significant part of the overall federal response to unplanned ignitions. In 2005, of the one million acres of USFS lands which burned from unplanned ignitions, more than 300,000 acres were managed as WFU. Prospects for future expansion of the WFU are bright. Many diverse groups are demonstrating support for WFU. The federal Office of Management and Budget has encouraged expansion because WFU is recognized as the lowest cost method for achieving hazard fuel reduction. Environmental groups are expressing support due to the reduced suppression damage and benefits to ecosystem resilience and sustainability. Firefighter safety analyses are demonstrating reduced exposure of firefighters to hazards. Several incipient organizational changes associated with WFU will become institutionalized in the next few years. These changes are centered on the recognition that WFU will no longer be a “specialized function” relegated to a few fire managers. WFU will soon be incorporated into the regular duties of all fire management personnel. Hotshots, smokejumpers, helitack, engines, local land crews and incident management teams will be trained and available for assignment to WFU events. In the National Forests of Utah Forest land management plans authorize WFU across all landscapes except limited “protection” areas such as campgrounds, especially vulnerable threatened and endangered species habitat and high hazard wildland urban interface areas. This broad scale authorization of WFU will soon become the norm rather than the exception on forests throughout the U.S., greatly expanding the area available for WFU.

TRACK 6

Tuesday, November 14, 2006

Wildfire Impacts on Fishes, Aquatic Organisms and their Habitats

John Rinne
USDA Forest Service
Flagstaff, Arizona, USA

8:00 – 8:15	***John Rinne*** ***USDA Forest Service***	Wildfire Impacts on Fishes, Aquatic Organisms and their Habitats: Introduction to Symposium
8:15 – 8:30	***David Propst*** ***New Mexico Game & Fish Department***	Wildfire and Conservation of Gila trout
8:30 – 8:45	***Stephanie Coleman*** ***USDI Fish & Wildlife Service***	Wildfire effects on Gila trout (Oncorhynchus gilae) populations and habitat
8:45 – 9:00	***Gerald Jacobi*** ***Jacobi and Associates***	Long term aquatic macro invertebrate recovery after the 1989 Divide fire, Main Diamond Creek, NM, USA
9:00 – 9:15	***Kara Hilwig*** ~~***U.S. Geological Survey***~~	The Ponil Fire Study: Impacts of fire on fish and their habitat
9:15 – 9:30	***Codey Carter*** ***Arizona Game & Fish Department***	The Boreggo Fire: Short term effects on a brown trout population
9:30 – 9:45	***Dennis Miller*** ***Western New Mexico University***	The Club Mountain Fire: Short term fire effects on a native Gila River Fish assemblage
9:45 – 10:00	***John Rinne*** ***USDA Forest Service***	Rinne - Questions/Discussion
10:30 – 10:45	***Don Mitchell*** ***Arizona Game & Fish Department***	Impacts of the 2003 Aspen Fire on Gila chub in Sabino Canyon, Arizona.
10:45 – 11:00	***Codey Carter*** ***Arizona Game & Fish Department***	Immediate and short term impacts of the Picture Fire on native and nonnative fishes
11:00 – 11:15	***Jonathan Long*** ***Arizona Cooperative Extension Service***	Effects of three recent wildfires on fishes and habitats on the Apache-Sitgreaves National Forest
11:15 – 11:30	***John Rinne*** ***USDA Forest Service***	The Dude Fire: Short and long term effects on fishes
11:30 – 11:45	***John Rinne*** ***USDA Forest Service***	Rinne - Questions/Discussion

13:30 – 13:45	***Dan Neary*** ***USDA Forest Service***	Post-wildfire floods: Causes, magnitudes, and effects on fishes
13:45 – 14:15	***Ed Little*** ***U.S. Geological Survey***	Environmental persistence, toxicity, and ecological effects of fire-fighting chemicals to fish
14:15 – 14:30	***Jason Dunham*** ***U.S. Geological Survey***	Multiple responses of rainbow trout to wildfire and human influences
14:30 – 14:45	***Codey Carter*** ***Arizona Game & Fish Department***	Ash LC50s and fishes: corroboration of field results of wildfires
14:45 – 15:00	***Andi Thode*** ***Northern Arizona University***	Fire Effects on Fish Populations in the Southwestern USA: The Role of Soil Burn Severity
15:30 – 15:45	***Tim Burton*** ***USDI Bureau of Land Management***	Re-shaping fish habitats following large wildfires: An evaluation of risks for sensitive and imperiled fish species in Southern Idaho
15:45 – 16:00	***Clint Sestrich*** ***USDA Forest Service***	Changes in fish assemblages and habitat following wildfire in the Bitterroot River Basin, Montana
16:00 – 16:15	***Alvin Medina*** ***USDA Forest Service***	Long Term Effects of the Dude Wildfire on Aquatic Habitats
16:15 – 16.30	***Shaula Hedwall*** ***USDI Fish & Wildlife Service***	After the Fire Ends: Challenges and Lessons Learned Caring for Salvaged Fish
16:30 – 17:00	***Bruce Rieman*** ***USDA Forest Service***	Wildfire and Aquatic Systems: Implications for Management
17:00 – 17:15	***John Rinne*** ***USDA Forest Service***	Management Implications Rinne - Close-out

Session Title: Impacts on Fishes, Aquatic Organisms and their Habitats

Organizer:

John Rinne
USDA Forest Service
Flagstaff, Arizona, USA

Presentation Title: Wildfire Impacts on Fishes, Aquatic Organisms and their Habitats: Introduction to Symposium

Presenter:

John Rinne
USDA Forest Service
Flagstaff, Arizona, USA

Abstract:

Many threatened and endangered fishes, other introduced sport fishes and extant aquatic macro-invertebrates in the western United States reside in isolated, headwater streams and rivers. In this setting these already imperiled species have a high risk of extirpation through the impacts of post wildfire runoff. In the past decade, data have been accumulated on these impacts as they have either totally eliminated species from fire impacted reaches or reduced their numbers dramatically. Resource and land managers have by default, become increasingly involved in salvage and repatriation of species on numerous occasions and fire use plans. Forest management over the past half century, recent drought and increased extent and intensity of wildfires have elevated to the forefront the issue of wildfire and fire use fire program impacts on the persistence and sustainability of all fishes and aquatic organisms, especially rate, often isolated, threatened and endangered fishes. The symposium is divided into three components: 1) Case histories, 2) Influencing factors, and 3) Management implications. This symposium will present results of contemporary research and monitoring on species in streams and rivers across the West impacted by wildfires--largely in the past decade. Papers will discuss post wildfire impacts on aquatic macro invertebrates, both invasive and rare, federally listed native fishes and their habitats in the wild, ad hoc management activities of removal and repatriation, fire use management plans to sustain these species, results of laboratory ash LC 50s, post wildfire hydrology and stream habitat alteration and loss, and retardant impacts. Post wildfire salvage and ex situ holding impacts and mortality, protocols for removal and repatriation or rare fishes, risk analysis, and life history responses, and future implications for the management of threatened and endangered fishes and wildfires on the landscape will be addressed.

Presentation Title: Wildfire and Conservation of Gila trout

Presenter: *David Propst*
New Mexico Department of Game and Fish
Santa Fe, New Mexico, USA

Abstract: Following the 1989 Divide Fire, summer storm-induced ash flows eliminated Gila trout, a federally- and state-protected species, from Main Diamond Creek, New Mexico. By 1994, the stream was deemed sufficiently "recovered" from effects of wildfire that it could again sustain Gila trout. Consequently, about 150 individuals (mixed ages) from McKnight Creek were stocked in Main Diamond Creek in autumn 1994. Subsequent stocking of hatchery-reared fish were made in 1995 and 1996 (about 300 age 0 fish each year). In May 1997, Main Diamond Creek was sampled and recruitment of 1996 year-class individuals was documented. Subsequent sampling of the stream indicated that Gila trout had attained pre-fire densities (between 2.5 and 4.5 fish/minute electrofishing) and demographics (particularly size-structure and relative condition) similar to that of pre-fire population within 5 years of initial repatriation. Since the Divide Fire, other wildfires have impacted all extant populations of Gila trout and provided the opportunity to document the variable responses of populations to wildfire and associated after-effects. Although wildfire remains a threat to all populations of Gila trout, they also eliminate, or greatly diminish, nonnative trout populations and thus provide opportunities to restore Gila trout to streams of historical occupancy. The challenge for management agencies is to balance the need for restoration of a more natural fire regime with protections needed to conserve and recover a rare species.

Co-Authors: *James Brooks, USDI Fish and Wildlife Service, Albuquerque, NM - Jerry Monzingo, USDA Forest Service, Silver City, NM*

Presentation Title: Wildfire Effects on Gila trout (Oncorhynchus gilae) Populations and Habitat

Presenter: *Stephanie Colema*
USDI Fish and Wildlife Service
Las Cruces, New Mexico, USA

Abstract: Endangered Gila trout in New Mexico have been affected by recent wildfires in the Gila and Aldo Leopold Wildernesses. The extent of the relationship between fire severity and its effect on aquatic systems is not fully understood creating challenges for wilderness fire and endangered species management. This research focuses on that relationship by studying a Gila trout stream exposed to varied levels of wildfire severity and characterizing post fire effects on attributes such as stream morphology, habitat complexity, and fish population structure. Correlating a range of fire severity effects to an array of observable stream variables will improve understanding of fire as a disturbance and integral stream ecosystem process. Sampling in 2005 showed major habitat types consisted of riffles and runs with gravel and cobble substrate. Pools were uncommon in any of the burn areas from lack of instream large woody debris. Siltation of fine sediment and ash was evident after summer rains. No Gila trout in low burn areas, while unburned areas showed multiple size classes and reproductive effort.

Co-Authors: *Colleen A. Caldwell, New Mexico State University-*
James E. Brooks, USDI Fish and Wildlife Service

Presentation Title: Long term aquatic macro invertebrate recovery after the 1989 Divide fire, Main Diamond Creek, NM, USA

Presenter: *Gerald Jacobi*
Jacobi and Associates
Santa Fe, New Mexico, USA

Abstract: Benthic macro invertebrates were collected after the Divide fire and flood in August 1989 and then seasonally or yearly through 2000. The first sampling yielded few organisms, but recovery was evident during the first year post-fire and flooding. During the second year of sampling, another major flood reduced the community again to a few organisms. In succeeding years, reduced standing crops occurred after minor flood events; increased standing crops occurred during non-flood years. The number of taxa and diversity indices both showed a steady increase during the 10 year post-flood period. High densities of organisms may appear quickly after flooding, but for the community structure to become more diverse (and stable ?), it may take much longer than previously expected.

Presentation Title: The Ponil Fire Study: Impacts of fire on fish and their habitat.

Presenter: *Kara D. Hilwig*
~~*U.S. Geological Survey*~~
~~*Flagstaff, Arizona, USA*~~

Abstract: The Ponil Complex fire burned over 90,000 acres in northeastern New Mexico in June of 2002. Seven research sites along 20 miles of Middle Ponil Creek were set up after the fire was contained to study the impacts fire would have on fish and their habitat. Sites were chosen along Ponil Creek to represent no impact and fire-impacted reaches. All sites were sampled before the summer runoff events and continue to be monitored for fish recolonization and habitat regeneration (2002 –2005). In August 2002, ash and sediment flows heavily impacted several of the lower sites, resulting in complete removal of fish in these sites. Re-colonization of fishes has since been slow. During the two years after the ash flows, only 1 fish, an adult white sucker, was found at the fire-impacted sites. When the sites were re-sampled in 2004, 51 fish were found at site 2, approximately 1 ½ miles downstream from the non-impacted area (the likely source of recolonization). No fish were found further downstream of site 2 until 2005 when 3 adult fish were found. To monitor habitat changes, stream cross-sections were installed at all sites to measure channel changes and to estimate peak flood flows. Significant channel down-cutting was not observed. Pebble counts done in 2002 before and after the ash flow events showed a dramatic increase in fine <2mm substrate material. Visual observations indicated that the substrate was buried in ash and fine sediment at all pool, glide and eddy habitats. The pebble count data from 2003 through 2005 shows that most of the fine sediment had been flushed out of the system.

Co-Authors: *John Rinne, USDA Forest Service - Codey Carter, AZ Game and Fish Department*

Presentation Title: The Boreggo Fire: Short Term Effects on a Brown Trout Population.

Presenter: *Codey Carter*
Arizona Game & Fish Department
Flagstaff, Arizona, USA

Abstract: The Boreggo Fire ignited in June, 2002 on the Santa Fe National Forest. Over 13,000 acres of the Rio Medio watershed was affected by the fire. The stream contained a brown trout population. Sampling was conducted immediately after the fire (June), in late summer (August), and finally in October. Between June and August sampling at one site, brown trout were reduced by 50% in total numbers. Sampling in late October suggested a 70% or greater reduction in total numbers of brown trout at the three sampling locations. Short term data confirm the immediate impact of post fire indirect effects on fish populations in low order, southwestern montane streams. Sustained monitoring has documented the lack of recovery of brown trout in Rio Medio.

Co-Authors: *John N. Rinne, USDA Forest Service, Northern Arizona University, Flagstaff, Arizona, USA*

Presentation Title: The Cub Mountain Fire: Short Term Fire Effects on a Native Gila River Fish Assemblage

Presenter: *Dennis Miller*
Western New Mexico University
Silver City, New Mexico, USA

Abstract: The Cub Mountain fire was ignited in June 2002 and burned 13,525 acres in the Gila Wilderness Area on the headwaters of the West Fork of the Gila River. Fish populations, aquatic macro-invertebrates, geomorphology and flow regimes were measured at two sites in early July 2002, late July, and again in early October, 2002. Water quality was also monitored before and during ash flows. No significant change in total numbers of fishes occurred between early and late July—a period of several ash flows. By contrast, marked reductions in total fish populations and certain species occurred between late July sampling and October. Over bank flow occurred during September. Data on a half a dozen native species indicated longfin dace, Agosia chrysogaster, and speckled dace, Rhinichthys osculus, were dramatically impacted by ash/flood flows, whereas Sonora, Catostomus insignis, and desert, C. clarki, although reduced in numbers were not negatively impacted. The West Fork was sampled annually from 2003-2005. In 2003 fish populations had not yet recovered, but by 2005 populations of native fishes were approach those pre-fire. Implications of these short term effects of fire on native fishes are offered.

Co-Authors: *Codey Carter, Arizona Department of Fish and Game - John N. Rinne, USDA Forest Service*

Presentation Title: Impacts of the 2003 Aspen Fire on Gila chub in Sabino Canyon, Arizona.

Presenter: *Don Mitchell*
Arizona Game and Fish Department,
Flagstaff, Arizona, USA

Abstract: Wildfire impacts on invasive and threatened and endangered fishes, aquatic organisms and their habitats During the summer of 2003 the Aspen fire burned a considerable portion of the Sabino Canyon watershed within the Santa Catalina Mountains of the Coronado National Forest. Sabino Canyon was home to of one of the few remaining Gila chub (Gila intermedia) populations within the Santa Cruz drainage located in southern Arizona. Due to concerns that the entire population could be lost due to severe sedimentation and ash run-off in upcoming summer monsoon events, approximately 1,000 chub were removed from the watershed and housed in temporary facilities around the state of Arizona. This presentation will highlight the cooperative effort between the Arizona Game and Fish Department, US Forest Service, US Fish and Wildlife Service, the University of Arizona, and several volunteers to remove these fish to temporary housing. Effects of the ash and sediment run-off on fish that remained in the canyon will be discussed along with the observed impacts to the habitat that occurred as well. Additionally, the re-establishment effort and the current status of the population in Sabino Canyon will be presented.

Presentation Title: Immediate and Short Term Impacts of the Picture Fire on Native and Nonnative Fishes

Presenter: *Codey Carter*
Arizona Game & Fish Department
Flagstaff, Arizona, USA

Abstract: The Picture Fire burned approximately 5,000 hectares on the Tonto National Forest in June of 2003. Seven monitoring sites were established to determine the effects of postwildfire ash and sediment inputs on fishes and their habitats. Sites were sampled prior to runoff events and following the post-fire, summer monsoon season. Native fishes sampled at these sites were headwater chub Gila nigra, desert sucker Catostomus clarki, and speckled dace Rhinichthys osculus. Percent decrease in total fish numbers varied with position on the watershed. Numbers of all species decreased after the summer, postfire runoff events at five of the six sampling sites and ranged from 52% to 94% reductions. The most upstream and downstream sites on the watershed sustained the greatest reductions in fish numbers with a complete loss of all fish species occurring at the lowest site in the watershed. Spikes in turbidity of over 1000 NTU were recorded and initial spikes of high turbidities were correlated with a pronounced drop in dissolved oxygen. High turbidity also was negatively correlated with a dampening of the diurnal pattern of dissolved oxygen rise and fall. Little change in pH was observed. Suspended solids and pebble counts suggested periodic, immediate, and dramatic changes in water quality and stream channel substrates. Short-term results of this study corroborate previous studies documenting the short-term, dramatic and negative impact on native fishes in fire-impacted streams.

Co-Authors: *John N. Rinne, USDA Forest Service*

Presentation Title: Effects of Three Recent Wildfires on Fishes and Habitats on the Apache-Sitgreaves National Forest

Presenter: *Jonathan Long*
Arizona Cooperative Extension Service
Flagstaff, Arizona, USA

Abstract: Recent high-elevation wildfires in the White Mountains have posed threats to native fish species, including the Apache trout and the loach minnow. We sampled several streams on the Apache National Forest following the Steeple fire of 2003, the KP fire of 2004, and the Three Forks fire of 2004 to evaluate whether those fires negatively impacted fish populations and their habitats. We surveyed the streams after the 2004 fires had been contained and before major flood events had occurred. We resampled fish populations at the sites one year later, and we also compared our results to surveys that the Arizona Game and Fish Department had completed in similar locations in 1995. We observed debris flows and channel incision in KP and Grant Creeks; however, trout survived in those streams in amounts comparable to the levels reported a decade earlier. Streams draining the Three Forks fire exhibited temporary increases in turbidity shortly after the fire, but otherwise habitat impacts appeared negligible and populations of various native fishes did not show a substantial reduction. Impacts from the fires were related to the extent of watershed areas burned at moderate to high severity (ranging from 4-28%). The patchy, mixed-severity burns may explain why impacts to fish were much reduced compared to those from other fires in the region. These surveys revealed both the value and the challenge of evaluating post-fire impacts using historical data.

Co-Authors: *Codey Carter, Arizona Department of Fish and Game*

Presentation Title: The Dude Fire: Short and long term effects on fishes

Presenter: *John Rinne*
USDA Forest Service
Flagstaff, Arizona, USA

Abstract: The Dude fire was ignited by a lightening strike on June 25th, 1990 on the watershed of Dude Creek. The fire ultimately burned over 30,000 acres on the watersheds of Dude, Ellison and Bonita Creeks. Populations of rainbow (Dude and Ellison) and brook (Bonita) trout were extant prior to the fire. Data on fish populations for a period of 5 years existed on each stream. No fishes were lost due to direct effects of the fire, and a few were observed dead after slurry/ash flows that occurred within two weeks after the fire. Flood events in late July and throughout the summer biologically extirpated all fishes from these three streams. Trout were introduced the following year and although reduced more in Ellison than Bonita Creek, survived and grew rapidly. However, resampling of these creeks and comparison of fish populations to several contiguous streams suggest up to 16 years post-fire fish populations in both streams have not recovered. Numbers and biomass in fire-affected streams are a fifth or less those in non-affected. Stream habitat characterized by large substrates and lack of pools appears to be responsible.

Presentation Title: Post-Wildfire Floods: Causes, Magnitudes, and Effects on Fishes

Presenter: *Daniel Neary*
USDA Forest Service
Flagstaff, Arizona, USA

Abstract: Wildfires can produce significant changes in the hydrology of forest, woodland, and grassland watersheds. Next to the combustion of forest vegetation during a wildfire, the most destructive impact of a wildfire comes from post-fire flood peak flows. These flows can severely affect stream physical conditions, aquatic habitat, aquatic biota, cultural resources, and human health and safety. Flood flows in forest, woodland, and rangeland watersheds after wildfires can increase dramatically due to factors such as combustion of vegetation and forest floor cover, development of water repellant layers in the soil, and accelerated development of post-fire thunderstorms. Increases in storm flows of 1.5 to 2,350 times measured pre-fire flood peaks, well beyond observed ranges of variability in managed watersheds, have been documented after wildfires. These flood flows need to be understood in order to safely manage watershed and cultural resources, human health and safety, and wildlife in a post-fire environment. Ash- and sediment-laden flood flows after wildfires constitute the largest threat to aquatic biota and fish populations in the Southwest.

Co-Authors: *John N. Rinne, USDA Forest Service*

Presentation Title: Environmental Persistence, Toxicity, and Ecological Effects of Fire-fFghting Chemicals to Fish

Presenter: *Edward Little*
U.S. Geological Survey
Columbia, Missouri, USA

Abstract: Fire retardants and suppressants are used extensively in the United States for suppression and control of range and forest fires. Each year, millions of gallons of these mixtures are applied on a wide array of ecosystems. These chemicals may be formulated as liquids, powders, foams, or gels and are often applied in environmentally sensitive areas that may contain endangered, threatened, or economically significant plant and animal species. Our research has demonstrated that these chemicals represent a minimal risk to terrestrial organisms; however, they may cause adverse effects in the aquatic environment. Fire-fighting foams are consistently more toxic to aquatic organisms than liquid and powder retardants. In addition, some retardants contain sodium ferrocyanide as a corrosion inhibitor that in the presence of sunlight significantly increases the toxicity of fire chemicals in aquatic ecosystems. Residues of applied fire chemicals remain toxic for long periods of time, thus may persist in rainwater runoff from treated areas, particularly when associated with sandy or rocky surfaces. Chemical degradation is greatly increased in regions characterized by highly organic soils. Fish are capable of detecting and avoiding many of these chemicals, and exposure may be minimized if an avenue of escape is available. Many of these chemicals are ammonium based and may act as fertilizers to encourage the establishment of invasive plant species in areas immediately after a fire. Other fire-related effects including ash effluents and elevated water temperatures may result in aquatic effects more severe than those associated with chemical exposure, therefore, fire chemicals remain an important management tool in the control and suppression of fire.

Co-Authors: *R. Calfee and S. Finger, U.S. Geological Survey*

Presentation Title: Multiple Responses of Rainbow Trout to Wildfire and Human Influences

Presenter: *J.B. Dunham*
U.S. Geological Survey
Corvallis, Oregon, USA

Abstract: Wildfire is a major force shaping headwater streams in the Boise River basin, located in central Idaho. The prevalence of wildfire in this basin has increased dramatically in the past 20 years. By looking at different types of biological responses, we were able to identify the potential roles that wildfire may play in the dynamics of rainbow trout populations. We compared spatial distributions, abundance, life history characteristics, and genetic characteristics of local populations in relation to wildfire, channel disturbance, and isolation caused by human-constructed fish passage barriers. Our results showed that common indicators (e.g., distribution, abundance) were not informative. However, changes in the life history of rainbow trout showed marked responses. Patterns of genetic variability within populations provided further indications of the relative effects of wildfire versus human impacts (e.g., barriers and hybridization with nonnative trout). Together, this series of studies provides useful perspectives on potential mechanisms explaining the resilience of native fish to wildfire, and the role of wildfire relative to other threats caused by human influences.

Co-Authors: *Amanda Rosenberger, Bruce Rieman, USDA Forest Service –*
Helen Neville, University of Nevada-Reno

Presentation Title: Ash LC50s and Fishes: Corroboration of Field Results of Wildfires

Presenter: *Codey Carter*
Arizona Game & Fish Department
Flagstaff, Arizona, USA

Abstract: Recent research has demonstrated that post fire runoff impacts can be devastating to aquatic habitats and fishes. Presently, the direct cause(s) for the loss of fishes resulting from post-fire flow events is not known. Hypotheses are that flood (physical effect) and ash flows (chemical effect) acting either singularly or in combination are responsible for mortalities observed in the field. Ash LC 50s were generated in the laboratory on a suite of native fishes, one introduced fish and crayfish species. Values ranged from an LC 50 of 10.6 for the native longfin dace Agosia chrysogaster to almost 27.0 for the introduced red shiner Cyprinella lutrensis. Laboratory data suggest that toxicity associated with ash flows may be lethal in itself. Stream hydrology, annual southwestern weather patterns and timing of fire events all contribute to the short and long-term impacts on native southwestern fishes, many of which are threatened and endangered species. Water samples collected from fire-impacted streams have been measured at, and many times above, the LC50s calculated in the lab. Comparison of field data and laboratorygenerated ash LC 50s indicate that brief exposure to very high suspended solids can directly explain the loss of fishes; however, in other studies, the cause(s) of population reductions in fishes isn't clear. The results of this study in concert with field studies have pressing management implications for the conservation of native fishes.

Co-Authors: *John N. Rinne, USDA Forest Service*

Presentation Title: Fire Effects on Fish Populations in the Southwestern USA: The Role of Soil Burn Severity

Presenter: *Andi Thode*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: In recent years we have documented the effects of fire on fishes from 10 fires, impacting 17 streams and over 20 species of fishes in the Southwest. Information from these fires has been compiled largely as anecdotal reports or unrelated studies. Results have varied from little or no impact, to 70-90% reductions in fish numbers, to complete extirpation of entire fish assemblages. Land managers are in need of information on how to manage fish populations post wildfire. Field data collected at the sites have included: fish data, habitat, water quality, flood flows, macro-invertebrates, and BAER severity maps. We hypothesized that burn severity may be a major player in legislating these recorded impacts. Burn severity data have been obtained from several fires that displayed a spectrum of stream fish population losses. Immediate post-fire assessments were used to assess severity on the soils and watersheds. In the southwest, the summer monsoons immediately follow fire season and therefore immediate post-fire soil and watershed severity was used in lieu of vegetation severity as sedimentation is thought to be the major issue affecting fish. The soil severity data has been used to analyze the portions of watersheds impacted at different severity levels and compared to the fire effects on the local fish populations. Preliminary analyses suggest that burn severity does explain some of the variation in relative fish losses, however further analysis is being done to compare the importance of burn severity to other measures such as amount of precipitation, time since fire, fish species, and sediment loads

Co-Authors: *Codey Carter, Arizona Department of Fish and Game - John N. Rinne, USDA Forest Service*

Presentation Title: Re-Shaping Fish Habitats Following Large Wildfires – an Evaluation of Risks for Sensitive and Imperiled Fish Species in Southern Idaho

Presenter: *Timothy A. Burton*
USDI Bureau of Land Management
Boise, Idaho, USA

Abstract: A number of large, uncharacteristic wildfires burned in ponderosa pine (Pinus ponderosa) and Douglas fir (Pseudotsuga menziesii) forests of Southern Idaho during the past 20 years. The period from 1987 to 1994, was particularly severe with wildfires burning almost 50% of the ponderosa pine forest types (about 200,000 ha) within the Boise National Forest. In 1988, 248 wildfires burned 486,000 hectares in the greater Yellowstone area, almost 36% of the forest ecosystem. From post-fire monitoring we have learned that the intensity of these fires varied across the landscape, with a mix of low to moderate severity, and lesser amounts of high severity. During the first 5 years following the fires, localized debris flows scoured smaller-order to main-stem stream channels in watersheds less than 4000 ha in size, where there had been mostly high severity burning. Heavy deposition occurred in larger channels downstream. Locally, headwater stream systems that had high heat and post-fire debris flows had reduced fish numbers and altered fish habitats. In some cases fish were completely eliminated. Uncharacteristic wildfires on the managed portions of the Boise National Forest appeared to have more pronounced, short-term effects on fish habitats as compared with characteristic wildfires in the Central Idaho Wilderness. However, in the most severely impacted streams, habitat conditions and trout populations improved dramatically within 5–10 years. Post-fire floods associated with intensively burned landscapes, rejuvenated stream habitats by exporting fine sediments and by importing large amounts of gravel, cobble, woody debris, and nutrients, resulting in apparent increases in fish densities. Similar results were observed after the 1988 Little Lost Fire in East-central Idaho. These observations suggest that important elements of biodiversity and fish habitat structure may be strongly influenced, or even created by fire-related disturbances. In some cases, habitats that were completely devoid of salmonid fishes just after the debris floods, were later re-colonized with migrants returning from downstream or nearby tributary rearing habitats. Re-population was likely enhanced by higher fecundity, homing instinct, and greater mobility of the larger migratory fish. However, where local fish populations are isolated by downstream barriers to migration, the risk of extirpation after wildfire could be substantial.

Presentation Title: Changes in Fish Assemblages and Habitat Following Wildfire in Bitterroot River Basin, Montana

Presenter: *Clint Sestrich*
USDA Forest Service
West Yellowstone, Montana, USA

Abstract: Wildfire frequency and severity have increased over the past decade but few studies have assessed the effects of large, intense fires on native salmonids in the Intermountain West. I utilized a unique data set with 1-11 years of pre-fire population data in 24 small streams in the Bitterroot River basin in western Montana to determine if habitat changes caused by a large (1,108 km2) wildfire and associated debris flows favored nonnative brook trout Salvelinus fontinalis over native westslope cutthroat trout Oncorhynchus clarkii lewisii and bull trout S. confluentus. I used before-after control-impact (BACI) and extensive post-treatment study designs to determine whether changes in species abundance and habitat increased with increasing burn severity and debris flows. Species abundance was estimated pre- and post-fire with mark-recapture electrofishing and habitat conditions post-fire were assessed by measuring substrate, temperature, large woody debris, and habitat type. Stream temperature and sedimentation generally increased with burn severity whereas habitat complexity decreased with increasing burn severity and presence of debris flows. Native trout populations approached or surpassed predisturbance levels within three years. In contrast, brook trout recovery was less apparent especially in debris flow reaches as the proportion of brook trout to the total salmonid assemblage decreased each year post-fire. However, one notable exception occurred in a high burn severity reach on Rye Creek, where brook trout increased by 499% apparently replacing bull trout. Model results indicated that brook trout abundance was negatively related to stream gradient, elevation, and the proportion of a basin that was burned and positively related to watershed area, water temperature, and pool frequency. Although changes in aquatic habitat following wildfire have the potential to favor nonnative fishes, connected cutthroat trout and bull trout populations in the Bitterroot River basin were resilient to disturbance recovering more rapidly than nonnative brook trout.

Presentation Title: Long Term Effects of the Dude Wildfire on Aquatic Habitats

Presenter: *Alvin Medina*
USDA Forest Service
Flagstaff, Arizona, USA

Abstract: In 1990, the Dude wildfire was the largest recorded wildfire to date to burn over 24,000 acres in central Arizona. Riparian habitats were subjected to variable fire intensities that consumed riparian and upland vegetation of several streams of the Sub-Mogollon region. The purpose of this study was to assess long term post fire changes in channel conditions of three burned streams and contrast them to a reference stream – Pine Creek. We examined changes in channel conditions through repeated measurements post fire between 1990 and 2006 of channel profiles and pebble counts. The channel incised to bedrock and widened to accommodate post fire flood flows. Channel morphology changed post fire from narrow step pool to wide riffle pool habitat. Substrates changed predominantly from gravel/cobble to rock/boulder/bedrock, with intermittent phases of fine accretions. Some stream reaches changed flow from perennial to intermittent. Mean pool depth was reduced nearly 82%. Pool area was reduced nearly 5 fold across all burned study sections. One stream, Perley creek accreted woody debris and fines from adjacent uplands and changed flow from intermittent to ephemeral. Three other streams, Dude, Bonita and Ellison, incised and widened extensively immediately after the first major rainfall events. These streams remain in a high state of instability that continues to change channel substrates and aquatic habitat area. Recommendations for post fire riparian habitat treatments designed to stabilize and enhance channel conditions are discussed.

Co-Authors: *Jackson Leonard, USDA Forest Service*

Presentation Title: After the Fire Ends: Challenges and Lessons Learned Caring for Salvaged Fish

Presenter: *Shaula Hedwall*
USDI Fish and Wildlife Service
Flagstaff, Arizona, USA

Abstract: Fish salvage efforts are often necessary when wildfires threaten endemic fish habitat. During the 2005 wildfire season in Arizona, fish-holding space at traditional facilities such as Arizona Game and Fish Department's Bubbling Ponds Fish Hatchery was limited because holding capacity had been reached due to previous salvage efforts. Therefore, alternative facilities were used to hold fish during the Cave Creek Complex fire. In response to the fire's rapid movement, we salvaged, young-of-the-year Gila chub (Gila intermedia), speckled dace (Rhinichthys osculus) longfin dace, (Agosia chrysogaster) desert sucker (Catastomus clarki) and lowland leopard frog tadpoles (Rana yavapaiensis) from Sycamore Creek and held them at the Rocky Mountain Research Station's aquatics facility in Flagstaff, Arizona. Following transport, ectoparasites found on fins, gills and skin were removed by using a combination of copper sulfate, methyl blue and salt. Mortality rates during salvage and initial treatment were low (less than 1%) and feeding commenced for all species within one week of transport. However, in the ensuing weeks, attempts to maintain a healthy nitrogen cycle within the newly established tanks, while preventing subsequent endoparasite outbreaks, was a challenge. Despite aggressive chemical treatment, reoccurring outbreaks of ich contributed to a 20% loss of salvaged fish, composed primarily of small desert suckers and longfin dace. Personnel time required to care for these fish during their 3 month stay averaged 10 hours/week and increased significantly when fish health issues arose or tank maintenance was required. We recommend that in advance of emergency salvage efforts non-traditional facilities participating in holding salvaged fishes have the proper equipment and chemicals to treat disease as well as the training necessary to implement long-term care. Even expert facilities like Bubbling Ponds may not have medicines and chemicals necessary to treat native species, which can be different than those materials used for treatment of sportfishes.

Co-Authors: *Pam Sponholtz, USDI Fish and Wildlife Service - Kara Hilwig, ~~U.S. Geological Survey~~ - Mike Childs and Frank Agyagos, Arizona Game and Fish Department*

Presentation Title: Wildfire and Aquatic Systems: Implications for Management

Presenter: *Bruce Rieman*
Charlie Luce
USDA Forest Service
Boise, Idaho, USA.

Abstract: It is clear that wildfire can have a profound influence on watersheds and streams and the aquatic organisms associated with them. What managers and biologists think about those effects is not clear or at least not consistent in the perspectives outlined from emerging research. The immediate effects of a severe fire may be perceived as a catastrophic event (e.g. the local extinction of a rare species), or as one of the necessary costs associated with longer term maintenance of a diverse and productive system. As a result, management of fire and fuels has been perceived both as a threat and a benefit to conservation of aquatic species and their habitats. We have argued that the differences are not based on the merit of different scientific work, but on different perspectives inherent in the fires and systems that have been observed. Our synthesis of the emerging research suggests at least three implications for management: 1) Context matters; changing fire regimes and the loss, fragmentation, and isolation of stream habitats with human development differ dramatically across the landscapes of interest. Spatially explicit analyses are needed to understand both conflicts and opportunities. 2) Large disturbances will happen; even if it is possible to mitigate uncharacteristic fuels loads, extreme climatic events, such as prolonged drought or large floods, will still be important. Systems vulnerable to large fires will be vulnerable to other events if the ultimate constraints on populations or habitats cannot be addressed. And 3) Integration is important; conflicts in land management often emerge from conflicting objectives. Maintenance and restoration of ecological processes shaping both terrestrial and aquatic systems is needed. Fuels management alone will not mitigate the threats that face the species and systems we hope to conserve. We argue there is an important opportunity to find common solutions that has not been realized in current management.

TRACK 7

Tuesday, November 14, 2006

Fuels Management

8:00 - 8:15	*Alicia Reiner* *Adaptive Management Services Enterprise Team*	Prescribed Fire and Fuel Treatment Effectiveness and Effects Monitoring in National Forests in California: Surface Fuels and Understory Vegetation
8:15 – 8:30	*Jonathan Stober* *J. W. Jones Ecological Research Center*	Ichauway's prescribed fire management program 1994-2006: a balanced approach
8:30 – 8:45	*Jennifer Rechel* *USDA Forest Service*	Seasonal difference in live fuel moisture in conifer, pinyon-juniper, oak, aspen, and shrup communities in the southwestern U.S.
8:45 – 9:00	*Clint Wright* *USDA Forest Service*	Predicting fuel consumption from prescribed burning trials in western forests and shrublands
9:00 – 9:15	*Jennifer Gibson* *USDI National Park Service*	Native and Non-native Vegetation Response to Fuel Treatments in Northern California Mixed Shrub Woodlands
9:15 – 9:30	*Chuck Harrell* *Virginia Tech*	Effects of prescribed burning, mechanical and chemical treatments to curtail Rhododendron dominance and reduce urban interface fuel loads
9:30 – 9:45	*Leda Kobziar* *University of Florida*	The Effects of Fuel Reduction Treatments on Soil Carbon Respiration in a Sierra Nevada Pine Plantation
9:45 – 10:00	*Sharon Hood* *USDA Forest Service*	Forest floor consumption and tree injury after prescribed burning old-growth pine sites in California
10:30 – 10:45	*Jeffrey Kane* *USDA Forest Service*	Influence of time since treatment on fuel loading and shrub cover of mechanically masticated areas
10:45 – 11:00	*Kyle Jacobson* *Cal Poly State University*	Effects of lop and scatter slash treatment on potential fire behavior and soil erosion following a selection harvest in a coast redwood forest
11:00 – 11:15	*Malcolm North* *USDA Forest Service*	Different ecological effects of prescribed fire and thinning restoration treatments on mixed conifer
11:15 – 11:30	*Matt Busse* *USDA Forest Service*	Long-term effects of prescribed fire and thinning in central Oregon ponderosa pine forests
11:30 – 11:45	*Eric Just* *Cal Poly State University* *San Luis Obispo, CA*	Effects of fuel loading on potential fire behavior and soil erosion in coast redwood stands
11:45 – 12:00	*Peter Cowan* *University of California -Berkeley*	New method for the assessment of fuel loads in chaparral

Fire and Dynamics of Arid and Semi-Arid Landscapes

Peter Weisberg and Ashley Sparrow
Department of Natural Resources & Environmental Science
University of Nevada-Reno
Reno, Nevada, USA

13:30 – 14:00	*Ashley Sparrow* *University of Nevada-Reno*	Fires in arid and semi-arid landscapes: what are their special characteristics, ecological impacts and evolutionary outcomes?
14:00 – 14:30	*Matt Brooks* *U.S. Geological Survey*	The history, ecology, and management of fire in the Mojave Desert
14:30 -15:00	*Peter Clarke* *University of New England Australia*	Burnt to blazes. Are Down-Under desert fire regimes exceeding risk thresholds?
15:30 – 16:00	*David Bowman* *Charles Darwin University Australia*	Millennial to decadal and century-scale dynamics of spinifex--mulga communities in Cental Australia
16:00 – 16:30	*John Bauer* *University of Nevada – Reno*	Fire history and stand structure of a central Nevada pinyon-juniper woodland
16:30 – 17:00	*Peter Weisberg* *University of Nevada – Reno*	Fire and landform influences on the distribution of old-growth pinyon-juniper woodland
17:00 – 17:30	*Peter Weisberg* *University of Nevada – Reno*	Panel Discussion

Session Title: Fuels Management

Presentation Title: Prescribed Fire and Fuel Treatment Effectiveness and Effects Monitoring in National Forests in California: Surface Fuels and Understory Vegetation

Presenter: *Alicia Reiner*
Adaptive Management Services Enterprise Team
Nevada City, California, USA

Abstract: In 2001, Fire and Aviation Management of the Pacific Southwest Region of the USDA Forest Service (Forest Service) commenced a programmatic fire effects and fuel treatment monitoring program. The primary purpose of this monitoring, identified as part of the National Fire Plan, was to quantify and evaluate the effectiveness of projects in meeting fire effects and fuel objectives. In order to meet the objectives of this monitoring program, Adaptive Management Services Enterprise Team has collected fuels vegetation data before and after prescribed fires and mechanical fuels treatments in all National Forests in Region Five. To date, pre-treatment monitoring has been completed on 47 fuels projects across the region. A long-term goal of the project is to monitor post-treatment conditions at 1, 2, 5, 10 and 20-year intervals. The data presented here incorporates 2001 through 2005 monitoring seasons which entail 90 sampling plots at the year one post-treatment monitoring status and 49 plots at year two. Three to ten plots were randomly placed within each project unit monitored. Data gathered in plots is based mostly upon the National Park Service fire monitoring protocol with modifications to include tree cover and chaparral structure. Plots were grouped for analysis based on dominant vegetation and treatment types. Results are presented here for surface fuel loading, cover by physiognomic layer and understory species richness. This includes both comparisons of pre and post-treatment and major vegetation type as well as a multivariate analysis. Longer-term monitoring data would benefit fuels treatment and fire use planning.

Co-Authors: *Jo Ann Fites-Kaufman, Erin Noonan, Scott Dailey, Carol Ewell, Crystal Kolden, Nicole Vaillant, Wendy Boes*

Presentation Title: Ichauway's prescribed fire management program 1994-2006: a balanced approach

Presenter: *Jonathan Stober*
J. W. Jones Ecological Research Center
Newton, Georgia, USA

Abstract: Ichauway, an 11,733 ha preserve in southwest Georgia, contains significant remnants of the fire dependent longleaf pine-wiregrass (Pinus palustris-Aristida beyrichiana) community. Prescribed fire is the principal forest management tool utilized at Ichauway for over 75 years. During the past 12 years the fire management program has documented all prescriptions and evaluations for all fire events. Fires are prescribed to meet specific objectives for each burn unit with an overall objective to burn 4,500-5,300 ha annually. Keystone objectives for every prescribed fire are safety, fire control, smoke management and resource protection. After each fire event fire extent and degree of crown scorch are mapped and placed in a GIS. Weather conditions, fire objectives, fire origin, containment, and subjective evaluations of fuel consumption, duff consumption, and woody plant top-kill are recorded for each burn. Stated fire objectives are often focused on fuel reduction and hardwood control, but can vary widely from educational demonstrations to wiregrass seed production. Typically 99% of all fire events are prescribed with containment median above 97% for over 1980 recorded fire events in the past 12 years. Two-thirds of the acreage is burned in the dormant season (before April) in a given year, and 87% of all prescribed fires occur with a KBDI value below 400. Overstory crown scorch averages 5% of area burned. Analyses of 11 years' data found crown scorch to be dependent on understory type, with 65% of all scorch occurring on wiregrass, 26% on oldfield and 5% on shrub-scrub groundcovers. By focusing on burn unit objectives and frequency rather than season of burn the fire management program has, over the past 12 years, consistently met the goal of burning 50% of Ichauway's landbase each year, including drought years. The current management strategy provides a balanced approach to meet objectives and sustain the ecosystem.

Co-Authors: *Steve Jack, J.W. Jones Ecological Research Center*

Presentation Title: Seasonal Difference in Live Fuel Moisture in Conifer, Pinyon-Juniper, Oak, Aspen, and Shrub Communities in the Southwestern U.S.

Presenter: *Jennifer Rechel*
USDA Forest Service
Riverside, California, USA

Abstract: Fuel moisture is a major determinant in fire danger rating systems. Fire managers monitor live fuel moisture to assess fire risk and plan for current prescribed and wildland fire management activities. Using consistent field sampling methods, differences in seasonal live fuel moisture (LFM) can be estimated over an entire fire season based on low risk (early) and high risk (late) fire periods for landscape level LFM estimates. Major vegetation communities were sampled and LFM was calculated for the Sierra, Gila, Rio Grande, Los Padres, Kaibab, and Coconino National Forests during 2002 and 2003. Vegetation communities included mixed conifer (Pinus and Abies), aspen (Populus), oak (Blue, Black, Canyon Live, and Coast Live), and aspen (Populus). Vegetation plots were selected in relatively homogeneous locations. Percent LFM varied among vegetation types as expected and the percent change decreased for most of the vegetation types sampled, except for Douglas fir (Pseudotsuga). There were similarities in % change in LFM for aspen, oak, and pinyon-juniper for some of the sites. Generally, there was no significant difference between early and late season LFM, with the exception of sites with predominantly junipers (Juniperous), and the shrub communities (Chrysothamnus, Arctostaphylos, Adenostema, and Ceonothus sp). There were some differences in LFM between upper and lower elevations in the shrub and mixed conifer vegetation communities.

Presentation Title: Predicting fuel consumption from prescribed burning trials in western forests and shrublands

Presenter: *Clint Wright*
USDA Forest Service
Seattle, Washington, USA

Abstract: Fuel consumption is a key variable in fire effects modeling and is a critical factor in understanding when and how fire should be applied to meet site and landscape objectives. Early fuel consumption research focused on prescribed burning following forest harvest. The main objective of this project was to improve our understanding of fuel consumption in unmanaged, wildland fuels. We developed empirically-based fuel consumption models for western forest and shrublands that have not been significantly altered by recent logging or other management activities. A total of 17 sagebrush units and 53 ponderosa pine/ mixed-conifer forest units were sampled before and after experimental and operational prescribed fires in the western United States. Linear regression models were constructed from measurements of fuel consumption, pre-burn fuel loading, wind speed, slope, woody and duff fuel moisture, and post-burn blackened area. A number of fuel consumption categories were modeled; in shrub systems models predict total aboveground biomass consumption, and in forest systems, unique models predict forest floor reduction (i.e., litter and duff) and woody fuel consumption by size classes that correspond to timelag categories (i.e., 1-hr, 10-hr, 100-hr, 1000-hr, and >1000-hr fuels). Model predictions can be used to evaluate the potential success of a burn under prescribed conditions and to identify a range of fuel moisture and environmental conditions within which fire can be applied to meet management objectives related to fuel consumption (e.g., smoke emissions).

Co-Authors: *S.J. Prichard, University of Washington, Seattle, WA - R.E. Vihnanek, USDA Forest Service, Seattle, WA - R.D. Ottmar, USDA Forest Service, Seattle, WA*

Presentation Title: Native and Non-native Vegetation Response to Fuel Treatments in Northern California Mixed Shrub Woodlands

Presenter: *Jennifer Gibson*
USDI National Park Service
Whiskeytown, CA, USA

Abstract: Land managers in many urban interface regions are expanding their fire risk reduction options beyond traditional prescribed fire to include manual and mechanical fuel treatments. In this study, we evaluated vegetation response to three individual fuel reduction treatments (manual thinning, vegetation mastication, and spring burning) and one combination of treatments (vegetation mastication followed by spring burning) in a Northern California mixed shrub woodland. Vegetation cover and frequency data two years post treatment were analyzed to determine the differences in native and non-native species composition and shrub response between treatments. One-Way Analysis of Variance on mean cover values revealed significant differences in native ($P = 0.001$) and exotic ($P < 0.001$) grass cover and exotic herbaceous cover ($P = 0.002$) between treatments. The manually thinned treatment had the highest cover of both native and exotic grass species, while the combination of vegetation mastication and spring burning led to the highest cover of exotic herbaceous species. Targeted surveys of high management priority invasive species during the late season also revealed distinct spatial patterns of establishment and spread, with much higher densities in the combination (mastication and burning) and thinning (both manual and mastication) treatments compared to burn-only and control treatments. Native shrub response varied between treatments, with resprounting species responding vigorously to all manipulative treatments and non-resprouting species showing the greatest response in the combination (mastication and burning) treatment. Implications for managers emphasize a need to retain overstory or shrub vegetation where exotic plant establishment and spread is anticipated and to frequently monitor treatments to identify and control high priority exotic species.

Co-Authors: *Tim Bradley, USDI National Park Service*

Presentation Title: Effects of Prescribed Burning, Mechanical and Chemical Treatments to Curtail Rhododendron Dominance and Reduce Urban Interface Fuel Loads

Presenter: *Chuck Harrell*
Virginia Tech
Blacksburg, VA, USA

Abstract: Rosebay Rhododendron (Rhododendron maximum L.) is an ericaceous shrub commonly found in abundance in riparian areas of the Appalachian Mountains. After a century of fire exclusion, rhododendron populations have been expanding out of traditional wet site habitats and proliferating towards drier midslope and ridgetop areas. in this region, researchers and ecologists are beginning to see the negative effects of the dense understory of rhododendron growth that has colonized in the absence of fire. Two such negative effects are the stunted growth or absence of overstory tree regeneration and dangerous fuel conditions near suburban structures where rhododendron is commonly planted as an ornamental shrub. The expansion of rhododendron has been exacerbated by the cessation of cattle grazing in the mountains and the shift away from clearcutting on federal property. This study is aimed at determining the efficacy and efficiency of various vegetation control measures (and their combinations) on rhododendron including reintroducing fire to mountain ecosystems, mechanical thinning, and herbicide application. The results of the treatments from this study will be used over the long term to demonstrate to land managers the effects of vegetation control on rhododendron. First year fuel loading and post-treatment rhododendron survival/growth results (to be collected in August 2006) will be presented at this conference.

Co-Authors: *Shep Zedaker, Virginia Tech*

Presentation Title: The Effects of Fuel Reduction Treatments on Soil Carbon Respiration in a Sierra Nevada Pine Plantation

Presenter: *Leda N. Kobziar*
University of Florida
Gainesville. Florida, USA

Abstract: Fire-prone forests in the American west are presently slated for extensive fuels reduction treatments, yet the effects on soil carbon respiration rates (SRR) have received little attention. This study utilizes the homogeneity of a Sierra Nevada ponderosa/ Jeffrey pine plantation to investigate changes in SRR following mastication in 2004, mastication coupled with prescribed burning in 2005, and burning alone also in 2005 as measured over the growing seasons from 2003 to 2005. SRR, soil temperature and soil moisture were measured in two masticated stands, which were burned the following year, and in one burned stand; the three of which were compared with two controls stands. SRR response to treatments was detectable even though spatial variability within sites was high (coefficients of variation of 39-66%). Mastication produced short-term reductions in SRR, reduced soil moisture by 20%, and mitigated a year-to-year reduction in soil temperature evidenced by controls. Prescribed fire in masticated stands lowered SRR from 3.42 to 2.68 mmol m-2 s-1 while fire in the untreated stand raised SRR from 3.41 to 3.83 mmol m-2 s-1, although seasonal increases in control sites were also detected. Masticated then burned site soil moisture increased by 52% while soil temperature decreased. Microclimate variables were not consistently effective in explaining spatial trends. Exponential (Q10) models using soil temperature and/or moisture to predict temporal trends in SRR were only significant in treated stands, suggesting that treatment implementation increased SRR sensitivity to environmental factors. These results imply that fuels reduction practices in water-stressed forests may have important consequences for ecosystem carbon dynamics.

Co-Authors: *Scott Stephens, Joe McBride, University of California - Berkeley*

Presentation Title: Forest Floor Consumption and Tree Injury after Prescribed Burning Old-Growth Pine Sites in California

Presenter: *Sharon Hood*
USDA Forest Service
Missoula, Montana, USA

Abstract: There is growing concern in northern California that prescribed burning to reduce fuel in areas with large diameter and old-growth trees is causing increased mortality of these high-value trees. A probable cause is the extended burning of large duff accumulations resulting from 100 years of fire suppression. Burning when duff moistures are low can lead to root mortality and basal girdling from the duff mounds smoldering. Even with mechanical thinning to reduce ladder fuels and the probability of crown damage, the problem of deep duff mounds and below-ground damage still exists. A project was initiated to 1) evaluate the economic feasibility and biologic effectiveness of removing duff mounds from trees to reduce large tree mortality and 2) develop prescribed fire guidelines to reduce damage to large-diameter ponderosa and Jeffery pine in areas of deep duff. Three old-growth ponderosa and Jeffrey pine sites were selected in Lassen National Forest and Lassen Volcanic National Park. The two national forest sites were thinned from below prior to burning and activity fuels on one site was masticated. The national park site was not mechanically treated. At each site, trees were paired based on similar dbh, vigor, and duff mound depths. The duff mound from one tree in each pair was raked to mineral soil from the tree bole out to two feet. Fuel loading around each tree was measured using small fuel transects and duff and litter consumption spikes extending from the tree bole out to the crown drip line were installed. All sites were prescribed burned in 2005. Soil temperatures over time and fuel moistures were recorded during the burns. Fuel consumption, soil heating profiles, fire-injury, and one-year tree mortality data are presented.

Co-Authors: *Sheri Smith, Danny Cluck, Jim Reardon, USDA Forest Service*

Presentation Title: Influence of time since treatment on fuel loading and shrub cover of mechanically masticated areas

Presenter: *Jeffrey Kane*
Humboldt State University
Arcata, California, USA

Abstract: Mechanical mastication is increasingly being relied upon to treat shrub and small tree fuels throughout the western US. Given the high treatment costs, a major concern for managers is the longevity of mastication's effectiveness at reducing shrub cover and biomass. Use of mastication is often conducted irrespective to the life history of the pre-treatment shrub and small tree species, but has major connotations to the treatments effectiveness. We quantified fuel loading and post-treatment shrub cover across eight masticated sites throughout northern California and southwestern Oregon that were treated from 5 to 37 months prior to sampling. Mean total woody fuel loading varied significantly by site (P= 0.04) and ranged from 15.3 to 63.4 Mg ha-1 (6.8 to 28.3 tons ac-1). Total woody fuel loading was not significantly correlated with time since mastication (P= 0.15). Post-mastication shrub cover ranged from 0 to 40 % across all sites and was composed primarily of resprouting species (83%; predominantly Arctostaphylos spp. and Ceanothus spp.). Post-treatment shrub cover was negatively correlated with woody fuel loading (P= 0.02; R2=0.56), with less cover at sites with more fuel. Post-treatment shrub cover was greatest at sites with the longest time since mastication (P= 0.03; R2=0.62). At one site dominated by resprouting shrub species shrub cover was already 40% only two years after the mastication treatment. Conversely, another site that was dominated by a non-resprouting shrub species maintained 0% cover one year after treatment. These findings suggest that the efficacy of mastication as a long-term fuel reduction treatment varies based on the life history of the masticated vegetation. In areas dominated by resprouting shrub species, frequent retreatment of the area may be necessary to meet fuel reduction targets.

Co-Authors: *J. Morgan Varner, Humboldt State University - Eric E. Knapp, USDA Forest Service*

Presentation Title: Effects of Lop and ScatterSlash Treatment on Potential Fire Behavior and Soil Erosion Following a Selection Harvest in a Coast Redwood Forest

Presenter: *Kyle Jacobson*
Cal Poly State University
San Luis Obispo, California, USA

Abstract: Harvesting timber is one method of disrupting the horizontal continuity of fuels to reduce potential fire behavior. However, if left untreated, the residual slash can greatly increase the surface fuel loading and subsequent risk on the site. Alternatively, the slash may serve to hold soil in place, thereby decreasing post-harvest soil erosion and stream sedimentation, which may be of greater importance in some forest types. This research examined the relationship of surface fuel loading on potential fire behavior and soil erosion following a single-tree selection harvest and subsequent lop and scatter slash treatment in coast redwood (Sequoia sempervirens (D. Don) Endl.) stands near Aptos, California. Fuel loading was recorded at 40 continuous forest inventory plots for one year prior and three years following harvest on both cable and tractor-skidded sites. Further, soil erosion was estimated in the same plots for two years following harvest. Results indicated that total fuel loading and calculated fireline intensity was significantly increased for one year after harvest, but returned to pre-harvest conditions by the second year. Only small differences were found in fuel loading between cable and tractor-skidded sites. Post-harvest soil erosion was found to be more related to skidding method than fuel loading, which appears to be largely a product of slope.

Co-Authors: *Christopher A. Dicus, Cal Poly State University*

Presentation Title: Different Ecological Effects of Prescribed Fire and Thinning Restoration Treatments on Mixed Conifer

Presenter: *Malcolm North*
USDA Forest Service
Davis, California, USA

Abstract: Mechanical thinning and prescribed fire are widely used to restore western forests after a century of fire suppression, yet we know little about how these different treatments affect plant diversity and ecosystem function. The Teakettle Experiment followed plant diversity, and soil moisture and respiration in old-growth, Sierran mixed conifer for two pre-treatment and three post-treatment years on permanent plots using a full-factorial combination of burning (burn and no burn) and thinning (no thin, understory thin, overstory thin) treatments. Historically the forest burned on average every 12-17 years but Teakettle's the last widespread fire was in 1865. Thinning significantly increased soil moisture which was the most limiting resource on many functions in the pre-treated forest but it negatively impacted plant diversity by increasing slash and litter already high from 135 years of fire exclusion. The fire-only treatment was lit in the late fall due to air quality restrictions and containment concerns and had little impact on the forest. Without additional fuels from logging slash, the prescribed fire was low intensity and had limited coverage. Thinning and burning combined treatments had the greatest increase in herb richness, reduction in shrubs, which are strong understory competitors for space and soil moisture, and signficantly increased habitat heterogeneity. Pre-treatment vegetation patches had a significant legacy effect on post-treatment conditions including soil nutrients, burn intensity and plant diversity. Our study suggests that the means by which forests are restored affects plant diversity and ecosystem function. Fire is essential for restoring some ecosystem processes, but when applied off-season, additional fuels provided by mechanical thinning increase burn area and reduce litter and slash, increasing plant diversity and the heterogeneity of ecosystem functions.

Co-Authors: *Jiquan Chen, The University of Toledo - Andy Gray, USDA Forest Service*

Presentation Title: Long-term effects of prescribed fire and thinning in central Oregon ponderosa pine forests

Presenter: *Matt Busse*
USDA Forest Service
Redding, California, USA

Abstract: Ponderosa pine forests in central Oregon support a vibrant array of vegetation, wildlife, soils, recreational opportunities, and urban growth. Consequently the importance of limiting wildfire risk is a primary goal of land managers in this fire-prone region. While no single silvicultural tool offers a panacea solution, prescribed fire and mechanical thinning are often preferred means to reduce the century-long buildup of live and dead fuel loads. We evaluated the ecological effects of thinning and repeated prescribed fire on vegetation production and diversity, soil quality, and wildlife habitat in fifty-year-old stands of second-growth pine. Sixteen treatments were replicated across a range of site qualities beginning in 1989, including combinations of thinning method (whole tree removal; bole removal; no removal; no thin) and spring burning. Low- to moderate-severity burns in 1991 consumed about one-half of the forest floor, while less severe repeated burning in 2002 was prescribed to reduce the cover of needle-draped shrubs. Results after fifteen years show that thinning plus repeated fire is the most effective treatment to reduce fuel buildup, optimize tree density, and maintain soil quality. Thinning alone also was an effective means to reduce the predicted risk of a crown fire, while encouraging understory habitat for wildlife species and avoiding soil nitrogen losses that occurred during prescribed burning. Burning alone under prescription was ineffective at reducing high tree densities or stimulating understory vegetation. Our results suggest that thinning alone or thinning with subsequent burning provide sound options to reduce fire risk without causing detrimental changes in these pine ecosystems.

Co-Authors: *Gregg Riegel, USDA Forest Service*

Presentation Title: Effects of fuel loading on potential fire behavior and soil erosion in coast redwood stands

Presenter: *Eric Just*
Cal Poly State University
San Luis Obispo, CA

Abstract: Fuel loading, by size class, inherently influences potential fire behavior and is therefore regularly modified by land managers to reduce the risk of catastrophic wildfire. However, high surface fuel loads could serve to reduce other hazards, specifically soil erosion, which may be of greater concern in some forest types. While fuels increase fire behavior, they also serve to intercept rainfall and impede overland flow, thereby reducing soil erosion potential. Thus, in theory, the degree of soil erosion on a site should be inversely related to potential fire behavior. This paper examines the tradeoffs of fuel loading on potential fire behavior versus soil erosion on coast redwood stands near Santa Cruz, California. Sediment traps were utilized to estimate soil erosion on 24 plots over a year period. Surface fuel loading, by size class, was calculated on each plot using a point-transect method. Multiple regression was utilized to investigate the relationship of fuel loading and soil erosion. Further, custom fuel models were developed from the fuel inventory and were then used to estimate potential fire behavior on each plot using BehavePlus and across the entire research area with FARSITE under 50th and 99th percentile weather conditions.

Presentation Title: New method for the assessment of fuel loads in chaparral

Presenter: *Peter Cowan*
University of California – Berkeley
Berkeley, California, USA

Abstract: Current methods of fuel load quantification perform poorly in chaparral and other shrubland systems. This is largely because the primary fire fuel source in these systems is the canopy of the plants, often in the form of dead retained branches. Ground fuels and dead and down materials do not play a significant role in the spread or intensity of fires these systems. We sought to develop new method for rapid field assessment of shrub canopy fuels. At each of five sites in three separate stands of chaparral at the Jasper Ridge Biological Preserve in Northern California we sampled four species (Adenostoma fasciculatum, Prunus ilicifolia, Ceanothus cuneatus, and Heteromeles arbutifolia) using two different methods to measure fuel loads. Our rapid assessment method consisted of placing a thin pole vertically through the plant canopy and recording the diameter of all branches touching it. To validate this we used a second destructive method where we collected a 30 cm diameter cylinder of the canopy encircling the location of the pole. We found a strong correlation between the rapid method and the destructive calibration measurement for canopy fuels. Additionally significant differences in the canopy architecture of the four species were associated with post-fire regeneration strategy. Post-fire seeders were found to have both a higher proportion of dead branch material as well as smaller diameter twigs. This study demonstrates a new way for assessing fuel loads in chaparral systems, and also demonstrates species specific variation in several canopy characteristics. These methods will be useful in parameterizing fire models for these systems and assessing fire risk in chaparral landscapes.

Co-Authors: *David Ackerly, University of California - Berkeley*

Session Title: Fire and Dynamics of Arid and Semi-Arid Landscapes

Session Organizer: *Peter Weisberg and Ashley Sparrow*
University of Nevada-Reno
Reno, Nevada, USA

Abstract: Fire regimes in arid environments are changing due to complex interactions of altered human and natural ignition rates, fire suppression, climate changes, invasive exotic plant species and pastoral grazing impacts – just as they are in more mesic environments. However, in xeric environments, these primarily anthropogenic impacts occur within an ecological context of greater stress and generally lower productivity. In such ecosystems, changed fire regimes can have far-reaching impacts on ecosystem form and function across large landscapes and extremely long timeframes. The aim of this session is to bring together researchers from around the world to compare and contrast their findings in case studies of fire in arid and semi-arid ecosystems, and to achieve a meta-analysis of aridland landscape dynamics and trend controlled by current and changing fire regimes

Presentation Title: Fires in Arid and Semi-arid Landscapes: Special Characteristics, Ecological Impacts and Evolutionary Outcomes

Presenter: *Ashley Sparrow*
University of Nevada-Reno
Reno, Nevada, USA

Abstract: Arid ecosystems have the lowest biological productivity of terrestrial habitats. Many consequent ecological characteristics and unique adaptations of biota are well understood, but the extent, nature and role of aridland fire are less well known. It is not clear whether fire plays a fundamentally different role, and leads to fundamentally different ecological and evolutionary outcomes, in xeric environments than in mesic environments. The aim of this paper is to examine key principles underlying arid ecosystem form and function in terms of effects on fire regimes, and to assess whether these effects differ from more mesic ecosystems. There are seven main conclusions: (1) In arid ecosystems, the tension between low average biomass and high dehydration and flammability of biomass is more extreme than in mesic ecosystems; thus fire regimes are highly dependent on the spatio-temporal co-variance of factors that determine ignition and firespread. (2) Due to continental climates with strong convection and thunderstorm development, ignitions rarely limit arid-zone fire regimes. (3) Increasingly pulsed precipitation (right-skewed frequency distribution), leading to greater periods of coincident high biomass and high flammability, increases fire-spread opportunities and thus fire frequencies. (4) Resource (water, nutrient) redistribution at larger spatial scales generates heterogeneity in community composition and productivity, giving heterogeneous fire regimes. (5) Resource redistribution at small scales reduces likelihood of firespread after small to medium precipitation pulses, but not after the largest pulses. (6) Spatio-temporal variation in resource availability yields a strongly bimodal frequency distribution of life history strategies, placing arid ecosystems at greatest risk of experiencing dramatic transitions between states dominated by one of the two life history modes as fire regimes change. (7) There is likely a semi-arid threshold in the global terrestrial precipitation/productivity gradient below which ecosystems are likely to show extreme sensitivity to incremental change in fire regime.

Presentation Title: The History, Ecology, and Management of Fire in the Mojave Desert

Presenter: *Matt Brooks*
U.S. Geological Survey
Henderson, Nevada, USA

Abstract: Fire is thought to be historically infrequent in the Mojave Desert. However, since the 1970s there has been a trend towards more frequent and larger fires in this region. This has been largely attributed to increased ignitions associated with human activities and increased amounts of flammable fine fuels created by non-native annual grasses such as Bromus rubens, Bromus tectorum, and Schismus spp. Native Mojave Desert vegetation is often slow to recover following fire, and areas that experience recurrent fire appear to be headed towards type-conversion from high diversity native shrublands to low diversity nonnative annual grasslands. The potential effects of these vegetation changes on wildlife such as the Federally Threatened desert tortoise (Gopherus agassizii) are becoming major concerns for land managers. Five fire ecology zones were recently defined to help guide fire management in the Mojave Desert: 1) low elevation shrublands; (2) middle elevation shrublands and grasslands; (3) high elevation shrublands and woodlands; (4) montane woodland and forest; and (5) riparian woodland and oasis. Each of these zones will be described in this presentation, including a summary of their characteristic historical and current fire behavior and fire regimes, responses of dominant plant species to fire, post-fire successional patterns, and major fire management issues and strategies.

Presentation Title: Burnt to Blazes: Are Down-under Desert Fires Regimes Exceeding Risk Thresholds

Presenter: *Peter Clarke*
University of New England
Armidale, NSW, Australia

Abstract: Fire regimes in Central Australian deserts are skewed toward infrequent large events following extended periods of rainfall that increase fuel connectivity. These rare events strongly influence landscape scale cumulative fire interval patterns which show large proportions of landscapes being burnt at intervals of more than 20 years. Landscape geomorphic heterogeneity strongly influence vegetation patterns which, in turn, regulate fuel connectivity and flammability. Paradoxically, some resource rich habitats (e.g. Mulga shrublands) are infrequently burnt because of the competitive exclusion of flammable grass (Spinifex hummock grasslands). Experiments have shown that competition regulates boundary patterns between shrub and hummock grass dominated communities whilst fire sharpens these boundaries into striking patterns. The resprouting response of woody species to fire is highly variable, being regulated by fire intensity and season; whilst post-fire seedling recruitment is mediated by seed predators, fire cued dormancy release, and rainfall. These complex interactions make 'function group' classification problematic. Hence, modelling the biodiversity risk associated with fire regimes rests upon experimental testing of both the regeneration and persistence niche in the context of droughts and flooding rains. The widespread invasion of an exotic perennial grass (Cenchrus ciliaris) is, however, changing fire regimes and the risk to communities by being 'burnt to blazes' are high because of fuel connectivity and high ignition rates.

Co-Authors: *Catherine Nano. Northern Territory Parks and Wildlife Commission & University of New England – Boyd Wright, University of New England, NSW, Australia*

Presentation Title: Millenial to Decadal and Century-scale Dynamics of Acacia aneura – Triodia boundaries in Central Australia

Presenter: David Bowman
Charles Darwin University
Darwin, Northern Territory, Australia

Abstract: A long history of Aboriginal landscape burning is thought to have maintained the fragmentary distribution of Acacia aneura shrublands within a matrix of Triodia grassland in central Australia, and this mosaic may be threatened by the breakdown of Aboriginal fire management following European colonisation. This view was tested on a near level sandsheet at the southern limit of the Tanami Desert in central Australia by (i) determining the chemical and carbon and nitrogen stable isotopic composition of 16 soil profiles across abrupt Triodia hummock grassland – Acacia aneura shrubland boundaries and (ii) analysing repeat aerial photographs taken over the last 50 years at this site. Accelerator Mass Spectrometry (AMS) 14C dating of 32 soil samples revealed that soil organic matter accumulated in profiles about 1 m deep had a radiocarbon age of less than 2000 years. The observed patterns of soil nutrients and delta 13C and 15N are consistent with only minor attrition of the A. aneura shrublands over this time period. Likewise, analysis of aerial photography revealed only minor shifts in the Acacia shrubland boundaries since 1950, although field checking revealed numerous areas of Acacia shrubland that had been recently burnt or were regenerating following fire. Acacia shrublands occurred on more clay rich soils with higher concentrations of total phosphorus, nitrogen and potassium than the surrounding grasslands. The transition from Aboriginal to European fire management appears to have increased the coverage of Acacia regrowth, yet the shrubland – grassland mosaic appears to be stable at both the century and decadal scales.

Presentation Title: Fire history and stand structure of a central Nevada pinyon-juniper woodland

Presenter: *John Bauer*
University of Nevada - Reno
Reno, Nevada, USA

Abstract: In the twentieth century, pinyon-juniper woodlands have expanded into former grassland and sagebrush ecosystems, altering wildlife habitat and geomorphic processes. Fire suppression is frequently attributed as a primary cause, along with intensive nineteenth century grazing and climate change. Restoration plans such as chaining and prescribed fires attempt to restore the presumed degraded systems to a pre-settlement reference condition. However, little is known regarding pinyon juniper pre-settlement densities or fire regimes. This dendrochronologically based study established the pre-settlement fire regimes and stand structure for a 1600 hectare watershed in the Shoshone Mountains. Results suggest a pre-settlement high severity fire regime with a fire cycle of approximately 400 years, and a post-settlement fire regime of no stand replacing fires. The largest reconstructed pre-settlement woodland fires were about 20 ha in size. Frequent grassland and shrubland fires were recorded by fire scars on trees near valley floors. Stand reconstruction analysis revealed that most of the woodlands within the watershed have experienced large increases in stem density commencing with settlement. However, considerable variation in stem density across the landscape was observed. Another key finding was that old growth pinyon-juniper woodland groves are not limited to small rocky outcrop areas, but can be as large as 100 ha in size. Restoration plans should consider the variability in pre-settlement woodland structure

Co-Authors: *Peter J. Weisberg, University of Nevada – Reno, Reno, Nevada, USA*

Presentation Title: Fire and landform influences on the distribution of old-growth pinyon-juniper woodland

Presenter: *Peter Weisberg*
University of Nevada – Reno
Reno, Nevada, USA

Abstract: Encroachment of Pinus and Juniperus into sagebrush in the semi-arid Great Basin has been widely documented and attributed to altered fire regimes. If decreased fire frequency has been an important causal factor for woodland expansion, one would expect to find woodland age structures dominated by younger trees on more fire-prone sites, with old-growth woodland limited to sites with a lower probability of burning. We compared current old-growth distribution with spatial models for fire risrttin a watershed in central Nevada. Multiple static spatial models were developed in a GIS environment to represent fire susceptibility, according to factors representing fuels and barriers to fire spread. We also developed dynamic spatial models using cellular automata algorithms to generate fire probability surfaces according to fuels and topographic barriers. Multi-scale map comparison methods and logistic regression were used to compare model outputs to the existing landscape pattern of old-growth woodland. Only two models predict old-growth distribution significantly better than a random model: a cellular automata model which takes fuels into account, and a simple GIS model using topographic convergence index, an indicator of site productivity. The cellular automata model is the better predictor, suggesting that neighborhood effects of topographic barriers to fire spread are important for mapping fire risk and fire regime in these semi-arid environments. Old growth is more likely in areas predicted by the simulation model be more fire-safe, and in areas of lower productivity. However, both models have weak predictive power, because of the highly variable burn patterns of a few large fires. Spatial controls of fire regime on woodland structure may generally be weak when considering landscapes at the scale of individual canyons. Future conservation efforts will need to consider the historical and ecological role of old-growth woodlands across a broad landscape, and not just on fire-safe sites.

Co-Authors: *Dongwook J. Ko, Ashley Sparrow, D. Bauer, John - University of Nevada, Reno - Camille Py,Institut national agronomiquie Paris*

TRACK 8

Tuesday, November 14, 2006

Landfire: Scientific Foundation for Multi-scale Fuels and Risk Assessments Across the United States

Kevin Ryan
USDA Forest Service
Montana, USA

8:00 – 8:15	***Kevin Ryan*** ***USDA Forest Service***	Scientific Foundations for Multi-scale Fire, Fuels and Risk Assessments Across the United States
8:15 – 8:45	***Jim Menakis*** ***USDA Forest Service***	LANDFIRE Rapid Assessment of Fire Regime Condition Class for the Conterminous United States
8:45 – 9:00	***Don Long*** ***USDA Forest Service***	Development of Vegetation Map Units for the LANDFIRE Project
9:00 – 9:30	***Matt Rollins*** ***USDA Forest Service***	The LANDFIRE Potential Vegetation Maps
9:30 – 9:45	***Jay R. Kost*** ***SAIC***	Mapping Existing Vegetation and Structure in LANDFIRE
9:45 – 10:00	***Matt Reeves*** ***USDA Forest Service***	Fuel Products of the LANDFIRE Project
10:30 - 11:00	***Doug Haulina*** ***USDI Bureau of Land Management***	Fuels treatment and restoration applications
11:00 – 11:30	***James L. Smith*** ***The Nature Conservancy***	Applications of LANDFIRE Data for Conservation Planning By The Nature Conservancy
11:30 – 12:00	***Zhiliang Zhu*** ***U.S. Geological Survey***	Developing an Operational Methodology to Update LANDFIRE: Preliminary Results

Do past Management Activities Compound the Effects of Exclusion in Western Forests?

Anna Sala
The University of Montana
Missoula, Montana, USA

13:30 – 14:00	***Pete Fulé*** ***Northern Arizona University***	Do never-logged forests differ from logged forests in their response to fire exclusion, Arizona and Durango?
14:00 – 14:30	***Jonathan Bakker*** ***Northern Arizona University***	Land use legacies in southwestern ponderosa pine forests: Effects of historical livestock grazing.
14:30 – 15:00	***Andrew Sanchez Meador*** ***Northern Arizona University***	Land use legacies in southwestern ponderosa pine forests: Effects of historical harvesting practices
15:30 – 16:00	***Mike Battaglia*** ***Colorado State University***	Fire behavior in Black Hills Ponderosa Pine forests: Potential effects of past management activities
16:00 – 16:30	***Peter Morrison*** ***Pacific Biodiversity Institute***	Fire-induced mortality and prior landscape condition in western forests
16:30 – 17:00	***Jonathan Thompson*** ***Oregon State University***	Fire Severity in Ten to Fifteen Year Old Salvage Units
17:00 – 17:30	***Anna Sala*** ***The University of Montana***	Do past harvesting practices in ponderosa pine forests (Montana) influence the response to fire exclusion?

Session Title: LANDFIRE: Scientific Foundations for Multi-scale Fire, Fuels and Risk Assessments Across the United States

Session Organizer: *Kevin Ryan*
USDA Forest Service
Missoula, Montana, USA

Abstract: Managers are faced with reducing hazardous fuels, restoring fire regimes, and decreasing catastrophic wildfire threats. Often, the comprehensive scientifically-credible data and models needed to test alternative fuel treatments across multi-ownership landscapes is lacking. The USDA Forest Service, Department of the Interior, and The Nature Conservancy are implementing the LANDFIRE project, which produces consistent and comprehensive spatial data on vegetation, historic fire regimes, fire regime condition class and fuels across the entire United States, including Alaska and Hawaii. While it will fill immediate needs for testing alternative fire management scenarios, planning fuel treatments, and allocating resources, the data and models will also have much broader applications in research, biodiversity conservation, and strategic forest and resource management planning. We will discuss the objectives and methods of the LANDFIRE project, management challenges it aims to address, and research opportunities afforded by the data and models. The session will focus on what new science is being conducted by the LANDFIRE project, research findings, and potential applications to the fire research/vegetation ecology communities and fuels treatment and restoration to protect communities at risk.

Co-Organizer: *Zhiliang Zhu*
U.S. Geological Survey
Sioux Falls, South Dakota, USA

James L. Smith
The Nature Conservancy
Jacksonville, Florida, USA

Presentation Title: Scientific Foundations for Multi-scale Fire, Fuels and Risk Assessments Across the United States

Presenter: *Kevin Ryan*
USDA Forest Service
Missoula, Montana, USA

Abstract: Managers are faced with reducing hazardous fuels and wildfire risks to communities, restoring fire regimes, and decreasing the threat of catastrophic wildfire across landscapes. Comprehensive scientifically-credible data and models are needed to test alternative fuel treatment and restoration strategies. While models for analyzing potential fire behavior exist, in general, the data do not exist to run the models across multi-ownership landscapes. As one component to the solution of fire problems the USDA Forest Service, Department of the Interior, and The Nature Conservancy are implementing the LANDFIRE project. LANDFIRE produces consistent and comprehensive spatial data on vegetation, fuels, historic fire regimes, and fire regime condition class across the entire United States, including Alaska and Hawaii. While LANDFIRE products fill immediate needs for testing alternative fire management scenarios, planning fuel treatments, and allocating resources, the data and models also have much broader applications in research, biodiversity conservation, and strategic forest and resource management planning. This paper provides a synopsis of the background, objectives and deliverables of the LANDFIRE project and the management challenges it addresses. Potential applications are presented for using LANDFIRE data for fire research and vegetation ecology studies and wildland fuel treatment and restoration projects to protect communities at risk.

Co-Authors: *Zhiliang Zhu, U.S. Geological Survey - James L. Smith, The Nature Conservancy - Kristine M Lee, Bruce Jeske, Daniel Crittenden, Sidney Yates, USDA Forest Service - Henry Bastian USDI, Office of Wildland Fire Coordination*

Presentation Title: LANDFIRE Rapid Assessment of Fire Regime Condition Class for the Conterminous United States

Presenter: *Jim Menakis*
USDA Forest Service
Missoula, Montana, USA

Abstract: Over the last couple of decades, we have seen a tremendous increase in the size, number, and intensity of wildfires in the United States, resulting in Congress implementing the National Fire Plan, 10-Year Comprehensive Strategy, and Healthy Forests Restoration Act. In response of these events, Hardy and others (2001) developed several coarse scale spatial data layers to try to get an estimated of the extent of this problem. One of these layers Fire Regime Condition Classes (FRCC) proved very valuable for visualizing and estimating the fuels problems, as it relates to the departure from the Historical Natural Fire Regimes. Unfortunately this data was developed at too coarse a scale for regional and sub-regional level planning. To address this data need, the Wildland Fire Leadership Council authorized the LANDFIRE project, a five-year project to develop geospatial data that will support the analyses required for prioritization and planning of fire management activities at national, regional, and sub-regional level. Part of the LANDFIRE project, is the Rapid Assessment (RA), a "first pass", regional scale assessment for the conterminous United States, that is intended to support national and regional fire management planning. The RA provides rapidly produced and quickly delivered products, which include models of Reference Condition and spatial data of Potential Natural Vegetation Groups, Reference Fire Regimes, and FRCC. This paper summarizes the results of the RA.

Co-Authors: *Kelly Pohl, Gallatin Valley Land Trust - Ayn Shlisky, The Nature Conservancy - Wendel Hann, USDA Forest Service*

Presentation Title: Development of the Vegetation Map Units for the Landfire Project

Presenter: *Donald Long*
USDA Forest Service
Missoula, Montana, USA

Abstract: LANDFIRE is a nation-wide mapping project that supports the National Fire Plan and many other national wildland fire management strategies. The LANDFIRE Project, which is based on peer-reviewed scientific methods, integrates extensive field reference data, gradient modeling, remote sensing, landscape fire regime simulation, and spatial analysis to produce nationally consistent and comprehensive maps of vegetation, wildland fuel characteristics, simulated historical fire regimes, and departure of current vegetation from simulated historical conditions. Products are created at 30-meter grid resolution and are intended for nationally consistent use at multiple spatial scales. The LANDFIRE vegetation GIS layers describe a number of elements of existing and potential vegetation for each LANDFIRE mapping zone including Existing Vegetation Type (EVT), Environmental Site Potential (ESP), and Bio-physical Setting (BpS). These layers are mapped using predictive landscape models based on extensive field reference data, satellite imagery, biophysical gradient layers, and classification and regression trees. LANDFIRE's vegetation map units originate conceptually from NatureServe's Ecological Systems classification, which is a nationally consistent set of mid-scale ecological units. The map unit legends are derived from this classification and portray existing and potential vegetation composition and physiognomy at a suitable thematic resolution for a mapping project of LANDFIRE's large spatial extent and somewhat abbreviated timeframe. The objectives of this presentation are to describe the process by which LANDFIRE has incorporated the Ecological Systems classification into it's map unit development process, outline the criteria and methods used to identify the individual map units for each map unit theme on plot data in order to develop training sites to drive the vegetation mapping process, and to characterize how each vegetation map unit theme is used to derive fuel and fire regime related deliverables.

Co-Authors: *Matt Rollins, USDA Forest Service*

Presentation Title: The LANDFIRE Potential Vegetation Maps

Presenter: *Matt Rollins*
USDA Forest Service
Missoula, Montana, USA

Abstract: The LANDFIRE project relies on biophysical gradient modeling and the concept of potential vegetation as foundational concepts for developing vegetation, wildland fuel, and historical reference condition data products for the United States. LANDFIRE potential vegetation products consist of environmental site potential (ESP), climate constrained potential vegetation; and biophysical settings (BpS), disturbance constrained potential. The LANDFIRE ESP map represents the vegetation that could be supported at a given site based on the biophysical environment. The ESP map is used in LANDFIRE to inform the existing vegetation and surface and canopy fuel mapping processes. The BpS map represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime. It is a refinement of the ESP map, in which we attempt to incorporate current scientific knowledge regarding the functioning of ecological processes -- such as fire – in the centuries preceding non-indigenous human influence. The BpS map forms the spatial template for simulating fire regimes using the LANDSUM landscape succession model. Each BpS map unit is associated with a reference successional model that contains information about the frequency, characteristics, and effects of wildland fire. The LANDFIRE ESP map is developed from a floristic map unit classification implemented within the LANDFIRE reference database along with a suite of biophysical gradient predictor layers developed using the WX-BGC ecosystem simulation model. The BpS map is an evolution of the ESP map and is based on information contained in a database compiled from numerous vegetation dynamic workshops held by The Nature Conservancy across the United States.

Co-Authors: *Greg Dillon, USDA Forest Service*

Presentation Title: Mapping Existing Vegetation and Structure in LANDFIRE

Presenter: *Jay R. Kost*
SAIC
Sioux Falls, South Dakota, USA

Abstract: The LANDFIRE project is a cooperative effort involving the USDA Forest Service, the U.S. Department of the Interior, and the Nature Conservancy. The overall goal of the project is to provide spatial data and predictive models required to characterize fuel conditions and fire regimes, and to evaluate fire hazard status. As part of LANDFIRE, we are developing three thematic datasets for the entire United States at a 30-meter resolution: Existing Vegetation Type, Vegetation Canopy Cover, and Vegetation Canopy Height. NatureServe's Ecological Systems classification is being used to categorize Existing Vegetation Types. Vegetation canopy height represents the average height of the dominant life-form (tree, shrub or herbaceous) for each pixel (grouped into several height range classes), and vegetation canopy cover represents the average percentage canopy of the dominant life-form for each 30-meter pixel (grouped into incremental 10 percent classes). These vegetation products are developed through decision tree and regression tree modeling, based on three dates of Landsat imagery (leaf-off, spring, and leaf-on), digital elevation data and derivative products, biophysical gradient data, and biophysical settings data in conjunction with a large volume of field reference plot information. To date, vegetation map data layers have been created for map zones located throughout most of the Rocky Mountains, ranging from eastern Washington, Idaho and western Montana south through eastern California and southern Arizona. The entire western third of the United States is scheduled for completion by the end of 2006, and the rest of the country is scheduled for completion during 2009. Keywords: vegetation, imagery, mapping, spatial data, decision tree, ecological system This work was made possible in part by Science Applications International Corporation under U.S. Geological Survey contract 03CRCN0001. Any use of trade, product, or firm names is for description purposes only and does not imply endorsement by the U.S. Government.

Co-Authors: *James E. Vogelmann, SAIC*

Presentation Title: Fuel Products of the LANDFIRE Project

Presenter: *Matt Reeves*
USDA Forest Service
Missoula, Montana, USA

Abstract: LANDFIRE generates consistent, comprehensive maps and data describing vegetation, fire, and fuel characteristics across the United States. These layers are produced at scales fine enough to assist in prioritizing and planning specific hazardous fuel reduction and ecosystem restoration projects. Fuel data layers are produced in support of fire behavior and fire effects analysis. Critical parameters for predicting fire behavior fire behavior assessment are produced including fire behavior fuel models, canopy base height, bulk density, cover and height. Layers developed in support of fire effects include new fuel loading models and fuel characteristic and classification system. This comprehensive suite of layers is the first of its kind and will enable predictions of fire behavior and effects anywhere in the Nation. Here we provide insight to methods, data and assumptions used during the fuel mapping process and demonstrate some potential applications.

Co-Authors: *Tobin Smail, USDA Forest Service*

Presentation Title: Fuels Treatment and Restoration Applications

Presenter: *Doug Haulina*
USDI Bureau of Land Management
Boise, Idaho, USA

Abstract: LANDFIRE data, models, descriptions, and publications provide a framework for assessment of wildland hazards and opportunities across the Nation. This framework has been tested for multiple scales of applications. In this paper an overview is provided of the types and scales of uses. Four primary types of applications were evaluated: 1) use of LANDFIRE as a foundation for transfer of integrated fuels, fire, and landscape assessment technology; 2) information and tools for wildland fire decision support; 3) strategic fuels management prioritization and planning at multiple scales; and 4) integration with local data and other tools for design of complex strategies to address multiple fire and resource objectives.
As a result of the first type of application online training was developed, as well as workshops targeted at fuels assessment tools that use LANDFIRE data. These workshops were well attended and received high marks from participants. LANDFIRE data has been used to support decision making on a number of incidents, as well as for wildland fire situation analysis. The data has been tested across a wide variety of scales of strategic fuels management prioritization and planning for Fire Planning Analysis (FPA), land and fire management unit program of work development, and Wildland Fire Use (WFU) options. LANDFIRE has been found to be most useful for these types of applications when combined with other data and tools, such as Wildland Urban Interface (WUI) mapping and fire behavior and Fire Regime Condition Class (FRCC) modeling. The integration of LANDFIRE data with local data and knowledge, combined with finer scale data and modeling, has been applied to resolve potential conflicts between multiple objectives. Many applications of LANDFIRE remain to be tested, but this evaluation of applications indicates LANDFIRE will become a cornerstone for fuels, fire, and land management planning and monitoring.

Co-Authors: *Wendel Hann, USDA Forest Service*

Presentation Title: Applications of LANDFIRE Data for Conservation Planning By The Nature Conservancy

Presenter: *James L. Smith*
The Nature Conservancy
Jacksonville, Florida, USA

Abstract: The mission of The Nature Conservancy (TNC) is "to preserve the plants, animals and natural communities that represent the diversity of life on earth by protecting the land and waters they need to survive." To achieve this goal, TNC needs to work at global, national, regional and local scales, and needs data to identify needs (establish goals) and measure success (monitor programs) at all these scales. LANDFIRE data has been, or will be used, by the Global Fire Initiative and operational TNC programs in their planning processes to accomplish these ends. The purpose of this presentation is to describe selected TNC applications that demonstrate the utility of LANDFIRE data in conservation planning

Co-Authors: *Darren Johnson, Kori Buford, Elena Contreras, Ayn Shlisky, The Nature Conservancy - Kelly Pohl, Gallatin Valley Land Trust*

Presentation Title: Developing an Operational Methodology to Update LANDFIRE: Preliminary Results

Presenter: *Zhiliang Zhu*
U.S. Geological Survey
Sioux Falls, South Dakota, USA

Abstract: Primary deliverables from the interagency LANDFIRE project are three groups of interrelated geospatial data layers including vegetation types and structure, fire fuel models, and ecosystem fire regime conditions, mapped at a 30m-resolution for all land ownerships and major life forms (forest, shrub, and herbaceous) covering all 50 states. The data are developed using satellite imagery (circa 2001) and modeled/summarized biophysical gradients such as soil, topographic, and climate variables. While the data describe composition, structure, and processes of vegetated ecosystems, new disturbances that occur yearly, such as wildfire, insect & disease, or timber harvest, render the data less useful and less accurate than intended. A solution to this problem is to develop an operational methodology to keep the primary deliverables up to date, by mapping detected disturbance areas and integrating the captured spatial data with the baseline LANDFIRE data layers. In this presentation, we will present research findings related to mapping changes in aboveground biomass (fire, forest cuts, fuel treatments, insect and diseases, and hurricanes), developing vegetation transition models, and updating fuel models and fire regime data. We will discuss operational capabilities of the updating approach and potential for projecting vegetation and fuel model changes to future years in the context of land use and management policies.

Co-Authors: *Nate Benson, USDI National Park Service - Matthew Rollins, Donald Long, USDA Forest Service*

Session Title: Do Past Management Activities Compound the Effects of Fire Exclusion in Western Forests?

Session Organizer: *Anna Sala*
The University of Montana
Missoula, Montana, USA

Abstract: Recent evidence suggests that historic management practices such as logging and grazing may compound the effects of fire exclusion on biomass accumulation and fuel buildup. Evidence is also accumulating that past management may increase fire risk due to changes in fuel quality. To date, no comprehensive effort has been done to examine if and the extent to which past management practices in western coniferous forests could have counterproductive effects on fuel buildup and fire risk. We also do not know whether such potential effects are site, forest-type or case specific. This topic has profound management implications and deserves some attention. This session will bring experts from distinct areas of the western United States with specific data and ideas on this important topic. The session will hopefully stimulate interaction among scientists and will help identify priority areas of future research.

Presentation Title: Do Never-Logged Forests Differ from Logged Forests in their Response to Fire Exclusion, Arizona and Durango?

Presenter: *Pete Fulé*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Pine-oak forests in Arizona, USA, and Durango, Mexico, were characterized by frequent surface fire regimes and open forest structure until the onset of fire exclusion due to grazing and fire suppression in the late 19th century (USA) to mid-20th century (Mexico). Although most forests were heavily logged in both nations, a few never-logged “relict” forest sites serve as useful reference points to compare fire exclusion effects in the presence or absence of logging. Both logged and unlogged sites had large, roughly equivalent, increases in density of small trees following fire exclusion. However, logging has had several important consequences, making logged sites different from unlogged ones: (1) the great majority of large old trees was removed, affecting forest structure, snag density, and coarse woody debris. (2) Cutting of large trees led to long-term reduction in biomass, so even though both logged and unlogged forests became dense, the greatest total biomass occurred in unlogged forests. (3) Logged areas have numerous weed propagules in the seed bank, some persistent for a very long time, so understory communities in logged sites are much more likely to support invasive exotic species after disturbance (whether from wildfire or forest treatments) than unlogged sites. At the landscape scale, logged sites tend to have more roads, fragmentation, recreationists, and other impacts.

Presentation Title: Land use legacies in southwestern ponderosa pine forests: Effects of historical livestock grazing.

Presenter: *Jonathan Bakker*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: In the American Southwest, livestock grazing practices in the decades immediately following Euro-American settlement were highly unsustainable and likely had long-term consequences on forest stand development. Five grazing exclosures were established in northern Arizona in 1912 to study grazing effects and vegetation recovery. The tree overstory and shrub and herbaceous understory vegetation were evaluated in 1941 and 2004 inside and outside these exclosures. Canopy cover of tree regeneration was significantly higher inside exclosures in 1941, and total canopy cover and tree density were higher inside exclosures in 2004. Also in 2004, basal area was higher and trees were smaller inside exclosures. Understory cover and density were negatively correlated with overstory vegetation in both years. Most understory variables did not differ between grazing treatments in 1941 and were lower inside exclosures in 2004, but did not differ between treatments after accounting for overstory effects. Between 1941 and 2004, species density declined by an average of 34%, herbaceous plant density by 37%, herbaceous cover by 59%, graminoid cover by 39%, and forb cover by 82%. These declines were largely due to the growth of the overstory rather than to grazing or climatic differences. These results indicate that grazing history can have long-term effects on the overstory vegetation, which in turn strongly affects the understory vegetation. While historical livestock grazing practices contributed to the pulse of ponderosa pine regeneration in the early 1900s, continued livestock grazing reduced the magnitude and rate of increases in stand density and thus delayed the development of hazardous fuel conditions. Also, since overstory effects are the dominant force affecting the understory in this ecosystem, it should respond positively to ecological restoration and silvicultural activities that reduce the dominance of the overstory.

Co-Authors: ***Margaret M. Moore, Andrew J. Sanchez Meador, Northern Arizona University***

Presentation Title: Land use Legacies in Southwestern Ponderosa Pine Forests: Effects of Historical Harvesting Practices

Presenter: *Andrew Sanchez Meador*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Abstract not available

Co-Authors: ***J. D. Baker, M. M. Moore, Northern Arizona University***

Presentation Title: Fire behavior in Black Hills Ponderosa Pine forests: Potential effects of past management activities

Presenter: *Mike Battaglia*
Colorado State University
Fort Collins, Colorado, USA

Abstract: The Black Hills Forest Reserve was established in 1897, 21 years after the gold rush and settlement of the area. Although wasteful logging was apparent in areas close to mining centers, much of the Pinus ponderosa forests were intact. After the creation of the reserve, the first regulated timber sale from a national forest reserve was enacted. Since then, the majority of stands in the Black Hills have been harvested, often with multiple entries using a two-cut shelterwood system. Fire exclusion in conjunction with past harvesting practices has resulted in a simplification of structure contributing to greater vertical and horizontal fuel continuity. This has resulted in increased crown bulk density and decreased canopy base height. We hypothesize that these changes in forest structure due to harvesting practices have increased the potential for crown fire initiation. To test this hypothesis, we used FVS to simulate 100 years of growth and fire exclusion for 112 reconstructed ca. 1900 Pinus ponderosa stands and assessed the current potential fire behavior. Current stand structure data was obtained from Forest Inventory Analysis plots to assess potential fire behavior for harvested stands. Potential fire behavior was compared between fire-excluded non-harvested and harvested stands under 90th and 97th percentile weather conditions. Non-harvested stands experienced both surface and passive crown fire under 90th percentile weather, but no surface fire for the 97th percentile weather. Harvested stands had higher probability of active crown fire only if adjacent to stands experiencing active crown fire, otherwise a surface fire was predicted. These results suggest that by excluding both fire and harvesting, no disturbance reduces sapling density, which results in higher potential for passive crown fire initiation. Instead, the use of varied harvesting systems in conjunction with fire can be used to create structural diversity on the landscape and reduce fire risk.

Co-Authors: *Frederick Smith, Colorado State University – Peter Brown, Wayne Shepperd, USDA Forest Service*

Presentation Title: Fire-Induced Mortality and Prior Landscape Condition in Western Forests

Presenter: *Peter Morrison*
Pacific Biodiversity Institute
Winthrop, Washington, USA

Abstract: Examination of fire-induced mortality and fire behavior in recent wildfires that have burned in the western United States reveals that prior landscape condition exerts effects that challenge currently popular views about the influence of forest management activities. Fire behavior and fire-induced mortality for seven, recent 30,000+ hectare fires in the western USA are examined in relation to prior landscape condition. The landscape condition of portions of each fire was affected by prior forest management activities. Other portions were unaffected. Prior fire suppression activities also influenced the pre-fire landscape condition of each area, however, a small portion of each fire burned in previous recent wildfires. The outcome of these major wildfires presents a challenge to the currently popular view that forest management activities, particularly thinning, will effectively reduce fire-induced mortality and limit fire spread and severity. In the seven fires discussed, some managed areas experienced low fire-induced mortality, but many other managed areas experienced high fire-induced mortality. Also, despite the extreme fire weather that occurred in each fire, many unmanaged stands faired reasonably well with only moderate to low fire-induced mortality. The outcome of these seven fires demonstrates that prior forest management activities can increase fire-induced mortality as often as they decrease mortality. The solution to reduction of fire-induced mortality is not as simple as many currently popular notions regarding thinning and other fuel reduction treatments would like us to believe. Thinning and logging significantly influence forest microclimates and can result in an increase in rate of fire spread and fire-line intensity. This can translate into more area burned and higher vegetation mortality. Regrowth of shrubby and herbaceous vegetation can be rapid after partial or complete canopy removal. In less than 10 years after treatment, fine fuel loading may increase significantly above levels in the untreated stand.

Presentation Title: Fire Severity in Ten to Fifteen Year Old Salvage Units

Presenter: *Jonathan Thompson*
Oregon State University
Corvallis, Oregon, USA

Abstract: We examined the portion of the 2002 Biscuit Fire that re-burned the region of the 1987 Silver Fire in SW Oregon. Using a time-series of Landsat TM imagery, the differenced normalized burn ratio index, and high resolution aerial photography, we analyzed the layering of the two burn severity mosaics and the association of severity with previous management. Our results suggest that Biscuit Fire severity was significantly and positively correlated with fire severity in the Silver Fire. Areas that were logged and planted following the Silver Fire tended to burn with significantly higher severity than comparable areas that burned at high severity in the Silver Fire but were not logged and planted, even after controlling for topography and weather on the day of the burn.

Co-Authors: *Thomas A. Spies, USDA Forest Service*

Presentation Title: Do past harvesting practices in ponderosa pine forests (Montana) influence the response to fire exclusion?

Presenter: *Anna Sala*
The University of Montana
Missoula, Montana, USA

Abstract: A generalized response of ponderosa pine forests of the western United States to fire exclusion is an increase in forest density. Most of what is known about the consequences of fire exclusion on ponderosa pine forest structure is derived from either reconstruction of past structure based on current conditions in fire excluded forests, or from analyses of changes of vegetation in stands with increasing time since fire. While both approaches have been helpful and provided much insight, they suffer from the caveat that, along with fire exclusion, other factors such as anthropogenic disturbances may have contributed to the documented changes in forest structure over time. If so, what is often attributed to fire exclusion may, in fact, be the combined result of several interacting factors. A potential interacting factor is the disturbance from selective harvesting of large trees during the late 1800s and early 1900s. Our goal is to examine the degree to which past harvesting practices in pure and mixed ponderosa pine forests of the Interior Northwest contribute to increases in stand density above and beyond those caused by fire exclusion. We first documented the isolated effects of lack of fire on stand density by comparing contemporary, minimally disturbed stands in remote areas subjected to 2-4 fires in the past century with similar paired stands not subjected to fire during the same period. While density in stands not subjected to fire was significantly higher than in stands subjected to repeated fire, differences were generally moderate. Results from the literature tentatively suggest that changes in stand density during the fire exclusion era are greater in stands that experienced harvesting in the past relative to stands never harvested. Field data will be presented to evaluate whether past disturbance compounds the effect of fire exclusion on stand density

Co-Authors: *Cameron Naficy, The University of Montana*
Eric Keeling, The University of Montana

TRACK 9

Tuesday, November 14, 2006

2003 Southern California Fires: Science Insights into the Fire Event and Recovery

Jon Keeley
U.S. Geological Survey
Western Ecological Research Center

8:00 – 8:30	*Randy Lyle* *California Division of Forestry and Fire Protection*	On the Ground at the Cedar Fire with the Incident Commander
8:30 – 9:00	*Philip Riggan* *USDA Forest Service*	Remote Sensing of the 2003 Southern California Wildfires
9:00 – 9:30	*Richard W. Halsey* *California Chaparral Institute*	Weather, Fuels, and Suppression During the Cedar Fire: Which Variables Made the Critical Difference?
9:30 – 10:00	*Max Moritz* *University of California – Berkeley*	The Strength of Environmental Factors on the Spread of the 2003 Wildfires in Southern California
10:30 – 11:00	*Jan Beyers* *USDA Forest Service*	BAER Team Approach to the Massive Wildfires of 2003
11:00 – 11:30	*Peter M. Wohlgemuth* *USDA Forest Service*	Evaluating the Effectiveness of Post-fire Mulching
11:30 – 12:00	*Janet Franklin* *San Diego State University*	Impact of the 2003 Cedar Fire on Mixed Conifer Forest in San Diego County, California, USA
13:30 – 14:00	*Jon Keeley* *U.S. Geological Survey*	Impact of Fuel Age on Fire Severity and Vegetation Recovery
14:00 – 14:30	*Robert N. Fisher* *U.S. Geological Survey*	Differential Animal Responses to the 2002-2003 Wildfires in Southern California
14:30 – 15:00	*Wayne Spencer* *Conservation Biology Institute*	Fire Effects on Chaparral-Associated Mammals: Progress on a Multi-Year Study Following the Cedar Fire
15:30 – 16:00	*Philip Unitt* *San Diego Natural History Museum*	Effects on Birds of the 2002-2003 Wildfires in Southern California
16:00 – 16:30	*Hugh Safford* *USDA Forest Service*	Southern California and Fire: A Separate Reality
16:30 – 17:00	*John Keely* *USDA Geological Survey*	Concluding Remarks

Session Title: The 2003 Southern California Fires: Science Insights Into the Fire Event and Recovery

Session Organizer: *Jon Keeley*
U.S. Geological Survey
Western Ecological Research
Three Rivers, California, USA

Presentation Title: On the Ground at the Cedar Fire with the Incident Commander

Presenter: *Randy Lyle*
California Division of Forestry and Fire Protection
El Cajon, California, USA

Abstract: The 2003 Southern California Fires: On the Ground at the Cedar Fire with the Incident Commanders From the very beginning, this fire left the commanders with a sick feeling in the stomach. A fire in a roadless area, after dark, with a forecast for Santa Ana winds, and limitied fire suppression resource availability. This was a prescription for trouble with the commanders not realizing at the time, that this would be the worst fire suppression situation they had ever encountered. When the winds did indeed arrive, Incident Commander Randy Lyles' worst fears were realized, the fire would spread from the national forest westerly into his jurisdiction. With a fire spreading at a rate of 5,000 acres per hour for an extended period, this was destined to become a very large fire. Firefighters were awed by area ignitions that were attributed to the widespread mortality of chaparral species. Firefighters quickly ran out of resources and with the Pacific Ocean to the west and the Pines Fire burn area to the east as the only barriers to spread of this fire, it would take over a week to contain. Climate, topography, and vegetative condition played a role in this becoming the largest recorded fire in state history.

Co-Authors: *Rich Hawkins, USDA Forest Service*

Presentation Title: Remote Sensing of the 2003 Southern California Wildfires

Presenter: *Philip Riggan*
USDA Forest Service
Riverside, California, USA

Abstract: There is a fundamental and largely unmet need in fire science and management to consistently monitor and understand the behavior of wildland fires at their full scale and as they occur. Wildfires are by nature shrouded in smoke, difficult and dangerous to approach, sometimes obscured by terrain, and often unpredictable as to location, impact, and rate of spread, especially in heterogeneous fuels and rapidly changing weather. Reliable fire information is needed for deployment of resources during tactical fire suppression; to mitigate fire effects in the environment; and to design and evaluate strategies for fire management including the use of landscape-scale fuel treatments. The Forest Service Pacific Southwest Research Station (PSW) and its partners are developing and applying the airborne FireMapper® remote-sensing system for strategic fire mapping and measurement to improve fire suppression operations, fire-fighter safety, and our understanding of the behavior and environmental impacts of wildland fire. Collected thermal images are transmitted by satellite communications, rapidly processed, and displayed via the Internet to provide a current, detailed, and synoptic view of fire spread and activity for ready use by fire operations. PSW provided fire intelligence to the California interagency Southern Operations Coordination Center during the October 2003 fire emergency in southern California. Data from the FireMapper documented the hour-to-hour progress and intensity during critical periods of the Old, Grand Prix, Cedar, and Paradise fires, which destroyed thousands of homes in San Bernardino and San Diego counties. Imagery from the Old and Cedar fires documents patterns of fire behavior in chaparral and forest fuels including effects of extensive forest mortality caused by drought and bark beetles. Insight from these data will provide a firmer basis for fire-behavior prediction and for strategic planning of fuel treatments.

Co-Authors: *Robert Tissell, Robert N. Lockwood, USDA Forest Service*

Presentation Title: Weather, Fuels, and Suppression During the Cedar Fire: Which Variables Made the Critical Difference?

Presenter: *Richard W. Halsey*
California Chaparral Field Institute
Escondido, California, USA

Abstract: There is often controversy surrounding the relative role of individual variables affecting wildfire spread and extinguishment. For example, the fuel-driven model suggests wildfires are spread primarily by fuel loads. This model suggests the use of prescribed burning and other methods designed to reduce the amount of vegetation on a landscape level are the best way to deal with wildfire risk. An alternative weather-driven model focuses on extreme weather conditions and hypothesizes large wildfires are primarily powered by extreme weather conditions. This model sees wildfires as inevitable and focuses on improving community and structural design along with the strategic placement of vegetation treatments to reduce wildfire risk. Extreme weather conditions are altered by landforms so topography plays an important role in this model as well. Both models imply that firefighters are not particularly effective unless favorable environmental conditions are in place. The 2003 Cedar fire provides an excellent opportunity to examine the role of variables in southern California wildfire behavior because it covered such a large area and involved numerous environmental conditions and suppression strategies. This study analyzes various points along the final Cedar fire perimeter through both on-site investigations and extensive interviews with firefighters who were on the scene. Although extreme weather typically dominated other variables where it occurred, especially during the first 18 hours of the fire, rarely did a single variable dictate how the fire spread or where it stopped. Topography, historical fire corridors, fuel loads, previous burn scars, and firefighter skill played critical roles as well. Understanding the relative importance of such variables has important implications on how land use policies are formulated and implemented.

Presentation Title: The Strength of Environmental Factors on the Spread of the 2003 Wildfires in Southern California

Presenter: *Max Moritz*
University of California – Berkeley
Berkeley, California, USA

Abstract: Understanding the influence of various environmental factors on fire spread is important for both the ecology and management of fire-prone ecosystems. For analysis of the 2003 southern California complex of wildfires, among the largest in recorded history for chaparral-dominated ecosystems, we examined relatively high-resolution data in space and time. Our goal has been to quantify the importance of topography, the age and spatial patterns of fuels, and weather-related factors in controlling burn patterns during these events. In one study, we used traditional methods of fire frequency analysis to assess the role of age dependency in fire spread. Results indicate a much weaker avoidance of burning through young age classes of fuels during Santa Ana wind conditions, in comparison to after extreme fire weather conditions had subsided. Results also demonstrate that fire frequency analysis methods can be quite sensitive to how fire interval distributions are generated (e.g., through mapped age-at-burn surfaces versus through overlapping historical fires) and the inclusion of censored data (i.e., incomplete observations for with time since fire is only partially known). Additional modeling work using classification and regression tree analysis has demonstrated inherent tradeoffs in the strength of environmental factors, again highlighting the importance of extreme fire weather while Santa Ana wind conditions persisted. Our findings do not address whether fire management activities are capable of altering fire spread patterns during extreme weather events; however, the relative lack of influence of the age and spatial patterns of fuels during Santa Ana wind conditions raises questions about what we expect fire management activities to accomplish and the level of risk that we are willing to live with on fire-prone landscapes.

Co-Authors: *Tadashi Moody, Lori Miles, Matthew Smith, University of California – Berkeley*

Presentation Title: BAER Team Approach to the Massive Wildfires of 2003

Presenter: *Jan Beyers*
USDA Forest Service
Riverside, California, USA

Abstract: After a major wildfire, federal land management agencies are required to assess the burned area to determine whether an emergency exists and if action needs to be taken to mitigate the adverse effects of wildfire on human life and property, water quality, and natural and cultural resources. This effort is known as Burned Area Emergency Response (BAER) in the U.S. Department of Agriculture Forest Service and as Emergency Stabilization and Rehabilitation (ESR) in Department of Interior agencies (including Bureau of Indian Affairs [BIA] and Bureau of Land Management [BLM], both affected by the 2003 fires). The massive wildfires of 2003 necessitated the formation of multiple BAER and ESR assessment teams. This presentation will describe the make-up of a typical BAER team, the type of analysis conducted by BAER teams, and the factors they consider when deciding whether to prescribe treatments and what kind to design. This analysis generally must be completed within 7 days of a fire being contained so that treatments can be applied before damaging storms occur. A separate BAER team is assembled to implement the treatments, which after the 2003 fires ranged from road patrols to channel check dams to hillslope stabilization methods such as straw mulch and aerially-applied hydromulch. After the 2003 fires only a limited amount of seeding was done on federal land by BLM; California Department of Transportation (CalTrans) and the affected counties also applied postfire stabilization treatments such as hydromulch with seed. The Forest Service convened a team of scientists to design an effectiveness monitoring strategy for its BAER treatments because of the high public profile of the fire events and subsequent treatment decisions. Both the Forest Service and Department of Interior agencies can monitor treatment effectiveness using BAER/ESR funding sources for up to 3 years after a fire.

Presentation Title: Evaluating the Effectiveness of Post-fire Mulching

Presenter: *Peter Wohlgemuth*
USDA Forest Service
Riverside, California, USA

Abstract: Wildfire renders upland landscapes susceptible to flooding and accelerated erosion, posing threats to life, property, and infrastructure downstream at the wildland/urban interface. To reduce and delay this imminent erosion, land managers constantly seek cost-effective, landscape-level erosion control measures. Mulching is the wet or dry application of materials to act as a ground cover that protects the denuded soil from the agents of erosion until the native vegetation can regenerate. During the 2003 southern California fire siege, straw was used as a mulch on the Old/Grand Prix Fire. The straw was applied both by hand and by helicopter. Hand application produced an even cover of mulch, but was very time-consuming. Depending on labor charges, the cost of hand-applied straw could exceed $500 per acre. Aerial straw mulching often produced uneven clumps, but could be applied much quicker, but at a cost of $750 per acre. All straw was susceptible to removal or re-distribution by high winds. Also in 2003, a proprietary hydromulch mixture was applied to a small section of the Cedar Fire. A combination of a bonded wood fiber matrix and a tackifier, the hydromulch was delivered as a slurry from a helicopter at a cost of $2000 per acre. Dams were constructed in three small watersheds to trap and measure the sediment from two levels of hydromulch treatment and an untreated control. First year results suggest that 100 percent hydromulch coverage reduced both runoff and sediment yield compared to 50 percent coverage and the untreated control. Second year results indicate that runoff was no different amongst the three watersheds, but that sediment yield on the treated sites was only 60 percent that of the untreated control. There were no apparent differences in vegetation re-growth between any of the study watersheds. These findings reveal that mulching can be an effective but expensive form of erosion control.

Presentation Title: Impact of the 2003 Cedar Fire on Mixed Conifer Forest in San Diego County, California, USA

Presenter: *Janet Franklin*
San Diego State University
San Diego, California, USA

Abstract: Fire disturbance regimes affect function and structure of mixed conifer forests in Southern California. However, humans have altered fire regimes across forested landscapes in the western United States by excluding fire from some parts of the landscape while altering its intensity, seasonality and frequency elsewhere. Fire suppression has been blamed for increasing stand densities and a shift from fire-tolerant trees to shade-tolerant but fire sensitive trees in some western forests, changes that had been observed in the Peninsular Ranges in San Diego County, CA, USA. We surveyed an area of oak, pine, and mixed conifer forest (elevation 1500-2000 m) in Cuyamaca Rancho State Park that was severely burned in the historically large and severe Cedar Fire in October 2003. Forty one-hectare stands were monitored during the first two post-fire growing seasons to determine patterns of tree mortality and plant community recovery. Most conifers were killed by the fire and very few pine seedlings have established. Oaks were top-killed but most were resprouting by the second year. Resprouting shrubs as well as obligate seeders established in abundance. Fire-following native annuals were diverse in the first postfire year. With a record rainy season during the winter of 2004-2005, all plant functional groups increased in abundance in the second postfire year, including exotic annual grasses. The increase in exotic grasses, and the lack of pine regeneration, represent plant community changes that may be of concern to resource managers.

Co-Authors: *Spears, L., Deutschman, D. H., San Diego State University -*
Marsden, K., California State Parks

Presentation Title: Impact of Fuel Age on Fire Severity and Vegetation Recovery

Presenter: *Jon Keeley*
U.S. Geological Survey
Three Rivers, California, USA

Abstract: Field studies have investigated the relationships between fuel age, fire severity and postfire vegetation recovery at 250 tenth ha sites across 5 of the largest burns. Our primary hypothesis is that as fuel age increases, fire severity increases and leads to reduced vegetative recovery by increased mortality of seed banks and mortality of resprouters. These data are also important for understanding how stand age affects natural regeneration of shrubland species and the necessity for different post-fire rehabilitation treatments. We have completed 2 years of field work, establishing and intensively sampling 250 tenth ha sites distributed across the Cedar Fire, Otay Fire, Paradise Fire and Old Fire. At each site we have detailed measures of cover and species lists at three different spatial scales for both the first and second postfire years. Fine scale fire severity estimates have been made using shrub skeletons and measures of biomass consumption. These sites span a substantial range in prefire age and fire severity and demonstrate rather complex patterns of interaction between fuel age, fire severity and postfire recovery. The relationship between field measures of fire severity and Landsat dNBR measures are very strong and illustrate that these remote image methods are assessing the same measure of fire severity, which is tied to biomass loss. However, postfire recovery of vegetation is not strongly correlated with field measures or Landsat measures of fire severity and thus these indices do not appear to measure ecosystem impact in these shrublands.

Co-Authors: *Teresa Brennan, U.S. Geological Survey*

Presentation Title: Differential Animal Responses to the 2002-2003 Wildfires in Southern California

Presenter: *Robert Fisher*
U.S, Geological Survey
San Diego, California, USA

Abstract: *Fires have a direct effect on both terrestrial and aquatic fauna, although for California these effects have been little studied or understood.*

Presentation Title: Fire Effects on Chaparral-Associated Mammals: Progress on a Multi-Year Study Following the Cedar Fire

Presenter: *Wayne Spencer*
Conservation Biology Institute
San Diego, California, USA

Abstract: We present a progress report midway through a 3-year study of the Cedar Fire's effects on chaparral-associated mammal species, with a focus on the effects of fire severity and distance from unburned edge on species distributions and recovery. Beginning about 13 months post fire, we repeatedly sample the species assemblage using a combination of small mammal trapping grids, bat echolocation monitoring, remotely triggered camera stations, and baited track stations. Sample sites vary in burn severity and range from the burn edge to ~10 km inside the perimeter. Control plots sample sites outside the fire's perimeter that were similar in pre-fire vegetation condition to burned plots. Small mammal species richness has been higher in control than in burn sites and nearer the burn perimeter than interior, but species-specific responses vary. Detections of species associated with open or young chaparral communities, such as kangaroo rats (Dipodomys simulans) and San Diego pocket mice (Chaetodipus fallax), have been consistently higher on burned than unburned plots. Kangaroo rats have increased more in the burn interior than near the perimeter. Generalist species, like deer mice (Peromyscus maniculatus), appeared to increase following fire, but differences between burned and unburned plots may be decreasing over time. Species associated with older, denser chaparral--such as big-eared woodrats (Neotoma macrotis), brush mice (Peromyscus boylii), and California mice (Peromyscus californicus)--decreased dramatically following fire. Although both mice are showing signs of recovery ~2 years post fire, the woodrat is not. Bats remain most common in control sites and least common in burn interior, probably reflecting insect abundances. Carnivores are detected across all plot types, with no clear patterns yet established. We have detected no effects of burn severity on any species. The record winter rains of 2004-2005 caused temporary crashes in many small mammal populations, complicating interpretation of post-fire trends.

Co-Authors: *Jay Diffendorfer, Illinois Natural History Survey - Scott Tremor, Genie Fleming, Julio Angel Soto-Centeno, San Diego Natural History Museum - Jan Beyers, USDA Forest Service – Jenny Duggan, Dana Morin, Paul Schuette, San Diego State University*

Presentation Title: Effects on Birds of the 2002-2003 Wildfires in Southern California

Presenter: *Philip Unitt*
San Diego Natural History Museum
San Diego, California, USA

Abstract: In 2002 and 2003, over 738 square miles of San Diego County burned. To evaluate the effects on birds of fires of such unprecedented size, we initiated survey transects in the area burned by the Pines fire in 2002, which affected mainly chaparral and oak woodland. Following the Cedar fire in 2003, we added transects in the Cuyamaca Mountains in burned mixed coniferous forest. The transects include 7 unburned routes for comparison as well as 40 burned routes. Each transect is run 3 times in winter, 4 times between 15 April and 15 July. Almost every possible pattern of postfire response is exemplified by some species. Species favoring the burned area, once vegetative recovery had begun, include granivores exploiting open habitats (e.g., Mourning Dove, House Finch, Lesser and Lawrence's Goldfinches), insectivores foraging on exposed rock or bare ground (e.g., Rock Wren, Loggerhead Shrike), and migratory summer visitors adapted to early successional habitats (e.g., Costa's Hummingbird, Lazuli Bunting, Black-chinned Sparrow). Species especially disfavored by the fires include winter visitors characteristic of mature chaparral (e.g., Hermit Thrush, Fox Sparrow) and small nonmigratory birds that nest above the ground in shrubs or trees (e.g., Bushtit, Wrentit, California Thrasher, Mountain Chickadee, Pygmy Nuthatch). In coniferous forest whose canopy burned the composition of the avifauna changed greatly, whereas in forest where only the understory burned the change was slight. Because the Cuyamaca Mountains constitute a nearly isolated island of coniferous forest, some severely affected species (e.g., White-headed Woodpecker, Brown Creeper, Saw-whet Owl) at the southern tips of their ranges could see their distributions cut back. Effects on birds in the area burned in the Williams fire in the San Gabriel Mountains in 2002 were similar, suggesting that each species' response to large-scale fire is similar throughout southern California, if not the species' entire range.

Co-Authors: *Jennifer Rechel, USDA Forest Service*

Presentation Title: Southern California and Fire: A Separate Reality

Presenter: *Hugh Safford*
USDA Forest Service
Vallejo, California, USA

Abstract: The conflagrations of 2003 force us to confront two basic realities regarding fire and southern California, one ecological, one political. The ecological reality is that chaparral is not Ponderosa Pine. In political circles, in fire suppression policy, and in fuels-treatment planning in the western U.S., a yellow-pine-centric world-view dominates which tends to disregard pronounced regional variability in the way that fire works and fuels grow. Chaparral is one of several extensive vegetation types in the West that do not fit the yellow-pine paradigm. Large, destructive fires in southern California chaparral are primarily weather-driven events and are not as dependent on fuels as fires in coniferous systems. Furthermore, unlike in much of the montane West, fire suppression has not resulted in increasing fire severity or fire size in southern California chaparral: fire hazard in chaparral is inherently high, and intense, stand-replacing events are the norm and not a function of human mismanagement. The current nationwide focus on removing ladder-fuels and "overstocked" trees (e.g., Healthy Forest Restoration Act) has little or no application in the southern California lowlands. The second reality is that, sooner rather than later, politically difficult choices will have to be made regarding the juxtaposition of man and chaparral in southern California. Housing developments and highly flammable vegetation coexist throughout southern California. The fires of 2003 made it abundantly clear how naive it is to think that federal and state land management agencies can protect poorly located and designed housing tracts in the face of steep terrain, high winds, and 100-foot flames. Until now, local governments and residents have relied heavily on Uncle Sam to bail them out when fire catastrophes have struck, but the rising costs (and futility) of such efforts raises serious questions about the wisdom – and fairness – of such practices. The issues are similar to those that have been raised in areas chronically threatened by other natural disasters like hurricanes, floods, or earthquakes. As a result of the current situation, agencies like the U.S. Forest Service have been forced to direct a huge proportion of their budget to protecting private structures from fire, to the detriment of their other duties as land managers and ecosystem stewards. Although it will be a political minefield, a stakeholders' debate must be had about the future of man and fire in southern California. In the light of warming climates, population growth, and increasingly strained federal budgets, there is no wisdom in preserving the status quo.

TRACK 10

Tuesday, November 14, 2006

Session Title: Plant, Species and Communities

8:00 – 8:15	*Robert (Bob) Martin* *University of California - Berkeley*	High temperature Tolerance of Plant Tissue and Seeds
8:15 – 8:30	*Tasila Banda* *University of California - Davis*	Effects of fire on the germination of Pterocapus angolensis
8:30 – 8:45	*Shibu Jose* *University of Florida*	Can prescribed fire save dogwood (Cornus florida) populations from anthracnose?
8:45 – 9:00	*David Wester* *Texas Tech University*	Effect of prescribed fire on Kuenzler's hedgehog cactus, an endangered species
9:00 – 9:15	*Miguel Luna* *Texas Tech University*	Spring and Summer Burning Effects on Four Chihuahuan Desert Plants
9:15 – 9:30	*Thomas Kaye* *Institute for Applied Ecology*	Effects of the Biscuit Fire on Frasera umpquaensis, a rare plant of western forests
9:30 – 9:45	*Neil Burrows* *Western Australian Department of Conservation and Land Management*	Managing fire sensitive communities in fire-prone landscapes
10:30 – 10:45	*Jah Sah* *Florida International University*	Assessing the interactions of fire and hydrology on marl prairie vegetation in the southern Everglades, Florida, USA
10:45 – 11:00	*Sandra Rideout–Hanzak* *Texas Tech University*	Summer and winter burn effects on Matagorda Island Vegetation
11:00 – 11:15	*Andi Thorstenson* *USDI National Park Service*	Using cover of upland sedges for predicting success of prescribed fire treatments in reducing cover of non-native cool-season grasses
11:15 – 11:30	*Julie Draper* *U.S. Geological Survey*	Fire Effects on Seed Banks and Vegetation in the Eastern Mojave Desert: Implications for Post-fire Management
11:30 – 11:45	*Bridget Lair* *U.S. Geological Survey*	Effects of fire temperatures, microhabitat and land use history on seed banks in the Eastern Sierra Sagebrush Steppe
11:34 – 12:00	*Mai Hassan* *Agriculture Research Center*	Effect of fire on Acacia seyal, Brachairia obtusiflora and Cymbobogon nervatus soil seed bank in Elnour forest, Blue Nile State, Sudan

Session Title: Plant, Species and Communities

13:30 – 13:45	*Leigh Lentile* *University of Idaho*	Fire Effects and Vegetation Recovery Following Eight Large Western Wildfires
13:45 – 14:00	*Trent Penman* *Department of Primary Industries*	Effect of forest management practices on understorey community composition in managed dry sclerophyll forests in south-eastern Australia
14:00 – 14:15	*Peter Kolb* *Montana State University*	Natural vegetation recovery across three fire severities in Western Montana
14:15 – 14:30	*Evelyn Hamilton* *B.C. Ministry of Forest and Range*	Modelling resilience to slashburning across a sub-boreal to subalpine forest gradient
14:30 – 14:45	*Jen Hooke* *USDI National Park Service*	Yosemite National Park's Ackerson Fire: 10 Years Later
14:45 – 15:00	*Paul Hosten* *USDI Bureau of Land Management*	150 years of vegetation change in the grasslands, shrublands, and woodlands of southwest Oregon
15:30 – 15:45	*Scott Stephens* *University of California – Berkeley*	Old-growth mixed conifer forests in northwestern Mexico, what can they tell us?
15:45 – 16:00	*Jose Iniguez* *USDA Forest Service*	Effects of moisture and fire on historic age structure patterns
16:00 – 16:15	*Penny Morgan* *University of Idaho*	Thirty years of wildland fire use: Evaluating the effects of multiple fires on ponderosa pine forest structure in two southwestern wilderness areas, USA
16:15 – 16:30	*Rick Everett* *University of California – Berkeley*	The 1911 Project: Reconstruction of Forest Change in Yosemite National Park Using 20th Century Timber Inventory Data
16:30 – 16:45	*Eric Keeling* *University of Montana*	Long- and short-term tree growth responses to wildfire in unlogged ponderosa pine/Douglas-fir forests
16:45 – 17:00	*Charlotte Reemts* *The Nature Conservancy*	The role of crown fires in limiting the extent of oak-Ashe juniper woodlands in central Texas
17:00 – 17:15	*Timothy Paysen* *USDA Forest Service*	Twenty year Response of Canyon Live Oak to Thinning and Prescribed Burning

Session Title: Plant Species and Communities

Presentation Title: High temperature Tolerance of Plant Tissue and Seeds

Presenter: *Robert (Bob) Martin*
University of California - Berkeley
Berkeley, California USA

Abstract: Grants Pass Many studies have been done on the high temperature tolerance of plant tissue, such as needles, seedling stems and phloem. On a plot of temperature versus time to 50 percent mortality, the line is a reverse "J", which becomes a straight line on a semi-logarithm plot of t = a -b lnT, where t is temperature and T is time. This equation can be manipulated to give a rate of killing the tissue. The temperature tolerance of dry, refactory seeds is substantially higher than other plant organs - until they imbibe water. At that time their thermal tolerance drops to approximately that of other plant tissues. This may have implications for conditions under which prescribed fires are conducted Grants Pass Many studies have been done on the high temperature tolerance of plant tissue, such as needles, seedling stems and phloem. On a plot of temperature versus time to 50 percent mortality, the line is a reverse "J", which becomes a straight line on a semi-logarithm plot of t = a -b lnT, where t is temperature and T is time. This equation can be manipulated to give a rate of killing the tissue. The temperature tolerance of dry, refactory seeds is substantially higher than other plant organs - until they imbibe water. At that time their thermal tolerance drops to approximately that of other plant tissues. This may have implications for conditions under which prescribed fires are conducted .

Presentation Title: Effects of fire on the germination of Pterocapus angolensis

Presenter: *Tasila Banda*
University of California - Davis

Abstract: High demand for Pterocarpus angolensis (Fabaceae), a leguminous tree species commonly known as "wild teak" from miombo region of sub-Saharan Africa, has led to depletion of adult trees in many areas and reduced recruitment. We investigated the effects of natural and experimental fire, fire intensity, and seed attributes on germination of Pterocarpus angolensis in the greenhouse. It was necessary for fruits to be burnt in order for the seeds to germinate. Indeed, seeds were less likely to germinate if they were severely burned in the field. Similarly, experimentally burned seeds were less likely to germinate with longer burn duration. Germinating seeds had heavier fruit and seeds. Very few seeds in husks over germinated. Finally, seeds without husks persisted in the soil and continued to germinate even after 18 months in wet soil, indicating potential long soil longevity. We suspect that some early cool burns may augment germination in the field but that hot or repeated fires kill seeds, resulting in poor rates of recruitment witnessed in the wild.

Co-Authors: *Mark W. Schwartz, Tim Caro,*
University of California, Davis, CA

Presentation Title: Can prescribed fire save dogwood (Cornus florida) populations from anthracnose?

Presenter: *Shibu Jose*
University of Florida,
School of Forest Resources and Conservation
Gainesville, Florida, USA

Abstract: Flowering dogwood (Cornus florida L.), a common understory tree species in eastern forests, is currently threatened throughout its range by a fungus, Discula destructiva Redlin., that causes dogwood anthracnose. This disease rapidly kills dogwood trees and mortality has exceeded 90% in some forest types. The health and ecological integrity of forest ecosystems throughout the eastern U.S. are threatened by the decline of dogwood populations and management techniques to control anthracnose have received little attention. We examined C. florida populations in burned and unburned oak-hardwood stands in Great Smoky Mountains National Park to determine if burning prior to anthracnose infection has reduced the impacts of the disease. The results showed that burned stands contained greater C. florida densities and lower disease severity than unburned stands. Stands burned twice during a 20 year period had higher stem densities than that burned once or thrice in the same 20 year period. Results indicate that burning could be used as a management tool to reduce the severity of anthracnose infections in affected stands.

Co-Authors: *Eric Holzmueller, University of Florida, Gainesville, FL*
Michael A. Jenkins, Ecologist, USDI National Park Service

Presentation Title: Effect of prescribed fire on Kuenzler's hedgehog cactus, an endangered species

Presenter: *David Wester*
Texas Tech University
Dept. Range, Wildlife and Fisheries Mgt
Lubbock , TX

Abstract: Kuenzler's hedgehog cactus (Echinocereous fendleri var. kuenzleri) is an endangered species known to occur in only 4 counties in New Mexico. The species is found in pinyon-juniper habitat at elevations from 1,500 to 2,100 mm, typically on south to southeastern aspects. Historically, fire has been common in pinyon-juniper habitats, with mean return intervals estimated at 12 to 25 years. Mean fire return intervals have lengthened since the late 1800s as pinyon-juniper vegetation has changed. Prescribed fire is widely used in this habitat for fuels reduction and to reduce woody plant density. However, burning is not conducted within 1,600 m of known Kuenzler's cactus populations (in the Carlsbad, NM BLM District) because of its endangered status. Little is known of the effect of fire on Kuenzler's cactus. We have conducted prescribed burns in 4 study areas in 2 counties to better understand fire effects on this species. Individual plants were randomly assigned to burn or control treatments. Pretreatment data included plant size and a description of fuel load and fuel arrangement surrounding each plant in a 110-cm diameter plot. Plots were individually burned with hand-held drip torches, and have been monitored for post-treatment response for 1 or 2 growing seasons. Mortality in burned (n=111 plants, 8.3%) and control (n=131 plants, 13.5%) treatments is similar (P =0.2176). Plants continue to be monitored for future mortality.

Co-Authors: *Ben C. May and Carlton M. Britton, Texas Tech University, Lubbock, TX*

Presentation Title: Thirty years of wildland fire use: Evaluating the effects of multiple fires on ponderosa pine forest structure in two southwestern wilderness areas, USA
Thirty years of wildland fire use: Evaluating the effects of multiple fires on ponderosa pine forest structure in two southwestern wilderness areas, USA

Presenter: *Penny Morgan*
University of Idaho
Moscow, Idaho, USA

Abstract: Little is known about the effects of repeated wildland fires on forest structure. We compared trees per ha, tree diameter-class distributions, and basal area in ponderosa pine forests burned 0, 1 and 2 or more times through 30 years (1974-2003) of Wildland Fire Use. In both of our study areas, the Gila Wilderness Area, NM and the Rincon Mountain Wilderness Area, AZ, fewer small-diameter (0-22.5 m) trees occurred in areas that burned multiple times than in unburned areas ($p < 0.05$). The density of 45-90 cm+ trees in the Gila Wilderness was highly variable and did not differ significantly between fire treatments ($p > 0.32$). Mean 10-year basal area increment growth rates from tree cores were similar prefire for areas that burned in the Gila Wilderness in 1946, but diverged significantly post-fire ($p<0.05$). This thinning effect was also reflected in significantly different tree size class distributions sampled in 2002-2004, suggesting that timing of fires in the last century has been critical to the development of current stand structures. In the Gila Wilderness, mean densities of large (>47.5 cm) snags were densities were significantly higher in once burned areas but did not differ between twice and thrice burned areas, suggesting that repeated wildland fires may leave many large snags standing. Fire-caused canopy openings ranging in size from 0.5-20 ha have been observed across both study areas. In the Gila Wilderness, we compared 2003 Quickbird satellite imagery to 1969 aerial photographs. Canopy openings occurred more frequently on north-facing slopes, and where trees were small and dense pre-fire. Forests in the Gila Wilderness and RMW are structurally diverse and resilient to fires burning under dry, hot, windy conditions, suggesting that repeated WFU fires have restored forest resilience to fire.

Co-Authors:

Presentation Title: Spring and Summer Burning Effects on Four Chihuahuan Desert Plants

Presenter: *Miguel Luna*
Texas Tech University,
Texas, USA

Abstract: Prescribed burning is an excellent vegetation management tool although is currently not used in Mexico. The objective of this work was to evaluate the effect of spring and summer burning on plant mortality of broomgrass (Muhlenbergia rigida), blue grama (Bouteloua gracilis), broomweed (Isocoma venetus), and bricklebush (Brickellia spinulosa) in the Chihuahuan desert. Fire effects were estimated using a individual burner simulating the time-temperature curves of natural fires with 1700 kg/ha (low fuel load), 2800 kg/ha (high fuel load) plus a no fire control for two plant sizes (big and small) determined by the height of plants and canopy diameter. Plants with heights greater than 26 cm and canopy diameter greater than 30 cm were considered large plants. Plants with lesser canopy diameter and height were considered small plants. Fifty plants of each species were individually burned per season, per fuel load, and plant size. Broomweed was strongly affected ($P<0.05$) by all burn treatments regardless of plant sizes, averaging 85% and 80% of mortality of small and big plants, respectively, and 2% in control plants. However, Broomgrass was not affected by any burning treatment (0% mortality). Small bricklebush plants were slightly affected in spring, high fuel treatment with 26% mortality ($P>0.05$) versus 10% mortality in the other fire treatments and 0.0% in the control. Big plants of blue grama were only affected by spring high fuel treatment (22% mortality). Small blue grama plants suffered greater damage by spring burning with 60% mortality versus 33% mortality for summer burning, and 0.0% in the control. Spring burning has a greater impact on plants than summer burning in Southern Chihuahuan desert.

Co-Authors: *Carlton M. Britton*, J.Carlos Villalobos**, and David B. Wester* * Professors; Department of Range, Wildlife, and Fisheries Management ** Associate Professor; RWFM*

Presentation Title: Effects of the Biscuit Fire on Frasera umpquaensis, a rare plant of western forests

Presenter: *Thomas Kaye*
Institute for Applied Ecology
Corvallis, Oregon, USA

Abstract: Wildfire can impact rare and endangered species in various ways, but information on the effects of fire on many rare species is unavailable. Frasera umpquaensis (Umpqua gentian) is a rare plant of gaps and forested habitats ranging from the central western Cascade Mountains of Oregon south to the Klamath Mountains in northwestern California. The Biscuit Fire of 2002 burned several F. umpquaensis populations on federal lands that had been monitored annually since 1995. The availability of long-term pre-fire data on F. umpquaensis and associated forest canopy at these monitoring sites provided an opportunity to detect changes in populations of the species associated with fire. Prior to the fire, populations varied slightly in size annually, with a marked periodicity to reproduction. In general, flowering occurred on a two-year cycle, and seedling recruitment was often episodic in alternate years, but this cycle was disrupted by the fire. One year after the fire we detected significant negative effects on individuals and populations. Plants in burned habitat were killed, dormant, or smaller than those in undisturbed areas. The number of plants in each plot generally declined, and the proportion of population loss was significantly correlated with amount of habitat burned. Two to three years after the burn, however, the number of plants in many plots and the vegetative size of plants recovered substantially. Burned plants regrew to nearly the size of unburned plants and the populations in many burned plots recovered to pre-burn sizes, probably due to emergence from dormancy of damaged plants. Wildfire appears to pose little immediate threat to the species, especially in areas of low fuel loads, but the failure of burned populations to resume pre-burn flowering rates is cause for concern and continued monitoring. Maintaining lower fuel loads may lessen the negative impacts of burning on Frasera umpquaensis.

Co-Authors: *Linda C. Mazzu, Bureau of Land Management, Boise, ID*

Presentation Title: Managing fire sensitive communities in fire-prone landscapes

Presenter: *Neil Burrows*
Western Australian Department of
Conservation & Land Management
Australia

Abstract: A Mediterrenean type Climate and flammable vegetation have ensured that fires, ignited by lightning and by people, have been a feature of south-west Western Australian bushland for tens of thousands of years. Embedded in the flammable and fire-resilient landscapes are a variety of fire sensitive ecosystems, including massive rock outcrops known locally as monadnocks or inselbergs. These make up a small proportion of the total landscape, but they are biologically important, functioning as biotic islands because of their distinctive assemblages of plants, animals and other life forms. They are fire refugia for ancient Pangaean and Gondwanan relicts, and other fire sensitive species that are only associated with rock outcrops. In the Monadnocks Conservation Park, the fire management strategy over the last 2-3 decades has been to limit the use of prescribed fire and to suppress wildfires. In summer 2003 this strategy culminated in a large and intense lightning-caused wildfire that completely burned the monadnock communities, providing a unique opportunity to document the impacts of such a fire on these communities and to re-assess fire management. Surrounded by heavy, long unburnt forest fuels, monadnocks cannot function as fire refuges, but are funeral pyres waiting to be ignited. The regular introduction of low intensity prescribed fire in the surrounding landscape under fuel and weather conditions such that the less flammable monadnocks are unlikely to burn is essential to protect monadnock communities from lethal wildfires and to allow them to function as fire refugia. Such a fire regime will also provide habitat diversity at appropriate scales and will reduce the size, intensity, damage potential and suppression difficulty of wildfires.

Co-Authors: *Bruce Ward and Ray Cranfield*

Presentation Title: Effect of fire on Acacia seyal, Brachairia obtusiflora and Cymbobogon nervatus soil seed bank in Elnour forest at Blue Nile State

Presenter: *Mai Hassan*
Agriculture Resaerch Corporation. Forest Forst Research center.
Soba. Khartoum. Sudan Khartoum Sudan

This study was carried out in Elnour forest at Blue Nile State, Sudan. The selected site was dominated by trees of A. seyal and grasses of Brachiaria obtusiflora and Cymbobogon nervatus. The objective of this study was to determine the soil seed bank of these trees and grasses and its power to regenrate the site under fire condition. Trees was cleared from the site and then the site was treated with three levels of fire intensities (Light, modrate and severe)to determine the effect of fire on natural regenration, fire was repeted for three successive years 2001.2002.2003. Results revealed that the soil seed bank of trees and grasses is huge and enough to regenrate the area which was found to coinside with the seed life span in the soil. Results showed that fire had no effect on the soil seed bank of A.seyal and C.nervatus on the other hand B. obtusiflora soil seed bank was increased with regard to the number of seeds per unit area but fire had a positive effect on seed dormancy of A.seyal; light fire intensity significantly raised the germination percentage of seeds above the control while modrate and severe fire intensity had an adverse effect on seed viability due to overheating. The soil seed banks of A.seyal ,B. obtusiflora and C.nervatus decreased with time. For the grass soil seed bank most of the seeds accumulated in the top soil (2cm). Although light fire had apositive effect on soil seed bank germinability, it is not recommended as apractice in regeneration of A.seyal forests, because of the difficulty and cost of removal of 75% of the dense tall grass and there was enough viable seeds in the soil to regenerate the site. It is recommended to use soil seed bank rather than replanting for reforestation of A. seyal forests. this method is cheaper and may create rich biodiversity.

Co-Authors: *Dr Sayda Mahgoub Mohammed Director of National Tree Seed Center, Sudan*

Presentation Title: Fire Effects on Seed Banks and Vegetation in the Eastern Mojave Desert: Implications for Post-fire Management

Presenter: *Julie Draper*
USGS, WERC Henderson, Nevada, USA

Abstract: U.S. Geological Survey It is generally thought that Mojave Desert plant communities are poorly adapted for recovery following fire, due to high mortality rates of annual plant seed banks and low survival rates of perennial plants. However, there is relatively little data to support these assumptions. The lack of high quality, quantified information becomes problematic when large fires occur such as those during summer 2005, and decisions must be made regarding the expenditures of significant resources on Emergency Stabilization and Rehabilitation (ES&R) actions. Information is especially needed regarding the short-term (3-year) effects of fire on soil seed banks to help determine if seedings are appropriate ES&R treatments in the Mojave Desert. Seeding is the preferred management tool in large burned areas because it requires the least amount of lead time. Information is also needed on the longer-term (multi-decadal) effects of fire on vegetation to provide quantitative assessments that will help develop effective fire management plans. This project took advantage of a unique opportunity presented by the Hackberry Fire Complex that burned 70,736 acres of the Mojave National Preserve in the eastern Mojave Desert during summer 2005. We collected seed bank and fire severity data on the plots in fall 2005 and collected vegetation data during peak annual plant production in April and May 2006. We will share the first year results of seed bank and vegetation surveys in this presentation.

Co-Authors: *Matthew L. Brooks, USGS*

Presentation Title: Effects of fire temperatures, microhabitat and land use history on seed banks in the Eastern Sierra Sagebrush Steppe

Presenter: *Bridget Lair*
USGS BRD Nevada, USA

Abstract: We examined interactions between fire, soil nutrients, and changes in the plant community of the eastern Sierra Nevada sagebrush steppe, a low-nutrient ecosystem currently threatened by invasive annual grasses. Using quantitative measures of fire temperatures, fuel load, microhabitat and land use history we discuss changes in seed bank density and richness in the immediate postfire environment. Results indicate that there is a significant relationship between burning, microhabitat and seed mortality. Total seed bank richness and density decreased approximately 50% immediately postfire and there is a significant difference in changes to the seed bank based on fire, microhabitat location, land use history and their interactions. Seed bank density and richness decreased greatest in the beneath canopy microhabitat and least in the shrub interspace. Sites subject to historical grazing demonstrated lower seed densities prefire and therefore experienced less overall change than ungrazed sites. Understanding the relationships between fire and plant community dynamics and how they function in the soil seed bank provides land managers tools to better evaluate strategies for postfire restoration as well as where to focus mitigation for invasive species in unburned landscapes.

Co-Authors: *Matthew L. Brooks, USGS, Western Ecological Research Center*
Matt Brooks, Anne Halford, BLM Bishop Field Office

Presentation Title: Assessing the interactions of fire and hydrology on marl prairie vegetation in the southern Everglades, Florida, USA

Presenter: *Jay Sah*
Florida International University
Southeast Environmental Research Center USA

Abstract: Marl prairie landscape, a mosaic of short hydroperiod wetlands with calcitic marl substrates in the southern Everglades, is the only habitat of an endangered species, the Cape Sable seaside sparrow, Ammodramus maritimus mirabilis (CSSS). Our objective was to assess the effects of fire and hydrology on vegetation structure and plant biomass within the range of CSSS habitat. We sampled vegetation at 100 m intervals along six transects of 2.5 to 11 km, and at 608 sparrow census sites. We developed a weighted-averaging partial least square (WAPLS) regression model, using vegetation and hydroperiod data from the transects, and applied the best model to species data to estimate vegetation inferred-hydroperiod at all census points. In conjunction with the vegetation survey, we also collected biomass at 160 census sites sampled in 2005 & 2006. Step-wise regression was applied to select structural variables that contributed to the best model for predicting aboveground biomass. The model was then applied to estimate biomass at 293 transect and 608 census sites. We used annual fire data for 25 years (1981-2005) obtained from Everglades National Park to calculate fire frequency and time since last fire, and determined relationships among fire, vegetation-inferred hydroperiod and plant biomass. In the prairies and marshes within CSSS habitat, the aboveground plant biomass varied from 129 to 1320 g/m2 and was affected by fire history, though the relationship was curvilinear with variability indicative of the influence of external factors, including hydrology. In marshes with relatively long hydroperiod, biomass was controlled by hydrology rather than fire. In wet prairies with shorter hydroperiod, post-fire vegetation recovery depended on both pre- and post-fire hydrologic conditions. Finally, because prairies and marshes within the marl prairie landscape differed in species composition, soil characteristics and hydrologic regimes, the synergistic effects of hydrology and fire on these communities differed as well.
regimes, the synergistic effects of hydrology and fire on these communities differed as well.

Co-Authors: *M. S. Ross[1, 2,] J. R. Snyder[3,] P. L. Ruiz[1] and D. T. Jones[1] 1. Southeast Environmental Research Center (SERC), Florida International University, University Park, Miami, FL 33199, USA. 2. Department of Environmental Studies, Florida International University, Miami, FL 33199, USA 3. US Geological Survey, Florida Integrated Science Center, Ochopee, FL 34141, USA*

Presentation Title: Summer and winter burn effects on Matagorda Island Vegetation

Presenter: *Sandra Rideout-Hanzak*
Texas Tech University
Lubbock, Texas, USA

Abstract: Fire, both natural and human-caused is well-documented in the Texas Coastal Prairie. It is logical to assume that fire played a role in the development and maintenance of barrier island plant communities along the Gulf Coast. The primary objective of this study was to compare vegetation response of winter and summer burn treatments on Matagorda Island, Texas, USA. Twelve main study plots were established on the southwestern uplands of the island. Prescribed burns were conducted in late summers (August) and early winters (January) of 1992/93 and 1993/94 to determine vegetation and fuels responses. Litter loads were reduced one year after burning, but approached pre-burn levels by two years after burning. No difference was found in production of grasses, forbs, or the dominant Juncus/Carex species complex one year post-burn. There was a significant difference in the Juncus/Carex species complex production when treatment years were compared. Precipitation differences among treatment years were the presumed cause. Percent frequency was not different in burned and unburned plots one year post-burn for most species examined. However, coast mistflower (Eupatorium betonicifolium), Fabaceae spp. and Carex spp. showed significant increases in occurrence one year after summer burning. Beach groundcherry (Physalis viscosa) and Fabaceae spp. increased in occurrence two years following burn treatments. Vertical structural density was unaffected by any prescribed burn treatment. Late summer burns are recommended every two to five years to increase the incidence of legumes and other preferred wildlife forage. .

Co-Authors: *Steven D. Brown, Carlton M. Britton, Sandra Rideout-Hanzak, Texas Tech University*

Presentation Title: Using cover of upland sedges for predicting success of prescribed fire treatments in reducing cover of non-native cool-season grasses

Presenter: *Andy Thorstenson*
USDI National Park Service

Abstract: Invasion of native grasslands by non-native cool-season grass species has altered the vegetative composition of Northern Great Plains National Parks. The occurrence or persistence of native upland sedges (Carex spp.) on grassland sites has been observed following prescribed fire. Twelve monitoring plots have been established in 5 prescribed fire units in Badlands National Park, Devil's Tower National Monument, Theodore Roosevelt National Park, and Wind Cave National Park. Cover of all herbaceous species was measured using a point-intercept method. Plots have been measured pre-fire, 1-, 2-, and 5-Years postburn. The stated objectives of these prescribed fires were to reduce cover of cool-season grass species, primarily Kentucky bluegrass (Poa pratensis) and smooth brome (Bromus inermis) and increase cover of native grasses, sedges, and forbs. Initial observations indicate that the pre-fire presence of Carex spp. may lead to greater success in enhancing native cover following fire. Observed species were grouped by guild and nativity for analysis. Areas which had pre-fire populations of native sedge and showed post-fire decreases in non-native grass cover, generally exhibited increased cover of Carex spp. following fire. Several other areas are under consideration for treatment with prescribed fire in the Northern Great Plains. Monitoring pre-fire cover of sedge species may serve as an indictor and allow managers to target restoration areas with high potential for improvement.

Co-Authors: *Cody L. Wienk, Tyler J. Schmitt, USDI National Park Service*

Presentation Title: Fire Effects and Vegetation Recovery Following Eight Large Western Wildfires

Presenter: *Leigh Lentile*
University of Idaho
Moscow, Idaho, USA

Abstract: We examined vegetation diversity and landscape pattern relative to burn severity following eight large wildfires that burned in 2003 and 2004 in California chaparral, in mixed-conifer forests in Montana, and in boreal forests in interior Alaska. Our goal was to relate post-fire vegetation recovery and field and remotely sensed indicators of burn severity. We describe initial fire effects on soil, forest floor, and plant communities in areas of different burn severity, and relate this information to one year post-fire plant species richness, cover, and diversity. For all eight fires, plant canopy cover and species richness were low and non-native species were more abundant where fires burned severely. Species diversity was highest on less severely burned sites. We found a greater number of forbs when compared to other plant life forms, independent of burn severity. Plant cover was dominated by grasses in chaparral systems, forbs in mixed-conifer forests, and shrubs in boreal forests. Site conditions, prefire vegetation, as well as post-fire revegetation strategies most likely explain the high variation observed in post-fire response across sites and burn severities. Preliminary results suggest that initial fire effects such as soil charring, litter and duff reduction, and tree mortality are correlated with reduced one-year post-fire understory plant cover and richness, and thus could be used as indicators of burn severity influencing vegetation recovery rates. The proportion and pattern of patches burned in different burn severities (as indicated by delta Normalized Burn Ratio, dNBR) were dissimilar across sites. Thus burn severity at both plot and landscape scales will influence successional trajectories following fires. Quantified indicators of burn severity will facilitate consistent characterization of post-fire effects and prediction of likely post-fire responses across a broad range of sites and conditions.

Co-Authors: *Penny Morgan, Mike Bobbitt, University of Idaho*
Sarah Lewis, Andrew Hudak, Peter Robichaud, USDA Forest Service

Presentation Title: Effect of forest management practices on understory community composition in managed dry sclerophyll forests in south-eastern Australia

Presenter: *Trent Penman*
Department of Primary Industries
Australia

Abstract: The long term effects of forest management practices on ecological values of native forests have been subject to considerable debate. There are very few Australian studies that have reported changes in the vegetation at sites subject to repeated operational scale disturbances over extended periods. This study was conducted within the Eden Burning Study Area, a long term ecological and management research site in south-eastern NSW, Australia. We examined the impact of three fire regimes (unburnt, routine and frequent) on the composition of the understorey (1 to 10m) and ground vegetation (0-1m) in logged and unlogged sites over a fifteen year period. A two step approach to the analysis was adopted. In the first step, we used multi-dimensional scaling to examine whether the disturbance regimes resulted in consistent changes to plant community composition over time. This was not apparent for any of the fire or logging treatments. In the second step, we used generalized estimating equations to model the trajectory of an individual plot over time in relation to the fire and logging treatments and environmental variables. The community composition of all plots had changed significantly since the pre-disturbance measures independently of fire or logging treatments. Logged sites were more dissimilar to their original state than the unlogged sites, however the magnitude of the difference decreased with the time since logging. Repeated fuel-reduction burning had no effect on community structure by the final measurement (approximately 15 years after the first fire). In these forests, burning and logging treatments do not appear to result in significantly different understory or ground communities. Changes in these forests may represent a natural succession in response to the time since the last wildfire.

Co-Authors: *Dr Rod Kavanagh, Forest Science Centre, Department of Primary Industries Doug Binns, Native Forest Division, Forests NSW*

Presentation Title: Natural vegetation recovery across three fire severities in Western

Presenter: *Peter Kolb*
Extension Service
Montana State University Bozeman, Montana. USA

Abstract: In the summer of 2000, approximately 356,000 acres burned in a mosiac across forests of the southern Bitterroot Valley. Three forest fire severities were common across the landscape: nonlethal understory, mixed lethal understory, and lethal overstory. Monitoring plots were established within the Douglas-fir habitat type series across all three fire severities one year post-fire and remeasured three years later. In addition, monitoring plots were also established on sites that had lethal overstory fire severities that were also salvaged logged within 7 months of the fire. First year recovery rates were signficantly different among fire severities with less difference notable after 3 years. Native plant species that had both resprouting and prolific seed production capacity were the most successful to occupy burned sites. Salvage logged sites did not show differences in plant recovery compared to similar fire severities that were not logged. The exotic noxious weed Centaurea maculosa tripled its cover and plot occupancy during the three year monitoring period.

Co-Authors: *Lawen Hollingsworth, Helena National Forest Fire Ecologist MT*

Presentation Title: Modeling resilience to slashburning across a sub-boreal to subalpine forest gradient

Presenter: *Evelyn Hamilton*
B.C. Ministry of Forests and Range,
Victoria, British Columbia, Canada

Abstract:

Stability refers to rate at which a system returns to an equilibrium state, whereas resilience refers to the amount of disturbance a system can absorb without shifting to an alternative stability domain. We
modelled differences in stability and resilience of coniferous forest plant communities following slash burning in central British Columbia, Canada across gradients of resource availability as indicated by site index (SI), fire return interval (FRI) and fire severity as indicated by depth of burn (DOB).Pre-and-post-burn fuel loads were recorded and the regrowth of vegetation was monitored for 5 to 11 years at twelve clearcut-and-slashburned sites. Stepwise regression was used to model the rate of revegetation, the increase in vascular species diversity, and pre- and post-burn similarity of species composition as a function of environmental variables. NMS ordination explained 91% of the variation in composition by plant functional group. Composition-free response variables (rates of vegetation and diversity increase) were strongly correlated with resource availability, whereas composition-based response variables were more strongly correlated with the fire return interval. Thus, if species composition is deemed unimportant, a mesic subalpine ecosystem with low SI (15 m at 50 yr) and long FRI (1000 yr) would be ranked as having lower stability than a mesic sub-boreal ecosystem with high SI (22 m at 50 yr) and short FRI (200 yr). Conversely, if taxonomic composition is deemed important, the mesic subalpine ecosystem would be ranked as much more stable than the mesic sub-boreal ecosystem. Predicted resilience was even more strongly dependent upon the choice of response variables. Based on revegetation rates, all ecosystems were predicted to have equal resilience, remaining within the same stability domain at burn depths < 10 cm.

Co-Authors: *Sybille Haeussler, University of British Columbia*

Presentation Title: Yosemite National Park’s Ackerson Fire: 10 Years Later

Presenter: *Jen Hooke*
Yosemite National Park Service, Yosemite, California, USA

Abstract: The Ackerson Fire was ignited by a pulse of lightning in August 1996. This fire burned 59,000 acres, the majority of which fell within Yosemite National Park. Prior to 1996, several fires had burned within this area with the concentration being near North Mountain and Lower Frog Creek. Lightning and Management Ignited fires had burned as recently as 1994 in the North Mountain area. Lower Frog Creek had seen fire in 1991 and Yosemite lit a large prescribed fire there in 1978. Pre-fire vegetation cover was dominated by lower montane forest types (ponderosa pine/mixed conifer, white fir/mixed conifer). Jeffrey pine occurred in the higher elevations along with red fir and lodgepole pine forests. The lower elevations were dominated by foothill pine, live oak, and chaparral woodlands. The large size of this fire is unprecedented in especially the lower elevation vegetation types, as they historically experienced fires of lower intensities and greater frequencies under a pre-suppression fire regime. The area affected by the Ackerson Fire within Yosemite has been allowed to recover largely unimpeded by management actions. In this 10-year postfire investigation, we examine the changes in vegetation and fuels that have occurred as a function of burn severity, fire history, and fire containment tactics. We also use field plots that were installed immediately after the burn to follow trends in vegetation and fuels over time. Lastly, we model future fire behavior and fire potential in this area and discuss management issues associated with allowing early succession to play out across the landscape.

Co-Authors: *Kent van Wagtendonk, USDI National Park Service*

Presentation Title: 150 years of vegetation change in the grasslands, shrublands, and woodlands of southwest Oregon.

Presenter: *Paul Hosten*
Bureau of Land Management
Medford, Oregon, USA

Abstract: There is a paucity of information about vegetation change in the grasslands, shrublands, and woodlands of southwest Oregon. Recent documents indicate that public and agency officials are aware of the effects of fire suppression on patterns of vegetation change and the accumulation of fuels. Multi-aged stands of oak, loss of pine, invasion by shade-tolerant conifer, and the loss of high elevation meadows indicate that vegetation was historically 'more open'. A collation of historic anecdotes, photos, General Land Office (GLO) surveys, and homestead patent applications indicate a diversity of historic vegetation conditions and patterns of vegetation change by ecological site (defined by soil, topography, and past management). The historic presence and persistence of chaparral, oak thickets, and open woodland/grassland on high clay/shallow soils regardless of lack of recent fire are a deviation from general assumptions about vegetation dynamics. While current stand structures indicate that invasion of historic woodland/savanna by younger tree cohorts are a common pattern of change, historic information indicates that stand-replacement fire occurred commonly in many non-conifer communities, and that a mixed fire-regime in resprouter dominated woodlands also results in the observation of mixed-age classes. Areas of naturally low fuels (rocky and/or high clay soils and ecotones between edaphic mediated grasslands and woody dominated sites) continue to harbor large oaks despite fire suppression. Increased density of chaparral in areas of past mechanical fuel reduction identify the role fire may play in reducing the effective shrub seedbank and expression of vegetation consequent to fire. Recognizing the varying roles of wildfire and ecological site in shaping vegetation may improve site-specific vegetation management objectives to facilitate natural vegetation dynamics, and aid the strategic location of treatments to better attain landscape objectives. Such a strategy may improve the mutual attainment of fuel-reduction and the conservation of grasslands, shrublands, and woodlands

Co-Authors: *Gene Hickman (retired, Natural Resource Conservation Service) Frank Lang (professor emeritus, Southern Oregon University)*

Presentation Title: Old-growth mixed conifer forests in northwestern Mexico, what can they tell us?

Presenter: *Scott Stephens*
University of California, Berkeley
Berkeley, California, USA

Abstract: Quantification of live forest structure, fuel lods, tree regeneration, and mortality in Jeffrey pine-mixed conifer forests in the Sierra San Pedro Martir (SSPM), Mexico, was done to assist in the development of restoration goals and to increase our understanding of old growth forests. Conifer forests in the SSPM have not experienced systematic fire suppression or harvesting making them unusual in western North America. Tree and soil data were collected from a systematic design of plots. High variability characterized all structural attributes measured in this forest. This high variation is probably the result of the relatively intact frequent surface fire regime and no history of harvesting in the sampled area. Cumulative tree mortality was 2.7 – 3.6%; the annual rate of tree mortality was 0.162% yr-1. Hierarchical cluster analysis determined that 33% of sampled plots included a relatively small number of large trees, 24% of plots had bi-modal diameter distributions, and 43% of plots had inverse-J diameter distributions. Separating these categories into seral stages is difficult since all plots included relatively large trees. Stand structure classes include old forest single-stratum, young multi-strata, and old-forest, spatially distinct multi-strata. The forests of the SSPM have a great deal of variation and California forests with similar species, soils, topography, and disturbance regimes would be expected to have similar variation prior to fire exclusion. Restoration of similar western United States forests should not use uniform restoration targets. Methods must be developed to incorporate more variation in stand-level prescriptions. Conservation of the forests in the SSPM is critical because it is one of the last landscape-scale, old-growth mixed conifer forest with a relatively intact frequent surface fire regime in western North America.

Presentation Title: Effects of moisture and fire on historic age structure patterns

Presenter: *Jose Iniguez*
USDA Forest Service
Flagstaff USA

Abstract: Natural experiments in southern Arizona forests show that tree cohorts occurred historically during periods of reduced fire frequency. Age structure, fire history and moisture patterns we compared in two sites within Rincon Peak and one site in the Santa Catalina Mountains of southern Arizona. Cohorts, or periods of greater than expected tree establishment, in the 1670s -1680s and 1770s-1780s coincide with periods of reduced fire activity in Rincon Peak- north (RP-n), but were not found in Rincon Peak-south (RP-s) site which continued to experience frequent fires during this time. Both RP-n and RP-s sites had at least one decadal cohort between the 1830s and 1850s which was a period lacking widespread fires through the study area. In the Catalina Rose Canyon (CRC) site, a large cohort that established between 1800 and 1869 was also related to a period of reduced fire frequency. In some decades cohorts coincided with regional favorable moisture conditions (based on Palmer Drought Severity Index) but this was not always the case. Instead, age cohorts consistently occurred during either fire-free or reduced fire frequency periods. These results show that although favorable moisture conditions are conducive for tree regeneration, reduced fire frequencies were historically the necessary component for age cohort development.

Co-Authors: *Tom Swetnam, Chris Baisan, Laboratory Of Tree-Ring Research, University of Arizona*

Presentation Title: The 1911 Project: Reconstruction of Forest Change in Yosemite National Park Using 20th Century Timber Inventory Data

Presenter: *Rick Everett*
University of California

Abstract: Changes within Sierra Nevada forests in response to forest management, fire suppression and other human activities over the last 125 years are still imperfectly understood and documented. Increases in stand density, changes in the numbers of large trees, and alterations in regeneration are being noted by managers and researchers alike. Quantification of prehistoric reference conditions of the forest and its fire regime is essential to development and implementation of realistic ecologically sound management goals for these forests. The intent of this study is to statistically re-sample a collection of 4 acre belt transects that were first documented in 1911 in areas within, and surrounding, Yosemite National Park, examining changes in the forest, and the relationship of fire history to these changes. This specific project strives to assess long-term fire history, changes in forest structure as a function of time-since-fire, and the impacts of fire suppression and timber harvesting on forest structure and composition within, and adjacent to, the environment of Yosemite National Park

Co-Authors: *Scott L. Stephens, University of California Berkeley,*
Robin Wills, USDI National Park Service
Jan van Wagtendonk, U.S. Geological Survey

Presentation Title: Long- and short-term tree growth responses to wildfire in unlogged ponderosa pine/Douglas-fir forests

Presenter: *Eric Keeling*
University of Montana,
Hamilton, USA

Abstract: There is justifiable concern over whether favorable conditions for tree growth in western forests can remain sustainable as stand densities increase due to fire exclusion. However, because fire may have both positive and negative effects on trees, the integrated effect of recurrent fire versus lack of fire on tree growth and vigor is not clear. The objective of this study was to measure tree growth responses in old-growth ponderosa pine trees exposed to different numbers of natural wildfires in the Selway-Bitterroot region of Idaho. Basal area increments computed from tree-rings were used to compare long- and short-term growth and stress responses between burned stands (3-4 20th century wildfires) and unburned stands (0-1 20th century wildfires) at four remote sites. Three out of four sites showed no significant long-term growth response to recurrent wildfire, while a fourth site showed a positive response. Short-term responses to individual fires were also predominantly neutral. These results suggest that 20th century fire exclusion has not inhibited growth or increased the stress of mature ponderosa pine trees in these forests, despite higher densities in unburned stands.

Co-Authors: *Anna Sala, Tom DeLuca, University of Montana*

Presentation Title: The role of crown fires in limiting the extent of oak-Ashe juniper woodlands in central Texas

Presenter: *Charlotte Reemts*
The Nature Conservancy,
Fort Hood, Texas, USA

Abstract: The pre-settlement distribution of Quercus spp.-Juniperus ashei (oak-Ashe juniper) woodland, a dominant vegetation type on the Edwards Plateau in central Texas, was likely controlled by fire: unlike most woody species in this area, J. ashei does not resprout after crown fires. While fire suppression has allowed J. ashei to expand into communities from which it was formerly absent, little is known about the role of crown fires in limiting J. ashei's distribution. In 1996, wildfires burned more than 2000 ha of oak-juniper woodland on the Fort Hood Military Reservation. Permanent transects (n=65) on three soils in severely burned areas were sampled annually from 1996 to 2002, and in 2005. In 2001 and 2005, 36 transects were sampled in unburned areas. Stem density and basal area changed significantly through the study period (repeated measures ANOVA, $p<0.001$). Sapling density increased almost monotonically, while shrub density increased for three years before leveling off. Tree stem density remained low until 2005 (2001: 20±36 stems/ha; 2005: 326±260 stems/ha). Response to the fires varied by species. Quercus buckleyi (Texas red oak), which resprouts after fire, recovered rapidly. In 2005, tree stem density was similar in all transects (burned: 460±346 stems/ha; unburned: 325±199 stems/ha), although basal area was still lower in burned areas (1.1±0.8 m2/ha vs. 3.7±3.6 m2/ha). In contrast, only 6 J. ashei saplings (and no trees) were found in burned transects in 2005, compared to 792±226 trees/ha (basal area: 12.4±4.4 m2/ha) in unburned areas. Clustering and NMS ordination (based on basal area) indicated that burned transects on the same soil types tended to have similar vegetation. In contrast, there was little relationship between unburned transects and soil type; all unburned areas were dominated by J. ashei. These results indicate that low-frequency crown fires likely determined the pre-historic extent of J. ashei and oak-juniper woodlands.

Co-Authors: *Laura Sanchez, Department of the Army, Sheila Jackson, The Nature Conservancy*

Presentation Title: Twenty year Response of Canyon Live Oak to Thinning and Prescribed Burning

Presenter: *Timothy Paysen*
USDA Forest Service
Pacific Southwest Research Station, USA

Abstract: Canyon live oak (Quercus chrysolepis), the most common live oak in California, has ecological homologues in all Mediterranean-type ecosystems. Information regarding canyon live oak short and long term responses to silvicultural treatments and natural disturbance is of interest to managers working in these ecosystems. This species has broad physiological amplitude and is capable of surviving in disturbance prone ecosystems where it often maintains tree dominance. Canyon Live Oak serves as a mid-elevation transitional ecotone to conifer forests. This species functions to stabilize slopes, serves as critical wildlife habitat, and is used for incidental wood products. Few studies have evaluated effects of prescribed fire and thinning on growth of thin-barked oaks such as canyon live oak. Our study was located in a stand of mature canyon live oak in the San Bernardino Mountains of southern California, USA. Using a randomized block design, two treatments 1) thin, and 2) thin and burn were applied to the north facing slope of a closed canopy canyon live oak forest. DBH (diameter at breast height) measurements were taken quarterly on sample trees from 1984 through 1990. Repeated measures analysis was used to test for the effects of treatment over time on basal area growth. Canyon live oak growth during the first few years after treatment was greatest in thin plots, and least in control plots. Thin and burn plots were intermediate in their response. Growth measurements after 20 years showed a recovery in the thin/burn plots that was not expected during initial monitoring activities. Self thinning in the control, and reduced competition in the thin/burn plots, showed increased basal growth. Overall stand integrity was retained in the thinned plots. These study results of thinning and fire response can serve as a blueprint to facilitate resource management and research on similar species throughout the world.

Co-Authors: *Marci G. Narog, USDA Forest Service*

TRACK 1

Wednesday, November 15, 2006

Tropical Ecosystems

10:30 – 11:00	***Tim Bradley*** ***USDI National Park Service***	Regional Strategies and Coordination for Fire Management in Central America
10:45 – 11:00	***Marco Millones*** ***Clark University***	Integrated fire risk modeling using MODIS data for the southern Yucatan Peninsula
11:00 –11:15	***Caroline Lehmann*** ***Charles Darwin University***	An analysis of the changes in overwood cover from 1964-2004 in a humid tropical savanna in Kakadu National Park, North Australia.
11:15 – 11:30	***Aaron Petty*** ***Charles Darwin University***	Grazing /Fire Interactions in the Tropical Savannas of Australia's Kakadu National Park: Results from a 100 Year Natural Experiment
11:30 – 11:45	***Laura Johnson*** ***University of Victoria***	Occurrence , cause and effect of fire in seasonsllydry evergreen forests, Thailand
11:45 – 12:00	***Girraj Amarnath*** ***French Institute of Pondicherry***	Regional level fire pattern analyses and vegetation dynamics in tropical ecosystems, Western Ghats (India)

Californian and Australian Aboriginal Burning Practices and Contemporary Fire Management: Restoration of Culturally Significant Habitats

Frank K. Lake
USDA Forest Services
Arcata, California, USA

13:30 – 14:30	***Aaron M. Petty*** ***Charles Darwin University***	Comparison of Indigenous Pyrogeography in Central California, U.S.A. and the Northern Territory, Australia: An Ethnoecological Primer
14:30– 15:00	***Don Hankins*** ***California State University***	Effects of Fire on Riparian Vegetation in Central California
15:30 – 16:00	***Frank K. Lake*** ***USDA Forest Service***	Flood Trumps Cultural Prescribed Fire: Disturbance Effects on Willow Community Structure, Composition, and Fuel Load
16:00 – 16:30	***Diana Immel*** ***University of California-Davis***	Traditional Burning Practices Applied to the Restoration of a Rare and Endangered Clover, Trifolium amoenum
16:30 – 17:00	***Heather Busam*** ***USDA Forest Service***	Characteristics and Implications of Traditional Native American Fire Management on the Orleans Ranger District, Six Rivers National Forest
17:00 – 17:30	***Presenters***	Panel - Questions and Answers

Session Title: Tropical Ecosystems

Presentation Title: Regional Strategies and Coordination for Fire Management in Central America

Presenter:

Tim Bradley
USDI National Park Service
Whiskeytown, California, USA

Abstract:

Within the past several years the perception of wildland fire as an issue of concern within Central America has increased greatly, most notably following the 1998 fire season in which more than 1 million acres burned in Central America just ahead of a devastating El Nino year. On a formal level, an international approach to fire management was recognized by the recent participation of the seven Central American countries (Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica and Panama) in the drafting of the San Jose Declaration on Pan-American Cooperation on Wildland Fire Management 23 October 2004. While this declaration presents a number of recommendations for strengthening international fire management cooperation in the future, a number of ongoing activities have already been occurring within the region involving a range of different agencies and groups. Of those groups, the Central American Commission on the Environment and Development (CCAD) has played a primary role in the development and coordination of fire management efforts. Among the recent efforts of the fire management working group of the CCAD is a multi-year (2005-2015) strategy for the management of fire within the region. This strategy builds upon the ongoing efforts of different groups among which are the United States Agency for International Development (USAID) and the United States Department of the Interior International Technical Assistance Program (DOI-ITAP). This paper includes a summary of the CCAD's multi-year strategic plan, including a presentation of recent wildland fire statistics for each of the countries, discussion of fire impacts and causes, an outline of the organizational fire management structure within each country, and details on the DOI-ITAP efforts and future needs within the region.

Presentation Title: Integrated Fire Risk Modeling Using Modis Data For the Southern Yucatan Peninsula

Presenter:

Marco Millones
Clark University
Worcester, Massachusetts, USA

Abstract:

Fire is increasingly becoming a dominant agent of landscape change in the biodiversity-rich Southern Yucatan Peninsula subtropical forests, Mexico. This increase is thought to be promoted by fire-dependent swidden cultivation, and the rapid diffusion of invasive bracken fern (Pteridium aquilinum (L.) Kuhn,). Together these two processes appear to be responsible for the spread of a fire-friendly conditions composed of open agricultural lands, successional forest growth and an increasingly fragmented old-growth forest. This paper uses coarse spatial resolution remotely sensed and environmental data to produce fire risk maps for the Yucatan Peninsula. The method exploits the statistical relationships between fire events, and a series of proxy indicators of fire fuel type and condition; environmental configuration; and human disturbance sources. The goal is to find the best indicator (or combination of indicators) to estimate and predict the spatial distribution of fire events in the study area. Fire event locations are based on the MODIS 8-day, 1 km active fire summary product for a five year period (2000-2005). Proxy indicators of fire fuel include: the distribution of bracken fern, as well as a series of spectral products derived from multi-seasonal MODIS imagery (e.g., Dead-to-Live Fuel Ratio, degree-of-deciduousness). Logistic Regression and Classification Trees were used to predict fire-risk locations over time and space. The performance of the two methods was compared and validated using 30 m resolution Landsat ETM+ imagery and a portion of the fire location data not included in the model calibration. Advantages and disadvantages of the two methods are reported. A final discussion evaluates the extent to which the model results meet the theoretical and empirical (on site) expectations about the factors responsible for fire-driven landscape change.

Co – Author:

John Rogan , Clark University - Laura Schneider, Rutgers University - Billie Lee Turner II, Clark University

Presentation Title: An analysis of the changes in overwood cover from 1964-2004 in a humid tropical savanna in Kakadu National Park, North Australia.

Presenter: *Caroline Lehmann*
Charles Darwin University
Darwin, Australia

Abstract: Kakadu National Park (20,000km2) situated in northern Australia is a World Heritage Area; over 60% of this park is mesic savanna and currently has a fire return interval of one in two years and how this is affecting the biota is uncertain and contested. We used a detailed forty year aerial photographic history with three time slices of 1964, 1984 and 2004 to describe and analyse changes in overwood cover at 50 locations across the region. We used multi-model inference techniques and Akaikes Information Criterion to test the importance and interactions of the 300mm rainfall gradient, soil heterogeneity, fire activity and feral herbivory in determining the extent and direction of change of overwood cover. It was found that over the 40 year period, areas inland were more stable in overwood cover, while closer to the coast there was much greater variability in overwood cover associated with greater and more variable fire activity: for example 12% of the deviance in overwood cover could be attributed to a five year fire history. In total, 41% of the variation in overwood cover change could be explained by the model representing the gradient of rainfall, soil type and five-year fire history. A synergism of site productivity and consequent fire activity is believed to be responsible for this. This work significantly contributes to the understanding of the complex dynamics of mesic savannas and provides management in Kakadu National Park with greater ecological depth to develop sustainable fire management strategies.

Co – Author: *David M. J. S. Bowman, Lynda Prior, Charles Darwin University*

Presentation Title: Grazing/fire interactions in the tropical savannas of Australia's Kakadu National Park: Results from a 100 year natural experiment

Presenter: *Aaron Petty*
Charles Darwin University Darwin, Australia

Abstract: The tropical savannas of Kakadu National Park (KNP), a world heritage park located in northern Australia, were invaded in the late-1800s by Asian water buffalo (Bubalus bubalis), a novel large herbivore that subsequently expanded to carrying capacity and was rapidly removed one-hundred years after its introduction by a state-sponsored eradication campaign. As the first large grazer in northern Australia since the mid-Pleistocene, buffalo had a profound effect on fuel loads and fire regimes through three mechanisms: i)_Directly through selective herbivory of grasses. ii)_Indirectly by altering competitive relationships between trees, grass and herbaceous plants. iii)_Altering fuel loads and fire regimes which in turn affected species composition and stand structure. We present evidence that the presence and removal of buffalo in KNP altered ecological process in two ways. The first major change in upland savannas occurred through a cascade of effects during the exponential increase in buffalo numbers from 1960-1982. The second change occurred with the institution of a non-historical fire regime in response to post-buffalo vegetation release. The introduction and then rapid removal of buffalo was an unprecedented landscape-scale "natural experiment" on herbivore-fire interactions. It also emphasizes the importance of historical context when managing dynamic ecosystems. Through an analysis of historical records, published scientific studies, the aerial photographic record and experimental work we present some implications of this natural experiment for tropical fire ecology.

Co – Author: *P. A. Werner, Charles Darwin University and Australian National University.*
J. E. Riley, C. E. R. Lehmann, L. P. Elliott, D. S. Banfai, Charles Darwin University.

Presentation Title: Occurrence, cause and effect of fire in seasonally dry evergreen forests, Thailand

Presenter: *Laura Johnson*
University of Victoria
Victoria, British Columbia. Canada

Abstract: In recent years landscape-scale fires have occurred in mainland Southeast Asia, including important protected areas (PAs). There has been increasing concern that landscape-scale fires are degrading the seasonally dry evergreen forest (SEF) element of the forest mosaic to more open deciduous forest and savanna, with serious implications for biodiversity conservation. Research was undertaken to investigate the occurrence, cause, and effect fire in SEF. SEF has the greatest species biodiversity in the forest mosaic and is potentially the most affected by fire, yet little research has been done on fire in SEF in mainland Southeast Asia. Huai Kha Khaeng (HKK) Wildlife Sanctuary in Thailand was selected as the study area. The objectives included: 1) investigate the area of SEF burned in HKK from 1988 to 2002; 2) investigate the conditions for fire in SEF; 3) determine whether the area of SEF in HKK declined as a result of fire. Methods included: development of a Landsat fire history with associated interviews and reconnaissance field checks; fieldwork lighting test fires and measuring fuel characteristics; remote sensing change detection work using Landsat imagery. Results showed: 1. Extensive areas of SEF have burned, but that Landsat imagery was not suitable for detecting fire in intact SEF. 2. SEF burned in years when there were fires burning adjacent to SEF in mid March and the moisture content of the SEF leaf litter fuel was less than 15%. 3. Fifteen percent of SEF in HKK has been either degraded or converted to deciduous forest forms in 12 years. Implications are that large-scale fires have adversely affected intact SEF in HKK. Whereas the extent of burning in intact SEF is not known, the need to manage the situation is immediate.

Presentation Title: Regional level fire pattern analyses and vegetation dynamics in tropical ecosystems, Western Ghats (India)

Presenter: *Girraj Amarnath*
French Institute of Pondicherry
Pondicherry , India

Abstract: Fire is one of the most widespread and ancient ecological factors affecting many terrestrial ecosystems from tropical to temperate through fragmentation and loss of biodiversity. Fire not only brings loss of biological richness, but has far reaching effect on health, economy and global climate and could be considered as one of the man-made disasters. In India, out of 67.5 million ha of forests, about 55% of the forest cover is being subjected to fires each year. Majority of these forests burning are surface fires, deliberately linked to human activities and has close relationship to their socio-economic conditions. The objective of the study is to understand the fire pattern and frequency in relation to vegetation, bioclimate, topography and anthropogenic pressures in the Western Ghats. The global datasets from MODIS (2000 – 2005) on a multi-temporal basis are related with spatial drivers using GIS to elucidate fire patterns. Active fire detection using MODIS was found to be higher in the northern Western Ghats compare to the southern Western Ghats which might be due to change in phenology and physiognomic condition of the vegetation. It was observed most of the fires are occurred in deciduous, savannah woodlands and reed brakes. It is interesting to note that not only the length of dry season but wind and undulating terrain are the other inducing factors that enhance severity of the forest fires. Proximity analysis have shown that buffer of 250-500m in the fringes areas of the habitation are prone to more fire, it might be due to dependency of people for fuel wood, NTFP and cattle grazing. Multicriteria decision analysis was used to identify sensitive areas of forest fire in integrating all the drivers for the management of forest fire in protected and non-protected areas to address the conservation of tropical ecosystems.

Co-Authors: *P.V. Karunakaran, French Institute of Pondicherry - B.R.Ramesh, French Institute of Pondicherry, - Pierre Couteron, French Institute of Pondicherry - M.S.R.Murthy, National Remote Sensing Agency, Balanagar*

Session Title: **Californian and Australian Aboriginal Burning Practices and Contemporary Fire Management: Restoration of Culturally Significant Habitats**

Session Organizer: *Frank K. Lake*
USDA Forest Service
Arcata, California, USA

Presentation Title: Comparison Indigenous Pyrogeography in Central California, USA and the Northern Territory, Australia: An Ethnoecological Primer

Presenter: *Aaron Petty*
Charles Darwin University
Darwin, Australia

Abstract: Abstract missing Despite being isolated by the vastness of the Pacific Ocean, central California in the United States and the northernmost tip of the Northern Territory of Australia frequently referred to as the "Top End" share a lot in common. Both areas support diverse indigenous cultures with a long-tenured relationship with the natural world (at least tens of thousands of years of recorded occupancy). The indigenous people's presence in these areas has created landscapes that are a product of their cultural practices, particularly millennia of anthropogenic fire regimes. The climates of both central California and the Top End have comparatively high amounts of annual precipitation in consideration of their respective climate types. Biodiversity in both areas is quite high, and equally unique. Lastly, immigrants from primarily European nations have more recently settled both areas, and the settlers have had profound repercussions on the respective indigenous cultures and practices, particularly with respect to land management with fire. This paper presentation will discuss the cultural implications and applications of fire by comparing indigenous fire-use practices of California Indians and Aboriginal Australians with an emphasis on central California and the "Top-End" respectively.

Co-Authors: *Don L. Hankins, California State University*

Presentation Title: Effects of Fire on Riparian Vegetation in Central California

Presenter: *Don Hankins*
California State University
Chico, California, USA

Abstract: The role of fire in riparian ecosystems is poorly documented. However, it is known that Native Americans have used fire in riparian ecosystems for millennia in order to manage riparian resources. The effects of such indigenous management practices on wildlife are important to understand when considering the restoration of fire as a process in riparian ecosystems. The objectives of this research are to study the effects of indigenous prescribed fire on herpetofauna and small mammals utilizing riparian ecosystems in central California, and facilitate an understanding of how indigenous land management practices might benefit contemporary resource management and conservation practices. The results suggest that fall burning had an insignificant effect on trap captures and the number of species captured. However, when outlier trap captures are removed, species richness is higher in burned areas in comparison to control areas. Thus, fall burning may be a useful tool in managing and conserving herpetofauna and small mammal biodiversity.

Presentation Title: Flood trumps cultural prescribed fire: Disturbance effects on willow community structure, composition and fuel load

Presenter: *Frank Lake*
USDA Forest Service
Arcata, California, USA

Abstract: Originally, this study was to examine fire's role in rejuvenating stands of willow after many years without flooding disturbance. Ironically, after the prescribed fire was implemented, flooding complicated analysis of the evidence of fire's effects on willows. Flooding historically scoured and redistributed willows, causing regrowth that the Native American basket weavers relied upon for basket material. My original hypothesis was that in the time periods between flooding disturbance, Native American basketweavers burnt willows to induce resprouting and rejuvenation for useable shoots. In the absence of flooding of sufficient magnitude, burning has been used between major flooding events. Cultural risk management always involved the uncertainty of when the next flood of sufficient magnitude would occur versus when to the conditions would allow for an effective burn. Objectives to burn the willows were to reduce pest infestations and stimulate willow resprouting. Historically, if a flood occurred the winter following a fall burn, the disturbance created similar environmental effects. In the case of my prescribe fire research, flooding compounded the ability to discern fire effects for the study. Preliminary findings demonstrate that prescribe fire effects are now affected by the recent flooding activity. The photo point data and surveys along transects show the condition of the willow patch for the two years (2004 and 2005) of pre-fire vegetation composition, structure and cover, and the pre and post-fire fuel load. Prior to the December 31, 2005 flooding, the anticipated effects of prescribe fire would have been to top kill older, taller willows and other shrubs, removing dead material, duff and litter. Post-fire and post-flood conditions at the sites reveal less willow mortality than anticipated, with recruitment of sandy soil and flood (organic) debris affecting the sites more than fire. Post-fire vegetation surveys will be completed in June 2006.

Presentation Title: Traditional burning practices applied to the restoration of a rare and endangered clover, Trifolium amoenum

Presenter: *Diana Immel*
University of California,
Davis, California, USA

Abstract: Currently, there is only one known population of showy Indian clover (Trifolium amoenum Greene; Fabaceae), a native annual clover endemic to coastal grasslands in several counties surrounding San Francisco Bay. Factors thought to have contributed to the near loss of the plant are habitat conversion, livestock grazing, and competition from introduced species. However, native clovers were an important food resource for tribal people in the area, and were traditionally managed for quantity and quality by small-scale burning. I experimentally planted T. amoenum seeds at two sites in Sonoma County, California to quantify the effects of burning on germination and survival. Plants in burned plots grew faster and survived longer than plants in nonburned plots. However, both sites experienced high seedling mortality due to herbivory by the European grey field slug, Deroceras reticulatum. The introduction of D. reticulatum into California in 1891 and its subsequent expansion into suitable habitat for T. amoenum may have been the final blow to remnant populations already pushed into marginal areas. This research illustrates that, even in the face of novel threats, traditional management practices may prove valuable in restoring threatened native flora, especially in areas that historically sustained high levels of indigenous resource management activity.

Presentation Title: Characteristics and Implications of Traditional Native American Fire Management on the Orleans Ranger District, Six Rivers National Forest

Presenter: *Heather Busam*
USDA Forest Service
Anchorage, Alaska, USA

Abstract: The role of traditional Native American fire management in the formation of American landscapes is debated. Ecologists either negate human influence on large-scale vegetation patterns or argue for total manipulation of the ecosystem. Using an evolutionary ecology framework that examines human behavior in an ecological context, this paper argues that resource management behaviors among the Hupa, Karuk, and Yurok in Northern California influenced the development of contemporary landscapes.

Ethnographic references describing traditional burning and historic Forest Service fire records with approximate ignition locations were used to compare ignition patterns with described ethnographic burning. The analysis found that traditional Native American burning practices between 1910 and 1939 created patterns of fine-grained vegetation within three miles of the Klamath River, and created coarse-grained vegetation patterns outside the three mile radius of the Klamath River.

TRACK 2

Wednesday, November 15, 2006

Professional and Community Cooperation Created after the 2003 Wildfires in San Diego

Anne Fege
San Diego Natural History Museum
San Diego, California, USA

10:30 – 10:45	***Jane Fortier*** ***University of California***	San Diego Fire Stories: Remembering our Relationship to Fire
10:45 – 11.00	***Valerie Nash*** ***Disaster Relief Fund***	Fire Disaster Relief Fund
11:00 – 10:15	***Nancy Owens Renner*** ***San Diego Natural History Museum***	Earth, Wind & Wildfire Exhibition
11:15 – 11:30	***Geoffrey Smith*** ***Escondido Creek Conservancy***	Volunteers on Public Lands
11:30 – 12:00	***Anne Fege*** ***San Diego Natural History Museum***	Discussion and Questions on Panel on Community Cooperation
13.30 – 13:45	***Bruce Goff*** ***AMEC***	San Diego Fire Recovery Network
13:45 – 14:00	***Marty Leavitt*** ***Fire Safe Councils of Greater San Diego***	Fire San Diego Fire Recovery Network Safe Councils in San Diego
14:00 – 14:15	***Drew Potocki*** ***City of San Diego***	San Diego Urban Ecosystem Analysis After the Cedar Fire
14:15 - 14:30	***Thomas Porter*** ***California Department of Forestry and Fire Protection***	Fuels Management and the Progression of the 2003 Cedar Fire
14:30 - 14:45	***Pamela Padgett*** ***USDA Forest Service***	The Southern California Chaparral Fire Project: Providing Tools for Decision Makers
14:45 – 15:00	***Anne Fege*** ***San Diego Natural History Museum***	Panel Discussion and Questions

Professional and Community Cooperation Created after the 2003 Wildfires in San Diego

Anne Fege
Natural History Museum
San Diego, California, USA

15:30 – 16:00	***Julian Duval*** ***Quail Botanical Garden***	Between Wildfires" (DVD), Public Education Messages about Wildfire Risk Reduction
16:00 – 16:15	***Anne S. Fege*** ***San Diego Natural History Museum***	Lessons from Workshops with Many Professionals across Southern California
16:15 – 16:30	***Drew Hubbell*** ***Hubbell and Hubbell Architects***	Fire Resistive House Design and Construction
16:30 – 16:45	***Stephen Quarles*** ***University of California-Berkeley***	Performance of California Structures during Southern California Wildfires of 2003
16:45 – 17:00	***Ron Montague*** ***FireWise2000***	Multi-scale Community Planning for Fire Protection and Watershed Values
17:00 – 17:15	***Ann Fege*** ***San Diego Natural History Museum***	Panel Discussion and Questions

Session Title: Professional and Community Cooperation Created after the 2003 Wildfires in San Diego

Session Organizer: *Anne Fege*
San Diego Natural History Museum
San Diego, California, USA

Presentation Title: Professional and Community Cooperation Created After the October 2003 Wildfires in San Diego

Presenter: *Jana Fortier*
University of San Diego
San Diego, California, USA

Abstract:

A local anthropologist created the San Diego Fire Stories Project and collaborated with a local historian to record the October 2003 wildfire experiences of more than twenty-five individuals: Native Americans, biologists, land managers, fire fighters, artists, and property owners. Interviews are archived at the San Diego Historical Society, and were supported by the California Council for the Humanities, the San Diego Commission for Arts & Culture, the San Diego Historical Society, and the San Diego Foundation Blasker Environment Fund. Some of these stories are woven into a 17-minute videotape, "Fire Stories," that plays continuously in the Earth, Wind & WILDFIRE exhibition at the San Diego Natural History Museum. These narratives reveal varied perspectives on human interrelationships with fire while confirming the value of everyone's stories. And everyone has a story: where they were during the October 2003 fires: the loss of homes; evacuations; whether favorite natural places burned; and evidence of nature's recovery in burned areas. The 17-minute videotape will be shown.

Presentation Title: Fire Disaster Relief Fund

Presenter:

Valerie Nash
Disaster Relief Fund
San Diego, California, USA
Mariano Diaz
Community Partnerships San Diego Foundation
San Diego, California, USA

Abstract:

The San Diego Foundation activated the San Diego Regional Disaster Fund on Sunday, October 26, the first day of the disaster, to receive donations for making emergency grants to nonprofit service organizations engaged in disaster relief and restoration. The After-the-Fire Fund is an initiative of the San Diego Regional Disaster Fund, an affiliate of The San Diego Foundation, which was fortuitously established in 2003 to prepare for regional crises. The After-the-Fire Fund distributed \$3.5 million: \$1.6 million in donations from businesses and the public, \$200,000 from donors affiliated with the San Diego Foundation, and \$1.5 million from a donor-advised fund opened by the Alex Spanos Family and the San Diego Chargers. The Foundation also established the Fire Victims Scholarship Fund, with \$190,000 to address the educational needs of high school students whose plans for post-secondary education were disrupted by the fires. As the air cleared, it became apparent that effective grant-making would require a swift and sure organizational effort. "Field teams" composed of staff and volunteers from The San Diego Regional Disaster Fund Board of Directors traveled to affected communities, spending several days observing conditions and activities and conducting interviews, then writing a needs assessment that would aim funds at fire-ravaged targets quickly and effectively. Eighty-one grants were awarded to support public health information and services, emergency animal rescue, emergency communications systems, fire department supplies and equipment, legal counsel, public wildfire education, plant and animal recovery monitoring, natural lands restoration, volunteer support, and more. Many others assisted communities and individuals in the years following the fires, with an estimated \$30 million donated by non-profit organizations and community group.

Presentation Title: Earth, Wind & WILDFIRE Exhibition

Presenter:

Nancy Owens Renner and Anne Fege
San Diego Natural History Museum
San Diego, California, USA

Abstract:

In the midst of the intense shared experience of all San Diego residents in October 2003, the San Diego Natural History Museum saw a tremendous opportunity for learning, collaboration, and community building. With assistance from scientists, artists, anthropologists, educators and volunteers, interactive exhibition was created to focus on these driving questions: How can nature, fire, and people coexist in southern California? Why should they coexist? The exhibition opened a week before the one-year anniversary of the October 2003 wildfires, and was awarded Best Exhibition of 2004 by the Western Museum Association. The first gallery "Our Place on Earth" establishes a sense of place with chaparral-green walls, huge photographs, and diaromas depicting the beauty and diversity of the region. Children can create a story about nature and fire with puppets and costumes in the interactive children's theater, and learn about San Diego County through transparent map overlays. The second gallery "The Power of Fire" features a wall-sized video projection of raging wildfire; a Geographic Information Systems-based animation from San Diego State University that shows the rapid progression of the October 2003 wildfires and is often viewed for 3-4 cycles by visitors as they identify their community and where they were during the six days. Our relationships with fire are physically represented by fire-fighting equipment; a burned landscape of trees, stumps, rocks, and melted metal; and a sculpture created from colored glass melted in the fires. The third gallery "Living with Fire and Nature" shows new life pushing through fire-blackened earth, with photographs and taxidermy specimens illustrating plant and animal adaptations to fire. Visitors can build a fire-wise house on a three-dimensional topographic table--choosing a location, miniature house components made from various materials, and landscaping elements--then rate it for fire safety using the concepts articulated in the interpretive panels.

Presentation Title: Factors Influencing Volunteer Public Lands Stewardship After the 2003 Wildfires in San Diego County

Presenter: *Geoffrey Smith*
USDA Forest Service

Abstract: In October 2003, a series of three wind-driven wildfires scorched thousands of acres of San Diego County backcountry. The fires moved quickly, fueled by drought-weakened vegetation and high 'Santa Ana' winds, nearly overwhelming the ability of firefighters who could only watch as hundreds of homes and acres of habitat were transformed by nature's fury. The resulting public response overwhelmed public resources agencies with offers to help heal the damaged public lands. The agencies found themselves ill-equipped to manage the volume of citizen response. This presentation describes the experience of the USDA Forest Service, Cleveland National Forest and the San Diego Fire Recovery Network (SDFRN) as the two organizations stepped up to the challenge of accommodating this new influx of "public lands stewards." Employing the part-time services of a university graduate student to build a volunteer program where none previously existed, the successes and failures over the 1-1/2 year term of the program provide valuable material for learning. Lessons learned from practical experience include such topics as: Public-private partnerships; Local versus Regional approaches to volunteer coordination; Research-based studies of motivational factors for public lands service among college students; Agency willingness to embrace changes in the social structure of volunteerism; Push-down bureaucratic approaches to problem solving versus grass-roots consensus building; Risk and liability considerations; Program funding mechanisms; Coordination and outreach strategies; and the elusive "tipping point" in public and agency perceptions of public lands stewardship.

Presentation Title: San Diego Fire Recovery Network

Presenter: *Bruce Goff,*
AMEC
Anne Fege,
Natural History Museum
San Diego, California, USA

Abstract: The San Diego Fire Recovery Network is an open network with representation from more than 100 scientific and community organizations, and public agencies working together to foster the recovery of our human and natural environment through sound science, public education, land and community restoration. On October 30, 2003, in the aftermath of San Diego's wildfires, 70 professionals gathered together at the San Diego Natural History Museum to share their reactions to the wildfires and begin working together, initially on public education about erosion control measures, data acquisition and retention, web portal for long-term data retrieval, volunteer projects, and web-page establishment. Since then, more than 500 professionals attended one or more workshops and field trips sponsored by the San Diego Fire Recovery Network (SDFRN) on such topics as Watershed, Fire, Flood, and Post-Wildfire Recovery; Reducing Fire Risk Within 100' of the Home; Fire Ecology and Silviculture of Forested Ecosystems in San Diego; and Fire Ecology of Chaparral and Coastal Sage Scrub. More than 30 scientists participated in the Research and Monitoring Committee, and they worked with the interagency Burned Area Emergency Response (BAER) team after the fires; posted data on a San Diego State University webpage; developed priorities for research monitoring projects; authored a 35-page report, A Summary of Affected Flora and Fauna in the San Diego County Fires of 2003; and received funds to conduct immediate monitoring of wildfire effects, five-year bird and mammal recovery, and tree mortality and forest recovery of Cuyamaca Rancho State Park. Many provided public education programs with funding from the San Diego Foundation, assisted the San Diego Natural History Museum with the Earth, Wind & WILDFIRE exhibition, gave public lectures associated with that exhibition, and developed workshops to educate the business sector about protecting homes and communities from wildfires.

Co-Author: *Bruce Goff, AMEC, Inc., and Anne Fege, San Diego Natural History Museum*

Presentation Title: FireSafe Councils in San Diego

Presenter: ***Marty Leavitt***
FireSafe Councils of Greater San Diego
San Diego, California, USA

Abstract:

The mission of the San Diego County Fire Safe Council is to provide education, exchange information and foster fire prevention and fire safety within the County of San Diego by helping communities to identify local leaders and form community-based fire safe councils. The California Fire Safe Council's mission is to preserve and enhance California's manmade and natural resources by providing leadership and support that mobilizes all Californians to protect their homes, communities and environment from wildfires. As people are enticed by secluded settings and beautiful vistas, California's population has soared in the last 40 years. Suburbanization has pushed communities into the wildland-urban interface, blurring the boundaries between cities and nature. What many may not consider when moving to the backcountry is that when we choose to live with nature, we must learn to live with fire. California's wildland ecosystems are fire dependent; they need fire to survive. Fire is a fact in California. Local councils, or community fire safe councils, are led by volunteers who are dedicated to saving lives and reducing fire losses by making their communities fire safe through locally-led projects. Towns, regional areas and counties all have formed Fire Safe Councils. Fire Safe Council can Mobilize people in the community who stand to lose something of value to fire; Create a powerful group initiative; Save lives, property and money lost from wildfire. To 2006, over 50 local councils in San Diego County have made their communities safer, better places to live, by: creating defensible space around homes, businesses and evacuation corridors by reducing flammable vegetation near homes, structures and roads, installing visible signage, creating accurate mapping, creating fuel breaks around communities; creating Community Wildfire Protection Plans and Community Protection/Evacuation Plans for their communities; and providing an opportunity for community awareness and participation.

Presentation Title: San Diego Urban Ecosystem Analysis After the Cedar Fire

Presenter: ***Drew Potocki***
City of San Diego
San Diego, California, USA

Abstract:

An Urban Ecosystem Analysis was completed by American Forest analysts, for the city of San Diego in July of 2003 and a digital green data layer was provided to the city. The green data layer provides San Diego with a quantitative measure of the green infrastructure, which is a significant city asset that was not previously documented as part of the city infrastructure. A GIS software tool called CITYgreen and training were also provided. The Cedar Fire affected 28,466 acres of land within the San Diego city limits, about 13% of the entire city area. This project updated the green data layer for the entire city in 2005, with special focus on the vegetation loss as a result of the fall 2003 Cedar Fire. High-resolution satellite images collected after the fire were classified into Level 1 land covers which identify trees, shrubs, open space and impervious surfaces.

Comparing pre- and post- fire conditions in the Cedar Fire area, American Forests reported a loss of 49% tree canopy and 73% each of chaparral and shrub. For this analysis, chaparral was distinguished from other vegetation cover using a shape file of chaparral cover provided by local agencies. This loss in vegetation resulted in estimated decreased ecosystem services, including increased stormwater runoff of 12,674,490 cubic feet. The value of retaining this additional stormwater, replacing what the trees did for free, is estimated at $25,349,000. The ability of the Cedar Fire's canopy to remove air pollutants decreased by 314,870 lbs per year, a loss in value estimated at $798,000 annually. This project is supported by the California Department of Forestry and Fire Protection and the San Diego Water Department.

Presentation Title: Fuels Management and the Progression of the 2003 Cedar Fire

Presenter: ***Thomas Porter***
California Department of Forestry and Fire Protection

Abstract: Fire behavior and firefighting tactics were altered due to two large fuel management projects that were completed in the years prior to the Cedar Fire. During the first night and second morning of the Cedar Fire, the right flank of the fire ran in to the Tullock Vegetation Management Prescription, a prescribed burn that saved ranch and house structures and possibly lives. In the final days of the Cedar Fire, the path of the fire was shifted along the Tragedy Springs Burn, saving significant property losses in the communities of Pine Valley and Mount Laguna. This burn was conducted by the Cleveland National Forest, California State Parks, and the California Department of Forestry and Fire Protection, in the three years prior to the Cedar Fire.

Presentation Title: The Southern California Chaparral Fires Project: Providing Tools for Decision Maker

Presenter: ***Pamela Padgett***
USDA Forest Service

Abstract: After the 2003 wildfires in southern California, the USDA Forest Service Pacific Southwest Research Station, (Riverside Fire Lab) undertook a project to strengthen links between science and management decisions, for fire ecology and wildland-urban interface dynamics in chaparral ecosystems. Four working groups were established with cooperators: Scientific Expertise Unit, University of California at Berkeley; People and Ecosystem Interface Unit, San Diego Natural History Museum; Policy and Planning Unit, Blakely Center for Sustainable Suburban Development at the University of California at Riverside; and Traditional Stakeholders Unit, USDA Forest Service. Each group conducted workshops and field trips in 2005 and presented their findings at the Project Summit on January 10-12, 2006 in Riverside, CA. The program for the Summit was centered on presenting “tools for decision makers,” and each of the three days featured presentations and discussions focused on a theme: “Before the fire,” “During the fire,” and “After the fire.” Out of these discussions, five “do-able tasks” were identified, to provide decision support for firefighters, planners, building departments and enforcement, land managers and homeowners: (1) Shelter in place/Stay or go – developing guidelines for new and existing communities; (2) Vegetation management – the question is not whether it will work, but is it worth it? ; (3) Engage county and city planners – fire protection begins before the first site is leveled; (4) Improve fire modeling for chaparral WUI, as ember attack is the primary source of ignition, and wildland/urban boundaries are not in the current models; and (5) Web-based information center – on demand access to research data, management actions and expertise.

Co-Authors: ***Pamela Padgett, USDA Forest Service; Anne Fege, San Diego Natural History Museum; Max Moritz, and Andy McCue, and Rick Burnham, University of California, Berkeley***

Presentation Title: "Between Wildfires" (DVD), Public Education Messages about Wildfire Risk Reduction

Presenter: ***Julian Duval***
Quail Botanical Garden
Encinitas, California, USA

Abstract: Quail Botanical Gardens in San Diego County produced a 30-minute magazine-style video entitled "Between Wildfires" that incorporates wildfire loss reduction, wildfire preparedness, and living with nature and fire. Featured speakers/personalities include garden director Julian Duval, ecologist Rick Halsey, wildlife spokesperson Joan Embery, biologist Anne Fege, marketing specialist Muriel McElhinney, architect Drew Hubbell, landscaper Greg Rubin, and horticulturalist Dave Ehrlinger. The video airs on the county television network and has been featured in numerous local articles, along with the "Landscape for Fire Safety Garden" at Quail Botanical Gardens in Encinitas, California.

Presentation Title: Lessons from Workshops with Many Professionals across Southern California

Presenter: ***Anne S. Fege***
San Diego Natural History Museum
San Diego, California, USA

Abstract: After the 2003 wildfires in southern California, a project was undertaken to provide a stronger link between science and management decisions for fire ecology and wildland-urban interface dynamics in chaparral ecosystems. The USDA Forest Service Pacific Southwest Research Station's Riverside Fire Lab Riverside Fire Lab established four working groups, representing scientific expertise, the people-ecosystem interface, policy and planning, and traditional stakeholders such as state and federal land management agencies. Each group conducted workshops and field trips in 2005 and presented findings in January 2006 in a summit conference with about 150 participants. present their findings in a final summit conference in January 2006. Cooperators are the University of California at Berkeley and the Center for Sustainable Subdivision Development, University of California at Riverside. As part of this overall project, the San Diego Natural History Museum and the San Diego Fire Recovery Network conducted three workshops in June, 2005 to assess the knowledge about wildfire risk reduction in chaparral-urban interface settings, and the information still needed to reduce these risks. The 164 participants were professionals across southern California who make decisions about and advise homeowners and landowners. Small-group discussions focused on homes and housesites, habitats and watersheds, and planning and policies. After each discussion, feedback forms were completed and then later transcribed and subjected to textual analysis. Research social scientists interpreted and tabulated results to find emergent themes and shared ideas. Many professionals called repeatedly for multi-agency cooperation; more dialogue with regulatory agencies; and moving away from strict regulation toward shared decisions and collaboration. They articulated that education is not the same as understanding, especially about 100 feet vegetation reduction, and encouraged discounts, incentives, other "inducements" to participation or behavior change.

Co-Authors: ***Jim Absher, Pam Padgett, USDA Forest Service***

Presentation Title: Fire Resistive House Design and Construction

Presenter: ***Drew Hubbell***
Hubbell and Hubbell Architects
San Diego, California, USA

Abstract: Since the wildfires touched our lives in 2003, a considerable amount of new information has become known about what building features are more fire-susceptible, and what actions can be taken to safeguard structures. New information will be presented about fire-resistive building practices, incorporating examples of alternative building materials that are often more environmentally-sustainable and less fire-prone than conventional construction methods. Fire-resistive design and construction were incorporated into reconstruction of the home of architect and artist James Hubbell in Julian, as well as other San Diego-area residences and public buildings that burned in October 2003. Hubbell & Hubbell Architects specializes in ecological, nature-inspired designs.

Presentation Title: Performance of California Structures during Southern California Wildfires of 2003

Presenter: ***Stephen Quarles***
University of California
Richmond, California, USA

Abstract: Post-fire surveys conducted after the Southern California wildfires of 2003, coupled with recent research evaluating the performance of common construction materials, has resulted in a better understanding of the vulnerable components of structures. The 2003 wildfires reinforced the importance of embers in structure ignition, and the vulnerability of vents to ember entry and subsequent ignition and structure loss. The objective of this talk will be to review findings of post-fire surveys, and summarize actions that have taken place to improve the performance of new construction and existing structures. The Office of the California State Fire Marshal commissioned a comprehensive review of specific fire performance data collected after the major wildfires in Southern California in 2003conducted by Fire Cause Analysis 1 of Point Richmond, California. Site-specific data, gathered in the after-action analysis of these fires, included detailed evaluations of thousands of structures whose post-fire condition ranged from undamaged to total losses. Another data set consisted of general, historical and peer reviewed technical information from the past 50 years; and a third data set included results of fire safety engineering and research activities, primarily conducted by the University of California Forest Products Laboratory. Review of these three data sets led to the conclusion that enhancing the survivability and reducing the vulnerability of homes constructed in urban-wildland interface areas is both feasible and cost effective in California. Specific, reasonable solutions exist to the problem of building vulnerability to ignition of specific construction elements, including window glazing, doors, venting, wall constructions, roof assemblies and appurtenances such as combustible decks and patios. There is great potential for further development of both performance-based design issues and cost-benefit implications. Adoption and application of the proposed standards should be part of a broader mitigation strategy that includes enhanced planning activities prior to development, evolution of fuel management techniques, local initiatives regarding defensible space, and assurance to insurance carriers that buildings constructed in urban-wildland interface areas are cited and properly maintained.

Presentation Title: Multi-scale Community Planning for Fire Protection and Watershed Values

Presenter: *Ron Montague*
FireWise2000
Murietta, California, USA

Abstract: The threat of catastrophic wildland fire in many communities is magnified by the continued population growth that has led to urban expansion or sprawl and to rapid rates of development in our rural and urban interface landscapes. As prime developable locations are consumed, increasing demand pushes new development into more constrained or hazardous locations. As our remaining watersheds, ecosystems and wildlife habitats diminish, political pressure to set aside high value watersheds, open space, wildland and habitat areas increases. Fire agencies have proven to be internationally recognized first responders to natural and man-made disasters, however there is a diminishing rate of return additional resources. Many preparedness and incident damage assessments have demonstrated that proactive mitigation and planning save lives, property, resources and minimized impact on the local community values. We must recognize the roles of land use planning, community design and watershed management and seek opportunities to integrate strategic fire management solutions. Community-based planning has gained momentum in its role of sharing environmental and land stewardship and local governance through cooperative efforts with federal and state land management agencies. New geospatial, computer and web-based technology such as GIS, fire behavior modeling, real-time predictive climate/weather assessments, and other resources greatly enhance the capacity of data sharing and information exchange and provide greater visualization and clarity of land management and planning issues facing communities. We must change the paradigm of fire protection planning from a linear approach of targeting the hazards to a dynamic, multi-scale and comprehensive approach. It is critical to our communities' public safety that we enlighten communities of the complexity of these issues, engage the greatest diversity of expertise, empower these community-based collaborations, elicit new solutions, and to embed these solutions strategically into all forms of development planning, community design, watershed management and landscape or forest management.

TRACK 3

Wednesday, November 15, 2006

Advances in Fire Climatology: Using Modern and Paleofire Data to Understand Long-Term and Broad-Scale Fire Regime Changes in Western North America

Tom Swetnam
Laboratory of Tree-Ring Research
University of Arizona
Tucson, Arizona, USA

R. Scott Anderson
Northern Arizona University

10:30 – 10:45	***Patrick Bartlein*** ***University of Oregon***	Temporal and Spatial Structure in the Climatic Controls of Wildfire in the Western United States
10:45 – 11:00	***Anthony Westerling*** ***Scripps Institute of Oceanographiy***	Applied Dendrochronology for Fire Management in the Western United States
11:00 –11:15	***Timothy Brown*** ***Desert Research Institute***	Using fire climatology in fire management
11:15 – 11:30	***Cathy Whitlock*** ***Montana State University***	Long-term relationships between fire, fuel and climate in the northwestern U.S.
11:30 – 11:45	***R. Scott Anderson*** ***Northern Arizona University***	Holocene Vegetation and Forest Regimes in Subalpine and Mixed Conifer Forests
11:45 – 12:00	***Jennifer L. Pierce*** ***Boise State University***	Late Holocene Records of Fire in Alluvial Fan Sediments: Fire Climate relationships and Implications for Management of Rocky Mountain Forests
13:30 – 13:45	***Grant A. Meyer*** ***University of Mexico***	The Holocone Aluvial sedimentary record New Mexico of Fire in the Sacramento Mountains, New Mexico: Prelimenary Findings
13:45 – 14:00	***Craig Allen*** ***US Geological Survey***	Paired Charcoal and Tree-Ring Records of High-Frequency Fire from Two New Mexico Bog Sites
14:00 – 14:15	***Thomas T. Veblen*** ***University of Colorado***	Fire-Climate Relationships from Lower Montane to Upper Subalpine Forests in the Colorado Rocky Mountains
14:15 – 14:30	***Peter M. Brown*** ***Rocky Mountain Tree-Ring Lab***	Fire climatology across local to regional gradients: Separating top-down and bottom-up forcings
14:30 – 14:45	***Amy Hessl*** ***West Virginia University***	Climate Drivers of Fire in the Pacific Northwest
14:45 – 15:00	***Alan H. Taylor*** ***Pennsylvania State University***	Annual and Decadal Climatic Influences on Fire Regimes in Mid-Mondane Forests in the Southern Cascades

Session Title — Advances in Fire Climatology: Using Modern and Paleofire Data to Understand Long-Term and Broad-Scale Fire Regime Changes in the Western North America

Session Organizer:
Tom Swetnam
Laboratory of Tree-Ring Research
The University of Arizona
Tucson , Arizona, USA

Abstract:
The recent availability of long time series of fire occurrence and extent in broad spatial networks has greatly facilitated fire climatology investigations. These data sets include documentary records from the 20th century to present, and "proxy" time series from tree-rings and charcoal sediments extending to past centuries and millennia. Further impetus to fire climatology advances include new understanding of ocean-atmosphere patterns and teleconnections to terrestrial climates (e.g., ENSO and PDO), and increasing evidence of climate warming and drought trends in the Western US and elsewhere. This special session will bring together paleo and modern climatologists and fire ecologists to present the latest findings on fire climatology in western North America. These talks parallel a set of papers in preparation and review for a special issue on Fire Climatology to be published in the International Journal of Wildland Fire in 2007.

Co-Organizer:
R. Scott Anderson, Northern Arizona University

Presentation Title: Temporal and Spatial Structure in the Climatic Controls of Wildfire in the Western United States

Presenter:
Patrick Bartlein
University of Oregon Department of Geography, Eugene, Oregon, USA

Abstract:
The climatic controls of the temporal and spatial structure of 332,404 daily fire-start records from the western United States for the period 1986 through 1996 are illustrated using visualizations of the fire-start data and observations and simulations of climatological and meteorological controls. Several complimentary visualization techniques are used to reduce the spatial dimensionality of the fire start data in order to reveal the underlying space-time structure. These visualization show that the distributions of lightning- and human-started fires during the 11-year interval have similar first-order patterns that reflect the broad-scale distribution of vegetation across the West, and the seasonal cycle of soil-moisture deficits and sensible heating. Interannual variations in the overall number and size of fires are related to variations in precipitation (as represented by the standardized precipitation index, SPI) and the synoptic-scale patterns of upper-level atmospheric circulation, mid-tropospheric moisture flux, and vertical motions. Within a given year, lightning-started fires are concentrated in the summer half-year, and occur in widespread outbreaks few days in duration that reflect coherent weather-related controls, while fires started by humans occur over a longer interval during the year, and tend to be concentrated in regions surrounding large-population or intensive-agricultural centers. The lightning started fires are well-correlated with episodes of atmospheric instability that are favored by weak upper-level troughs and mid-tropospheric moisture convergence. Although the primary controls of human-started fires are location and the consequent level of human activity, spatially coherent, weather-related variations in their incidence can also be noted as gaps in fire occurrence during several day-long spells of abundant precipitation.

Co-Author:
S.W. Hostetler, U.S. Geological Survey, and Oregon State University

Presentation Title: Applied Dendrochronology for Fire Management in the Western United States

Presenter: *Anthony Westerling*
Scripps Institution of Oceanography
La Jolla, California, USA

Abstract: Documentary histories of forest wildfire in the western United States are limited in most places to the 20th Century, and comprehensive forest wildfire histories only begin around 1970. Integrating these records with fire scar histories on a regional scale is possible, using wildfire reconstructions based on statistical relationships between dendrochronological reconstructions of climate and documentary forest wildfire histories. Westerling and Swetnam (2003) demonstrated a methodology for reconstructing annual wildfire extent by state in the western US for 1700 – 1978 using a western dendrochonolgy-based drought reconstruction, and validated the results for the Southwestern United States against an extensive network of fire-scar histories. Building on this work, we introduce a statistical reconstruction of western U.S. wildfire using a comprehensive new high-resolution documentary wildfire history for western North America and updated drought reconstructions from Cook et al that extend our wildfire reconstructions to approximately 1500 years b.p. In this presentation, we will demonstrate applications for western U.S. fire management planning, constructing conditional probability distributions for wildfire risk and placing recent annual to decadal variability in wildfire risks in a long-term context. Using the International Multiproxy Paleofire Database we will compare our reconstruction to a regional fire scar network.

Presentation Title: Using fire climatology in fire management

Presenter: *Timothy Brown*
Desert Research Institute
Reno, Nevada, USA

Abstract: Climate and fire are intricately linked. Variable dry and wet periods drive vegetation conditions and subsequent management responses in suppression and fuel treatments. El Nino, drought, climate variability and climate change are example phenomena impacting fire business. In the past few years, research studies have begun to examine and assess fire climate relationships, and quantify the links. But only recently has climate information been used as a decision support tool for fire management. For example, historical and predicted climate is used to produce seasonal outlooks of national fire potential. Climate change is discussed in the quadrennial fire and fuels report as a potential impact on fire management. However, there still remain significant gaps in integrating climatology concepts and information into fire policy. This paper provides a synthesis of the current understanding of fire and climate relationships, and discusses how climate information is currently used and how it might be used in fire management.

Co-Author: *Gregg Garfin, University of Arizona, Tom Wordell, USDA Forest Service,*
Roger Pulwarty, NOAA-CIRES Climate Diagnostics Center

Presentation Title: Long-term relationships between fire, climate, and fuels in the northwestern U.SA

Presenter: *Cathy Whitlock*
Montana State University
Bozeman, Montana, USA

Abstract: A network of paleoecological records in the northwestern U.S. provides an opportunity to examine the linkages among fire, climate, and vegetation change on multiple temporal and spatial scales. The reconstructions are based on high-resolution charcoal and pollen data obtained from radiocarbon-dated lake-sediment records. Calibration of the records is provided by information on charcoal deposition following recent fires and the age of historical fires provided by dendrochronological studies. In general, charcoal levels were low in the late-glacial period and increased steadily through the last 11,000 years, suggesting that both climate and vegetation (i.e., fuel conditions) influence charcoal abundance. Regional differences are apparent in the long-term fire frequency data: the Coast Range has been characterized by relatively few fires, the Klamath Mountains has experienced frequent fires, and fire regimes in the northern Rocky Mountains have been strongly governed by millennial and centennial climate variability and elevation. Variations in long-term fire activity are attributed to large-scale changes in the climate system during the Holocene. A stronger-than-present Pacific subtropical high-pressure system in the early Holocene promoted drier summers and increased fire frequencies between 11,000 and 5000 cal yr BP in the Pacific Northwest. Concurrently, strengthened monsoons in the early Holocene increased effective moisture in summer-wet regions of the northern Rockies and resulted in lower-than-present fire activity there. Heightened fire activity occurred at many sites ca. 1000 years ago during the Medieval Climate Anomaly. The association between periods of drought, increased fire occurrence, and available fuels is observed on several time scales in the paleoecological record and suggests that long-term fire history patterns should be considered in current assessments of historical fire regimes and fuel conditions.

Co-Author: *Patrick Bartlein, University of Oregon, -*
Christy Briles, University of Oregon -
Andrea Brunelle, University of Utah -
Colin Long, University of Wisconsin -
Jennifer Marlon, University of Oregon

Presentation Title: Holocene Vegetation and Forest Fire Regimes in Subalpine and Mixed Conifer Forests

Presenter: *R. Scott Anderson*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Our elevational transect of sites includes locations at the alpine – treeline boundary, within the Picea engelmannii – Abies lasiocarpa forest, the mixed conifer forest, and the Quercus – Pinus woodland. Two records – one each from subalpine and mixed conifer forests – illustrate vegetation change over the last ca. 15,000 years. At Hunter's Lake (subalpine site) an open Picea forest with Artemisia grew around the pond until ca. 12,000 cal BP. Pinus pollen increased briefly during the period of the Younger Dryas. Vegetation around the pond during the Holocene was a Picea engelmannii – Abies lasiocarpa forest, with little variation in composition. At Chihuahueños Bog (mixed conifer site) an open Picea forest grew around a small pond until ca. 11,500 cal BP when Pinus ponderosa became established. This shallow pond lasted until ca. 9,000 cal BP. From ca. 8,600 to 6,200 cal BP the pond dessicated in what must have been the driest period of the Holocene there. Wetter conditions returned after 6,200 years ago, with conversion of the site to a sedge bog. Little change in the overstory species occurred throughout the Holocene, with mixed conifer forest dominating throughout. Our high-resolution fire history records are determined from fine interval sediment sampling and charcoal particle analysis. For most sites, especially those in and near the Picea – Abies forest, extreme "peakedness" is apparent in the charcoal records, each peak corresponding to stand-replacing fires within the watershed. Fire event frequency calculations are ca. 150 – 200 years between fires. Two upper treeline sites have the lowest deposition rates of charcoal, which may be due to their open nature and significant portions of the drainage basin above treeline that contributes less charcoal to the record when burned. Lower elevation mixed conifer sites show significantly higher charcoal concentrations throughout the Holocene (one to two orders of magnitude) than at the Picea – Abies sites. "Peakedness" is less prominent in the charcoal records from the mixed conifer sites, where surface fires may have been more common, although the stand-replacing regime becomes more pronounced in the late Holocene. Periods of highest fire event frequency occur from ca. 1,000 to 2,000 and ca. 9,000 to 12,000 calendar years ago. The most significant changes in the fire record occur within sediments deposited in the late 19th and early 20th centuries, when charcoal is essentially absent. There is no analog to this phenomenon in the earlier record. This period corresponds to initiation of widespread cattle and sheep grazing in the region, and the initiation of a fire suppression period characteristic of most locations in the western United States. Major shifts in the pollen record occur contemporaneously with these important environmental changes, including an increase in Quercus at many sites within the mixed conifer forest and Quercus – Pinus woodland.

Co-Author: *C.D. Allen, U.S. Geological Survey -*
J.L. Toney, R.B. Jass, A. N.Bair, Northern Arizona University,

Presentation Title: Late Holocene Records of Fire in Alluvial Fan Sediments: Fire-Climate Relationships and Implications for Management of Rocky Mountain Forests

Presenter: ***Jennifer Pierce***
Boise State University Geosciences Dept.
Boise, Idaho, USA

Abstract: While fire-scar records from tree-rings and charcoal records in lake sediments provide more familiar sources of paleofire proxy data, highly informative, millennial-scale records of fire are also preserved in alluvial fans, which are common in mountainous areas. Fire-related sediments and burned soil surfaces in fan stratigraphy record fires and geomorphic response. Fire-related deposition on fans is contingent on postfire storms, but regional fire history can be constructed by combining records from many fans, analogous to compiling data from many fire-scarred trees. We used alluvial-fan sediments to examine changes in fire regimes over the last 8,000 years in Yellowstone National Park high-elevation mixed-conifer forests and in more xeric central Idaho ponderosa pine forests. In Idaho, frequent small fire-related erosional events occurred during cool episodes, e.g., within the Little Ice Age (LIA) 350-500 cal yr BP, when greater effective moisture likely promoted grass growth and low-severity fires. This record is consistent with tree-ring records of frequent fires in ponderosa forests before European settlement. In Yellowstone mixed-conifer sites, cool LIA conditions limited fire activity altogether. Conversely, both Idaho and Yellowstone fan records show a peak in fire-related debris flows between ~1000-800 cal yr BP, corresponding with severe multidecadal droughts ~1050-650 cal yr BP (Cook et al. 2004). In Idaho, large fire-related debris flows ~1000-800 cal yr BP represent over 25% of total dated fan sediments. During this time, large, severe fires occurred from low-elevation rangeland sites, through mid-elevation ponderosa pine-dominated sites, to high-elevation mixed-conifer forests. Stand-replacing fires were clearly within the natural range of variability in fire regimes in Idaho ponderosa pine forests during past droughts. Recent stand-replacing fires in ponderosa pine forests are likely related to both changes in management and increasing temperatures and drought severity during the 20th century. Given predicted future warming, severe fires in ponderosa forests are increasingly probable.

Co-Author: ***Dr. Grant A. Meyer University of New Mexico***

Presentation Title: The Holocene alluvial sedimentary record of fire in the Sacramento Mountains, New Mexico: Preliminary findings

Presenter: *Grant A. Meyer*
University of Mexico
Albuquerque, New Mexico, USA

Abstract: In conifer forests of the southwestern U.S., tree-ring data provide detailed fire histories for the last ca. 500 yr, but the scarcity of perennial lakes limits opportunities to reconstruct longer fire records from lake-sediment charcoal, especially at lower elevations. Because mixed- to high-severity fires promote storm runoff and slope erosion, charcoal-based fire histories can also be derived from alluvial deposits that receive postfire sediments. We are developing alluvial-stratigraphic records of fire and erosion in the Sacramento Mountains of southern New Mexico, where forest types range from low-elevation pinyon-juniper through ponderosa-pine and mixed-conifer to spruce-fir stands near the range crest. Initial radiocarbon ages show that a fire history of at least 9000 yr is preserved in alluvial fans and valley fills. Although tree-ring data show that stand-replacing fires were rare from 1550 AD until severe burns of the last few decades (Brown et al. 2001), fire-related debris-flow deposits indicate that high-severity burns were part of fire regimes over longer timescales, including within ponderosa-dominated basins, and as recently as about 150-250 years ago. Collaborative tree-ring studies in young debris-flow basins may improve understanding of the timing and causes of such events. A major pulse of fire-induced sedimentation in Caballero Canyon 1050-1450 AD implies that widespread multidecadal droughts in Medieval time (Cook et al. 2004) caused severe fires in the diverse forests of this watershed. Large Gambel oak brushfields in this and other steep basins of the western Sacramento escarpment suggest origin and maintenance by stand-replacing fires. We are testing this hypothesis by analysis of charcoal fragments to identify woody taxa burned in past fires. Overall, preliminary results suggest the possibility that in addition to Euro-American fire suppression and land use, Holocene climate change (likely including 20th century warming) has had a strong influence on fire regimes in this "sky island" mountain range.

Co-Author: *Jennifer New and Jedediah Frechette,*
University of New Mexico

Presentation Title: Paired charcoal and tree-ring records of high-frequency Holocene fire from two New Mexico bog sites

Presenter: *Craig D. Allen*
US Geological Survey
Los Alamos, New Mexico, USA

Abstract: We developed long-term records of fire activity from paired and replicated charcoal and tree-ring proxies of fire at two bog sites in the Jemez Mountains, northern New Mexico. Chihuahueños Bog occupies an upland basin amidst mixed conifer forest. Alamo Bog is situated along a valley bottom, surrounded by mixed conifer and ponderosa pine forests. Both locations have high-resolution charcoal records covering most to all of the Holocene, with replication of charcoal concentrations determined in the top meter of a second core at each site. In the ~ 14,000 calendar year Chihuahueños Bog record, background and peak charcoal concentrations increase markedly in the early Holocene, ranging from 100's to >15,000 particles/cc until ca. AD 1890, when concentrations decline to zero in the top of both cores. Cross-dated fire scars from 13 trees in the forest adjoining the bog confirm frequent spreading fires until AD 1902, with ten spreading fires recorded between AD 1617 – 1902. The ~ 8,700 calendar year Alamo Bog record also shows very high concentrations of charcoal throughout the Holocene, except from the topmost portions of the cores, since ca. AD 1900, where charcoal is essentially absent. Cross-dated fire scars from 52 sampled trees in the adjoining upslope forests record fires back to AD 1422, and confirm the cessation of widespread fires since the late 1800s. Pre-1900 fire frequencies in this watershed varied by forest type and landscape position, with higher-frequency spreading fires in ponderosa pine settings (4-27 year return intervals, mean ~11 years from 1696-1879), versus 9-45 year intervals in mixed conifer stands. The historic cessation of fire since ~AD 1900 seen in these charcoal and tree-ring records at both bog sites is consistent with many other tree-ring fire histories from the Southwest as a whole. Temporal changes in fire regimes are related to climate and land use histories.

Co-Author: *R.Scott Anderson, Renata B. Jass, Jamie L. Toney, Chris H. Baisan,*
University of Arizona, Laboratory of Tree-Ring Research

Presentation Title: Fire-climate relationships from lower montane to upper subalpine forests in the Colorado Rocky Mountains

Presenter: *Thomas Veblen*
University of Colarado
Boulder, Colorado, USA

Abstract: Regional patterns of variability in climate and wildfires in western North America have been strongly linked statistically to variations in the El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the Atlantic Multidecadal Oscillation (AMO) based on both modern instrumental records and tree-ring proxy records of climate. In the current study, we examine how fire occurrence from low elevation (below 2200 m), through mid-montane (c. 2200 to 2800), to subalpine forests (above 2800 m) in central and northern Colorado has varied in relationship to variation in regional climate as well as ENSO, PDO, and AMO. Fire spread in xeric ponderosa pine forests near the Plains grasslands appears to be limited by lack of fine (mainly grass) fuels in many years, and consequently there is a strong association of fire occurrence with above average antecedent moisture conditions that favor the growth of fine fuels. Alternation of wet and dry conditions at a quasi-annual time scale are highly conducive to fire occurrence in the low elevation ponderosa pine forests. At increasing elevations within the ponderosa pine zone and in the subalpine zone of lodgepole pine and spruce-fir forests, this association of widespread fire years with above average antecedent moisture availability weakens and then disappears. The most severe droughts tend to synchronize fire years across the study region but fire occurrence also varies according to forest type and sub-region. Years of greatest regional fire extent across Colorado in upper montane and subalpine forests are strongly associated with the phase combination of cool ENSO (La Niña conditions), negative PDO (cool), and positive AMO (warm). At a c. 60-year temporal scale the warm AMO phase plays a controlling role in the occurrence of regionally extensive fire years.

Co-Author: *Rosemary L. Sherriff, University of Hawaii at Hilo- Jason S. Sibold, Universidad Austral de Chile - Tania Schoennagel, University of Colorado - Dominik Kulakowski, University of Colorado*

Presentation Title: Fire Climatology across local to regional gradients: separating top-down and bottom-up forcings

Presenter: *Peter M. Brown*
Rocky Mountain Tree-Ring Research
Ft. Collins, Colorado, USA

Abstract: Annual area burned in the western US has trended upward over the last few decades. A major question confronting managers in dealing with this trend is how much of this increase is the result of changes in fuel and vegetation conditions due to past management practices (primarily fire suppression and timber harvest) and how much may be the result of changing regional and global climate regimes that are affecting warmer and drier fire seasons. Fire atlas data only cover the last few decades and are both too short to answer this question and biased by fire management actions. Broad-scale, centuries-long networks of tree-ring based fire and forest histories have proven critical to distinguish fire occurrences that are affected by top-down, regional climatic variations from bottom-up factors such as local fuel complexes or climate regimes that vary across gradients in elevation and vegetation types. In this talk, we describe a recently completed network of crossdated fire-scar and tree-recruitment chronologies from 13+ watersheds in Utah and eastern Nevada. Chronologies were developed from pinyon-juniper, ponderosa pine, mixed-conifer, aspen, and subalpine forests. We graphically and statistically compare synchrony and asynchrony in fire occurrences across multiple scales - including within and between forest types, watersheds, and those that were synchronous across the entire region - with independently derived climate reconstructions - including Palmer drought severity and global circulation indices, such as the El NiZo-Southern Oscillation, Pacific Decadal Oscillation, and Atlantic Multidecadal Oscillation - to derive inferences about the relative contribution of local and regional effects on past fire occurrence. Results allow parsing of variance in fire occurrences by forest type, elevation, and year, and provide both a longer-term perspective in which to place the recent increase in area burned as well as implications for future fire and forest management.

Co-Author: *Emily K. Heyerdahl - Stanley Kitchen , M. Weber - USDA Forest Service*

Presentation Title: Climate Drivers of Fire in the Pacific Northwest

Presenter: ***Amy Hessl***
West Virginia University
Morgantown, West Virginia, USA

Abstract: Our objective was to identify the climate drivers of historical surface fires (1651-1900) in the interior Pacific Northwest using existing annually accurate fire-scar chronologies from 15 sites spanning 7 degrees of latitude in Oregon, Washington and British Columbia. Most of the sites were dominated by ponderosa pine and Douglas-fir, although the northernmost was dominated by Douglas-fir and lodgepole pine. We explored the influence of regional climate (PDSI and temperature) and interacting large-scale climate patterns that affect the modern climate of the region (ENSO and PDO). Climate was strongly related to widespread synchrony in historical surface fires among our sites. Years of widespread synchronous fires (35 years with fire at 6 to 11 sites) had significantly warm springs and warm/dry summers whereas synchronous years with no fire (18 years with no fire at any site) had significantly cool springs and cool/wet summers. Spring climate was likely driving the length of the fire season whereas summer climate influenced fuel moisture during the fire season. Climate in prior years was not a significant driver of regionally synchronous fire years, consistent with the assumption that fuels are generally sufficient for fire ignition and spread in these forests. But despite being strong drivers of modern spring climate in the region, indices of ENSO and PDO did not differ significantly during years of regionally synchronous fire or no-fire years, either individually or in combination. However, during the 18 no-fire years, reconstructed sea-surface temperatures were anomalously low in the eastern Pacific, similar to composite characteristics associated with cold phases of ENSO and PDO. Thus, annually varying regional climate was the primary driver of past surface fire in the PNW whereas large-scale climate patterns that vary at lower frequency were only weak drivers, in part because they are not the sole drivers of spring climate in the region.

Co-Authors: ***Emily K. Heyerdahl, USDA Forest Service Lori D. Daniels, University of British Columbia, Jeremy S. Littel, University of Washington, Nathan Mantua, NOAA/University of Washington, Donald McKenzie, USDA Forest Service***

Presentation Title: Annual and Decadal Climate Influences on Fire Regimes in Mid-Montane Forests in the Southern Cascades

Presenter: *Alan H. Taylor*
The Pennsylvania State University
University Park, USA

Abstract: Fire regimes in the western United States are locally controlled by topographical and vegetation conditions, but fire event synchronicity across a range of spatial scales reflects the influence of regional climatic variation. The interaction between fire, climatic variation and the hemispheric-scale mechanisms driving climatic variation is complex and understanding past interactions is crucial to effective wildfire management planning. This study examines the temporal variability in regional-scale fire-climate interactions in mid-montane conifer forests in the Southern Cascade Range in northern California. Pre-settlement (1700-1900) records of fire frequency and extent were developed for seven sites based on fire scar dendrochronology. Individual site records were aggregated to emphasize the regional scale of the studied fire-climate interactions and the fire record was related to proxy climatic records at interannual to interdecadal time-scales. Large fire years were drought-induced both on a site-scale and on a regional scale, but the relationship between fire and drought conditions was stronger on a regional scale. Global circulation patterns (El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO)) modulated fire occurrence and extent on an interdecadal rather than interannual time-scale. Widespread fires coincided with ENSO and PDO positive phases, a pattern similar to the fire-climate interactions found for the Pacific Northwest. Interannual and interdecadal fire-climate relationships showed temporal variability on a centennial scale. The sensitivity of fire regimes to climate variability in the Southern Cascade Range suggests a regulating effect of climate on mid-montane conifer forest ecosystem dynamics before EuroAmerican settlement. An understanding of pre-settlement fire-climate interactions can provide insights in the response of contemporary fire regimes to future climate change and can serve as a basis for effective ecosystem management.

Co – Authors: *Trouet V., The Pennsylvania State University - Skinner, C.N., USDA Forest Service - Beaty, M.B., CSIRO Sustainable Ecosystems, Bekker, M., Department of Geography, Brigham Young University, Norman, S., USDA Forest Service*

TRACK 4

Wednesday, November 15, 2006

Liability, Threatened and Endangered Species, Clean Water, and Cultural Resources: Issues and Challenges

Jim Brenner
Florida Division of Forestry

13:30 – 13:45	***Tom Buman*** ***AGREN***	Liability Issues for Wildland Fire Managers
13:45 – 14:00	***Jeff Stephens*** ***California Division of Forestry and Fire Protection***	Regulation and Liability Risk: Influences on the Practice and Price Tag of Prescribed Fire
14:00 – 14:15	***Stephen Bakken,*** ***California Department of Parks***	Liability of Not Burning in California (Maintaining a Dangerous Condition)
14:15 - 14:30	***Panel***	Questions and Answers - Liability Issues
14:30 – 14:45	***Therese O'Rourke*** ***USDI Fish and Wildlife Service***	The Endangered Species Act and Fire Management
14:45 – 15:00	***Chris Knopp*** ***USDA Forest Service***	Are Fire Prevention Measures Helping or Hurting T&E Wildlife?
15:30 –15:45	***Laila Lienesoh*** ***USDA Forest Service***	Retardant -- Legal Issues Related to its Effect
15:45 - 16:00	***Panel***	Questions and Answers - Threatend and Endangered Species Act
16:00 – 16:15	***Sherry Hazelhurst*** ***USDA Forest Service***	Overview of the Intersection of the Federal Clean Water Legislation and Wildland Fire Management
16:15 – 16:30	***John Greis*** ***USDA Forest Service***	The Clean Water Act and Wildland Fire Management in the South
16:30 – 16:45	***Bruce Sims*** ***USDA Forest Service***	The Clean Water Act and Wildland Fire Management in the Western US
16:45 - 17:00	***Panel***	Questions and Answers - Clean Water Issues
17:00 –17:15	***Gary Knudsen*** ***USDA Forest Service***	Overview of the National Historic Preservation Act and Related Legislation and their Relation to Wildland Fire Management
17:15 – 17:30	***Julie A. Bell*** ***USDI National Park Service***	Fire and Water: Effects of Wildfire and Erosion on the Archaeological Sites of Mesa Verde National Park
17:30 – 17:45	***Kathy Foppes*** ***USDI National Park Service***	CRM and Fire: Strategies for Cultural Resources Management and Fire
17:45 - 18:00	***Panel***	Questions and Answers - Cultural Resources

Session Title: Air Quality and Wildland Fire: Issues and Challenges

Session Organizer: *Jim Brenner*
Department of Agriculture
Tallahassee, Florida, USA

Abstract: Air Quality Environmental Regulation and Wildland Fire topics are examined and discussed. The purpose of this special session is to identify where regulatory requirements are in conflict with the goals and objectives of land management agencies in their quest to more appropriately manage fuels across the landscape. Once identified, possible solutions are suggested to work with the Environmental Regulatory Community to mitigate these concerns.

Presentation Title: Liability Issues for Wildland Fire Managers

Presenter: *Tom Buman*
Agren, Inc.
Carroll, IA, USA

Abstract: The insurance industry has been reluctant to enter into the prescribed fire liability insurance market because of the high degree of uncertainty. Insurance companies perceive that prescribed fire is risky, and therefore the cost of insurance is prohibitive. This insurance limitation reduces a private contractor’s willingness to burn. In 2002, the Iowa Bureau of Forestry and Agren, Inc., initiated a two-phase process to gather the information necessary to develop an insurance policy for private contractors and non-government organizations (NGOs) that use prescribed fire. During Phase I, Agren built the foundation and collected the actuarial data (frequency and severity) necessary for constructing an insurance policy. Private contractors and NGOs in eight states (Oregon, Texas, Florida, Oklahoma, Missouri, Iowa, Wisconsin and Minnesota) were asked to complete an eight-page survey about their prescribed fire practices and frequency of escapes. The written surveys were followed by telephone surveys to obtain the severity of losses from the reported escaped prescribed fires. This actuarial data can be used by insurance companies to rate a prescribed fire insurance policy. Phase II of the project involves writing a sample policy and providing marketing and education services to advance the development and implementation of the policy. Although the project does not commit insurance companies to provide insurance for prescribed fire, it does provide the necessary actuarial data to help insurance companies make an informed decision. If insurance does become more available for private contractors and NGOs, it should be incorporated into a national strategy to reduce the threat of wildland fires and restore the health of forest ecosystems. Agren, Inc. has completed Phase I of this process and will complete Phase II by mid-summer of 2006. Upon completion, Agren will provide the actuarial data and information to insurance companies and to private contractors who wish to obtain prescribed fire liability insurance.

Co-Author: *Paul D. Mitchel, University of Wisconsin-Madison*

Presentation Title: Regulation and Liability Risk: Influences on the Practice and Price Tag of Prescribed Fire

Presenter: *Jeff Stephens*
Vegetation Management Program Manager
Department of Forestry and Fire Protection
Sacramento, California, USA

Abstract: The California Department of Forestry and Fire Protection (CDF) conducts prescribed fire operations on private lands that are within State responsibility areas for fire protection. The Vegetation Management Program (VMP), is the program for accomplishing prescribed fire projects, and is conducted within one of the most stringent regulatory environments among states that conduct prescribed burning operations. Prescribed burning projects carried out with State assistance qualify as a project subject to analysis under the California Environmental Quality Act (CEQA). CEQA requires that projects are implemented in a manner that does not result in significant adverse environmental impacts. The process of project approval under CEQA includes consultation with responsible agencies such as the Department of Fish and Game, US Fish and Wildlife Service, Archeology Information Centers, and local Air Quality Management Districts and Regional Water Control Boards. Consultation with these entities includes fees that often increase the cost of burn projects. Liability for VMP is born by CDF via a contract with private landowners. The State agrees to hold harmless and indemnify private landowners that cooperate with the State for completion of prescribed fire projects. In addition to the hold harmless clause within the VMP contract there are State laws and regulations that govern liability, which will be discussed in detail within this report.

Presentation Title: The Liability and Environmental Consequences of Not Burning [Maintaining a Dangerous Condition]

Presenter: *Stephen Bakken*
Forester, California Department of Parks and Recreation

Abstract: In California, the obstacles to prescription burning have been increasing incrementally. Fear of litigation, a multitude of environmental concerns, and a media enhanced public perception of the risk of burning seem to be the stumbling blocks. Concurrently, there has been a marked increase in mechanical fuels reduction. This also has environmental stumbling blocks and is expensive, but the fear of litigation is rarely a concern. Given the difficulty to conduct prescription burns and a limited budget to conduct mechanical fuel reduction, what does the wildland manager risk by doing neither? This presentation examines the details of a tort litigation by a private property owner against the agency that manages a small wildland park following a wildland fire.

Presentation Title: The Endangered Species Act and Fire Management

Presenter: *Therese O'Rourke*
USDI Fish and Wildlife Service

Abstract: The Endangered Species Act protects species identified as endangered or threatened with extinction and strives to protect the habitat on which it depends. There are several tools used by the administering agencies, the Fish and Wildlife Service and NOAA – Fisheries, to implement the Act – including the listing of a species, designation of critical habitat, permits given through habitat conservation plans, and consultations on projects where there is a federal nexus.

Fire management is a tool that can help or hinder species management and implementation of the Endangered Species Act. Prescribed burns, natural fires, and unplanned fires can all have effects on species and their habitats. It is important that fire managers understand species and habitat needs and incorporate them into their fire planning. Suppression efforts should have information readily available to avoid sensitive resources where possible. Conversely, regulators need to better understand fire ecology, fire management, and suppression options. Regulators and land managers should be working together to cross-train and better understand and optimize where fire can better benefit species. The tools regulators have regarding ESA implementation are: the listing of a species (pre-listing, listing, de-listing), designation of Critical Habitat, Habitat Conservation Plans (small and large scale efforts, fire mitigation, urban planning) and Section 7 consultations. Options for inclusion in fire related activities include: participation on BAER teams, serving as a resource advisor for fires, getting red-carded, and participating in fire planning. Fire managers need to recognize and understand their responsibilities under the ESA and work in advance to make sure those responsibilities are met.

In conclusion, fire management has a role in implementing the Endangered Species Act and fire managers should be actively working with regulatory agencies on pre-fire planning, implementation, and BAER. Fire managers should seek out regulators with fire backgrounds and help to expand the knowledge of fire ecology within the regulator community. Both fire managers and ESA regulators need to learn more about each others areas of expertise and work together to capitalize on it.

Presentation Title: Are Fire Prevention Measures Helping or Hurting T&E Wildlife?

Presenter: *Christopher M. Knopp*
USDA Forest Service
Vallejo, California, USA

Abstract: The southern Sierra Nevada mountain range currently supports a small population of American Fisher. The US Fish and Wildlife Service has determined that the population warrants listing. As a result, concerns among the some segments of the public are focused on forest management activities designed to reduce fuel loadings and reduce the intensity and size of wildfires in fisher habitat.

The issue is; do fuels reduction projects do more harm than good to the fisher? This presentation explores the scientific complexity and political sensitivity of answering this question and the broader ramifications to land management in the southern Sierra Nevada mountains of California.

Presentation Title: Retardant -- Legal Issues Related to its Effect

Presenter: *Laila Lienesoh*
USDA Forest Service

Abstract: Prior to 2000, Endangered Species Act (ESA) compliance for fire-fighting activities was implemented under the Emergency Consultation Procedures (50 CFR 402.05). In early 2000, a situation developed over the use of sodiumferrocyanide in fire retardants. In response, the fire-fighting bureaus within the US Department of Agriculture and the Department of the Interior jointly developed the "Guidelines for Aerial Application of Retardants and Foams in Waterways" (Guidelines). These Guidelines, published in the chapter on Suppression Chemicals and Delivery Systems in the Interagency Standards for Fire and Aviation Operations handbook (Red Book), provide guidelines for protecting aquatic species that are listed as threatened or endangered. In 2003, the US Forest Service (FS) received a notice of intent to sue from the Forest Service Employees for Environmental Ethics (FSEEE) charging that the Agency was in violation regarding application of retardants. In October, 2003, FSEEE filed suit alleging that the FS was in violation of the National Environmental Policy Act (NEPA) and that it had failed to consult with U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) under ESA regarding use of fire retardant chemicals. Ultimately, in September, 2005 the federal district court in Montana agreed with FSEEE that the FS decision not to analyze its use of chemical fire retardants was unreasonable and ordered the FS to assess in a NEPA document its use of fire retardants and to formally consult with the FWS regarding the effects retardant has on threatened and endangered species. In July, 2006 the FS published a scoping letter proposing to conduct an environmental analysis and prepare an Environmental Assessment (EA) on the aerial application of fire retardant. An EA is expected to be completed by Spring 2007.

Presentation Title: Overview of the Intersection of Federal Clean Water Legislation and Wildland Fire Management

Presenter: *Sherry Hazelhurst,*
USDA Forest Service
Washington, DC, USA

Abstract: Wildland fire management activities, including fuels reduction, fire fighting, and burned area rehabilitation, can intersect with our responsibilities under the Federal Clean Water and Safe Drinking Water Acts. Some of the intersections may be more apparent than others, such as the collateral application of fire retardants directly to surface waters and the loss of vegetation and the effects on soil from fire that can result in runoff and erosion problems; while others may not, such as appropriately designing fuels reduction activities in the watersheds of Impaired Streams and incorporating the presence and location of Source Water Protection Areas into determining appropriate firefighting techniques. The Clean Water Act establishes goals, policies and procedures for the maintenance and improvement of the Nation's waters from both point and nonpoint sources of pollution. The Safe Drinking Water Act establishes goals, policies and procedures for the provision of safe drinking water to the public and the protection of public drinking water sources. There are two main non-firefighting processes associated with wildland fire management where the Clean Water and Safe Drinking Water Acts need to be considered: 1) in developing and implementing fire management plans, and 2) in developing and implementing wildfire burned area emergency response (BAER) projects. Both processes need to take into consideration the location of Source Water Protection Areas (water sources for public water systems), section 303(d) listed Impaired Streams, and best management practices (BMPs) to address nonpoint source control requirements.

Presentation Title: Impacts of the Clean Water Act on Wildland Fire | Management in the South

Presenter: *John G. Greis*
USDA Forest Service
Tallahassee, FLorida, USA

Abstract: Prescribed burning is essential to the health and sustainability of southern forested ecosystems, and is becoming increasingly difficult to conduct as the South urbanizes. In response to the Clean Water Act of 1977, all southern states adopted Best Management Practices (BMPs) to prevent nonpoint pollution from silviculture activities, including those associated with wildland fire management. Like most BMPs for other silviculture practices, they are primarily aimed at preventing sedimentation. Nearly all southern states have monitored implementation of these practices; a very limited amount of effectiveness monitoring has been conducted. These practices, their implementation in southern states, and what is known of their effectiveness in protecting water quality will be reviewed.

Presentation Title: The Clean Water Act and Wildland Fire Management in the Western US

Presenter: *Bruce Sims*
USDA Forest Service
Missoula, Montana, USA

Abstract: The impacts of fire suppression practices on resources in general, and water quality in particular, are controlled through a variety of methods. The mitigation methods are typically communicated through a National Forest briefing package or Delegation of Authority to the Incident Commander. During the course of a type I or II incident, a Suppression Rehabilitation Plan is also created and the implementation supervised by a Resource Advisor. The Resource Advisor applies MIST (Minimum Impact Suppression Tactics) and other guidelines from the Resource Advisor's Guide for Wildland Fire. Subsequent BAER activities also are used to mitigate emergency impact needs. Program funds are used to address longer-term rehab and restoration needs.

Presentation Title: Overview of Cultural Resource Act as it has Impacted Wildland Fire Management

Presenter: ***Gary Knudsen***
USDA Forest Service
Russelville, Arizona, USA

Abstract:

The National Historic Preservation Act and a number of related pieces of legislation have long been a source of confusion, frustration and intimidation for land and resource managers including those charged with Wildland Fire Management. In reality this does not have to be the case and in fact Heritage Management and Wildland Fire Management can be very complimentary when the right processes are in place, all of the stakeholders have a vested interest and are willing to work together to meet common objectives. Most federal agencies have some sort of process in place to deal with heritage resources during the suppression of wildfires and have fire qualified archeologists working with the fire organization to minimize the effects of fire suppression upon heritage resources in these "emergency' types of situations. The recent increase in the use of prescribed fire for management of vegetation within a number of federal agencies has however raised the question of the compatibility of fire management and heritage management.

This paper briefly explores the common objectives of heritage and fire management presents the ideal situation and then expounds on some of the potential pitfalls and opportunities presented to Wildland Fire Managers when trying to meet their objectives and be in compliance with the plethora of legislation designed to protect the nation's heritage resources.

Presentation Title: Fire and Water: Effects of Wildfire and Erosion on the Archaeological Sites of Mesa Verde National Park

Presenter: ***Julie A. Bell***
USDI National Park Service
Mesa Verde, CO, USA

Abstract:

Mesa Verde contains one of the largest concentrations of archaeological sites in North America. Ancestral Puebloan people lived on the mesas and in the canyons of this large escarpment for more than seven centuries, from approximately AD. 550 to 1300. The remains of their culture range from small scatters of sherds and flakes to large well-preserved pueblos and cliff dwellings. Between 1996 and 2003 five large wildfires swept over more than fifty percent of the Park, burning 28,340 acres. Fire can hurt archaeological sites in various ways. Direct effects cause rock to spall (break off in slabs) and building stone and cliff faces to oxidize. While direct fire impacts can be devastating to archaeological sites, the most harmful damage can occur during fire suppression activities and from accelerated water erosion during the first few months following a fire. The deforestation and increased ground visibility resulting from the fires has allowed archaeologists to conduct more thorough and accurate surveys of the Park's burned areas than ever before. These surveys have contributed significantly to our understanding of Mesa Verde's prehistory. By opening up sweeping vistas across the mesas and canyons, the fires have allowed us to see how sites were distributed and understand more holistically how communities were organized and how they interacted with each other, especially during the Pueblo I and II periods (AD 750 to 1150). Additionally, we have discovered evidence of how ancestral Puebloans manipulated their environment to maximize water resources, and that water control systems were far more common than anyone previously knew. Verde National Park

Presentation Title: CRM and Fire: Strategies for Cultural Resources Management and Fire

Presenter

Kathy Foppes
USDI National Park Service
Statten Island, New York, USA

Abstract:

Since the passage of the National Historic Preservation Act of 1966, management conflicts have arisen due to the nature of fire and the potential for impacts on cultural resources. Many of these conflicts are a direct result of a failure to develop a streamlined, consistent, and rationale approach to cultural resource protection for a variety of fire management undertakings and circumstances. This is most apparent when federal agencies stove pipe archeology and historic preservation under S106 that promulgates last minute approaches to obtaining information and mitigating any "archeology issues" by simple environmental damage mitigation techniques.

Management of the nation's significant historic and natural resources is imperative. The trick is to do so in such a way that is consistent with law, regulations, and good public policy while achieving the goals of both cultural resources and fire management.

This session will take a hands on practical approach by looking at the various policies and procedures, examples of past mistakes, lessons learned, helpful hints, working with SHPOs, cultural resource specialists, fire managers, etc. and ways in which each side can learn to help each other accomplish their respective programs. The goal is to get on with the practical process of seeking an agreement that all concerned can live with.

TRACK 5

Wednesday, November 15, 2006

Fire Ecology and Fuels Management Collaboration: The Good, the Bad & the Ugly

Paul Reeberg
USDI National Park Service

13:30 – 13:45	***Matt Brooks*** ***US Geological Survey***	Evaluating effects of fuels treatments in arid and semiarid ecosystems
13:45 – 14:00	***Jon E. Keeley*** ***US Geological Survey***	Cost and benefits of chaparral fuel modifications in crowm fire ecosystems
14:00 – 14:15	***Kevin Greenhalgh*** ***Dixie National Forest***	FPA and Fuels: Where are we going?
14:15 – 14:30	***Bruce Fields*** ***USDI National Park Service***	Interagency Wildland Fire Use: How do we proceed?
15:30 – 15:45	***Jennifer L. Allen*** ***USDI National Park Service***	Interagency fire monitoring planning in Alaska: vast lands, large fires, and limited budget
15:45 – 16:00	***Caroline Noble*** ***USDI National Park Service***	Southeast Fire Ecology Partnership
16:00 – 16:15	***Fred Wetzel*** ***USDI Fish and Wildlife Service***	Greater Okefenokee Association of Landowners(GOAL) A Nontraditional Approach to Fire Management,
16:15 – 16.30	***Lynn Decker*** ***The Nature Conservancy***	Collaborative Learning as an Approach to Restore Fire Adapted Ecosystems: The U.S. Fire Learning Network
16:30 – 17:00	***Bill Leenhouts*** ***USDI Fish and Wildlife Service***	Making Post-Wildfire Recovery Decisions
17:00 – 17:30	***Paul Reeberg*** ***USDI National Park Service***	Panel Discussion

Session Title — Fire Ecology and Fuels Management Collaboration: The Good, the Bad, and the Ugly

Session Organizer: ***Paul Reeberg***
USDI National Park Service
Oakland, California, USA

Abstract: The National Fire Plan brought the most aggressive interagency mandate to date for fire management activities. With subsequent increased staffing and funds, there is a desire to see integrated and adaptive landscape management strategies. Collaborative fuels management and fire ecology efforts pose unique challenges that existed even before the Fire Plan was enacted. This session will explore current and future opportunities for collaboration at local, regional, and national levels. The session format will include small working groups, panel discussions, and critically assessed case studies.

Co – Organizer: ***Amanda G. McAdams, USDA Forest Service, Bev Schwab, USDI Bureau of indian Affairs, Caroline Noble, USDI National Park Service, David J. Brownlie, Regional Fire Ecologist, Ed Brunson, The Nature Conservancy, Geoff Babb, jenifer Mata, USDI Bureau of Land Management, Mark Kaib, USDI Fish and Wildlife Service, Peter Maholland, Wildlife Enhancement Program Coordinator***

Presentation Title: Evaluating effects of fuels treatments in arid and semiarid ecosystems

Presenter: ***Matt Brooks***
US Geological Survey
Henderson, Nevada. USA

Abstract: Fire management in arid and semi-arid ecosystems is hindered by a general lack of information, especially related to the ecological effects of fire and fire management treatments. This is partly due to the historical infrequency of fire, and the relatively few scientists who have studied fire in these ecosystems. During recent decades, fire management activities in arid and semi-arid ecosystems have increased substantially, and the lack of solid information to support these actions has become a major issue. In response to this need, specific plans have been developed to evaluate the effectiveness of various fire management treatments. These efforts often involve collaborations between land managers and scientists, each contributing their unique expertise to research and monitoring teams. In many cases these collaborations result in highly skilled and efficient teams that produce valuable information. However, in other situations they can lead to dysfunctional relationships that are not productive. In this presentation I describe some of my experiences with interagency collaborations on effectiveness monitoring projects, and specifically highlight what can make or break these collaborative teams.

Presentation Title: Costs and Benefits of Fuel Modifications in Crown-Fire Ecosystems

Presenter: *Jon Keeley*
US Geological Survey
Three Rivers, California, USA

Abstract: The efficacy of fuel modifications differs markedly between forests with surface-fire regimes and shrublands with crown-fire regimes. In forests, fuel modification may contribute to both fire hazard reduction and provide resource benefits that enhance ecosystem sustainability. In crown fire ecosystems fuel modification treatments may reduce fire hazard, but they often contribute to resource degradation and can threaten the sustainability of natural plant and animal communities. Thus, management sensitive to both fire and resource issues must carefully weigh the potential benefits of fuel modifications in these crown-fire ecosystems. Historically this has been sorted out by prioritizing these issues; not surprisingly fire hazard goals with any potential for success have weighed in as more important than resource issues. However, with increasing threats to natural ecosystems, resource issues are playing a bigger role in fire management decisions, and thus rather than prioritizing fire hazard and resource issues we need to carefully balance the costs vs benefits of such treatments. The potential benefits of fuel modification include barriers to fire spread and defensible space for suppression activities. Whether or not these benefits are realized is a function of weather conditions associated with the fire event and geographical placement of fuel modification treatments. On many coastal California landscapes severe weather events are the major cause of fires that result in catastrophic losses of property and lives and the evidence clearly demonstrates that fuel modifications seldom act as barriers to fire spread and are primarily of value for providing defensible space. Costs of fuel treatments include funds for installation and maintenance, and resource costs include the creation of conditions that enhance alien plant populations and encouraging their spread into untreated wildland areas, as well as contributing to erosion and slope instability, and swapping hazardous fuels for highly combustible grasses that enhance the risk of ignition and alter the fire regime. Cost benefit analysis argues strongly for strategic placement and increasingly it is apparent the highest benefit is application at the WUI. Creation of fuel mosaics on these shrubland landscapes ranks low in our cost benefit analysis and as competition for funding intensifies we believe decisions to divert funding to forest treatments with proven value will provide the most cost effective use of limited fuels funding.

Co-Author: *Richard W. Halsey, The California Chaparral Field Institute,*
C.J. Fotheringham, University of California, Los Angeles

Presentation Title: FPA and Fuels: Where are we going?

Presenter: *Kevin Greenhalgh*
Dixie National Forest, Cedar City , USA

Abstract: The FPA process continues to be modified and altered prior to implementation. The process of how fuels will be incorporated into FPA remains unclear. We will discuss the most recent updates on how the fuels program is expected to be included in this interagency funding process, particulary how each local fuels program may be affected.

Presentation Title: Interagency Wildland Fire Use: How do we proceed?

Presenter: ***Bruce Fields***
Bryce Canyon National Park Bryce Canyon. Utah, USA

Abstract: We are learning that managers who choose wildland fire use over suppression tend to be comfortable with their program, understand the importance of wildland fire use and are willing to take a little bit of risk to implement the unknown. Through continued successful management of wildland fire use and using every opportunity to educate our managers, employees and public on why fire is necessary, we can continue to expand the role of wildland fire use across agency boundaries. A case study of the Dixie NF and Bryce Canyon NP will help demonstrate how this may be achieved. Interagency planning on fire management plans is the first step to ensure successful implementation of fire use across political boundaries. The Powell District of the Dixie NF shares an extensive boundary with Bryce Canyon NP (BRCA). In the fall of 2004 the Powell District managed a fire for resource benefit even though the NPS would not allow the fire onto their lands. This fire was successfully managed with Bryce Canyon personnel serving in key roles, including the Fire Use Manager. The park Superintendent also worked to support the District Ranger in choosing this option and managing it. The fire was successfully managed with NPS and FS resources. In April 2005 an Interagency Fire Management Plan was approved between Bryce Canyon NP and Dixie NF. This plan has the same fire management units on both sides of the fence. In the summer of 2005 BRCA managed their first WFU event even though the Dixie NF would not allow the fire to cross onto their lands. Although interagency plans help agencies work together it does not preclude that all actions will be the same on both agencies. Perhaps the fire season of 2006 will provide the spark to manage fire across boundaries.

Presentation Title: Interagency fire monitoring planning in Alaska: vast lands, large fires, and limited budget.

Presenter: ***Jennifer Allen***
USDI National Park Service
Anchorage, Alaska, USA

Abstract: Fire suppression and management in Alaska has been managed on an interagency basis from its inception around 1939 in Alaska by the Alaskan Fire Control Service (under the General Land Office, which later became BLM). An interagency approach was born out of necessity due to the efficiency required to reach vast expanses of roadless wilderness and remote settlements with a limited budget. As fire management evolved, fire planning, research, monitoring, and technology have also been developed and managed by multi-agency groups. The Alaska Wildland Fire Coordinating Group (AWCG) formed an interagency Fire Effects Task Group in 1999. Over the last several years this group developed a framework of monitoring intensities and designed a monitoring protocol suitable for black spruce and shrub/tundra areas. The intent of the protocol was to provide a basic method for monitoring fire and fuels treatments in Alaska that could be implemented rapidly and by a variety of personnel; and to encourage interagency sharing of data, thus increasing sample sizes across the landscape. Initially an outline of three monitoring intensity levels was defined and objectives and variables were identified. The protocols selected combined aspects of the USFS FIREMON techniques and NPS Fire Monitoring Handbook (FMH) methods; these protocols were refined so that they give better results in boreal forest and tundra ecotypes. After review it is hoped that these monitoring methods will gain wide acceptance and use by Federal, State, and private land managers. Use of common protocols will facilitate data sharing, training, and collaboration and is expected to increase our knowledge of fire effects in Alaska. Monitoring is a critical aspect that allows fire management the ability to improve prescriptions and develop fire plans based on knowledge gained from field measurements.

Co-Author: ***Karen Murphy; USDI Fish and Wildlife Service –***
Randi Jandt, Bureau of Land Management – Alaska Fire Service

Presentation Title: Southeast Fire Ecology Partnership

Presenter: ***Caroline Noble***
National Park Service Tall Timbers Research Station Tallahassee, USA

Abstract: The Southeastern Fire Ecology Partnership is composed of fire ecologists from the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, The Nature Conservancy, and Tall Timbers Research Station. The mission of this group is to serve as a reference point for southeastern fire ecology issues and to support collaborative research, training, and education efforts within the field of fire ecology. As this partnership develops it will serve as a centralized reference point known to academic, research, federal, state, and private communities regarding fire ecology issues in the southeast. An additional objective is to serve as a clearinghouse for identification and prioritization of cooperative fire ecology related research and educational needs. By capitalizing on co-location at Tall Timbers research station we have a unique opportunity to pool resources and realize a synergistic effect based on differing perspectives from all partners. The partnership's vision is that our efficient, creative, and cooperative efforts will lead to a workforce and society that understands and supports the role of fire as a fundamental cultural, social, and ecological force.

Co-Author: ***Bruce Davenport, U. S. Forest Service David Brownlie, U. S. Fish and Wildlife Service Paula Seamon, The Nature Conservancy Ronald E. Masters, Tall Timbers Research Station***

Presentation Title: Greater Okefenokee Association of Landowners (GOAL), |
A Nontraditional Approach to Fire Management

Presenter: ***Fred Wetzel***
Fish & Wildlife Service
Folkston, Georgia, USA

Abstract: "We know it will burn and it will come out of the swamp when you least expect it". This is the historical knowledge we started with and the coalition of landowners and managers known as GOAL, is what we built. GOAL's growth was not easy and the organization as we know it today did not happen over night. The organization is always changing as partners come and go, but the intense desire to manage fire and other areas of mutual interest in a seamless, success proven organization is what keeps us together. A major fire on the south end of the Okefenokee NWR, called the Shorts Fire, in 1990 stretched the manpower and equipment of industry, private landowners, state and federal agencies. It was apparent that a more concerted and coordinated effort by those involved would make everyone's job a little easier and hopefully be successful in keeping future wildfires in check.
In response to the lessons learned from the Shorts Fire, GOAL was started with a couple of informal landowner group supper meetings. Originally, the emphasis was on being better prepared for the potential of fighting and controlling wildfire. After this beginning, those involved, envisioned a more formal gathering of landowners that could possibly deal with other issues related to the management of forest and wildlife resources in and around the Okefenokee Swamp. The GOAL organization provides an excellent opportunity and forum for communicating to a large group of landowners about any number of issues. We have a diverse group of individuals managing a large land-base—this presents opportunities to share ideas and consolidate resources. In 2005 GOAL received the Pulaski Award because it characterizes all the hallmarks recognized by the Award.

Co-Author: ***David J. Brownlie ,USDI Fish & Wildlife Service***

Presentation Title: Collaborative Learning as an Approach to Restore Fire Adapted Ecosystems: The U.S. Fire Learning Network

Presenter: ***Lynn Decker***
The Nature Conservancy
Salt Lake City, Utah, USA

Abstract: The U. S. Fire Learning Network (USFLN) is part of the collaborative Restoring Fire Adapted Ecosystems (RFAE) project of the USDA Forest Service, U.S. Department of the Interior (National Park Service, Bureau of Land Management, Fish & Wildlife Service and Bureau of Indian Affairs), and The Nature Conservancy. Since 2002, the U.S. Fire Learning Network has been building success through local, state and federal partnerships. The USFLN furthers The Nature Conservancy's biodiversity conservation goals and goals of the National Fire Plan by: Accelerating ecosystem restoration at landscapes that are implementing or are poised to implement fire restoration at ecologically meaningful scales; and Fostering innovation and transferring lessons learned to other projects, scientists, and decision-makers through regional learning networks. The foundations of the Fire Learning Network approach are to: 1) Use science and collaborative learning as a foundation; 2) Use structured facilitation and learning-by-doing to accelerate planning processes; and 3) Share, test and apply information through direct peer-to-peer engagement. As of Fall 2006, the National Network consisted of 9 Regional Fire Learning Networks, led by The Nature Conservancy with 61 individual community-based projects in 33 states. More than 400 partners engage in collaborative conservation on more than 76 million acres. All landscapes have been affected by altered fire regimes and human land uses. Partners develop and implement shared goals for: fire regime restoration; protection of human communities; biodiversity conservation; and ecologically-appropriate fire policies. The Fire Learning Network is evolving to meet the challenges of working across boundaries with others to effectively conserve ecologically appropriate fire regimes in priority landscapes both nationally and internationally.

Co-Author: ***Tom Dooley, The Nature Conservancy***

Presentation Title: Making Post-Wildfire Recovery Decisions

Presenter: ***Bill Leenhouts***
USDI Fish and Wildlife Service
Boise, Idaho, USA

Abstract: Wildfires are significant ecological, social, and economic change agents and create numerous post-wildfire recovery challenges, opportunities and management decisions. From an immediate need to repair suppression activity damage and stabilize the burned area and prevent further degradation from the next rain storm to longer term burned area rehabilitation and restoration, managers are confronted with having to make frequent and difficult decisions concerning whether actions should be taken, what are they, will they work, what will they cost, where does the funding come from and what are the consequences. Post-wildfire recovery management decisions are based on subjective cultural perceptions, political paradigms, and ecological and economic information. There are many post-wildfire recovery issues, interests and concerns. The public is concerned about the future and expects action. Political leaders want to help or at least be perceived as helping. Economic interests were affected by the wildfire and may benefit from the recovery. Managers worry about responsibility, liability and funding questions. The state of knowledge concerning the actual cost effectiveness of post-wildfire recovery actions is not definitive. In the current social, political, legal, economic, and information context actual management decisions are relatively predictable. In order to significantly change these decisions the current context in which the decisions are made will need to change.

TRACK 6

Wednesday, November 15, 2006

Insects

10:30 – 11:00	*Brad Hawkes* *Natural Resources Canada*	Interaction of fire and mountain pine beetle disturbances in the Chilcotin Plateau
10:45 – 11:00	*Michael Jenkins* *Utah State University*	Mountain pine beetle effects on fuels and fire behavior in lodgepole pine stands
11:15 – 11:30	*Fiona Christie* *The University of Melbourne*	The Effects of Frequent Burning on Invertebrate Herbivory in Australian Eucalypt Forests
11:00 –11:15	*Allan York* *The University of Melbourne*	Effects of Frequent Fires on Terrestial Invertebrates in an Australian Eucalypt Forest
11:30 – 11:45	*Roy Wittkuhn* *Western Australia Department of Conservation and Land Management*	Fire refugia: The mechanism governing animal survivorship in a highly flammable understorey plant

Interactions of Wildfire and Insect Outbreaks

Daniel Tinker
University of Wyoming

13:30 – 13:45	***Ken Gibson*** ***USDA Forest Service***	Recent Fire/Bark Beetle interactions in the Northern Rocky Mountains
13:45 – 14:00	***William H. Romme*** ***Colorado State University***	Trends in fuels characteristics over 16 years following a bark beetle outbreak in lodgepole pine
14:00 – 14:15	***Rich A. Fleming*** ***Canadian Forest Service***	Large-scale interaction of spruce budworm and wildfire in central Canada's forests
14:15 – 14:30	***Dominik Kulakowski*** ***University of Colorado***	Influences of bark beetles and other disturbances on fires in Colorado subalpine forests
14:30 – 14:45	***Martin Simard*** ***University of Wisconsin***	Factors explaining broad-scale patterns of mountain pine beetle infestation in the greater Yellowstone ecosystem
14:45 – 15:00	***Nancy K. Bockino*** ***University of Wyoming***	The effects of tree species composition and white pine blister rust on the susceptibility of whitebark pine trees to mountain pine beetle
15:30 – 15:45	***Hugh J. Barclay*** ***Pacific Forestry Centre***	Effects of fire return rates on traversability of lodgepole pine forests for mountain pine beetle and the estimation of traversability
15:45 – 16:00	***Barbara Bentz*** ***USDA Forest Service***	Bark beetle attack preferences and brood production following wild and prescribed fire
16:00 – 16:15	***Kevin C. Ryan*** ***USDA Forest Service***	Measuring fire injury and monitoring post fire response in conifers
16:15 – 16:30	***Diana L. Six*** ***University of Montana***	Bark beetle responses to fire-affected trees: The dangers of overgeneralization

Session Title: Insects

Presentation Title: Interaction of fire and mountain pine beetle disturbances in the Chilcotin Plateau

Presenter:

Brad Hawkes
Natural Resources Canada
Victoria, BC, Canada

Abstract:

A research project was established in 2001 to examine the impact of mountain pine beetle (MPB) on stand dynamics in British Columbia. A unique multi-age and size stand structure exists in the Chilcotin Plateau as a result of lodgepole pine being able to regenerate under its own canopy, and past multiple MPB outbreaks and surface fires. Fire and MPB beetle disturbance dates were determined from scarring on lodgepole pine that allowed examination of fire and MPB interactions. In examining 272 fire-scarred lodgepole pine tree discs, 127 were found to have one or more mountain pine beetle scars. The number of MPB scars in any year ranged from 1 to 22 (1984). On the tree discs with MPB scars, a total of 83 fire years were identified. The number of fire scars in any year ranged from 1 to 32 (1922). Fire years identified with 10 or more fire scars were in 1839, 1869, 1896, 1904, 1905, 1911, 1922, and 1926. Prior to 1905, only one MPB scar was available to date a MPB scar year and prior to 1839, less than 10 fire scars were found. The reduction in the number of MPB and fire scars over time was because very few lodgepole pines were able to survive multiple fire and MPB disturbances. The incidence of fire scarring appears to have declined since the early 1900s. Less than 10 fire scars were found after 1926 and no fire scars were found after 1982. This suggests that the incidence of surface fires has declined in these forests. The possible reasons for the lack of fire include the introduction of fire control laws in the early 1900s; lack of aboriginal burning; fire suppression activities; and changing land use practices.

Presentation Title: Mountain pine beetle effects on fuels and fire behavior in lodgepole pine stands

Presenter:

Michael Jenkins
Utah State University
Logan, Utah, USA

Abstract:

The purpose of this research was to quantify and compare mountain pine beetle induced changes to lodgepole pine stands during endemic, current epidemic, and post-epidemic beetle populations and use these data to construct custom fuel models to predict fire behavior. Three study sites were selected, a 20 year old post-epidemic on the Ashley National Forest, a current epidemic on the Sawtooth National Recreation Area, and another current epidemic on the Wasatch-Cache National Forest. Results indicated that in the current epidemic stands there were significantly greater amounts of fine surface fuels (litter and 1 hour) and dead aerial foliage compared to the associated endemic stands. In the post-epidemic stands, all but the smallest size classes of down woody debris were significantly greater than the endemic stands with an almost eight fold increase in the largest size class. Additionally, fuel bed depth and live shrub loading were significantly higher in the post-epidemic stands. Increases in the amounts of fine fuels in the current epidemic stands caused sharp increases in predicted rates of surface fire spread and fireline intensities compared to the endemic stands. In the post-epidemic stands, rates of surface fire spread, fireline intensity, and total heat release were also higher than in the associated endemic stands due to decreased vegetative sheltering and heavy accumulations of large diameter fuels. Crown fire potential was also higher in the post-epidemic and current epidemic stands due to low crown base heights, high fireline intensities, and abundance of dead aerial foliage. However, potential for active crown fire spread was lower in the post-epidemic stands due to decreased aerial fuel continuity.

Co-Authors: *Wesley G. Page, Elizabeth G. Hebertson, USDA Forest Service*

Presentation Title: The Effects of Frequent Burning on Invertebrate Herbivory in Australian Eucalypt Forests

Presenter: *Fiona Christie*
The University of Melbourne
Creswick, Victoria, Australia

Abstract: Low intensity fires are used extensively in forest management around Australia despite there being known about the long-term effects of repeated burning on ecological functioning. Understanding the impacts of disturbance on ecological functioning are fundamental to predicting the long term effects of repeated fire events on forest systems. Invertebrate herbivory is one of the most important ecological processes affecting forest health and hypotheses of Plant Vigour and Plant Stress have examined the responses of invertebrate herbivores to changes in foliar nutrient content. Prescribed burning may affect plant foliar chemistry through changes in nutrient availability which can subsequently influence herbivore feeding patterns. We examined the effects of different fire regimes on forest health and addressed the following questions: 1) what is the effect of fire regime on foliar nutrients; and 2) what is the effect of different fire regimes on levels of invertebrate herbivory? Eighteen independent sites (0.5 ha) were studied representing three experimental fire regimes: fire exclusion (at least 45 years), frequently burnt (every 3 years), and fire exclusion followed by the recent introduction of frequent burning (2 fires in 6 years). Fifty mature leaves were collected from the canopy of ten Eucalyptus pillularis trees in each site and analysed for nutrients and invertebrate herbivore damage. Preliminary results indicate that frequent burning affects nutrient levels in forest systems. These finding have important implications for the development of strategies for the management of prescribed burning.

Co-Authors: *Alan York, The University of Melbourne*

Presentation Title: Effects of frequent fire on terrestrial invertebrates in an Australian eucalypt forest: Can active habitat management ameliorate impacts on biodiversity and ecosystem processes?

Presenter: *Alan York*
The University of Melbourne
Creswick, Victoria, Australia

Abstract: Interactions among vegetation, soil flora and fauna and litter- and soil-dwelling invertebrates are responsible for regulation of carbon mineralisation and immobilisation in litter and soil. Knowledge of soil biota and how these relationships are influenced by fires and fire regimes is critical for good management of forests. Frequent fires in Australian Eucalyptus forests have been shown to cause changes in the composition and structure of terrestrial invertebrate communities, with the potential to impact upon rates of litter decomposition and nutrient cycling. This research utilised a long-term fire research experiment to investigate the impact of altered fuel levels on the ground-active and litter-dwelling invertebrate fauna. Leaf litter (fine-fuel) and understorey vegetation levels were experimentally manipulated by successive fires to produce replicated sites with similar habitats but different fire histories. The composition of the invertebrate fauna was most strongly determined by the fire history of the site, rather than recent fire-induced habitat changes. Despite this apparent resilience, there was, however, clear indication that communities were shifting slowly towards a 'new' state which did reflect the altered environmental conditions. Surface-active invertebrates were most strongly influenced by changes in understorey vegetation, whilst litter-dwelling organisms were responding strongly to altered fuel loads. Measured soil parameters also responded in a similar fashion to the experimental treatment, particularly soil organic matter, bulk density, soil moisture and total organic carbon. This would suggest that the mechanisms behind carbon and nutrient cycling are tightly linked in these systems and that fire has the potential to alter relationships between constituent elements. A major implication of these results for forest managers is that fuel loads can be manipulated to achieve both positive biodiversity outcomes and the maintenance of ecological processes in these fire-prone ecosystems.

Presentation Title: **Fire refugia: The mechanism governing animal survivorship in a highly flammable understorey plant**

Presenter: *Roy Wittkuhn*
Department of Conservation and Land Management
Manjimup, Western Australia

Abstract: Knowledge of factors influencing the survival of individual animals following forest fires is critical to understanding subsequent patterns in species diversity during recolonisation. Although most studies of post-fire succession acknowledge the potentially important contribution of animals that have survived in situ, only a few studies have measured the effectiveness of refugia for plant-dwelling invertebrates. This study tests the claim that some understorey plants provide a refuge for invertebrates during fire using the most paradoxical of plants, the highly flammable grasstree (Xanthorrhoeaceae: Xanthorrhoea). Invertebrates were sampled destructively from four unburnt grasstrees (X. preissii Endl.), and immediately following burning from five grasstrees experimentally prescribed fire. Also collected were invertebrates fleeing from burning grasstrees. The dataset comprised 879 specimens, representing 84 species from 18 orders. Slaters (Isopoda), silverfish (Thysanura), spiders (Araneae), and true bugs (Hemiptera) dominate invertebrate assemblages of unburnt grasstrees. Despite grasstrees burning at temperatures of up to 515˚C, invertebrates survive in situ. Species richness and mean abundance is highest in the skirts of unburnt grasstrees and least on the burnt grasstrees. Survivorship of invertebrates following burning appears related to species-specific microhabitat preferences within the plant. Species burrowing into small spaces between the compacted leaf fronds of the living crown are more likely to survive than species inhabiting the dead skirt. The mechanism causing differential mortality relates to fire temperature. In the dead skirt, temperatures reach 225.33 ▒66.57˚C. In contrast, a region of mild temperature (25.00 ▒3.54˚C) persists throughout burning at the top of the apical meristem (within the crown). We conclude that grasstrees can function as refugia, and as a potential reservoir from which invertebrates might re-colonise recently burnt areas. However, owing to species-specific microhabitat preferences and differing mortality rates across microhabitats, the invertebrate assemblage remaining in situ will be restricted taxonomically compared to the original grasstree fauna.

Co-Author: *Tom Hamilton, Department of Conservation and Land Management*

Session Title: The Interactions of Wildfire and Insect Outbreaks

Session Organizer: *Daniel Tinker*
University of Wyoming
Laramie, Wyoming, USA

Abstract: The importance of wildfire and insect outbreaks as influences on forest structure and function is increasingly recognized. Acting independently, each disturbance type produces a unique set of structural and function changes in forested ecosystems, as well as initiating various post-disturbance successional trajectories. However, these disturbances do not always act in isolation, and the interactions between these two major disturbances, which co-occur at multiple spatial and temporal scales, are less well understood. For example, conventional thinking maintains that forests subjected to beetle infestations are highly susceptible to severe wildfires. Conversely, trees that survive low-intensity fires are thought to be stressed and weakened, providing increased opportunity for invasion by bark beetles and wood borers. However, findings in these research areas vary widely. This session will focus specifically on the interactions of fire, both wildland fire and prescribed fire, and beetle activity, at both endemic and outbreak levels

Co-Organizer: *Nancy K. Bockino,*
University of Wyoming,
Laramie, Wyoming, USA

Presentation Title: Recent Fire/Bark Beetle interactions in the Northern Rocky Mountains

Presenter: *Ken Gibson*
USDA Forest Service
Missoula, Montana, USA

Abstract: In the several decades prior to 1988, wildfires in the Northern Region were generally less frequent, typically less widespread, and rarely precipitated bark beetle outbreaks as they have in the years since. Significant wildfires in 1988, 1994, 2000, and 2003 have generated damaging and often long-lasting bark beetle outbreaks. As a result, we have been challenged with developing strategies to reduce bark beetle-caused mortality in areas adjacent to those affected by fire. Following widespread fires in Yellowstone National Park and several national forests in eastern Montana, in 1988, engraver beetle populations reached epidemic proportions in lodgepole and ponderosa pine stands. In 1994, aggressive salvage and pheromone trapping programs forestalled Douglas-fir beetle and spruce beetle outbreaks in northwestern Montana. Extreme Douglas-fir beetle outbreaks in southwestern and central Montana exacerbated by wildfires in 2000 and 2003 are just now beginning to return to endemic levels. Management efforts have been aided by pheromone-based population manipulation strategies, but often hampered by our ability to respond quickly enough. Present and continuing activities resulting from recent legislative actions—Healthy Forest Initiative and Healthy Forest Restoration Act—may enable us to promote and maintain forested lands less negatively impacted by the combined affects of wildfires and bark beetles.

Presentation Title: Trends in fuels characteristics over 16 years following a bark beetle outbreak in lodgepole pine

Presenter: *William H. Romme*
Colorado State University,
Fort Collins, Colorado, USA

Abstract: Conventional wisdom holds that bark beetle outbreaks increase fuel loads, thereby increasing fire risk. However, the effects of beetle-caused mortality on fuel characteristics are more complex than a simple increase in dead fuel mass. There is an urgent need for better information on how outbreaks change all components of live and dead fuels over short and long time scales. This paper presents results of a chronosequence study of fuels characteristics in lodgepole pine forests of the Greater Yellowstone Ecosystem. Fourteen stands were sampled, ranging from 0-16 years after mountain pine beetles killed 41-67 % of canopy basal area. Once the dead needles fell, generally within the first two years after the outbreak, canopy fuel mass and continuity were reduced and remained lower than before the outbreak throughout the 16 year period. Fine dead surface fuels (1-hour timelag) probably increased in individual stands because of increased litterfall after the outbreak, but because of high variance among stands no trend was detected over the chronosequence. Large dead surface fuels (1000-hour timelag) did increase significantly, from 2000-10000 kg/ha to 27000-36000 kg/ha, as large beetle-killed boles fell. Surviving understory trees also grew as much as three times faster than before the outbreak, thereby increasing vertical continuity of the fuel matrix. These changes in live and dead fuels characteristics produced complex changes in potential fire behavior, changes that varied over the 16 years represented by the chronosequence. More such studies are needed before we can make confident predictions about the effects of insect outbreaks on fire risk.

Presentation Title: Large-scale interaction of spruce budworm and wildfire in central Canada's forests

Presenter: *Richard A. Fleming*
Canadian Forest Service
Sault Ste. Marie, Canada

Abstract: The boreal forest is Canada's largest forest ecosystem. Its dominant natural disturbances are wildfire and outbreaks of spruce budworm (SBW), a defoliating insect. We analysed Ontario's historical fire & insect survey records from 1941-1996 to see if there was large-scale evidence of an interaction between these two disturbance types. Within the 417 x 10^3 km^2 defoliated by SBW at least once during this period, the maximum total area recorded as defoliated in any year was over 20 times the maximal area burnt. In the 20,000 km^2 experiencing both SBW defoliation and large (> 2 km^2) wildfires, analysis of the spectra of time lags between the two disturbance types indicated that fires occurred 3-9 years after a SBW outbreak disproportionately often. This 'window of opportunity' for wildfire varies geographically: it starts later after SBW outbreak and lasts longer in western than in eastern Ontario. In addition, 7.5% of the areas containing SBW killed trees were burnt in western compared to 4.8% in eastern Ontario. We review what we have learned so far from small-scale and landscape-scale studies of the fire-SBW interaction and discuss our understanding of the ecological processes involved.

Co-Authors: *Jean_Noël Candau, Institut National de la Recherche - Rob S. McAlpine, Ontario Ministry of Natural Resources - Bill de Groot, Canadian Forest Service*

Presentation Title: Influences of bark beetles and other disturbances on fires in Colorado subalpine forests

Presenter: *Dominik Kulakowski*
University of Colorado
Boulder, Colorado, USA

Abstract: Widespread and severe wildfires and outbreaks of bark beetles strongly influence the structure and function of subalpine forests in the Colorado Rocky Mountains. In the late 19th century, severe fires affected extensive areas of subalpine forests in western Colorado. In the 1940s an outbreak of spruce beetles affected 100s of square km of subalpine forests in the Flat Tops area of western Colorado. In 1997 a windstorm blew down over 10,000 ha of subalpine forest in the Routt Divide area of northwestern Colorado. This blowdown was followed by outbreaks of spruce beetles and mountain pine beetles and by salvage logging. During a severe drought in 2002, extensive areas of subalpine forests in both of these areas burned in wildfires. We evaluated and modeled the extent and severity of the 2002 fires in relation to previous disturbances by stand-replacing fire, blowdown, spruce beetle, mountain pine beetle, and salvage logging. The occurrence of disturbances prior to 2002 was reconstructed using a combination of tree-ring methods, aerial photograph interpretation, field surveys, and GIS. The extent and severity of the 2002 fires were based on the Normalized Difference Burn Ratio (NDBR) derived from satellite imagery. GIS and multivariate modeling were used to analyze the effects of pre-fire conditions on the 2002 fires. Previous disturbance by fire and blowdown had a major influence on the effects of the 2002 fires, but outbreaks had only a minor influence. In the Flat Tops area, the most important predictors determining fire severity were stand structure, forest cover type, the late 19th century fires, and elevation. The late 19th century fires reduced the probability of burning in 2002 and the 1940s beetle outbreak had a minor effect and slightly increased the probability of fire, particularly at high severity. In the Routt Divide area, stands that were severely blown down (> 66% trees down) in 1997 burned more severely than other stands, and stands that burned in the late 19th century burned less severely and less extensively than older stands. Salvage logging and beetle outbreaks that followed the 1997 blowdown did not appear to significantly affect fire extent or severity. Overall, fire severity, even during extreme fire weather and in conjunction with a multi-year drought, is influenced by pre-fire stand conditions, including the history of previous disturbances, especially previous fires and blowdown. However, outbreaks of bark beetles appear to have a relatively minor effect on fire extent and severity in these subalpine forests.

Co-Authors: *Thomas T. Veblen, Christof Bigler, University of Colorado*

Presentation Title: Factors explaining broad-scale patterns of mountain pine beetle infestation in the greater Yellowstone ecosystem

Presenter: *Martin Simard*
University of Wisconsin
Madison, Wisconsin, USA

Abstract: The Mountain Pine Beetle (Dendroctonus ponderosae; MPB) has reached epidemic conditions in many parts of the intermountain West, affecting more than 400,000 ha of lodgepole (Pinus contorta) and whitebark pine (P. albicaulis) stands. Other species of bark beetles (spruce beetle [Dendroctonus rufipennis], Douglas-fir beetle [Dendroctonus pseudotsugae], and fir engravers [Ips sp.]) are also showing increased populations in many parts of the Greater Yellowstone Ecosystem (GYE). Although infestations primarily occur in mature stands, the complete suite of factors that explain the presence and severity of MPB damage are unknown. The objective of this study was to determine the factors that explained the broad-scale patterns of bark beetle damage and mortality in the GYE. We used broad-scale field surveys to determine 1) forest attributes (composition, % mortality, serotiny, mean phloem thickness); 2) stand structure (diameter and age); 3) presence and damage by MPB and other bark beetle species; 4) soil characteristics; and 5) site conditions (elevation, slope, aspect, drainage class, surficial deposits, etc.) in lodgepole pine stands that spanned the full gradient of beetle activity (no damage to severe damage). We also used aerial detection survey maps and stand initiation maps to determine the proximity of beetle source and of contiguous tracts of old-growth stands (caused by historic fires), which were also used as explanatory variables. Regression analysis was used to relate bark beetle damage to the biotic and abiotic explanatory variables. Analyses were performed for all species of beetle together as well as for each species individually. These results will help understand and hopefully predict at a landscape scale the factors that make host stands susceptible to MPB infestations.

Co-Authors: *Monica G. Turner, University of Wisconsin*

Presentation Title: The effects of tree species composition and white pine blister rust on the susceptibility of whitebark pine trees to mountain pine beetle

Presenter: *Nancy K. Bockino*
University of Wyoming
Laramie, Wyoming, USA

Abstract: The current mountain pine beetle (MPB) outbreak in the eastern and northern parts of Yellowstone National Park (YNP) is affecting largeareas dominated by lodgepole pine (Pinus contorta var latifolia). However, many areas of high MPB activity in YNP include conifers other than lodgepole pine, yet whether mixed stands alter susceptibility to MPB is not known. For example, whitebark pine (Pinus albicaulis) may be more vulnerable to MPB in mixed stands that are dominated by lodgepole pine, because of the common association of MPB with lodgepole pine. Similarly, whitebark pine trees that are symptomatic for white pine blister rust (WPBR; Cronartium ribocila) may already be weakened and less resistant to beetle infestation than trees that are asymptomatic. The objectives of our study were to investigate whether susceptibility of whitebark pine trees to MPB infestation is higher in individual trees that are symptomatic for WPBR and if MPB activity is higher in stands where whitebark pine is a minor component of a stand dominated by lodgepole pine, or in stands where whitebark pine is dominant. We estimated the relative proportion of whitebark pine trees in five stands in YNP in each of four categories (total of 20 stands) that varied by the proportion of whitebark pine present: 0-25%; 25-50%; 50-75% and > 90%, using three circular plots located at 30-m intervals along the center of a 2 x 60-m belt transect. Each circular plot was divided into four equal quadrants and for the five closest trees in each quadrant we recorded dbh, bark (phloem) thickness, presence/absence of MPB, and whether each sampled tree was symptomatic for WPBR. Our results will provide important insights into the importance of multiple species as hosts for MPB within an individual stand, and will help to predict the susceptibility of whitebark pine to MPB when trees are symptomatic for white pine blister rust.

Co-Authors: *Daniel B. Tinker, University of Wyoming*

Presentation Title: Effects of fire return rates on traversability of lodgepole pine forests for mountain pine beetle and the estimation of traversability

Presenter: *Hugh J. Barclay*
Pacific Forestry Centre
Victoria, British Columbia, Canada

Abstract: A Monte-Carlo simulation was used to examine the effects of fire return rates on the equilibrium age structure of a one-million hectare lodgepole pine forest and yielded a mosaic of ages over the one million hectares for each fire regime modelled. These were used to generate mosaics of susceptibilities to mountain pine beetle attack. This susceptibility is related to the age distribution to calculate the mean susceptibility of the forest. Susceptibility maps have been produced for the province of British Columbia. In addition, we defined a quality, called traversability, which describes the ability of a beetle population to disperse across a landscape according to defined rules of susceptibility and maximum distance for dispersal through unsuitable habitat. Using each of 40 combinations of susceptibility classifications and dispersal limits, the landscape was categorized as traversable or non-traversable. This represents the suitability of a landscape to allow an incipient beetle population to spread unimpeded across the landscape under consideration. It was found that (i) long fire cycles yield an age structure that is highly susceptible to beetle attack; (ii) fire suppression reduces the frequency of fires and yields an age structure highly susceptible to beetle attack; (iii) harvesting one age class reduced the mean susceptibility to MPB attack, and this reduction decreased with increased harvest age and increased fire cycle length. When fires were limited in size to less than 100 ha, the area was always traversable. For larger fires, traversability declined and for the largest fires (up to one million ha) the area was often not traversable. Harvesting reduced the mean susceptibility and traversability, often substantially. The area most traversable was the area in Tweedsmuir Park and the Lakes TSA, where most of the present outbreak has been centred.

Presentation Title: Bark beetle attack preferences and brood production following wild and prescribed fire

Presenter: *Barbara Bentz*
USDA Forest Service
Logan, Utah, USA

Abstract: Bark beetles in the genus Dendroctonus (Coleoptera: Curculionidae, Scolytinae) require live phloem to successfully reproduce, and therefore many species are often described as primary tree killers. During the incipient population phase stressed trees are often preferred, although at large beetle population densities highly vigorous trees are also successfully attacked. Following fire, many Dendroctonus spp. are attracted to fire-injured trees. However, for many species it is unclear the degree of fire injury that is most conducive to beetle attack, the time frame of attractiveness following fire, and fire-injured tree characteristics that are most significant for successful brood production. We monitored bark beetle attacks on fire-injured ponderosa pine (Pinus ponderosa) and Douglas-fir (Pseudotsugae menziesii) 4 years post-fire. Brood production, as measured by adult beetle emergence, was determined for host trees with a range of crown and cambium fire injuries. From these data, models were developed to predict the probability of beetle attack and associated post-fire delayed tree mortality. We also describe fire-injured tree characteristics most conducive to beetle population buildup.

Co-Authors: *Sharon Hood, Ryan Davis, USDA Forest Service*

Presentation Title: Measuring fire injury and monitoring post fire response in conifers

Presenter: *Kevin C. Ryan*
USDA Forest Service
Missoula, Montana, USA

Abstract: Results of numerous studies are reviewed to provide an overview of the effects of fire on conifers. Three types of injury are reviewed, crown, stem, and root, in relation to the fire behavior characteristics associated with each. The presentation critiques qualitative and quantitative methods used to document tissue injury, discusses post fire physiological ecology and insect interactions. These are reviewed in the context of susceptibility to, and monitoring of, post fire insect attack.

Presentation Title: Bark beetle responses to fire-affected trees: The dangers of over generalization

Presenter: *Diana L. Six*
University of Montana,
Missoula, Montana, USA

Abstract: With increasing numbers of high intensity and often spatially extensive fires occurring in the west in recent years as well as the increased use of prescribed fire as a management tool, knowledge of the indirect effects of fire through increased tree susceptibility or attractiveness to bark beetles is critically needed. Fire-affected trees are generally assumed to be at increased risk of attack by bark beetles. However, results of studies investigating beetle responses after fire have often been variable, with beetles responding to fire-affected trees in some cases, but not responding in others. This indicates that broad generalizations across systems, and even within systems, are risky and likely to be misleading. This is because a large number of factors other than fire also influence beetle response including beetle species, beetle life history (primary vs. secondary), host tree species and condition (physiology), environmental conditions, degree and type of damage to the tree, and time of year that the fire occurred. We will discuss how these various factors can affect beetle response and tree susceptibility using examples from studies we are conducting in Douglas-fir, ponderosa pine and whitebark pine stands in the northern Rockies, as well as results from several other studies conducted in past years in several conifer systems across the west.

Co-Authors: *Kjerstin Skov, University of Montana*

TRACK 7

Wednesday, November 15, 2006

Ecological Restoration

10:30 – 10:45	***Don Falk*** ***University of Arizona***	Process-centered restoration and the concept of reference dynamics
10:45 – 11:00	***Rebecca Stratton*** ***University of Tennessee – Knoxville***	The Effects of Long-Term Annual and Periodic Prescribed Fires on Restoring Stand Structure and Composition to an Oak Barrens System in South Central Tennessee
11:00 – 11:15	***Troy Morris*** ***University of Arkansas***	Reintroducing fire in the Arkansas Ozark Highlands: Early effects on woody vegetation in a degraded oak-hickory forest
11:15 – 11:30	***Stacy Clark*** ***USDA Forest Service***	Effectiveness of thinning and prescribed burning on fuel reduction and residual oak tree health on the Bankhead National Forest, Alabama
11:30 – 11:45	***Robert Klein*** ***USDI National Park Service***	Ten Years of Prescribed Burning and Fire-Effects Monitoring at Great Smoky Mountains National Park, USA

Wildland Fire Decision Support

John Szymoniak
USDA Forest Service
Boise, Idaho, USA

13:30 - 13:45	***John Szymoniak*** ***USDA Forest Service***	Wildland Fire Decision Support
13:45 - 14:15	***Bret Butler*** ***USDA Forest Service***	Surface Wind Simulations for Support of Fire Management
14:15 – 14:45	***Mark Finney*** ***USDA Forest Service***	FS Pro: A Method for Estimating Wildland Fire Spread Probabilities
15:30 – 16:00	***Krista Gebert*** ***USDA Forest Service***	Wildland Fire Suppression Cost Estimation
16:00 – 16:30	***David Calkin*** ***USDA Forest Service***	Rapid Assessment of Values At Risk for Wildland Fire Decision Support Systems
16:30 – 17:00	***Richard Stratton*** ***Systems for Environmental Managemrnt***	Wildland Fire Decision Support Management Implications
17:00 – 17:15	***John Szymoniak*** ***USDA Forest Service***	Wildland Fire Decision Support - Concluding Remarks

Session Title: Ecological Restoration

Presentation Title: Process-centered restoration and the concept of reference dynamics

Presenter: *Don Falk*
University of Arizona
Tucson, Arizona, USA

Abstract: Accurate and ecologically meaningful characterization of reference conditions is a fundamental premise of restoration ecology. Restoration practice and research commonly define reference conditions in terms of compositional and structural elements. We propose a “process-centered” framework that places central emphasis on ecological functions and ecosystem processes. A wide variety of processes are central to the functioning and dynamics of ecological systems, and can be placed at the center of restoration research and practice. The process-centered approach allows the definition of “reference dynamics”, where spatial and temporal variability and underlying mechanisms of change are primary. We illustrate this approach using a 303-yr reconstruction of the natural surface fire regime to guide restoration of a Pinus ponderosa forest in the Jemez Mountains of southwestern North America. Fire occurrence varied over space and time during the period of record, with ecologically significant variation in fire intervals (yr fire-1) governed by process-structure interactions. We defined a variety of reference variables for reintroduction of fire as the keystone ecological process, along with related structural variation. A process-centered approach and the reference dynamics paradigm can replace the more static concept of “reference conditions” in defining restoration baselines and provide an improved standard of comparison for restoration ecology.

Co-Authors: *William Armstrong, Santa Fe National Forest*

Presentation Title: The Effects of Long-Term Annual and Periodic Prescribed Fires on Restoring Stand Structure and Composition to an Oak Barrens System in South Central Tennessee

Presenter: *Rebecca Stratton*
University of Tennessee – Knoxville
Knoxville, Tennessee, USA

Abstract: Oak savannas and barrens were once widespread throughout the Midwestern United States covering millions of acres; however due to fire suppression and land use changes to agriculture, these areas are rare. A disjunctive endemic oak barrens community occurs in the Highland Rim Province of Tennessee. Historically this area had similar stand structure and understory composition to savannas and barrens of the Midwest. This research was designed to re-introduce a frequent fire regime in the restoration of this pyric system. Our objective was to document changes in stand structure and development as a result of 43 years of annual and periodic late winter prescribed fire. The study was initiated in 1962 in a randomized block design with three replications of three treatments: annual, periodic (5-year interval), and control. The annual and periodic burning began in 1963 and 1964, respectively, and have continued since study inception. Overstory and understory vegetation were recorded in 1963, 1970, 1989, and 2005. Results, analyzed using analysis of variance with a mixed model (SAS 2006), show differences in total stems per acre and stems per diameter class between the control treatment and the two burning treatments. The control treatment has developed into a closed canopy stratified mixture stand. The annual and periodic burn treatments have developed into oak savanna-like conditions. The overstory structure is similar for each of the burn treatments, with little recruitment of regeneration into the smaller diameter classes; thus creating a diameter distribution skewed toward the larger diameter classes. However, the understories of the annual and periodic burn treatments differ. The periodic treatment has created an old-field-like condition, while the annual treatment has created a prairie-like condition. Overall, the prescribed fire treatments after 43 years have restored similar overstory structure to historic accounts but not the traditional understory structures.

Co-Authors: *Wayne K. Clatterbuck, University of Tennessee*

Presentation Title: Reintroducing fire in the Arkansas Ozark Highlands:
Early effects on woody vegetation in a degraded oak-hickory forest

Presenter: *Troy Morris*
University of Arkansas
Monticello, Arkansas, USA

Abstract: The frequent use of low-intensity fire by Native Americans and future groups of "backwoods" Euro-Americans has played an important role in the establishment of oak forests in the Arkansas Ozarks. Oaks have developed specialized adaptations over millennia such as thick bark, leaf morphology that encourages fire, and seed germination tactics which favor their establishment in frequent fire regimes over that of many competitors. The modern era of fire exclusion has spurred a series of unintended consequences, including the inability of oaks to compete on high-quality sites, oak regeneration failures, and an overall shift in forest composition favoring late-successional, shade-tolerant species. Northern Arkansas forests once rich in oak regeneration are rapidly being replaced by a conglomerate of mixed shade tolerant species such as red maple (Acer rubrum), flowering dogwood (Cornus florida), blackgum (Nyssa sylvatica), and black cherry (Prunus serotina). The reintroduction of fire may be beneficial in shifting species composition in degraded stands suffering fire exclusion back to a prominent oak component. Prescribed fire treatments were implemented in a degraded oak-hickory forest in the northwestern Arkansas Ozark Highlands to gauge their effects on oak regeneration and competing woody vegetation. Pre-treatment data indicated a prominent oak presence in the overstory (72%), with regeneration predominantly consisting of non-oak species (82%). Initial dormant season burns were conducted in late March and early April 2005. Maximum fire temperature and uniformity were monitored using Tempilaq® temperature indicating pyrometers. Fire temperatures varied widely according to individual site characteristics (from 0°F to >1,100°F) with a mean overall temperature of 332°F. Preliminary results suggest it may take multiple prescribed burns to effectively regenerate oak in the wake of shade-tolerant invasion.

Co-Authors: *Matthew Pelkki, Hal Liechty, University of Arkansas*

Presentation Title: Effectiveness of thinning and prescribed burning on fuel reduction and residual oak tree health on the Bankhead National Forest, Alabama

Presenter: *Stacy Clark*
USDA Forest Service
Normal, Alabama, USA

Abstract: Forest managers in the southeastern United States are increasingly using fire and thinning to achieve restoration objectives. These management decisions are largely driven by administrative, political or social pressures with limited input from rigorous scientific studies. A large-scale replicated study was initiated in 2005 on the Bankhead National Forest (BNF) in Alabama to examine the effectiveness of thinning and prescribed burning for conversion of 20-35 year-old non-native pine dominated stands (Pinus taeda L.) to native hardwood species dominated by oak (Quercus spp.). Study areas were located on ridge tops within the southern Cumberland Plateau region, recognized as an area of biological concern from conservation groups. We specifically addressed how fuel loading and residual oak tree condition were affected by six restoration treatments currently used by the BNF: two levels of thinning, a dormant season prescribed burn, two combinations of thinning and burning, and a control. We present preliminary results of fuel loading changes before and after implementation of all treatments in one replication and residual oak tree condition changes before and after implementation of thinning treatments in three replications. Fuel loading was sampled using planar intercept transects and litter and duff collections. Oak tree condition was sampled by measuring bole damage, crown class, crown dieback and char burn heights. Restoration treatment effects on overall fuel loading and bole damage were relatively small. Prescribed burns will need to have high intensity to achieve restoration goals if used alone. A fourth replication will be implemented next year and prescribed burns will be conducted every three years. This replicated long-term experiment provides a unique opportunity to understand the effectiveness of restoration treatments used by land managers working in upland hardwood ecosystems of the southeastern United States.

Co-Authors: *Callie Jo Schweitzer, USDA Forest Service - Luben Dimov, Alabama A&M University*

Presentation Title: Ten Years of Prescribed Burning and Fire-Effects Monitoring at Great Smoky Mountains National Park, USA

Presenter: *Rob Klein*
USDI National Park Service
Gatlinburg, Tennessee, USA

Abstract: Fire suppression and exclusion during the 20th century has allowed fire-intolerant woody species to replace pine regeneration and native herbs in the understory of ridge-top yellow pine communities of the Southern Appalachian Mountains. Managers at Great Smoky Mountains National Park (GRSM) began using prescribed fire in 1997 to restore the structure and composition of these fire-adapted communities to pre-fire suppression era conditions. Typical prescribed fire objectives have included reducing litter and duff fuel loading, reducing pole-size tree density, and increasing the density of yellow pine seedlings. Long term fire-effects monitoring was initiated in 1997 to evaluate the effectiveness of these treatments in meeting management objectives and to detect any undesirable changes. Twenty-four 0.1ha plots were installed randomly within the ridge-top yellow pine community type across six prescribed-burn units. We used National Park Service Fire Monitoring Handbook (FMH) protocols to record vegetation and fuels characteristics during the growing-season prior to burning and at various post-burn intervals. Results from the first-entry of prescribed burning into these six burn units include a 28% mean reduction of total fuel loading ($p < 0.001$) immediately post-burn with a mean duff load reduction of 30% ($p < 0.001$). The mean density of pole-sized trees (2.5-15 cm dbh) was reduced 56% ($p < 0.001$) during the first growing season after burning while the mean density of yellow pine seedlings was increased nearly 600% ($p= 0.013$). These results are well within the target range of management objectives; however high variability in these responses was observed among burn units. The most common post-burn severity rating for these plots was light, however eight plots representing two of the prescribed-fire units experienced moderate-high average burn severity. While these two burn units experienced the greatest duff load reductions and the largest increases in pine seedling density, they also contained the greatest abundances of invasive exotic plants after burning. These results indicate that several management objectives can be achieved with a single burn, which may be appropriate in some situations. However, undesirable levels of mortality of mature yellow pines and pronounced invasions by various exotic species suggest that planning to achieve objectives through multiple burns may be more appropriate for widespread yellow pine restoration efforts in the Southern Appalachian Mountains.

Co-Authors: *Virginia McDaniel, USDA Forest Service - Mike Jenkins, Bob Dellinger, USDI National Park Service*

Session Title: Wildland Fire Decision Support

Session Organizer: *John Szymoniak*
USDA Forest Service
Boise, Idaho, USA

Presentation Title: Introduction to Wildland Fire Decision Support

Presenter: *John Szymoniak*
USDA Forest Service
Boise, Idaho, USA

Abstract: This session will present emerging wildland fire decision support applications. Presenters will discuss new tools under development in the areas of surface wind modeling; wildland fire spread probability forecasting; appropriate management response cost estimation; valuation of threatened resources both market and non-market; and management implications. Discussions with managers from the fire community are encouraged.

Presentation Title: Surface Wind Simulations for support of Wildland Fire Management Decision Support

Presenter: *Bret Butler*
USDA Forest Service
Missoula, Montana, USA

Abstract: A new tool for simulating surface wind flow in mountainous terrain has been developed. Over the last four years this tool has been used to simulate local wind speed and direction on more than 300 fires. Results from the simulations have been used to improve the accuracy of fire growth predictions in both time and space, to identify locations of high and low fire potential, to communicate local wind conditions to firefighting crews, to improve safety zone reliability, inform IMT fire management efforts, explore appropriate prescription specifications for Rx burns, increase firefighter and public safety, and determine environmental conditions leading to fire entrapments. This tool is readily available to all wildland fire personnel, can run on a laptop pc with minimal training and experience.

Co-Authors: *M. Finney, L. Bradshaw, J. Forthofer, R. Stratton, C. McHugh*

Presentation Title: FS Pro: A Method for Estimating Wildland Fire Spread Probabilities

Presenter: *Mark Finney*
USDA Forest Service
Missoula, Montana, USA

Abstract: A method is presented to estimate the probability of fire spreading from an existing location for a finite time period. The program, FSPro, requires GIS landscape data as provided by LANDFIRE or other sources. Additionally, data from a representative NFDRS or RAWS station are used to develop an historical data set for wind (speed and direction) and ERC (energy release component (ERC) from the National Fire Danger Rating System). A time-series analysis is used to stochastically develop thousands of possible ERC trends and, along with winds, uses them to simulate the 2-D growth of the fire across the landscape. The probability of burning for each cell is a calculated by counting how many times a cell burns divided by the total number of simulations.

Presentation Title: Wildland Fire Suppression Cost Estimation

Presenter: *Krista Gebert*
USDA Forest Service
Missoula, Montana, USA

Abstract: The extreme cost of fighting wildland fires has brought fire suppression expenditures to the forefront of budgetary and policy debate in the United States. Inasmuch as large fires are responsible for the bulk of fire suppression expenditures, understanding fire characteristics that influence expenditures is important for both strategic fire planning and on-site fire management decisions. These characteristics can then be used to produce estimates of suppression expenditures for large wildland fires for use in wildland fire decision support or after-fire reviews. The primary objective of this research was to develop regression models that could be used to estimate expenditures on large wildland fires based on area burned, variables representing the fire environment, values at risk, resource availability, detection time, and region. Variables having the largest influence on cost included fire intensity level, area burned, and total housing value within 20 miles of ignition. These equations can be used for detecting "extreme" cost fires-- those fires with actual expenditures falling more than one or two standard deviations above or below their expected value. In a wildland fire decision support environment, this type of information could be used to provide fire managers with an indication that projected suppression expenditures on the current fire are outside what would be expected, given the fire's characteristics, and that the fire would likely be subject to a post-season cost review.

Presentation Title: Rapid Assessment of Values At Risk for Wildland Fire Decision Support Systems

Presenter: *David Calkin*
USDA Forest Service
Missoula, Montana, USA

Abstract: Severe wildland fires experienced in recent years have resulted in loss of life, significant private and public resource losses, and increased federal expenditures on wildfire suppression. Private development in the wildland urban interface has complicated fire suppression decision making, and these values at risk often dictate fire suppression response. Tools and techniques to rapidly identify both private and public resource values at risk from wildland fire can prove invaluable in strategic fire suppression efforts to reduce losses, may help control suppression expenditures, and can provide important performance metrics to evaluate the efficiency of federal wildfire suppression programs. Researchers with the Rocky Mountain Research have developed tools to rapidly identify resource values at risk from wildfire and integrated these value data with a new fire behavior model (FSPro). FSPro simulates fire behavior in the absence of control for a number of potential future weather patterns and allows for the analysis of likely fire behavior over longer time periods than typically modeled in existing tools such as FARSITE. By integrating values at risk with fire behavior probabilities we develop improved risk measures that may provide the foundation for strategic fire decision support tools. We have tested these tools on a number of large fire events during the 2005 and 2006 fire seasons. These tools have the ability to improve strategic fire suppression planning, prioritize large fires, and improve pre-season fire management planning.

Presentation Title: Wildland Fire Decision Support Management Implications

Presenter: *Richard Stratton*
Systems for Environmental Management
Missoula, Montana, USA

Abstract: This concluding presentation will integrate information from Wind Wizard, FireFamily Plus, FARSITE, FlamMap, FSPro, suppression cost estimates, and the valuation of market and non-market values for informed decision making on wildland fire incidents using case study examples from the 2006 fire season. It is anticipated that a similar process can be followed in other areas to aid the decision-making process.

TRACK 8

Wednesday, November 15, 2006

Remote Sensing and GIS Application

10:30 – 10:45	***John Hom*** ***USDA Forest Service***	Multi-Disciplinary Fire and Atmospheric Science Research in New Jersey : National Fire Plan and Eastern Landfire Prototype
10:45 – 11:00	***Birgit Peterson*** ***USDA Forest Service***	Lidar Supplementation of Field Data for LANDFIRE Vegetation Height Mapping
11:00 – 11:15	***Cristóbal Rullán*** ***Univerisdad Juárez Autónoma de Tabasco, Mexico***	Ecological Change Detection of Burnt Vegetation Areas in the Pantanos de Centla Biosphere Reserve using Multi-temporal Landsat TM Data
11:15 – 11:30	***Kelly O'Neal*** ***University of Maryland***	Analysis of post-fire vegetation regeneration using Landsat data and multitemporal spectral mixture analysis
11:30 – 11:45	***Matt Crawford*** ***Texas Tech University***	An Analysis of Terrain Roughness: Generating a GIS Application for Least Cost
11:45 – 12:00	***Dale Hamilton*** ***Systems for Enviromental Management***	Use of the Area Change Tool as an Integral Component in the Signal Peak Assessment

Wildfire Observational Science and Applications

Vince Ambrosia
NASA-Ames Research Center
Moffett Field, CA, USA

13:30 – 14:00	***Everett Hinkley*** ***NASA***	The Use of Unmanned Aerial Systems for Wildfire Mapping.
14:00 – 14:30	***Marco Trombetti*** ***University of California - Davis***	Multi-temporal Vegetation Canopy Water Content Retrieval Using Artificial Neural Networks for the USA
14:30 – 15:00	***Dar A. Roberts*** ***University of California – Santa Barbara***	AVIRIS and MODIS Measures of Live Fuel Moisture and Fuel Condition in California Shrubland Ecosystems
15:30 – 16:00	***Diane Davies*** ***University of Maryland***	Global Fire Information for Resource Management
16:00 – 16:30	***Louis Giglio*** ***Science Systems and Applications***	Global active fire observations from MODIS and the active fire Earth Science Data Record
16:30 – 17:00	***Brad Quayle*** ***USDA Forest Service***	Near Real Time Monitoring Of North American Fire Activity Using EOS MODIS
17:00 – 17:30	***Amber Soja*** ***NASA***	How Well Does Satellite Data Quantify Fire in the United States: A Detailed Analysis with Ground-Based Data

Session Title: **Remote Sensing and GIS Applications**

Presentation Title: Multi-Disciplinary Fire and Atmospheric Science Research in New Jersey : National Fire Plan and Eastern Landfire Prototype

Presenter: *John Hom*
USDA Forest Service
Newtown Square, Pennsylvania, USA

Abstract: Twenty-three percent of New Jersey's land area (1.1 million acres) is occupied by the Pine Barrens, considered among the most volatile fire cycle vegetation in the East. Much of the uplands are dominated Pitch Pine (Pinus rigida), dense scrub oaks and Ericaceous shrubs. Support for our current work through the National Fire Plan and the Eastern LANDFIRE prototype has integrated our regional fire weather monitoring with fuels and vegetation mapping to improve predictions of fire danger and to reduce wildfire risk in the wildland urban interface (WUI) in New Jersey and the East. As part of the Eastern LANDFIRE prototype, we are providing new vegetation mapping, testing of the national LANDFIRE methods for the region, and producing fire regime condition class (FRCC) maps for identifying areas for restoration and hazardous fuel reduction. Vegetation maps derived from Landsat, LIDAR (Light Detecting and Ranging) measurements of stand height and canopy density, Forest Inventory and Analysis (FIA) census data, fuel photoseries plots, and our intensive forest inventories are used to obtain accurate estimates of fuel loads for approximately 500,000 acres of the Pinelands. LIDAR data is being used to evaluate the arrangement of branches and foliage within the forest to detect the presence of "ladder fuels. Collectively, these data are being integrated into GIS layers to produce high-resolution maps of forest structure and fuel loading across the Pinelands. Along with observations of fire behavior, these data are being used to assign the appropriate fire behavior models, and characterize fuel beds. By combining these new spatial tools with our existing research in quantifying forest carbon flux, and the effects of atmospheric chemistry and climate change on productivity, we can improve on predictions of vegetation responses to changing environmental conditions in the East.

Co-Authors: *Kenneth Clark, Steve Van Tuyl, Jason Cole, Nick Skowronski, Yude Pan, Robert Somes. USDA Forest Service*

Presentation Title: Lidar Supplementation of Field Data for LANDFIRE Vegetation Height Mapping

Presenter: *Birgit Peterson*
USDA Forest Service
Sioux Falls, South Dakota, USA

Abstract: LANDFIRE is a nationwide ecosystem, fire fuel, and wildfire assessment project. An important part of LANDFIRE is the mapping of vegetation structure, including canopy height, a critical canopy fuel variable. Current LANDFIRE methods for mapping vegetation height rely on Landsat satellite imagery, digital elevation models and associated derivatives, and biophysical gradients to train decision tree models. These spatial data are used in conjunction with plot-based field reference data to train decision tree models and define the variables being mapped. LANDFIRE relies on an extensive field data set that collects a vast amount of reference plot data from a variety of sources. However, canopy height information is not available for many of the plots in the reference data base, which leads to inadequate informational and spatial distributions in the reference data. This, in turn, may lower the accuracy of the resulting height map. This paper explores the use of lidar data for augmenting existing canopy height reference data to improve height mapping for a study area located in the Sierra Nevada Mountain Range. Unlike Landsat imagery, lidar directly measures the vertical structure of vegetation, thereby providing a large set of additional height data points. The lidar data used in this study were acquired with the Laser Vegetation Imaging System, a large-footprint, waveform-digitizing lidar that was used to map the study area in October of 1999. Random samples were taken from the complete lidar data set to be used as additional reference data and to examine the effects of different sampling schemes and sampling densities. Preliminary results showed that the inclusion of additional reference data obtained from lidar significantly improve cross validation results, indicating that lidar-derived canopy height can be a valuable addition to the suite of data currently used in the LANDFIRE height mapping process.

Co-Authors: *Michelle Hofton, Ralph Dubayah, University of Maryland - J. Bryan Blair, NASA/Goddard Space Flight Center*

Presentation Title: Ecological Change Detection of Burnt Vegetation Areas in the Pantanos de Centla Biosphere Reserve using Multi-temporal Landsat TM Data

Presenter: *Cristóbal Rullán*
Univerisdad Juárez Autónoma de Tabasco
Villahermosa, Tabasco, Mexico

Abstract: The "Pantanos de Centla" Biosphere Reserve (RBPC spanish acronym) located in the southeast part of México is considered an important and international wetland ecosystem, a Ramsar site. This reserve represents the most important hydrologic valley of Mesoamérica. The diversity of habitat developed in the reserve makes a favorable conditions for their biological richness. But the RBPC in particular, suffers reiterated anthropic fires made mainly to capture wild fauna by the increasing human population of the reserve buffer area, seriously threatening the biodiversity of species in the zone. The great extension, more than 300 000 ha, the poor accessibility and the furtive hunting using fire forbidden by the reserve authorities, makes very difficult the prevention, detection, location and measurement of the burnt areas. To help counterattack this problem we apply several change detection techniques on two Landsat-TM images, obtained prior and after the date of one of the fires officially registered in the reserve. The data was processed by the following digital methods multi-temporal classification, ratios and images differences. The results indicate that the combined Tasseled cap with difference was the method that provided the best results for the area under study, allowing to determine on the produced image the areas of change affected by fires. Thematic cartography was then obtained, over it where located the critical habitats of indicator species and finally was determined the spatial relation between habitats and burnt areas analyzing the sustainability of both.

Co-Authors: *Claudia E. Zenteno Ruiz; Lilia M. Gama Campillo; Eunice Pérez Sánchez; Adalberto Galindo Alcántara; Humberto Hernández Trejo - State University of Tabasco*

Presentation Title: Analysis of post-fire vegetation regeneration using Landsat data and multitemporal spectral mixture analysis

Presenter: *Kelley O'Neal*
University of Maryland
College Park, Maryland, USA

Abstract: Fire suppression over the past century has contributed to the conversion of grasslands to shrublands in Madrean Sky Island communities located in the southwestern U.S. and northern Mexico. In the last ten years local ranchers, with the help of the U.S. Forest Service, have attempted to reintroduce fire to the region to reduce shrub cover and restore grassland extent. Three prescribed fires were ignited in the Peloncillo Mountains located on the Arizona/New Mexico/Mexico border: Baker Canyon in 1995 and again in 2003, and Maverick Spring in 1997. A calibrated times-series of Landsat TM/ETM+ data were used to examine the effectiveness of prescribed fire in reducing shrub cover and to monitor post-fire regeneration. Data were transformed using spectral mixture analysis, a linear unmixing model, using four endmembers - green vegetation, non-photosynthetic vegetation, soil, and shade. Spectral fraction images collected during the monsoonal greenup in the summer months were compared to those collected during the winter months, and it was determined that the regeneration signal was clearer during the monsoonal greenup. Land cover change maps identified an initial decrease in shrub cover due to foliage loss and top-killing, with shrub cover increasing in following years where low burn severity did not kill shrubs completely and regeneration occurred. Results indicate the need for a regular schedule of prescribed fire to achieve permanent shrub cover reduction.

Co-Authors: *John Rogan, Clark University - Stephen Yool, University of Arizona*

Presentation Title: An Analysis of Terrain Roughness: Generating a GIS Application for Least Cost

Presenter: *Matt Crawford*
Texas Tech University
Lubbock, Texas, USA

Abstract: The current method of planning a prescribed burn is a time consuming and arduous task. By combining the power of a technology with the knowledge of a burn expert, the time and effort that is currently required for an effective burn may be greatly reduced. This innovative approach to planning a burn will incorporate existing programs to build a model that will predict the smoothest and most suitable path for fire lines. _Research has indicated that trafficability, terrain roughness, and least-cost path applications have been designed for a wide range of uses, from habitat corridor analysis to Mars Rover exploration. However there has yet to be an application specifically designed for prescribed burning. By combining some of the principles from other models and a working knowledge of prescribed burning, a single Geographic Information System application can be formulated to greatly assist in collecting information and determining results. _This model will be primarily based on three areas of terrain analysis: trafficability, terrain roughness, and least-cost. To begin, the model will calculate roughness from a Digital Elevation Model (DEM), through a series of algorithms. After these calculations have been developed, an attempt to standardize these calculated values will be done. Next these calculations will be automated with a Visual Basic script. Then, after the program has been tested, it will be easily incorporated into a Geographic Information System interface. Once inside the GIS, the least-cost path model can be finalized. After vigorously testing, this model can be used in the field, ultimately anywhere in the world.

Co-Authors: *Ernest B. Fish, Carlton M. Britton, Texas Tech University*

Presentation Title: Use of the Area Change Tool as an Integral Component in the Signal Peak Assessment

Presenter: ***Dale Hamilton***
Systems for Enviromental Management
Missoula, Montana. USA

Abstract: Geographic Information Systems (GIS) are commonly being used by fuel and wildland fire managers and forest planners to develop strategic plans pertaining to fuels and fire behavior and ecosystem restoration. Deriving adequate estimates of fire behavior and ecosystem condition require that spatial data used in GIS-based applications accurately reflect those conditions being modeled. Since ecosystems are dynamic, vegetation and fuels spatial data must be updated to reflect current, local conditions. In addition, many fuel managers must be able to change fuel layers so that they can evaluate the effects of their proposed treatment on potential fire behavior. The Area Change Tool is an ArcMap tool that facilitates the editing process of ArcGRID data by automating the many steps involved to update existing layers. This tool allows users to simply edit tables representing a value attribute table, and then output a new raster layer containing the updated values. This paper will demonstrate an application of the Area Change Tool to easily edit spatial data used for the Signal Peak Assessment Project in the Gila National Forest, New Mexico. This tool was used to update LANDFIRE data layers for biophysical settings and succession class to improve Fire Regime Condition Class prediction and to change the LANDFIRE fuels layers required to run FARSITE and FlamMap. The resulting outputs were then used to assess pre- and post-treatment effects of fuels and vegetation management scenarios in a multi-ownership area with significant wildland-urban interface. With updated data layers, the project used the FRCC Mapping Tool to assess restoration options for fire-adapted ecosystems, FlamMap to assess minimum travel time of wildfire scenarios, the Fire Behavior Assessment Tool to assess the combination of rate of spread, type of fire, and flame length, and FARSITE to assess wildfire progressions scenarios.

Co-Authors: ***Marc Levesque - Acadia West, Wendel J. Hann - USDA Forest Service***

Session Title: Wildfire Observationnal Science and Applications

Session Organizer: *Vince Ambrosia*
NASA-Ames Research Center
Moffett Field, CA, USA

Presentation Title: The Use of Unmanned Aerial Systems for Wildfire Mapping

Presenter: *Everett Hinkley*
NASA

Abstract:

The USDA Forest Service and NASA-Ames Research Center have partnered to evaluate and demonstrate new technologies which will lead to improved wildland fire mapping capabilities. In November 2005 the two agencies issued a "Request for Participation" to the unmanned aeronautics community to provide suitable aircraft and imaging capabilities for a demonstration and capabilities evaluation. As a result of this RFP, a demonstration of unmanned airborne systems (UAS) technology occurred the week of June 5th, 2006 at Fort Hunter Liggett Military Facility Garrison (FHLG) near King City, California. The FHLG Fire Department conducted a series of prescribed fires to coincide with the UAS data collection flights. Five vendor-supplied aircraft, equipped with the latest thermal imaging and GIS-compatible technologies, flew over the managed fires and provided real-time images of the burn locations. Another technology demonstrated at this event was a portable radar system developed by the UAV Collaborative at the NASA-Ames Research Park. The Sense-and-Avoid Display System (SAVDS) provides situational awareness capabilities that enable UAS pilots to be fully aware of the air traffic environment to ensure safe operations. Small UAS platforms equipped with thermal imaging systems can fill an ongoing need for wildland fire monitoring. Small UASs are less expensive to operate, have long-duration capabilities, and reduce the risk to aviators flying over active fires. The participating UAS providers were able to highlight the mobility, imaging, and real-time air-to-ground capabilities of these unmanned systems. Forest Service personnel and a science and research team from NASA-Ames Research Center evaluated these capabilities against established parameters for effective flight and data gathering. The Forest Service and NASA will continue to assess, evaluate, and develop these technologies for future inclusion in the day-to-day wildfire monitoring role.

Co-Authors: *Vince Ambrosia, Randy Berthold, NASA Ames Research Center -*
Tom Zajkowski, RedCastle Resources

Presentation Title: Multi-temporal Vegetation Canopy Water Content Retrieval Using Artificial Neural Networks for the USA

Presenter: *Marco Trombetti*
University of California – Davis
Davis, California, USA

Abstract: Fuel moisture content is the dynamic component of fire risk, a measure related to shortterm variability of canopy water content. A reliable and repeatable assessment of vegetation canopy water content is essential for drought monitoring in natural vegetation. The use of radiative transfer models has shown that spectral information are related to the canopy water content while, on the other hand, the inversion of these models requires intensive computation time, making them difficult or impossible to apply them globally. In order to speed up and automate the generation of canopy water content, we used a data mining approach. A Neural Network was trained to perform the inversion of a linked leaf-canopy radiative transfer model, Prospect-Sailh, to obtain canopy water content from MODIS reflectance bands and derived indexes. Airborne AVIRIS data were used for reference at several study sites having different vegetation cover types and these were applied to calibrate the model and validate MODIS predictions of canopy water content. AVIRIS is an instrument that has demonstrated to retrieve vegetation water content based on spectroscopy principles, where, due to its high spectral and spatial resolutions, the water absorption depth and width can be clearly identified and quantified providing reliable estimates of canopy water content. The model was calibrated for different vegetation cover types, shrub, forest and grassland, showing that the ANN significantly outperformed independent estimations based on the same parameters derived from multiple regression analysis. The model was successively applied to monthly MODIS composite images of the USA for the whole year 2005 in order to assess the multi-temporal trends in canopy water content. The study area was divided into ecoregions and the results were analyzed in relation to their different structural and phenological features and to the precipitation/temperature regime.

Co-Authors: *Riaño, D.1, Rubio, M.A.2, Cheng, Y.B.1 and Ustin, S.L.1 1Centre for Spatial Technologies and Remote Sensing, University of California 2 Departamento de Ciencias de la Computación e Inteligencia Artificial Facultad de Ecuación y Humanidades. Ceuta, Spain*

Presentation Title: AVIRIS and MODIS Measures of Live Fuel Moisture and Fuel Condition in California Shrubland Ecosystems

Presenter: *Dar A. Roberts*
University of California – Santa Barbara
Santa Barbara, California, USA

Abstract: Seasonal changes in live fuel moisture (LFM) and fuel condition combined with ignition and weather are the primary factors controlling fire danger in shrublands. Empirical relationship between field-measured LFM and remotely-sensed greenness and moisture measures were investigated using data acquired by the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) and the Moderate Resolution Imaging Spectrometer (MODIS). A major goal was to assess the nature of these relationships as they varied between sensors, across sites and across years. Most AVIRIS-derived greenness and moisture measures were highly correlated with LFM. Two greenness measures, the Visible Atmospherically Resistant Index (VARI) and Visible Green Index (VIg) outperformed all moisture measures.Moisture measures showing the highest correlation include the Water Index (WI), and Normalized Difference Water Index (NDWI). All AVIRIS relationships were non-linear and a linear relationship only applied above a 60% LFM. Fractional changes in green vegetation (GV) and non-photosynthetic vegetation (NPV) were good indicators of changes in LFM below the 60% LFM threshold. AVIRIS and MODIS-derived measures were highly correlated but lacked a 1:1 relationship. MODIS-derived greenness and moisture measures were also highly correlated to LFM, but varied between sites and had a lower overall correlation compared to AVIRIS measures. LFM correlations improved when the data were pooled by plant functional type. Relationships between LFM and remotely sensed measures varied interannually, producing higher correlations in wetter years, with VARI and VIg showing the highest correlations across years. Lowest correlations were observed for sites that included two different plant functional types or multiple land-cover classes such as urban areas or roads within a MODIS footprint. Higher correlations for uniform sites and improved relationships for plant functional types suggest that MODIS can map LFM effectively in shrublands.

Co-Authors: *Dennison, P.E., University of Utah - Peterson, S., University of California, Sweeney, S. University of California, Santa Barbara - Rechel, J. USDA Forest Service*

Presentation Title: Global Fire Information for Resource Management

Presenter: *Diane Davies*
University of Maryland
College Park, Maryland, USA

Abstract: The Fire Information for Resource Management System (FIRMS) provides near-real time MODIS active fire products to natural resource managers around the world. Until recently, protected area managers have faced considerable challenges in obtaining timely satellite-derived information on vegetation fires that are burning within and around their management area. To be of most value, protected area managers require fire information to be delivered while fires are still burning, with minimal file sizes and in easy–to-use formats. FIRMS is meeting these requirements in four ways: by delivering fire alerts through emails and cell phone text messages; by providing MODIS active fire information via an interactive Web Mapping interface; by providing shape files containing the locations of the latest fires that have been detected; and by providing subsets of true color MODIS images. In 2003 FIRMS was applied to meet the needs of Eskom, South Africa's primary electricity company. For Eskom, wildfire is one of the primary causes of faults on electricity transmission lines. Knowing when a fire occurs close to a transmission line enables ESKOM staff to take action: depending on the situation Eskom staff will either suppress the fire or switch power lines off and re-route the electricity through the grid. In addition to supporting the effort in South Africa FIRMS delivers active fire data available to natural resource managers in more than 30 countries. FIRMS is transitioning NASA-funded research results and observations to operational partners to support decision making for management of Protected Areas worldwide. The operational partners in for FIRMS are the United Nations Food and Agriculture Organization (FAO), the United Nations Environment Program (UNEP) and Conservation International (CI). This paper describes FIRMS and how the system has been applied to fire management in South Africa and outlines the preliminary results of its impact.FIRMS is supported by the National Aeronautics and Space Administration under Cooperative Agreement No. NNS06AA04A issued through the Decision Support Program.

Co-Authors: *Philip Frost, Satellite Interpretation Center and ESKOM Transmission, South Africa*

Presentation Title: Global Active Fire Observations from MODIS and the Active Fire Earth Science Data Record

Presenter: *Louis Giglio*
Science Systems and Applications
Greenbelt, Maryland, USA

Abstract: The Moderate Resolution Imaging Spectra-radiometer (MODIS) aboard the polar orbiting Terra and Aqua satellites of the NASA Earth Observing System has channels specifically designed for active fire detection. The MODIS Fires and Thermal Anomalies product has been generated systematically since late 2000. The standard product includes an active fire and cloud mask, the Fire Radiative Power, quality assessment information and extensive metadata. Rigorous validation of the product, using coincident fire observations from higher spatial resolution sensors, has yielded data on detection limits and commission and omission error rates. The MODIS active fire data record has been processed into global spatially and temporally aggregated Climate Monitoring Grid datasets. Various metrics of the spatial and temporal dynamics of fire activity have been derived from a large scale multi-year analysis of the data. Fire observations from MODIS are a NASA contribution to the Fire Mapping and Monitoring theme of the Global Observation of Forest Cover and Landcover Dynamics program, which is promoting, among other goals, the creation of a long-term climate quality active fire data record. The active fire algorithm proposed for VIIRS (Visible Infrared Imager Radiometer Suite) on the future operational National Polar Orbiting Environmental Satellite System and the experimental NPOESS Preparatory Project platforms builds on the heritage of the MODIS product. Efforts are being made to ensure continuity between the MODIS and VIIRS data records and to explore the potential to extend the data record into the past using heritage sensors, such as the Advanced Very High Resolution Radiometer and the Along-Track Scanning Radiometer series. These activities are also part of NASA's efforts to generate an active fire Earth Science Data Record and the creation of global active fire and fire radiated power time series as part of the Fire Disturbance Essential Climate Variable of the Global Climate Observing System.

Co-Authors: *I. Csiszar, C.O. Justice, University of Maryland*

Presentation Title: Near Real Time Monitoring Of North American Fire Activity Using EOS MODIS

Presenter: *Brad Quayle*
USDA Forest Service
Salt Lake City, Utah, USA

Abstract: This paper provides an overview of the USDA Forest Service MODIS Active Fire Mapping Program. The objective of the program is to provide timely satellite-derived geospatial products, imagery and analytical data to characterize current fire conditions over broad geographic areas. The MODIS Active Fire Mapping Program leverages high temporal thermal and surface reflectance observations by the MODIS sensor onboard NASA - Earth Observation System (EOS) satellites Terra and Aqua. MODIS-derived data are acquired by the program in near real time, year round for most of North America to monitor fire activity within the changing fire seasons throughout the continent. The operational near real time acquisition and processing of MODIS data for North America is facilitated by a partnership between the USDA Forest Service Remote Sensing Applications Center (RSAC) with NASA Goddard Space Flight Center (GSFC), MODIS Land Team members at the University of Maryland, and several MODIS ground station facilities. Near real time fire detection data and imagery utilized by the program are provided by two sources: 1) a designated MODIS ground station network that receives MODIS direct broadcast data directly from Terra and Aqua providing daily data coverage over nearly all of North America; and, 2) the NASA MODIS Rapid Response System at GSFC that acquires daily MODIS data directly from the global MODIS data stream provided by the NOAA MODIS Near Real Time Processing System. Fire detection data and imagery are continually compiled, processed and analyzed by the MODIS Active Fire Mapping Program located at RSAC and used to generate a suite of geospatial fire products for comprehensive fire detection and monitoring, characterization of smoke conditions and burned area assessment. These products provide an integrated decision support tool for wildland fire managers and also support several wildland fire-related applications.

Presentation Title: How Well Does Satellite Data Quantify Fire in the United States: A Detailed Analysis with Ground-Based Data?

Presenter: *Amber Soja*
National Institute of Aerospace
NASA Langley
Hampton, Virginia, USA

Abstract: Biomass burning is a major contributor of particulate matter and other pollutants to the atmosphere, and it is one of the most poorly documented of all sources. Biomass burning can be a significant contributor to a regions inability to achieve the National Ambient Air Quality Standards for PM 2.5 and ozone, particularly on the top 20% worst air quality days. It is also anticipated that fire regimes might increase in response to climate change. Currently, the United States does not have a standard methodology to track fire occurrence or area burned, which are essential components to estimating fire emissions. One problem is the ownership and management of the land belongs to multiple organizations and private individuals, so there is not one organization that is responsible for thoroughly monitoring fire. Satellite imagery is available almost instantaneously, which could be valuable to warning the public about potential health concerns. Additionally, satellite data provides the opportunity to consistently sense fire across boundaries. The goal of this investigation is to define the ability of satellite-based fire products to detect active fire and quantify area burned in an effort to enhance existing area burned databases to enhance emissions estimates and support climate change science. Two satellite-based fire products are compared temporally and spatially to ground-based data from Alaska, Oregon and Arizona. The satellite data identify 38% of the Oregon fire scars, which accounts for 90% of the area burned and 15% of the fire counts in Arizona, which accounts for 58% of the area burned. In Alaska, 112% of the total area burned is classified. Satellite-based fire data could be used to increase the timeliness of emission estimates, augment existing fire databases, and to estimate area burned when detailed ground-based fire data are not available. However, it is imperative to understand the limitations of satellite fire detection.

Co-Authors: *Jassim Al-Saadi, Brad Pierce, Chieko Kittaka, James Szykman (EPA) NASA Langley Research Center - David J. Williams, Tom Pace USEPA, Environmental Sciences Division - T.W. Alexander, Louis Giglio, Science Systems and Applications - Joe Kordzi, USEPA - Dave Randall, Air Sciences - Tom Moore Colorado State University*

TRACK 9

Wednesday, November 15, 2006

Landscape models of fire and vegetation dynamics in research and management - A strategy for future development

Robert E. Keane
USDA Forest Service
Missoula, Montana, USA

10:30 – 11:00	***Jimmie Chew*** ***USDA Forest Service***	Designing fuel treatments on landscapes: SIMPPLLE - What makes the difference
11:00 – 11:30	***Donald McKenzie*** ***USDA Forest Service***	Stochastic modeling of fire at daily time steps from mesoscale meteorology
11:30 – 12:00	***F. Mouillot*** ***CEFE/CNRS***	A simulator for Mediterranean fire-prone landscapes (SIERRA): application for climate change studies
13:30 – 14:00	***Garry Cook*** ***CSIRO and Tropical Savannas Cooperative Research Centre Australia***	Modelling the interactive effects of fire management and rainfall variability on trees in savanna woodlands
14:00 – 14:30	***Chao Li*** ***Canadian Forest Service***	Management implicantions of spatially explicit landscape fire models
14:30 – 15:00	***Michael C. Wimberly*** ***South Dakota State University***	Fire, Feedback, and Forest Landscape Dynamics - - Applying Landscape Simulation Models to Untangle Ecological Complexity
15:30 – 16:00	***Robert Scheller*** ***University of Wisconsin***	A simulation of the effects of rural development and urbanization on forest fire regimes and forest successional dynamics
16:00 – 16:30	***Robert E. Keane*** ***USDA Forest Service***	How Big is a Landscape - Determining the size of a landscape using spatial simulation modeling
16:30 – 18:00	***Robert E. Keane*** ***USDA Forest Service***	Workshop on landscape modeling: Developing a key for model selection and a strategy for future model development

Session Title: Landscape models of fire and vegetation dynamics in research and management - A strategy for future development

Session Organizer: *Robert E. Keane*
USDA Forest Service
Missoula, Montana, USA

Abstract: Many managers are confused and unsure of what landscape models to use in any given situation. There is a wide diversity of models, computer programs, and simulation systems available to researchers and managers, but only a few of these offer the managers exactly what they need to solve a given problem. The purpose of this special session is to present current spatial models of fire and vegetation dynamics and then develop a strategy for the continued support and development of these models as they are used by management. The special session is divided into two parts: the first part of the session consists of eight, 30 min presentations on current landscape models and their applications while a subsequent session puts managers and modelers in the same room and charges them to develop a strategy on the continued development of spatial models and to develop a key that allows managers to select the most appropriate model for their desired application. This focused workshop is designed to identify those model attributes that management desires, and then to construct a key that managers can use to identify the most appropriate model for their application

Co-Organizer: *Sue Conard , USDA Forest Service*

Presentation Title: Designing fuel treatments on landscapes: SIMPPLLE - What makes the difference

Presenter: *Jimmie D. Chew*
USDA Forest Service,
Missoula, Montana, USA

Abstract: SIMPPLLE is a spatially explicit, landscape level simulation system that is being used in landscape analysis and planning at a range of scales from broad regional analyses, to watershed evaluations, to project planning. It is being used as a vehicle for transferring research results to managers. A primary use of the system is to facilitate collaboration between resource managers, scientists and stakeholders. A managers decision to use any tool is based on what is required to adequately address issues. Many design features in SIMPPLLE that may make it different from other modeling systems provides managers choices to fit the tool to specific issues using available data. These design features and the choices they provide managers will be discussed. Examples of these features and choices will be covered using current applications of SIMPPLLE.

Presentation Title: Stochastic modeling of fire at daily time steps from mesoscale meteorology

Presenter: *Donald McKenzie*
USDA Forest Service

Abstract: Significant changes in fire severity and fire size are predicted for many ecosystems as a result of land-use change, climatic change, and fire exclusion. In many ecosystems, warmer temperatures and associated drought are significantly related to increased fire. Statistical models can predict annual or seasonal averages of fire extent at scales from watersheds to ecoregions, but both fire forecasting and estimation of fire effects such as smoke production, carbon release, and air-quality reduction require daily or hourly time steps to be useful. We present a Fire Scenario Builder (FSB) that uses a simultaneous weighting of known influences on fire occurrence to create mapped distributions of fire probabilities, including both the likelihood of a fire occurring and the probabilistic distribution of fire sizes. Key input layers are mesoscale meteorology (MM5) at scales from 12-36 km, atmospheric stability indices (CAPE) and fuel moistures (from NFDRS), and mean-field estimates of seasonal area burned at the same scale as the meteorology. Combining these influences into a probabilistic model produces downscaled (to daily) estimates of fire-occurrence probability and fire sizes. We present the results of simulations at 12-km for the Pacific Northwest and 36-km for the western United States, using simulated meteorology for both current (1990-1999) and future (2045-2054) decades. We show two applications of the FSB in conjunction with other models: continental-scale increases in fire emissions from the 36-km simulations and visibility reductions over national parks and wilderness areas in the Pacific Northwest and northern Rocky Mountains. The FSB provides a partly mechanistic alternative to probabilistic estimates of fire frequency or natural fire rotation from historical fire-regime statistics, and is best used at intermediate scales between those associated with global vegetation models and those associated with landscape fire succession models.

Co-Authors: *Susan M. O'Neill, Narasimhan A. Larkin, USDA Forest Service -*
Robert A.Norheim, Jeemy S. Littell, University of Washington

Presentation Title: A simulator for Mediterranean fire-prone landscapes (SIERRA): application for climate change studies

Presenter: *F. Mouillot*
IRD UR060 CEFE/CNRS
Montpellier, France

Abstract: Fire is by far the most frequent and widespread disturbance in Mediterranean ecosystems, and the fire regime might be altered by climate change. With the objectives to evaluate the interrelated effects of climate change on vegetation dynamics, aboveground biomass, water fluxes and the induced fire regime for a typical Mediterranean ecosystem, we developed a simulation process-based model SIERRA built for simulating plant communities and landscapes and their response to fire. SIERRA is a spatially explicit model which combines both processes determining vegetation dynamics and mechanisms affecting ecosystem-scale flows. It is based on 3 main assumptions: 1) Water and solar radiation are the overriding factors limiting primary production. 2) two types of interactions between individuals are simulated: the same use of water resource and the extinction of solar radiation and 3) plant status is determined but its water and carbon budget and specific life history traits as seeders or resprouters. Space is explicitly considered by simulating the changes in soil and plant water status and plant cover at each cell (30m x 30m resolution) of a landscape and the spatially explicit processes relating to adjacent cells such as runoff, seed dispersal and to allow some coupling with fire spread processes. Space is also implicitly considered by a spatial representation of soil properties, rainfall event and solar radiation according to topography. We present here the major processes included in the model, and some application on climate change scenarios forecasted for the Mediterranean basin.

Co-Authors: *Rambal, S., IRD UR060 CEFE/CNRS, France*

Presentation Title: Modelling the interactive effects of fire management and rainfall variability on trees in savanna woodlands

Presenter: *Garry Cook*
CSIRO and Tropical Savannas Cooperative Research Centre
Winnellie, NT, Australia

Abstract: Northern Australian savannas are subject to very frequent fires, over about one every two years. While the trees are highly fire tolerant, fire intensity and tree survival varies with fire seasonality. Land managers are concerned with how seasonality and frequency affect the savanna landscapes. We have used observations from the Kapalga fire experiment and other data to develop the Flames model of tree dynamics. The Flames model is a process based simulation model that follows the fate of individual trees in a stand over time. It model considers a range of factors important to trees. For example water is modeled where daily rainfall provides water which is stored in the soil or runs off to downslope areas. Trees and grasses use the stored water for growth and water limitations lead to tree mortality and grass death. Grass competes with trees for water and provides fuel for fire. A large range of fire regimes can be simulated which use the amount of fuel, weather conditions at the time of the fire, and the fire ignition type to determine the fire characteristics. Trees survive fire as a function of the fire intensity and the size of the tree. By simulating a wide range of aspects affecting trees, the model is able to provide the outcome of fire management and climatic variability over time scales of a couple centuries. In this talk we will explain how the model works, the use of the model to better understand ecosystem processes, and how the model has been used in education and engagement of land managers.

Co-Authors: *Adam Liedloff , CSIRO and Tropical Savannas Cooperative Research Centre, Winnellie, NT, Australia*

Presentation Title: Management implicantions of spatially explicit landscape fire models

Presenter: *Chao Li*
Canadian Forest Service
Edmonton, Alberta, Canada

Abstract: Forest managers are facing increased challenges from multiple management Objectives including social, environmental, ecological, and economic considerations. For making balanced management decisions, proper tools are required to assist the decision making Spatially explicit landscape fire models are one kind of the tools that could assist forest fire and land managers in making management decisions either strategically or operationally. Despite the capabilities of different models in addressing a particular issue may or may not be the same, each model has its own strengths and weakness because of its original purpose of development. There are many spatially explicit landscape fire models, and I will focus on the SEM-LAND model developed originally for the reconstruction of natural fire regimes based on current forest conditions. The model has been further developed to address other management implications including climate change impact and mitigation, forest age distribution dynamics and fire regime, and forest productivity and carbon dynamics. In this presentation, an overview of model structure and the model applications will be described. A case study will also be presented to demonstrate how the model could be useful in exploring the changes in the dynamics of forest age distribution under different fire regimes, and the associated changes in forest conditions such as old growth forests, wildlife habitats, and carbon dynamics.

Presentation Title: Fire, Feedback, and Forest Landscape Dynamics -- Applying Landscape Simulation Models to Untangle Ecological Complexity

Presenter: *Michael C. Wimberly*
South Dakota State University
Brookings, South Dakota, USA

Abstract: Spatially explicit computer simulation models of natural disturbances, land management activities, and ecological processes are playing an increasingly large role in the development and evaluation of landscape management strategies. One potential application of these models is to explore the potential for unexpected behavior arising from interactions among system components. We carried out a modeling experiment to examine the influence of fire frequency on old growth forests in ecosystems characterized by strong feedbacks between vegetation structure and fire behavior, and assessed how sensitive the results were to changes model parameterization and specification. This study used the LADS (Landscape Dynamics Simulator) model, which was originally developed to study historical variability of old growth forests in the coastal Pacific Northwest. The model has since been extended to incorporate live and dead biomass dynamics, species metapopulation dynamics, and state-and-transition modeling of multiple successional pathways. We parameterized LADS to simulate vegetation dynamics for a hypothetical forest community comprised of both fire-resistant, early successional species and fire-sensitive, late-successional species. Fuel accumulation affected both fire severity and the probability of fire spread in the various successional stages. Key findings were that (1) there is a possibility of large changes in landscape composition resulting from small shifts in fire frequency near critical thresholds, (2) simulation results are potentially sensitive to initial conditions, and (3) parameters controlling the rate of development of ladder fuels, fire severity in older successional stages, and fire spread into older successional stages have a strong influence on model predictions. The results of this type of modeling experiment can be used to derive general principles upon which to base landscape management strategies, and to identify key sources of information that are need to refine model parameterization and improve predictions for specific landscapes.

Co-Authors: *Rebecca S. H. Kennedy, Thomas A. Spies, USDA Forest Service*

Presentation Title: A simulation of the effects of rural development and urbanization on forest fire regimes and forest successional dynamics

Presenter: *Robert Scheller*
University of Wisconsin
Madison, Wisconsin, USA

Abstract: In many landscapes, forests are becoming increasingly fragmented and urbanized. Consequentially, there will be significant alterations to disturbance regimes with subsequent effects on forest tree species composition. Fragmentation will also reduce the ability of tree species to disperse across forest landscapes. We examined these issues in the context of the New Jersey pine barrens (NJPB). The NJPB is experiencing rapid rural development and urbanization causing increased forest fragmentation that has limited the size and frequency of wild fires and has limited the use of prescribed fires as a management tool. To assess and understand the consequences of fragmentation and the altered fire regime on forest communities, we used a simulation modeling approach. Specifically, we used LANDIS-II, a spatially dynamic forest succession model that represents individual tree species and fires that are sensitive to fuel loads and their spatial configuration. We compared simulations of the current day landscape and the historical unfragmented landscape. Our simulations indicate that relative to the historic landscape and fire regime, the current landscape will change over time from a pine-dominated to an oak-dominated state. In general, there will be substantial departure from the historic vegetation (a change in the 'fire regime condition class') except for isolated areas where prescribed burning remains a viable management option. Total aboveground biomass would also increase, causing increased intensity of wind disturbances. In summary, rural development and an altered fire regime will likely lead to a significant shift in the dominant vegetation type and the fire regime condition class.

Co-Authors: *David J. Mladenoff, University of Wisconsin*

Presentation Title: How Big is a Landscape - Determining the size of a landscape using spatial simulation modeling

Presenter: *Robert E. Keane*
USDA Forest Service
Missoula, Montana, USA

Abstract: Dividing large regional areas into smaller, manageable landscape units presents a special problem in landscape ecology and land management. Ideally, a landscape should be large enough to capture a full range of vegetation, climatic and disturbance dynamics, but small enough to be useful for management objectives. The purpose of this study was to determine the optimal landscape size and corresponding map resolution to summarize ecological processes for two large land areas in the southwestern United States. LANDSUMv4, a vegetation and disturbance dynamics model, was used to simulate a set of scenarios that involved systematic variation of landscape topographic complexity, map resolution, and model parameterizations of fire size and fire frequency for a range of landscape sizes called reporting units. Spatial input data were supplied by the LANDFIRE (LANDscape FIRE Management Planning System) prototype project, a national project that will provide comprehensive and scientifically credible mid-scale data to support implementation of the National Fire Plan. We analyzed output from 2,000 year simulations to determine the thresholds of landscape behavior based on the variability of burned area and dominant vegetation coverage. For these southwestern landscapes, results show that optimal landscape extent using burned area variability is approximately 100 km2 in size depending on topographic complexity, map resolution, and model parameterization. The variability of dominant vegetation class is higher and the optimal landscape sizes are slightly larger in comparison to those determined from burned area. Results of this study provide specific recommendations of summary landscape size and map resolution choices for the LANDFIRE project. Additionally, the study introduces a methodology for determining landscape sizes and map resolutions that optimally summarize ecosystem dynamics of fire regime, vegetation composition and vegetation structure.

Co-Authors: *Eva C. Karau, USDA Forest Service*

Workshop Title: Workshop on landscape modeling: Developing a key for model selection and a strategy for future model development

Organizer: *Robert E. Keane*
USDA Forest Service
Missoula, Montana, USA

Abstract: This workshop will be conducted in two sections. The first two hours of the workshop will attempt to build a key for managers to use when selecting a landscape model for a specific task, and the second two hours will attempt to develop a set of guidelines that funding agencies can use to support model development into the future. The model selection key development will be accomplished by, first, identifying those issues that land managers are most concerned when selecting models. The most important aspect is the ability of a model to answer the simulation objective, but other issues may include cost, simplicity, ease of use, and degree of complexity. Simulation objectives must be classified into broad groups. Next, we identify those attributes that the modelers feel best describes their models in the context of the identified issues. Then, we will attempt to construct a key that can be used to identify the set of models that can be used for a specific task. The second part of the workshop will be a session that will document what modelers, managers, and administrators feel is important in developing and refining models into the future. These ideas should help funding agencies, project leaders, and other modelers develop integrated models for the right publics and clients. Ideas might include the posting of a model's code to a web site, conducting and publishing extensive sensitivity analyses on developed models, developing a strategy for the transfer of a model to land management. The results of the two parts of this workshop will be written into a report and published in a general technical report. Everyone is invited to attend.

TRACK 10

Wednesday, November 15, 2006

Fire History – Fire Regimes

10:30 – 10:45	***Gregory Nowacki*** ***USDA Forest Service***	Altered disturbance regimes: The demise of fire in the eastern United States
10:45 – 11:00	***Brean W. Duncan*** ***Dynamac Corp.*** ***University of Central Florida***	Characterization of a managed fire regime within a pyrogenic ecosystem on Kennedy Space Center/ Merritt Island National Wildlife Refuge, Florida
11:00 – 11:15	***Dana Cohen*** ***USDA Forest Service***	Characteristics of Lightning Caused Fires at Great Smoky Mountains National Park
11:15 – 11:30	***Patricio Pedemera-Alvarez*** ***School of Forestry Engineering*** ***Universidad Mayor***	Spatial and Chronological evaluation of forest fires in Chile between 1985 and 2005
11:30 – 11:45	***Klaus Braun*** ***ICS Group***	Diverse fire regimes in a fire-prone environment - Charles Darwin Reserve, Western Australia
11:45 – 12:00	***Roy Wittkuhn*** ***Western Australia*** ***Department of Conservation and Land Management***	Mapping fire regimes of Western Australian in a GIS - viewing temporal data in a spatial context
13:30 – 13:45	***Rand R. Evett*** ***University of California - Berkeley***	Using phytolith analysis to test the hypothesis that livestock overgrazing a grass understory led to changes in prehistoric fire regimes at two locations in Californian mixed-conifer forests
13:45 – 14:00	***Russell Parsons*** ***USDA Forest Service***	Assessing accuracy of point fire intervals across landscapes with simulation modeling
14:00 – 14:15	***David Mladenoff*** ***University of Wisconsin - Madison***	Testing historical forest landscape reconstructions vs. models
14:15 – 14:30	***Edward Berg*** ***USDI Fish and Wildlife Service***	Fire history of spruce forests on the Kenai Peninsula, Alaska, on scales of decades to millennia, using fire scars, soil charcoal and lake sediments
14:30 – 14:45	***Andrea Thode*** ***Northern Arizona University***	Quantifying the fire regime attributes of severity and spatial complexity using Landsat TM imagery in Yosemite National Park, CA
14:45 – 15:00	***Steve Wathen*** ***University of California - Davis***	Evidence that abrupt climate change over the last 8,500 yrs caused massive forest die-off followed by catastrophic fire and severe soil erosion

15:30 – 15:45	***Elaine Kennedy Sutherland*** ***USDA Forest Service***	Temporal and spatial patterns of fire in riparian and upland subalpine forests of western Montana
15:45 – 16:00	***Peter M. Brown*** ***Rocky Mountain Tree-Ring Research***	The evidence for mixed-severity fire regimes in Black Hills ponderosa pine forests
16:00 – 16:15	***Calvin Farris*** ***USDI National Park Service***	A Multi-Scale Assessment Of Targeted And Systematic Fire Scar Sampling At Three Sites Across The Southwest
16:15 – 16:30	***Tadashi Moody*** ***University of California - Berkeley***	Fire History and Climate Influences from Forests in the Northern Sierra Nevada, USA
16:30 – 16:45	***Andrew Scholl*** ***Pennsylvania State University***	Reconstructing historic spatial and temporal patterns of fire regimes and forest dynamics in Sierra Nevada mixed conifer forests
16:45 – 17:00	***Anthony Caprio*** ***USDI National Park Service***	Fire History of Lodgepole Pine in the Southern Sierra Nevada, California

Session Title: Fire History – Fire Regimes

Presentation Title: Altered disturbance regimes: The demise of fire in the eastern United States

Presenter:

Gregory Nowacki
USDA Forest Service
Milwaukee, Wisconsin, USA

Abstract:

Past and current fire regimes and temporal changes were mapped for the eastern United States using Geographic Information Systems (GIS) and available vegetation data layers. Substantial reductions in fire (in terms of frequency and severity) were shown throughout the East, consistent with the historical record. The most dramatic shifts took place in the former grasslands of the Midwest and across a broad swath of southern and central States where pine and oak communities historically dominated. Change was somewhat limited in northern hardwood systems (Upper Great Lakes; New England), in mixed mesophytic forests, and within the Mississippi Embayment — areas where fire was historically infrequent. Fire-dependent species, already negatively affected by long-term fire regime alteration, will further degrade with continued fire suppression. Likewise, restoration opportunities for fire-dependent communities will wane over time for a combination of reasons (lack of regeneration opportunities; local population extirpation; replacement by shade-tolerant and invasive non-native species).

Co-Authors: *Robert Carr, USDA Forest Service*

Presentation Title: Characterization of a managed fire regime within a pyrogenic ecosystem on Kennedy Space Center/Merritt Island National Wildlife Refuge, Florida

Presenter:

Brean W. Duncan
University of Central Florida
Orlando, Florida, USA

Abstract:

Pyrogenic ecosystems of the southeast and their native biodiversity have been impacted by fire suppression. The John F. Kennedy Space Center (KSC)/Merritt Island National Wildlife Refuge (MINWR) is the largest conservation land holding on the east coast of Florida and is important habitat for many fire adapted T&E species. A 20 year fire suppression period followed the establishment of KSC/MINWR in the early 1960's. In 1981 after severe wildfires, a prescribed burning program was implemented to maintain fuels at safe levels and has become the primary mechanism for maintainin upland habitat for native species. In this study, we document the first 23 years of a human-managed fire regime on KSC/MINWR. We employed a time series of Landsat Thematic Mapper and SPOT satellite imagery dating from 1984 to 2004. We utilize 2 scenes per year, because rapid regrowth after fire obscures burn scars. A stepwise image processing routine was used that selects the best image features for accurately classifying burned from unburned areas. The classification routine performs well in xeric/mesic upland sites and moderately well in hydric sites such as wetlands and impoundments. A confidence attribute was utilized in the GIS database, labeling each fire scar giving the end user the ability to use or not use scars with known mapped confidence. Preliminary results indicate that 270 fires larger than 10 hectares in size were mapped. Roughly 92% of the burns were prescribed ignitions with the remaining 8% being lightning caused. Summer fires were most abundant with 29%, fall was second at 27%, winter was third with 26%, and spring was least abundant at17%. Prescribed burning programs should be a prominent part of all conservation efforts in pyrogenic systems, it is important that we learn from current programs that have the potential to teach us about managing fire regimes.

Co-Authors: *Guofan Shao, Purdue University - Frederic W. Adrian, Merritt Island National Wildlife*

Presentation Title: Characteristics of Lightning Caused Fires at Great Smoky Mountains National Park

Presenter: *Dana Cohen*
USDA Forest Service
Fredonia Arizona,USA

Abstract: Great Smoky Mountains National Park had a policy of suppressing all fires from its inception in 1934 until the adoption of wildland fire use (WFU) policy in its 1996 Fire Management Plan. This enables Park fire staff to manage lightning-caused fires to accomplish resource objectives, providing that the fires meet certain predefined conditions. The Smokies is the first federal land management unit in the Southern Appalachians to address natural ignitions without suppressing them. Since the first WFU fire was implemented in 1998, the fire use statistics have been revealing an impressive lesson about the nature of lightning ignitions in the park. Fire control records compiled for the time period from 1942 through 1997 show 1,261 in-park acres burned due to suppressed lightning-ignited fires. Unsuppressed lightning fires, including one experimental fire in 1976 and the ignitions managed under the park's WFU policy from 1998-2005, come to a total of 1,130 acres. As Great Smoky Mountains National Park comes towards the end of its first decade of implementing a wildland fire use (WFU) policy, it is becoming clear that the increased acreages observed from unsuppressed lightning fires are not an experimental fluke or an aberration from an extreme fire season. The success of these wildland fire use fires raises an important question. Have we been underestimating the type of fire that shaped the landscape we are now trying to manage? This presentation will explore the features of lightning caused fires within the park, from fire behavior and effects to burn seasonality and intensities. From studying these fires, managers may learn important details of the nature of fire within the southern Appalachians and discern the most appropriate means to restore fire to the landscape.

Presentation Title: Spatial and Chronological evaluation of forest fires in Chile between 1985 and 2005

Presenter: *Patricio Pedemera-Alvarez*
School of Forestry Engineering
Universidad Mayor
Santiago, Chile

Abstract: This work shows the spatial and chronological evaluation of forest fires occurrence in Chile recorded between the years 1985 to 2005. The goal of the analysis was to identify changes in the spatial and chronological patterns of the fire problem in Chile. The methodology considers the analysis of 118,956 fire reports recorded in the National Fire Management Information System owned by Corporación Nacional Forestal (CONAF). The reports included complete information about date and time of fire beginning, control actions, causes, affected areas and others. The reports were sorted and processed by using MS Access database administrator to compile the numerical statistics needed for the study. The chronological analysis considered use of moving means and statistical tests to probe the existence of significant differences between fire seasons at national and regional levels. For the spatial analysis, it was constructed a computer program to convert the spatial reference system of the CONAF database to UTM coordinates, in order to construct seasonal fire maps for both analysis levels (national and regional). The spatial analysis was developed using Arcgis as GIS software. By using image comparison methods, we can be able to demonstrate the existence of repetitive spatial patterns inside each administrative region of Chile. The chronological analysis showed that there was three the causes which concentrates the 60% of forest fires in our country: Arsons, Pedestrians and Children Playing. The arson causes shows a big increase in the last five years, moving from 14.2% (in 1985) to 26.8% in the 2005 season. The spatial patterns determined by the analysis showed a significant difference (a change in the spatial distribution) in the IX region; also, it showed an increment in the fire activity in some regions where we didn't have historical records of fires.

Presentation Title: Diverse fire regimes in a fire-prone environment - Charles Darwin Reserve, Western Australia

Presenter: *Klaus Braun*
ICS Group
Narrikup, Western Australia

Abstract: The Charles Darwin Reserve is located 300km north of Perth in Western Australia. The reserve was purchased in 2003 by the Australian Bush Heritage Fund and is approximately 68,000ha in size. Predominant vegetation communities are woodland and shrublands. Wildland fires regularly burn in the Reserve and are part of its dynamic ecosystem. Lightning is the main cause of fires in the Reserve. Early aerial photographs and satellite images were used to establish the recent fire history of the Reserve. It was found that landscape-scale fires burned essentially the same area in the west of the Reserve in the late 1960s and again in December 2000. A number of smaller fires also burned in this area between the late 1960s and 2000. A large part of the Reserve (approximately 60%), however, remained unburned during this period. The fire history indicates that most fires in the Reserve, and the largest areas burned, were in one particular land system – the Joseph land system. At the same time approximately 30% of the Joseph land system remained unburned during this period. It appears that vegetation in other land systems have some resilience to fire. Even though the fire history could only be established for the past 50 years, the age of woodland trees in some areas suggests that large parts of the Reserve have remained unburned, or have not been burned in a moderate or high intensity fire, for more than 100 years, and possibly several hundred years. Very diverse fire regimes exist in the Reserve. These are most likely linked to land systems and habitats. The challenge is to learn more about these fire regimes to ensure that long term wildland fire management achieves the conservation objectives for the Reserve in a fire-prone environment.

Presentation Title: Mapping fire regimes of Western Australian in a GIS - viewing temporal data in a spatial context

Presenter: *Roy Wittkuhn*
Department of Conservation and Land Management
Manjimup, Western Australia

Abstract: The focus of fire research has shifted over the last few years from impacts of individual fires on ecosystem processes to influence of fire regimes (cumulative effects of fire). One of the difficulties associated with fire data is its complexity in both space and time. In particular, diagnostic methods to investigate temporal patterns of certain factors (e.g. season-of-burn, fire interval, fire type), often ignores the spatial component. We used a recently completed fire history database (FHD) from southwestern Australia to test a classification method we developed to map temporal data in a spatial context. The FHD contains records of past fires (both planned and unplanned) in a geographic information system (GIS) with data layers and attributes of fires for each year. In this paper we introduce a classification technique that creates a new shapefile for mapping temporal fire data in a spatial context. This technique is particularly useful when a large area has the same fuel age but different fire histories. By classifying each value within a factor (e.g. season of burn) with a unique number (e.g. spring = 1, summer = 2, autumn = 3 and winter = 4), we can assign these numbers to every fire in the FHD. By lining up each fire at a given point in space in reverse time series (most recent to least recent), we can create a sequence of numbers that shows the temporal pattern for that factor. Using the season-of-burn example: if the most recent fire was in spring (=1), prior to that autumn (=3), prior to that summer (=2), then the sequence '132' is generated. For overlapping fires through time, polygons with unique fire histories are created and the sequence of numbers is generated. These sequences can be mapped spatially, allowing a rapid assessment of temporal patterning for a given factor across the landscape. This categorical system can be used for any historical data with a finite number of classifications.

Co-Authors: *Tom Hamilton, Department of Conservation and Land Management*

Presentation Title: Using phytolith analysis to test the hypothesis that livestock overgrazing a grass understory led to changes in prehistoric fire regimes at two locations in Californian mixed-conifer forests

Presenter: *Rand R. Evett*
University of California – Berkeley
Berkeley, California, USA

Abstract: Tree ring fire-scars in stands throughout the range of Californian mixed-conifer forest record a high frequency, low intensity prehistoric fire regime. One hypothesis, well-established in the monsoonal
southwestern USA, proposed to explain the dramatic decrease in fire frequency occurring throughout the region following the arrival of European settlers in the late 18th-mid-19th centuries is the introduction of livestock led to overgrazing of a prehistoric grass understory and substantial disruption of fine fuel continuity required for frequent fires. We used phytolith analysis to test this hypothesis at two widely separated locations currently with minimal grass cover: a Jeffrey pine-mixed conifer forest in the Sierra San Pedro Mártir, Baja California, Mexico, and a giant sequoia-mixed conifer stand in Calaveras Big Trees State Park in the central Sierra Nevada, California. Phytoliths, microscopic silica bodies found in many plants but produced in large quantities with distinctive morphotypes in grasses, are preserved for thousands of years in the soil. Soils under vegetation with extensive prehistoric grass cover retain a high concentration of grass phytoliths regardless of historic vegetation changes. Phytoliths extracted from soil samples collected from several sites at each location told the same story: total phytolith concentrations in forest soils were generally <0.5% by weight, with most <0.1%; grass phytoliths were generally <10% of the total. These values suggest each location was forest with sparse grass cover in the understory, similar to current vegetation, prior to European settlement. The presence of shrubs in the prehistoric understory could not be determined because most of them produce negligible quantities of non-diagnostic phytoliths. Because heavily grazed forests in the monsoonal southwestern USA continue to have considerable grass cover, the current and prehistoric lack of substantial grass cover in Californian mixed-conifer forests may be more related to minimal summer precipitation characteristic of a Mediterranean climate rather than overgrazing.

Co-Authors: *Scott L. Stephens, James W. Bartolome, University of California, Berkeley - Ernesto Franco-Vizcaino, Departamento de Biología de Conservación, Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), Ensenada, Baja California*

Presentation Title: Assessing accuracy of point fire intervals across landscapes with simulation modeling

Presenter: *Russell Parsons*
USDA Forest Service
Missoula, Montana, USA

Abstract: We assessed accuracy in point fire intervals using a simulation model that sampled four spatially explicit simulated fire histories. These histories varied in fire frequency and size, and were simulate on a flat landscape with two forest types (dry versus mesic). We used three sampling designs (random, systematic grids and stratified). We assessed the sensitivity of estimates of point fire intervals to factors that degrade the fire-scar record: failure of a tree to record a fire, and loss off fire-scarred trees. Accuracy was affected by all the factors investigated and generally varied with fire-regime type. The maximum error was from degradation of the record, primarily because degradation reduced the number of intervals from which mean intervals were estimated. The sampling designs were roughly equal in their ability to capture the overall mean point fire interval, regardless of fire regime, but the gridded design yielded more accurate estimates of spatial variation in point fire intervals. Accuracy increased with increasing number of points sampled for all fire regimes and sampling designs, but the number of points needed to obtain accurate estimates was greatest for fire regimes that yielded complex spatial patterns of fire intervals than for those that yielded relatively homogeneous patterns.

Co-Authors: *Emily Heyerdahl, Robert E. Keane, USDA Forest Service -*
Brigitte Dorner, Simon Fraser University

Presentation Title: Testing historical forest landscape reconstructions vs. models

Presenter: *David Mladenoff*
University of Wisconsin
Madison, Wisconsin, USA

Abstract: Forest reconstructions from independent historical data are often offered as a test for simulation model results. The opposite is also true: if correctly parameterized, model results should be able to serve as tests for the historical reconstructions. Multiple assumptions need to be made on both sides of this equation for this to be a suitable evaluation. I will review these assumptions, and present results from a historical landscape in northern Wisconsin, USA, and compare this to the results of a LANDIS simulation of the same landscape. Results show that spatial resolution of the historical data, and the simulation resolution (cell size) are critical for a valid comparison, as is the level of dynamics contained in the model. Results may be valid at one scale, but not another.

Presentation Title: Fire history of spruce forests on the Kenai Peninsula, Alaska, on scales of decades to millennia, using fire scars, soil charcoal and lake sediments

Presenter: *Edward Berg*
USDI Fish and Wildlife Service
Soldtona, Arkansas, USA

Abstract: We conducted three data-intensive studies to examine the fire history of the Kenai Peninsula on three different time scales. The Kenai Peninsula has two distinct fire regimes: a high frequency regime in black spruce (Picea mariana) and a low frequency regime in white (P. glauca) and Lutz (Picea x lutzii) spruce. We estimated a mean fire return interval (MFI) of 79 years in black spruce forests from the analysis of 189 fire scars, death dates of fire-killed trees, and age class analysis. We used 121 radiocarbon-dated soil charcoal samples to estimate an MFI of 400-600 years for extensive Lutz spruce stands over the last 2500 years, at 22 sites. Times-since-last-fire ranged from 90 to approximately 1500 years. Using dendrochronology and growth releases, we determined Lutz spruce forests are thinned to varying degrees by spruce bark beetles (Dendroctonus rufipennis) with an estimated mean beetle return interval of 52 years. To assess the entire post-glacial fire record, we conducted a high-resolution analysis of sedimentary charcoal in a 9-meter core from Paradox Lake in an area of mixed white and black spruce forests. Charcoal was measured at 1-cm intervals which provided a 13,000 year record of fire activity. Fire frequency was lowest during the initial shrub tundra period with an MFI of 130 years beginning 13,000 years before present (BP), increased after the arrival of birch (Betula papyrifera), willow (Salix spp.), and Populus to a MFI of 77 years at 10,700 years BP, and decreased slightly to a MFI of 81 years with the arrival of white spruce at 8500 years BP. When black spruce arrived at 4500 years BP, fire activity declined to the present MFI value of 138 years, presumably reflecting the onset of a cooler and wetter climate.

Co-Authors: *R. Scott Anderson, Northern Arizona University - Andrew D. DeVolder,*
USDI Fish and Wildlife Service

Presentation Title: Quantifying the fire regime attributes of severity and spatial complexity using Landsat TM imagery in Yosemite National Park, California

Presenter: *Andrea Thode*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Fire regimes are a useful way to classify, describe and categorize the pattern of fire occurrence through time and space and can be described using seven fire regime attributes: seasonality, frequency, size, spatial complexity, intensity, severity and type. Over the last 20 years, assessing different methods for mapping burn severity using remote sensing has been an active area of research with good results. This work uses remote sensing to quantify the fire regime attributes of severity and spatial complexity for a 19-year time period in Yosemite National Park. Eight different methods for mapping burn severity were tested and the top four indices showed no significant difference in their final classifications for burn severity. One of these top four indices was chosen to map burn severity for 99 large fires in Yosemite National Park that burned between 1984 and 2003. The resultant burn severity atlas was used to quantify the fire regime attributes of severity and spatial complexity. These current distributions of severity and spatial complexity are compared to historic, theoretical distributions and discussed. This study is a first attempt at quantifying the distribution of effects by fire regime types for a large landscape over a longer time period. As this process is refined and combined with other fire regime attributes, a new set of valuable information will be available for researchers and land mangers. This information can be used to understand how fire regimes have changed from the past and how we might be able to change them in the future.

Co-Authors: *Jay Miller, USDA Forest Service*

Presentation Title: Evidence that abrupt climate change over the last 8,500 yrs caused massive forest die-off followed by catastrophic fire and severe soil erosion

Presenter: *Steve Wathen*
University of California – Davis
Davis, California, USA

Abstract: Evidence from Greenland ice cores and elsewhere suggest that climate change sometimes occurred abruptly during the Holocene resulting in rapid changes in vegetation patterns. The Earth is warming rapidly and there is concern that additional warming could trigger destructive changes in the Earth's climates. This paper will report on an investigation into the environmental effects of abrupt climate change during the Holocene. The timings of large charcoal peaks in lake sediments from Coburn Lake, California were compared with evidence for abrupt climate change events over the last 8,500 yrs as recorded in sediments from pluvial Pyramid Lake, Nevada and ice cores from central Greenland. Charcoal peaks from Coburn Lake, California were significantly correlated with abrupt declines in precipitation during the Holocene as recorded in Greenland. Evidence suggests that catastrophic fires and erosion in the northern Sierra Nevada during the Holocene coincided with drought, and often cold temperatures and soot deposition, in central Greenland, including during the 8,200 yr event. The results of this investigation suggest that abrupt climate changes during the Holocene caused vegetation and mountain slopes around Coburn Lake to be severely out of balance with changing climates. This resulted in instances of massive forest die-off, followed by catastrophic fire and severe soil erosion. Comparisons with published results from other charcoal studies undertaken in the Sierra Nevada, Idaho, and Montana suggest that abrupt climate change may have had similar effects over large areas of the western United States. Finally, the results provide additional evidence that the 8200 yr event recorded in Greenland ice cores, and perhaps other abrupt climate change events, occurred simultaneously in different regions of the world.

Presentation Title: Temporal and spatial patterns of fire in riparian and upland subalpine forests of western Montana

Presenter: *Elaine Kennedy Sutherland*
USDA Forest Service
Missoula, Montana, USA

Abstract: Fire is a dominant process in forest dynamics of the northern (U.S.) Rocky Mountains, but we know little about the spatial and temporal variation of fire in subalpine forests, particularly about sensitive riparian zones. Our objective was to build spatially- and temporally-explicit fire histories in west central Montana. These coniferous forests are dominated by Pseudotsuga menziesii and Pinus contorta, with admixtures of Abies and Picea. Using a systematic approach, we collected fire-scar and tree core samples from the uplands and riparian zones of 12 remote, unlogged, unroaded drainages with similar biophysical characteristics. Our results show that over the past 400 years, fire severity and frequency varied over the landscape, sometimes and in some places killing trees, but in others only injuring them. Fires continued well into the 20th century, virtually to the present in these remote locations. Fires were about as frequent in riparian zones as in the uplands, occurring about every 10-20 years, and patchily distributed, with a range of severities. Positioning of scars within and between annual rings shows that in the uplands, fires burned throughout the dormant season and summer, but almost entirely during the dormant season in riparian zones. In riparian zones, low intensity fires may play an important ecological role in the dynamics of shrubs, grasses, and forbs, and hence wildlife and fish habitats. These results may shed new light on disturbance processes and vegetation dynamics in riparian systems.

Co-Authors: *Zeigler, E.T., M.J. Burbank, and D.K. Wright, USDA Forest Service*

Presentation Title: The evidence for mixed-severity fire regimes in Black Hills ponderosa pine forests

Presenter: *Peter M. Brown*
Rocky Mountain Tree-Ring Research
Ft. Collins, Colorado, USA

Abstract: Annual area burned in the western US has trended upward over the last few decades. A major question confronting managers in dealing with this trend is how much of this increase is the result of changes in fuel and vegetation conditions due to past management practices (primarily fire suppression and timber harvest) and how much may be the result of changing regional and global climate regimes that are affecting warmer and drier fire seasons. Fire atlas data only cover the last few decades and are both too short to answer this question and biased by fire management actions. Broad-scale, centuries-long networks of tree-ring based fire and forest histories have proven critical to distinguish fire occurrences that are affected by top-down, regional climatic variations from bottom-up factors such as local fuel complexes or climate regimes that vary across gradients in elevation and vegetation types. In this talk, we describe a recently completed network of crossdated fire-scar and tree-recruitment chronologies from 13+ watersheds in Utah and eastern Nevada. Chronologies were developed from pinyon-juniper, ponderosa pine, mixed-conifer, aspen, and subalpine forests. We graphically and statistically compare synchrony and asynchrony in fire occurrences across multiple scales - including within and between forest types, watersheds, and those that were synchronous across the entire region - with independently derived climate reconstructions - including Palmer drought severity and global circulation indices, such as the El Niño-Southern Oscillation, Pacific Decadal Oscillation, and Atlantic Multidecadal Oscillation - to derive inferences about the relative contribution of local and regional effects on past fire occurrence. Results allow parsing of variance in fire occurrences by forest type, elevation, and year, and provide both a longer-term perspective in which to place the recent increase in area burned as well as implications for future fire and forest management.

Co-Authors: *Emily Heyerdahl, Stanley Kitchen, USDA Forest Service*

Presentation Title: A Multi-Scale Assessment Of Targeted And Systematic Fire Scar Sampling At Three Sites Across The Southwest

Presenter: *Calvin Farris*
USDI National Park Service
Klamath Falls, Oregon, USA

Abstract: Fire scars are the primary source of physical evidence for reconstructing fire history in forests dominated by non-lethal fires. Because fire scars are not distributed uniformly in space and time, random and systematic sampling strategies are not always feasible. Consequently, fire historians often "target" samples across the landscape to obtain spatially distributed and well-preserved sequences of fire scars to encompass maximum time periods. Empirical comparisons of targeted and non-targeted samples for a given area are needed to determine whether targeting results in biased estimates of fire frequency. In this study, we compared fire frequency parameters reconstructed from targeted sampling and non-targeted sampling (systematic or complete census) at three ponderosa pine-dominated study sites across the Southwest: Centennial Forest near Flagstaff, AZ (100 ha), Monument Canyon near Albuquerque, NM (256 ha), and Mica Mountain near Tucson, AZ (2,780 ha). Analytical techniques used to quantify fire frequency were first calibrated against modern mapped fires. We found no significant differences between Mean Fire Return Intervals (MFI) and Natural Fire Rotations (NFR) calculated from targeted and non-targeted data. Percentage of sample sites scarred in any given year was highly correlated between targeted and non-targeted sets (r2 = 0.73, 0.90, and 0.84 respectively). Moreover, all sampling strategies generally identified the same major fire dates in each study area. Not surprisingly, targeted sampling yielded considerably longer temporal records and required fewer trees to estimate fire frequency. These results demonstrate that given an adequate number and spatial distribution of sample locations, targeted sampling produces accurate and efficient estimates of fire frequency in ponderosa pine forests in the Southwest. We will discuss the potential applications and limitations of targeted sampling in relation to different fire history objectives.

Co-Authors: *Peter Z. Fulé, Megan L. Van Horne, Northern Arizona University - Thomas W. Swetnam , Christopher H. Baisan, Donald A. Falk, The University of Arizona*

Presentation Title: Fire History and Climate Influences from Forests in the Northern Sierra Nevada, USA

Presenter: *Tadashi Moody*
University of California – Berkeley
Berkeley, California, USA

Abstract: Fire chronologies were developed for four regions representing two general forest types in the Plumas National Forest, Northern Sierra Nevada, California. Chronologies were developed using dendrochronological techniques largely from remnant woody materials, since past logging has left few live trees with long fire scar records. Over the period from 1454 to 2001, 113 fire years were identified in the four regions. Mean composite fire return intervals (CFI) ranged from 8 to 22 years when examining fires scarring more than 10% of sample trees within a given site. Individual sample sites were 0.3-2.0 ha in size. These CFI values are consistent with fire return intervals derived from similar forests in the Southern Cascades and Northern Sierra Nevada. Differences in CFI were not significantly different among most sites or forest types, or between two management eras. Fire scar formation was predominantly recorded in the latewood and at the ring boundary, suggesting that most fires for this region occurred in the late summer or fall. Fire years in each of four regions were found to correspond significantly to drought conditions when compared to the Palmer Drought Severity Index and to salinity levels in the San Francisco Bay. Fire years also corresponded significantly to transitions from warm to cool phases of the Pacific Decadal Oscillation and the El Niño-Southern Oscillation, which are climate forcing atmospheric processes operating on decadal time scales.

Co-Authors: *JoAnn Fites-Kaufman, USDA Forest Service - Scott L. Stephens, University of California Berkeley*

Presentation Title: Reconstructing historic spatial and temporal patterns of fire regimes and forest dynamics in Sierra Nevada mixed conifer forests

Presenter: *Andrew Scholl*
Pennsylvania State University
University Park, Pennsylvania, USA

Abstract: Resource managers in National Parks have been directed to manage environments according to natural conditions and processes that were present prior to Euro-American settlement in the region. Reconstructions of historic fire regimes and forest conditions are used to determine the influence of fires on the structure and dynamics of mixed conifer forests. For this study, we collected fire history and forest structural data (e.g., species composition, size, age, spatial pattern) from two large study areas in the Merced (1600 ha) and Tuolumne (2100 ha) river drainages of Yosemite National Park. Data was collected on a grid in order to assess fire patterns at stand to landscape scales. We reconstructed the fire history and forest structure for 1899, the time of last fire. Prior to 1899 the forests experienced frequent, low to moderate severity fires that were relatively small in size. The mean point fire return interval (FRI) was 12 years, while the mean composite FRI for both study areas was 2 years, and the average fire size was 103 ha. In addition, the majority (80%) of fires prior to 1899 were less than 250 ha in size. Very few fires occurred in the 20th century due to fire suppression. The pre-suppression canopy was primarily ponderosa pine and sugar pine, with lesser amounts of incense cedar. Most plots were multi-aged without significant clumping of stems. The forest structure and fire data indicate that the forest experienced relatively small, frequent fires of low to moderate severity that maintained a multi-aged forest without distinct cohorts of trees related to fire events.

Co-Authors: *Alan H. Taylor, Pennsylvania State University*

Presentation Title: Fire History of Lodgepole Pine in the Southern Sierra Nevada, California

Presenter: *Anthony Caprio*
USDI National Park Service
Three Rivers, California, USA

Abstract: In August 1992 a 3,378 ha lightning ignited wildfire burned 82% of Devils Postpile National Monument. Large high severity patches with complete tree mortality hundreds of hectares in size, were produced by the Rainbow Fire in conifer forest composed of red and white fir and Jeffrey and lodgepole pine. Management questions, such as whether the effects of the fire were within the natural range of variability and whether fire should be reintroduced, have been raised, however, little or no information on pre-EuroAmerican settlement fire regimes exists for the area. Using fire effects plots established postfire, we examined fuel and forest conditions and regeneration patterns at sites burned with varying severity. Additionally, fire history sampling provided information on past fire returns intervals. These reconstructions showed that the area experienced moderate fire frequency (8 to 33 years between fires) and indicated that a surface fire regime predominated. Plot data showed that ten-year postfire, fuel loads were approaching prefire levels at some sites and most high severity patches were now shrub dominated. Conifer regeneration was plentiful in areas under or adjacent to surviving overstory trees but limited in areas >100 m from surviving trees. Nearly all regeneration at the latter sites was Jeffrey pine originating shortly postfire. Results suggest application of fire to areas of low-to-moderate severity may be beneficial for restoring more natural conditions but in the large high-severity patches, it might lead to long-term persistence of shrubs where limited tree regeneration is susceptible to fire caused mortality.

Co-Authors: *MaryBeth Keifer, USDI National Park Service -*
Karen Webster, Sequoia & Kings Canyon National Parks

TRACK 1

Thursday, November 16, 2006

Fire Regimes and Fire Effects in Mexican Ecosystems

Ronald L. Myers
The Nature Conservancy
Tallahassee, Florida, USA

Dante Arturo Rodriguez-Trejo
Universidad Autonoma Chapingo
Chapingo, Mexico

8:00 - 8:30	***Ronald L. Myers*** ***The Nature Conservancy***	Altered fire regimes as a conservation issue in Mexico
8:30 - 9:00	***Ernesto Alvarado*** ***University of Washington***	Fuel and Fire Hazard Characterization for Mexico
9:00 – 9:30	***Jose German Flores Garnica*** ***Instituto Nacional de Investigaciones Forestales***	Comparative Techniques for Evaluating Fuels to Determine Fire Regimes
9:30 – 10:00	***Juan de Dios Benavides Solorio*** ***Instituto Nacional de Investigaciones Forestales***	Fire effects on soils of different forested ecosystems in Mexico
10:30 – 11:00	***Richard A. Minnich*** ***University of California at Riverside***	A probalistic view of pre-suppression fire regimes for conifer forest and chaparral in northern Baja California
11:00 - 11:30	***Peter Z. Fule*** ***Northern Arizona University***	Fire regime changes in Durango and Chihuahua
11:30 –12:00	***Dante Arturo Rodriguez-Trejo*** ***Universidad Autonoma de Chapingo***	Past, present and next steps of the Ajusco Project: Fire ecology, restoration and integrated fire management in Central Mexico

Fire Regimes and Fire Effects in Mexican Ecosystems

Ronald L. Myers
The Nature Conservancy
Tallahassee, Florida, USA

Dante Arturo Rodriguez-Trejo
Universidad Autonoma Chapingo
Chapingo, Mexico

13:30 –14:00	***Enrique J. Jardel Pelaez*** ***Instituto Manantlan de Ecologia y Conservacion***	Fire regimes and fire effects in subtropical montane forest ecosystems in western Mexico
14:00 –14:30	***Leonardo Cabrera Carcia*** ***McGill University***	Traditional ecological knowledge on fire informs habitat management and conservation needs in central Mexico
14:30 – 15:00	***Maria de Lourdes Villers Ruiz*** ***Universidad Nacional Autonoma de Mexico***	Fire hazard assessment at La Malinche National Park, Central Mexico
15:30 – 16:00	***Rosa Maria Roman Cuesta*** ***Oxford University***	Fire management challenges in tropical Mexico: the role of protected areas
16:00 – 16.30	***Mary Huffman*** ***Colorado State University***	Community-based restoration of fire regimes in tropical pinelands, La Sepultura Biosphere Reserve, Chiapas, Mexico
16:30 – 17:00	***Heidi Asbjornsen*** ***Iowa State University***	Satellite hot spot detection patterns and ecosystem response to fire in Mexican cloud forest
17:00 – 17:25	***Alfredo Nolasco Morales*** ***The Nature Conservancy of Mexico***	Challenges and strategies for addressing fire management in Mexico
17:30 – 18:00	***Dante Arturo Rodriguez-Trejo*** ***Universidad Autonoma de Chapingo***	Session Synthesis: Towards new horizons in fire research in Mexico

Session Title: Fire Regimes and Fire Effects in Mexican Ecosystems

Organizer: *Ronald Myers*
The Nature Conservancy
Tallahassee, Florida, USA

Abstract: Mexico, with the world's highest diversity of pine and oak species, has a large number of ecosystems that appear to be dependent on fire. It also has an equally large number of ecosystems, mainly in the tropics, which are sensitive to fire. In some landscapes, fire-dependent and fire-sensitive ecosystems are adjacent to each other within protected natural areas, presenting complex fire management problems. There is an increasing body of scientific and management information about the role of fire in these ecosystems, including their status and trend with respect to fire regime and ecosystem condition. This session will bring together fire scientists, fire ecologists, and fire managers from Mexico and other countries (USA, Canada, Spain) to present and discuss the state of knowledge of the ecological role of fire in Mexico's diverse ecosystems, identify research gaps and needs, illustrate the role of local communities in addressing fire threats and needs, and propose strategies for the management of fire in protected natural areas.

Co-Organizer: *Dante Arturo Rodriguez Trejo, Universidad Autonoma Chapingo, Chapingo, Mexico*

Presentation Title: Altered fire regimes as a conservation issue in Mexico

Presenter: *Ronald Meyers*
The Nature Conservancy
Tallahassee, Florida, USA

Abstract: Recent global assessments have focused on the impact of altered fire regimes, i.e. too much fire, too little fire, or the wrong kind of fire, on the conservation of biodiversity. Fire as a necessary ecological process determines the nature and characteristics of many ecosystems. Fire also impacts some ecosystems very negatively. Broadly speaking, there are three classes of ecosystems that are determined by their overall response to fire events and fire regimes: 1) fire-dependent ecosystems--those that need a specific regime of fire and are characterized by plant species with adaptations to respond positively to fire and to facilitate its spread, 2) fire-sensitive ecosystems--those that are negatively impacted by most fires and plant species are intolerant of fire, and 3) fire-independent ecosystems--those where fire normally plays little or not role. In Mexico, over half of the native vegetation types are fire-dependent. These are primarily various types of pine forests, grasslands, oak woodlands and scrublands, and herbaceous wetlands. Mexico has the highest diversity worldwide of both pine and oak species suggesting that there are a multitude of specific fire regimes that shape and maintain these ecosystems. The vegetation of tropical Mexico is primarily, but not exclusively, fire-sensitive. Arid regions are fire-independent. This paper will define the concept of fire regime, provide some examples of fire effects in Mexico's diverse ecosystems, discuss the status and trend of current fire regimes in Mexico, point out some of the sources of fire regime alteration, and emphasize that the restoration and maintenance of ecologically appropriate fire regimes should be a priority strategy in the conservation of Mexico's biodiversity
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Presentation Title: Fuel and Fire Hazard Characterization for Mexico

Presenter: *Ernesto Alvarado*
University of Washington
Seattle, Washington, USA

Abstract: Mexico's fire agencies are moving toward developing a national fire management policy. Adoption and success of these policies require a wealth of quality information that is not currently available for most of the country. Mexico, as well as countries with more tradition in fire management recognizes the need to modernize fire decision-making tools to cope with an increasing threat from more catastrophic wildfires. One of the most important components to develop a successful fire management program is the assessment of the amount, condition, structure and distribution of forest fuels, which determine how easy fuels can ignite and how difficult is to suppress a fire. We present the progress of a joint venture between the USFS and Mexico to characterize fuels and fire hazard for the most important forest types in Mexico. The approach is based on current work conducted by the USFS FERA team to develop a national fuel characterization system for the United States. The system is intended for mapping and characterizing fuels at any scale, and for predicting fire behavior and effects. The system can drive models for land and fire management, air pollution, carbon accounting, policy analysis, and for quantification of fire behavior and effects. The authors, in collaboration with federal land managers and fire specialists from Mexico are working on collecting actual fuel information by using a photo series approach. This information will be the base to develop FCCS fuelbeds for Mexico. Currently, photo series have been completed for the Natural Protected Areas of Sierra de Manantlan in Jalisco and northern Sierra Madre Oriental on the limits between Coahuila and Nuevo Leon. Additional photo series have been developed near the US-Mexico border in California, Arizona and New Mexico that can be applicable to northern Mexico. Additional fieldwork continues for tropical forest in Chiapas

Co-Authors: *Enrique Fardel, Universidad de Guadalajara - Robert Vihnanek, USDA Forest Service - David V Sandberg, USDA Forest Service - Roger D Ottmar, USDA Forest Service - Roberto Martinez, Comision Nacional Forestal - Jorge Morfin, Universidad de Guadalajara*

Presentation Title: Comparative analysis of two techniques for evaluating fuels to determine fire regimes story and Evolution of Wildland Fire Use

Presenter: *Jose German Flores Garnica*
Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias Colonia Providencia,Guadalajara, Mexico

Abstract: Although fire is one of the most important factors of disturbance in forest ecosystems, not all fires have the same effect. The level of disturbance of a fire is related to its intensity and frequency, which in turn is determined by both fuel loading and fuel spatial distribution. Although, there are many techniques to determine such spatial distribution, their accuracy has not been evaluated and compared. This paper presents a comparative analysis of the spatial distribution of forest fuel loadings, which were generated based on two techniques: a) direct evaluation; and b) photo series. The study area is located in the Manantlan Mountain Range, Jalisco, México. The following fuel variables were evaluated: 1) solid and rotten fuels larger than 7.5 cm of diameter, 2) weight of litter, 3) depth of litter, and 4) depth of duff. These variables were measured directly in the field using a total of seventy-nine 600-m2 circular sample plots. Plot center locations were determined using a global positioning system (GPS) receiver. In the other technique, the photoseries were generated by the Fire and Environmental Research Applications Team (FERA- PNW Research Station). In order to best characterize fuel variables, the same plots used in the direct evaluation were used for the photo series. In general, fuel distribution determined by direct evaluation was better than the one based on photo series The reason for this is that the amount of available photo series is not enough to cover all the vegetation conditions found in the study area. This suggests that a greater number of photo series would have to be used to generate equivalent information. Based on the knowledge of the spatial distribution of fuel, it is possible to develop thematic maps that show potential fire intensity, and, indirectly, potential fire regime.

Co-Authors: *Juan de Dios Benavides Solorio -David Arturo - Moreno González - Jorge E. Morfín Ríos*

Presentation Title: Fire Effects on Soils of Different Ecosystems in Mexico

Presenter: *Juan de Dios Benavides Solorio*
Instituto Nacional de Investigaciones Forestales, Agricolas Y Pecuarias
Guadalajara, Mexico

Abstract: Recent statistics from forest fires in Mexico indicates that wildfires are a major concern; during the last decade, the area damaged by wildfires was around 332,000 ha year-1. Based on this information, most of the efforts on fire protection and fire suppression efforts have been made in this field and not much in rehabilitation. In order to make a post-fire rehabilitation plan, a comprehensive knowledge on water and soils is needed. Forest fires can dramatically alter the hydrologic cycle and produce damage to the soil, decreasing infiltration rates and producing large amounts of runoff and erosion; as a result, fires increase soil erosion rates and the risk of post-fire flooding. This paper discusses the role of the fire research that has been done in México and similar ecosystems around the world to understand the post fire effects on runoff and erosion and the factors that control them. The changes in the forest floor like the consumption of the organic material affect the infiltration and the magnitude of overland flow directly. Those changes have been very little studied in México, and the efforts have been concentrated on prescribed burns mostly in pine forests and tropical ecosystems, where the researchers can have a better control. Studies in wildfires are not well studied due to economical and accessibility reasons. The results from prescribed burns plots show increases in overland flow and consequently increases in erosion. Erosion from prescribed burns in México had values of 1.6 t ha-1, but wildfires around the world can have values up to 370 t ha-1. The factors associated with increases in overland flow and surface erosion are: fire severity, rainfall intensity, surface cover, time since burning, soil water repellency, slope and soil erodibilty.

Co-Authors: *J. German Flores-Garnica, INIFAP*

Presentation Title: A probablistic view of pre-suppression fire regimes for conifer forest and chaparral in northern Baja California

Presenter: *Richard Minnich*
University of California at Riverside
Riverside, California, USA

Abstract: The fire regime in northern Baja California chaparral and conifer forests—the long-term pattern of burning on the landscape—is characterized by fine-grained mosaics produced by frequent low to moderate intensity fires. While individual fires are each associated with a unique combination of weather and fuel conditions, the cumulative impact of fires at scales of centuries or millennia results in frequency distributions of fire occurrence that are centered on modal weather states of the local climate. Firescapes exhibit a profound spatial pattern that is self-regulated, as expressed in nonrandom patch emplacement in response to time-dependent fuel accumulation. The success of ignitions depends on whether they strike flammable targets in the mosaic. This depends on the ignition flux, the time required for vegetation to become flammable, and patch size. Few ignitions grow into large fires for lack of fuel. The weather risk of individual fires involves chance timing between ignitions and vegetation status. Fires establishing at random over many fire cycles occur most frequently in modal weather states and integrate two countering trends: high spread rates in ephemeral extreme-risk weather states versus low spread-rates under prevailing climate. The species composition and architecture of plant assemblages represent integrations between long-term succession and growth (fuel) and "instantaneous" combustion events that remove biomass. Each vegetation assemblage is associated with characteristic accumulation patterns of combustible biomass. Chaparral and closed-cone conifer forests sustain frequent stand-replacement burns and recover by cohort regeneration. Mixed conifer forests, with limited understory fuels, sustain frequent surface fires of moderate intensity. Both of these assemblages experience fire at rates of twice per century. Unproductive pinyon-juniper woodlands experience stand-replacement burns at intervals of centuries. Fire intervals in mixed conifer forests are underestimated because fire-scar dendrochonological methods record both mass- and micro-burns and lack sampling density to differentiate spatial fire patterns from site-specific data...

Co-Authors: *Ernesto Franco Vizaíno, Centro de Investigación Científica y de Educación Superior de Ensenada*

Presentation Title: Fire regime changes in pine-oak ecosystems, Durango and Chihuahua

Presenter: ***Peter Z. Fulé***
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Pine-oak forests of northern Mexico historically had frequent surface fire regimes but twentieth-century land use patterns led to widespread changes including fire exclusion and uncharacteristically severe modern wildfires. While there are many parallels to the altered fire ecology of ponderosa pine forests in the United States, northern Mexico is important because: (1) some relict forests maintain near-natural surface fire regimes, (2) the later onset of fire exclusion, as compared to the U.S., permits separation of fire regime effects from climate effects, and (3) modern forest fire behavior provides clues about fire patterns to expect under the likely climate and management influences in coming decades. Mexican forests are among the most biologically diverse in the world, providing critical habitat corridors and natural resources. Historical reconstruction of fire regimes in Durango and Chihuahua can be applied to suggest potentially useful management strategies for fire use for long-term conservation of these ecosystems

Presentation Title: Past, present and next steps of the Ajusco Project: Fire ecology, restoration and integrated fire management in Central Mexico

Presenter: ***Dante Arturo Rodríguez-Trejo***
Universidad Autonoma de Chapingo
Mexico

Abstract: The forests around Mexico City are exposed to the greatest number of forest fires in Mexico. Current fire regimes in these forests are inappropriate to their long-term maintenance. The most important causes of fire are related to agricultural activities, cattle raising, and visitors from the City. To address these fire problems, new, more integrated approaches to fire management are needed not only in these forests but also throughout Mexico, i.e. the fusion of the classical prevention and firefighting approaches with the ecological use of fire in fire-maintained ecosystems, coupled with community-based approaches to addressing fire problems. The Ajusco Project of the Universidad Autónoma Chapingo, focuses on research on fire ecology, restoration of burned areas, integrated fire management concepts, and fire economics in the forests around Mexico City. So far, 17 topics, mostly related to fire ecology, have been or are being developed, with the participation of 23 graduate and bachelor students. Topics include effects of fire on secondary growth of pines; synecology of understory species; emissions of CO, NO, NO2, and SO2; survival and growth of planted seedlings on burned sites, including the effect of nurse shrubs; germination of seeds of shrub species, pine survival during different seasons of burn and burn intensities within open and closed stands; forest fuel dynamics; soil erosion from burned areas; and strategies for disseminating the results to the general public. Next steps include the establishment of a demonstration area to look at the interaction between cattle grazing intensities and prescribed fire, including their interactive effect on pine growth and understory shrubs. The goal the Ajusco Project is to provide information to facilitate the development and implementation of integrated fire management concepts that will lead to a reduction of destructive wildfires and a greater use of prescribed fire.

Presentation Title: Fire regime and fire effects in Western Mexico subtropical montane forest ecosystems

Presenter: *Enrique Jardel Peláez*
Universidad de Guadalajara
Autlan, Jalisco, Mexico

Abstract: Wildfire is a common mode of disturbance in Mexican forests and is perceived as a threat to biodiversity and ecosystem integrity. A better understanding of the ecological role of fire is needed in order to improve management strategies in the highly diverse montane forests of Western Mexico. We are implementing long-term fire ecology and fire management research at Las Joyas Research Station, Sierra de Manantlan Biosphere Reserve (SMBR). The station is a mosaic of pine-oak forest, cloud forest and secondary shrublands. Cloud forest stands (representative of a highly endangered ecosystem) have been impacted by anthropogenic disturbances, including timber extraction, grazing and wildfires. Fire suppression is being used to protect the fire-sensitive arborescent elements in these stands and to encourage successional replacement of pines by hardwoods on sites thought to have historically supported cloud forest. Our work demonstrates that pine-oak stands experience high frequency (4 -18 years mean fire interval), low-severity burning, while cloud forest hardwood associations persist in topographic fire refuges. Pines species (Pinus douglasiana, P. herrerare and P. oocarpa) regenerate well in openings (>8,000 seedlings ha-1) two years after crown fires. Surface fires create a thinning effect, eliminating suppressed pines and hardwoods. In stands subjected to long-term fire suppression (>20 years) dense hardwood understories develop. A chronosequence analysis showed that total fuel loads increased during a succesional transition from young pine stands (49 Mg ha-1) to mixed pine-hardwood stands (96 Mg ha-1), and then diminished as sites matured to cloud forest hardwood associations (25 Mg ha-1). Species richness is higher in hardwood than in unburned pine-oak stands. We have not, however, found statistically significant differences in plant species richness between burned and unburned pine-oak stands, although species turnover is high (0.38 Jaccard index). Our results indicate that ecosystem restoration and biodiversity conservation on the SMBR will require the maintenance of a landscape mosaic with a combined strategy of fire exclusion and prescribed burning.

Co-Authors: *Jorge E. Morfin, Jose M. Michel, Ernesto A. Rubio, Universidad de Guadalajara - Fabiola Castillo., University of Washington - Erminio Quiñonez, Oscar E. Balcázar, Universidad de Guadalajara*

Presentation Title: Traditional Ecological Knowledge on Fire Habitat Management and Conservation Needs in Central Mexico

Presenter: *Leonardo Cabrera Garcia*
McGill University
Montreal, Quebec, Canada

Abstract: Fire is a rejuvenating force of ecosystems. Many plant and animal species depend on fire for their maintenance, and people have learned this and manipulate fire for multiple cultural and ecological purposes. This knowledge resides in a variety of indigenous communities around the world, but it is poorly acknowledged and rarely integrated into resource management and biodiversity conservation. The purpose of this study is to examine the traditional ecological knowledge on fire in two Mexican indigenous communities and integrate it with relevant ecological information of one of the most endangered bird species in the world, the Sierra Madre Sparrow (Xenospiza baileyi). The study was carried out from 2000-2003 and employed a combination of ethnographic, participative and spatial-ecological approaches and methods to address the inherent complexity of studying fire from a social-ecological perspective. Social data were obtained through 9 workshops which included site visits; transect walks, participatory mapping, oral histories and semi-structured interviews. Ecological data were obtained from a parallel study on the sparrow's nest-site selection strategies. Results from this study indicated that local people, principally herders, hold a rich knowledge of fire use to achieve diverse objectives including pasture renewal and grassland maintenance, pest control, prevention of dangerous fires and grass species management. In order to accomplish such goals, herders have established a local fire regime that considers timing, frequency and extent of chamusquinas. Hence, fires are used during the dry season, peaking from February to March; they are ignited every two years in a rotational way; and they occur extensively over a large area. This local fire regime was found to benefit the Sierra Madre Sparrow by maintaining the grassland cover at the regional level, and promoting a mosaic of successional conditions at the landscape scale that included mature grassland patches composed of specific grass species suitable for the bird's successful breeding. Unfortunately, official conservation perspectives and interests, and internal land tenure conflicts have altered this fire regime, threatening the social-ecological resilience of the ecosystem. Consequently, important native grasses and traditional ecological knowledge on fire use are disappearing. The survival of the Sierra Madre Sparrow, in particular, and of associated biodiversity in general, is in peril if these conflicts are not solved in a relatively short time. A community-based fire co-management program is recommended to promote integrative biodiversity conservation-local development scenarios

Presentation Title: Fire hazard Assessment at La Malinche National Park, Central Mexico

Presenter: *Maria de Lourdes Villers Ruiz*
Universidad Nacional Autonoma de Mexico
Mexico City, Mexico

Abstract: The central region of Mexico is experiencing greater land use changes as a result of the high percentage of population inhabiting the area. La Malinche volcano, located at the east of Mexico City is one of the seventeen natural protected areas that have been stated in this region. La Malinche National Park has an area of 45 711 ha, occupying the fourth place in altitude. Elevation ranges from 2,300 to 4,461 m, and the area is surrounded by livestock, agricultural activity and human settlements. The use of fire in agriculture and stockbreeding is highly scattered through the area. There are three aspects that are taken into account to evaluate the fire hazard: 1. The influence of biophysical aspects on fuels distribution. Based on nine physical-biological variables, four models were obtained using linear regression techniques to explain the weight and depth of duff, alongside the quantity of ligneous material for small diametric classes (0 to 0.5 cm and 0.6 to 2.7 cm). The amount of ligneous material for greater diametric classes was not fitted to a linear function. Therefore, it is necessary to develop other type of mathematical models through which a relation can be eventually set up. 2. Fuels availability to fire up was assessed by means of the percentage of humidity. Results on humidity content in fuels were obtained according to diametric classes and forest community type. 3. The relation between wind direction and velocity were assessed in diverse slopes of the volcano, considering monthly, daily and hourly data. The information registered was analyzed every hour from five Davis metheorological stations, placed in different slopes around the volcano. The goal is to shape the direction and velocity of the wind for different periods of time.

Presentation Title: Fire management challenges in tropical Mexico: the role of protected areas

Presenter: *Rosa Maria Roman Cuesta*
University of Oxford
Oxford, England

Abstract: Alteration of historic fire regimes causes serious changes in ecosystem processes and ecological homeostasis. Much debate exists today about the resilience of protected areas to the increasing impacts of fire disturbances, and best management alternatives to prevent fires and reduce risks. This is an area in which perceptions about sustainability are being informed by new knowledge, and the institutional framework conditioning how we manage forest fires is evolving. In spite of the weaknesses surrounding reserves´ efficiency to fulfill their conservation goals, some are slowing extreme forms of forest disturbances such as transformation to agriculture. From a fire management point of view, preserving fire impacted forests into forest use automatically transforms reserves into natural experimental areas for fire planning debates, and risk assessment analyses. With a two-decade history of diverse fire frequencies and severities, reserves can offer some of the much needed information on the ecological impacts of fire on different tropical ecosystems: I) composition and biodiversity losses, ii) fire adaptations and tolerance mechanisms, and iii) structural, successional and functional changes. However, while fire management might respond to a short-term opportunity to improve the conservation efficiency of the reserves, the future of these areas depends more on getting the long-term institutional and social arrangements right rather than on devising better systems of environmental management. In this line, the idea of conservation through preservation is being displaced by the "new conservation narrative", where the balance between biodiversity conservation and human development is the central debate ("people-oriented approaches"). This conservation approach reinforces the role of local communities, reconceptualizes conservation based on utilization and sustainable development, and incorporates neo-liberal ideas to make conservation pay. Fire management alone is not going to solve the fire problem and reserves offer a unique arena to experiment with the economic, political, social and ecological impacts of different management alternatives.

Presentation Title: Community-based restoration of fire regimes in tropical pinelands, La Sepultura Biosphere Reserve, Chiapas, Mexico

Presenter: *Mary Huffman*
Colorado State University
Fort Collins, Colorado, USA

Abstract: Alteration of fire regimes throughout Mexico and the tropics often results from the fire management activities of thousands of small farmers, foresters and ranchers ("producers"). While burning is accepted as a necessary component of local agricultural production, agricultural fires are altering fire regimes in both fire-maintained and fire-sensitive ecosystems. In many places, current practices emphasize short fire return intervals; result in a high proportion of "wandering" fires; or both. Though the decentralized, practical nature of the current fire situation is well known, the response by natural resource agencies in many countries, including Mexico, has been toward fire prevention and control. Though producers are unlikely to stop burning, little research has focused upon their fire-related motivations, knowledge and methods; or upon their capacity to contribute solutions. At La Sepultura Biosphere Reserve, producers from two ejidos and agency managers are working together to develop community-based fire management plans. Producers use fire to maintain tropical pine-oak ecosystems for timber and forage production, while agency managers appreciate burning to maintain biodiversity. Managers also want to reduce fire escape into nearby, species-rich moist tropical forests, which are fire-sensitive. An inter-disciplinary approach that incorporates local knowledge and Western science may assist the planning partners to discover practical ways to tweak burning practices to benefit both agricultural production and biodiversity conservation. Using participatory research methods, the authors are engaging the planning partners in four areas of social and natural science related to fire regime restoration at the reserve: 1) document producers' fire management knowledge and methods; 2) record fire behavior produced from existing practices; 3) begin to characterize current fire-related stand dynamics of the primary timber species, Pinus oocarpa; 4) compare observed fire behavior with predictions from a standard Western fire model (BehavePlus). Through these lines of inquiry, and any relationships noticed among the findings, new ideas for fire management may emerge.

Presentation Title: Satellite Hot Spot Detection Patterns and Ecosystem Response to Fire in Mexican Cloud Forests

Presenter: *Heidi Asbjornsen*
Iowa State University
Ames, Iowa, USA

Abstract: Although fires are increasingly occurring in tropical montane cloud forests (TMCF), little is known about fire regimes and fire effects in these foggy, cool, and biodiverse ecosystems. Further, because of the small coverage of TMCFs on the landscape, most monitoring initiatives of fire incidence do not effectively capture temporal and spatial patterns of fire events in TMCFs. Our objective with this study was two-fold: first, to document patterns of fire incidence in Mexican TMCFs in relation to landscape features and land-use patterns, and second, to analyze the ecological consequences of fire in TMCFs. An analysis of hotspots detected with AVHRR and MODIS sensors was performed for 2001-2005 for areas classified as primary and secondary cloud forest in Mexico's national Forestry Inventory 2000. Changes in biomass and species composition and processes of ecosystem recovery were assessed for TMCF in the Chimalapas mountains in Oaxaca, Mexico four years after the 1998 ENSO-related fires. Results indicate that in 2005 (a dry year) there were a 116 nighttime and 1328 daytime hot spots detected, whereas 2004 (a relatively wet year) revealed only 20 nighttime and 436 daytime hotspots. Daytime hotspots are typically agricultural fires that die out in the evening, whereas nighttime hotspots are considered forest fires strong enough to persist into the night. Biomass loss after first year fires (mostly high severity crown and deep ground fires) reached 80-100% and resulted in shifts in species composition to early successional species. We conclude that most forest fires in TMCFs occur along the margins of and in the transition between secondary to primary cloud forest, and that long-term recovery processes in TMCF ecosystems is likely to be slow. Fire management efforts should focus on preventing fire escapes in agricultural zones, enhancing community participation in fire detection and suppression, and preventing previously burned areas from reigniting.

Co-Authors: *Bart Wickel, Mexican National Commission for Knowledge and Use of Biodiversity*

Presentation Title: Challenges and strategies for addressing fire management in Mexico

Presenter: *Alfredo Nolasco Morales*
The Nature Conservancy
Merida, Yucatán, México

Abstract: Mexico is addressing a public policy of exclusion of the fire from forest ecosystems; for that reason it has solely developed technical capacities oriented to the prevention and forest fire suppression, and it does not consider the ecological roll of fire in the fire-adapted ecosystems. Ecologists and experts consider that at least 50% of the Mexican forest ecosystems are fire-adapted, whereas 30% are fire-sensitive. In the Southeastern of Mexico, the greater surface covered by fire-sensitive ecosystems is concentrated; coincidently it is in this region where the greatest number of slash and burn and cattle dealers happen and are not being done in the proper way, and this frequently originates forest fires that have harmful effects in the ecosystems. If fire exclusion from fire-adapted ecosystems is a threat, also is the excessive fire in fire-sensitive ecosystems. For that reason it is advisable and necessary to put in the discussion table the challenges that Mexico must confront to evolve from Fire Suppression towards Fire Management. The most important challenges are: a) change of the present legislation which is oriented towards the suppression of fire; b) a change of society attitude to understand the two faces of fire; c) public policy that considers the use of prescribed fire, wildland fire management, management of slash and burn and, of course, fire suppression as a part of fire management; d) a fire regime assessment in Mexican ecosystems and e) development of technical capacities that are not yet available.

TRACK 2

Thursday, November 16, 2006

Public Fire Management: Understanding Social Issues of Fire Management at Multiple Scales

Sarah McCaffrey
USDA Forest Service
Evanston, Illinois, USA

8:00 – 8:15	***Susan Stewart*** ***USDA Forest Service***	Social Implications of Wildland Urban Interface Growth
8:15 – 8:30	***David N. Bengston*** ***USDA Forest Service***	Public Understanding of Defensible Space: An Analysis of the News Media Discussion
8:30 – 8:45	***Pamela Jakes*** ***USDA Forest Service***	Communities Taking Responsibility for Wildfire Preparedness
8:45 – 9:00	***Victoria Sturtevant*** ***Southern Oregon University***	Firewise, FireFree, and FireSafe Councils: How three education programs encourage adoption of fire mitigation practices
9:00 – 9:15	***Christine Vogt*** ***Michigan State University***	Social Acceptance Over Time: Research from 2002 and 2006 on Huron-Manistee NF WUI Homeowners
9:15 – 9:30	***Sarah McCaffrey*** ***USDA Forest Service***	Understanding What Shapes Public Responses to Fire and Fuels Management
9:30 – 9:45	***Sarah McCaffrey*** ***USDA Forest Service***	McCaffrey - Special Session - Panel Discussion

San Diego Wildfires Education Project: From Wildland Fires to School Curriculum

Stephen F. Barnes
San Diego State University
San Diego, California

10:30 – 11:00	***Stephen F. Barnes***	Overview: San Diego Wildfires Education Project
11:00 – 12:00	***Stephen Barnes*** ***San Diego State University*** ***Tracy Albrecht*** ***USDI Bureau of Land Management*** ***Ivan Golakoff*** ***San Diego County Water Authority*** ***Adrienne Marriott*** ***San Diego County Office of Education*** ***Carol Radford*** ***San Diego Natural History Museum*** ***Nancy Taylor*** ***San Diego County Office of Education***	Panel Discussion

Session Title: Public and Fire Management: Understanding Social Issues of Fire Management at Multiple Scales

Organizer: *Sarah McCaffrey*
USDA Forest Service
Evanston, Illinois, USA

Presentation Title: Social Implications of Wildland Urban Interface Growth

Presenter: *Susan Stewart*
USDA Forest Service
Evanston, Illinois, USA

Abstract: The Wildland-Urban Interface (WUI), defined as “the area where structures and other human developments meet or intermingle with undeveloped wildland,” is the setting in which managers work with communities and property owners to mitigate wildfire hazards, and to plan for evacuation and other emergency measures in the event of wildfire. The WUI was a magnet for housing development during the 1990s. Between 1990 and 2000, 60% of all new housing units built in the U.S. were located in the WUI, and the WUI expanded by 115,898 km2. Overall, the addition of new houses to existing WUI areas was more prevalent than WUI area expansion. While WUI growth has some obvious effects (e.g., more people, homes, and infrastructure are potentially at risk from wildland fire) it also has more subtle implications. When new homes are developed in existing WUI areas, new WUI residents may have neighbors and community leaders already knowledgeable about wildland fire. This social capital can facilitate the process of communicating about wildfire; but it also highlights the need for ongoing efforts to reach new owners, even in communities with long-established programs. Where WUI area was newly created during the 1990s, outreach and communication may be difficult because these are predominantly new communities, and the community organization and cohesion required to support community outreach programs take time to develop. This paper will summarize 1990s WUI growth, suggest a typology of WUI growth patterns, and discuss their implications for wildland fire community outreach programs.

Co-Authors: *Roger B. Hammer, Oregon State University - Volker C. Radeloff, University of Wisconsin-Madison*

Presentation Title: The Public Understanding of Defensible Space: An Analysis of the News Media Discussion

Presenter: *David Bengston*
USDA Forest Service
St. Paul, Minnesota, USA

Abstract: The news media are the most important source of information for most people about a wide range of natural resource and environmental issues. But news media coverage of wildfire and other natural disasters often focuses on immediate and dramatic events, rather than on the broader context in which they occur. As part of a larger study examining how wildfire management issues are covered in the news media, this paper analyzes the media discussion of defensible space. Computer coded content analysis was used to analyze a database of about 77,000 news stories from more than 200 newspapers, newswires, television and radio news transcripts, and news magazines covering the period January 1, 2002 through January 31, 2005. News media discussion of wildfire is overwhelmingly dominated by firefighting, and discussion of defensible space is a minute fraction of the total. Coverage of defensible space focuses on vegetation clearing around homes to the exclusion of other practices such as maintenance and fire resistant building materials. Only 20 percent of all defensible space media coverage mentions defensible space around communities. Managers have an opportunity during times of peak media coverage of wildfire to expand the discussion about defensible space from the current focus on vegetation clearing to include the full range of activities a homeowner can undertake do to mitigate damage

Co-Authors: *Jayne Fingerman Johnson, University of Minnesota - Kristen C. Nelson, University of Minnesota - David P. Fan, InfoTrend, Inc*

Presentation Title: Communities Taking Responsibility for Wildfire Preparedness

Presenter: *Pamela Jakes*
Northern Research Station
St. Paul, Minnesota, USA

Abstract: Certain actions to reduce wildfire risk--such as ensuring adequate water systems, sufficiently wide streets, clear and consistent street signage, and maintenance of perimeter green belts, can only be done at the community level. In this presentation we will look at what the research tells us about community wildfire preparedness--community-level actions implemented before a wildfire to minimize the potential impacts of the event

Presentation Title: Firewise, FireFree, and FireSafe Councils: How three education programs encourage adoption of fire mitigation practices

Presenter: *Victoria Sturtevant*
Southern Oregon University
Ashland, Oregon, USA

Abstract: Innovative programs have been created to reach the growing number of people moving to the urban wildland interface and into high fire hazard environments. This presentation will discuss three fire education programs— Firewise Communities/USA, Fire Free, and Fire Safe Councils—specifically designed to educate residents about living in fire dependent ecosystems and to encourage adoption of mitigation strategies, specifically creating defensible space by using fire resistant building materials and landscaping, and reducing hazardous fuel loads across ownership boundaries. Rogers' Diffusion of Innovation Theory is employed to compare features (e.g., compatibility, observevibility, simplicity, divisibility and change agents) of these programs' relative success at mobilizing communities and changing homeowners' perception of risk and fire preparation activities. In addition to discussing the relative advantages of various programs and their communication strategies, we will present some key lessons and findings for managers and planners, such as the importance of tailoring efforts to local values, promoting programs that foster neighbor contact, and making practices more accessible via checklists and demonstration sites

Co-Authors: *Sarah McCaffrey, USDA Forest Service*

Presentation Title: Social acceptance over time: Research from 2002 to 2006 on Huron-Manistee National Forest WUI homeowners

Presenter: *Christine Vogt*
Michigan State University
East Lansing, Michigan, USA

Abstract: This research extends a 2002 survey of homeowners living in or near the Huron-Manistee National Forest (in northeast Michigan) to test for changes in beliefs, attitudes and support for fuel management approaches by repeating the methods in 2006 with the same homeowners. Data will be presented on both the 2002 and 2006 datasets with emphasis on matched cases of the same households for both time periods and testing of the significance of any differences over time. This presentation will explain changes in terms of fuels work, suppression efforts, planning and education programs that occurred between 2002 and 2006 that may have influenced acceptability of fuels reduction approaches. The 2006 data was collected in spring (March and April). Interestingly, the Hughes Lake wildfire occurred in our last week of data collection. A non response survey included questions about the recent fire and how that event may have changed homeowner's responses. Managers will benefit from this research by understanding levels of and stability of residents' acceptability of fuels management. The strategies tested in this research include prescribed burning, mechanical thinning, and defensible space practices by homeowners. Michigan data will be featured, but comparisons to data collected in California, Florida, and Missouri will also be made.

Co-Authors: *Greg Winter, Cornerstone Strategies - Sarah McCaffrey, USDA Forest Service*

Presentation Title: Understanding what shapes public response to fire and fuels management practices

Presenter: *Sarah McCaffrey*
USDA Forest Service
Evanston, Illinois, USA

Abstract: As the October 2003 fires in Southern California clearly demonstrated, a critical component of the current wildfire problem in the United States is the growing number of people living in high fire hazard areas. The active involvement of the public will be central to efforts to mitigate the wildfire hazard. As such, understanding their relevant beliefs and expectations—of the landscape and of land management agencies—is crucial information for managers in developing effective fire management plans. This presentation will present key findings from over a dozen studies conducted as part of a project funded by the National Fire Plan that examined public understanding and preferences in relation to wildfire and fuels management. Topics explored include what influences homeowner willingness to mitigate wildfire hazard on their property, what elements make prescribed fire and mechanical thinning more or less acceptable fuels management practices, how different demographic characteristics shape beliefs, and how the public responds to post-fire restoration efforts. Findings from the studies, which are ongoing, will provide fire managers, planners, and educators at the national, state, and local level with useful guidelines about the most effective means of fostering public support for and participation in pro-active fire management activities.

Session Title: San Diego Wildfires Education Project: From Wildland Fires to School Curriculum

Organizer: *Stephen F. Barnes*
San Diego State University
San Diego, California

Presentation Title: Overview: San Diego Wildfires Education Project

Presenter: *Stephen F. Barnes*
San Diego State University
San Diego, California

Abstract: This presentation offers an overview of the process of translating the 2003 San Diego wildfires into an educational opportunity for children in grades K-8. This includes project funding, creating a community-wide partnership, development of a fire ecology website and curriculum structure for K-8 teachers, and integrating the curriculum with statewide learning standards and the recent California Environmental Education Initiative.

Presentation title: Panel: San Diego Wildfires Education Project

Presenter:

Stephen Barnes
San Diego State Universityy

Tracy Albrecht
USDI Bureau of Land Management

Ivan Golakoff
San Diego County Water Authority

Adrienne Marriott
San Diego County Office of Education

Carol Radford
San Diego Natural History Museum

Nancy Taylor
San Diego County Office of Education

Abstract:

The panel discuss will focus on the following issues: Where does environmental education, such as fire ecology, fit into California Public Education? How does environmental curriculum get developed? What are the possible linkages between the scientific community, government agencies, non-profits, and education in the development of a fire ecology curriculum? How does environmental curriculum get into the schools and specific classrooms? What is the ideal balance between classroom and field experiences in the environmental education area? What do teachers and school administrators want in terms of environmental curriculum, student learning tools, and teacher support?

TRACK 3

Thursday, November 16, 2006

Fire Mediated Changes in the Alaskan Boreal Forest

Amy Lauren Lovecraft
University of Alaska - Fairbanks
Fairbanks, Alaska, USA

Dr. Terry Chapin
University of Alaska
Fairbanks, Alaska, USA

Dr. Sarah Fleischer Trainor
University of Alaska
Fairbanks, Alaska, USA

8:00 - 8:30	***Sarah Trainor*** ***University of Alaska***	Changes in the Alaskan Boreal Forest: Interactions of Changing Climate and Human Activities
8:30 – 9:00	***Jill Johnstone*** ***USDA Forest Service*** ***Teresa Hollingsworth*** ***Yukon College***	Impacts of climate change and shifting fire regime on boreal post-fire successional trajectory
9:00 – 9:30	***Sarah Trainor*** ***University of Alaska - Fairbanks***	Fire effects on ecosystem services and their use by rural communities
9:30 – 10:00	***La'ona DeWilde*** ***DeWilde Consulting***	Human impacts on fire regime in the Alaskan boreal forest
10:30 – 11:00	***Amy Lovecraft*** ***University of Alaska - Fairbanks***	Comparing Fire policy in Interior Alaska and the Yukon Territory: Policy Development and Change
11:00 –11:30	***Paul Duffy*** ***University of Alaska - Fairbanks***	Long-term implications: Projections of human-fire interactions in the 21st century

Changing Spatiotemporal Dynamics of Fire Regimes in the Appalachian Mountains

Charles Lafon
Texas A & M University
College Station, Texas, USA

Henry Grissino-Meyer
University of Tennessee
Knoxville, Tennessee

James Vose
USDA Forest Service
Otto, North Carolina

13:30 – 13:45	***Sally Horn*** ***University of Tennessee***	Charcoal Evidence of Long-Term Fire History in Great Smoky Mountains National Park, U.S.A
13:45 – 14:00	***Norman Christensen*** ***Duke University***	Age Distribution of Soil Charcoal Fragments along a Topographic Moisture Gradient in the Southern Appalachian Mountains
14:00 – 14:15	***Henri Grissino-Mayer*** ***University of Tennessee***	Reconstructed Fire Regimes of the central Appalachian Mountains using a Nested-Layer Network of Dendroecological Sites
14:45 – 15:00	***Marc Abrams*** ***Pennsylvania University***	Historical Variation in Fire and Oak Forest Dynamics in the Mid-Atlantic Region
14:30 – 14:45	***Patrick Brose*** ***USDA Forest Service***	Changes in the Disturbance Regime of Upland Yellow Pine Stands in the Southern Appalachian Mountains since 1850
14:45 – 15:00	***Ted Gragson*** ***University of Georgia***	Pattern and Process in the Historic Fire Regime of Southern Appalachia
15:30 – 15:45	***Charles Lafon*** ***Texas A &M University***	The Contemporary Fire Regime of the Central Appalachian Mountains: Spatial and Temporal Patterns of Fire
15:45 – 16:00	***Daniel Graybeal*** ***Northeast Regional Climate Center***	Climatology Applied to Fire Ecology: Frontiers and Needs in Monitoring and Outlooks
16:00 – 16:15	***Jim Vose*** ***USDA Forest Service***	Using Fire to Restore Structure and Function in Southern Appalachian Ecosystems
16:15 – 16:30	***Tom Waldrop*** ***USDA Forest Service***	Low-Intensity Fires May Be Adequate for Stand Replacement of Table Mountain Pine (Pinus pungens Lamb.) in the Southern Appalachian Mountains
16:30 – 16:45	***Katherine Elliott*** ***USDA Forest Service***	Effects of Prescribed Fire on Southern Appalachian Ecosystems

Session Title: Fire Mediated Changes in the Alaskan Boreal Forest

Session Organizer: *Amy Lauren Lovecraft*
University of Alaska Fairbanks
Fairbanks, Alaska, USA

Abstract: This session examines the interactive effects of human activities, climate, and vegetation on the fire regime in the Alaskan boreal forest. Our approach has been interdisciplinary and problem-driven. We have researched the boreal forest fire regime using natural- and social-science methodologies to create both a historical pattern of human-landscape interactions and also forecast future consequences. We seek to both challenge and complement academic studies of fire ecology as well as create a body of work that is of use to fire managers.

Co-Organizer: *Terry Chapin, Sarah Fleischer Trainor, University of Alaska - Fairbanks*

Presentation Title: Fire-Mediated Changes in the Alaskan Boreal Forest: Interactions of Changing Climate and Human Activities

Presenter: *Sarah Fleischer Trainor*
University of Alaska Fairbanks
Fairbanks. Alaska, USA

Abstract: Climate warming and human activities are altering wildfire frequency in Alaska and other boreal regions. We explain an interdisciplinary research project that documents the changing role of wildfire, particularly as affected by human activities, on the Boreal System and its human residents. The research focuses on three key fire-related feedback loops in interior Alaska and adjacent Canada. Climate-fire-vegetation interactions. We use a landscape model to simulate the effects of climate and vegetation on fire regime and on the landscape patterns of post-fire vegetation. People also influence fire regime through ignitions, suppression, and land-cover change. Fire effects on vegetation, in turn, influence climate through patterns of energy exchange (e.g., albedo) and carbon emissions (combustion and post-fire carbon emissions or storage), with implications for policy efforts to reduce the rate of global climate change. Ecosystem-fire-community interactions. Wildfire affects rural communities in Alaska, not only through risks to life, health, and property, but also by altering vegetation in ways that influence subsistence opportunities and by determining wages for communities, where fire-fighting is one of the few sources of cash income. We work with Athabascan communities to understand how wildfire affects them and with wildlife managers and ecologists to integrate their understanding of wildfire effects on wildlife and other ecosystem services. Community-fire-policy interactions. We trace the evolution of fire policy in Alaska and evaluate how it has been shaped by the social-ecological factors of the region. Comparative research in the Yukon Territory examines the dimensions of institutional learning that result from extreme fire events and the extent to which land tenure regime influences the role of indigenous people in fire management. Finally, we theorize how the effects of climate change on the disturbance regime of the Alaskan Interior may affect multiple policy contexts.

Presentation Title: Impacts of climate change and shifting fire regime on boreal post-fire successional trajectory

Presenter: *Jill Johnstone*
USDA Forest Service

Teresa Hollingsworth
Yukon College - Whitehorse
Whitehorse, Yukon Territory, Canada

Abstract: The Alaskan boreal forest is experiencing rapid directional changes in climate that are predicted to continue into the next century. The responses of boreal forest plant communities to climate change may be constrained over the short term by factors that create resistance to change, such as slow population turnover rates and strong plant-environment interactions. In this situation, disturbance may act as a key catalyst for ecosystem change. However, important disturbance agents such as fire are also sensitive to climate, and climate-induced changes in disturbance regime are likely to have direct effects on ecological communities. In this paper, we examine how changes in one component of the fire disturbance regime, fire severity or biomass consumption, may interact with climate change to lead to altered community composition. Black spruce forests occupy 40% of interior Alaska and the current distribution is strongly related to patterns of moisture drainage and substrate acidity. Variations in fire severity that affect the amount of surface organic material present after a burn can modify local edaphic controls by altering soil drainage and surface pH. In addition, patterns of fire severity influence the availability and regenerative success of on-site seeds and buds. This study examines the early post-fire recovery of vegetation in response to variations in fire severity across a wide gradient of site moisture conditions within black spruce forests in Alaska. Changes in early plant recovery are strongly related to successional trajectory, and provide a means to estimate fire effects on subsequent forest composition. The relative impact of fire severity is evaluated across landscape gradients in moisture and temperature to assess the interactive controls of climate and fire on forest change. These data provide information about portions of the landscape likely to be most sensitive to changing fire conditions, and of most interest to forest managers.

Presentation Title: Fire effects on ecosystem services and their use by rural communities

Presenter: *Sarah Fleischer Trainor*
University of Alaska - Fairbanks
Fairbanks. Alaska, USA

Abstract: Fire is a major source of disturbance in the boreal forest ecosystem of the Alaskan Interior and the Yukon Territory and wildfires have been common in this region for thousands of years. Two of the three most extensive wildfire seasons on record in Alaska occurred in 2004 and 2005 and, as the physical effects of climate warming disproportionately impact northern latitudes, increasingly extensive and intensive fire activity is predicted in the future. This paper describes ecological and economic wildfire impacts in rural Alaskan communities to better understand the implications of a changing fire regime and to plan for social-ecological resilience. We focus on the role of fire fighting employment in the mixed-subsistence village economy and impacts on regional provisioning ecosystem services such as moose, berries and firewood.

Presentation Title: Human impacts on fire regimes in the Alaskan boreal forest

Presenter: *La'ona DeWilde*
DeWilde Consulting
North Pole, Alaska, USA

Abstract: Wildfire is the major natural agent of disturbance in interior Alaska and plays an essential role in the regeneration of the boreal forest. Humans influence wildfires directly via fire starts and suppression, though once fires escape initial attack, suppression is nearly impossible. We evaluated the magnitude of human impacts on fire ignitions and suppression in interior Alaska by analyzing 20th century fire records, fire management zones as indicators for suppression efforts, fuel types based on a 1991 land cover classification, and distances from settlements, roads, and rivers in a Geographic Information System (GIS). Two-thirds of interior Alaska has an essentially natural fire regime with few human ignitions, negligible suppression activity, and many large, lightning-caused fires. Humans are responsible for a high frequency of fire ignitions near settlements and roads which is directly related to human access and population size. However, human caused fires remain small because they tend to occur at times and places less favorable for fire spread and are more accessible to fire fighters. Of the 17% of land designated for fire suppression due to its proximity to communities and roads, there is a 50% reduction in the proportion of area burned relative to areas without suppression. Alaska's fire policy of focusing suppression efforts on small proportions of regions occupied by human population, maximizes the ecological and social benefits associated with fire-dependent ecosystem services, while minimizing the social and ecological costs of suppression. Application of this policy to other areas would require well-informed managers and stakeholders to make difficult decisions about the relative costs and benefits of fire across ecologically and culturally variable landscapes.

Presentation Title: Comparing Fire policy in Interior Alaska and the Yukon Territory: Policy Development and Change

Presenter: *Amy Lauren Lovecraft*
University of Alaska - Fairbanks
Fairbanks, Alaska, USA

Abstract: This presentation uses the fire season of 2004, which set records in both locations, to explore the changing policy contexts of wildfire in the U.S. and Canada. Both the state of Alaska and the Yukon Territory have extensive boreal forests that provide ecosystem services to a variety of public and private interests. Although they have evolved similar management strategies related to fire since the 1970s, they have fairly different governing institutions when it comes to what branches of government manage fire, relationships with aboriginal peoples, and long term planning. The 2004 uncharacteristic season did not result in major regional or national policy change but it did trigger public reviews of wildland fire policy and the series of recommendations flowing from these is compared. For example, Canada appears to be converging with the U.S. national fire policies with its recent National Wildland Fire Strategy Declaration in 2005. Overall, this season is one in a national pattern in both countries that has begun to shift public and agency attention towards wildfire policy especially in relation to future planning for limited budgets; climate change; and wildland-urban interface expansion.

Presentation Title: Long-term implications: Projections of human-fire interactions in the 21st century

Presenter: *Paul Duffy*
University of Alaska - Fairbanks
Fairbanks, Alaska, USA

Abstract: Projected climatic warming has direct implications for future disturbance regimes, particularly fire-dominated ecosystems at high latitudes, where climate warming is expected to be most dramatic. The general conclusion of research to date indicates the severity, number, season-length, and total area burned will increase throughout much of the boreal biome. The boreal forest version of ALFRESCO was developed to explore the interactions and feedbacks between fire, climate, and vegetation in interior Alaska. ALFRESCO is a frame-based model of successional dynamics that explicitly represents the spatial processes of fire and vegetation recruitment across the landscape. Our research aims to examine potential effects of increased human activity (both ignitions and suppression) and climate change, individually and together. Modeling results show that human fire starts and climate change both have the potential to alter vegetation cover at the landscape scale through increasing the area burned over time. This effect is greatest when human activity and climate change occur together. The impacts of altered vegetation cover are significant to ecosystem services such as habitat for moose, caribou, and berries. Furthermore, changes to albedo may result in a negative feedback to climate warming, which is one of few such negative feedbacks yet identified at high northern latitudes.

Session Title: Changing Spatiotemporal Dynamics of Fire Regimes in the Appalachian Mountains

Session Organizer: *Charles Lafon*
Texas A&M University
College Station, Texas, USA

Abstract: This session will convene fire scientists working in the Appalachian Mountains to assess the current state of knowledge about past and present fire regimes. Scientific understanding of Appalachian fire regimes has increased greatly during recent years. New research demonstrates that, before the fire-exclusion era, fire occurred frequently and exerted strong influences on vegetation. Fire is relatively uncommon on the contemporary landscape, but large and hazardous wildland fires can occur during periodic droughts. Presenters will discuss ongoing research that characterizes the past and present fire regimes, and will also consider the effects of burning (including prescribed burning) on ecosystems.

Co-Organizer: *Henri Grissino-Mayer, University of Tennessee, Knoxville - James Vose, USDA Forest Service, Otto, North Carolina*

Presentation Title: Charcoal Evidence of Long-Term Fire History in Great Smoky Mountains National Park

Presenter: *Sally Horn*
The University of Tennessee
Knoxville, Tennessee, USA

Abstract: Records of long-term fire history based on analyses of fire-scarred trees and of charcoal in soils and sediments are attracting increasing attention for their applied importance in resource management and for their relevance to studies of paleoclimate, vegetation history, and human impacts. Detailed dendrochronological records of fire history can be developed in forested areas in which trees produce annual rings and are scarred by non-lethal fires. For time periods beyond the reach of tree-ring records, and for areas that lack suitable trees for study, charcoal fragments in soils and in lake or wetland sediments provide critical information on past fires. This presentation focuses on ongoing research on soil and sedimentary charcoal in selected habitats of Great Smoky Mountains National Park. Samples prepared for pollen analysis from wetland and heath bald sites within the park contain microscopic charcoal derived from local or regional fires along with pollen evidence of past vegetation. Identifying the source area of "pollen-slide" or microscopic charcoal is difficult because charcoal of this size can be dispersed long distances under certain fire and wind conditions. Larger, macroscopic fragments of charcoal recovered from soil and sediment samples by sieving provide spatially precise information on past fires because these larger charcoal fragments are subject to little or no post-burn transport. Macroscopic charcoal fragments sieved from soil cores in five stands of Table Mountain Pine (Pinus pungens Lamb.) in the park extend available dencrochronological records of fire by documenting historic and prehistoric fires prior to stand establishment.

Presentation Title: Age Distribution of Soil Charcoal Fragments along a Topographic Moisture Gradient in the Southern Appalachian Mountains

Presenter: *Norman Christensen*
Duke University
Durham, North Carolina, USA

Abstract: Lacking long-term dendrochronological and lake sediment data, little is known regarding the history of fire in southern Appalachian forests through the Holocene. Here we used over 75 radio-carbon ages for soil charcoal collected from local depositional sites along a topographic gradient from mixed hardwood (Liriodendron tulipifera and Quercus spp.) to pine-oak (Quercus prinus and Pinus rigida) forests to provide a coarse-grained picture of changes in fire frequency through the past 10,000 years. The likely date ranges of individual fire events were calculated based on a normal distribution around the radio-carbon date taking into account dating error and the fact that such dates reflect the age of burned material not the actual date it was burned. Charcoal ages ranged from 0 to 10,560 years BP, although ages >4,000 years BP were infrequent. The data suggest fire return intervals of about 500 years between 4,000 and 2,000 years BP, followed by a rapid increase in fire activity from 2,000 to about 400 years BP. Fire return intervals during this latter period were 50-100 years. Fire return intervals appear to have declined during the period of European exploration and settlement. We discuss these patterns of change in relationship to changes in human activity in these regions. We also consider the range of possible errors inherent in this methodology.

Co-Authors: *Kurt Fesenmyer Nicholas, Duke University*

Presentation Title: Reconstructed Fire Regimes of the Central Appalachian Mountains using a Nested-Layer Network of Dendroecological Sites

Presenter: *Henri Grissino-Mayer*
University of Tennessee
Knoxville, Tennessee, USA

Abstract: We present detailed, tree-ring-based analyses of fire regimes from xeric ridgetop sites in the central Appalachian Mountains dominated by Table Mountain pine (Pinus pungens Lamb.) and other southern yellow pines. This endemic species and its communities are declining in numbers and spatial extent due to extensive changes in fire regimes (most notably fire exclusion) that have taken place largely in the 20th century. Preservation of these communities is a key goal of land management agencies. The objective of our research was to reconstruct fire frequency, seasonality, and severity/ spatial extent using fire-scar analyses coupled with age and stand structure analyses to help evaluate both low- and high-severity fires in the past. We collected samples and stand information from eight primary locations (31 sites) on a N-S transect through the western mountains of Virginia. We found fire was frequent at most sites back to ca. 1750, occurring once every ca. 4-5 yrs. More spatially extensive fires occurred once every 8-10 yrs. We found some evidence of higher-severity fires in the age/stand structure analyses but these were uncommon. Dormant season (likely early spring) fires clearly dominated the seasonality. All sites show dramatic decreases in fire occurrence at various times during the 20th century leading to unprecedented fire-free intervals. These suggest fuel loads may be at critical/unprecedented levels, creating a fire hazard in central Appalachian forests that could lead to more catastrophic fires in the future.

Co-Authors: *Charles W. Lafon, Texas A&M University - Georgina G. DeWeese, University of Tennessee - Serena R. Aldrich, Texas A&M University - Elaine K. Sutherland, USDA Forest Service – Steven Q. Croy, USDA Forest Service*

Presentation Title: Historical variation in fire and oak forest dynamics in the mid-Atlantic region

Presenter: *Marc Abrams*
Penn State University
Pennsylvania, USA

Abstract: Prior to European settlement vast areas of the eastern U. S. deciduous forest were dominated by oak species. Evidence indicates that periodic understory fire was an important ecological factor in the historical development of oak forests. During European settlement of the late 19th and early 20th century much of the eastern U.S. was impacted by land-clearing, extensive timber harvesting, severe fires, the chestnut blight, and then fire suppression and intensive deer browsing. These activities had he greatest negative impact on the once dominant white oak, while temporarily promoting the expansion of other oaks such as red oak and chestnut oak. More recently, however, recruitment of all the dominant upland oaks waned on all but the most xeric sites. Mixed-mesophytic and later successional hardwood species, such as red maple, sugar maple, black birch, beech, black gum and black cherry, are aggressively replacing oak. The leaf litter of these replacement species is less flammable and more rapidly mineralized than that of the upland oaks, reinforcing the lack of fire. The trend toward increases in non-oak tree species will continue in fire-suppressed forests, rendering them less combustible for forest managers who wish to restore natural fires regimes. This situation greatly differs from the western U.S., where fire suppression during the 20th century has made a variety of conifer-dominated forests more prone to stand-replacing fire.

Co-Authors: *Tom Waldrop, USDA Forest Service*

Presentation Title: Changes in the Disturbance Regime of Upland Pine Stands in the Southern Appalachians since 1850

Presenter: *Patrick Brose*
USDA Forest Service
Irvine, Pennsylvania, USA

Abstract: A dendrochronology study was conducted in four upland yellow pine stands in Georgia, South Carolina, and Tennessee to determine whether the number and frequency of stand-level disturbances had changed since 1850. Increment cores of Table Mountain pine (Pinus pungens Lamb.), pitch pine (P. rigida Mill.), shortleaf pine (P. echinata Mill.), and chestnut oak (Quercus prinus L.) were obtained from the stands and analyzed for major, moderate, and minor canopy releases. Cross sections of intermediate hardwoods were collected and examined for fire scars. Historical drought and hurricane records were obtained from the National Oceanic and Atmospheric Administration. These records and the data from the cores and cross sections were analyzed for changes in the number and frequency of canopy releases, droughts, fires, and tropical storms in three 50-year increments; 1851 – 1900, 1901 – 1950, and post-1950. The number of canopy releases, droughts, fires, and tropical storms decreased considerably after 1950. These disturbances are less common now than they were a century ago and no longer coincide in occurrence. This change may result in dramatic repercussions for sustaining these conifer communities.

Co-Authors: *Tom Waldrop, USDA Forest Service*

Presentation Title: Pattern and Process in the Historic Fire Regime of Southern Appalachia

Presenter: *Ted Gragson*
University of Georgia
Athens, Georgia, USA

Abstract: While forest fires in Southern Appalachia are most frequently the result of human agency, fires occur when forest conditions are favorable to fire and this is directly related to weather. We examine the influence of monthly-to-yearly weather variation in Southern Appalachia and its relation to fire size-class, occurrence, cause and losses at scales from days to years. The analysis is based on fire records of the State of North Carolina from 1923-2003 and modeled water balance derived from instrumental weather records for the same period from the National Climate Data Center. Analyzing mid-term weather variation serves to discriminate between the effects of seasonal and annual climatic variations on fuel desiccation and ignition frequencies, longer-term climatic influences on fuel types and loads, and the contribution of humans as a fuel ignition source to the overall effect of fire on ecosystems. If humans through the fires they cause are the agents of environmental change they are frequently said to represent, then it is important to go beyond the mere origin of a particular blaze and examine the historical dependency of fire on anthropogenic relative to physical factors of combustion.

Presentation Titke: The Contemporary Fire Regime of the Central Appalachian Mountains: Spatial and Temporal Patterns of Fire

Presenter: *Charles Lafon*
Texas A&M University
College Station, Texas, USA

Abstract: Dendroecological reconstructions of fire history in the Appalachian Mountains indicate that fire occurred frequently in the past, prior to fire suppression, but declined during the twentieth century. Nonetheless, fire remains an important natural hazard and forest disturbance. This paper focuses on the contemporary fire regime of the central Appalachian Mountains of Virginia and West Virginia, using a record of wildland fires occurring on federal lands between 1970 and 2003. Fire activity varied temporally in response to climatic variability. On a seasonal basis, the dry conditions of spring and fall were favorable for burning. On an interannual level, drought years had more extensive burning than wet years. Burning also exhibited spatial variations. At the regional scale, the Allegheny Plateau physiographic province had less fire activity than other parts of the region. The Allegheny Plateau is higher, cooler, and wetter than the Ridge and Valley and the Blue Ridge provinces to the east. The Blue Ridge, which occupies the eastern edge of the region, was the most fire-prone environment. Fire activity also exhibited fine-scale spatial variations related to local topography: ignition density declined with increasing elevation, but showed weaker, less consistent relationships to aspect. Spatial variations in the importance of natural (lightning-ignited) fires may be especially important for federal resource managers who are developing wildland fire use plans that will permit natural fires to burn to restore fire-associated ecosystems. Undoubtedly, these spatial patterns of fire also influence the distribution of vegetation across the landscape.

Co-Authors: *Henri Grissino-Mayer, University of Tennessee*

Presentation Title: Climatology Applied to Fire Ecology: Frontiers and Needs in Monitoring and Outlooks.

Presenter: *Daniel Graybeal*
Northeast Regional Climate Center
Ithaca, New York, USA

Abstract: Attending several regional fire assessment workshops has convinced the author of the need for a greater number of both applied climatology studies and monitoring tools, to benefit fire managers with charge over state and federal landholdings. Key among both research and application needs summarized are for climatologically relative indices to commonly measured conditions, indices specialized to the needs of different regions and land cover types, and probabilistic seasonal outlooks linking specialized indices to commonly forecast conditions and atmosphere/ocean circulation regimes. An example of a climatologically relative index is an expression of the ground snow mass as a percentile. More specialized indices than are currently or widely reported include number of consecutive dry days (without measurable precipitation), including dry-humidity days and windy days, as well as a snowmelt-to-greenup phenological season-length index. Underlying these monitoring needs are needs for research into further understanding the climatology of dry-day durations, their relations to humidity, wind, and cloudiness conditions, and their links to lightning strike frequency and fire starts. Research is also needed into the probability of exceeding fire-relevant dry-day length thresholds, conditioned upon atmosphere/ocean regime. Expressing standing snow mass as a climatological percentile, especially on a given day or week during the snow season, is a monitoring need that requires support from research into the spatial and temporal climatology of daily snow mass.

Spatial work can extend the climatological information to the fine grid supplied in current snow monitoring, thus enabling managers to reach uninstrumented areas and account for land cover differences. Over much of the northern Appalachians, the spring period from snowmelt to greenup is an important fire season. Climatology of that period's lengths and timings is needed, from ground and satellite data and models, as well as links to fire occurrences and atmospheric/ocean regimes, and to seasonal-average temperature and moisture.

Presentation Title: Using Fire to Restore Structure and Function in Southern Appalachian Ecosystems

Presenter: *James Vose*
USDA Forest Service
Otto, North Carolina, USA

Abstract: Vast acreage across the southern Appalachians has been severely impacted by the recent southernpine beetle (SPB; Dendroctonus frontalis Zimmerman (Coleoptera: Scolytidae)) epidemic (1999-2003). Although prior outbreaks of SPB were documented in the mid-1950s and again in the mid-to-late-1980s, in comparison to this most recent outbreak, previous outbreaks were non-significant. As a result of the most recent SPB epidemic, the structure and function of these beetle–killed stands have been substantially altered. Without management, these pine/hardwood stands will be replaced by low quality hardwoods or, in some cases, dense ericaceous shrub monocultures. Land managers are now faced with the daunting task of restoring vast acreages of degraded pine or pine/hardwood stands. Over the past 20 years, the application of fire in southern Appalachian ecosystems has progressed from intensive site-preparation burns to lower intensity stand restoration burns. Much of this progression has been based on an increased understanding of the historical role of varied disturbance regimes on contemporary forest condition. For example, in some cases, current applications of fire are designed to mimic historical fire regimes with a desired future condition that more closely resembles pre-settlement conditions. In this paper, I will characterize the range of fire treatments used by land managers in the southern Appalachians, and describe there merits for restoring ecosystem structure and function in the context of historical and contemporary disturbance regimes.

Presentation Title: Low-Intensity Fires May be Adequate for Stand Replacement of Table Mountain Pine

Presenter: *Thomas A. Waldrop*
USDA Forest Service
Clemson, South Carolina, USA

Abstract: Interest in using stand replacement prescribed fires to regenerate stands of Table Mountain pine (Pinus pungens) has increased in the past decade but the type and intensity of fire needed to achieve success have been undefined. Most observations after wildfires indicate that crown fires are most successful. However, prescribed crown fires are difficult to achieve because of a limited number of burning days and a concern for worker safety. In an earlier paper, we concluded from first-year results that flames must reach into the crowns to kill most overstory trees and provide sunlight to the forest floor. In this paper, we show that lower-intensity flames will eventually achieve the same results. Overstory mortality of pines and hardwoods continued throughout the 6-year measurement period while pine regeneration increased from seed sources outside of the burned stands. Stand replacement was successful at all intensities measured.

Co-Authors: *Patrick Brose, USDA Forest Service*

Presentation Title: Effects of prescribed fire on southern Appalachian ecosystems

Presenter: *Katherine Elliott*
USDA Forest Service,
Otto, North Carolina, USA

Abstract: The magnitude and duration of watershed responses to fire depends on the interactions among burnseverity, post-fire precipitation intensity and duration, topography, soil characteristics, and vegetative recovery rate. The typical impact of fire is an immediate change in vegetative cover, forest floor surface, and chemical properties of the soil, followed by mid- and long-term changes in biological pools and nutrient cycling processes. We conducted watershed scale studies on the effects of prescribed fire on nutrient and carbon cycling, water quality, and vegetation dynamics (regeneration, compositional changes, mortality, and diversity) in multiple forest types and among fire types (ignition source, intensity, and severity) in the southern Appalachian region. The fire types included: stand-replacement fires (simulated wildfire and cut-and-burn prescriptions); low-to moderate intensity, understory fire prescriptions; and a wildfire in an old-growth deciduous forest. The ecosystems studied were xeric, low productivity pitch pine (Pinus rigida)/hardwood forests; dry, moderate productivity shortleaf (P. echinata)/Virginia pine (P. virginiana)/oak forests; and mesic, high productivity, mixed/hardwood (Liriodendron tulipifera/Quercus rubra) forests. With prescribed burning in the southern Appalachians, the forest floor humus layer remains largely intact, which mitigates surface erosion and off-site deposition of sediment. For the simulated wildfire in the pine/hardwoods, stream nitrate (NO3-N) did not increase, most likely because the unburned riparian zone served to buffer fire effects. A fell-and-burn treatment in pine/hardwoods showed a significant elevated stream NO3-N response (0.075 mg L-1) for 30 weeks. We found no significant response in stream NO3-N following low-severity fire in dry, shortleaf pine forests or mesic, mixed/hardwoods forests. After stand replacement fires, vegetation composition and diversity were altered with more deciduous species and less evergreen shrub cover; and ground flora diversity and cover were significantly higher. After low-severity, understory fires, we found no significant change in overstory, midstory, or ground flora species diversity

Co-Authors *James M. Vose, USDA Forest Service*

TRACK 4

Thursday, November 16, 2006

Air Quality Regulations and Wildland Fire: Issues and Challenges

Pete Lahm
USDA Forest Service,
Washington, DC,USA

8:00 - 8:30	***Pete Lahm*** ***USDA Forest SWervice***	The Air Quality Issues Related to Wildland Fire
8:30 – 9:00	***Rosalina Rodriguez*** ***US Environmental Protection Agency***	The Health Effects of Ozone and Particulate Matter
9:00 – 9:30	***Larry Elmore*** ***US Environmental Protection Agency***	Interim Air Quality Policy for Wildland and Prescribed Fire
9:30 – 10:00	***Tom Pace*** ***US Environmental Protection Agency***	EPA's Perspective on Fire Emission Inventories - Past, Present and Future
10:30 – 11:00	***Jim Homolya*** ***US Environmental Protection Agency***	Smoke Monitoring Strategies and Tools
11:00 – 11:30	***Jim Brenner*** ***Florida Division of Forestry***	The Importance of Accurate Fire Information
11:30 – 12:00	***Dan Johnson*** ***Western States Air Resources Council***	How State and Local Agencies are Addressing Federal Air Quality Standards, Regulations, and Policies
13:30 – 14:00	***Bob Habeck*** ***Montana Department of Environmental Quality***	How RPOs are Addressing Fire
14:00- 14:30	***Jim Brenner*** ***Florida Division of Forestry***	Innovative State and Local Air Quality Statutes and Regulations
14:30 – 15:00	***Debra Wolfe*** ***Montana Departmental of Environmental Quality***	Regional Coordination Efforts
15:30 – 15:45	***Evan Shipp*** ***San Joaquin Valley Air Pollution Control District***	Strategies for Addressing Wildland Fire in Non-Attainment Plans and Burning in Non-Attainment Areas
15:45 – 16:00	***Pete Lahm*** ***USDA Forest Service***	Strategies for Addressing Wildland Fire Use Fires
16:00 – 16:15	***Sarah McCaffrey*** ***USDA Forest Service***	Influencing Public Attitudes on Wildland Fire Policies and Smoke
16:15 – 16:30	***Duane Weis*** ***Florida Division of Forestry***	Non-Burning Alternatives, Issues and Tradeoffs
16:30 – 16:45	***Ed Gee*** ***USDA Forest Service***	Implementing Healthy Forest Restoration Act through Integration of Levelized Supply Wood and Strategic Placement of Treatments
16:45 – 17:30	***Pete Lahm*** ***USDA Forest Service***	Question & Answer

Session Title: Air Quality Regulations and Wildland Fire: Issues and Challenges

Organizer:

Pete Lahm
USDA Forest Service
Washington, DC,USA

Abstract:

Air Quality Environmental Regulation and Wildland Fire topics are examined and discussed. The purpose of this special session is to identify where regulatory requirements are in conflict with the goals and objectives of land management agencies in their quest to more appropriately manage fuels across the landscape. Once identified, possible solutions are suggested to work with the Environmental Regulatory Community to mitigate these concerns.

Presentation Title: The Air Quality Issues Related to Wildland Fire

Presenter:

Pete Lahm
USDA Forest Service
Washington, D.C., USA

Abstract:

No abstract available

Presentation Title: The Health Effects of Ozone and Particulate Matter

Presenter: *Rosalina Rodriguez*
US Environmental Protection Agency
Research Triangle Park, North Carolina, USA

Abstract: New evidence about the health effects of exposure to ozone comes from animal and in vitro toxicology, human clinical and epidemiological studies. Controlled exposures of human volunteers provide evidence of effects on lung function at levels below 0.08 ppm. Human clinical and in vitro toxicology studies indicate that people with asthma are more susceptible to O_3. They are likely to have greater decreases in lung function and respiratory symptoms in response to O_3. Studies indicate that people with allergic asthma and rhinitis may have increased airway responsiveness to allergens following O_3 exposure. This means that prior exposure to O_3 is associated with larger responses to allergen triggers. Ozone-induced exacerbation of airway responsiveness persists longer and attenuates more slowly than O_3-induced lung function decrements and respiratory symptom responses, and can have important clinical implications for people with asthma. Epidemiological studies have found associations between O_3 exposure and total (non-accidental) and cardio-respiratory mortality. Epidemiological studies continue to link ozone to a wide range of effects, including: school absences; emergency room visits; and hospital admissions. New evidence about the health effects of PM comes from animal toxicology, human clinical and epidemiological studies. PM is associated with aggravation of heart and lung diseases leading to premature death in people with heart or lung disease. It is also associated with non-fatal heart attacks, increased hospital admission and ER visits for cardiovascular diseases and less serious cardiac effects such as changes in heart rate variability; arrhythmia (irregular heartbeat) and changes in subtle indicators of cardiovascular health, including levels of C-reactive protein and fibrinogen. Aggravation of lung disease can result in increased hospital admissions, emergency room visits and doctor's visits for respiratory diseases. In people with or without lung disease, exposure to PM can lead to increased respiratory symptoms such as coughing, wheezing and shortness of breath, and decreases in lung function, especially in children and people with lung diseases such as asthma. Long-term exposure to PM is associated with premature death from heart or lung disease, including death from lung cancer. It can also lead to the development of chronic lung disease and reduced lung function growth in children EPA is in the process of reviewing the NAAQS for Ozone and Particulate Matter (PM). The final ozone Staff Paper will be available in Fall 2006, and a final decision on the NAAQS for PM will be issued in September 2006. The major findings of the O_3 Staff Paper and PM final decision will be discussed.

Presentation Title: Interim Air Quality Policy for Wildland and Prescribed Fires

Presenter: *William Larry Elmore*
US Environmental Protection Agency
Research Triangle Park, North Carolina, USA

Abstract: Emissions from wildland and prescribed fires can impact local and regional air quality and result in violations of national ambient air quality standards (NAAQS) that may impact an area's attainment status. Since 1977, the Environmental Protection Agency (EPA) has implemented policies to address the treatment of air quality data that has been affected by exceptional or natural events. In 2005, Congress promulgated The Safe Accountable Flexible Efficient-Transportation Equity Act (SAFE-TEA), which requires EPA to propose and finalize a rulemaking action which identifies the criteria and procedures that States should follow to get data excluded from regulatory consideration that has been determined to be affected by an exceptional event. The EPA has defined exceptional events as unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques tribal, state or local air agencies may implement in order to attain and maintain the NAAQS. The proposed Exceptional Events rule outlines procedures and criteria that would be used to identify, evaluate, interpret and use monitored air quality data for comparison to the NAAQS in situations where state, local, and tribal air quality agencies request special treatment because the data has been affected by an exceptional event. In addition, the General Conformity requirements of the Clean Air Act are intended to prevent the air quality impacts of Federal actions from causing or contributing to a violation of the NAAQS or interfering with the purpose of a State, Tribal or Federal implementation plan. Federal agencies are required to demonstrate their actions, including prescribed burning.

Presentation Title: EPA's Perspective on Fire Emission Inventories - Past, Present and Future

Presenter: *Thompson G. Pace*
US Environmental Protection Agency
Research Triangle Park, North Carolina, USA

Abstract: This presentation will outline the ongoing progress to improve fire emissions estimates in the National Emissions Inventory (NEI). Each year, the US Environmental Protection Agency estimates the emissions from all important sources of air pollutants and makes this information available to the public in the NEI. The NEI is often used as the basis for air quality modeling to estimate the pollutant concentrations found in the air due to various sources, including fires. Modelers need hourly emissions from each fire and its location. Also, an estimate of the heat release from the fire is needed so the initial plume rise can be estimated. This type of information is challenging to gather for stationary sources that operate in a single location all year with a relatively stable and predictable process. Fires present an even greater challenge owing to their transitory nature and the wide range of fuel types, fuel conditions, and terrain, meteorology and suppression efforts encountered. The development of a fire inventory has evolved over time from relatively crude "rules of thumb" for emissions from fires in different parts of the US into a more sophisticated process where fire events are compiled into electronic databases and input to emission models to estimate fuel consumption, emissions and heat release. The future holds promise for even better databases and emissions models by exploiting satellites to detect fires (as a supplement and quality enhancement to ground-based fire data records. Satellites can also be used to track plume movement and to characterize fuels and fuel characteristics in near-real time.

Presentation Title: Smoke Monitoring Strategies and Tools

Presenter: *Jim Homolya*
US Environmental Protection Agency
Research Triangle Park, North Carolina, USA

Abstract: EPA has been conducting a project to develop guidance for wildfire smoke monitoring and data reporting. The overall goal of this project is to provide appropriate monitoring data to better protect public health from the effects of wildfire smoke. EPA coordinates an interagency discussion group whose members are currently charged with providing wildfire air monitoring data. That group has shared current approaches (instrumentation, staffing, logistical experience, quality assurance, reporting etc.) and built consensus on essential minimum needs and requirements. A working group of ten State agency collaborators worked with EPA to develop/receive training on appropriate, portable fine particulate monitors selected and gain operational experience in the use of the monitors to be sited at existing national air monitoring sites for several months. During that time, participants developed comparative data with existing PM2.5 monitors such as TEOMS and FRMS as well as other related measurements (nephelometers and/or aethelometers) which might be already located at the sites. Also, the group consolidated their training and experience with the formulation of a Standard Operating Procedure for the monitoring instrument along with appropriate QA guidelines. A multi-site monitor comparative assessment report was produced from this work. The workgroup has obtained remote data transmission technology experience from the USFS for use with the portable fine particulate air monitors to be operated during wildfire events. The multi-site data comparisons were accomplished by linking the monitors through a satellite-based telemetry system and displayed on a secure section of the EPA AIRNOWTech website. Currently, the group is beginning the process of developing a mobilization and field deployment SOP to be tested during upcoming wildfire events in the western US.

Presentation Title: The Importance of Accurate Fire Information

Presenter: *James Brenner*
Florida Division of Forestry
Tallahasee, Florida

Abstract: This presentation briefly describes the important role that good data management plays in the fire community today. It is important for fire managers to clearly understand how the information they are supplying to other agencies and the general public might be used. In recent years there have been many examples where data supplied by state and local agencies to the federal level have been used as inputs into models with little or no understanding on the part of the originator or the receiver how these data will be used or what exactly they describe. In several instances this has resulted in embarrassing situations for both parties. In some cases the data that has been distributed resulted in gross exaggerations and concern over non-existent problems. Most of these concerns dealt with air quality e.g, the EPA Air Toxics Report for 1998 showed that prescribed fire was the leading contributor to air toxics in the state of Florida. In this particular example, the problem revolved around errors in the amount of vegetation burned (consumed) and dispersed into the air. The problem was magnified even more by the fact that the acreages burned in the neighboring states to Florida only contained the federal contribution, the private and state burns were not included and so Florida stood as an exceptional example of air toxics compared to its neighbors. What is needed is a universal method for measuring and reporting both wildfire and fire use to all of those agencies concerned with these data no matter if they are private, local, state or federal.

Presentation Title: How State and Local Agencies are Addressing Federal Air Quality Standards, Regulations, and Policies

Presenter: *Dan Johnson*
Western States Air Resources Council

Abstract: The public expects state and local air quality management agencies to ensure that the air is clean, and that the cost of providing clean air is not a significant burden, either financially or in terms of undue restrictions on personal choice. Faced with shrinking budgets and increasingly complex and resource-intensive problems, most state and local agencies are hardly able to implement public health protection programs, leaving little time to devote to resource protection and enhancement initiatives. Objective Federal land management agencies and state and local air quality management agencies must work cooperatively to minimize air pollution, Experiment Not applicable Results State and local air quality management agencies are implementing a variety of programs to address emissions fire emissions. Smoke management programs are becoming increasingly common as states develop plans to address regional haze. Still, as more and more programs are implemented to address the health effects of air pollution, in many areas the relative contribution of fire emissions to the air pollution problem is growing, and is becoming a conspicuous concern to air quality regulators, elected officials and the public. Policies to address this growing problem will be based on an appropriate balance between public health protection, regulatory oversight, resource protection and management, and public education. Conclusion This presentation will summarize several common elements of state and local air quality management programs that, in the opinion of the author, appear to effectively balance public health protection with the resource protection and enhancement aspects of prescribed fires.

Presentation Title: How Regional Planning Organizations are Addressing Fire

Presenter: *Bob Habeck*
Departmental of Environmental Quality
Helena, Montana

Abstract: For visibility protection purposes, the United States is divided into five regional planning organizations (RPO). The mission of each RPO is to develop and implement planning and policy tools to reduce anthropogenic emissions that impair visibility in select national park and wilderness areas. Each RPO is addressing emissions from wildland fire (wildfire, prescribed natural fire, wildland fire managed for resource benefits), and prescribed fire (silvicultural, rangeland, and agricultural). Other types of burning such as residential wood combustion and open burning may be considered, but are not the primary focus. The RPO in the West is the Western Regional Air Partnership (WRAP). WRAP assigned the Fire Effects Joint Forum (FEJF) to make recommendations on policies and methodologies. Specifically, FEJF is charged with: (1) estimating air pollution emissions and their effects on air quality and visibility due to smoke from various natural and human-caused fire; (2) developing a data set and associated tracking system for those emissions in the geographical area at least encompassed by the Grand Canyon Visibility Transport Commission states and tribes; and (3) recommending strategies and methods to manage emissions from sources. This presentation highlights the products from the FEJF within the context of visibility protection.

Presentation Title: Innovative State and Local Air Quality Statutes and Regulations

Presenter: *Jim Brenner*
Florida Division of Forestry
Tallahassee, Florida, USA

Abstract: This presentation briefly describes the importance of fuels management in the Southeast, outlines a history of the Region's interest and involvement in promoting the judicious use of fuels management, mentions the situation that led to many of the fire management statutes and provides an overview of some of the more significant legislation e.g., Florida's 1990 Prescribed Fire Act and the 1999 changes to that act that significantly strengthen the law. The state of Florida passed landmark legislation in 1990 protecting responsible burners from civil liability with one goal in mind: to increase the number of acres treated with prescribed fire. This move has subsequently been copied in many other parts of the South as well as other parts of the nation. The reason for introducing this type of legislation was the clear message coming from the land management community that "burning the land was too risky", not because of potential fire control problems, but because of potential smoke management problems that were beyond the control of the burner. As an example, during a Florida land managers conference on prescribed burning issues held January, 1999, the four most common reasons cited for not using fire as a management tool pertained to liability. In the wake of the disastrous 1998 fire season which was partially blamed on abnormal fuel accumulations, Florida made a simple modification to this law so that a prescribed burner cannot be found civilly liable even if simple negligence can be demonstrated; now a court must demonstrate that the burner was "grossly negligent." This modification has since been copied in several other states and is a huge step that further protects the right to prescribe burn in Florida.

Presentation Title: Regional Coordination Efforts

Presenter: ***Debra J. Wolfe***
Montana Department of Environmental Quality
Helena, Montana, USA

Abstract: Emissions from fire often cross jurisdictional boundaries and obscure visibility miles from the source. Regional coordination harmonizes planning and tracking of fire emissions that are continuous across state and tribal boundaries. Regional coordination promotes frequent and familiar communication between burners and regulators, minimizes possible regulatory inconsistencies across state and tribal boundaries, and builds mutually beneficial relationships. To ensure the efficacy of smoke management plans (SMP), burners and regulators develop strategies to share SMP data and/or predictive services on a regional basis. Communication and data sharing occurs prior to burning to predict outcomes and plan accordingly. States, tribes, and burners coordinate during the course of the burn and implement contingent actions, if necessary. After the burn, archiving SMP elements for future retrieval allows burners and regulators to assess past activities and make appropriate corrections for future activity

Presentation Title: Strategies for Addressing Wildland Fire in Non-Attainment Plans and Burning in Non-Attainment Areas

Presenter: ***Evan Shipp***
San Joaquin Valley - Air Pollution Control District
Fresno, California, USA

Abstract: Wildland fire creates air emissions that can impact downwind areas with primary particles and secondary formation of particulate and ozone. Areas that are non-attainment for PM10, PM2.5, and ozone use multiple strategies to mitigate the air quality impacts from fire emissions. These strategies are implemented generally through the State Implementation Plan and more specifically through rules developed by Air Pollution Control Districts and States. In general, smoke management for prescribed and wildfire use burning in non-attainment are controlled by using the best available control technology. These controls address the size, duration, location, types of materials, weather conditions, fuel moisture, and cumulative impacts of adjacent fires. Impacts from fire emissions are mitigated through burning during good atmospheric dispersion conditions, seasonal and diurnal timing, and use alternatives to burning techniques. In practice, local air pollution control District's use planning, active tracking, and post burn analyses to minimize and document impacts from wildland fire. In California, larger fires require a burn plan that provides agencies information on the potential impacts to sensitive populations. This plan contains specific information on the fire as outlined above. The local air pollution control District must approve this plan before burning takes. After approval, burn decisions are made on a daily basis, taken into consideration weather and fire emissions information. Both prescribed and wildfire use fires are handled in a similar manner. Wildland fire in non-attainment areas requires special more rigorous review than in attainment areas. For non-attainment areas, considerations are given to the cumulative emissions impacts from all sources in the area. Not only are localized impacts addressed, but also the regional impact of burning into existing ozone, PM10 and PM2.5 federal health standard exceedances. State of the art meteorological and fire emissions tools are used to make burning decisions. Fire emissions from agricultural burning, residential wood combustion, and hazard reduction burning are also considered. Specifically, in the San Joaquin Valley, an area with exceptionally poor air quality, rules that apply to agricultural and residential burning are considered when making wildland fire burn decisions. The San Joaquin Valley uses an agricultural burn allocation program where fire emissions are allocated to small zones. Wildland fire influences the allocation of emissions to these zones, in that; buffers of low amounts of emissions are placed near planned fires. Conversely, prescribed may be mitigated in areas of more intense agricultural burning.

Presentation Title: Strategies for Addressing Wildland Fire Use

Presenter: *Pete Lahm*
USDA Forest Service
Washington, DC, USA

Abstract: Federal land available for Wildland Fire Use (WFU) is increasing dramatically as is the annual area burned under this fire management option. In addition, economics and firefighter safety support even more utilization of this option. Air quality and smoke are among several key evaluation criteria for wildland fire use incidents per the interagency Wildland Fire Use Implementation Procedures Reference Guide. The air quality strategy chosen by a fire manager should depend on the air quality complexity and impact potential for a single WFU incident as well as how that incident could interact with other ongoing fire activities (wildfires, WFU and prescribed fires) in the region. With the growth of the area available for WFU, accounting for adjacent fire activities is critical in determining the smoke generation potential and duration of impacts in order to avoid serious down-wind cumulative particulate matter and other air quality impacts. Fire activity and potential smoke impact should influence decisions to allow new natural ignitions to become larger WFU incidents. As more area is open to the WFU option there will be an increasing need to: 1) assess individual incident smoke impact potential, 2) choose the appropriate strategy to address that individual WFU smoke impact, 3) assess regional fire activity and subsequent cumulative smoke impact potential, and 4) choose the appropriate strategies to address that cumulative smoke impact. A variety of strategies are available to managers to address WFU smoke impacts and develop the appropriate response for not only a single incident but also several adjacent incidents. Communication mechanisms as well as smoke monitoring and development of specific air quality trigger points are useful for a single WFU as well as for regional fire activity smoke impacts. Many air quality strategies and trigger points can be developed well in advance of the incident.

Presentation Title: Influencing Public Attitudes on Wildland Fire and Policies and Smoke

Presenter: *Sarah McCaffrey*
USDA Forest Service
Evanston, Illinois, USA

Abstract: A key public issue with fire management is the smoke created by wildfires as well as by prescribed burns. In the case of prescribed fire, such public concerns can have a significant effect on the ability to conduct burns. This presentation will review recent research findings about public response to smoke and fire management. As smoke is a health issue for roughly one-third of households, it clearly is a key concern that managers need to take into account as they develop their management plans. Findings indicate that several factors are associated with a more positive response towards smoke including who is doing the burning and understanding the forest health benefits associated with prescribed fire.

Presentation Title: Non-Burning Alternatives, Issues and Tradeoffs

Presenter: *Duane Weis*
Florida Division of Forestry
Punta Gorda, Florida, USA

Abstract: While the State of Florida continues to administer one of the most active prescribed fire programs in the nation, the use of this management tool is becoming increasingly difficult due to smoke management concerns and values at risk in the wildland urban interface. Land managers are becoming more dependent on alternative methods of fuel reduction, including herbicide application, mowing, masticating, silvicultural thinning and grazing, to accomplish wildfire hazard mitigation objectives. There are issues and tradeoffs associated with each of these alternative treatment methods that must be weighed against the benefit of increased fuel reduction opportunities. Cost effectiveness is often one of the most limiting factors in determining the most appropriate method of fuel reduction. While the cost per acre value for prescribed fire application can vary significantly based on the complexity and the resources required to conduct the burn, it is generally considered to be more cost effective than the alternative treatment methods. Cost effectiveness is not the only consideration in selecting a site-specific treatment method. Production rate, or the measure of area treated during a specified time, can vary significantly between treatment methods, depending on fuel characteristics. The logistical concerns related to transporting and utilizing heavy equipment in wildland urban interface settings may be a limiting factor. The long-term ecological effects of replacing fire with mechanical treatments in fire dependent ecosystems may not yet be fully understood. In many cases, aesthetics or public acceptance can be important factors.

Co-Authors: *Jim Brenner, Florida Division of Forestry*

Presentation Title: Implementing Healthy Forest Restoration Act through Integration of a Levelized Supply Woody Biomass (CROP) and Strategic Placement Of Treatments (SPOT)

Presenter: *Edmund Gee*
USDA Forest Service
Washington, DC, USA

Abstract: The Healthy Forests Restoration Act of 2003 (P.L. 108-148) contains a variety of provisions to expedite hazardous-fuel reduction and forest-restoration projects on specific types of Federal land that are at risk of wildland fire or insect and disease epidemics. The Act helps rural communities, States, Tribes, and landowners restore healthy forest and rangeland conditions on State, Tribal, and private lands. One focus it encourages biomass removal from public and private lands. The USDA-Forest Service is proposing to integrate two separate studies (levelized supply study-coordinated resource offering protocol (CROP) and strategic placement of treatments (SPOT)) into three to five pilot studies to remove biomass from these pilot areas. The study will look at several key issues: 1. Can the USDA-FS attain a levelized supply of woody biomass; 2. Will the strategic placement of treatments make a difference in fuel loading from a FRCC 3 to FRCC2 to FRCC1; and 3. Will the mechanical treatment of fuels provide carbon banking credits and make a difference to air quality with less smoke emissions? The presentation will discuss the process and potential outcomes of the pilot studies

Co-Authors: *Sue Stewart, USDA Forest Service*

TRACK 5

Thursday, November 16, 2006

Effects on Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective

Scott Stephens,
University of California – Berkeley
Berkeley, California, USA

John Bailey
Oregon State University
Corvallis, Oregon

8:00 – 8:15	*Jim McIver* *Oregon State University*	Introduction to the national fire and fire surrogate study
8:15 – 8:45	*Dylan Schwilk* *US Geological Survey*	Multi-site vegetation responses to fuels treatments
8:45 – 9:15	~~*Tom Waldrop*~~ *USDA Forest Service*	Delayed mortality of eastern hardwoods -- a function of fire behavior, site, or pathology?
9:15 – 9:45	*Andrew Youngblood* *USDA Forest Service*	Delayed mortality of ponderosa pine in northeastern Oregon: structural equation modeling of causal factors
9:45 – 10:00	*Leda N. Kobziar* *University of Florida*	Tree mortality patterns following replicated prescribed fires in a mixed conifer forest
10:30 –10:45	*Bruce Hartsouth* *University of California - Davis*	Cost and Productivity Analysis of Mechanical and Burn Treatments to Remove Biomass on FFS Sites
10:45 – 11:00	*Sarah McCaffrey* *USDA Forest Service*	Social responses to fire and fire surrogate treatments in the central Sierra Nevada, California
11:00 – 11:30	*D.W. Schwilk* *US Geological Survey*	Interactions of bark beetles and tree mortality from mixed conifer forests at Sequoia National Park
11:30 – 12:00	*John Bailey* *Oregon State University*	Fire and Fire Surrogate fuels treatments in ponderosa pine forests and their effectiveness across the West

Effects on Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective

Scott Stephens,
University of California – Berkeley
Berkeley, California, USA

John Bailey
Oregon State University
Corvallis, Oregon

13:30 – 14:00	***Carl Fiedler*** ***University of Montana***	Multi-disciplinary effects of fire and fire surrogate treatments in ponderosa pine forests in Montana
14:00 – 14:30	***Scott Stephens*** ***University of California, Berkely***	Simulated wildfire performance of the western US fire and fire surrogate treatments
14:30 – 14:45	***R.E.J. Boerner*** ***Ohio State University*** ***Columbus, Ohio, USA***	I. Network stratification, meta-analytical methods, and soil microbial community responses
14:45 – 15:00	***Stephen Hart*** ***Northern Arizona University***	II. Soil physical and chemical responses to fire and fire surrogate treatments
15:30 – 15:45	***Stephen Hart*** ***Northern Arizona University***	III. Carbon and nitrogen dynamics of soils, forest floor, and woody debris following fire and fire surrogate treatments
15:45 – 16:00	***Sarah Converse*** ***Patuxent Wildlife Research Center***	Small Mammal Responses to Forest Fuel Reduction: National- Scale Results from the Fire and Fire Surrogate Project
16:00 – 16:15	***Kerry Farris*** ***Wildlife Conservation Society***	The Effects Of Fire And Fire Surrogate Treatments On Avian Nest Survival
16:30 – 17:00	***Christopher Fettig*** ***USDA Forest Service***	Bark beetle responses to burning and thinning treatments of the fire and fire surrogate study, a multi-site approach.
17:00 – 17:30	***Jim McIver*** ***Oregon State University***	Panel Summary of the fire and fire surrogate study: Where do we go from here?

Session Title: Effects on Fire and Fire Surrogate Treatments for Ecological Restoration: A National Perspective

Session Organizer: *Scott Stephens,*
University of California–Berkeley
Berkeley, California, USA

Abstract:

There is a general agreement that past management actions have increased fire hazards and risks in many forested areas in the USA. The need for restoration is clear. Less clear, however, is the appropriate balance of restoration treatments including thinnings, mechanical fuel treatments, and prescribed fire. This special session will report on the National Study of Fire and Fire Surrogate Treatments. This is a large study with 12 sites in 10 states (California, Oregon, Washington, Montana, Arizona, Florida, Alabama, North Carolina, South Carolina, Ohio) and we will report on the first 6 years of this interdisciplinary (vegetation, soils, wildlife, entomology, fuels, utilization, economics) study. Presentations on multiple sites or interdisciplinary analyzes on a single site will be emphasized. This is currently the largest research project in the USA that is investigating the ecological and economic effects of fuels treatments in forests

Co-Organizer: *John Bailey, Oregon State University*

Presentation Title: Introduction to the Fire and Fire Surrogate Study

Presenter: *James McIver*
Oregon State University
Union, Oregon, USA

Abstract:

The Fire and Fire Surrogate Study (FFS) is composed of a national network of 13 seasonally dry forest sites, from longleaf pine of the southeast Piedmont to ponderosa pine of the Pacific Northwest. Each site represents a forest type with a natural low-severity, high-frequency fire regime, but now has a high risk of severe wildfire, due to the accumulation of fuel after almost a century of fire suppression. Forest managers have recently used various techniques to reduce fuels in these forests, but there is very little comparative information on the consequences of the alternative methods available, principally prescribed fire and mechanical treatments. The FFS study has experimentally evaluated the consequences of four management options: 1) mechanical treatment alone; 2) prescribed fire alone; 3) mechanical + fire; and 4) untreated control. A host of variables have been measured, including aspects of the vegetation, fuel and fire behavior, soils and the forest floor, wildlife, entomology, pathology, treatment costs, and utilization economics. The FFS research design allows for robust interdisciplinary analyses at the site level and meta-analytic procedures at the national level. Today we focus on both kinds of analyses, by presenting initial effects information across the FFS network. We also present papers that discuss both economic and social considerations relevant to the use of fuel reduction methods in dry forests nation-wide.

Presentation Title: Multi-site vegetation responses to fuels treatments

Presenter: *D.W. Schwilk*
US Geological Survey
Three Rivers, California, USA

Abstract: The Fire and Fire Surrogate Study (FFS) investigates restorative management options in forests that have experienced nearly a century of fire suppression. The nationwide study is composed of a network of 13 seasonally dry forest sites across the U.S. that experienced frequent low-severity fire prior to fire suppression. Concern that these forests now have a high risk of severe wildfire has led forest managers to attempt to reduce fuels. There is very little comparative information on the ecological consequences of the alternative methods available, principally prescribed fire and mechanical treatments. The FFS study experimentally examines the consequences of four management treatments: 1) mechanical fuel reduction, 2) prescribed fire, 3) mechanical + fire, and 4) untreated control. The wide range of sites in the study, from Southeastern long leaf pine forests to ponderosa pine forests of the Pacific Northwest, provides an opportunity to find generalizable vegetation responses to these fuel reduction treatments. Network-level results indicate that overstory tree response differs significantly between treatments that include mechanical thinning and those that do not. Understory vegetation, on the other hand, responds fundamentally differently between treatments that include burning and those that do not.

Co-Authors: *Jon E. Keeley, U.S. Geological Survey*

Presentation Title: Delayed mortality of eastern hardwoods – a function of fire behavior, site, or pathology?

Presenter: ~~*Tom Waldrop*~~
~~*USDA Forest Service*~~
~~*Clemson, South Carolina, USA*~~

Abstract: Two sites of the National Fire and Fire Surrogate study are located in hardwood dominated forests: the Southern Appalachians and the Ohio Hills. Increased first-year post-treatment mortality of overstory trees (DBH>4 cm) was expected in the units receiving prescribed fire. What was not expected was that these units displayed increased mortality in trees of all size classes for up to 4 years post-treatment. The likelihood of mortality was related to prior tree health, species related bark thickness, and first order fire effects. Site quality, based on moisture availability, had no effect on mortality. The Ohio Hills site had significant defoliation in two of the years of this study; however, degree of defoliation did not contribute to mortality in this time period. Prior to treatment, both sites were unmanaged and competition for resources was stressing the trees. The additional stress due to cambial damage caused by the heat of the fires possibly put the trees at greater risk for opportunistic secondary agents of mortality, such as fungal attacks or insect infestations. This study indicates that monitoring the first-year post-treatment effects of a prescribed burn or wildfire may not afford an accurate assessment of the effects on the overstory. The study also suggests that managers should consider tree health when making fire prescriptions for hardwood stands.

Co-Authors: *Colleen A. Caldwell, New Mexico State University - James E. Brooks, USDI Fish and Wildlife Service*

Presentation Title: Ponderosa pine and Douglas-fir mortality after fuel reduction and restoration treatments in northeastern Oregon

Presenter: *Andrew Youngblood*
USDA Forest Service
LaGrande, Oregon, USA

Abstract: Many low elevation dry forests of the Pacific Northwest contain more small trees and fewer large trees, more down woody debris, and less diverse and vigorous understory plant communities compared to conditions under historical fire regimes. These altered structural conditions may contribute to increased probability of unnaturally severe wildfires, susceptibility to uncharacteristic insect outbreaks, and drought-related mortality. Broad-scale fuel reduction and restoration treatments are proposed to promote stand development on trajectories toward more sustainable structures. Little research to date, however, has fully quantified the effects of these treatments, especially delayed and latent tree mortality resulting directly or indirect from treatments. We explored complex hypotheses about individual tree mortality resulting from multiple causal pathways by using structural equation modeling (SEM). We used annual census and plot data from an operational-scale, replicated (N=4), completely randomized experiment in ponderosa pine (Pinus ponderosa) and Douglas-fir (Pseudotsuga menziesii) forests of northeastern Oregon, one of national Fire and Fire Surrogate study sites. Treatments included a single entry thin from below, a late season burn, a thin followed by burning (thin + burn), and a no action treatment which served as a control. Thin, burn, and thin + burn treatments reduced the density of live trees, especially the smaller size classes, leaving both ponderosa pine and Douglas-fir with more modal or normal diameter distributions. Bark beetle-caused tree mortality was greatest in years after thin + burn treatments. SEM results indicate that the probability of bark beetle attack was directly related to fire intensity as estimated by heat tiles. Site characteristics such as soil depth and presence of rock also contributed to treatment responses. These results are discussed in the context of management options for restoration of ecosystem health in similar ponderosa pine and Douglas-fir forests.

Co Authors: *James B. Grace, US Geological Survey - James D. McIver, Eastern Oregon Agriculture Research Center*

Presentation Title: Tree mortality patterns following replicated prescribed fires in a mixed conifer forest

Presenter: *Leda N. Kobziar*
University of Florida
Gainesville, Florida, USA

Abstract: During the late fall of 2002, we administered three burns in mixed conifer forest sites in the north-central Sierra Nevada. The sites contained 1300 trees. Using logistic regression, an array of crown scorch, stem damage, fuels, and fire behavior variables were examined for their influence on tree mortality. In Douglas-fir, white fir, and incense-cedar, smaller trees with higher total crown damage had higher mortality. Smaller diameters and denser canopies best predicted mortality in ponderosa pine. Consumption of duff and bark char severity increased model discrimination for white fir, and incense-cedar and black oak, respectively. In tanoak, higher total crown damage in shorter trees resulted in higher mortality rates. Along with tree diameter and consumption of large (>7.6 cm) rotten downed woody debris, fire intensity was a significant predictor in overall tree mortality for all species. White fir mortality patterns in relation to crown damage resembled each other between sites, while incense-cedar did not, suggesting that species in replicated sites responded to similar burns differently. Our results demonstrate actual fire behavior data incorporated into mortality models, and can be used to design prescribed burns for targeted reduction of tree density in mixed conifer forests. We will also report on secondary tree mortality caused by insects from surveys through 2004.

Co-Authors: *Jason Moghaddas, Dan Stark, David Wood, Andrew Storer, and Scott L. Stephens*

Presentation Title: Cost and productivity analysis of mechanical and burn treatments to remove biomass on FFS sites

Presenter: *Bruce Hartsouth*
University of California-Davis
Davis, California, USA

Abstract: Costs for the prescribed fire and/or mechanical treatments were estimated for many of the FFS sites. For burning, expert opinion-derived costs for treatments under typical conditions were obtained in addition to estimates of actual costs, due to concerns that study sites might have atypical operating conditions. For mechanical treatments, costs were derived from empirical productivity data and estimated costs for replacement equipment. On sites where harvesting took place, the values of the materials removed were also estimated. Costs of mechanical treatments (ignoring revenues) were substantially higher than the burn costs. Net costs for mechanical treatment were less on average than the burn costs.

Presentation Title: Social responses to fire and fire surrogate treatments in the central Sierra Nevada, California

Presenter: *Sarah McCaffrey*
USDA Forest Service
Evanston, Illinois, USA

Abstract: Equally important to understanding the ecological and economic effects of different restoration treatments is the need to understand public response to the treatments. Recent research has indicated that interactive learning and demonstration sites can be particularly effective ways of gaining increased acceptance of a fuel treatment method. The Fire and Fire Surrogate study provides a unique opportunity to better understand these dynamics in relation to an array of on the ground fuel treatments. This presentation will discuss findings from a short survey that was given to different groups who had recently toured the Blodgett Station surrogate study site in California. Topics discussed will include how touring the treatment sites influenced treatment acceptability, differences in treatment preferences based on land ownership and professional affiliation, and what variables people considered in determining their preferences

Co-Authors: *Jason Moghaddas, USDA Forest Service - Scott Stephens, University of California - Berkeley*

Presentation Title: Interactions of bark beetles and tree mortality in mixed conifer forests at Sequoia National Park

Presenter: *D.W. Schwilk*
US Geological Survey
Three Rivers, California, USA

Abstract: The Picture Fire burned approximately 5,000 hectares on the Tonto National Forest in June of 2003. Seven monitoring sites were established to determine the effects of postwildfire ash and sediment inputs on fishes and their habitats. Sites were sampled prior to runoff events and following the post-fire, summer monsoon season. Native fishes sampled at these sites were headwater chub Gila nigra, desert sucker Catostomus clarki, and speckled dace Rhinichthys osculus. Percent decrease in total fish numbers varied with position on the watershed. Numbers of all species decreased after the summer, postfire runoff events at five of the six sampling sites and ranged from 52% to 94% reductions. The most upstream and downstream sites on the watershed sustained the greatest reductions in fish numbers with a complete loss of all fish species occurring at the lowest site in the watershed. Spikes in turbidity of over 1000 NTU were recorded and initial spikes of high turbidities were correlated with a pronounced drop in dissolved oxygen. High turbidity also was negatively correlated with a dampening of the diurnal pattern of dissolved oxygen rise and fall. Little change in pH was observed. Suspended solids and pebble counts suggested periodic, immediate, and dramatic changes in water quality and stream channel substrates. Short-term results of this study corroborate previous studies documenting the short-term, dramatic and negative impact on native fishes in fire-impacted streams.

Co-Authors: *Eric E. Knapp, USDA Forest Service - Scott M. Ferrenberg, US Geological Survey - Jon E. Keeley, US Geological Survey - Anthony C. Caprio, USDI National Park Service*

Presentation Title: Fire and Fire Surrogate fuels treatments in ponderosa pine forests and their effectiveness across the West

Presenter: *John Bailey*
Oregon State University
Corvallis, Oregon, USA

Abstract: Many forest types of western North America have high fuel loads after a century or more of heavy grazing, scattered logging and active fire suppression. The ponderosa pine type is perhaps the most studied and recognized of these types. Contemporary dense forest conditions promote stand-replacing wildfires where frequent low-severity surface fires were once the norm. Land managers are now struggling with precisely how to treat these forests to reduce future wildfire risk and restore appropriate stand and landscape structure, particularly in the wildland-urban interface. Proposed solutions include various forms of mechanical thinning and prescribed fire, alone and in combination. There is, however, uncertainty surrounding the separate and combined effects of these silvicultural treatments on long-term productivity and ecological function in these forests, and the degree of fire hazard reduction actually provided. Four of the 13 regional study sites in the FFS project were located in the ponderosa pine forest type. In this presentation, we will provide some details on their treatment approaches and establishment details, and report some short-term responses of the overstory trees to treatments. Mechanical treatments ranged from fairly light thinning on a regular spacing to a multi-aged group selection harvest; prescribed fire included pile and broadcast burning. Harvest damage to overstory trees was low throughout the study. Tree mortality from crown scorching was also surprisingly low in the prescribed fire only treatment, higher in the harvest and burn treatment given differences in fire behavior. Resulting diameter distributions show a major alteration in forest structure with mechanical harvest, but little change with initial prescribed fire entries. Ecosystem responses predictably follow from the intensity of disturbance relative to pre-existing stand conditions.
Fire and Fire Surrogate fuels treatments in ponderosa pine forests and their effectiveness across the West.

Co-Authors: *Sally Haase, USDA Forest Service - Jim McIver, Oregon State University - Carl Edminster, USDA Forest Service*

Presentation Title: Multi-disciplinary effects of fire and fire surrogate treatments in ponderosa pine forests in Montana

Presenter: *Carl Fiedler*
University of Montana
Missoula, Montana, USA

Abstract: Abstract not available

Presentation Title: Simulated wildfire performance of the western U.S. fire and fire surrogate treatments

Presenter: *Scott Stephens*
University of California Berkeley
Berkeley, California, USA

Abstract: Modification of potential fire behavior is a central management focus in western coniferous forests. Managers must manage vast forested landscapes effectively within complex financial, political, and social frameworks while concurrently providing for ecosystem values. The principles of fuel reduction which can modify fire behavior are recognized by managers and scientists, though quantitative desired conditions for fuel treatments are not readily available to planning teams for use in designing and evaluating different fuel treatments on both public and private lands. The Fire and Fire Surrogate Study has quantified the initial effects of fire and fire surrogate treatments on a number of response variables, including vegetation structure, fuel loading, and potential fire behavior. We will present results of the effects of mechanical, fire only, and a combination of these treatments on potential fire behavior and severity from 6 western Fire and Fire Surrogate Study Sites. These sites include Blodgett Forest Research Station, in the Central Sierra Nevada, Sequoia and Kings Canyon National Park, in the Southern Sierra, the Goosenest Experimental Forest, in the Southern Cascades, the Hungry Bob Site, in Northeastern Oregon, the Lubrecht Site, in Western Montana, and the Southwest Plateau, in Northern Arizona. Results from the Fire and Fire Surrogate Study treatments will help managers succeed in effectively implementing fuel treatments at a landscape level.

Co-Authors: *Jason Moghaddas, University of California–Berkeley - Carl Fiedler, University of Montana - Sally Haase, Eric Knapp, Carl Skinner, Andy Youngblood, USDA Forest Service - Kerry Metlen, University of Montana*

Presentation Title: I. NETWORK STRATIFICATION, META-ANALYTICAL METHODS, AND SOIL MICROBIAL COMMUNITY RESPONSES

Presenter: *Ralph Boerner*
Ohio State University
Columbus, Ohio, USA

Abstract: Background soil properties vary greatly among the network sites. Variation ranges from soil pH differences of by 2.6 units to 6.5 fold, 45.6 fold, and 247.8 fold differences in mean soil organic C, forest floor N, and available Ca among sites, respectively. We used an ordination approach to array the twelve network sites along two gradients, one of which correlated with N availability and base saturation and the other with organic matter content and texture. Overall, the fire and fire surrogate treatments had modest effects on overall soil microbial activity, though changes in functional community structure were present and significant in the sites where it was assessed. Analysis of samples taken 3-4 years post-treatment will determine whether such effects are persistent. [Note: the results described here are preliminary, represent only the pre-treatment and first post-treatment sampling years, and should not be cited as either final or formally published.]

Co-Authors: *Jianjun Huang, Ohio State University –*
Stephen C. Hart, Northern Arizona University

Presentation Title: II. Soil physical and chemical responses to fire and fire surrogate treatments

Presenter: *Stephen Hart*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Longer term ecosystem productivity depends on adequate supplies of essential nutrients, a physical substrate suitable for root and microbial growth, and a physiochemical environment suitable for metabolic activity. In this portion of the larger consideration of the impacts of fire and fire surrogate treatments on belowground ecosystem attributes, we present preliminary meta-analysis of effects on a subset of the soil physical properties (soil bulk density, mineral soil exposure) and nutrient status indices (soil pH, plant available P, and extractable Ca and K) that we monitored across the network. Despite the strong differences among network sites in pre-treatment soil conditions, responses to the fire and fire surrogate treatments were relatively consistent and modest across the network. [Note: the results described here are preliminary, represent only the pre-treatment and first post-treatment sampling years, and should not be cited as either final or formally published.]

Co-Authors: *R. E. J. Boerner and J. Huang, Ohio State University,*

Presentation Title: III. Carbon and nitrogen dynamics of soils, forest floor, and woody debris following fire and fire surrogate treatments

Presenter: ***Steve Hart***
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: Understanding how the fire and fire surrogate treatments impact longer term storage and turnover rates of carbon and nitrogen is critical to the evaluation of these management alternatives in the context of increasing atmospheric CO_2 and deposition of anthropogenic N. In this last segment of the consideration of the belowground effects of the FFS treatments, we consider the first year effects on C and N in mineral soil organic matter, forest floor materials, fine and coarse woody debris, and also components of organic N turnover (net N mineralization, net nitrification, proportional nitrification, and total inorganic N in the soil solution {TIN}). Even at this early stage of analysis, it is clear that fire and fire surrogate treatments have the potential to affect significantly carbon and nitrogen sequestration and turnover, both in overall mass and the distribution of these elements among ecosystem pools. In addition, the combined fire and mechanical treatment has a greater range of significant impacts, both in terms of C and N cycling parameters and geography/ecosystem type than does either prescribed fire or mechanical treatment alone. [Note: the results described here are preliminary, represent only the pre-treatment and first post-treatment sampling years, and should not be cited as either final or formally published].

Co-Authors: ***R.E.J. Boerner, J. Huang, Ohio State University***

Presentation Title: Small Mammal Responses to Forest Fuel Reduction: National-Scale Results from the Fire and Fire Surrogate Project

Presenter: ***Sarah Converse***
Patuxent Wildlife Research Center
Laurel, Maryland, USA

Abstract: The National Fire and Fire Surrogate Project (FFS) was designed to evaluate comparative ecological impacts of prescribed fire and alternative, or "surrogate" fuel reduction treatments. We examined short-term patterns in small mammal responses to mechanical thinning, prescribed fire, and mechanical thinning/prescribed fire combination treatments based on live-trapping data from 8 study areas in the FFS network. Our research questions were, 1) do treatments differ in their effect on small mammal densities and biomass, and 2) are effects of treatments consistent across study areas? We considered responses of several small mammal taxa—including deer mice (Peromyscus maniculatus), yellow-pine chipmunks (Tamias amoenus), golden-mantled ground squirrels (Spermophilus lateralis), Peromyscus spp., and Tamias spp.—as well as total small mammal biomass. We modeled response variables as functions of treatment type (thinning, fire, and combination) and study area, and ranked models based on an information-theoretic model selection criterion. We found that taxa-specific response variables had top-ranked models including both treatment type and study area. However, the top-ranked model of total small mammal biomass included only treatment (i.e., treated versus untreated). Individual taxa demonstrate variable responses to fuel reduction treatment types—indicating that thinning does not act as an ecological surrogate of fire with respect to particular small mammal taxa—and responses varied geographically as well. In contrast, total small mammal biomass appears to generally increase with any type of fuel reduction treatment. These results suggest that adaptive management policies, which take account of uncertainty in predicting management outcomes, may be useful when applying fuel reduction treatments in areas where management of particular small mammal taxa is of interest.

Co-Authors: ***Sarah J. Converse, Gary C. White, Colorado State University -***
Kerry L. Farris, Steve Zack, Wildlife Conservation Society

Presentation Title: The Effects Of Fire And Fire Surrogate Treatments On Avian Nest Survival

Presenter: *Kerry Farris*
Wildlife Conservation Society
Klamath Falls, Oregon, USA

Abstract: We examined initial short-term response of avian nest success to fire and "fire surrogate" treatments across a national network of 9 study sites. Our objectives were to evaluate the effects of 3 treatment types (mechanical thinning, prescribed fire, and mechanical thinning followed by prescribed fire) on daily nest survival of four avian nesting guilds: ground, shrub, snag, and tree-nesting birds. We modeled daily survival as a function of a bivariate treatment variable (treated or untreated), treatment type, and study area, and ranked models using information-theoretic techniques. For each nesting guild, the top-ranked explanatory model was the null or "constant survival" model. However, this model was not overwhelmingly supported for 2 of the 4 nesting guilds, so we relied on model averaging techniques to estimate treatment and study area effects. Ground-nesters experienced an estimated increase in daily nest survival in all of the treated areas relative to controls, but this effect was weak and the estimated 95% confidence interval included 0. Conversely, shrub-nesting birds experienced lower daily nest survival in all manipulated areas relative to controls and this response was specific to study area. However, again, estimated 95% confidence intervals on the model averaged treatment effects included 0 for all areas. We did not detect an effect of treatment for either snag or tree-nesting guilds. The lack of strong evidence for treatment effects with each of the 4 nesting guilds could be due to several aspects of this study including high response variability within study areas and also between species within guilds. These results suggest a variable pattern in the response of avian nest success to fuel reduction techniques in fire dependent forests. Site-specific monitoring of nest success should be considered when planning fuel reduction activities in areas where maintenance of avian communities is of management interest.

Co-Authors: *Sarah J. Converse, Patuxent Wildlife Research Center - Steve Zack, Wildlife Conservation Society - Andy J. Amacher, University of California - Thomas Contreras, University of Florida - William Gaines, USDA Forest Service - Donald Miles, Ohio University - Nash Hall, Oregon State University - Ghislain Rompré, University of Laval*

Presentation Title: Bark beetle responses to burning and thinning treatments of the fire and fire surrogate study, a multi-site approach

Presenter: *Christopher Fettig*
USDA Forest Service
Davis, California, USA

Abstract: Compared to their historical counterparts, today's forests are in many cases more dense, have more smaller trees and fewer larger trees and are dominated by more shade-tolerant and fire-intolerant tree species. Areas that were previously open have become forested. These conditions have led to increases in competition among trees for below-ground nutrients, water and growing space, thereby increasing the vulnerability of such forests to bark beetles (Coleoptera: Scolytidae) and other forest insects and diseases. Bark beetles are a large and diverse group of insects consisting of approximately 550 species in North America and over 6000 species worldwide. They are commonly recognized as the most important mortality agent in North American forests, and influence forest ecosystem structure and function by regulating certain aspects of primary production, nutrient cycling, ecological succession and the size, distribution and abundance of forest trees. Extensive amounts of bark beetle-caused tree mortality may exacerbate problems associated with heavy fuel loads. In this presentation, we examine the initial, short-term response of bark beetles to prescribe fire and fire surrogate (mechanical fuel) treatments at several spatial scales.

TRACK 6

Thursday, November 16, 2006

Ecosystem Process

8:00 - 8:15	*Paul Hessburg* *USDA Forest Service*	Reintroducing Fire to Fire-Prone Forests: Creating Landscapes within Landscapes
8:15 – 8:30	*Carl Skinner* *USDA Forest Service*	Changes in conifer radial growth patterns since the onset of fire suppression at the Blacks Mountain Experimental Forest, California
8:30 – 8:45	*Kirsten Stephan* *University of Idaho*	Comparison of wildfire and spring prescribed burn effects on nitrogen dynamics in Rocky Mountain headwater areas
8:45 – 9:00	*Anthony Caprio* *USDI National Park Service*	Long-Term Effects of the 1992 Rainbow Fire, Devils Postpile National Monument, California.
9:00 – 9:15	*Carlton Britton* *Texas Tech. University*	Ecological Implications of Fire Temperatures from Grassland Fuels
9:15 – 9:30	*Meg Krawchuk* *University of Alberta*	Evidence for accelerated, compound disturbance in the mixedwood boreal forest via increased lightning fire initiation in harvested landscapes
9:30 – 9:45	*Hal Liechty* *University of Arkansas*	Impacts of long-term prescribed fire on litterfall decomposition and nutrient dynamics in uneven-aged loblolly pine stands
9:45 – 10:00	*Fiona Christie* *University of Melbourne*	Fuel for thought: Do litter-dwelling invertebrates mediate fine fuel loads in frequently burnt eucalypt forests?

Soil, Watershed and Aquatic

10:30 – 10:45	*Luis Outeiro* *University of Barcelona*	Spatial variability of P_2O_5 before and just after a prescribed fire in two Mediterranean plots
10:45 – 11:00	*Emily Moghaddas* *University of California-Berkeley*	Fire and Fire Surrogate treatment effects on soil properties in a Sierran mixed conifer forest
11:00 – 11:15	*Leda Kobziar* *University of Florida*	The effects of fuels reduction treatments on soil carbon respiration in a Sierra Nevada pine plantation
11:15 – 11:30	*Kevin Robertson* *Tall Timbers Research Station*	Fire regime effects on soil C and nutrients in a southeastern U.S. pineland
11:30 – 11:45	*William Massman* *USDA Forest Service*	Long term consequences of a controlled slash burn and slash mastication to soil moisture and CO2 at a southern Colorado site
11:45 – 12:00	*Matt Busse* *USDA Forest Service*	Lethal soil heating during burning of masticated fuels: effects of soil moisture and texture

13:30 – 13:45	***Peter Robichaud*** ***USDA Forest Service***	An Interactive Probabilistic Postfire Hillslope Erosion and Mitigation Model
13:45 – 14:00	***Robert Arkle*** ***California Polytechnic State university***	Interactions Between Fire, Flow, and Sediment Affect Aquatic Macroinvertebrate Communities
14:00 -14:15	***Alvin Medina*** ***USDA Forest Service***	Long Term Effects of Wildfire on Channel Geomorphology on Riparian Habitats of The Submogollon Region
14:15 – 14:30	***Chad Mellison*** ***USDA Fish & Wildelife Service***	Fire Effects on Stream Temperature: An Example from the Eastern Sierra Nevada, California

Wildlife and Habitat

14:30 – 14:45	***David Pilliod*** ***California Polytechnic State University***	Fire in Riparian Forests: Effects on Stream Amphibian Reproduction in the Northwest, USA
14:45 – 15:00	***Elizabeth Tasker*** ***Department of Environment & Conservation***	The impacts of fire on Australian fauna: A synthesis of research since 1995
15:30 – 15:45	***Thalia Partridge*** ***Macquarie University***	Fire and Fauna in Purnululu (Bungle Bungle) National Park
15:45 – 16:00	***Natasha Kotliar*** ***US Geological Survey***	Avifaunal response to fire along a burn severity gradient in montane forests of the southern Rocky Mountains
16:00 – 16:15	***Susan Roberts*** ***US Geological Survey***	The effects of fire on California spotted owls and their prey in Yosemite National Park
16:15 – 16:30	***Richard Hutto*** ***University of Montana***	Plant and animal species closely associated with severely burned conifer forests: are we managing for their maintenance?
16:30 – 16:45	***Jennifer Potts*** ***University of California- Berkeley***	Bird Community Response to Prescribed Fire and Mechanical Cutting in California Chaparral
16:45 – 17:00	***Marc Meyer*** ***USDA Forest Service***	Microhabitat Associations of Northern Flying Squirrels in Burned and Thinned Forest Stands of the Sierra Nevada
17:00 – 17:15	***David Wester*** ***Texas Tech University***	Effects of prescribed fire on vegetation and non-game wildlife in central Texas

Session Title: Ecosystem Process

Presentation Title: Reintroducing Fire to Fire-Prone Forests: Creating Landscapes within Landscapes

Presenter: *Paul Hessburg*
USDA Forest Service
Wenatchee, Washington, USA

Abstract: Large scale stand replacing wildfires are now relatively common in western dry forests that prior to the advent of management experienced a broad assortment of fires varying in severity, size and intensity. Today, prescribed fires, alone or in combination with thinning, may be needed to improve the fire tolerance of dry mixed coniferous landscapes. Questions abound though, about when, where, and how to reintroduce fire to these forests, and with what effects. Here, we expand on principles from the fire ecology literature that are associated with improving the fire resistance of fire-prone landscapes. We discuss the chief effects of stand-level fire and thinning treatments that are based on these principles advantages of the treatments to forest and fire managers, and the advantages and disadvantages to native biota that may be associated. We add two principles that apply within-stands and to landscape that, when considered alongside of stand-level principles, incorporate fine to coarse filter considerations, and a broader variety of habitat patterns and processes than are currently addressed. For many dry forests, it will be sensible to reduce surface fuels, increase the height to live crowns, and decrease crown density to some extent, but the resulting spatial patterns matter to native biota and processes. The trick will be to create landscapes within landscapes; patterns of living and dead forest vegetation over space and time that enable all native species and processes to persist in the long term, through highs and lows, regardless of the scale of their habitats, home ranges, body sizes, and mobility.

Co-Authors: *Paul F. Hessburg, USDA Forest Service - R. Brion Salter, USDA Forest Service*

Presentation Title: Changes in conifer radial growth patterns since the onset of fire suppression at the Blacks Mountain Experimental Forest, California

Presenter: *Carl Skinner*
USDA Forest Service
Redding, California, USA

Abstract: Trees affected either by injury or the removal of adjacent competition may exhibit sudden changes in radial growth. We investigated the influence of fires on radial growth by collecting increment cores from over 600 trees on a 300x300m grid (approximately one sample point for 9ha) on three 100ha plot on the Blacks Mountain Experimental Forest in northeastern California. At each point, trees of each species present in five canopy layers (i.e., suppressed, intermediate, codominant, dominant, and emergent) were sampled. Additionally, we collected 103 fire-scarred samples from the three 100ha plots. All cores were cross dated and ring-widths were measured. We then determined dates of growth suppressions and releases as follows: 1) suppressions were defined as >50% reduction in radial growth for 5yrs compared with the previous 5yrs, and 2) releases were defined as >50% increase in radial growth for 5yrs compared with the previous5 yrs. All fire-scar samples were cross dated to accurately determine the year of the fire. Dates of suppressions and releases were then compared to fire dates. We found little correspondence between dates of suppressions/releases and fire occurrence. Before 1900, when fires were frequently burning through these stands, growth suppressions and releases were found only occasionally on scattered, individual trees and did not appear to be related to fire occurrence, suggesting fires were of low intensity. However, after 190 when fires in these stands had mostly ceased to be recorded, radial growth generally decreased, while growth releases became more common and were synchronous on many trees across the study area This may be due to a flush of conifer seedling establishment beginning in the 1880s coincident with heavy sheep grazing and the waning of fire occurrence, that by the 1930s produced stand densities where tree growth appeared to have become more strongly regulated by competition.

Co-Authors: *Neil A. Flagg, USDA Forest Service*

Presentation Title: Comparison of wildfire and spring prescribed burn effects on nitrogen dynamics in Rocky Mountain headwater areas

Presenter: *Kirsten Stephan*
University of Idaho
Moscow, Idaho, USA

Abstract: Fire can have profound effects on nitrogen (N) dynamics, however little is known about the simultaneous effects on N in soil, plants and streams within watersheds. This replicated study compares wildfire with spring prescribed burn effects on watershed ecosystems in central Idaho headwaters. We measured N concentrations in major ecosystem N pools (soil, foliage, streamwater, aquatic biota) during the two growing seasons following the burns. In the first growing season post-fire soil ammonium concentrations were increased about 19-fold (spring) and 3.5-fold (summer) in burned watersheds relative to controls (3 and 9 µg NH_4^+-N kg^{-1}, respectively) regardless of fire type. Soil nitrate concentrations were increased in summer only, and more so in wildfire sites than prescribed burn sites (wildfire: 11 µg NO_3^--N kg^{-1}, prescribed burn: 0.7 µg NO_3^--N kg^{-1}, unburned: 0.3 µg NO_3^--N kg^{-1} or below detection limit). Resprouting shrubs and forbs retained some of the post-fire available N in their foliage (foliar N concentrations: burned 2.3 %, unburned 1.5 %) in both fire types. Not all post-fire released soil N was retained by vegetation; streamwater nitrate concentrations increased on average about 5-fold (burned: 140 µg l^{-1}, unburned: 28 µg l^{-1}) in wildfire sites, and no increase occurred in prescribed fire sites. Aquatic moss also retained post-wildfire available aquatic N in its tissues (N concentration: burned 3.2 %, unburned 2.3 %). During the second post-fire season wildfire effects on streamwater nitrate and moss N concentrations persisted at equal magnitude, effects on soil nitrate and plant foliar N concentrations had a much lower magnitude, and fire effects on soil ammonium were not detectable anymore. No fire effects could be detected in prescribed burn sites in the second post-fire season. In sum, wildfire effects strongly influenced N dynamics both locally (i.e. sampling plots) and also across the entire watershed (i.e. streamwater biochemistry as integrator of watershed processes). Prescribed burn effects are shorter lived and localized. Therefore, from a nitrogen cycling perspective, managers have room to aim for higher spring burn severity.

Co-Authors: *Akihiro Koyama, Kathleen Kavanagh, University of Idaho*

Presentation Title: Long-Term Effects of the 1992 Rainbow Fire, Devils Postpile National Monument, California

Presenter: *Anthony Caprio*
USDI National Park Service
Three Rivers, California, USA

Abstract: In August 1992 a 3,378 ha lightning ignited wildfire burned 82% of Devils Postpile National Monument. Large high severity patches with complete tree mortality hundreds of hectares in size, were produced by the Rainbow Fire in conifer forest composed of red and white fir and Jeffrey and lodgepole pine. Management questions, such as whether the effects of the fire were within the natural range of variability and whether fire should be reintroduced, have been raised, however, little or no information on pre-EuroAmerican settlement fire regimes exists for the area. Using fire effects plots established postfire, we examined fuel and forest conditions and regeneration patterns at sites burned with varying severity. Additionally, fire history sampling provided information on past fire return intervals. These reconstructions showed that the area experienced moderate fire frequency (8 to 33 years between fires) and indicated that a surface fire regime predominated. Plot data showed that ten-year postfire, fuel loads were approaching prefire levels at some sites and most high severity patches were now shrub dominated. Conifer regeneration was plentiful in areas under or adjacent to surviving overstory trees but limited in areas >100 m from surviving trees. Nearly all regeneration at the latter sites was Jeffrey pine originating shortly postfire. Results suggest application of fire to areas of low-to-moderate severity may be beneficial for restoring more natural conditions but in the large high-severity patches, it might lead to long-term persistence of shrubs where limited tree regeneration is susceptible to fire caused mortality.

Co-Authors: *MaryBeth Keifer, Karen Webster, USDI National Park Service*

Presentation Title:	Ecological Implications of Fire Temperatures from Grassland Fuels

Presenter: *Carlton Britton*
Texas Tech University
Lubbock, Texas, USA

Abstract: Experimental fires conducted throughout Texas have evaluated temperatures at the soil surface in fuels varying from 1,000 kg/ha to 15,000 kg/ha. These fires have been conducted by the Texas Tech University fire program starting in the late 1960's and continuing into the 21 century. We will examine the temperatures generated and the estimated ecological impacts for grassland communities from shortgrass prairie to weeping lovegrass on the Texas High Plains to marsh hay cordgrass along the Texas coast. With fine fuels loads of 1,500 kg/ha in the short grass prairie soil surface temperatures averaged about 125C. With tobosagrass fuel loads from 4,000 kg/ha to 6,500 kg/ha, the soil surface temperature varied from 310C to 360C. On Matagorda Island with heavy fuel loads, back fires produced twice the heat pulse compared to headfires. We will discuss the ecological impacts resulting from these varied fire temperatures on various plant communities and where possible, compare summer and winter fires. We will also explore how plant morphology interacts with fire temperature and season.

Co-Authors: *David B. Wester, Carlos Villalobos, Sandra Rideout-Hanzak, Texas Tech University*

Presentation Title:	Evidence for accelerated, compound disturbance in the mixedwood boreal forest via increased lightning fire initiation in harvested landscapes

Presenter: *Meg Krawchuk*
University of Alberta
Edmonton, Alberta, Canada

Abstract: The emulation of natural disturbance as a management strategy for ecosystems is prominent in forest practice and policy in Canada's boreal region, but the degree to which harvesting emulates fire for fire – i.e., from the perspective of future fire events - has not been systematically studied. We quantified the annual pattern of lightning fire initiation in 10 000 ha landscapes over a 5 800 000 ha region of the western mixedwood boreal forest in Alberta, Canada with respect to variation in forest composition over eight years (1994 to 2001) while accounting for influential covariates such as weather and topography. In particular, we compared parameter estimates relating the probability of lightning fire initiation to the area of a landscape that had been previously burned relative to the area of harvest activity and found them in opposition. Lightning fire initiation was more likely to occur in landscapes with more harvested area, specifically in harvested stands, and less likely to occur in landscapes where more area that was previously burned. The emulation of natural disturbance (fire) through harvesting is not supported for the process of fire initiation. We used a simple scenario in the dynamic simulation model to demonstrate potential long-term (100 years) effects of these fuel-based statistical relationships. We hypothesized that harvested stands were likely to be burned after a shorter interval than previously burned areas due to increased initiation in harvested landscapes. We demonstrated the distribution in the number of years between disturbances in stands that were harvested then burned (HARVESTED – BURNED) differed from those that were burned and then burned again (BURNED – BURNED), and that a substantial regional area is affected by both combinations. We suggest that a manifestation of the spatiotemporal regulation of lightning fire initiation through harvesting activity is accelerated, compound disturbance.

Co-Authors: *Dr. Steve G. Cumming, Universite Laval - Dr. Fiona Schmiegelow, University of Alberta*

Presentation Title: Impacts Of Long-Term Prescribed Fire On Litterfall Decomposition And Nutrient Dynamics In Uneven-Aged Loblolly Pine Stands

Presenter: *Hal Liechty*
University of Arkansas
Monticello, Arkansas, USA

Abstract: Modification or manipulation of fire regimes can have an impact on forest ecosystem processes and functions. In Gulf Coastal Plain southern pine forests, prescribed fire is frequently utilized to accomplish a variety of management objectives. To better understand the effect of fire on decomposition and nutrient dynamics of the forest floor, we monitored weight loss and nutrient concentrations of loblolly pine litter collected from and then located in uneven-aged loblolly pine stands that had periodic dormant season prescribed fires during an 18 year period and stands that had no prescribed fires. Loblolly pine foliar litterfall was collected, placed in litterbags, and then installed at several locations within the stands. Mass loss and concentrations were determined periodically for this material over a 15-month period. Mass loss was significantly higher in the litterfall collected from stands that were periodically burned than the unburned stands but mass loss did not differ between litter bags located in the burned and unburned stands. Differences between litterfall collected in the two stand types appeared to be related to initial leaching of materials during the first two weeks of the study rather than changes in overall decomposition rates. Changes in concentrations of most nutrients were similar regardless of treatment. However, ash free concentrations of Ca, Mg, and Mn were significantly higher in the decomposing litterfall collected from stands that were periodically burned compared to the unburned stands. These results show minimal differences in the nutrient dynamics and mass loss of decomposing litterfall as a result of these periodic prescribed fires.

Co-Authors: *Michele L. Reinke, Missouri Valley College - Michael G. Shelton, USDA Forest Service*

Presentation Title: Fuel for thought: Do litter-dwelling invertebrates mediate fine fuel loads in frequently burnt eucalypt forests?

Presenter: *Fiona Christie*
University of Melbourne
Creswick, Victoria, Australia

Abstract: Land managers regularly prescribe fires in Australian forests to reduce levels of fine fuels. However, we know little about the long-term effects of repeated burning on ecological functioning. Leaf-litter accumulates rapidly in many of these forest systems, with fine fuel levels representing a dynamic balance between accumulation and decomposition of dead plant material. Litter-dwelling invertebrates are important decomposers of fuel on the forest floor and a major component of biodiversity. We examined the effects of different fire regimes on the decomposition of leaf litter in the presence and absence of macro-invertebrates. Specifically we addressed the following questions: 1) what is the effect of different fire regimes on rates of decomposition; and 2) how does the presence of invertebrates mediate these rates? Eighteen independent sites (0.5 ha) were studied that represented three experimental fire regimes: fire exclusion (at least 45 years), frequently burnt (every 3 years), and fire exclusion followed by the recent introduction of frequent burning (2 fires in 6 years). At each site, twenty bags filled with 10 g of leaves were placed amongst the litter. Ten bags were constructed of 8 mm mesh and ten were of 0.2 mm mesh. The large coarse mesh bag allowed litter-dwelling animals, bacteria and fungi to enter and contribute to the decomposition of leaves. The fine mesh bag excluded litter dwelling-animals but still allowed decomposition by fungi and bacteria. Results show that frequent burning significantly reduces the proportion of nitrogen in leaves but not carbon, thereby altering the C:N ratio. Litter invertebrate communities vary substantially between treatments, probably as a response to habitat structure (litter availability and structural arrangement) and litter quality (C:N). These differences, and associated differences in the microbial community, are likely to have substantial implications for rates of litter decomposition and hence rates of fuel accumulation.

Co-authors *Karl Brennan, Alan York, Josie Lawrence, University of Melbourne*

Session Title: **Soil, Watershed and Aquatic**

Presentation Title: Spatial variability of P_2O_5 before and just after a prescribed fire in two Mediterranean plots

Presenter: *Luís Outeiro*
University of Barcelona
Barcelona, Spain

Abstract:

In natural systems like soil and water, P will exist as phosphate, a chemical form in which each P atom is surrounded by 4 oxygen (O) atoms. In water, orthophosphate mostly exists as H_2PO_4- in acidic conditions or as HPO_4- in alkaline conditions. Humans have changed the natural phosphate supply radically by addition of phosphate-rich manures to the soil and by the use of phosphate-containing detergents. The effects are mainly consequences of emissions of large quantities of phosphate into the environment due to mining and cultivating. During water purification phosphates are often not removed properly, so that they can spread over large distances. Soil's buffer capacity facilitates the accumulation in three different pools: solution, active and fixed P. The ability of the active P pool to replenish the soil solution P pool in a soil is what makes a soil fertile with respect to phosphate. The controversial prescribed fire has been enforced by the Catalunya administration, requiring a comprehensive study of the effects on the environment. Two randomly selected plots were designed in two different areas burned by a prescribed fire. One abandoned crop field and a grassland area formerly occupied with pasture activities. Both plots have a Mediterranean climate and calcareous bedrock. Statistics showed in the grassland a smaller coefficient of variation (CV) than in the grassland plot. In the grassland plot the pre-fire measurements were (60.91±0.52), and post-fire measurements (116.54±0.89). Whereas for the abandoned crop field, (84.7±0.29), and in the post fire measurements (132.24±0.32). Sampling results after the prescribed fire showed a significant spatial heterogeneous increase, especially in the grassland plot. These results are important to recognise a spatial pattern of change in P available pool when the fire disturbance happens. It enables to design the restoration plans of large areas affected by wildfires and therefore to minimize effects of the fire.

Co-Authors: *Xavier Úbeda, University of Barcelona*

Presentation Title: Fire and Fire Surrogate treatment effects on soil properties in a Sierran mixed conifer forest

Presenter: *Emily Moghaddas*
University of California - Berkeley
Berkeley, California, USA

Abstract: The Fire and Fire Surrogate Study utilizes forest thinning and prescribed burning in attempt to create forest stand structures that reduce the risk of high severity wildfire. Replicated fuel treatments consisting of mechanical tree harvest (commercial harvest plus mastication of sub-merchantable material), mechanical harvest followed by prescribed fire (mechanical+fire), prescribed fire alone, and no-treatment controls, were completed at the Blodgett Forest Research Station in the central Sierra Nevada in fall 2002. We conducted pre-treatment and post-treatment assessments of soil physical, chemical, and biological characteristics. The fire and mechanical+fire treatments accounted for the majority of differences in soil properties. Burning treatments decreased pools of carbon and nitrogen in the forest floor, increased soil pH, and increased the pool of inorganic nitrogen in the soil relative to the mechanical and control treatments. The mechanical+fire treatment had greater effects on nitrogen cycling, with NH4-N concentrations increased more than 40-fold compared to the control mean value. Nitrification rates were also increased in the mechanical+fire treatments. Harvest operations influenced the heterogeneity of the prescribed fire treatments and their effects. The majority of unburned areas were occupied by skid trails. Skid trails in many managed stands cover upwards of 10 to 20 percent of stand area, and can have substantial influence on soil properties. Understanding the effects of fuel treatments on soil properties and processes will better help managers develop long-term treatment strategies that address both stand structure and ecosystem function.

Co-Authors: *Scott Stephens, University of California at Berkeley*

Presentation Title: The Effects Of Fuels Reduction Treatments On Soil Carbon Respiration In A Sierra Nevada Pine Plantation

Presenter: *Leda Kobziar*
University of Florida
Gainesville, Florida, USA

Abstract: Fire-prone forests in the American west are presently slated for extensive fuels reduction treatments, yet the effects on soil carbon respiration rates (SRR) have received little attention. This study utilizes the homogeneity of a Sierra Nevada ponderosa/ Jeffrey pine plantation to investigate changes in SRR following mastication in 2004, mastication coupled with prescribed burning in 2005, and burning alone also in 2005 as measured over the growing seasons from 2003 to 2005. SRR, soil temperature and soil moisture were measured in two masticated stands, which were burned the following year, and in one burned stand; the three of which were compared with two controls stands. SRR response to treatments was detectable even though spatial variability within sites was high (coefficients of variation of 39-66%). Mastication produced short-term reductions in SRR, reduced soil moisture by 20%, and mitigated a year-to-year reduction in soil temperature evidenced by controls. Prescribed fire in masticated stands lowered SRR from 3.42 to 2.68 mmol m-2 s-1 while fire in the untreated stand raised SRR from 3.41 to 3.83 mmol m-2 s-1, although seasonal increases in control sites were also detected. Masticated then burned site soil moisture increased by 52% while soil temperature decreased. Microclimate variables were not consistently effective in explaining spatial trends. Exponential (Q10) models using soil temperature and/or moisture to predict temporal trends in SRR were only significant in treated stands, suggesting that treatment implementation increased SRR sensitivity to environmental factors. These results imply that fuels reduction practices in water-stressed forests may have important consequences for ecosystem carbon dynamics.

Co-Authors: *Scott Stephens, Joe McBride,*
University of California Berkeley

Presentation Title: Fire regime effects on soil C and nutrients in a southeastern U.S. pineland

Presenter: *Kevin Robertson*
Tall Timbers Research Station and Land Conservancy
Tallahassee, Florida, USA

Abstract: In the southeastern U.S., few studies have addressed the influence of fire regime on soil chemistry. This study sought to determine the effects of fire interval (1-40 years) on soil carbon, nitrogen, and mineral nutrients in an old-field, open pine forest previously managed for wildlife using frequent fire (1-2 year interval). Since 1960, at least three replicates of 0.2 ha areas (Fire Plots) were burned at 1, 2, 3, 4, 5, 7, 9, and 12 year intervals. Also, a 9.6 ha area was fire suppressed since 1966 (NB66). In 2004, soil was collected from 0-20 cm depth in the Fire Plots and from the A and Bt horizons at paired locations inside (fire suppressed) and outside (2 year fire interval) NB66. The Fire Plots showed lowest total C and N values in the 1 year Fire Plots, the highest values in the 2 year Fire Plots, and intermediate values at longer intervals. A similar trend was observed for the inside vs. outside of NB66. In the fire suppressed area, the A high horizon increased significantly in depth. Mineral nutrients (Ca, Mg, K, P) were inversely related to fire interval, with the highest levels in the 1 year Fire Plots. C, N, and mineral nutrients decreased markedly with soil depth. These results suggest that the 2 year fire interval is associated with the highest net primary productivity and root turnover rate, presumably because of rapid regrowth during the second year following fire, resulting in high C and N levels. Also, high fire frequencies apparently return mineral nutrients back to the soil at a high rate relative to volatization and preclude high levels of above-ground storage in plants, resulting in increased soil nutrient levels at high fire intervals.

Co-Authors: *Wes Wood*

Presentation Title: Long term consequences of a controlled slash burn and slash mastication to soil moisture and CO2 at a southern Colorado site

Presenter: *William Massman*
USDA Forest Service
Fort Collins, Colorado, USA

Abstract: Thinning of forest stands is frequently used to reduce the risk of catastrophic fire. But thinning requires that the refuse (or slash) be removed from the site, which can be done either by burning it or by mastication and dispersal. Either method has long term consequences to the soil and to soil moisture and soil CO_2 levels. This study presents 2+ years of continuous soil moisture and CO_2 measurements at two experimental slash treatment sites within Manitou Experimental Forest in the Rocky Mountains of southern Colorado: (i) a controlled burn site and (ii) a site at which the slash was masticated and dispersed. Each experimental site has a separate control plot (with no treatment). The instrumentation was installed before each treatment (either burning or mastication). In the case of the controlled burn the soil moisture sensors had to (and did) survive temperatures exceeding 200 C. The results suggest that: (1) The burn area tends to have higher soil moisture and lower concentrations of CO_2 than the control site. This result is consistent with the loss of plant cover, roots, and microbial biomass at the burn site, which would reduce transpiration and root and microbial respiration. This difference between treatments reaches its maximum during the late summer of 2005, approximately a year and a half after the burn, when the volumetric soil moisture at the control site is only about half of that at the burn site. As a consequence of this depletion of soil moisture at the control site, the normal gradient of CO_2 (for which CO_2 increases with depth) is virtually eliminated yielding similar and relatively low concentrations at 0.05 and 0.15 m. But the burn site appears to have sufficient moisture at the lower depth for microbial respiration to continue at levels sufficient to maintain the soil CO_2 gradient and relatively greater amounts of CO_2. (2) Relative to the control area, the areas covered by the masticated wood chips tend to have higher soil moisture at 0.15 m depth and relatively less soil moisture at 0.05 m, and considerably higher CO_2 concentrations at both depths. This is consistent with the expectation that a layer of wood chips act as a barrier to precipitation (reducing the soil moisture at the upper level) and to the diffusional loss of water vapor (at the lower level) and the loss of CO_2 (at all levels). In addition, the chips can apparently have unusual effects on the production of soil CO_2. During mid through late March 2005 the amount of CO_2 at 0.05 m soil depth at the chip-covered areas increased from a relatively constant 2500 ppm to about 10,000 ppm. The amounts of CO_2 increased at lower depths as well, but by lesser amounts. However, the increase at 0.05 m was enough to reverse the usual soil CO_2 gradient. Although the control area had higher soil moisture at this time than the chip site, it showed no significant change in the amount of CO_2 or the CO_2 gradient.

Co-Authors: *J. M. Frank, W. D. Shepperd, USDA Forest Service -*
A. E. Jimenez, M. E. Stromberger, Colorado State University

Presentation Title: Lethal soil heating during burning of masticated fuels: effects of soil moisture and texture

Presenter: *Matt Busse*
USDA Forest Service
Redding, California, USA

Abstract: Mastication of woody understory vegetation is a preferred method to reduce fire risk at the forest-urban interface. Recent evidence from our laboratory suggests that the potential for soil damage is high if masticated fuels in excess of 100 Mg/ha are burned. Here we examined the role of soil moisture and soil texture as regulators of soil heating during prescribed burns in a controlled setting, using large undisturbed soil columns from the field. Replicated treatments included four soil moisture contents, ranging from spring-wet to summer-dry conditions, in combination with three soil textures (clay, loam, sand). Maximum temperature and heat duration were measured using thermocouples placed at 0, 2.5,5.0, 10, and 15 cm depths in the soil profile. Fuel loads were 135 Mg/ha and burning resulted in near complete consumption of surface fuels. Maximum soil temperatures reached 850°C at the mineral soil surface and 45°C at a depth of 15 cm. Soil moisture was a dominant factor controlling the intensity and duration of heating. The lethal temperature for roots (60°C) was exceeded at a depth of 10 cm in dry soil, yet was rarely surpassed below 2.5 cm when soil moisture approached 50% of water-holding capacity. In contrast, the importance of soil texture was minor: differences in heating between the three soil types were relatively small at each moisture content. The results suggest that burning when soil moisture content is high is an effective means of limiting heating and potential biological damage in soils of differing texture.

Co-Authors: *Carol Shestak, Eric Knapp, Gary Fiddler, USDA Forest Service -*
Ken Hubbert, Hubbert and Associates

Presentation Title: An Interactive Probabilistic Postfire Hillslope Erosion and Mitigation Model

Presenter: *Peter Robichaud*
USDA-Forest Service
Moscow, Idaho, USA

Abstract: Modeling erosion after major disturbances, such as wildfire requires that the temporal and spatial variability in fire effects and disturbance recovery be accommodated within the model. Increased erosion after fire is the result of the consumption of the protective litter and duff, loss of soil water storage, and in some cases, creation of water repellent soil conditions. These conditions increase the potential for flooding and sedimentation, which pose increased risk to the people and resources in and around the burned areas. Land managers must assess these risks to make appropriate decisions concerning postfire erosion mitigation treatments. A web-based Erosion Risk Management Tool (ERMiT), has been developed to predict surface erosion from postfire hillslopes and to evaluate the potential effectiveness of various erosion mitigation practices. The model uses a probabilistic approach that incorporates variability in weather, soil properties, and burn severity for forests, rangeland, and chaparral hillslopes. Using multiple runs of the Water Erosion Prediction Project (WEPP) model, ERMiT provides event-based erosion rate probabilities for the first five years with and without treatments. The one-page custom interface, targeted for hydrologists and soil scientists, allows users to select climate, soil texture, burn severity, and hillslope topography. For a given hillslope, the model uses a single 100-year WEPP run to obtain weather variability, followed by 20 to 40 WEPP runs to incorporate variability in soil properties (including ground cover and water repellency) and burn severity. The output, both graphical and tabular, relates the probability of soil erosion exceeding a given amount in each of the first five years following the fire. ERMiT also allows users to compare the effects of various mitigation treatments (mulches, seeding, and contour-felled logs or straw wattles erosion barriers) on the erosion rate probabilities. Data from rainfall simulation and concentrated flow (rill) simulations were used to parameterize ERMiT for these varied conditions. Model validation efforts are ongoing at nine paired watershed sites around the western US.

Co-Authors: *W.J. Elliot, USDA Forest Service - F.B. Pierson, USDA Agricultural Research Service -*
D.E. Hall, USDA Forest Service - C.A. Moffet, USDA Agricultural Research Service

Presentation Title: Interactions Between Fire, Flow, and Sediment Affect Aquatic Macroinvertebrate Communities

Presenter: *Robert Arkle*
California Polytechnic State University
San Luis Obispo, California, USA

Abstract: Despite the role of fire as an important evolutionary force in shaping biotic communities in the western United States, our understanding of fire effects on stream ecosystems is limited. To determine the effects of wildfire on low-order lotic ecosystems in temperate forests, we performed a multi-year retrospective analysis of streams burned at varying levels of severity and compared these streams to unburned reference streams. Several patterns have emerged. For wildfires, the percentage of a watershed burned at high severity (%HighSev), was associated with greater year-to-year variation, rather than a perennial increase in sediment loads (V*). Temporal changes in V* were correlated with yearly peak flow. V* was associated with %HighSev, peak flow, and more importantly, an interaction between these two variables. MRPP of burn severity categories and macroinvertebrate taxa densities indicates that community composition differs significantly in across burn categories. CCA suggests that these community differences are due, predominantly, to differences in sediment. In years where mobile sediment loads were high, silt has the greatest influence on community composition of all habitat variables measured, whereas in years with low residual sediment loads, other habitat variables are more important in determining community structure. MANOVA analysis of taxa density, percent Ephemeroptera, Plecoptera, and Trichoptera (%EPT), and taxa richness (S) shows a strong interaction between burn category and year. Yearly changes in density appear to track changes in sediment loads, instead of exhibiting a steady post-fire recovery, while %EPT decreases over time for the most burned watersheds, suggesting that interactions among fire, flow, and sediment may destabilize habitat conditions, driving effects on macroinvertebrate communities. These findings argue for examining multiple factors at once, over a suitable temporal duration, as various disturbances may occur in close succession, and unpredictable interactions among variables can change the directionality of observed trends.

Co-Authors: *David Pilliod, California Polytechnic State University - Katherine Strickler, University of Idaho*

Presentation Title: Long Term Effects Of Wildfire On Channel Geomorphology On Riparian Habitats Of The Submogollon Region

Presenter: *Alvin Medina*
USDA Forest Service
Flagstaff, Arizona, USA

Abstract: Riparian habitats subjected to wildfire are prone to long term channel degradation processes. Post-fire rehabilitation often does not address the restoration of physical and biological functions of stream channels. The purpose of this study was to assess long term post fire changes in channel geomorphology of four streams of the sub-Mogollon region and contrast changes to McKnight Creek which burned 55 years ago. Channel profiles and vegetation transects were installed and repeat measurements were taken between 1975 and 2002. Similar processes in channel degradation were observed across all streams over time. Channels incised and widened extensively immediately after the first major rainfall events. Channel incisement was limited principally by depth to bedrock, thereby inducing channel widening. These processes were detected longitudinally over several miles of the riparian corridor, resulting in extensive changes in riparian vegetation density and composition. Vegetation type may further exacerbate channel disturbance and maintain the channel in high state of instability that may have adverse secondary effects on fisheries. These conditions were similarly observed on streams burned 55 years ago, suggesting that hydrologic disequilibria persists beyond 50 years, despite post fire rehabilitation treatments of uplands and exclusion of livestock grazing. Post fire treatment of channels with riffle formations are discussed based on extensive channel restoration trials.

Presentation Title: Fire Effects on Stream Temperature: An Example from the Eastern Sierra Nevada, California

Presenter: *Chad Mellison*
USDI Fish and Wildlife Service
Reno, Nevada, USA

Abstract: Recently, much attention has been given to the effects of fire on aquatic ecosystems. Fires can have profound short and long-term change to streams and their associated riparian vegetation communities. With the loss of riparian vegetation, streams are no longer protected from solar radiation and stream temperatures rise. Little information exists for the magnitude of the temperature change and how long this change persists. Here I present pre and post-fire stream temperature data in a small eastern Sierra Nevada stream occupied by the Federally threatened Lahontan cutthroat trout (Oncorhynchusclarki henshawi).

Co-Authors: *Jason Kling, USDA Forest Service -*
Dawne Becker, California Department of Fish and Game

Session Title: Wildlife and Habitat

Presentation Title: Fire in Riparian Forests: Effects on Stream Amphibian Reproduction in the Northwest, USA

Presenter: *David Pilliod*
California Polytechnic State University
San Luis Obispo, California, USA

Abstract: In ponderosa pine stands, riparian vegetation burns only slightly less frequently than the upland forests and yet most burn policies actively exclude prescribed fire from riparian forests. Because low-order stream ecosystems are tightly linked with riparian vegetation for allochthonous organic matter and shading, fire in riparian forests is likely to have played an important ecological function in the dynamics of stream biota. This question was examined in a multi-year study of over 30 streams in Idaho, Montana, and Oregon. The focal species was the tailed frog (Ascaphus spp.), a stream obligate whose larvae spend 1-3 years feeding on periphyton before going through metamorphosis. Comparing tailed frog reproduction in streams in which riparian forests recently burned to streams in watersheds that had not burned for 50-70 years, we found that tailed frog reproduction was highly variable among streams but generally lower in streams flowing through recently burned riparian forests. Within burned watersheds, tailed frog density decreased with increasing riparian burn severity, which explained 30-50% of the variation in tailed frog tadpole density, depending on the year since fire. Watershed burn severity did not explain as much of the variation in tailed frog tadpole density as riparian burn severity, suggesting that fire in riparian forests plays a different functional role in stream ecosystems than fire in upland forests. Initial results of a prescribed fire study where fire was intentionally excluded from riparian forests further support this relationship.

Co-Authors: *Robert Arkle, California Polytechnic State University - R. Bruce Bury, US Geological Survey -*
Teresa B. Jain, USDA Forest Service

Presentation Title: The impacts of fire on Australian fauna: a synthesis of research since 1995

Presenter: *Elizabeth Tasker*
Department of Environment & Conservation
Hurstville, New South Wales, Australia

Abstract: Fire affects the functioning of most Australian ecosystems, yet the majority of past research on its impacts on fauna has focused strongly on the change following a single fire event, without considering the series of fires of which it forms a part, or the particular attributes of the fire event itself. Seminal research in plant fire ecology in the 1970s and 80s, led by A. Malcolm Gill in Australia, made a clear case for the need to consider fire as a recurrent event in the landscape, and provided a conceptual framework – the "fire regime" – with which to do so. In the subsequent twenty-five years, research on the response of plants to fire in Australia has markedly changed direction, with most studies now considering fire regimes, often in an explicit and sophisticated spatial context. In addition, plant ecologists now routinely consider the responses of vegetation to different fire regimes using "functional types" (groupings of species that respond to disturbance in a similar way), and use these to predict and test different hypothesis. We review the Australian literature for fauna published over the last ten year sto determine whether the research and publications reflect a similar paradigm-shift. In particular, we assess the potential to develop functional types for fauna. Such an approach could greatly advance our (currently limited) ability to generalise, understand and predict the responses of fauna to fire, and resolve many apparent contradictions in the faunal literature.

Co-Authors: *Dr Jack Baker, Department of Environment & Conservation -*
Robert Whelan, University of Wollongong

Presentation Title: Fire and Fauna in Purnululu (Bungle Bungle) National Park

Presenter: *Thalie Partridge*
Macquarie University
North Ryde, New South Wales, Australia

Abstract: Purnululu (Bungle Bungle) National Park, situated in the Kimberley region of Western Australia, received World Heritage listing in 2003. The park lacks a specific fire management plan, though application of control burns for wildfire prevention is being used increasingly as a land management tool. Fire regimes have changed significantly since European settlement of the region. In 2004 and 2005, the effect of recent fire events on the habitat preferences of small mammals and reptiles was examined. In two land systems, fires, particularly late dry season wildfires, reduced capture rates of all species. However, fauna with preferences for open habitat persisted. Two native rodents, the desert mouse (Pseudomys desertor) and the western chestnut mouse (Pseudomys nanus), both known to prefer long unburnt habitat, were radio-tracked. Home ranges of both species were approximately 0.5 hectares, significantly smaller than the extent of recent wildfires. The habitat utilised by P. nanus in the Buchanan Sandplain contained extensive burrows used by a number of individuals. It is likely that other factors, such as food availability and cover, restrict the species post-fire. The diet of P. nanus is unknown. P. desertor, found in dense hummock grassland (Triodia sp.) within the Wickham Uplands land system, is solitary, semi-diurnal and often shelters within the grass hummocks upon which it feeds. The presence of readily identifiable feeding sites allows for non-invasive identification of P. desertor activity and assessment of habitat regeneration after fire. Individual P. desertor were found to cross open ground such as burnt habitat, however feeding sites were only found in unburnt habitat. Following a patchy, early dry season control burn, feeding sites were found in remaining unburnt patches. This work highlights the importance of small scale, early dry season, control burning. Given improved funding and resources, it will be possible to develop conservation directed fire regimes. =

Co-Authors: *Dr Jim Kohen, Macquarie University - Dr Tony Start, Western Australia Department of Conservation and Land Management*

Presentation Title: Avifaunal response to fire along a burn severity gradient in montane forests of the southern Rocky Mountains

Presenter: *Natasha Kotliar*
U.S. Geological Survey
Fort Collins, Colorado, USA

Abstract: Southwest ponderosa pine forests have been characterized as unnaturally dense due to decades of fire exclusion, increasing the risk of severe fires. A corollary of the southwest paradigm is the assumption that greater severity of recent fires has predominantly negative ecological effects. This assumption, although largely untested, is a fundamental justification for ecosystem restoration programs. To test this assumption, I evaluated avifaunal response along a burn severity gradient at recent large fires (Cerro Grande, Pumpkin, Outlet, Hayman, Hi Meadow, and Bobcat Gulch) across the southern Rocky Mountains. A broad range of responses to increasing burn severity was detected: (1) large significant declines, (2) weak, but significant declines, (3) no significant density changes, (4) peak densities in low- or moderate-severity patches, (5) weak, but significant increases, and (6) large significant increases. Overall, most species exhibited either positive or neutral density responses to fire effects across all or portions of the severity gradient (responses 2-6). Several species, however, demonstrated a negative response to fire, even at low severities. Spatial patterns of burn severity and cover type contributed to variation in responses among burns. At Cerro Grande, the availability of pre-fire data allowed analysis of post-fire community changes; pre- and post-fire community similarity was high except in high-severity patches. Species richness was similar pre- and post-fire even at the highest burn severity because the number of species absent in severely burned forests was balanced by species that only occurred in these patches post-fire. These results show that even in southwest ponderosa pine forests, high-severity burns can create conditions beneficial to many species. Thus, ecosystem restoration programs based on the assumption that recent severe fires degrade forest health are not supported by an analysis of post-fire avian communities.

Presentation Title: The effects of fire on California spotted owls and their prey in Yosemite National Park.

Presenter: *Susan Roberts*
U.S. Geological Survey
El Portal, California, USA

Abstract: As forest managers use fire to maintain healthy forests and manageable fuel loads, it is imperative to consider how fire and fire suppression affect forest wildlife. The California spotted owl, an old growth associated species, is sensitive to habitat changes with reduced nesting success in compromised habitat. We studied the occurrence and nesting success of spotted owls in 16 randomly chosen burned and unburned old growth mixed-conifer forests (Ntotal=32) throughout Yosemite National Park. We conducted systematic, nocturnal surveys for spotted owls throughout these areas, with a total of 120km2 surveyed in the spring of 2004 and 2005. We live-trapped mammalian prey in 20 of the owl survey areas. Prey abundance and diversity were similar between burned and unburned forests, but northern flying squirrels (spotted owl's primary prey) were captured only in unburned forests. Eighteen percent of all spotted owl responses were in burned forests, with 14% of the owls nesting in burned forests producing 19% of the total juveniles in the study group. We delineated a 203 ha core activity area around each nest and calculated the mean area of 4 fire severity classes (unchanged, low, moderate and high) within the core area. For owls inhabiting burned areas, the 203 ha core area encompassed a heterogeneous matrix of variable burn severities. Owls nesting in burned areas had over 42% of their core area burned, with 21% of the area defined as low severity and 19% moderate. We suggest that fire management plans should maximize the areas burned at low severity while maintaining a landscape with a heterogeneous matrix of burn severities to provide valuable foraging and nesting habitat for the California spotted owl.

Co-Authors: *Jan van Wagtendonk, US Geological Survey - Douglas Kelt, University of California-Davis - Keith Miles, US Geological Survey*

Presentation Title: Plant and animal species closely associated with severely burned conifer forests: Are we managing for their maintenance?

Presenter: *Richard Hutto*
University of Montana
Missoula, Montana, USA

Abstract: Many plant and animal species are nearly restricted in their distributions to burned forests, and many of the most-fire dependent species also occur disproportionately often in severely burned than in less severely burned forests. I will illustrate these facts with data from more than 50 different fires that have burned since 1988 in Montana, Idaho, and Wyoming. The presence of many of these bird species is tied to the presence of standing dead trees. The implications of these facts are profound. First, severe fires are clearly natural events that have molded the evolutionary adaptations of many species. This also implies that, although the number or extent of such fires may be unusually large nowadays, severe fires per se are not “unnatural” or “catastrophic” events. Secondly, of the species for which we have data (birds), none of the most fire dependent species persists in the face of post-fire salvage logging. These facts alone should engender an appreciation of the biological value of severely burned forests, and should move burned forests toward the bottom of the priority list of locations where we conduct timber harvesting operations on public lands.

Presentation Title: Bird Community Response to Prescribed Fire and Mechanical Cutting in California Chaparral

Presenter: *Jennifer Potts*
University of California-Berkeley
Berkeley, California, USA

Abstract: This chaparral fuel reduction project examines the ecological effects of prescribed fire and mastication (mechanical cutting) in Northern California. Specifically, this research looks at bird community response to 1) the type of fuel treatment - prescribed fire or mastication, and 2) the season of treatment - fall, winter or spring. Previous research suggests that the type and season of fuel reduction can alter bird community composition by changing habitat structure, food availability and predator movement. We studied bird response in five fuel treatment/season combinations including 1) fall fire, 2) winter fire, 3) spring fire, 4) fall mastication, 5) spring mastication, and an untreated control. Each treatment was replicated four times, for a total of 24 research plots and 100 acres of experimental area. Pre and post-treatment bird monitoring was conducted between 2001-2005 using six point counts each year. Our results show that birds are eight times more likely to be found in prescribed fire areas than in masticated areas. Over 45 species (~900 individuals) were found in post-fire habitat compared to 15 species (~100 individuals) in post-mastication habitat. This disparity is primarily due to the lack of plant skeletons in masticated areas and the related effects on perch/nest site availability, predator movement and microclimate. For example, species commonly found in post-fire plots included those that require some vertical habitat structure (ex. Western scrub jay, Sage sparrow, Spotted towhee). Species found in post-mastication sites were primarily ground-foragers and ground-nesters (ex. California quail, Dark-eyed junco). This study clearly illustrates that fuel reduction choices can have significant influence on bird community composition in the first four years following treatment. This is important news for chaparral managers who rarely have wildlife data related to fuel reduction. With this new information, we can strike a better balance between our ecological goals and fire safety priorities.

Presentation Title: Microhabitat Associations of Northern Flying Squirrels in Burned and Thinned Forest Stands of the Sierra Nevada

Presenter: *Marc Meyer*
USDA Forest Service
Davis, California, USA

Abstract: Prescribed burning and mechanical thinning are used to manage fuels within many western North American forest ecosystems, but few studies have examined the relative impacts of these treatments on forest wildlife. We sampled northern flying squirrels (Glaucomys sabrinus) and microhabitat variables in burned, thinned, and control stands of mixed-conifer forest of the southern Sierra Nevada at the Teakettle Experimental Forest. We used this information to determine the effects of burning and thinning on the microhabitat associations of flying squirrels. Across pretreatment stands, the probability of flying squirrel capture increased with decreasing distance to a perennial creek and increasing litter depth. The probability of flying squirrel capture also was greater with increased canopy cover in thinned stands and increased litter depth in burned stands. Greater canopy cover may provide protection from predators, thicker litter layers may harbor a greater abundance of truffles (a primary food of northern flying squirrels), and creeks may provide squirrels with food sources, drinking water, and nest trees. Forest management that protects riparian habitat and retains patches of minimum canopy and litter cover may provide key habitat for northern flying squirrels.

Co-Authors: *Douglas Kelt, Department of Wildlife Fish, and Conservation Biology, University of California - Davis. Malcolm North, USDA Forest Service and University of California - Davis.*

Presentation Title: Effects of prescribed fire on vegetation and non-game wildlife in central Texas

Presenter: *David Wester*
Texas Tech University
Lubbock, Texas, USA

Abstract: Prescribed fire is a common management tool used to reduce invasive plant populations and enhance wildlife habitat. Non-game species are important components of these ecosystems, and many of them are sensitive to changes in vegetation habitat structure that might result from prescribed fires. However, non-game species are often not considered in management practices that involve prescribed fire and few studies have focused on the effects of prescribed fire on them. We examined the effects of prescribed fire on vegetation, arboreal reptiles and amphibians, and other non-game species in central Texas. Eight study plots were established. Pre-treatment habitat measurements included litter depth, percent canopy cover, tree diameter, visual obstruction, foliar cover, and ground cover; these habitat features were also monitored seasonally following the burn. Plots were burned in February 2004 with a low-intensity fire. Between March and August 2004 we collected vertebrates and invertebrates from all plots via ground and arboreal traps (152 traps, 5,908 trap nights). Texas wintergrass (the most common perennial grass in the study areas) and three invertebrate orders (Homoptera, Microcoryphia, and Diplopoda) were reduced in burned plots. Vertebrates, other plants, and other invertebrates were not affected by the fire. Results indicate that a small-scale, low-intensity burn has minimal impact on vegetation structure and does not affect abundance of non-game species during the year following burning. Larger scale, higher intensity burns, and longer-term studies should be conducted to test the generality of this finding in this and other habitats.

Co-Author: *Nikki Radke, Sandra Rideout-Hanzak, Gad Perry, Texas Tech University,*

TRACK 7

Thursday, November 16, 2006

Risk Assessment

8:00 - 8:30	*Alexandra Syphard* *University of Wisconsin – Madison*	Predicting the spatial patterns of fire ignitions in southern California coastal shrublands
8:15 – 8:30	*Patricio Pedernera-Alvarez* *Universidad Mayor Chile*	Estimating human activity in forest fire occurrence in the VIII Region of Chile
8:30 – 8:45	*Jeffrey Prestemon* *USDA Forest Service*	Identifying Time-Varying Socioeconomic and Climate Influences on Wildfire Ignitions on National Forests of the U.S.
8:45 – 9:00	*Armando Rodriguez Montellano* *FOMABO*	Modelos de riesgo y vulnerabilidad a incendios forestales a partir de condisiones naturales y antropicas en el Parque Nacional Tunari Cochabamba-Bolivia. Models of vulnerability and risk to wildfires based on natural and human-caused conditions at Tunari National Park, Cochabamba, Bolivia
9:00 – 9:15	*Klaus Braun* *ICS Group*	Wildfire Risk - Integrating community resilience or vulnerability attributes and hazard assessments, to provide a comprehensive risk model
9:15 – 9:30	*David Weise* *USDA Forest Service*	Probabilistic estimation of fire danger - an example of simulation modeling using the FARSITE fire simulator in Hawai'i

Decision Support for Planning and Budgeting

10:30 – 10:45	*David Martell* *University of Toronto*	A Spatial Fuel Management Decision Support System
10:45 – 11:00	*Keith Reynolds* *USDA Forest Service*	Decision support for allocating fuels budgets to Forest Service Regions and Forests
11:00 – 11:15	*Karen Abt* *USDA Forest Service*	Nationwide Forest Service Suppression Cost Forecasting: Historical Analyses and Outlook

Fire and Behavior Modeling

13:30 – 13:45	*Randall Benson* *South Dakota School of Mines & Technology*	A Model to Predict the Total Probability of Wildfires
13:45 – 14:00	*Brian Sturtevant* *USDA Forest Service*	Fire-harvest interactions in central Labrador (Canada): Will harvesting change the fire regime?
14:00 – 14:15	*Valeriy Perminov* *Kemerovo State University*	A numerical study of forest fire initiation
14:15 – 14:30	*Craig Clements* *University of Houston*	Observing the dynamics of wildland grass fires: FireFlux - a field validation experiment
14:30 – 14:45	*Joe Scott* *Systems for Environmental Management*	Off the Richter: magnitude and intensity scales for wildland fire
14:45 – 15:00		
15:30 – 15:45	*Dominique Morvan* *Université de la Méditerranée*	Numerical simulation of crown fire behaviour in a northern jack pine-black spruce forest
15:45 – 16:00	*Jo Ann Fites* *USDA Forest Service*	Modeling Acceleration of Fire in Canyons and Operational Applications
16:00 – 16:15	*Kurt Menning* *University of California - Berkeley*	Modeling Landscape Fire Behavior and Effects in the Northern Sierra Nevada

Session Title: Risk Assessment

Presentation Title: Predicting the spatial patterns of fire ignitions in southern California coastal shrublands

Presenter: Alexandra Syphard
University of Wisconsin – Madison
Madison, Wisconsin, USA

Abstract: Periodic wildfire maintains the integrity and species composition of southern California coastal shrublands, but anthropogenic ignitions have increased fire frequency beyond the historic range of variability. Increased fire is often associated with the Wildland-Urban Interface (WUI), where human development intermingles with undeveloped vegetation; but better information is needed to understand how human activities affect fire and where these effects are most likely to be prevalent. If ignition patterns are better understood, locations of high fire potential can be identified and managers can evaluate the likelihood of fire spreading into housing developments or areas of high conservation potential. Our objective was to develop a probabilistic fire map by modeling the spatial relationships between fire ignitions and several human and biophysical variables in the Mediterranean-climate Santa Monica Mountains in southern California. Ignition locations were recorded by the National Park Service, and we used logistic multiple regression models combined with spatial statistical techniques to relate ignitions to environmental and human demographic variables. Results indicated that anthropogenic ignitions were located significantly closer to paved roads, trails, WUI, and developed land than the locations of a randomly generated point dataset. Ignitions were also more prevalent in coastal sage scrub and exotic grass, but less prevalent in northern mixed chaparral than the randomly generated points. Differences between the ignitions and random points were less substantial with regards to climate and percent slope. A probabilistic map generated from the models' predictions can be used to evaluate different scenarios of fire spreading from locations of high ignition potential.

Co-Authors: *Robert S. Taylor, USDI National Park Service - Volker C. Radeloff, Murray K. Clayton, Todd J. Hawbaker, Roger B. Hammer, University of Wisconsin-Madison - Susan I. Stewart, USDA Forest Service*

Presentation Title: Estimating human activity in forest fire occurrence in the VIII Region of Chile

Presenter: *Patricio Pedernera-Alvarez*
School of Forestry Engineering – Universidad Mayor
Santiago, Chile

Abstract: This work shows the spatial and chronological evaluation of forest fires occurrence in Chile recorded between the years 1985 to 2005. The goal of the analysis was to identify changes in the spatial and chronological patterns of the fire problem in Chile. The methodology considers the analysis of 118,956 fire reports recorded in the National Fire Management Information System owned by Corporación Nacional Forestal (CONAF). The reports included complete information about date and time of fire beginning, control actions, causes, affected areas and others. The reports were sorted and processed by using MS Access database administrator to compile the numerical statistics needed for the study. The chronological analysis considered use of moving means and statistical tests to probe the existence of significant differences between fire seasons at national and regional levels. For the spatial analysis, it was constructed a computer program to convert the spatial reference system of the CONAF database to UTM coordinates, in order to construct seasonal fire maps for both analysis levels (national and regional). The spatial analysis was developed using Arcgis as GIS software. By using image comparison methods, we can be able to demonstrate the existence of repetitive spatial patterns inside each administrative region of Chile. The chronological analysis showed that there was three the causes which concentrates the 60% of forest fires in our country: Arsons, Pedestrians and Children Playing. The arson causes shows a big increase in the last five years, moving from 14.2% (in 1985) to 26.8% in the 2005 season. The spatial patterns determined by the analysis showed a significant difference (a change in the spatial distribution) in the IX region; also, it showed an increment in the fire activity in some regions where we didn't have historical records of fires.

Presentation Title: Identifying Time-Varying Socioeconomic and Climate Influences on Wildfire Ignitions on National Forests of the U.S.

Presenter: *Jeffrey Prestemon*
USDA Forest Service
Research Triangle Park, North Carolina, USA

Abstract: Recent research has identified important and significant influences of socioeconomic variables on wildfires in the U.S. Arson wildfires are linked to labor market and law enforcement variables as well as climate, while accidental wildfires are connected to levels of some of the same variables. Humans and their machines are the dominant ignition sources for fires in the eastern U.S., but less is known about these influences on these fires in other parts of the country. We specify least square and Poisson time series statistical models of wildfire ignitions using cross-sectional time series data for fires on national forests, 1976-2005, relating such fires to measures of the labor market, aggregate economic activity, climate or weather, human populations, and other variables. Our results have implications for understanding long-term trends in fire activity nationwide.

Co-Authors: *Karen L. Abt, D. Evan Mercer*

Presentation Title: Models of vulnerability and risk to wildfires based on natural and human-caused conditions at Tunari National Park, Cochabamba, Bolivia

Presenter: *Armando Rodriguez Montellano*
FOMABO
Cochabamba, Cercado, Bolivia

Abstract: The purpose of this study is to create a model for evaluating the risk and vulnerability to forest fires in the representative area of Turani National Park. First, we look for the participation of the state institutions of Cochabamba (the users), in order to determine their view on what are the major variables influencing these events. We used a spatial analysis in GIS with multiple criteria in order to integrate and evaluate the variables that influence the high risk of wildfires. The structures of the forest fire danger index includes three components: 1) The component of forest fuels, which is generated from an evaluation of dead and live fuels, 2) the fire weather component, which is structured by integrating of the average high monthly temperature and the total monthly precipitation along with other weather factors y 3) The component of ignition source derived from the study of socio-cultural elements representative of geographic areas. The three components are integrated within a system of decision-making and we will generate maps periodically that show the locations of areas vulnerable and at risk to forest fires.

Co-Authors: *Gustavo Guzman T*

Presentation Title: Wildfire Risk - Integrating community resilience or vulnerability attributes and hazard assessments, to provide a comprehensive risk model

Presenter: *Klaus Braun*
ICS Group
Narrikup, Western Australia, Australia

Abstract: The Charles Darwin Reserve is located 300km north of Perth in Western Australia. The reserve was purchased in 2003 by the Australian Bush Heritage Fund and is approximately 68,000ha in size. Predominant vegetation communities are woodland and shrublands. Wildland fires regularly burn in the Reserve and are part of its dynamic ecosystem. Lightning is the main cause of fires in the Reserve. Early aerial photographs and satellite images were used to establish the recent fire history of the Reserve. It was found that landscape-scale fires burned essentially the same area in the west of the Reserve in the late 1960s and again in December 2000. A number of smaller fires also burned in this area between the late 1960s and 2000. A large part of the Reserve (approximately 60%), however, remained unburned during this period. The fire history indicates that most fires in the Reserve, and the largest areas burned, were in one particular land system – the Joseph land system. At the same time approximately 30% of the Joseph land system remained unburned during this period. It appears that vegetation in other land systems have some resilience to fire. Even though the fire history could only be established for the past 50 years, the age of woodland trees in some areas suggests that large parts of the Reserve have remained unburned, or have not been burned in a moderate or high intensity fire, for more than 100 years, and possibly several hundred years. Very diverse fire regimes exist in the Reserve. These are most likely linked to land systems and habitats. The challenge is to learn more about these fire regimes to ensure that long term wildland fire management achieves the conservation objectives for the Reserve in a fire-prone environment.

Presentation Title: Probabilistic estimation of fire danger - an example of simulation modeling using the FARSITE fire simulator in Hawai'i

Presenter: *David Weise*
USDA Forest Service
Riverside, California, USA

Abstract: Estimation of the risk of a fire occurring in wildlands of the United States has evolved over the past 80 years. Fire occurrence risk is currently predicted by the National Fire Danger Rating System (NFDRS). Risk is related to weather conditions, vegetation and fuel type, and ignition probability. Empirical probability distributions of various fire danger indices describing potential fire behavior are correlated with actual fire occurrence to determine fire risk levels which are then used to manage use of the wildlands. The fire danger indices are deterministic in formulation. In Hawai'i, the NFDRS was implemented state-wide for a few years in the early 1980s and is now being implemented once again. Human-caused fires occur regularly spreading through invasive grasses. Until 1999, limited data on fire occurrence and weather were available to the U.S. Army to estimate fire danger information in order develop a fire management plan for the 44,000 ha Pohakuloa Training Area (PTA) on the island of Hawai'i. Fire danger and fire behavior calculations in the United States both use the Rothermel fire spread equation to estimate potential fire behavior. FARSITE produces deterministic simulations of fire spread in a 2-D plane using vegetation and topography grids. In this study, FARSITE was used to simulate fire growth of 100 randomly located ignitions within the PTA boundary under 50th, 75th, and 95th percentile weather conditions. Relative fire risk was determined by determining the number of times each grid cell was burned by the 100 simulations. Comparison of fire risk defined by the Monte Carlo simulations will be compared with the deterministic risk predicted by the NFDRS.

Co-Authors: *Scott L. Stephens, Tadashi J. Moody, University of California-Berkeley - Francis M. Fujioka, USDA Forest Service - Galen Enriques, US Army Garrison - Hawaii*

Session Title: Decision Support for Planning and Budgeting

Presentation Title: A Spatial Fuel Management Decision Support System

Presenter: *David Martell*
University of Toronto
Toronto, Ontario, Canada

Abstract: Wildland fuel management specialists that must decide when and where to carry out fuel treatment activities must evaluate very large numbers of alternative strategies that vary with respect to the timing and placement of site-specific treatments. When they develop and evaluate fuel management strategies they must consider when and where fires might occur, where the values at risk are located, and the many paths that link potential fire occurrence sites with the values at risk that are spread across the landscape. We describe a fuel treatment decision support system (DSS) comprised of 1) a fuel treatment patch assessment model that can be used to assess the landscape level impact of treating specific fuel patches, 2) a landscape level fuel treatment pattern selection model that can be used to develop near-optimal landscape-level fuel treatment patterns, and 3) a spatial burn probability mapping model that can be used to assess the economic impact of alternative fuel treatment patterns. We illustrate how our DSS can be used by applying it to a hypothetical landscape and our results indicate that our DSS can be used to develop cost-effective fuel management strategies for large complex wildland urban interface areas.

Co-Authors: *A. Weintraub, Universidad de Chile, - C. Palma, The University of British Columbia - W. Cui, Ontario Ministry of Natural Resources*

Presentation Title: Decision support for allocating fuels budgets to Forest Service Regions and Forests

Presenter: *Keith Reynolds*
USDA Forest Service
Corvallis, Oregon, USA

Abstract: There has been dissatisfaction, both internally and externally, with the USDA Forest Service (FS) process for allocating budgets for hazardous fuels reduction, resulting in the common perception that the agency does not provide funding to the right geographic priorities (for example, OIG Draft Report - Healthy Forests Initiative Audit No. 08601-6-At). Key criticism of the process includes lack of a transparent and repeatable process for budget allocation. The Fire and Aviation Staff of the FS Washington Office, seeking to address these concerns, funded development of a prototype decision-support application that was tested for the 2007 federal fiscal year. The prototype application was developed with the Ecosystem Management Decision-Support (EMDS) system, which provides a general solution framework for integrated landscape analysis and planning in a GIS environment. In the EMDS solution, a logic-based model evaluates risk of wildfire at the scale of Forests and Regions, and a decision model, based on the analytic hierarchy process, assists with developing priorities for Regions and Forests. The decision model incorporates summary information from the logic-based analysis as well as additional logistical considerations such as efficiency and efficacy of fuels treatment, potential threats to people, etc. We present results of the prototype application for the 2007 budget allocation process, demonstrating how the application satisfies the key requirements for a transparent and repeatable process, and discuss longer-term development of a more comprehensive decision-support application, based on use of new national data layers being delivered by the LANDFIRE program.

Co-Authors: *Paul F. Hessburg, Robert E. Keane, James P. Menakis, Richard Lasko, USDA Forest Service*

Presentation Title: Nationwide Forest Service Suppression Cost Forecasting: Historical Analyses and Outlook

Presenter: *Karen Abt*
USDA Forest Service
Research Triangle Park, North Carolina, USA

Abstract: Forecasts of suppression expenditures are useful in long-term budget development, in prepositioning of suppression resources, and in short-term expenditure planning. Forecasting these costs requires development of robust statistical models relating costs to climate and landscape variables. Using time series econometric methods, we report the forecast performance of alternative models that require data at differing levels of spatial aggregation. Using these alternative models, we also report our forecasts for costs in fiscal years 2007, 2008, and 2009, including empirical probability densities. Results of this research suggest avenues for additional investigation that could lead to tighter confidence limits and hence improve agency budget decision making.

Co-Authors: *Jeffrey P. Prestemon, Krista Gebert, USDA Forest Service*

Session Title: Fire and Behavior Modeling

Presentation Title: A Model to Predict the Total Probability of Wildfires

Presenter: *Randall Benson*
South Dakota School of Mines & Technology
Rapid City, South Dakota, USA

Abstract: A single equation is developed by using multiple logistic regression to predict the probability of wildfire in the Black Hills of South Dakota and Wyoming. Both human and lightning activity are correlated to historical fire incidence and when combined with fuels and weather characteristics, prove effective as predictors of wildfire occurrence. The difference between fire danger and fire risk is evident through the use of probability. Probabilistic prediction information provides distinct advantages to decision makers and serves as an important substitute for complete knowledge. Daily assessments of staffing levels are currently based on a limited number of fire danger indexes that may be convenient and exhibit low day-to-day variability, but may prohibit more accurate assessments of fire potential. Improved probabilistic forecasts of fire potential will enhance the knowledge necessary to make more confident fire management decisions that may have significant economic impact. Results indicate that the Probability of Detection (POD) for lightning caused-fires for all months (May-October) and for all three stations during the period 1994 to 2003 is 0.77, 0.64 for human-caused fires, and 0.61 for all fires. The False Alarm Rate (FAR) for lightning- and human-caused fires is 0.22, and it is 0.23 for all fires. The Threat Score (TS) for lightning-caused fires is 0.37, 0.27 for human-caused fires, and 0.38 for all fires. The Peirce Skill Score (PSS) for lightning-caused fires is 0.55, 0.42 for human-caused fires, and 0.38 for all fires. An independent test was performed to compare the model to random days selected during the June-October period during 2005 for the Red Canyon RAWS station. The POD, FAR, TS, and PSS for the 2005 results and the 1994 to 2003 results respectively are as follows: 0.69 versus 0.67, 0.30 versus 0.18, 0.44 versus 0.39, and 0.46 versus 0.58.

Presentation Title: Fire-harvest interactions in central Labrador (Canada): Will harvesting change the fire regime?

Presenter: *Brian Sturtevant*
USDA Forest Service
Rhinelander, Wisconsin, USA

Abstract: Fire disturbance is an important factor affecting timber supply in the boreal forest. However, harvest patterns can also influence fire regimes by modifying landscape-scale fuel conditions affecting fire spread rates and ultimately the annual area burned. We investigated interactions between fire disturbance, harvesting, and forest succession by integrating three model systems: A spatially-explicit road-building and timber supply model (implemented in SELES), and a landscape forest disturbance and succession model (LANDIS) parameterized using cover type-specific spread rates from the Canadian Forest Fire Behavior Prediction System (FBP). We applied a duration-based approach to simulating fire regimes, where a fire duration distribution was calibrated to generate the fire size distribution observed in regional fire records, and fire duration for a given event was then selected from the calibrated distribution. This approach allows the fire regime to change in response to changing fuel conditions and/or fuel patterns. We parameterized the current fire regime using fire records from the Canadian large fire database, regional fire weather conditions published for the large fire database, and wind directions from a local weather station. A "no harvest" scenario was compared with a harvest scenario defined by the current forest plan to determine whether the fire regime changed in response to harvest disturbance over a 100 year period. Results indicate that harvest disturbance decreased mean fire size and annual area burned by creating temporary forest openings and also by increasing deciduous cover types, particularly in the more productive valleys where harvest activity was concentrated. Such results indicate that fire-harvest interactions should be considered when evaluating potential impacts of fire disturbance on timber supply over broad time horizons. Our approach also illustrates the potential for the integration of available simulation tools to address key questions affecting sustainable forestry within boreal forest ecosystems.

Co-Authors: *Neil Simon, Newfoundland and Labrador Department of Natural Resources - USDA Forest Service - Brian Miranda, USDA Forest Service - Andrew Fall, Gowlland Technologies*

Presentation Title: A numerical study of forest fire initiation

Presenter: *Valeriy Perminov*
Belovo Branch of Kemerovo State University
Belovo, Kemerovo Region, Russia

Abstract: The model of forest fire is based on an analysis of known and original experimental data, and using concepts and methods from reactive media mechanics. Within the framework of this model, the forest and combustion products during a fire represent a non-deformable porous-dispersed medium. The problem of crown forest fire initiation and spread are studied with due consideration for the effect of a turbulent atmosphere and the actual structure of the forest. With the aid of this model we obtain similarity criteria and understand the effects of various physical and chemical factors on the characteristics and energetic of forest fires. The research is done by means of mathematical modeling of physical processes. It is based on numerical solution of three dimensional Reynolds equations for reactive medium. To obtain discrete analogies a method of control volume is used. The boundary-value problem is solved numerically using the method of splitting according to physical processes. Using modern computers, current numerical method, and the model presented above, we determine fields of velocity, temperature, and component concentration, density, and heat fluxes, and predict the development of a forest fire in a given region with due regard for seasonal changes in the properties of the forest fuels.

Presentation Title: Observing the dynamics of wildland grass fires: FireFlux - a field validation experiment

Presenter: *Craig Clements*
University of Houston
Houston, Texas, USA

Abstract: Grass fires, although not as intense as forest fires, present a major threat to life and property in regions of drought in the Great Plains of the United States. Recently, major wildland grass fires in Texas burned nearly 5 million acres and destroyed over 400 homes since December. During the week of 16 March 2006, 11 people were killed and an estimated 10,000 head of livestock were lost, marking this the worst fire season to date for the state of Texas. As an aid to fire management, various models have been developed to describe fire behavior, but observational data in the immediate environment of grass fires are largely unavailable for validating these models. These models also emphasize fuels and fail to consider the role of convective dynamics in fire behavior. To fill this gap, an intensive field measurement campaign called FireFlux was conducted recently near Houston, Texas. The campaign used a variety of instrument platforms to collect mean and turbulence data at multiple levels within and immediately downwind of a 155 acre tall-grass prairie burn unit. The experimental burn was intended to replicate a natural wildland grass fire as closely as possible. Fire ignition occurred upwind, and the fire was allowed to spread through the instrumentation. Preliminary analyses show combustion-zone temperatures exceeding 920 ºC and vertical velocities exceeding 5 m s-1. These data are being used to understand the dynamic behavior of grass fires and to validate fire-behavior models used by fire managers and fire fighters. The intended purpose of this paper is to report on the FireFlux experiment, including its experimental goals, design, instrumentation, and preliminary results. The results include new findings and first time observations of atmospheric turbulence structures and turbulent fluxes associated with intense grass fires.

Co-Authors: *Sharon Zhong[1], Scott Goodrick[2], Xindi Bian[3], Brian E. Potter[3], Warren Heilman[3], Jay Charney[3], Ryan Perna[1], Meong-do Jang[1], Daegyun Lee[1], Monica Patel[1], Susan Street[1], Steven Krueger[3], Ju Li[4], and Glenn Aumann[5] - [1]University of Houston, [2]USDA Forest Service, [3]University of Utah, [4]Institute of Urban Meteorology, Beijing, [5]University of Houston*

Presentation Title: Off the Richter: magnitude and intensity scales for wildland fire

Presenter: *Joe Scott*
Systems for Environmental Management
Missoula, Montana, USA

Abstract: Size matters. We humans have an innate need to measure the sizes of things, including natural phenomena, like earthquakes, tornadoes, hurricanes and, of course, fires. In the context of protecting the public from harm or damage, size is not a simple, physical dimension; it is magnitude – the potential to release energy and consequently cause harm and damage property. Damage and harm are not only related to magnitude, but also to the rate of energy release as well – intensity. This presentation reviews characteristics of magnitude and intensity scales for earthquakes, tornadoes and hurricanes, and outlines the development of magnitude and intensity scales for wildland fire. The Fire Intensity Index (FII) is the common logarithm of fireline intensity as measured in kW/m; it ranges from just under 1.0 for creeping surface fires in light fuel (corresponding to 10 kW/m) to more than 5.0 for fast-spreading crown fires (corresponding to 100,000 kW/m). The Fire Magnitude Index (FMI) is the common logarithm of total fire flux as measured in MW; it varies from less than 1.0 for a slow-growing, 0.1-ha fire burning in light fuel (corresponding to 10 MW), to more than 7.0 for a large, fast-spreading, high-intensity fire (corresponding to 10,000,000 MW). FII and FMI are continuous variables, but lend themselves to classification by orders of magnitude; each unit increase in FII or FMI corresponds to a ten-fold increase in fireline intensity or total fire flux. FII and FMI will be useful for communication with the media and the public and in a variety of fire management applications. Conventions for calculating and communicating wildland fire magnitude and intensity are suggested.

Presentation Title: Numerical simulation of crown fire behaviour in a northern jack pine-black spruce forest

Presenter: *Dominique Morvan*
Université de la Méditerranée
Marseille, France

Abstract: The behavior of wildland fires was simulated using a fully physical approach based on a multiphase formulation including the resolution of the equations of conservation governing the coupled system formed by the vegetation and the surrounding atmosphere. The present approach (developed during the 4th and 5th European Framework program) included the major physical mechanisms governing the degradation of the vegetation (drying, pyrolysis and charcoal combustion), the behavior of the burning zone (turbulent flow, combustion, radiation heat transfer) and the interaction between the flame front and the vegetation (heat transfer by convection and radiation, drag effects). The model was compared and validated using experimental data obtained for homogeneous solid fuel in a wind tunnel (IFSL in Missoula MT-USA) and grassland (experimental campaign performed in Australia). Both plume dominated fires and wind driven fires can be simulated, highlighting the various regimes of propagation observed for surface fires. Then this approach was generalized to heterogeneous solid fuel and applied to simulate crown fires in similar conditions than the International Crown Fire Experiment (ICFME) performed in the North West territories in Canada. The mechanisms governing the vertical transition of the fire from the surface fuel to the canopy and the conditions (surface fuel load, wind speed) necessary to sustain the propagation of the crown fire were studied.

Co-Authors: *Jean Luc Dupuy, Institut National de la Recherche Agronomique*

Presentation Title: Modeling Acceleration of Fire in Canyons and Operational Applications

Presenter: *Jo Ann Fites*
USDA Forest Service
Nevada City, California, USA

Abstract: Acceleration of fire in certain topographic settings, such as chimneys or box canyons, post safety hazards to firefighters and has resulted in numerous fatalities and near misses. Existing, widely used fire behavior modeling systems, such as FARSITE, do not specifically address fire behavior in these settings where convective entrainment is important. Viegas developed a model specifically for acceleration of fire spread in canyons based on laboratory experiments and verified in a field experiment. He also applied this model to several fatality fires in the US, South Canyon and 30-mile. This model shows promise for applications in fire such as a training tool and in fire operations. I tested the model on the Rattlesnake fire in California that occurred in 1953 and resulted in 15 fatalities. The model matched the acceleration and arrival time of the reconstructed progression in the investigation report closely. In cooperation with fire incident management team operations, fire behavior analysts, superintendents and captains, I developed several potential operational applications. These include: a training session, maps for a fire incident that can be used to plan placement and spacing of safety zones, to compare egress times, to compare the "box" for wildland fire situation analysis planning, and for situational awareness and safety messages. The training session has been tested at several fire operational refresher sessions. A case study is presented on operational applications. The model also shows promise as an additional tool to reconstruct events in near-miss or fatality investigations. An example is shown how it was used to reconstruct fire behavior scenarios during the Tunnel #6 fatality fire on the Tahoe National Forest in 1954, where the investigation report was missing. Local firefighters wanted to utilize the fire as a staff ride and for lessons learned and the model was useful in supplementing limited fire behavior information.

Presentation Title: Modeling Landscape Fire Behavior and Effects in the Northern Sierra Nevada

Presenter: *Kurt Menning*
University of California – Berkeley
Berkeley, California, USA

Abstract: In the Northern Sierra Nevada, the public, scientists and land managers are concerned about the effects of forest management on fire and wildlife habitat. In the Plumas-Lassen Administrative Project (PLAS) our team is evaluating fire behavior and effects. We are modeling fire given current conditions as well as a set of proposed landscape-scale fuels treatments, defensible fuel profile zones (DFPZs). Ideally, DFPZs should moderate landscape-scale fire behavior by slowing or stopping canopy fire and allowing suppression forces access to key areas. Little is known, however, about how these fuel-reduction zones may actually affect fire behavior and what factors may influence their efficiency. To test the usefulness of DFPZs we have collected data to support our modeling effort. In an area of about 60,000 ha we have an extensive array of over 500 stratified-random field plots. These 12.6 m (0.05 ha) circular plots are used to characterize vegetation and fuel conditions. Our forest inventory at these sites has over 12,000 trees. These data, along with topographic, historic weather and ignition data from the area, are inputs to FARSITE and FlamMap models. We are examining fire behavior across a range of moderate (70th percentile), severe (90th) and extreme (97th) conditions. We are presenting results of modeling fire behavior and effects both before treatment (current conditions) and after installation of the DFPZs.

Co-Authors: *Scott L. Stephens, University of California - Berkeley*

TRACK 8

Thursday, November 16, 2006

Applications of Remotely Sensed Burned Area and Severity Data

Andrea Thode
Northern Arizona University
Flagstaff, Arizona, USA

8:00 – 8:30	*Jose Pereira* *Instituto Superior de Agronomia*	Characterizing Global Space-time patterns of Fire Incidence and Emissions
8:30 – 9:00	*Cameron Yates* *Bushfires Council of the Northern Territory*	The contribution of savanna burning to contemporary Australian fire regimes
9:00 – 9:15	*David Roy* *South Dakota State University*	Factors that promote and constrain the use of satellite derived fire products by resource managers in southern Africa
9:15 - 9:30	*Eric S. Kasischke* *University of Maryland*	Satellite estimation of fire severity in the North American boreal region
9:30 – 10:00	*Emilio Chuvieco* *University of Alcalá*	Simulation tools for burn severity estimation using remotely sensed images
10:30 – 11:00	*Jeffery Eidenshink* *U.S. Geological Survey*	Monitoring Trends in Burn Severity Program
11:00 – 11:30	*Sally Archibald* *CSIR*	Determinants of Fire across Southern Africa
11:30 – 11:45	*Mark A. Cochrane* *South Dakota State University*	The potential for remotely sensed burn severity estimation in tropical forest fires using Landsat imagery
11:45 – 12:00	*Andrea Thode* *Northern Arizona University*	Questions and Answers

Fire and Burn Severity Mapping

13:30 – 13:45	*Crystal Kolden* *Clark University*	Remote sensing and GIS methods for more accurate wildfire perimeter mapping
13:45 – 14:00	*Alistair Smith* *University of Idaho*	Potential of Char Fraction Maps for Evaluating Burned Area and Post-Fire Effects: Bridging the Immediate to Long-Term Divide
14:00 – 14:15	*John Rogan* *Clark University*	Use of Classification Generalization to Construct a Historical Burn Severity Database in Southern California
14:15 – 14:30	*Stephen Howard* *Scientific Applications Corp.*	Developing a Fire Atlas of the United States using Landsat Imagery
14:30 – 14:45	*Bill DeGroot* *Natural Resources Canada*	Characterizing burn severity from remote sensing: results from 4 fires in the boreal
14:45 – 15:00	*Karen Murphy* *USDI Fish and Wildlife Service*	Does the National Burn Severity Mapping methodology work on National Wildlife Refuge Lands in Alaska?
15:30 – 15:45	*Jay Miller* *USDA Forest Service*	Mapping burn severity in heterogeneous landscapes with a relativized version of the delta Normalized Burn Ratio (dNBR)
15:45 – 16:00	*Andrew Hudak* *USDA Forest Service*	Sensitivity of Landsat image-derived burn severity indices to immediate post-fire effects
16:00 – 16:15	*Tatiana Loboda* *University of Maryland*	Regionally adjustable dNBR based algorithm for burned area and impact severity assessment from MODIS data
16:15 – 16:30	*Rima Wahab-Twibell* *Clark University*	Setting the Scene for Burn Severity Mapping in Mediterranean-Type Ecosystems: An Application to the Cedar Wildfire in Southern California
16:30 – 16:45	*Sarah Lewis* *USDA Forest Service*	Mapping post-wildfire ground cover after two 2003 California wildfires

Postfire Rehabilitation and Management, Part One

16:45 – 17:00	*Jess Clark* *USDA Forest Service*	Assessing postfire burn condition using remotely-sensed data
17:00 – 17:15	*Mary Stuever* *White Mountain Apache Tribe*	Rodeo-Chediski BAER: Lessons in Mega-Fire Rehabilitation
17:15 – 17:30	~~*Todd Caplan*~~ ~~*Parametrix*~~	Monitoring results of aerial seeding treatments following the Rodeo-Chediski Fire

Session Title: Applications of Remotely Sensed Burned Area and Severity Data

Session Organizer: *Andrea Thode*
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: The session will focus on the available science supporting and using burned area and burn severity assessments derived from remotely sensed data. The session will be international in scope and focus on two major topics: global change, and monitoring and modeling. This session is meant to highlight current research that is being conducted around the world and will focus on international applications of remotely sensed data for burned area and burn severity mapping. The session will be summarized by a special publication in the Journal of Fire Ecology by the Association for Fire Ecology.

Presentation Title: Characterizing Global Space-time Patterns of Fire Incidence and Emissions

Presenter: *Jose Pereira*
Instituto Superior de Agronomia
Lisbon, Portugal

Abstract: The climatic, atmospheric and ecological importance of global vegetation fires has been recognized for almost 30 years. However, the first continental and global analyses of vegetation fires, relying on remotely sensed data, were produced in the late 1990s. Currently, there is great demand for global fire datasets, especially from atmospheric scientists concerned with global biomass burning. We present results from our screening and analysis of a 10-year (mid-1996 through mid-2006) global active fires dataset, the World Fire Atlas, produced by the European Space Agency. This analysis highlights major global vegetation fire hotspots, quantifies fire incidence by biome, and produces a detailed characterization of fire seasonality and interannual variability. Estimates of global emissions from wildfires, for the period 1960-2000 are also presented, based on an inventory and modeling study, which investigated trends and variability of tropospheric ozone and other atmospheric pollutants over recent decades. This was the first attempt at constructing a global emissions dataset with monthly resolution, over a 40-year period. Burned areas, emissions factors, and total carbon release were estimated for thirteen continental-scale regions. The role of long-term, global burned area datasets currently under development, to reduce uncertainties in emissions estimates will be discussed.

Co-Authors: *Martin Schultz, Research Centre Jülich, Germany - Duarte Oom, Tropical Research Institute, Portugal - Bernardo Mota, Instituto Superior de Agronomia, Portugal*

Presentation Title: The contribution of savanna burning to comtemporary Australian fire regimes

Presenter: *Cameron Yates*
Bushfires Council Northern Territory
Tropical Savannas Management Cooperative Research Centre
Australia

Abstract: Savannas are the most fire-prone of the earth's major biomes. The recent availability of various decadal-scale global and regional datasets which document the incidence, and in some cases extent of savanna fires, provides a framework within which to examine the implications of frequent and large fires, particularly on biodiversity values. The paper first documents the significance of savanna fires using 10 years of ATSR night-time active fire data. We then examine the incidence and extent of large fires (>100 km^2) in one highly fire-prone savanna region in the Northern Territory, Australia, based on (a) coarse-resolution AVHRR data for the period 1995-2005, and (b) fine-resolution Landsat data for a smaller sub-region over the same period. Collectively, these data illustrate that extensive savanna areas are burnt frequently (often annually or biannually), typically by large fires under relatively severe fire-weather conditions. In the northern Australian context, such fire regimes are shown to have major impacts particularly on fire-sensitive flora and vegetation types within the savanna matrix, and also on relatively immobile vertebrate fauna with small home ranges—fire size and frequency does matter.

Co-Authors: *Jose Pereira, Andrew Edwards, Jeremy Russell-Smith*

Presentation Title: Factors that promote and constrain the use of satellite derived fire products by resource managers in southern Africa

Presenter: *David Roy*
South Dakota State University
Brookings, South Dakota, USA

Abstract: This paper gives Southern Africa Fire Network (SAFNet) perspectives on the utility of satellite fire products, drawing on two main sources: insights gained during SAFNet's six years of working together, and relevant findings from semi-structured focus group interviews employed to examine factors that affect the likelihood that resource managers in southern African will use information on vegetation fires provided by the MODIS active fire and burned area products. The MODIS products provide systematic, near-global coverage and are freely available; as such, they give resource managers new opportunities to obtain or supplement information they need to manage vegetation fires effectively. However, the availability of these products does not mean that resource managers will use them, and many other factors are involved. To understand these factors, two focus groups were held at an annual SAFNet meeting in Malawi, Africa, August 2004. The SAFNet is an open network of southern Africa fire scientists, managers and communicators that are concerned with the local process of fire and have strong interests in obtaining long-term fire information to support their research and operational agendas in resource management, and environmental assessment. The qualitative, in depth nature of the focus group discussions revealed 12 main factors that influence product use. Analysis of the group discussions also suggests how the uptake of MODIS fire products by resource managers in southern Africa might be enhanced by affecting specific changes to how fire products are packaged and delivered to make them more relevant to users. Despite the focused nature of the study, the factors revealed are generally relevant to other types of satellite product and to other user communities in fire prone regions around the world.

Co-Authors: *D.P. Roy, South Dakota State University - S.N. Trigg, University of Maryland - R. Bhima, Department of National Parks and Wildlife, Malawi - B.H. Brockett, Pilanesberg National Park, South Africa - O.P. Dube, University of Botswana - P. Frost, CSIR-Satellite Applications Centre, South Africa - N. Govender, Kruger National Park, South Africa - T. Landmann, United Nations FAO - J. Le Roux, Ministry of Environment & Tourism, Namibia - T. Lepono, Maloti Drakensberg Transfrontier Project, Lesotho - J. Macuacua, Ministry of Agriculture Building, Mozambique - C. Mbow, Université Cheikh Anta Diop de Dakar, Senegal - K.L. Mhwandangara, Geospatial Solutions, Zimbabwe - B. Mosepele, Conservation International, Botswana - O. Mutanga, University of Kwazulu, South Africa - G. Neo-Mahupeleng, African Wildlife Foundation, Botswana - M. Norman, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Mozambique - S. Virgilo, Ministry of Urban Affairs and Environment, Angola*

Presentation Title: Satellite estimation of fire severity in the North American boreal region

Presenter: *Eric S. Kasischke*
University of Maryland
College Park, Maryland, USA

Abstract: Since the mid-1980s, Interior Alaska experienced a 2-fold increase in fire frequency, highlighted by the large fire years of 2004/5, when >10% of the land surface of this region burned. Scientists are now conducting the research needed to understand how changes to the fire regime coupled with recent climate warming and permafrost thawing affect the vegetation cover of this region, which in turn, will impact wildlife habitat, ecosystem services, and fuel loads for future fires. These scientists recognize that monitoring cumulative impacts of fires over broad areas is impossible using traditional field survey approaches, and that satellite remote sensing imagery provides the only logical approach for systematic monitoring of damage from fires and post-burn regeneration. Over the past several years, scientists from federal agencies and universities have carried out integrated studies of fire severity in Alaska's boreal forest region. The goals of these interdisciplinary studies have not only been to evaluate approaches to map fire severity using satellite imagery, but to link ground measures of burn severity to the impacts fires are likely to have on the post-fire site characteristics that control vegetation recovery. To address these goals, we collected field data from multiple fire events using the composite burn index (CBI) approach of Key and Benson, modified for the unique conditions found in boreal forests. Comparisons have been made between CBI and the Normalized Burn Ratio (NBR) derived from Landsat imagery from over 20 different fire events. While in some fire events, there were strong correlations between CBI and NBR or dNBR (the difference in pre- and post fire NBR), in many cases the correlations were low. In particular, low correlations were found in black spruce forests, the dominant vegetation type that burns in Alaska. We are presently evaluating other approaches to use satellite data for fire severity assessment.

Co-Authors: *Jennifer Allen, USDI. National Park Service - Nancy H.F. French, Altarum Institute - Elizabeth Hoy, University of Maryland - Randi Jandt, USDI Bureau of Land Management - A. David McGuire, David L. Verbyla, T. Scott Rupp, University of Alaska- Fairbanks, - Karen A. Murphy, USDI Fish and Wildlife Service - Merritt R. Turetsky, Michigan State University*

Presentation Title: Simulation tools for burn severity estimation using remotely sensed images

Presenter: *Emilio Chuvieco*
University of Alcala
Madrid, Spain

Abstract: Traditional field-based methods to estimate burn severity are time-consuming, labour intensive and normally limited in spatial extent. Remotely sensed data may provide a means to estimate severity levels across large areas, but it is critical to understand the causes of variability in spectral response with variations in burn severity. Since, experimental measurements of burn severities are difficult to obtain, the simulation tools provided by radiative transfer models (RTM) provide a sound alternative to better understand factors affecting burn severity reflectances. Two-layer RTM, such as the combined leaf (Prospect) and canopy (Kuusk) model can be used to simulate a wide range of burn severity conditions. Specifically, the effects of changes in soil background, leaf colour and leaf area index as a result of different burn severities can be simulated from these models, using a forward mode. Those simulations provide a deeper understanding of the effects of each factor in satellite-sensed reflectances, as well as their relative importance. Additionally, RTM can also be used in an inverse mode, and therefore burn severities can be retrieved from remotely sensed data by comparing actual and simulated reflectances. Examples for these two-way modes of RTM are presented in this paper. Simulation of burn severities scenarios was based on the Composite Burn Index (CBI), a well known field method of estimating burn severity. Statistical analyses examined the strength of the correlations between CBI and reflectance in individual wavebands in the 400-2500 nm range, and CBI and a range of spectral indices combining pairs of wavebands. The inverse mode of RTM was used to retrieve CBI values for a set of satellite data recently acquired over a large forest fire that affected central Spain in July, 2005. Landsat-TM, SPOT-HRV, Envisat-MERIS and IRS-AWIFS data were used for this retrieval.

Co-Authors: *Angela de Santis[1], and David Riaño[1,2], [1]University of Alcalá-Madrid,*
[2]University of California, Davis

Presentation Title: Monitoring Trends in Burn Severity Program

Presenter: *Jeffery Eidenshink*
U.S. Geological Survey
Sioux Falls, South Dakota, USA

Abstract: Agency leaders, fire managers, elected officials, and the general public need information regarding the effects of large wildfires. Recently, the Wildland Fire Leadership Council (WFLC), which implements and coordinates National Fire Plan (NFP) and Federal Wildland Fire Management Policies, adopted a strategy to monitor the effectiveness and effects of the National Fire Plan and the Healthy Forests Restoration Act. One component of this strategy is to assess the environmental impacts of large wildland fires and identify the trends of burn severity on all lands across the United States. To that end, WFLC is sponsoring a six year project, Monitoring Trends in Burn Severity (MTBS), which requires the USFS and the USGS to map and assess the burn severity for all large current and historical fires. Landsat imagery and the differenced Normalized Burn Ratio algorithm, will be used to map burn severity of all fires since 1984 greater than 500 acres in the east, and 1000 acres in the west. The number of historical fires from this period combined with current fires occurring during the course of the project will exceed 9000. The MTBS project will generate burn severity data, maps, and reports for each fire. The information will be available for use at local, state and national levels to evaluate trends in burn severity and help develop and assess the effectiveness of land management decisions. We will present examples of how fire severity data are currently being used today by land managers and we will propose additional questions that land managers, fire ecologists, and researchers may be able to address with the MTBS atlas. All satellite imagery and burn severity data will be distributed to the public via an internet interface.

Co-Authors: *Zhi-liang Zhu, Stephen Howard, Donald Ohlen, U.S. Geological Survey - Brian Schwind, Brad Quayle, Ken Brewer, Jay Miller, USDA Forest Service - Carl Key, U.S. Geological Survey*

Presentation Title: Determinants of Fire across Southern Africa

Presenter: *Sally Archibald*
Council for Scientific and Industrial Research
Pretoria, Gauteng, South Africa

Abstract: Vegetation fires occur extensively in southern Africa. An annual rainy season and a long dry season produce ideal conditions for fire that, in turn, contribute to shaping and maintaining savanna structure. Most fires are ignited by people, mainly for land management purposes, others are ignited by lightning associated with convective thunderstorms. Changes in land use are likely to affect fire regimes directly, through changes in the ways fire is used, and indirectly, by modifying fuel loads and landscape connectivity. Until recently, a lack of reliable regional information has limited opportunities to investigate the determinants of fire at this scale. In this paper we use recent MODIS satellite burned area data that define the 500m location and approximate day of burning. We develop a theoretical framework on the direct and indirect controls of fire across southern Africa, and examine which factors have the most influence using a regression tree analysis with annual area burned as the dependent variable and independent variables defined by summary statistics of rainfall, tree cover, soil fertility, population density, cattle density, and fuel load. Results at the 100x100km window scale for 2003 are presented, with regionally a 0.14 mean annual proportion burned (sigma=0.18, n=933). Preliminary analyses show that high burned proportions (>0.3) occur in regions with intermediate tree cover (20-45%), few people (<16 km-2) and annual rainfall >1100 mm. Regions with lower tree cover have large burn fractions when soil fertility and cattle density are low. Several different conditions can result in low burnt proportions; for example, low tree cover and high fertility, or low fertility but high cattle density. High cattle and people densities also correlate with low burnt proportions, as do tree covers > 45%. This research provides a foundation for developing mechanistic explanations of the controls and feedbacks of fire regimes on the continent, and indicate potential for predicting the timing and extent of burning in subsequent fire seasons.

Co-Authors: *David Roy, South Dakota State University*

Presentation Title: The potential for remotely sensed burn severity estimation in tropical forest fires using Landsat imagery

Presenter: *Mark A. Cochrane*
South Dakota State University
Brookings, South Dakota

Abstract: Forest fires are growing in size and frequency across the tropics. Continually eroding fragmented forest edges, they are unintended ecological disturbances that degrade vast regions of standing forest, diminishing ecosystem services and economic potential of these natural resources. The need for methods of detecting and quantifying the damages caused by tropical forest fires led us to previously develop a methodology for detecting and classifying burned forests in Amazonia using linear mixture models of Landsat imagery. Forested areas were unmixed using vegetation, non-photosynthetic vegetation (NPV) and shade endmembers. The NPV fraction provided excellent burned forest detection and was shown to have the potential for subclassification of burned areas into damage classes. We have recently developed the Normalized Difference Fraction Index (NDFI), for enhanced detection of forest canopy damages caused by forest fires. The NDFI synthesizes information from several component fraction images, derived from spectral mixture models. Interpretation of NDFI data is facilitated by a contextual classification algorithm (CCA) that enables accurate mapping of selective logging and fire-derived canopy damages. The CCA utilizes detected log landings, which are the spatial signature of selective logging, as starting locations for searching the NDFI image for canopy damage. This process separates canopy changes due to logging and forest fires from those caused by other natural disturbances. These methods were tested in the Brazilian Amazon. Forest transect inventories, conducted along a gradient of degraded forests, were used to evaluated the performance of the NDFI. The NDFI was more sensitive to canopy damage than any individual fraction and capable of sub-classification into damage severity levels. Map accuracy of forest damage estimates was 94%. The proposed NDFI-CCA classifier approach can be fully automated and therefore holds great promise as a forest monitoring tool in tropical forests.

Co-Authors: *Carlos M. Souza Jr,. Instituto do Homem e Meio Ambiente da Amazonia—Imazon, Brasil*

Session Title: Fire and Burn Severity Mapping

Presentation Title: Remote sensing and GIS methods for more accurate wildfire perimeter mapping

Presenter: *Crystal Kolden*
Clark University
Worcester, Massachusetts, USA

Abstract: Accurate mapping of wildfires is critical to fire management. Wildfire managers must have accurate perimeter maps to determine fire suppression strategies during the wildfire, and prioritize rehabilitation sites after the wildfire depending on resources at risk. Additionally, managers must have an accurate value for area burned by the fire to order adequate suppression resources during the fire, and to request appropriate funds for post-fire rehabilitation. Technological advances in remote sensing and Geographic Information Systems (GIS) over the last decade have been partially incorporated into wildfire mapping and management, but not assessed for accuracy and efficiency. In the first part of this study, remotely sensed imagery was analyzed to create accurate fire perimeter maps for 30 fires in Nevada. These maps were then used to assess the accuracy of ground fire mapping methods. Perimeters mapped by traditional methods were found to correlate poorly to actual fire perimeters, and significantly overestimated area burned ($p<0.05$). In the second part of this study, we hypothesized that mapping accuracy decreased in rough terrain due to human and GPS errors. Topographic roughness was calculated at five different scales (150m, 750m, 1350m, 2250m, fire-wide) to assess whether mapping accuracy correlated to increased topographic complexity. These results have implications for the utility of method routinely applied to mapping of burned areas, as well as for research that utilizes burned area values for analysis. Because technology and data availability have simplified methods for satellite-based mapping of fire boundaries and slope correction using digital terrain models, fire management can easily incorporate our suggested approach to fire mapping for generating more accurate fire perimeter maps and estimates of area burned.

Co-Authors: *Peter J. Weisberg, University of Nevada, Reno*

Presentation Title: Potential of Char Fraction Maps for Evaluating Burned Area and Post-Fire Effects: Bridging the Immediate to Long-Term Divide

Presenter: *Alistair Smith*
University of Idaho
Moscow, Idaho, USA

Abstract: It is vital in the development of remote sensing methods to evaluate ecosystem processes that such measures mechanistically relate to actual surface processes, such as changes in reflectance, surface temperature, or fractional cover. Currently, remote sensing methods are widely used in the assessment of the area burned and the evaluation of the immediate to long-term impact (i.e., severity) of the fire. The accurate production of regional burned area maps are necessary to reduce uncertainty in emission estimates from large-scale fires, and knowledge of the long term vegetation recovery and/or impact is important for carbon sequestration, monitoring invasives, and hydrological processes. We seek to evaluate one immediate post-fire remote sensing measure that should be mechanistically related to longer-term ecological effects. In this study we generated 30m maps of char fraction using the technique of spectral mixture analysis (SMA). In a case example within a southern African savanna, a highly accurate Landsat ETM+ map of burned area was achieved (k=1.00, a=99.5%); where pixels were defined as burnt if the charcoal fraction per pixel exceeded 50%. This same technique was then applied to imagery (pre, immediate post-fire, 1yr post-fire) of the Jasper Fire, South Dakota Black Hills and compared to field data collected 1 to 3 years post-fire in ponderosa pine forests. Field data included tree canopy scorch and consumption, soil char, litter and duff depth changes, etc. The char fraction maps were used to then evaluate whether the immediate post-fire effects were indicative of these longer-term field measures.

Co-Authors: *Leigh B. Lentile, University of Idaho - Andrew T. Hudak, USDA Forest Service*

Presentation Title: Use of Classification Generalization to Construct a Historical Burn Severity Database in Southern California

Presenter: *John Rogan*
Clark University
Worchester, Massachusetts, USA

Abstract: Wildfire is a major disturbance agent in Mediterranean Ecosystems including the Californian Chaparral and Woodlands, Mediterranean basin, Chilean Matorral, South African Fynbos, Southwestern Australia Forest and Scrub, and the Southern Australia Mallee and Woodlands. Fire has played an important role in shaping and maintaining the equilibrium of those ecosystems but there is evidence that increased anthropogenic pressures are altering the fire regimes, with effects whose interactions and feedbacks are not fully understood. There is a need to document wildfire damage in a historical perspective for long-term analysis. Provision of quantitative information on the area burned and the level of vegetation-damage is possible using remotely sensed satellite data. Although previous studies have mapped burn severity with moderate success, reliable mapping has not been demonstrated using the same method applied under different surface and remote sensing conditions. The objectives of this research are: develop and test a new methodology based on Landsat satellite map generalization to extend mapping rules from one burn site to others (spatial and temporal) and use it to map historical vegetation-burn severity in the Mediterranean Ecosystems of San Diego County (1985-2000); employ classification trees to map severity integrating environmental variables with spectral variables; and examine the contribution of environmental variables to mapping accuracy. Preliminary results show that burn severity mapping accuracy increased by ~10% with the inclusion of environmental variables such as slope and aspect. Sites dominated by grassland and chaparral were mapped the most accurately (means of 87% and 81% respectively), sites dominated by mixed vegetation types and heterogeneous soil-topography were mapped less accurately (77%), and sites with mixed vegetation types and variable topography the least accurately (60%).

Co-Authors: *David Roy, South Dakota State University*

Presentation Title: Developing a Fire Atlas of the United States using Landsat Imagery

Presenter: *Stephen Howard*
U.S. Geological Survey
Sioux Falls, South Dakota, USA

Abstract: This paper will discuss the methodology and details of identifying and processing Landsat imagery to compile a national "Fire Atlas." In the late 1980's, extensive fires in Yellowstone National Park focused the nation's attention on wildfire. Over the following two decades, various agencies at state and federal levels have worked to combat and mitigate the effects of wildfire. The Wildland Fire Leadership Council (WFLC) was formed in 2002 to coordinate wildland fire policy and implementation of the National Fire Plan among five Federal agencies and to ensure collaboration with state and local officials. The Monitoring Trends in Burn Severity (MTBS) project was commissioned by (WFLC) to compile a nationally consistent assessment of historical and current wildfires. The national Fire Atlas, will be used to assess national fire trends and the effectiveness of the National Fire Plan. The U.S. Geological Survey Center for Earth Resources Observation and Science (USGS/EROS) and the U.S. Forest Service Remote Sensing Applications Center (USFS/RSAC) are collaborating in a 6 year project to identify and assess the burn severity of all fires that affected more than 1000 acres in the West, and more than 500 acres in the East, that have occurred in the United States since 1984. The basis of the national assessment will be the USGS/EROS archive of Landsat Thematic Mapper (TM) imagery acquired since 1983. The MTBS project is currently searching this archive to identify suitable imagery. Historical and recent fire occurrence data, compiled from various Federal and State agencies, are used to guide the selection of Landsat imagery from the archive. The Normalized Burn Ratio is generated from pre- and post-fire imagery and the mathematical difference is computed to produce the differenced Normalized Burn Ratio (dNBR). Field studies in various ecosystems have shown the dNBR to be correlated with first-order fire effects such as the loss of vegetation and increased exposure of bare soil.

Co-Authors: *Brad Quayle, Brian Schwind, USDA Forest Service - Jeff Eidenshink, U.S. Geological Survey*

Presentation Title: Characterizing burn severity from remote sensing: results from 4 fires in the boreal

Presenter: *Bill DeGroot*
Natural Resources Canada
Edmonton, Alberta, Canada

Abstract: Burn severity is a measure of the degree to which an ecosystem has changed due to fire. Estimates of burn severity are of considerable interest for understanding the effects of fire on post-fire vegetation succession, and to determine its potential influence on forest fuel consumption. From a remote sensing perspective, the challenge has been to associate some measure of burn severity in the field with a remotely sensed vegetation index. Relationships between a field-based index called the Composite Burn Index (CBI), and numerous vegetation indices from single and pre-and post-burn images have been reported with variable results. Among the most frequently used image-based indices involve the ratio of Landsat Thematic Mapper bands 4 and 7 described as the Normalized Burn Ratio (dNBR). This study reports the nature of these relationships over 4 boreal fires located in Saskatchewan, Manitoba, Northwest Territories and the Yukon. New advances in the nature of these relationships were derived from a) comparing linear and non-linear models between CBI and dNBR; b) determining if the value of these indices varied by fuel type; and c) determining how these relationships could be used in mapping the variability of burn severity within boreal fires. Over the range of data sampled in the field and on the image, a non-linear model form was more suited for describing the relationship between CBI and dNBR than a linear model form, and that CBI and dNBR values varied by fuel type. Considerable variability in the spatial representations of burn severity were observed depending on the values used to classify burn categories, suggesting that values for the boreal are different than those published elsewhere. Research is continuing to document the nature of changes in burn severity characterized from immediate and 1-year post burn images, and determining the possible utility of dNBR in the modeling of fuel consumption.

Co-Authors: *Ron Hall, Natural Resources Canada*

Presentation Title: Does the National Burn Severity Mapping methodology work on National Wildlife Refuge Lands in Alaska?

Presenter: *Karen Murphy*
USDI Fish and Wildlife Service
Anchorage, Alaska, USA

Abstract: The change in the normalized burn ratio (dNBR), derived from satellite imagery, is commonly used to develop burn severity maps for large fires. However, recent results from Alaska suggest dNBR may not be adequate in some ecosystems. 2004 was a record-breaking fire season in Alaska with over 6.6 million acres burned, approximately 2.1 million of which were on National Wildlife Refuge lands. Many fires burned through September, driven by unusually warm and dry temperatures throughout the summer. These fires provided an opportunity to assess the performance of the National Burn Severity methodology on Refuge lands in Alaska using several fires from the same season. Six fires were sampled, including five from 2004 and one from 2003. The six fires spanned 813,689 acres on five boreal forest refuges. In total, 342 plots were sampled for vegetation composition and ground-based burn severity estimates strictly following national protocols. The data showed a surprisingly weak relationship between dNBR and CBI (composite burn index), in contrast to the strong relationship observed in application to National Park Services fires in Alaska. For example, eleven plots sampled from one fire had relatively similar dNBR values, from 300 to 388 on a 0-1200 scale, but widely divergent CBI values, from 0.61 to 2.63 on a 0-3 scale. Data and image processing errors have been eliminated as explanations. Ecological explanations are being explored to assess the impact on variation in performance due to plot covariates such as wetness, permafrost occurrence or vegetation type. The relationship of Landsat TM bands 7, 5, 4 and derivative wetness indices to CBI data will be assessed. Remote-sensing indices of burn severity for boreal forest fires are important for managing landscape-scaled fires in Alaska, but the dNBR method needs to be adapted to adequately represent fires on Refuge lands.

Co-Authors: *Joel H. Reynolds, USDI Fish and Wildlife Service – John Koltun, Geographic Resource Solutions*

Presentation Title: Mapping burn severity in heterogeneous landscapes with a relativized version of the delta Normalized Burn Ratio (dNBR)

Presenter: *Jay Miller*
USDA Forest Service
McClellan, California, USA

Abstract: Multi-temporal change detection is commonly used to aid in mapping fire effects due to wildland fire. Differencing single band vegetation indices derived from multi-spectral images is one of the most widely used change detection algorithms. Differencing pre- and post-change images produces an absolute measure of change. Measuring absolute change however, may be inappropriate when assessing ecological change due to fire. In a pixel with a sparse tree canopy for example, image differencing will measure a small change due to a stand replacing fire. Similarly, a pixel with a dense pre-fire tree canopy that experiences stand replacing fire will produce a large change value. Stand replacing fire occurred within both pixels, resetting both pixels to early successional states. If stand replacing fire is defined as severe fire, then thresholding an absolute change image derived through image differencing to produce a categorical classification of burn severity can therefore result in miss-classification of low vegetated pixels. This same logic can apply when classifying post-fire responses of different vegetation types within the same fire perimeter with one set of thresholds. Comparisons of classifications derived from customized thresholds of dNBR and relativized dNBR data for individual fires may result in similar classification accuracies. However, classifications of relativized dNBR data derived from a universal set of thresholds applied across multiple fires produce higher accuracies for the high burn severity category than do dNBR classifications. Maximizing producer and user accuracies for the high severity class should prove beneficial to land managers since it allows identification of more areas that are severely burned. Implementation of a relative index also allows a more direct comparison of severity between fires across the landscape, and forward and backward in time. In this poster we present a relative version of the dNBR derived from 14 fires in the Sierra Nevada mountain range of California, USA.

Co-Authors: Andrea E. Thode, Northern Arizona University

Presentation Title: Sensitivity of Landsat image-derived burn severity indices to immediate post-fire effects

Presenter: *Andrew Hudak*
USDA Forest Service
Moscow, Idaho, USA

Abstract: Maps indicative of burn severity are needed quickly by Burned Area Emergency Response (BAER) teams responding to major wildfires. Landsat imagery is preferred over other satellite sensors by the USFS Remote Sensing Applications Center and the USGS Center for Earth Resources Observation and Science. These centers are charged with producing Burned Area Reflectance Classification (BARC) maps as a rapid preliminary indication of burn severity. Currently the preferred burn severity index is the delta Normalized Burn Ratio (dNBR), which requires NBR values from both the immediate post-fire image and a pre-fire image acquired at approximately the same time of year. We generated NBR, NDVI, EVI, and 3 experimental NBRT indices incorporating the Landsat thermal band into the NBR calculation, from pre- and immediate post-fire images, and calculated delta indices. We assessed Pearson correlations between the selected burn severity indices and 32 physical measures of post-fire soil and vegetation effects, including charred and uncharred inorganic, organic, and green vegetation fractions. A spatially nested sampling design was used to sample 8 wildfires in western Montana and southern California in 2003 and interior Alaska in 2004. Aggregating the subplot-level measurements to the plot- and site-levels significantly increased the strength of the correlations at each step, by accounting for both fine-scale variability in the field and pixel variability in the imagery. Delta indices tended to be more highly correlated with the quantitative field variables than indices derived from the post-fire images only. The NDVI and dNDVI performed just as well or slightly better than NBR and dNBR, respectively, making NDVI and dNDVI suitable proxies for NBR and dNBR should Landsat or similar imagery with a short-wave infrared channel become unavailable. Incorporating the thermal band into the NBR calculation was an improvement over NBR, and merits further testing.

Co-Authors: *A.T. Hudak, S. Lewis, P. Robichaud, J. Clark, USDA Forest Service - P. Morgan, M. Bobbitt, L. Lentile, Z. Holden, A. Smith, University of Idaho - J. Clark, USDA Forest Service - R. McKinley, U.S. Geological Survey*

Presentation Title: Regionally adjustable dNBR based algorithm for burned area and impact severity assessment from MODIS data

Presenter: *Tatiana Loboda*
University of Maryland
College Park, Maryland, USA

Abstract: Recent advances in instrument design have lead to considerable improvements in wildfire mapping at the regional and global scales. Global and regional active fire and burned area products are currently available from various satellites. While only global products can provide consistent assessments of fire activity at the global, hemispherical or continental scales, the efficiency of their performance differs in various biomes. The available regional products are hard-coded to the specifics of a given biome (e.g. boreal forest) and their mapping accuracy drops dramatically outside the intended area. We present a regionally adaptable automated approach to mapping burned area from Moderate Resolution Imaging Spectroradiometer (MODIS). This is a flexible remote sensing/GIS based algorithm which allows for easy modification of algorithm parameterization to adapt it to the regional specifics of fire occurrence in the biome or region of interest. The algorithm is based on Normalized Burned Ratio differencing (dNBR) and therefore retains the variability of spectral response of the area affected by fire allowing for the first-order characterization of fire impact from remotely sensed data beyond the binary burned/unburned mapping. The algorithm runs on MODIS Surface Reflectance 8-Day L3 Global 500m product (MOD09A1) and outputs yearly maps of burned area with dNBR values as the attributive information. Comparison of this product with burn scars from Landsat/ETM+ imagery in boreal Russia shows high levels of accuracy in reporting burned area (1.01 with R2 = 0.99). In addition the spatial accuracy of burn mapping is also high with Kappa values ranging between 0.78 and 0.82.

Co-Authors: *Kelley O'Neal, Ivan Csiszar, University of Maryland*

Presentation Title: Setting the Scene for Burn Severity Mapping in Mediterranean-Type Ecosystems: An Application to the Cedar Wildfire in Southern California

Presenter: *Rima Wahab-Twibell*
Clark University
Worcester, Massachusetts, USA

Abstract: Wildfire burn severity is a qualitative measure of fire effects on the landscape caused by changes in vegetation canopy cover and soil biophysical and chemical processes. Accurate mapping of burn severity is critical to assess the ecological and hydrological conditions of the affected terrain. Given the heterogeneous characteristics of the Mediterranean-type ecosystems (MTEs), burned areas often exhibit complex patterns of spectral, thermal and spatial variability. Previous wildfire burn severity studies have traditionally attempted to map burned regions with limited geographic extent or with single or uniform vegetation type and cover using optical remotely sensed data. In this research, we propose a new and improved burn severity model that is capable of addressing the spatial heterogeneity of large wildfire disturbances in MTEs using optical and thermal data. Using the November 2003 Cedar wildfire scar in San Diego County as a pilot study, we attempt to stratify burn severity based on the existing vegetation life forms within the burn scar. To capture the variability of burn severity, we employ spectral linear mixture modeling to unmix pre-fire and post-fire Landsat data into corresponding fire-related scene elements comprised of green and non-photosynthetic vegetation, charcoal, ash, and shade. To further improve the accuracy of burn severity maps, we also incorporate normalized thermal data in addition to topographic variables before classification using a suite of machine learning (ML) classifiers. To test our burn severity model, we employ calibration and validation data derived from very fine spatial resolution (0.5 m) digital aerial data collected by the Airborne Digital Sensor (ADS 40) that provided a wall-to-wall coverage of the Cedar burn scar. A preliminary assessment of the results reveal that the suggested model yield high accuracies at the different burn severity classes and highlight the capability of ML classifiers to model complex relationships between dependent and burn severity related explanatory variables which enables them to accurately capture the complexities of wildfires effects in MTEs.

Co-Authors: *John Rogan, J. Ronald Eastman, Clark University - Douglas Stow, San Diego State University*

Presentation Title: Mapping post-wildfire ground cover after two 2003 California wildfires

Presenter: *Sarah Lewis*
USDA Forest Service
Moscow, Idaho, USA

Abstract: The effects of wildfire on the soil surface are indicative of potential postfire erosion response. Burned areas with organic ground cover (green, uncharred, or charred) remaining will likely experience less erosion than areas of complete ground cover combustion (ash) or exposed mineral soil. The Simi and Old Fires burned ~60,000 ha in southern California in 2003; Simi burned in primarily chaparral vegetation, while Old burned in mixed chaparral and forest. Chaparral vegetation is typically sparser and exposes more soil and rock than does forest vegetation. Burn severity indices (e.g., NBR) calculated from pre- and post-fire multispectral imagery are differenced (dNBR) to highlight fire-induced changes in soil and vegetation. The dNBR may overestimate area burned at high severity in a chaparral landscape, as high burn severity is typically characterized by exposed soil and lack of remaining vegetation. A recently proposed method, the relative dNBR, accounts for the relative preand post-fire soil and vegetation to more accurately measure direct fire effects. To investigate other post-fire mapping techniques, we collected aerial and field hyperspectral data together with field ground cover measurements after the Simi and Old Fires. Spectral endmembers representing soil, rock, green, uncharred, and charred vegetation were used in a constrained linear spectral unmixing process to determine the postfire fractional ground cover of each surface component. Significant correlations ($r > 0.3$, p-value < 0.0001) were found between the fractional cover images and corresponding field measurements indicating that these methods are appropriate for mapping postfire ground conditions. We compared dNBR, relative dNBR, and estimated fractional cover with the field data to see which map product best represented the measured ground conditions. Preliminary results suggest that the relative dNBR is an improvement on the dNBR, but that the fractional cover estimates have the highest correlations with the field ground cover data.

Co-Authors: *Andrew Hudak, Peter Robichaud, USDA Forest Service -*
Leigh Lentile, Penny Morgan, Michael Bobbitt, University of Idaho

Session Title: Postfire Rehabilitation and Management, Part One

Presentation Title: Assessing postfire burn condition using remotely-sensed data

Presenter: *Jess Clark*
USDA Forest Service
Salt Lake City, Utah, USA

Abstract: Burned Area Emergency Response (BAER) teams are assembled to make an emergency assessment of burned lands and to identify potential hazards to public health and property caused primarily by the loss of vegetative cover. An early step in the assessment process is the creation of a soil burn severity map that will be a major factor in determining treatment locations and treatment intensity. Since 2001, many BAER teams have relied on remote sensing and GIS technologies to create their soil burn severity maps. The U.S. Forest Service Remote Sensing Applications Center (RSAC) and USGS Center for Earth Resources Observation and Science (EROS) provide operational remote sensing support to BAER teams, providing them with pre- and immediate post-fire imagery of burned areas. Using an algorithm called the differenced Normalized Burn Ratio (dNBR), the Centers create a Burned Area Reflectance Classification (BARC). The BARC is a GIS-ready layer that is essentially a generalized index of environmental change particularly sensitive to vegetation and soil surface changes due to fire. The BARC data layer is easily modified by local GIS staff to accommodate different ecosystems and management priorities and concerns. Once the BAER team receives the BARC, they have flexibility to adjust the BARC index breakpoints to effectively increase or decrease the extent of burned area classified as low, moderate or high burn severity. Adjustments to the preliminary BARC severity classes, if necessary, are generally based upon ancillary information such as field sample points/ground truth, ocular aerial or ground observations, local expert opinion, and etc. Once the BARC classification is finalized it becomes the burn severity map used for BAER analyses. Along with other environmental and terrain variables, the burn severity information is a critical input to subsequent GIS modeling scenarios used to assess or predict potential fire effects such as increased surface water runoff, debris flows, and erosion.

Co-Authors: *Annette Parsons, USDA Forest Service and USDI Bureau of Land Management - Randy McKinley, DOI U.S. Geological Survey*

Presentation Title: Rodeo-Chediski BAER: Lessons in Mega-Fire Rehabilitation

Presenter: *Mary Stuever*
White Mountain Apache Tribe
Whiteriver, Arizona, USA

Abstract: In 2002, two mega-size fires, both ignited on the tribal lands of the White Mountain Apache, burned together forming one of the largest and most severe wildfires in the western United States. On tribal lands, the White Mountain Apache Tribe, through a self-determination contract, took the lead role on implementing the Burn Area Emergency Response (BAER) plan for the Rodeo-Chediski fire. This presentation will highlight the results of monitoring and observations on several of the stabilization and rehabilitation projects including aerial seeding, aerial straw mulching, log erosion barriers, infrastructure protection, wetland assessments and treatments, and reforestation. Much of the success of this project is related to the tribal approach to BAER which focuses on the people and their connection to land.

Presentation Title: Monitoring results of aerial seeding treatments following the Rodeo-Chediski Fire

Presenter: ~~*Todd Caplan*~~
~~*Parametrix*~~
~~*Albuquerque, New Mexico, USA*~~

Abstract: Aerial applications of grass seed to burned hillslopes is one of the most common emergency hillslope treatments used by the federal Burned Area Emergency Response (BAER) program. Following the Paradise Fire of October 2003, an interagency BAER team recommended seeding 4 native plant species to a 2,522-acre (1,021 hectare) tract of land managed by the Bureau of Land Management to establish native vegetation and to suppress encroachment by nonnative plant species. We monitored 17 plots across the project site to evaluate the relative contribution of aerially seeded plant species to vegetation density and cover. Data analyses indicate that mean plant densities in all sample strata exceeded the BAER goal of 3-5 plants/ft^2 (32.29-53.82 plants/m^2), and that this goal was met by the seeded grass Vulpia microstachys in both the chaparral and live-oak woodland strata. However, our results also indicate that this density goal was met by non-seeded plant species in all strata. Annual forbs contributed most to plant species richness and most native shrub species recorded in plots were either facultative or obligate root-sprouts rather than obligate seeding species. Nonnative plants composed 14% of the 138 plant species recorded in our plots, although none of these species are considered noxious by the state of California. The high cover and density of non-seeded plant species demonstrate that aerial seeding was unnecessary to jumpstart native plant recovery. It is not possible to know if seeding suppressed nonnative plant species because there was no control (unseeded) plots. However, the seeded grass V. microstachys composed approximately 32%-40% of the mean vegetation density in the chaparral and live-oak woodland strata, and this increase could result in an increased fire return interval with negative ecological implications to succession of the native vegetation community.

Co-Authors: *Lucinda Tear, Fred Sproul, Parametrix,*

TRACK 9

Thursday, November 16, 2006

Big Fires: Disaster or diversity:

Dick Williams
CSIRO Sustainable Ecosystems
Winnellie, Northern Territory, Australia

Ross Bradstock
NSW Department of Environment
Sydney, New South Wales, Australia

8:00 – 8:15	*Dick Williams* *CSIRO Sustainable Ecosystems*	Large fires in landscapes: Diversity or disaster? Introduction and overview
8:15 – 8:45	*Malcolm Gill* *CSIRO*	Large fires, fire effects and the fire-regime concept
8:45 – 9:15	*Tania Schoennagel* *University of Colorado*	Landscape heterogeneity following large fires: Insights from Yellowstone National Park
9:15 – 9:45	*Patrick Baker* *Monash University*	Landscape-scale fires in southeast Asia: Here be dragons
10:30 – 11:00	*William Bond* *University of Cape Town*	Big fires in grassy versus woody ecosystems: Fynbos shrublands vs. African savannas
11:00 – 11:30	*Jeremy Russell-Smith* *Northern Territory Bushfires Council*	Savanna fires: Size and frequency does matter
11:30 – 12:00	*Robert E. Keane* *USDA Forest Service*	The ecological effects of large fires on North American landscapes: Benefit or catastrophe?
13:30 – 14:00	*Phil Burton* *Canadian Forest Service*	Large fires as agents of ecological diversity in the North American boreal forests
14:00 – 14:30	*Juli Pausas* *Mediterranean Centre for Environmental Studies (CEAM)*	Big fires in the Mediterranean basin: From shaping diversity to generating disasters
14:30 – 15:00	*Tom Veblen* *University of Colorado*	The historical range of variability of fires in the Nothofagus forest region of southern South America
15:30 – 16:00	*Ross Bradstock* *New South Wales Department of Environment*	Large landscape scale fires: harbingers of ecological disaster or drivers of diversity? A transcontinental perspective from Australia
16:00 -16:30	*Richard J. Williams* *CSIRO Sustainable Ecosystems*	Bunchgrass, bushes, bogs and Burramys: Big fires in alpine landscapes of Australia
16:30 – 17:00	*Richard J. Williams* *Ross Bradstock*	Synthesis: Towards a global understanding of fire size

Session Title: Big Fires: Disaster or diversity:

Session Organizer:

Dick Williams
CSIRO Sustainable Ecosystems
Winnellie, NT, Australia

Ross Bradstock
NSW Department of Environment
Sydney, NSW, Australia

Presentation Title: Large fires in landscapes: Diversity or disaster? Introduction and overview

Presenter:

Dick Williams
CSIRO Sustainable Ecosystems
Winnellie, NT, Australia

Abstract:

In the last 5 years, big fires have occurred on most continents. New Scientist dubbed 2003 the 'year of the bushfire'. The theme of this Symposium is to examine the ecological impacts of large fires. Typically these events have involved complexes of large, landscape-scale fires, affecting a wide range of biomes, ranging from those where fire is rare to those where recurrence is regular. Uncertainty and debate surrounds both the causes and the ecological consequences of these fires. Much of this stems from perceptions concerning the scale, severity and intensity of such fires. For example, such fires are commonly popularised as 'disasters'. However, landscape heterogeneity as a consequence of large fires has been shown to be important for the maintenance of landscape function, e.g. following the Yellowstone fires of 1988. In this Symposium, we ask are there consistent ecological phenomena and outcomes across biomes that are prone to extensive fires?

Co-Authors: *Ross Bradstock, NSW Department of Environment*

Presentation Title: Large fires, fire effects and the fire-regime concept

Presenter: *Malcolm Gill*
Australian National University and Bushfire Cooperative Research Centre
Australia

Abstract: Huge fires - with areas of 10^5 to 10^6 ha (10^3 to 10^4 km^2) - have occurred across a wide spectrum of Australian environments. Such large fires are rare while fires with much smaller areas are common. All fires are ecological 'events' and have been considered to be a subclass of 'disturbances.' Fires, and perhaps all disturbances, occur within a 'regime' – an historical series. Both events and regimes have effects which may be discerned in terms of water, land, air or organisms. What have been regarded as the components of 'regimes' have differed between observers, the main issue being whether or not spatial variables – such as distance from a burnt edge, area of a burnt patch, or the pattern of burning within a patch together with any associated externally burnt patches - need to be included. This paper examines what are the components of fire regimes in relation to their effects and explores the promise of probability approaches to the subject. Large fires are important because they contribute substantially to mean area burnt and therefore mean fire interval - irrespective of inclusion, or not, of spatial variables in the 'regime' concept.

Co-Authors: *G. Allan, Bushfires Council of the Northern Territory*

Presentation Title: Landscape heterogeneity following large fires: insights from Yellowstone National Park

Presenter: *Tania Schoennagel*
University of Colorado
Boulder, Colorado, USA

Abstract: Large, high-severity burns typify the fire regime of relatively cool mesic high-elevation, high-latitude and coastal forests where canopy and ladder fuels are abundant. Areas affected by large, severe fires are commonly perceived as devastated, homogeneous, and biologically poor. To the contrary, early-successional forests often contribute to high biological, structural and ecosystem diversity. Yellowstone National Park provides an excellent laboratory for inferring the effect of the large fires on subsequent landscape heterogeneity. Although the 1988 fires burned 1.4 million acres in the Greater Yellowstone Area predominantly at high severity, the pattern of burning was heterogeneous, leaving a complex mosaic of burn severities. Variable burn patterns shaped the spatial distribution of biological legacies —organisms and structures that persist from the pre-fire forest. The abiotic template (e.g. elevation, soils) and past disturbance regimes (reflected in levels of serotiny and time since last fire), also contribute to the spatial heterogeneity of biological legacies. Such legacies had a significant influence on understory vegetation and post-fire tree densities, which varied 6 orders of magnitude, where smaller dense patches were interspersed within a matrix of larger patches of low-density trees. Patterns of initial post-fire succession generated significant spatial variation in ecosystem processes such as NPP. Although infrequent, the ecological consequences of large fires in Yellowstone have persisted for long periods of time, and with climate change, landscape structure may become more heterogeneous. Overall, the Yellowstone case study suggests that large fires tend to promote heterogeneity both within the burn perimeter and across the larger forested landscape. Biologically rich and ecologically important, large unmanaged post-fire landscapes are relatively rare in time and space, and should be maintained as an important source of ecological heterogeneity.

Co-Authors: *Monica G. Turner, University of Wisconsin-Madison*

Presentation Title: Landscape-scale fires in southeast Asia: here be dragons

Presenter: *Patrick Baker*
Monash University
Melbourne, Victoria, Australia

Abstract: Continental and insular Southeast Asia cover a broad range of bioclimatic zones that influence forest structure and composition as well as the occurrence of landscape-scale fires. In the evermoist, aseasonal forests of the southern Malay Peninsula and Borneo, tall, mega-diverse evergreen rain forests are common and forest fires are rare (but not absent). In the most seasonal monsoon forests of northern Thailand, Burma, Laos, and Cambodia, relatively species-poor deciduous dipterocarps forests and evergreen forests dominated by Pinus and Quercus species are common, as are fires. However, in much of the area in between there is a mosaic of deciduous and evergreen forest types that results from the interaction of the regional gradient in rainfall seasonality and local- and landscape-scale variability in topography and soil water-holding capacity. Landscape-scale fires may also play an important role in creating this mosaic pattern. Unfortunately, there is a general lack of knowledge regarding the frequency and extent of large fires across Southeast Asia, the predisposing conditions that generate such fires (particularly in the evermoist forests), and their impacts on the ecosystems in which they occur. This talk will review the available data on landscape-scale fires in Southeast Asia, consider the role of fire in the evergreen-deciduous forest mosaics of western Thailand, and discuss future avenues of fire ecology research in Southeast Asia.

Co-authors: *Sarayudh Bunyavejchewin, Royal Forest Department, Thailand -*
Andrew Robinson, University of Melbourne

Presentation Title: Big fires in grassy versus woody ecosystems:
Fynbos shrublands vs. African savannas

Presenter: *William Bond*
University of Cape Town
Cape Town, South Africa

Abstract: This contribution addresses two key concerns about large fires: 1) what are the biodiversity impacts of large fires? 2) can we prevent them form happening? Besides the threats to people and property, large fires are generally viewed negatively because they are assumed to homogenise habitats which then is assumed to have negative effects on biodiversity. Our ability to do anything about large fires, for example by prescribed burning, has recently been questioned. If large fires occur under extreme weather conditions, burning through all fuel types, than fire managers may be unable to prevent their homogenising effect. We address the two questions in two contrasting biomes in South Africa; fynbos, a flammable shrubland, and savanna.

Co-authors *Matt Waldram, Diane Southey, University of Cape Town*

Presentation Title: Savanna fires: Size and frequency does matter

Presenter: *Jeremy Russell-Smith*
Northern Territory Bushfires Council
Australia

Abstract: Savannas are the most fire-prone of the earth's major biomes. The recent availability of various decadal-scale global and regional datasets which document the incidence, and in some cases extent of savanna fires, provides a framework within which to examine the implications of frequent and large fires, particularly on biodiversity values. The paper first documents the significance of savanna fires using 10 years of ATSR night-time active fire data. We then examine the incidence and extent of large fires (>100 km^2) in one highly fire-prone savanna region in the Northern Territory, Australia, based on (a) coarse-resolution AVHRR data for the period 1995-2005, and (b) fine-resolution Landsat data for a smaller sub-region over the same period. Collectively, these data illustrate that extensive savanna areas are burnt frequently (often annually or biannually), typically by large fires under relatively severe fire-weather conditions. In the northern Australian context, such fire regimes are shown to have major impacts particularly on fire-sensitive flora and vegetation types within the savanna matrix, and also on relatively immobile vertebrate fauna with small home ranges—fire size and frequency does matter.

Co-Authors: *Jeremy Russell-Smith,[1,2] Jose Pereira[3], Andrew Edwards[1,2], Cameron Yates[1,2] [1]Bushfires Council NT, Australia [2] Tropical Savannas Management Cooperative Research Centre, Australia [3]Instituto Superior de Agronomia, Portugal*

Presentation Title: The ecological effects of large fires on North American landscapes: Benefit or catastrophe?

Presenter: *Robert E. Keane*
USDA Forest Service
Missoula, Montana, USA

Abstract: Many people assume that large fires are an ecological catastrophe because they typically burn vast areas with high intensities and severities. However, little is known of the ecological impacts of large fires on historical and contemporary landscapes and uncertainty and debate surrounds both the causes and the ecological consequences of these fires. This paper presents a review and summary of the current knowledge of the effect of large fires in United States ecosystems excluding Alaska and Hawaii. It is organized by those important North American biomes that have experienced large fires with each section written by a different author. Regions include the Pacific Northwest, Southern California, Northern Rockies, Southwestern United States, Midwest, and Great Basin with emphasis on the following ecosystems: ponderosa pine-Douglas-fir, sagebrush-grasslands, pinyon-juniper, chaparral, mixed conifer, and spruce-fir. This paper will deal with many important issues associated with large fires including 1) the scale of heterogeneity, 2) climate, vegetation, and topographical factors that may precondition large fire events, 3) departure of current large fire effects with those that occurred historically, 4) responses of key biota to large fires, including changes to habitat and biodiversity, and 5) broad generalities between and across major biomes. This paper will also contrast the effects of small fires with large fires in a spatial domain.

Co-Authors: *Robert E. Keane, Stanley G. Kitchen, USDA Forest Service - James K. Agee, University of Washington - Peter Fulé, Northern Arizona University - Jon E. Keeley, Carl Key, U.S. Geological Survey - Richard Miller, Oregon State University - Lisa A. Schulte, Iowa State University*

Presentation Title: Large fires as agents of ecological diversity in the North American boreal forests

Presenter: *Phil Burton*
Canadian Forest Service
Prince George, British Columbia, Canada

Abstract: Big fires in the boreal region typically disturb non-commercial forests and sparsely populated landscapes, and are important for maintaining the ecological integrity of this biome. The region is characterized by a common set of fuel types (Picea, Pinus, Abies, and Populus forests and woodlands, punctuated with wetlands dominated by Sphagnum or Carex species). Yet there is a hierarchy of regional, landscape, and site-level controls on fire regime and large-fire impacts; these factors collectively maintain a dynamic mosaic of endless diversity. Strong differences in climate are found among Canada's seven boreal ecozones, ranging from relatively dry areas in the eastern lee of the Rocky Mountains, to the more maritime portions of Québec and Labrador. The mean annual area burned ranges from <0.15%$\cdot$yr^{-1} in some eastern ecozones, to >0.76%$\cdot$yr^{-1} in some western ecozones, and even >1.5%$\cdot$yr^{-1} in particularly fire-prone pockets. More old-growth forest is naturally found in ecozones characterized by infrequent fire, where spruce budworm (Choristoneura fumiferana) and windthrow can be more important as agents of stand renewal. Terrain factors and fire history often limit the size of individual fires. Most of the area burned takes place in events <50,000 ha where discontinuities in fuel (due to mountains or lakes) occur; in the rest of Canada's boreal region, most of the area burned takes place in events >100,000 ha. The interaction of site factors (moisture levels, fuel loading and distribution) with weather during fires explains much of the variability in fire severity within individual fires, but can also limit fire size. Within fire perimeters, the proportional area occupied by patches of living trees increases with fire size in some areas, but can range from 5% to 50% regardless of fire size elsewhere. The diversity of within-fire severity results in a wide range of impacts to canopy trees, understory vegetation, forest floor and soil. A fire-adapted flora means that boreal vegetation usually recovers rapidly (<10 years for net primary productivity) after large fires, with stand development re-set to a uniformly even-aged forest. Yet the underlying variability in fire frequency, sizes, and severity generates diversity in the structure, composition, productivity, and habitat value of the post-fire forest. A number of forest management issues related to large fires exist, such as how to incorporate fires in timber supply planning, whether to salvage timber from burned forest, and the ways in which forest practices could or should emulate the effects of wildfire.

Co-Authors: *Philip J. Burton[1], Marc-André Parisien[1], Sylvie Gauthier[1], Yves Bergeron[2], and Mike Flannigan[1] [1] Canadian Forest Service / Service canadien des forêts, [2] Université du Québec en Abitibi-Témiscamingue*

Presentation Title: Big fires in the Mediterranean basin: From shaping diversity to generating disasters

Presenter: *Juli Pausas*
Mediterranean Centre for Environmental Studies (CEAM)
Valencia, Spain

Abstract: In a review of ca. 500 species (> 60 families) of the Mediterranean basin, resprouting occurs in a wide range of families; less than 20% of the families are composed of non-resprouters but they represent more than 50% of the total species. Species with fire-stimulated germination are also abundant, but most of them (ca. 40%) are included in relatively few families (ca. 20%). Thus fire-persistence mechanisms are widely present in the Mediterranean basin, suggesting that plant biodiversity has been shaped by the evolutionary fire history. The results also show that fire-stimulated germination is more phylogenetically aggregated than resprouting, which may indicate that these two characteristics may have followed a different evolutionary pathway. However, the number of fires and the area affected by these fires increased exponentially in the Mediterranean basin from the 1960s to the 1980s, and this increase is strongly linked to socio-economic and land-use changes (land abandonment). Comparison of a seven-year monitoring of soil erosion between burned and unburned slopes with different land-uses shows that soil losses are about one to four orders of magnitude higher on burned than on unburned sites, and that there is an interaction between fire occurrence and vegetation type. Furthermore, there are evidences that the vegetation and climatic zone affected by fire are changing. Fires occurring during the 70s affected typical Mediterranean-type ecosystems (dry shrublands and Aleppo pine woodlands), while areas burned during the 90s also include moister areas dominate by species without post-fire persistence mechanisms (e.g., Pinus nigra, Pinus sylvestris). Therefore, in the Mediterranean basin fire may have acted in the past as a force shaping biodiversity, but currently, and due to millenary human impact and climatic changes, fire disasters are increasingly common and may threat Mediterranean biodiversity.

Co-Authors: *Paula S.[1], Rodrigo, A.[2], Llovet J.[1], Vallejo V.R.[1] [1]CEAM [2]Universitat Autònoma de Barcelona*

Presentation Title: The historical range of variability of fires in the Nothofagus forest region of southern South America

Presenter: *Tom Veblen*
University of Colorado
Boulder, Colorado, USA

Abstract: In the Nothofagus forest region of the mid-latitude southern Andes, wildfires occurred in the late 1990s and early 2000s that were more extensive and more severe than any fires in recent memory. For example, severe fires burned 20,000 hectares of Nothofagus-Araucaria vegetation in Chile in a region where most resource managers believed there was no prior history of natural fires. In northern Patagonia, Argentina, more area burned in 1998-99 than in any previous fire season in the 50-year documentary record. These incidents of large, severe fires triggered several questions which are addressed in this paper. At centennial time scales what role has fire played in shaping landscape-scale vegetation patterns? Did burning by Native Americans significantly influence the vegetation patterns that existed at the time of large-scale permanent European settlement in the mid-19th century? Has 20th-century fire suppression had a significant influence on fuel accumulations and recent fire activity? How does climate in the 1990s and early 2000s differ from climate over the past several centuries, and can recent wildfire events be attributed to climatic trends associated with global warming? In addressing these questions we stress the importance of regional variations in climate, vegetation, and fire regimes within the Nothofagus forest region. Over the past c. 400 years, the tree-ring record provides a robust record of fire reflecting the effects of both climatic variation and humans. For the region as a whole, widespread, severe fires are not without precedent over the past c. 400 years, and for most vegetation types fire appears to have been a significant factor in shaping modern stand structures and landscape patterns. Nevertheless, for limited areas (usually ecotones) of particular vegetation types, recent fire events associated with climatic conditions that are either unprecedented or nearly unprecedented over the past 400 years are resulting in major, long-lasting shifts from forest to shrub communities.

Co-Authors: *Thomas Kitzberger and Estela Raffaele, Universidad Nacional del Comahue, Argentina - Mónica Mermoz, Administración de Parques Nacionales, Argentina - Mauro E. González, Jason S. Sibold Universidad Austral de Chile, Chile - C. Andrés Holz, University of Colorado-Boulder*

Presentation Title: Large landscape scale fires: harbingers of ecological disaster or drivers of diversity? A transcontinental perspective from Australia

Presenter: *Ross Bradstock*
NSW Department of Environment
Sydney, NSW, Australia

Abstract: The concept of the disturbance regime has been pivotal to understanding the ecological effects of fire in Australian ecosystems over the last three decades. A logical consequence of the concept is that the effects of any particular disturbance event cannot be understood in isolation. Rather, effects of disturbances such as fire have a cumulative component that requires an understanding of landscape "memory". Despite considerable scientific progress in unravelling the ecological effects of fire regimes in Australian ecosystems, perceptions of large fires as "ecological disasters" linger in the popular and scientific psyche. Depictions of disaster are predicated on the perceived extent, intensity and homogeneity of major landscape-level fires and are therefore focussed chiefly on putative event-based ecological effects. This perspective is deficient for understanding ecological effects for a number of reasons, namely that spatial variation and patterns of intensity and other fire regime components – interval and season - are largely unaccounted for. Emerging data on species and functional- type responses, landscape-level patterns of fire and fire regimes (landscape memory) and the contribution of large fires to these patterns indicate that effects of large fires are varied and complex. Such effects are strongly governed by local context (i.e. not easily generalised) and substantially influenced by interactions with other key ecological drivers such as post-fire rainfall. Examples, from the mesic to the arid, are reviewed in this paper to illustrate these points. It is concluded that effects of large landscape-scale fires are substantially influenced by their recurrence rate – that interactions between frequency and intensity are paramount in shaping long-term ecological responses. Additionally, spatial variation in patterns of intensity may be wide and predominantly linked to the syndromes of weather and terrain that prevail in particular ecosystems. Given forecasts of climate and land use change on the Australian continent, the potential for significant ecological change driven by fire regimes in general and large landscape fires in particular is real. Whether such changes constitute "disaster" or "perturbation" will depend on our dreams – the way in which we value and utilise ecological resources and indeed our enduring dreams about fire. A fulsome appreciation of fire regimes, their drivers and sensitivity to management is required to illuminate these dreams. In this paper some of the underlying causes (cultural, political and conceptual) of this disparity are briefly reviewed.

Presentation Title: Bunchgrass, bushes, bogs and Burramys: Big fires in alpine landscapes of Australia

Presenter: *Dick Williams*
CSIRO Sustainable Ecosystems
Winnellie, NT, Australia

Abstract: The fires of January 2003 in south-eastern Australia burnt several million hectares of montane and subalpine forests, and treeless alpine landscapes. These fires were widely and popularly reported as being disastrous, and an inevitable result of inadequate fuel reduction. Above treeline, extensive fires occur only when periods of extended regional drought, and severe local fire weather coincide, such as in 1939 and 2003. In 2003, all major alpine structural vegetation types - grasslands, herbfields, heathlands and peatlands - were burnt. The extent and severity of burning was very heterogenous, with about 50% of the treeless landscape burnt. Occurrence and severity of fire were both strongly related to vegetation type; heathlands burnt more extensively than grasslands or herbfields. Given this heterogeneity over hundreds of square kilometres, and the importance of Australian alpine landscapes to national biodiversity and catchment conservation, these landscapes are an ideal laboratory to explore the diversity-disaster paradigm. Post-fire monitoring of vegetation structure and composition in grasslands and heathlands indicated that, despite 100% removal of vegetation cover in many locations, plant regeneration commenced rapidly and the vast majority of plant species (>95%) had resprouted or reseeded within 1 year. Recovery of pre-fire structure, however, will be slower: 3-5 yrs in grassland, 10 years in heathland, and many decades in ground-water dependent bogs. The responses of alpine fauna to fire have been variable. Long-term monitoring of the nationally endangered mountain pygmy possum (Burramys parvus) allowed detailed examination of pre-and post-fire populations. Preliminary data indicate substantial spatial variation in post-fire numbers. Some sites experienced substantial falls, others substantial increases in numbers. The relative contribution of mortality, recruitment and migration to these patterns is unknown, but the subject of ongoing research. The core habitat (closed heathland) of another near threatened/vulnerable small mammal, the broad-toothed rat (Mastacomys fuscus), was extensively burnt. However, pyrogenic resprouting and flowering of sub-dominant grasses within and between patches of heath may have provided additional food resources for this species. Further monitoring of the responses of alpine fauna to the 2003 fires is urgently needed. We conclude that for both the flora and fauna of alpine Australia, there is no consistent quantitative evidence that the 2003 fires were a disaster. While the fires were extraordinary, and had immediate and major impacts on biota, and there remain uncertainties, the flora and fauna of alpine Australia are remarkably resilient to such large, intense fires, which appear to be a key component of the fire regime of alpine Australia. However, the sensitivity of these environments to variation in the interval between such fires is unknown.

Co-Authors: *Richard J. Williams[1], Keith L. McDougall[2], Carl-Henrik Wahren[3], Warwick A. Papst[3], Dean Heinze[3], Arn Tolsma[4] - [1] CSIRO Sustainable Ecosystems - [2] NSW Department of Environment and Conservation, - [3] La Trobe University, Australia - [4] Arthur Rylah Institute for Environmental Research, Australia*

TRACK 10

Thursday, November 16, 2006

Fire and Nonnative Invasive Plants

Jane Kapler Smith
USDA Forest Service
Missoula, Montana, USA

Matt Brooks, US Geological Survey
Henderson, Nevada, USA

Erik Martison,
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Steve Sutherland, USDA Forest Service
Missoula, Montana, USA

Kris Zouhar, USDA Forest Service

8:00 – 8:15	*Jane Kapler Smith* *USDA Forest Service*	Introduction to “Fire and Nonnative Invasive plants”
8:15 – 8:30	*Steve Sutherland* *USDA Forest Service*	Role of fire in promoting invasions by nonnative plant species
8:30 – 8:45	*Matt Brooks* *U.S. Geological Survey*	Ecological effects of fire regimes changed by plant invasions
8:45 – 9:00	*Peter Rice* *University of Montana*	Use of Fire to Manage Nonnative Invasive Plants
9:00 – 9:15	*Jane Kapler Smith* *USDA Forest Service*	Panel - Questions and Answers
9:15 – 9:30	*Rob Klinger* *University of California - Davis*	Fire and nonnative invasive plants in the southwest coastal regions: patterns, perceptions, misperceptions, and recommendations
9:30 – 9:45	*Steve Radosevich* *Oregon State University*	Fire and nonnative invasives in the northwest coastal region, including Alaska
9:45 – 10:00	*Anne Marie LaRosa* *USDA Forest Service*	The effects of fire on invasive plants in Hawaii

10:30 – 10:45	*Jane Kapler Smith* *USDA Forest Service*	Panel - Questions and Answers
10:45 – 11:00	*Kris Zouhar* *USDA Forest Service*	Patterns in knowledge gaps regarding fire and nonnative invasive plants
11:00 – 11:15	*Matt Brooks* *U.S. Geological Survey*	Effects of post-fire emergency stabilization and rehabilitation activities on nonnative invasive plants
11:15 – 11:30	*Steve Sutherland* *USDA Forest Service*	Monitoring strategies and what they mean for invasive plants
11:30 – 12:00	*Jane Kapler Smith* *USDA Forest Service*	Panel - Questions and Answers

Fire and Nonnative Invasive Plants

Jane Kapler Smith
USDA Forest Service
Missoula, Montana, USA

Matt Brooks, US Geological Survey
Henderson, Nevada, USA

Steve Sutherland, USDA Forest Service
Missoula, Montana, USA

Erik Martison,
Colorado State University

Kris Zouhar, USDA Forest Service

13:30 – 13:45	***Erik Martinson*** ***Colorado State University***	Introduction to the afternoon session on the relative effects of fuel treatments and wildfires on nonnative plant invasions in the western US
13:45 – 14:00	***Molly Hunter*** ***Colorado State University***	Factors that influence non-native species establishment after wildfires in the southern Rocky Mountains
14:00 – 14:15	***Paula Fornwalt*** ***USDA Forest Service***	Non-native plant species, restoration, and fire in ponderosa pine forests of the Colorado Front Range
14:15 – 14:30	***Jonathan Freeman*** ***Colorado State University***	Initial post-fire response of non-native plants after wildfire in three conifer forests of the Pacific Northwest
14:30 – 14:45	***Cara Nelson*** ***University of Washington***	Effects of fuel-hazard reduction treatments on understory composition and non-native plants in ponderosa pine forests of eastern Washington
14:45 – 15:00	***Jon Keeley*** ***U.S. Geological Survey***	Wildfire Impacts on Alien Plant Invasions in California Chaparral and Sage Scrub
15:30 – 15:45	***Kyle Merriam*** ***USDA Forest Service***	Pre-fire fuel manipulation impacts on alien plant invasion of wildlands
15:45 – 16:00	***Jane Kapler Smith*** ***USDA Forest Service***	Panel - Questions and Answers
16:00 – 16:15	***Lisa Floyd*** ***Prescott College***	Post-fire weed invasions in southwest Colorado, USA: Developing a weed-risk model and monitoring grass seeding treatments
16:15 – 16:30	***Jeanne Chambers*** ***USDA Forest Service***	A Demonstration Area on Ecosystem Response to Watershed-Scale Burns in Great Basin Pinyon-Juniper Woodlands
16:30 – 16:45	***Allison Ainsworth*** ***USDA Forest Service***	Hawaiian Islands: The synergy of fire and nonnative species on native plant community succession
16:45 – 17:00	***Mick Castillo*** ***Hawaii Natural Resource Services***	Effects of Grazing, Burning and Herbicides on Fountain Grass Fuel Beds in Hawaii
17:00 – 17:15	***Jane Kapler Smith*** ***USDA Forest Service***	Panel - Questions and Answers
17:15 – 17:30	***Geneva Chong*** ***U.S. Geological Survey***	Afternoon Session Summary

Session Title: Fire and Nonnative Invasive Plants

Session Organizer: *Jane Kapler Smith*
USDA Forest Service
Missoula, Montana, USA

Abstract: How does fire interact with nonnative invasive plants? Morning presentations will focus on a "Rainbow Series" literature review covering nonnative invasives' responses to fire, the effects of nonnative invasive plants on fire regimes, and use of fire to manage nonnative invasives. Three western bioregions will be featured: southwest coastal, northwest coastal, and Hawaiian Islands. Presentations will address management issues, including monitoring strategies and effects of post-fire emergency stabilization and rehabilitation processes. Afternoon presentations will compare responses of nonnative invasive plants to wildfire and fuel treatments. Wildfire has been assumed to cause greater impacts from nonnative invasive plants than fuel reduction programs; however, little published evidence demonstrates this pattern. Paired presentations will highlight nonnative plant responses to wildfire and fuel treatments in Pacific Northwest and Rocky Mountain conifer forests, Southern California chaparral, pinyon-juniper woodlands in the Intermountain region, and dry tropical forests of Hawaii.

Co-Organizers: *Matt Brooks, U.S. Geological Survey - Erik Martinson, Colorado State University - Steve Sutherland, Kris Zouhar, USDA Forest Service*

Presentation Title: Introduction to "Fire and Nonnative Invasive plants"

Presenter: *Jane Kapler Smith*
USDA Forest Service
Missoula, Montana, USA

Abstract: To develop effective plans and make well-informed decisions, managers need to understand the scientific principles that drive relationships between fire, invasive plants, and native plant communities, and they need to understand how fire-invasives issues affect management in specific geographic regions. The morning session synthesizes information from the scientific literature on fire and nonnative invasive plants. Discussions cover three main themes: effects of fire and fire exclusion on nonnative plant invasions, changes in fuel properties and fire regimes caused by nonnative plant invasions, and the intentional use of fire to control nonnative invasive plants. This presentation will provide a context for the rest of the morning by describing the structure and organization of the session, presenting terms and concepts common to all presentations in the session, and identifying themes that run through the entire session.

Presentation Title: Role of fire in promoting invasions by nonnative plant species

Presenter: *Steve Sutherland*
USDA Forest Service
Missoula, Montana, USA

Abstract: The effect of fire on plants is determined by the interaction of three factors: fire characteristics, plant characteristics, and the characteristics of the plant community in which the species occurs. Fire characteristics determine the amount and duration of the heat produced by combustion. Plant characteristics determine how the plant will respond to the initial heat pulse and the secondary ecosystem changes caused by fire. Community characteristics (pre- and postburn community composition and condition) determine the interaction between the target plant species and the other members of the postfire community. In this presentation, we will review fire adaptations and plant life history strategies and provide specific examples of nonnative invasive plant responses to fire.

Co-Authors: *Kris Zouhar, USDA Forest Service - Lisa Rew, Montana State University*

Presentation Title: Ecological effects of fire regimes changed by plant invasions

Presenter: *Matt Brooks*
U.S. Geological Survey
Henderson, Nevada, USA

Abstract: Plant invasions are widely recognized as significant threats to biodiversity conservation worldwide. One way invasions can affect native ecosystems is by changing fuel properties, which can in turn affect fire behavior and, ultimately, alter fire regime characteristics such as frequency, intensity, extent, type, and seasonality of fire. If the regime changes subsequently promote the dominance of the invaders, then an invasive plant/fire regime cycle can be established. As more ecosystem components and interactions are altered, restoration of preinvasion conditions becomes more difficult. Restoration may require managing fuel conditions, fire regimes, native plant communities, and other ecosystem properties in addition to the invaders that caused the changes in the first place. In this presentation I present a multiphase model describing the interrelationships between plant invaders and fire regimes, provide a system for evaluating the relative effects of invaders and prioritizing them for control, and recommend ways to restore preinvasion fire regime properties.

Presentation Title: Use of Fire to Manage Nonnative Invasive Plants

Presenter: *Peter Rice*
University of Montana
Missoula, Montana, USA

Abstract: A comprehensive literature search and case history review covering North America found only 235 references on control of nonnative invasives with prescribed fire. These reports were used to synthesize information on the use of prescribed fire to manage nonnative invasive plants. Treatments to reduce nonnative invasive species and favor native species are highly specific to the plant community being managed. Effective treatments address the regeneration strategies of both target and desired species by manipulating fire season, severity, extent, and return interval—often in combination with other treatment methods. Direct effects of fire can include preventing flowering or seed set, destroying seed in the inflorescence, and destroying seeds retained in the litter layer or very near the soil surface. Fire-stimulated germination can help deplete the seed bank of some invasives. It is generally not feasible to kill belowground perennating tissues with prescribed fire, but burning woody invasives during the growing season rather than the dormant period may lower carbohydrate reserves and reduce resprouting. Differences in fire-susceptible phenological stage between invasives and desired native species can provide opportunities to use fire effectively at particular times of year. Burning may reduce nonnatives that grow well in litter, but this technique is ineffective where litter removal leaves many surviving invasives or favors new colonizers. Where sparse fuels restrict opportunities to burn or limit fire severity, deferred grazing, addition of dead fine fuel, planting of noninvasive herbaceous species, and herbicide treatments have been used to prepare for a prescribed burn. Burning can also be used to increase the efficacy of other invasive plant treatments, including herbicides, flooding, biocontrol agents, and competitive plantings. Successful use of prescribed fire to manage nonnative invasive plants requires clear objectives, integration of various techniques and programs, monitoring of treated sites over the long term, and follow-up treatments as needed.

Co-Authors: *Jane Kapler Smith, USDA Forest Service*

Presentation Title: Fire and nonnative invasive plants in the southwest coastal regions: patterns, perceptions, misperceptions, and recommendations

Presenter: *Rob Klinger*
University of California – Davis
Davis, California, USA

Abstract: Fire has often been considered to be one of the most important factors leading to high rates of invasion by non-native plants in the southwest coastal region. While this view is not inaccurate, it is overly simplistic and (1) ignores how fire interacts with different phases of the invasion process, and (2) the relative importance of natural and human factors that can either promote or impede invasion rates into both burned and unburned areas. We have synthesized published data from the last 75 years to give an overview of the relationship between fire and invasive plants in the region from three different perspectives: how fire facilitates invasion by non-native plants, how invasive species alter fire regimes, and how fire can be used to manage invasive plants. Patterns are reviewed for each of five major vegetation types in the region where the management of both invasive plants and fire are primary concerns for land managers: grassland, chaparral and coastal scrub, mixed evergreen forest, coniferous forest, and wetlands. Emphasis is placed not just on reiterating already well-documented geographic patterns, but how landscape architecture resulting from both historic and contemporary land use and variation in environmental gradients have shaped these patterns. A general conclusion of our review is that there is a strong need for long-term, coordinated, and integrated studies in the region examining the relationship between fire and invasive species over relatively large spatial scales. In addition, most studies on fire and invasive species have focused on pattern; there is little mechanistic understanding of establishment and spread of invasive plants in burned areas, how higher-order interactions such as herbivory and seed dispersal facilitate or impede invasion into burned areas, or how changes in large-scale ecosystem processes will influence the relationship between fire and invasive species.

Co-Authors: *Matt Brooks, U.S. Geological Survey - Robin Wills, USDI National Park Service*

Presentation Title: Fire and nonnative invasives in the northwest coastal region, including Alaska

Presenter: *Steve Radosevich*
Oregon State University
Corvallis, Oregon, USA

Abstract: I will present the findings of a literature review on the relationship between fire and nonnative plant species within major vegetation communities of the northwest coastal region, and specifically address the role of fire in promoting nonnative species invasions, the effects of nonnative species on fire regimes, and usefulness of fire as a management tool for controlling nonnative species. Conifer forests dominate much of the landscape of the northwest coastal bioregion. In this forested environment, fire promotes nonnative species establishment by creating open canopy conditions for these predominantly shade-intolerant plants and exposing mineral soils for ruderal seedling establishment. The relationship between populations of nonnative species and fire regimes is poorly understood and needs more study. Within the northwest coastal bioregion, fire management of nonnative species is largely restricted to open environments, such as meadows and woodlands, and the relatively few nonnative species that respond negatively to fire. Vegetation communities within the northwest coastal region differ in terms of the extent of nonnative species invasion and their potential invasibility after fire. For example, in Douglas-fir (Pseudotsuga menziesii) forests of the northwest coastal region, the ecological impact of nonnative plant populations is restricted to the earliest stages of forest succession following fire and nonnative plants are typically eliminated from the plant community after a few years of forest stand development. In contrast, Oregon white oak (Quercus garryana) woodland communities of western Washington and Oregon are extensively invaded by nonnative plant species, and populations of individual plant species, both native and nonnative, are distributed heterogeneously across the landscape. Due to the diversity in plant community composition, responses to fire are variable and difficult to predict.

Co-Authors: *Dawn Anzinger, Oregon State University*

Presentation Title: The effects of fire on invasive plants in Hawaii

Presenter: *Anne Marie LaRosa*
USDA Forest Service
Hilo, Hawaii, USA

Abstract: The role of nonnative species in promoting fire is of increasing interest to Hawaii's land managers The introduction and spread of invasive species is altering fire regimes in many of Hawaii's ecosystems, increasing the potential for extinction of native species and significant losses to species diversity.
We review data from the last 25 years, including palynological and archeological information, and evaluate the impact of nonnative species on fire regimes in lowland and upland vegetation types in Hawai'i. Nonnative grasses have invaded native plant communities that once were dominated by relatively open stands of shrub and tree species, altering fuel loading and arrangement. Coupled with more frequent ignitions, the change in fuel characteristics is producing larger, more frequent fires in many areas. A grass-fire cycle, fueled by nonnative grasses, is relatively well established in submontane 'ohi'a woodlands. Much less is understood about other Hawaiian vegetation types, but many types have been affected by increased fine fuel loads from nonnative grasses. Fire is now an important disturbance factor in Hawai`I, and many fire-promoting weeds are altering disturbance regimes, community structure and ecosystem properties. Five species of nonnative grasses and one nonnative fern are the primary carriers of fire in Hawai`i today. Prescribed fire is not likely to be a useful tool to control invasives in most Hawaiian environments, and other methods to reduce fuel will be needed. Research is needed on the mechanisms of invasion, the nature of competitive interactions among native and nonnative species after fire, and the use of fire in restoration of degraded ecosystems. Long-term studies are needed to determine whether the short term competitive advantage observed for many fire-promoting nonnative grasses over native woody species persists over time.

Co-Authors: *J. Timothy Tunison, USDI National Park Service - Alison Ainsworth, Oregon State University - J. Boone Kauffman, USDA Forest Service*

Presentation Title: Patterns in knowledge gaps regarding fire and nonnative invasive plants

Presenter: *Kris Zouhar*
USDA Forest Service
Missoula, Montana, USA

Abstract: The potential for nonnative, invasive plants to alter an ecosystem depends on the plants themselves, the particular ecosystem and its condition, and the effects of disturbances, including fire. This study identifies gaps in science-based knowledge about the relationships between fire and nonnative, invasive plants in North America. The literature was searched for information on 60 nonnative invasives. Information was synthesized and placed online in the Fire Effects Information System (FEIS, www.fs.fed.us/database/feis), and sources were tallied for topics considered crucial for understanding each plant's relationship to fire. These tallies were analyzed to assess knowledge gaps. Fewer than half of the species studied had any high quality information on heat tolerance, postfire establishment, effects of varying fire regimes (severities, seasons, and intervals between burns), or long-term effects of fire. Information was generally available, although sometimes incomplete, on biological and ecological characteristics relating to fire. Most information about species distribution used too coarse a scale or non-systematic observations, rendering it of little help in assessing invasiveness and susceptibility of ecosystems to invasion, especially in regard to fire. Quantitative information on nonnative plants' impacts on native plant communities and long-term effects on ecosystems was sparse. Researchers can improve the knowledge available on nonnative invasive plants for managers by applying rigorous scientific methods and reporting the scope of the research, in both scientific papers and literature reviews. Managers can use this knowledge most effectively by applying scientific findings with caution appropriate to the scope of the research, monitoring treatment results over the long term, and adapting management techniques according to what is learned.

Co-Authors: *Greg Munger, Jane Kapler Smith, USDA Forest Service*

Presentation Title: Effects of post-fire emergency stabilization and rehabilitation activities on nonnative invasive plants

Presenter: *Matt Brooks*
U.S. Geological Survey
Henderson, Nevada, USA

Abstract: Fire can both promote invasions and be used to control invasions by non-native plants. So too can fire management activities such as those associated with burned area emergency response (BAER) projects. Treatments are increasingly being designed to manage non-native invasive plants in postfire landscapes, although the science behind these treatments is relatively scant. The net effects of BAER treatments are related to the degree that they influence propagule pressure of non-native plants and the resources available to those species. In this presentation we will discuss the various ways that BAER projects can affect non-native invasive plants in postfire landscapes.

Co-Authors: *Steve Sutherland, USDA Forest Service*

Presentation Title: Monitoring strategies and what they mean for invasive plants

Presenter: *Steve Sutherland*
USDA Forest Service
Missoula, Montana, USA

Abstract: Monitoring is essential in understanding the relationship between fire and invasive species whether it is documenting post fire changes in weed populations, recovery of native plant communities after wildfire, or efficacy of prescribed fire in controlling nonnative plant species. In this presentation, we will discuss the importance of: 1) identifying land management objectives, 2) identifying monitoring objectives, 3) selecting the appropriate monitoring scheme and the consequences of this selection, 4) selecting the appropriate statistical analyses and interpreting the results, and 5) modifying the monitoring plan as additional data and understanding become available. We will also identify how monitoring fire and weeds varies from monitoring plant populations and communities.

Co-Authors: *Matt Brooks, U.S. Geological Survey*

Presentation Title: Introduction to the afternoon session on the relative effects of fuel treatments and wildfires on nonnative plant invasions in the western US

Presenter: *Eric Martinson*
Colorado State University
Fort Collins, Colorado, USA

Abstract: Introduction of speakers and topics to be covered in the afternoon half of the special session on fire and nonnative invasive plants, which will focus on the relative effects of fuel treatments and wildfires.

Presentation Title: Factors that influence non-native species establishment after wildfires in the southern Rocky Mountains

Presenter: *Molly Hunter*
Colorado State University
Fort Collins, Colorado, USA

Abstract: Establishment and spread of non-native species following wildfires can pose threats to long-term native plant recovery. Factors such as disturbance severity, resource availability and propagule pressure may influence where non-native species establish in burned areas. In addition, pre- and post- fire management activities may influence the likelihood of non-native species establishment. In this study we examine the establishment of non-native species after wildfires in relation to native species richness, fire severity, dominant native plant cover, resource availability, and pre-and post-fire management actions (fuel treatments and post-fire rehabilitation treatments). We analyzed post-fire effects at multiple scales at three wildfires in Colorado and New Mexico. For large and small spatial scales at all fires, fire severity was the most consistent predictor of non-native species cover. Non-native species cover was also correlated with high native species richness, low native dominant species cover and high seeded grass cover. There was a positive but non-significant association of non-native species with fuel treated areas at one wildfire but no effect of fuel treatments at two other wildfires. While there may be some potential for fuels treatments to promote non-native species establishment, the threat of fuel treatments seems low relative to wildfire and post-fire seeding treatments.

Co-Authors: *Philip N. Omi, Erik J. Martinson, Colorado State University -*
Geneva W. Chong, U.S. Geological Survey

Presentation Title: Non-native plant species, restoration, and fire in ponderosa pine forests of the Colorado Front Range

Presenter: *Paula Fornwalt*
USDA Forest Service
Fort Collins, Colorado, USA

Abstract: We sampled the forest understory in burned, restored, and undisturbed (neither burned nor restored) areas in the Upper South Platte Watershed of Colorado to address the question of how these disturbances affect the distribution and abundance of non-native species. Both the wildfire and restoration treatment occurred in 2002, and seem to be similar in terms of overstory mortality due to the treatment (i.e., fire or restoration). Data was collected in 2004 and 2005, and will also occur in 2006. Preliminary data analysis indicates that: 1) In both 2004 and 2005, the number of non-native species per plot was significantly higher in the burned and restored plots than in the undisturbed plots, but there was no difference between the two treated groups. 2) In 2004, non-native percent cover was significantly higher in burned plots than in undisturbed plots; no other differences were significant. In 2005, non-native percent cover was significantly higher in the burned and restored plots than in the undisturbed plots, but there was no difference between the two treated groups. 3) A total of 30 non-native species were found over the two years sampled. The effect of fire and restoration on these individual species was variable. Most species were tolerant of or stimulated by the fire and restoration treatments, though sensitive species were also found. The regeneration success of each individual non-native species will likely be related to its life history and post-disturbance regeneration strategy. This preliminary analysis provides some evidence that both fire and restoration may encourage the establishment and growth of non-native plants. However, it does not suggest that there is much difference between the two disturbances. Further data collection and analysis is needed in this study to fully explore the effects of fire and restoration on non-native plants.

Co-Authors: *Merrill Kaufmann, USDA Forest Service, retired*

Presentation Title: Initial post-fire response of non-native plants after wildfire in three conifer forests of the Pacific Northwest

Presenter: *Jonathan Freeman*
Colorado State University
Fort Collins, Colorado, USA

Abstract: Fire is a natural part of forest ecosystems in the Northwestern United States, but its effects on non-native plant invasion have only recently been studied. Forest managers are engaging in fuel reduction projects to lessen fire severity, often without considering potential negative ecological consequences such as non-native species introductions. Increased availability of light, nutrients, and bare ground have been associated with high severity fires and fuels treatments, and are known to aid in the establishment of non-native species. To determine the effects of fire and fuel treatments on native and non-native species, I collected vegetation and environmental data in the first growing season following wildfire at three sites in coniferous forests in the Cascade and northern Sierra ranges. Fuel treatments of interest included prescribed fire and thinning, and neither had significant effects on plant species composition. I found no non-native species at the Davis fire (OR), but native species richness and cover did decrease significantly in burned plots. Wildfire was responsible for a significant decrease in native cover and a significant increase in native and non-native richness at the Fischer (WA) and Power (CA) fires. I used regression tree analysis and Pearson correlation matrices to determine which measured environmental variables best predicted native and non-native richness and cover in post-fire stands. Native species were highest in unburned plots and at lower elevations and preferred increased canopy cover and decreased bare soil. Non-native species were highest in plots that burned at low severity, as opposed to unburned or high severity plots. Non-natives also preferred high soil nutrients and lower elevations. Non-native species levels remain low in the first year post-fire, averaging only one species and 0.7% cover per plot. Long term monitoring of post-fire stand conditions is necessary to ensure that invasions do not intensify in the future.

Co-Authors: *Thomas J. Stohlgren, Geneva W. Chong, U.S. Geological Survey - Erik J. Martinson, Philip N. Omi, Colorado State University*

Presentation Title: Effects of fuel-hazard reduction treatments on understory composition and non-native plants in ponderosa pine forests of eastern Washington

Presenter: *Cara Nelson*
University of Washington
Seattle, Washington, USA

Abstract: Fire-adapted forests across the interior Northwest are increasingly susceptible to damage from insects, pathogens, and stand-replacing fires following decades of fire suppression. As a result, managers are employing thinning and prescribed burning treatments to reduce fuel loadings and to restore the stand structure, species, and processes that historically characterized these forests. However, the consequences of these activities for understory plant communities are not well understood. We examined the effects of thinning and prescribed fire on plant composition and diversity in ponderosa pine forests of eastern Washington. Data on the abundance and richness of native and non-native plants were collected in 70 stands in the Colville, Okanogan, and Wenatchee National Forests. Stands represented one of three types of restoration treatments (or a control) conducted 3-20 yr prior to sampling: thinning, burning, thinning plus burning, or no treatment. Multivariate analysis revealed no significant effect of thinning or burning on understory plant composition. Similarly, there were no significant differences among treatments in the cover or richness of native plants. In contrast, non-native plants showed small, but highly significant, increases in both cover and richness in response to thinning and/or burning. The combined treatment (thinning plus burning) yielded the greatest abundance and richness of non-native plants, although cover rarely exceeded 2% in any treatment. Analysis of temporal trends suggests slight increases in the abundance of non-native species with time in only burned treatments. Although thinning and burning may promote invasion of exotic plants in these forests, our data suggest that increases in their abundance and diversity are limited.

Co-Authors: *Charles B. Halpern, James K. Agee, University of Washington*

Presentation Title: Wildfire Impacts on Alien Plant Invasions in California Chaparral and Sage Scrub

Presenter: *Jon Keeley*
U.S. Geological Survey
Three Rivers, California, USA

Abstract: Fires, either planned or unplanned, potentially favor the spread of non-native plants in California shrublands. Multivariate models of postfire invasion show that the most significant variables directly determining alien success after fire are the presence of aliens in the immediate postfire environment, which contributes to a rapid buildup of the alien seed bank, and the rate of woody plant recovery. These factors are important throughout the region and do not appear to be dependent upon patterns of nitrogen pollution. When fire frequency increases to unnaturally high levels, e.g., once a decade in chaparral or several times a decade in sage scrub, native species are lost and alien annuals fill the void. These aliens alter the fire regime from a crown fire regime to a mixed crown and surface fire regime, as a consequence fires can carry through these mixed shrubland/grasslands under a far greater range of weather conditions than are required to carry fire in chaparral. In addition, the early curing of the alien grasses greatly expands the length of the fire season. Lastly, the lower temperatures resulting from fires in grass/shrub mixtures means much greater alien seed survivorship, which in turn enhances conditions for aliens in a feedback process that often ends in alien dominated annual grasslands.

Presentation Title: Pre-fire fuel manipulation impacts on alien plant invasion of wildlands

Presenter: Kyle Merriam
USDA Forest Service
Quincy, California, USA

Abstract: Federal, state, and local agencies are currently implementing large-scale fuel treatment programs throughout California to reduce the threat of catastrophic wildland fires. An unexpected result of these fuel reduction programs may be the introduction of invasive nonnative plant species. The establishment of nonnative plants within fuel treatments is a serious concern because many treated areas, such as fuel breaks, extend into remote wildland areas. Once nonnative species are established within fuel breaks, adjacent wildland areas might be more susceptible to widespread invasion following disturbances such as fire. We evaluated the abundance of nonnative plants on fuel breaks and in adjacent untreated areas to determine if fuel treatments promote the invasion of nonnative plant species. Our study examined 24 fuel breaks, including 8 sites in southern California. We found that nonnative plant abundance was significantly higher on fuel breaks than in adjacent wildland areas. Relative nonnative cover was greater on fuel breaks constructed by bulldozers than on fuel breaks constructed by other methods. Canopy cover, litter cover, and duff depth also were significantly lower on fuel breaks constructed by bulldozers, and these fuel breaks had significantly more exposed bare ground than other types of fuel breaks. There was a significant decline in relative nonnative cover with increasing distance from the fuel break, particularly in areas that had experienced more numerous fires during the past 50 years, and in areas that had been grazed. These data suggest that fuel breaks could provide establishment sites for nonnative plants, and that nonnatives may invade surrounding areas, especially after disturbances such as fire or grazing. Fuel break construction and maintenance methods that leave some overstory canopy and minimize exposure of bare ground may be less likely to promote nonnative plants.

Co-Authors: ***Jon E. Keeley, U.S. Geological Survey - Jan L. Beyers, USDA Forest Service***

Presentation Title: Post-fire weed invasions in southwest Colorado, USA: Developing a weed-risk model and monitoring grass seeding treatments

Presenter: *Lisa Floyd*
Prescott College
Prescott, Arizona, USA

Abstract: Large wildfires burned in Mesa Verde National Park and surrounding Ute Mountain Ute Reservation, southwestern Colorado, USA, in 1989, 1996, 2000, 2002, and 2003. Extensive portions of the burns were invaded by non-native plant species, including Carduus nutans (musk thistle) and (Canada thistle) before 1999 and Bromus tectorm (cheatgrass) became abundant in the post-fire communities after about 1999. In untreated areas, these weeds have persisted at least 13 years. We used patterns of weed distribution, pre-fire vegetation, and soil characteristics to identify plant communities most vulnerable to post-fire weed invasion and created a spatially explicit weed-risk model for Mesa Verde. At the scale of the entire park, mature piñon-juniper woodlands growing on Mikim and Arabrab-Longhorn soils were most vulnerable to post-fire weed invasion; mountain shrublands were the least vulnerable. In unburned areas, weed density increased with increased soil nitrogen, phosphorus, and salinity and in burned areas with soil nitrogen and silty texture. We also evaluated the effectiveness of chemical, mechanical and native grass seeding treatments to prevent weeds after the 1996 and the 2000 fires. Aerial seeding of targeted high-risk areas with mixtures of 4-7 native grass species was the most effective treatment tested; there was an 18-fold reduction of invasive species, with no reduction in native biodiversity. While invasive species have not been eradicated from the post-fire landscape, the effectiveness of grass seeding treatments in significantly reducing weed density has persisted for at least 8 years.

Co-Authors: *William H. Romme, Colorado State University -*
David D. Hanna, Timothy Crews, Prescott College

Presentation Title: A Demonstration Area on Ecosystem Response to Watershed-Scale Burns in Great Basin Pinyon-Juniper Woodlands

Presenter: *Jeanne Chambers*
USDA Forest Service
Reno, Nevada, USA

Abstract: Ongoing expansion of pinyon and juniper into sagebrush ecosystems is resulting in increases in the highly competitive trees and decreases in understory sagebrush species throughout much of the woodland zone. These changes are increasing the risk of high severity fires and the susceptibility of these ecosystems to nonnative invaders. We conducted a series of studies in the Great Basin Pinyon-Juniper Demonstration area that can be used to examine effects of prescribed fire on susceptibility of pinyon-juniper woodlands and their associated sagebrush ecosystems to the annual invader, cheatgrass (Bromus tectorum). These studies evaluated the effects of prescribed fire on resource availability, cheatgrass establishment and reproduction, and community recovery over the range of elevation, tree canopy cover, and residual native herbaceous vegetation typical of these woodlands. Sagebrush communities differ in species composition and productivity over elevation gradients and differ in their responses to prescribed fire and in their resistance to invasion. Increases in tree cover result in progressive decreases in sagebrush and perennial herbaceous species and can influence community recovery. Both spring and fall burning increase resource availability (soil water and nutrients) and these effects can persist for several years. Removal of perennial herbaceous species and burning have few effects on cheatgrass establishment and survival. However, cheatgrass biomass and seed numbers can increase 2 to 3 times after removal alone, and 2 to 6 times after just fire. Following both herbaceous species removal and fire, biomass and seed number can increase from 10 to 30 times depending on site and year. These data indicate that site characteristics as defined by elevation, soils and topographic position and the abundance of residual native herbaceous vegetation can be used to access both recovery potential and the need for active restoration.

Presentation Title: Hawaiian Islands: The synergy of fire and nonnative species on native plant community succession

Presenter: *Allison Ainsworth*
USDA Forest Service
Hilo, Hawaii, USA

Abstract: The nonnative species scaly sword fern (Nephrolepis multiflora) may alter the fuel properties by dramatically increasing fine surface fuels in mesic and wet forests. This could then alter fire regimes. In addition, the competitive nature of nonnative species in the post fire environment may slow or dramatically alter native forest recovery. To examine the effects of single and repeated wildfires (2002-2003) and nonnative species on plant community composition and structure, we established replicate plots across an elevation/climatic gradient at Hawaii Volcanoes National Park. Fires were stand replacing where over 95% of the dominant ohia trees (Metrosideros polymorpha) were top-killed. One year following a single fire event, a mean of 44% of the ohia were killed while only 7% of the wet forest subcanopy dominant hapuu tree fern (Cibotium glaucum) were killed. A second fire occurring the next year dramatically increased mortality of ohia (89%) and hapuu (44%). Seedling recruitment was not greater in the burned sites compared to the unburned sites. Nonnative species became increasingly important in the understory of previously native dominated communities following fire and appear to be strongly competitive with native seedlings and sprouts. Prefire communities that were dominated by nonnative species demonstrated little change in composition following fire. Reaccumulation of fine fuels was faster in these communities due to the rapid regeneration of scaly sword fern and nonnative grasses. Two years following fire, in-stand wind speeds were significantly higher and relative humidities were suggestively lower in the burned forest sites compared to unburned sites. Rapid recovery of fuels in nonnative communities, nonnative species invasions in previously native communities, and altered microclimatic conditions in the post fire environment may increase the probability of additional fires in these communities.

Co-Authors: *R. Flint Hughes, J. Boone Kauffman, USDA Forest Service - Rhonda K. Loh, J. Tim Tunison, USDI National Park Service*

Presentation Title: Effects of Grazing, Burning and Herbicides on Fountain Grass Fuel Beds in Hawaii

Presenter: *Mick Castillo*
West Hawaii Wildfire Management Organization
Kamuela, Hawaii

Abstract: Invasion of dry leeward aspects of the Hawaiian Islands by fountain grass (Pennisetum setaceum) has created a continuous and nearly monotypic fine fuel bed that carries roadside-ignited fires that kill dominant native forest species, alter community structure, and disrupt ecosystem function. The objective of this study was to evaluate the effects of a range of fuels treatment techniques, including prescribed burning, cattle grazing, and aerially-applied herbicide on fountain grass loading in a roadside area known to burn frequently. Three primary treatments of prescribed burning, cattle grazing, and the combination of the two, were applied to plots ranging in size from 4 to 6 hectares. Glyphosate herbicide was then applied to half of each of the three primary treatments and to a control, resulting in 8 unique treatment combinations. Fountain grass loading and species composition were monitored over a 2 year period. Burning reduced loading of fine fuels through the first year. Grazing was marginally effective in reducing loading in this study due to low stocking rates applied. The combined burning and grazing treatment effectively reduced grass loading after two years. Herbicide effectively killed the grass and resulted in a release of the existing and predominantly non-native soil seed bank which had apparently been suppressed by the nearly continuous fountain grass fuelbed. The combined burn x graze x herbicide treatment resulted in the greatest and most long-lasting reduction in grass loading, changed the composition and structure of the fuel bed, and resulted in the greatest increase in plant species richness. We conclude that aerially applied herbicide provides a cost-effective and long-lasting reduction in grass loading when applied alone and in combination with prescribed burning or cattle grazing or both, and can be used to initiate a shift in fuel type to one with a lower fine fuel component.

Co-Authors: David Weise, Robert Vihnanek, Amanda McAdams USDA Forest Service - Miles Nakahara, Hawaii Division of Foresty and Wildlife, Kamuela, HI - Gayland Enriques, Schofield Barracks - Lawrence Ford, University of California, Santa Cruz - Rodrigo Moraga, Anchor Point Group

TRACK 2

Friday, November 17, 2006

Policy and Programs

8:00 – 8:15	***Scott Stephens*** ***University of California, Berkeley***	Federal Forest Fire Policy in the United States
8:15 – 8:30	***Michael Medler*** ***Western Washington University***	The Fire Deficit
8:30 – 8:45	***Gordon Friend*** ***Department of Sustainability & Environment***	Bringing Biodiversity and Fire Management Together in Victoria - Integrating the Science, Planning and Implementation Processes
8:45 – 9:00	***Bo Wilmer*** ***The Wilderness Society***	Mapping Priorities for Fire Restoration: Why FRCC Fails
9:00 – 9:15	***Joe Bowersox*** ***Willamette University***	When and Where: Temporal and Spatial Scale Issues in the Politics of Post-fire Recovery Strategies
9:15 – 9:30	***David Ostergren*** ***Northern Arizona University***	The Practice and Politics of Restoring Fire into Wilderness Areas and National Parks: Lessons Learned and Future Challenges
9:30 – 9:45	***Timothy Ingalsbee*** ***Fire Fighters United for Safety, Ethics, and Ecology***	Collateral Damage: The Environmental Effects of the 2002 Biscuit Fire Suppression Actions

Session Title: Policy and Programs

PresentationTitle: Federal Forest Fire Policy in the United States.

Presenter:

Scott Stephens
University of California - Berkeley
Berkeley, California, USA

Abstract:

Forest fire policy of United States federal agencies has evolved from the use of small patrols in newly created national parks to diverse policy initiatives and institutional arrangements that affect millions of hectares of forests. Even with large expenditures and substantial infrastructure dedicated to fire suppression, the annual area burned by wildfire has increased over the last decade. Given the current and future challenges of fire management, several changes and re-emphases in existing policy are warranted. Most importantly, the actual goal of fuels management projects should be the reduction of potential fire behavior and effects, not the simple reduction of fuels. To improve safety and economic efficiency, fire suppression policies should recognize differences in the characteristics of wildfires, and strategies should be tailored to better respond to the unique demands of each fire. Where forest fires are burning large areas reducing this trend will require a diversity of treatments, including prescribed burning, mechanical fuels treatment, and increased use of the Wild land Fire Use Policy. Assessment of how fire is affecting forests would be enhanced if land management agencies reported the area burned by low-, mixed-, and high-severity fire and what proportion is outside the desired trend or range of conditions for each forest type. Congress should provide an improved budgetary process for fire and fuels management. Additionally, reducing annual area burned will require long-term coordinated efforts by federal and state governments, with robust partnerships between land management agencies and the public in collaborative planning and stewardship. Research and adaptive management are essential in allowing fire hazard reduction projects to move forward where proposed projects are met with uncertainty and mistrust. Building on existing programs that are consistent with a science-based strategy will enable land management agencies to better utilize information in pursuit of the overall objective of reducing uncharacteristically severe wildfires.

Co-Authors: *Larry Ruth, University of California - Berkeley*

Presentation Title: The Fire Deficit

Presenter:

Michael Medler
Western Washington University
Bellingham, Washington, USA

Abstract:

Understanding an area's fire regimes can provide expected fire return intervals (FRIs) for vegetation communities and associated ecosystems. If fire is suppressed for a sufficient length of time beyond these intervals, ecosystems will inevitably go through changes, which may or may not be desirable. In this study we examined the long term area of fire necessary to maintain the fire regimes and associated ecosystems in the 11 western states of the US, and compared these values to the fire acreages experience in the last few decades. The USFS Land fire project is producing high resolution, spatial fire regime data. We assembled these data for the 11 western states and eliminated all areas of urban development and agriculture. For the remaining data we totaled the area in each FRI class. These total areas were then divided by the associated FRIs. This calculation gives a rough approximation of the aggregate annual average area of fire that is necessary within each state to assure that current fire regimes and associated vegetation communities persist over time. We found that 55,000 km^2 of fire are required to sustain western fire regimes and their associated ecosystems. On average only 5,700 km^2 burned each year during our study period leaving an annual burning deficit of 49,300 km^2 or about 12 million acres per year. The yearly expected areas calculated here represent only average number of hectares per year, aggregated over decades, necessary to maintain natural fire regimes. These averages do not imply that these areas must burn in even yearly allotments, and this study makes no prediction about the consequences of forests being allowed to go unburned beyond their historical FRIs. The vegetation categories used in this study represent complicated systems that will respond in complex ways to fire exclusion and changes in FRIs.

Presentation Title: Bringing Biodiversity and Fire Management Together in Victoria – Integrating the Science, Planning and Implementation Processes

Presenter: *Gordon Friend*
Department of Sustainability & Environment
East Melbourne, Victoria, Australia

Abstract: Since 1998, the State Government agencies responsible for the management of fire on public and private land in Victoria (the Department of Sustainability and Environment, Parks Victoria and the Country Fire Authority) have been working together to guide the management of fire to achieve both biodiversity and asset protection objectives at a landscape level across all tenures. The approach uses the life history characteristics (vital attributes) of constituent flora and fauna species to determine appropriate, ecologically-based fire regimes for an area which can then be integrated at the local planning level with asset protection principles and objectives to develop an overall prescribed burn plan. This provides an objective, scientific basis on which to set clear and simple ecological and fuel reduction objectives, the achievement of which can then be monitored. The process has been documented in the Guidelines and Procedures for Ecological Burning on Public Land in Victoria (2004). Work is currently proceeding on a number of projects, including: Governance arrangements and linkages with Regional Fire Ecologists, Fire Management Officers, relevant stakeholders and related strategic planning processes; A Strategic Directions (2006-08) document which will provide the framework needed to implement the overall vision and objectives; Development and refinement of tools to assist planning and implementation of ecological burns and other fire management activities. Tools include databases of plant fire response parameters and fire regimes for major vegetation types, and the production of ecological burn planning and monitoring manuals; Development of faunal fire response parameters and their integration into the overall framework; A community engagement strategy.

Co-Authors: *Helen Bull[2], Laurie Ferns[1], Dennis Matthews[3], Alen Slijepcevic[1], Kevin Tolhurst[4], Tony Varcoe[3] and Craig Whiteford[1]*
1. Dept of Sustainability and Environment;
2. Country Fire Authority;
3. Parks Victoria;
4. University of Melbourne.

Presentation Title: Mapping Priorities for Fire Restoration: Why FRCC Fails

Presenter: *Bo Wilmer*
The Wilderness Society
Seattle, Washington, USA

Abstract: Fire Regime Condition Class (FRCC) is a method for mapping where natural fire regimes have been disrupted. Embraced by congressional lawmakers as a useful, simple metric, FRCC is currently the driving force under the Healthy Forests Restoration Act. In order to set priorities and quantify accomplishments, FRCC has been quickly adopted by federal land management agencies as a guide for prioritizing where fuel reduction treatments should be targeted. Despite its acceptance within the Forest Service and BLM however, FRCC has suffered increasing criticism from the broader scientific community. Many land managers misinterpret FRCC results. Assuming that Condition Classes 1, 2, and 3 represent increasing fuel loads and therefore fire risk, many fire managers mistakenly rely on Condition Class maps to target forest thinning projects. In fact, FRCC accounts for any and all disruptions to the natural fire regime, whether from fire suppression, grazing, or exotic plants. Apart from misinterpreting FRCC conclusions, however, there remain numerous additional scientific and technical problems with mapping FRCC. Methods are also ambiguous as to whether FRCC applies To specific places or broad landscapes and whether FRCC adequately accounts for the variability of ecosystems over space and time. FRCC determination also relies heavily on non-repeatable "expert workshops" where professional judgment plays more of a role than empirical data collection. FRCC determination relies on data with known shortcomings, such as the inadequate scale of historical vegetation maps and the absence of forest density data, a critical input into FRCC calculation. Most important, though, is that FRCC tells us nothing about how to address the highest priority of fire management: reducing risk to communities. FRCC measures only how different current vegetation is from historical vegetation; it says nothing about how those differences affect fire behavior, and it does Not account for the presence of communities in the landscape.

Co – Authors: *Greg Aplet, The Wilderness Society*

Presentation Title: When and Where: Temporal and Spatial Scale Issues in the Politics of Post-fire Recovery Strategies

Presenter: *Joe Bowersox*
Willamette University
Salem, Oregon, USA

Abstract: Issues of spatial and temporal scale provide a framework for examining the interplay between ecology and policy in post-fire recovery strategies on public lands. Contemporary policy dilemmas of salvage, fuel management, and regeneration work at resolutions of temporal and spatial scale deemed appropriate for decision making regarding economic and social priorities. However, such may not fully consider and reflect the ecological processes and patterns at work within a given forest ecosystem. By examining two noteworthy case studies of post-fire recovery on public lands in Oregon---the 2002 Biscuit Fire and the 2003 B and B complex fire—this paper analyzes the role of spatial and temporal scale in each with a focus on formation and achievement of stated management objectives. Data is drawn from agency planning documents, independent studies, congressional hearings, and participant interviews. After identifying relevant scalar issues (ranging from jurisdictional divisions and species ranges to global climate drivers) and their relation to stated management objectives, the paper develops a framework for better collaboration between the scientific and policy communities focused on achieving medium to long term ecosystem and social resilience.

Presentation Title: The Practice and Politics of Restoring Fire into Wilderness Areas and National Parks: Lessons Learned and Future Challenges.

Presenter: ***David Ostergren***
Northern Arizona University
Flagstaff, Arizona, USA

Abstract: The Bureau of Land Management, National Park Service and USDA Forest Service manage extensive wilderness areas that have excluded fire for decades. Agencies, researchers and NGOs acknowledge that these frequent fire ecosystems are out of their natural range of variability and that fire can contribute to the restoration of forest composition, structure and function. Management standards are designed to protect wilderness characteristics which imply that both natural and untrammeled (i.e. self-managed) conditions are maximized. Dense, small diameter stands of Ponderosa pine as well as overstocked stands of mixed conifer present particularly tough ecological challenges. Spiritual, aesthetic and intrinsic qualities reflect social values that need to be preserved. The challenge is to reintroduce fire without courting disaster while maintaining the incredibly complex array of Wilderness values that make these areas special. This policy analysis identifies the fundamental social and ecological challenges to reintroducing fire into small and large wilderness areas. Data collection utilized case study methodology and extensive interviews of informed elites from agencies, academia and NGOs. I conclude that protecting Wilderness values will require a gradual, perhaps decade's long process. This process includes: 1) documenting baseline conditions and determining whether the system is on a trajectory of degradation; 2) attempting to apply Wild Fire Use as the least invasive strategy; 3) instigating a series of prescribed burns only if the system is degraded and WFU will not work; 4) and finally, if fuel loads are impossibly high and ecological resources are either scarce or absolutely unique, the agency may consider fuel reduction by super-light thinning and prescribed burns. Any experimentation with one strategy or another would ideally be conducted in similar ecosystems outside of a wilderness area. In all cases, collaborative planning with the public will be essential to the smooth transition from one step to the next.

Presentation Title: Collateral Damage: The Environmental Effects of the 2002 Biscuit Fire Suppression Actions

Presenter: ***Timothy Ingalsbee***
Firefighters United for Safety, Ethics, and Ecology
Eugene, Oregon, USA

Abstract: The past century's policy of fire exclusion has caused significant alteration of historic fire regimes and degradation of ecological integrity in many fire-adapted ecosystems. There is widespread awareness and criticism of the adverse ecological impacts of fire exclusion by fire management professionals, policymakers, and various conservation-minded publics. However, the adverse environmental impacts of fire suppression have largely escaped critique until recently. This paper presents analysis from a case study of the Biscuit fire suppression operations and their environmental effects. The 499,570 acre Biscuit Fire on the Siskiyou National Forest in Oregon was the largest wildfire in the U.S. in 2002. At a cost of over $155 million, it also became the world's most expensive wild land firefighting incident in history. Standard firefighting techniques of fire line construction, tree felling, retardant and water use, burnout and backfiring all caused significant environmental damage to sensitive sites, natural resources, and ecological values in the Biscuit fire area. A key area of emphasis will be a critical discussion of the role of firing operations in the spread and severity of the Biscuit fire. This is an issue of wider concern given an apparent increasing use of indirect attack and large-scale burnout on project fires, especially in road less wild lands. This paper argues that full analysis and disclosure of the direct, indirect, and cumulative environmental effects of wild land fire suppression actions will provide long-term benefits to fire management. It is hypothesized that an analysis comparing the effects of wildfire suppression actions to prescribed burning and wild land fire use actions would help build support among policymakers and the general public for proactive fuels management and wild land fire restoration as a means of avoiding the need for reactive wildfire suppression.

TRACK 4

Friday, November 17, 2006

Planning and Assessment

8:00 – 8:15	***Mike de Luz*** ***ESRI***	Applications of Geospatial Technology and Information in Fire Planning
8:15 – 8:30	***Reese Lolley*** ***The Nature Conservancy***	Tieton Forest Collaborative – Using Conservation Action Planning for Collaborative Fire and Restoration Planning
8:30 – 8:45	***David Schmidt*** ***USDA Forest Service***	Development and Use of Historic Reference Conditions for Planning and Restoration on the Tahoe National Forest
8:45 – 9:00	***Bruce Blackwell*** ***B.A. Blackwell and Associates***	Strategic Plan For The Use Of Prescribed Fire To Restore Ecosystems In The Okanagan Region
9:00 – 9:15	***Paul F. Hessburg*** ***USDA Forest Service***	Evaluating Wildland Fire Hazard and Prioritizing Vegetation and Fuels Treatments--A Multi-scale Decision Support System
9:15 – 9:30	***Steve Norman*** ***USDA Forest Service***	Probabilistic Modeling of Fire Regimes and Management Tradeoffs in the Klamath Mountains of California
9:30 – 9:45	***Thomas DeMeo*** ***USDA Forest Service***	Refining Fire Regime Condition Class Assessments
9:45 – 10:00	***Rachel Smith*** ***University of California - Berkeley***	Fires as a Global Conservation Issue.

Session Title: Planning and Assessment

Presentation Title: Applications of Geospatial Technology and Information in Fire Planning

Presenter:

Mike de Luz
ESRI
Broomfield, Colorado, USA

Abstract:

Planning is often viewed as an iterative process, dependant on relevant and timely information to provide decision support. Today, planning efforts need to consider various outputs and outcomes, often with multiple objectives and constraints. There is seemingly an endless demand for data and analysis, often in compressed time frames. More importantly, many planners and managers are working to resolve the dual objectives between planning for public safety versus restoring ecological process. It is in this setting, fire planners and managers find themselves faced with escalating complexity and a broader scope of demands and expectations. As members of a wider fire community they face a need for interagency consistency and collaborative approaches. Tools and advances in information technology provide abilities to synthesize, analyze, display and store information, on temporal and spatial scales. This presentation will highlight applications and examples in Geographical Information Systems (GIS). It will attempt to illustrate features that enhance user capabilities and accessibility to key information, incorporating current understanding of fire ecology and community planning. This paper will also explore the role of geospatial information in planning, modeling and references for improving fire planning capabilities. It will forecast some of the changes both in emerging technology as well as policy implications for those in the public sector.

Presentation Title: Tieton Forest Collaborative – Using Conservation Action Planning for Collaborative Fire and Restoration Planning

Presenter:

Reese Lolley
The Nature Conservancy
Yakima, Washington, USA

Abstract:

Conservation action planning (CAP) is an integrated process created by The Nature Conservancy (TNC) to help land managers develop and prioritize conservation strategies, evaluate alternative actions, and measure the impact of their work. Agencies, tribal and private groups working in Washington State's Tieton River landscape have found CAP to be an ideal framework to facilitate collaborative conservation, ecosystem restoration, and fire planning. A large block of private commercial timber land held in checkerboard pattern within the Naches Ranger District of the Okanogan and Wenatchee National Forest was put up for sale. TNC, working with agency, tribal and other non-profit partners, optioned the 10,400-acre property and raised enough public funds to transfer it to the Washington State Department of Fish and Wildlife. With the imminent threat of private development solved, the problem of multiple agency ownership and cross boundary management remained. There was an agreed upon need to collaborate to manage this fire-adapted landscape, and TNC offered the CAP framework to help partners develop shared objectives at a landscape level. A series of five informal, one-day facilitated workshops were conducted to walk the newly formed team through the process over nine months. One of the team's first steps was to list, characterize and gauge the health of four high-priority, ecosystem-level "conservation targets": the shrub steppe ecotone, white oak, dry forest, and stream systems. It became clear that fire was one of the forces that knitted all these systems together and, therefore, a top priority for the partnership. The members of the collaborative signed a formal memorandum of understanding (MOU) based on the results of the CAP process forming the Tieton Forest Collaborative. This MOU, the foundation built through the CAP process, and the ability to revise components of the CAP as additional knowledge is gained will facilitate cross-boundary work and help make the group's collective vision a reality.

Presentation Title: Development and Use of Historic Reference Conditions for Planning and Restoration on the Tahoe National Forest

Presenter: *David Schmidt*
USDA Forest Service
Davis, California, USA

Abstract: We have recognized the need to integrate broader scales of time and space into USFS Region 5 planning and implementation of fuels and wildland fire activities. The FRCC (fire regime condition class) process involves the use of state-and-transition ("S&T") models of historic disturbance regimes to generate reference conditions that may be compared to current conditions to derive measures of departure (including condition class). The process is based on successional stages that form the "states" within the S&T models and are defined by structural characteristics of the overstory vegetation. The modeled distribution of these seral stages on a landscape under the assumption of historic, pre fire-suppression conditions can be compared to the current distribution (derived from a vegetation map or from field estimates) and a departure statistic calculated. The original S&T models were necessarily simplistic; more recent modeling by the Region 5 Ecology Program and TNC represents considerable improvement and includes increased model complexity, climate forcing, fuels growth, better documentation, and validation. Although the FRCC process was originally developed to generate a simple categorical measure of condition class, its potential for analyzing the cumulative effects of wildfires and fuels treatments at the landscape scale quickly became apparent, particularly when integrated into the region's "Fireshed Assessment" process. We recently used our modified FRCC approach on the Tahoe National Forest to: (1) assess the impacts of wildfires - essentially large, unplanned fuels treatments - on serial stage distribution at the landscape scale and guide post fire restoration efforts and wild land fire use policies; and to (2) predict landscape-scale impacts on forest structure of fuels treatment plans. Given that reference conditions generated by our S&T models theoretically approximate average historic, pre fire-suppression conditions in the analyzed landscapes, we were able to determine guidelines for restoration of sustainable, fire-resilient vegetation conditions.

Co-Authors: *Hugh D. Safford - USDA Forest Service (lead author)*

Presentation Title: Strategic Plan For The Use Of Prescribed Fire To Restore Ecosystems In The Okanagan Region

Presenter: *Bruce Blackwell*
B. A. Blackwell and Associates
North Vancouver, British Columbia, Canada

Abstract: The Okanagan Region represents one of the most biologically diverse regions of British Columbia. Low levels of precipitation, hot summers and mild winters provide a wide range of habitat for species that are unique to both British Columbia and Canada. This biological diversity is under considerable stress from a number of related problems associated with human population growth. Specifically these problems can be summarized as follows: Fire suppression has resulted in a change in fire regime (fire frequency and severity) throughout the region. Increasing tree densities and the resultant competition for moisture and nutrients have negatively impacted large areas of open grassland and forest. These changes have impacted forest health throughout the region. _Habitats are shrinking, threatening and endangering many species. For example, only approximately 9% of the natural grasslands native to the region remain, due to roads, human development, and orchards. Introduction of exotic species threaten many of the native habitats. Overgrazing has also had a major impact on biodiversity by causing disturbance of soil and native vegetation, and by providing ideal conditions for the invasion and spread of exotic species. While fire suppression is but one of many problems impacting biodiversity and ecosystem health in the region, it probably represents the single most important and spatially extensive issue that managers have the potential to impact. This paper: 1) documents a rationale for prioritizing prescribed burning as a restoration tool within the region; 2) uses GIS inventories and analysis tools to implement the rationale and spatially identify burn priorities, and; 3) outlines a five year plan to initiate the implementation of the project. Prescribed burn priorities identified during a GIS analysis were field checked in several locations within the study area. For the most part, the results indicated that the algorithm developed to identify restoration priorities met the objectives of a coarse scale analysis. Overall, a total of more than 36,000 ha have been classified as high priority for prescribed burning to facilitate restoration. In addition to prescribed burn priority identification, the report addresses the development of a five-year burning plan, monitoring treated areas, and discusses treatment strategies.

Co-Authors: *R.W. Gray, R.W. Gray Consulting*

Presentation Title: Evaluating Wildland Fire Hazard and Prioritizing Vegetation and Fuels Treatments--A Multi-scale Decision Support System

Presenter: *Paul F. Hessburg*
USDA Forest Service
Wenatchee, Washington, USA

Abstract: Wild land fuels have been accumulating in many western U.S. forests for the past 70 to 100 years due to 20th century settlement and management activities, and changing climatic conditions. As demonstrated by recent wild land fires, these added fuels are fostering more intense wildfires that are more difficult to contain and control. Consequently, property and natural resources have been destroyed, costs of fire management have escalated, fire-dependent forest ecosystems have deteriorated, and risks to human life and property continue to escalate. We present a prototype decision support system for evaluating wild land fire hazard and prioritizing sub watersheds for vegetation and fuels treatment. In a logic model, we evaluate hazard as a function of three primary topics: fire vulnerability, wildfire severity, and risk of ignition. Each primary topic has secondary topics under which data are evaluated. The logic model shows the state of each evaluated landscape with respect to fire hazard. In a decision model, we place the summarized fire hazard conditions of each evaluated landscape in the context of the amount of associated wild land-urban interface (WUI). The logic and decision models are executed in EMDS, a decision support system that operates in ArcGIS. We show that a decision criterion such as relationship to WUI can significantly influence the outcome of a decision to determine treatment priorities. We demonstrate the use of the decision support system with an example from the Rocky Mountain region in the State of Utah, which represents a planning area of about 4.8 million ha and encompasses 575 complete sub watersheds. We discuss considerations for extending the application to support strategic planning at national and regional scales, and tactical planning at local scales.

Co-Authors: *Paul F. Hessburg, Keith M. Reynolds, Robert E. Keane, Kevin M. James, R. Brion Salter, USDA Forest Service*

Presentation Title: Probabilistic Modeling of Fire Regimes and Management Tradeoffs in the Klamath Mountains of California

Presenter: *Steve Norman*
USDA Forest Service
Arcata, California, USA

Abstract: Assessing the tradeoffs associated with fire and ecosystem management inevitably involves modeling patterns and processes that are imperfectly understood. Probabilistic modeling allows effects to be analyzed and displayed in terms of their conditional probabilities. We use such an approach to compare the probable outcomes of management alternatives relative to multiple objectives in the Hayfork Adaptive Management Area of northern California. Building on planning efforts of the Shasta-Trinity National Forest and a local community group, we defined spatially explicit objectives related to fire behavior, vegetation and wildlife. We then used GIS modeling and Bayesian Belief networks to integrate results from various process models. For example, we characterized likely fire behavior using multiple runs of Flammap; these results informed successional pathways leading to probable vegetation and habitat conditions. Although the exact consequences of proposed fire and fuel management projects or no-action alternatives can never be predicted with certainty, the probability of achieving a desirable or undesirable outcome can be formally described using our approach. By understanding the conditional nature of management outcomes, decision makers can make more informed decisions and be more prepared to respond adaptively when conditions change. We demonstrate how our approach integrates and contextualizes diverse stakeholder objectives, expectations and values.

Co-Authors: *Danny C. Lee, Christine Damiani, Sandra Jacobson - USDA Forest Service*

Presentation Title: Refining Fire Regime Condition Class Assessments

Presenter: *Thomas De Meo*
USDA Forest Service
Portland, Oregon, USA

Abstract: Fire regime condition class (FRCC) assessments are becoming a widely used measure of departure from reference conditions in the Federal fuels management community. Because FRCC is scale dependent, a careful selection of the appropriate scale is essential. Initial implementation of the national rapid assessment layers has indicated a need to compare them with local mapping and refine the assessment approach. In the northeast Oregon sub region, planners are intersecting vegetation and activity layers (wildfire, activity fuel, landscape burning) to calculate a watershed-level existing fire return interval for each biophysical setting. This data will be used to assess departure from reference conditions for fire freq/severity; and when combined with vegetation departure, will provide better condition class estimates. Results will also be used to fine-tune the probabilities used in the succession model (VDDT) defining the reference conditions.

Co-Authors: *Thomas DeMeo, Bruce Countryman, Jane Kertis, Dave Swanson, Dave Powell, USDA Forest Service, Steve Barrett, Consultant - Jeff Jones, National Interagency Fuels Technology*

Presentation Title: Fires as a Global Conservation Issue

Presenter: *Rachel Smith*
University of California - Berkeley
Berkeley, California, USA

Abstract: In 2004, a group of fire experts and policy-makers from around the world met in Switzerland to discuss the state of global fire regime conditions and biodiversity conservation. The results of this workshop, sponsored by the Global Fire Partnership (a collaboration between The Nature Conservancy (TNC), the World Conservation Union (IUCN), and the World Wide Fund for Nature (WWF)) represented the first coarse-scale assessment of the extent of fire's benefit or detriment to conserving biodiversity, and identified common sources of threats to maintaining ecologically-acceptable fire regime dynamics (TNC 2004). While the conclusion that conserving fire regimes is a global conservation issue might be unremarkable, the results of the preliminary assessment also indicated that growing number of threats to fire regime conservation and maintenance are the same around the world. More, these threats are effectively posing barriers to maintaining ecologically- and socially-acceptable fire regime dynamics at the global scale. Based on current global trends in fire regime conservation and management, and on results of the Preliminary Assessment of Fire as Global Conservation Issue (TNC 2004), TNC, IUCN, and the University of California, Berkeley have continued to survey hundreds of fire experts from around the world, review thousands of pieces of literature, and implement workshops of scientists, managers and policy-makers to: 1) refine the science of assessing global fire regime conditions, 2) seek common ground in goals for maintaining or restoring ecologically-acceptable fire regime conditions at national, regional and global levels, 3) identify opportunities to implement high-level strategies to achieve mutual goals, and 4) strengthen connections and partnerships between experts, managers and policy-makers with common interests. Preliminary results indicate that significant numbers of ecoregions critical to biodiversity conservation are at risk from altered fire regimes. This reinforces the urgency of accounting for fire regime dynamics when assessing threats to conserving biodiversity and developing socially acceptable and ecologically appropriate conservation strategies. In this paper, we will present results from this continuing assessment: *An ecologically-based framework for assessing fire regime conditions across ecoregions, nations, and major habitat types, *Common visions and priorities for conserving and managing fire regimes globally around which partners can collaborate on solutions, and *Examples of linkages between regional and global data and fire regime conservation and management efforts.

Co – Authors: *Ayn Shlisky, Ron Meyers, The Nature Conservancy - John Waugh, World Conservation Union - Scott Stephens, Max Moritz, University of California - Berkeley*

TRACK 5

Friday, November 17, 2006

Wildland Urban Interface

8:00 – 8:15	*CJ Fotheringham* *University of California – Los Angeles*	An Assessment of Fuel Management Options at the WUI
8:15 – 8:30	*Joseph Mitchell* *M-bar Technologies and Consulting*	Reducing Urban Interface Ecological Impacts And Fire Losses Through Structural Firebrand Protection
8:45 – 9:00	*Wayne Zipperer* *USDA Forest Service*	Fire Spread And Structural Ignitions From Horticultural Plantings In The Wildland-Urban Interface
8:45 – 9:00	*Wayne Zipperer* *USDA Forest Service*	Quantifying and Ranking the Flammability of Ornamental Shrubs in the Southern United States
9:00 – 9:15	*Chris Dicus* *Cal Poly State University* *San Luis Obispo, California, USA*	Essential Elements of Sustainable Fire Management in the Wildland - Urban Interface
9:15 – 9:30	*Kevin Fuhriman* *Chubb Personal Insurance* *Jim Sulentich* *Santa Lucia Conservancy* *Carol Rice* *Wildland Resource Management*	Partnerships Between Landowners and Insurance Industry for Ecologically-Sound, Fire Safe Conditions
9:30 – 9:45	*Mike da Luz* *ESRI* *Broomfield, Colorado, USA*	Collaborative Planning in the Wildland Urban Interface
9:45 – 10:00	*Yvonne Everett*	Community Response from the WUI: California Fire Safe Councils

Session Title: Wildland Urban Interface

Presentation Title: An Assessment of Fuel Management Options at the WUI

Presenter: *CJ Fotheringham*
University of California – Los Angeles
Sherman Oaks, California, USA

Abstract: On California chaparral landscapes, changing paradigms about fire management and more limited budgets has led to a greater focus of fuel manipulation treatments at the WUI and less on more remote locations. In these crown-fire ecosystems fuel modifications are in the form of either prescribed burns or mechanical clearing of brush. Concomitant with this shift is the recognition that no longer is the primary goal one of stopping wildland fires but rather to provide defensible space and reduce community vulnerability to wildland fires. In recent years both state and county codes have mandated greater fuel modification and enlarged zones around structures. However, standards vary between jurisdictions and it is unclear how the various standards are derived. In addition there is little information as to how effective these fuel modification zones are at decreasing fire hazard and to what extent they alter fuel structure in ways that increase risk of ignition, or what effect they have on sedimentation and resource degradation. In this talk we look fuel management options at the WUI with a focus toward cost/benefit analysis and trade-offs with other less tangible resources.

Co-Authors: *Marti Witter, Mediterranean Coast Network Santa Monica Mountains National/Channel Islands National Park/ Cabrillo National Monument - Jon E. Keeley, U.S. Geological Survey*

Presentation Title: Reducing Urban Interface Ecological Impacts and Fire Losses Through Structural Firebrand Protection

Presenter: *Joseph Mitchell*
M-bar Technologies and Consulting
Ramona, California, USA

Abstract: Increased survivability of WUI structures would reduce the economic and social impact of wildland fire, allowing ecological considerations to have a greater role in shaping fire policy. The vast majority of structures consumed by wildland fire in Southern California have been destroyed under high-wind conditions. Under such conditions, firebrand showers are intense, and a growing body of evidence indicates that a large fraction of destroyed structures are lost due to secondary ignition from firebrands rather than direct ignition from radiant heat. Despite scientific evidence to the contrary, insurers and some fire agencies are requiring "defensible space" (in the form of vegetation clearance) to extend out to 200 feet or more from the structure. This does little to protect against firebrand showers while significantly expanding the ecological footprint of human habitation. This presentation proposes a two-tier strategy for structural defense in the Wildland-Urban interface. Radiant heat load is well-managed by a reasonable "defensible-space" perimeter. However, a "firebrand-defense" strategy also needs to be implemented in order to achieve high survival rates for undefended structures. One method that satisfies many firebrand defense criteria is the "Wind-Enabled Ember Dousing System," a simple public-domain external water sprinkler system designed specifically for high-wind conditions. It was developed by the presenter and tested under actual wildland fire conditions.

Presentation Title: Fire Spread and Structural Ignitions from Horticultural Plantings in the Wildland-Urban Interface

Presenter: *Wayne Zipperer*
USDA Forest Service
Gainesville, Florida, USA

Abstract: A new study, currently in progress, measures the rate of spread and heat release for fires moving through four common southern mulches under natural conditions. The mulches are also combined with gall berry shrubs planted at several densities to determine how mulches contribute to shrub (and ultimately structure) ignitions. For each of the mulches and shrub/mulch combinations, several drying schedules will provide insight into the value of irrigation for reducing fire risk close to structures. Mulch and shrub flammability will be repeated under controlled conditions in a national fire lab and the results of both studies will provide important information for new models that will be used for predicting fire spread and structural ignitions in a variety of landscape conditions. Upon completion of this study, the knowledge gained about flammability characteristics of landscape plantings will help answer important questions such as: what are the flammability characteristics of plantings with different compositions and heights, how do drought and irrigation affect flammability characteristics, and what are the effects of planting designs on structural ignitions?

Co-Authors: *Alan Long, University of Florida - Annie Hermansen-Baez, USDA Forest Service*

Presentation Title: Quantifying and Ranking the Flammability of Ornamental Shrubs in the Southern United States

Presenter: *Wayne Zipperer*
USDA Forest Service
Gainesville, Florida, USA

Abstract: The shrub species used in home landscaping directly affect fire behavior and the risk of wildfire damage to the home. Long flame lengths and high energy release levels from densely planted or poorly maintained shrubs can easily spread fires into overstory pines or nearby structures. In order to provide better information for firewise plant lists for southern WUI landscapes and to improve WUI fire behavior modeling, this study investigated the flammability of thirty-four landscape shrubs commonly used in the South. Twenty-two shrub species were found to have low flammability characteristics. These shrubs can be safely planted within the home landscape and are appropriate for addition to firewise plant lists. The eight species found to be moderately flammable can also be planted in home landscapes; however, they should not be planted adjacent to structures and should be isolated vertically and horizontally from other plantings to reduce the potential for fire spread. Gallberry (Ilex glabra), yaupon holly (Ilex vomitoria), Chinese juniper (Juniperus chinensis), and mountain laurel (Kalmia latifolia) were found to be highly flammable and were ranked as inappropriate for use within 30 feet of the home. Because species within the same genus were found to vary in flammability, it is important for homeowners and landscapers not to substitute plants on firewise plant lists with other species in the same genus without verifying flammability characteristics of the substitute species. All shrubs within the home landscape should be routinely maintained by removing dead or diseased branches and foliage.

Co-Authors: *Alan Long, University of Florida - Annie Hermansen-Baez, USDA Forest Service*

Presentation Title: Essential Elements of Sustainable Fire Management in the Wildland - Urban Interface

Presenter: *Chris Dicus*
Cal Poly State University
San Luis Obispo, California, USA

Abstract: Fire and fuels management in the wildland-urban interface is a multifaceted aggregation of biophysical and sociopolitical components. To best insure sustainable communities in the wildland-urban interface, stakeholders from a diversity of disciplines and worldviews must collaborate to develop a management plan for a given area that minimizes fire risk while simultaneously maximizing the benefits that distinct vegetation types and structures provide. This paper discusses critical elements that must be considered in order to maintain sustainable communities in the wildland-urban interface. These factors include fuels treatments, suppression forces, enforceable infrastructure and construction standards, and community education, each of which will vary dependent on the ecosystem and socioeconomic conditions of a given area. Further, the effects of various fuels treatments are also explored in terms of tradeoffs between mitigating fire behavior versus the loss of multiple benefits that vegetation provides.

Presentation Title: Partnerships Between Landowners and Insurance Industry for Ecologically-Sound, Fire Safe Conditions

Presenter: *Kevin Fuhriman*
Chubb Personal Insurance
Jim Sulentich
Santa Lucia Conservancy
Carol Rice
Wildland Resource Management
California, USA

Abstract: The Santa Lucia Preserve is a 20,000-acre parcel where 300 estate homes have been approved within an overlay of conservation lands, creating a perpetual interface between structural and ecological values, both possibly threatened by wildfire. To address this concern, a comprehensive fuel management plan was prepared for the Preserve. This plan detailed actions to take surrounding structures as well as ways to protect the wildland from wildfire and/or enhance those areas with fuel treatments. Only a few insurance carriers were positioned to write policies to cover the large values at risk, and those carriers were hesitant to take on the potential risk from wildfire. There was real concern that this situation could slow construction pace and delay occupancy of some structures. Chubb Personal Insurance is one of those insurance carriers willing to write policies, but constrained by the real risk of loss from wildfire. The Santa Lucia Conservancy and Chubb representatives met to hear underwriting concerns. The Fuel Management Plan was revised to address these concerns. Factors that improved the risk in the eyes of Chubb include a site-wide fuel management plan to protect entirety of Preserve, preparing individual fuel management plans for every site based on a consistent set of standards, and that a Design Review Board ensures fire wise exteriors of the structures. The Conservancy also worked with insurance representatives to enhance fuel management aimed at structural protection to be more compatible with ecological functions, particularly in riparian areas, in closed oak canopy forests and, where in grasslands .By working together, the homeowners are able to procure insurance at a reasonable price, Chubb can write that business, and the Conservancy can use ecologically sensitive methods to protect the area from a devastating fire.

Presentation Title: Collaborative Planning in the Wildland Urban Interface

Presenter: *Mike da Luz*
ESRI
Broomfield, Colorado, USA

Abstract: Issues and impacts previously viewed as either urban or rural have merged as a result of increased urbanization. Increased expectations, conflicting values and lack of understanding have added to the complexity of land use and community sustainability. There is a growing need for coordinated planning and understanding of impacts, mitigation and resource management for affected communities. This presentation focuses on incorporating current understanding of fire ecology and emergency preparedness into community planning. The presentation attempts to illustrate the magnitude of the issues and offers insights into several examples in the use of GIS to address the issue.

Presentation Title: Community Response from the WUI: California Fire Safe Councils

Presenter: *Yvonne Everett*
Humboldt State University
Arcata, California, USA

Abstract: There are over 100 Fire Safe Councils in California ranging from neighborhood homeowner groups to county level associations of fire service professionals, from rural councils focused on fuels treatments to urban groups working on public education. The groups have in common their voluntary membership and their focus on reducing wildfire in the Wildland Urban Interface. The first FSCs emerged in the mid-1990 with the founding of the California State Fire Safe Council umbrella organization. Many local, state and federal fire professionals are enthusiastic about FSCs as mechanisms for public outreach and education. In this paper we report on survey research undertaken to characterize the California FSCs and their accomplishments. We discuss what the FSCs are achieving and how much are they costing. We address the degree to which FSCs are a bridge between fire fighters and the general public.

TRACK 7

Friday, November 17, 2006

Fuels Treatment Effects on Fire Behavior

8:00 – 8:15	***Tim Bradley*** ***USDI National Park Service***	The Utilization of Burn Severity Maps of Prescribed Fires for Determination of Potential Post-Treatment Fire Behavior Changes in Mixed Shrub Woodlands of Northern California.
8:15 – 8:30	***Anthony Bova*** ***USDA Forest Service***	Beyond 'Fire Temperatures': Calibrating Thermocouple Probes to Estimate Surface Fire Characteristics
8:30 - 8:45	***Eric Knapp*** ***USDA Forest Service***	Behavior and Short-Term Effects of Fire in Masticated Fuel Beds
8:45 – 9:00	***Craig D. Kostrzewski*** ***The Nature Conservancy***	Effects of Single-Season Mechanical and Prescribed Fire Treatments in Restoring Inland Pitch Pine Scrub Oak Barrens.
9:00 – 9:15	***Erin Noonan*** ***USDA Forest Service***	Computing Canopy Fuels and the Prediction of Crown Fire Using Data from Region 5 Prescribed Fire Effects and Effectiveness Monitoring Program
9:15 – 9:30	***Glenn Mason*** ***New Mexico State University***	Crown Fire Potential in Mixed Conifer Wildland Urban Interface Fuel Treatments in the Lincoln National Forest, New Mexico
9:30 – 9:45	***David A. Schmidt*** ***The Nature Conservancy and USDA Forest Service***	The Influence of Fuel Treatments and Landscape Arrangement on Simulated Fire Behavior, Goosenest Adaptive Management Area, Klamath National Forest, California
9:45 – 10:00	***Reese Lolley*** ***The Nature Conservancy***	Effects of Modeled Fuel Treatments on Potential Wildland Fire Behavior and Severity in Dry Forests of the Wenatchee Mountains

Session Title: Fuels Treatment Effects on Fire Behavior

Presentation Title: The Utilization of Burn Severity Maps of Prescribed Fires for Determination of Potential Post-Treatment Fire Behavior Changes in Mixed Shrub Woodlands of Northern California.

Presenter: *Tim Bradley*
USDI National Park Service
Whiskeytown, California, USA

Abstract: During recent years Whiskeytown National Recreation Area has developed an ambitious fuels management program, with treatment averages over the past four years that have exceeded 2,000 total acres. While park goals and broader guiding policy clearly identify a need to monitor and evaluate these treatments, the diverse landscape, broad prescription windows and variable effects of treatments pose challenges for an effective monitoring program. One tool that has been recently applied for the evaluation of prescribed fires at Whiskeytown and many other public land management agencies have been fire severity maps. Burn Severity Maps, derived from Landsat imagery and produced by USGS analysts, are now a standard monitoring tool utilized by NPS units for the evaluation of prescribed fire treatments. While developed for application to landscapes in the Northern Rockies, the methods have proven to be a valuable tool for recording burn heterogeneity within the complex shrub, oak woodlands and pine forests at Whiskeytown. To date, a total of five different prescribed fires have been mapped, with three more planned during the current year. Field based data has been compared with satellite severity scores, showing a correlation (r^2) that has ranged between 0.59 and 0.82 for the different burns, with an r^2 of over 90 for moderate to high severity delineated pixels. Severity patterns are most strongly associated with slope position, aspect and distance from control line. This paper reviews the accuracy of the produced burn severity maps, summary of severity patterns as a function of topographic location, the application of severity maps for the creation of a living fuels map and modeling comparisons for assessing effectiveness of fire risk reduction within treated landscapes

Co-Authors: *Jim Hutton, USDI National Park Service*

Presentation Title: Beyond 'Fire Temperatures': Calibrating Thermocouple Probes to Estimate Surface Fire Characteristics

Presenter: *Anthony Bova*
USDA Forest Service
Delaware, Ohio, USA

Abstract: The maximum temperatures of thermocouples and temperature-sensitive paints exposed to flames in wildland fires are often called 'fire temperatures' but are determined as much by the properties and position of the measurement devices in the fires as by the fires themselves. These temperatures have no process-based relationship with fire effects and are not comparable among studies if the devices or their deployment differ. Rather than report device temperatures, it is preferable to calibrate the response of measurement devices to provide estimates of commonly used fire characteristics. Data from 44 experimental small-plot surface fires suggest that thermocouple probes can be calibrated to estimate fire line intensity and total heat output from combustion in prescribed burns. Fuel beds were composed of dead fuel elements of a range of materials, including hardwood litter, arranged on the forest floor.

Co-Authors: *Matthew Dickinson, USDA Forest Service*

Presentation Title: Behavior and Short-Term Effects of Fire in Masticated Fuel Beds

Presenter: *Eric Knapp*
USDA Forest Service
Redding, California, USA

Abstract: Shrubs and small trees that have grown since harvest or other disturbances present a fuel management challenge in many areas in the western US. Mechanically treating these ladder fuels by mastication is increasingly used to reduce fire hazard. While surface fuel loading after mastication is often considerable, compactness of the fuel bed may moderate fire activity. The objective of this research was to provide managers with tools for modeling fire behavior and predicting fire effects. Four 0.4ha plots consisting of needle-draped brush under a canopy of young ponderosa pine trees were masticated at Challenge Experimental Forest in northern California. After quantifying the fuel load, plots were burned under prescription conditions. Flame length and rate of spread were estimated for head fires and backing fires. Fuels were raked 0.5m from the base of a randomly selected subset of trees prior to the burns in order to separate mortality as a result of bole damage from mortality caused by crown scorch. Fuel loading averaged 89.6 Mt/ha prior to the burns, with fine fuels (<2.54cm diameter) comprising more than half of the woody fuel load. The fuel bed was compact, with depth averaging 0.13m. Flame length and rate of spread were adequately predicted with BehavePlus, employing several standard fuel models. However, measured scorch heights (ave. = 9.8m) were substantially greater than predicted. As a result of high moisture levels, heat penetration into the soil was minimal, with only 2% of thermocouples experiencing >60oC at 5cm depth. Tree mortality one year post-burn appeared to be primarily due to crown scorch. While mastication may moderate fire intensity, the long residence time and the high heat content of woody shrub fuels can still lead to substantial tree mortality if prescribed burning is not done with care commensurate with the size of the residual trees.

Co-Authors: *Matt Busse, Carl Skinner, Robert Powers – USDA Forest Service*

Presentation Title: Effects Of Single-Season Mechanical And Prescribed Fire Treatments In Restoring Inland Pitch Pine Scrub Oak Barrens.

Presenter: *Craig Kostrzewski*
The Nature Conservancy
Albany, New York, USA

Abstract: Pitch pine scrub oak barrens represent one of the most volatile wildland fuel types in the Northeastern United states. The 3,010-acre Albany Pine Bush Preserve contains one of the best remaining examples of an inland pitch pine scrub oak barrens (PPSOB) and more than 19 globally rare plant and animal species, including the federally endangered Karner blue butterfly (Lycaeides melissa samuelis). The Albany Pine Bush Preserve Commission (APBPC) and The Nature Conservancy (TNC) initiated prescribed fire management in 1991. Between 1991 and 2002, 700 acres of fire suppressed PPSOB have been managed with prescribed fire with varied success. During this time fire management focused primarily on dormant season burning. Single growing-season mechanical and prescribed fire treatments were initiated in 2003 on 8 acres. The treated area contained pitch pine scrub oak thicket and was mechanically treated in June 2003. Prescribed fire was applied to four of the eight acres in July 2003, and produced relatively slow but intense fire behavior. 30 1m2 quadrats were monitored along a single transect bisecting each treatment area. Results show that litter and duff was completely consumed in the combined treatment area with 20% mean mineral soil exposure in the burned area one year later. Median litter and duff depth in the four acres mechanically treated was 3.1cm and 1.2cm, respectively. To date, 239 acres of the Preserve received the single growing-season mechanical and fire treatments. Logistically, these fires have proven more manageable than dormant season fires in the same fuels, with monitoring results demonstrating treatment efficacy in meeting fire management and ecosystem restoration objectives. Treated areas are also providing TNC and APBPC with conditions favorable for planting the obligate larval host plant for the Karner blue butterfly, wild blue lupine (Lupinus perennis) and are facilitating endangered species recovery in the Preserve.

Co-Authors: *Neil Gifford, The Nature Conservancy - G. Thomas Dooley, The Nature Conservancy*

Presentation Title: Computing Canopy Fuels and the Prediction of Crown Fire Using Data from Region 5 Prescribed Fire Effects and Effectiveness Monitoring Program

Presenter: *Erin Noonan*
USDA Forest Service
Nevada City, California, USA

Abstract: The calculation of canopy fuel loading such as canopy base height (CBH) and canopy bulk density (CBD) is necessary to model crown fire behavior. The accuracy of these input values is important in determining the predicted crown fire initiation, fire type (surface, passive or crown) and is used for fuels and fire behavior prediction and planning. Crown fuels are estimated using allometric equations based on tree diameter and species. This approach is not sensitive to changes in crown fuels from pruning, either from crown scorch or other means. This is especially important for monitoring effectiveness of fuel treatments. We compared two different approaches of estimating crown fuels with monitoring data that includes pre- and post-treatment conditions. The first approach utilized the allometric equations. The second approach utilized a proportional reduction in individual crown fuel loading from the allometric equations based upon measured changes in canopy base height from treatment. We used the USFS Prescribed Fire Effects and Effectiveness Monitoring dataset for California, which includes 90 plots. Canopy fuel loading was calculated using an adaptation of FVS-FFE for California, called JAFDP, which includes allometric equations for California hardwoods. Canopy fire behavior was simulated in NEXUS and the variability of canopy fire behavior outputs, such as torching and crowning indices, given the different methods of computing canopy fuel loading were compared. Understanding the effect of different methods used to calculate canopy fuel loading is important to successful interpretation of modeled outputs from fire behavior models.

Co-Authors: *JoAnn Fites, USDA Forest Service*

Presentation Title: Crown Fire Potential in Mixed Conifer Wildland Urban Interface Fuel Treatments in the Lincoln National Forest, NM

Presenter: *Glenn Mason*
New Mexico State University
Las Cruces, New Mexico, USA

Abstract: Under the Healthy Forest Restoration Act, management agencies now have the framework established to implement broad scale fuel reduction programs. The ability of these treatments to mitigate severe fire behavior in dry mixed conifer forests is of particular interest to land managers, private landowners, and the public. To test treatment effectiveness we compared fuel loads and indices of crown fire potential in treated and untreated mixed conifer stands at three sites on the Lincoln National Forest in New Mexico. We hypothesized crown fire potential would be lowest in the commercial treatment followed by the non-commercial pile, non-commercial scatter, and untreated control treatments. To assess surface fuels we measured woody stem density, herbaceous biomass, litter mass, and dead and down fuels. Canopy fuels were calculated using the Fire and Fuels Extension of the Forest Vegetation Simulator. Crown fire potential was assessed using custom fuel models and very low fuel moistures scenarios in NEXUS 2.0. Results indicated herbaceous fuel loads were unchanged compared to controls 2 years post non-commercial and 1 year post commercial harvest treatment. Thousand-hour fuels were greater in all harvest treatments, with the most notable increase in the scatter treatment. Canopy base height increased in all treatments, with one exception. Commercial harvesting was the only treatment to consistently reduce canopy bulk density and crown fire potential, with the exception of the pile treatment. Based on these results, the observed non-commercial treatments appear to have failed to meet the management objective of decreasing crown fire potential. Prescribed fire may be used to further reduce fuels to meet specified torching indices in non-commercial treatments. However, due to the danger of crown fire initiation from adjacent stands, further overstory removal is needed to lower the crowning index. Future treatments should be designed so both the torching and crowning indices meet predetermined objectives.

Co-Authors: *Terrell T. Baker, Douglas S. Cram, Jon C. Boren, Sam Fernald, Dawn VanLeeuwen, New Mexico State University*

Presentation Title: The Influence of Fuel Treatments and Landscape Arrangement on Simulated Fire Behavior, Goosenest Adaptive Management Area, Klamath National Forest, California

Presenter: ***David A. Schmidt***
The Nature Conservancy and USDA Forest Service
Davis, California, USA

Abstract: Wildfire behavior can be modified by treating fuels with silvicultural prescriptions and/or prescribed burning. Studies have shown that the arrangement, type, and landscape location of fuel treatments are all individually important influences on wildfire behavior. This study analyzed the effectiveness of combinations of fuel treatment arrangement, type, and landscape location on simulated wildfires in the Goosenest Adaptive Management Area (GAMA) of the Klamath National Forest. Pre- and post-treatment fuel measurements were used to determine appropriate fuel models as input to several fire behavior models. BehavePlus was used to compare pre- and post-treatment stand-scale fire behavior (e.g., flame length and rate of spread). FlamMap was used to map potential landscape-scale fire behavior and guide the layout of theoretical fuel treatments. We used FARSITE (Fire Area Simulator) to simulate these fuel treatment scenarios by modeling wildfires burning through areas of the GAMA that contained both unmodified, natural vegetation, and the simulated treatment scenarios. Treatments were arranged as SPLATs (strategically placed area treatments) to maximize control over fire behavior while minimizing total area treated. The types of treatment compared were prescribed burning, thinning, both burning and thinning, and no treatment. Finally, the landscape location of the fuel treatments was addressed by placing simulated treatments on the GAMA landscape using defensible fuel profile zone (DFPZ) guidelines for treatment width, intensity, and location (i.e., ridgelines). The scenarios were created using GIS software and then evaluated for mitigation effect on the simulated fires' area and behavior under several fire weather conditions. At the stand-scale we found that the prescribed fire treatments were most effective in reducing surface fire behavior while the thinning treatments were most effective in reducing crown fire potential. At the landscape-scale, we found that the type of treatment was less important that the amount and arrangement of the fuel treatments

Co-Authors: ***Carl N. Skinner, USDA Forest Service – Alan H. Taylor, The Pennsylvania State University***

Presentation Title: Effects of Modeled Fuel Treatments on Potential Wildland Fire Behavior and Severity in Dry Forests of the Wenatchee Mountains

Presenter: *Reese Lolley*
The Nature Conservancy
Yakima, Washington, USA

Abstract: A pressing issue in fire management is understanding the immediate and long-term effects of fuel treatments on wildland fire behavior and severity in dry forests. Intensive fuels data were collected as part of the pre-assessment for the Fire and Fire Surrogate Treatments Study at the Mission Creek site in the Wenatchee Mountains of Washington State. A subset of data are used to model the effect of four fuel treatment scenarios (control, intermediate-thin, prescribed-fire, and combination) on the fuel array and potential short and long-term effects on wildland fire behavior and severity using the Forest Vegetation Simulator and Fire and Fuels Extension model (FVS-FFE). Intermediate-thin had a short-term effect of reducing flame length (FL) and associated mortality but may be an artifact of FFE fuel model selection. The failure to increase canopy base height (CBH) while simultaneously reducing canopy cover (CC) appears to reduce the effectiveness over time. The prescribed-fire treatment effectively increased CBH while maintaining greater CC resulting in lower mid-flame windspeeds and therefore having the greatest overall reduction of FL and severity over time. When fire weather was increased to 90 percentile plus conditions, treatment effectiveness in reducing severity was minimal under one set of fuel conditions, and treatments actually increased the level of severity under the second set of fuel conditions. Combined treatment was effective at increasing CBH overall, but increased mid-flame windspeeds, increasing FL and severity. The treatment was effective, but results were more erratic over the longer time period modeled. The combined treatment had the greatest effect on reducing crown fire hazard; however, it was low to start. Results indicate that the treatment of fuels can affect fire behavior and severity outcomes. However, the types of treatments have the potential to either increase or decrease intensity and severity depending on existing conditions of the vegetation fuel profile, design of prescriptions, fire weather extremes and time frames considered.

TRACK 8

Friday, November 17, 2006

Postfire Rehabilitation – Part Two

8:00 – 8:15	***Joe Wagenbrenner*** ***USDA Forest Service***	Watershed-scale post-fire treatment effects on runoff and erosion after the Hayman Fire, Colorado
8:15 – 8:30	***Pete Robichaud*** ***USDA Forest Service***	Evaluating post-fire treatment effectiveness and recovery at the hillslope scale, Hayman Fire, Colorado
8:30 – 8:45	~~***Todd Caplan***~~ ~~***Parametrix***~~	The Relative Contribution Of Four Aerially Seeded Species On Vegetation Recovery Following The Paradise Fire
8:45 – 9:00	***Troy Wirth*** ***U.S. Geological Survey***	Monitoring Post-fire Rehabilitation Projects: Testing a Common Strategy in Non-forested Ecosystems
9:00 – 9:15	***Joe Sabel*** ***ENCAP***	Integrated Vegetation Management for Post Fire and Erosion Control Programs
9:15 – 9:30	***Kristine Lee*** ***University of Montana***	Initial Effects of Post-Fire Salvage Logging on Plant Communities in the Northern Rocky Mountains
9:30 – 9:45	***James McIver*** ***Oregon State University***	Postfire Logging as a Fuel Reduction Strategy

Session Title: Postfire Rehabilitation and Management, Part Two

Presentation Title: Watershed-Scale Post-Fire Treatment Effects on Runoff and Erosion After the Hayman Fire, Colorado

Presenter: ***Joe Wagenbrenner***
USDA Forest Service
Moscow, Idaho, USA

Abstract: Wildfires can cause large increases in erosion and runoff. Rehabilitation treatments are applied to
mitigate these effects, but their effectiveness is not well documented. A paired watershed study was
implemented after the 2002 Hayman Fire to measure the effectiveness of three post-fire rehabilitation treatments (contour-felled logs, straw mulch, and hydromulch) and determine natural recovery rates.
Five burned watersheds (3-5 ha) were outfitted in 2002 to measure rainfall, runoff, and sediment delivery. Runoff in the controls was between 2 mm and 18 mm in 2003-2004, and between 0 and 0.8 mm in 2005. The maximum peak flow was 7.1 $m^3 s^{-1} km^{-2}$, and averaged 2.2 $m^3 s^{-1} km^{-2}$. In the first two years after burning, sediment yields from the two control watersheds were between 7 and 39 $Mg\ ha^{-1}$. In 2005, only one storm produced sediment, and the sediment yield in the control watershed was 5.1 $Mg\ ha^{-1}$. The treated watersheds generally produced lower peak flows, less runoff, and less sediment than the controls except for the hydromulch watershed, where these responses sometimes were greater than in the control watershed. Vegetative cover increased significantly between 2002 and 2005 but there were no differences among treatments until 2005 when the straw mulch watershed had greater cover. Although the treated watersheds generally had less runoff, peak flow and sediment yields than the controls, the differences between the treated responses and the control responses were smaller during storms with high intensity rainfall. This data suggests that contour-felled logging and straw mulch may reduce the post-fire erosion and runoff responses for low intensity rainfall events, but none of the treatments tested were effective at fully protecting burned hill slopes from the effects of high intensity rain events.

Co-Authors: ***P. Robichaud, USDA Forest Service***

Presentation Title: Evaluating Post-Fire treatment Effectiveness and Recovery at the Hillslope Scale, Hayman Fire, Colorado

Presenter: *Pete Robichaud*
USDA Forest Service
Moscow, Idaho, USA

Abstract: Post-fire rehabilitation treatments are commonly used, but few data are available on their efficacy. We compared runoff rates, sediment concentrations, and sediment yields among three treatments (wood straw, straw mulch, and contour raking) and untreated controls. Simulated rill experiments were conducted on 64 hillslope plots (30 m^2) and sediment fences were installed on 32 of these plots immediately after the 2002 Hayman Fire. Rill experiments were repeated in 2003-2006 in the 16 controls to determine natural recovery rates. The runoff in the control plots averaged 70% of the inflow rates in 2002, and only the straw mulch (48%) and wood straw (49%) were significantly lower. There was a decline in runoff rates in 2003 (33%) and again in 2005 (6%), but not in 2004 (36%). In 2002 the mean sediment concentration in the control plots was 29 g L^{-1}, and only the wood straw (8.5 g L^{-1}) and the straw mulch (9 g L^{-1}) produced less sediment. The sediment concentrations did not change significantly until 2005, when the mean was 5.1 g L^{-1}, or 18% of the first experiments. The annual erosion rates in the control plots were 22 Mg ha^{-1} in 2003, 3.5 Mg ha^{-1} in 2004, and 0.1 Mg ha^{-1} in 2005. The treated plots generally produced less sediment than the controls, but the differences were only significant for the wood straw plots in 2003 (4.6 Mg ha^{-1}) and the wood straw (0.6 Mg ha^{-1}) and straw mulch (2.1 Mg ha^{-1}) plots in 2004. Compared to the controls, the wood straw plots had more ground cover each year and the straw mulch plots had more ground cover in 2002 and 2003, and the greater amount of cover was related to the lower sediment yields. There were no measurable differences in these effects between the raked and control plots.

Presentation Title: The Relative Contribution Of Four Aerially Seeded Species On Vegetation Recovery Following the Paradise Fire

Presenter: ~~*Todd Caplan*~~
~~*Parametrix*~~
~~*Albuquerque, New Mexico, USA*~~

Abstract: Aerial applications of grass seed to burned hill slopes is one of the most common emergency hill slope treatments used by the federal Burned Area Emergency Response (BAER) program. Following the Paradise Fire of October 2003, an interagency BAER team recommended seeding 4 native plant species to a 2,522-acre (1,021 hectare) tract of land managed by the Bureau of Land Management to establish native vegetation and to suppress encroachment by nonnative plant species. We monitored 17 plots across the project site to evaluate the relative contribution of aerially seeded plant species to vegetation density and cover. Data analyses indicate that mean plant densities in all sample strata exceeded the BAER goal of 3-5 plants/ft² (32.29-53.82 plants/m²), and that this goal was met by the seeded grass Vulpia microstachys in both the chaparral and live-oak woodland strata. However, our results also indicate that this density goal was met by non-seeded plant species in all strata. Annual forbs contributed most to plant species richness and most native shrub species recorded in plots were either facultative or obligate root-sprouts rather than obligate seeding species. Nonnative plants composed 14% of the 138 plant species recorded in our plots, although none of these species are considered noxious by the state of California. The high cover and density of non-seeded plant species demonstrate that aerial seeding was unnecessary to jumpstart native plant recovery. It is not possible to know if seeding suppressed nonnative plant species because there was no control (unseeded) plots. However, the seeded grass V. microstachys composed approximately 32%-40% of the mean vegetation density in the chaparral and live-oak woodland strata, and this increase could result in an increased fire return interval with negative ecological implications to succession of the native vegetation community.

Co-Authors: *Lucinda Tear, Fred Sproul, Parametrix*

Presentation Title: Monitoring Post-fire Rehabilitation Projects: Testing a Common Strategy in Non-forested Ecosystems

Presenter: *Troy Wirth*
U.S. Geological Survey
Corvallis, Oregon, USA

Abstract: The federal government expends significant resources implementing ES&R and BAER treatments after wildfires; however, recent reviews have found that existing data from monitoring and research is insufficient to evaluate the effects of these activities both locally and regionally. The objective of this study is to evaluate the feasibility of a common monitoring approach to determine the effectiveness of post-fire seedings in sagebrush plant communities. Seven vegetation monitoring manuals were reviewed and six monitoring program design elements were identified as important for wildfire stabilization and rehabilitation monitoring. These design elements were objectives, stratification, control areas, random sampling, sample adequacy, and statistical analysis. These elements should enable determination of ES&R treatment success on a landscape scale when quantitative data are collected using objective, repeatable methods. Using these design elements, several fires were monitored in eastern Oregon and southern Idaho. Quantitative measurements made on the ground were point cover, density, basal gap, and a direct measurement of soil erosion using silt fences. Observers using tablet PC's collected data in 2005 and 2006. Inter-observer variation was also tracked between three teams of trained observers in 2006. We found the variability associated with landscape scale monitoring was significant, but determinations of treatment success could be made in most cases. Sample adequacy was achieved in most cases by grouping plants into important life forms. In combination with this approach we are developing a central web-based database that can be used to assess ES&R treatment effectiveness on an ecoregion level. Using this common monitoring program design with comparable methods, consistently documenting results, and creating and maintaining a central database for query and reporting, managers will ultimately determine the effectiveness of post-fire rehabilitation activities on local projects and region-wide. Additionally, these data can be used to aid adaptive management by informing decision-makers of effective treatments for future ES&R treatments.

Co-Authors: *David A. Pyke, U.S. Geological Survey*

Presentation Abstract: Integrated Vegetation Management for Post Fire and Erosion Control Programs

Presenter: *Joe Sabel*
ENCAP
Green Bay, Wisconsin, USA

Abstract: ENCAP has patented a carrier technology that makes the application of water-soluble polyacrylamides (WSPAMs) polymers so much easier and effective. ENCAP takes in a byproduct of recycled paper, makes it into spreadable mulch that contains water-soluble polyacrylamides (WSPAMs), making easier to cover large areas with small amount of water-soluble polymers ready to be release when in contact with rainwater, or melting snow. ENCAP's technology has been proven to reduce erosion, increase water infiltration and retention, reduce soil crusting, and increase seed germination. In addition, because of ENCAP's unique manufacturing process of its mulches, seed can be combined with the mulch to take two applications down to one if desired saving time and money. At the Unita National Forest in Provo, UT, the United States Forest Service used ENCAP's mulches (specifically PAM-12) to rehabilitate a forest after a devastating fire went through and compared them with current practices i.e. straw. The results were phenomenal. PAM-12 proved to be more effective than straw in reducing erosion, improving the hydrophobisity of the soil, and improving seed germination.

Co-Authors: *Aicardo Roa, University of Wisconsin - Madison*

Presentation Title: Initial Effects of Post-Fire Salvage Logging on Plant Communities in the Northern Rocky Mountains

Presenter: *Kristine Lee*
University of Montana
Missoula, Montana, USA

Effects of salvage logging on vegetation and forest regeneration were evaluated in five study areas scattered across the northern Rocky Mountains from near Yellowstone to the Idaho Panhandle. A broad range of logging intensities and techniques were sampled with paired burned, unlogged controls. Four of the sites burned in 2003 and one site was burned in 1991. All sites were salvage logged within two years after being burned. Sampling occurred on four sites within the first one to to years after treatment and on one site (1991) a decade after treatment. Logging generally resulted in initial decreases in plant diversity within the first one to two years after treatment. The greatest number and cover of exotic plant species occurred in the area of the most intense site disturbance. Not all areas showed a difference in exotic species invasion when comparing logged and unlogged sites. Tree regeneration was significant on all sites. There did not appear to be a strong effect of logging on tree seedling cover, with equal or greater cover on logged versus unlogged sites. Preliminary results suggest a variable effect of salvage logging on plant community composition, depending on how salvage logging is implemented. This conclusion underscores the importance of clearly quantifying and qualifying the exact nature of a salvage logging operation, and considering pre-burn conditions.

Co-Authors: *Paul B. Alaback, University of Montana*

Presentation Title: Postfire Logging as a Fuel Reduction Strategy

Presenter: *James McIver*
Oregon State University
Union, Oregon, USA

Abstract: Stand structure and fuel mass were measured before and after post-fire logging two years after the 1996 Summit Wildfire, in a ponderosa pine-dominated forest in northeastern Oregon. Variables were measured in four replicate units for each of three treatments [unlogged control, commercial harvest (most dead merchantable trees removed), fuel reduction harvest (most dead merchantable trees removed plus most dead trees > 10 cm diameter)]. Post-fire logging resulted in significant decreases in basal area, tree density, and snag density is both types of logged units, compared to unlogged controls. Total woody fuel mass increased significantly in fuel reduction units when compared to controls, especially for the slash fuel component. Model projections of the fuel bed using FVS-FFE indicate that the disparity in slash fuel mass between logged and unlogged units would be sustained until about 15 years post-logging, but a reburn of moderate severity occurring during this time would likely kill all young trees, even in unlogged units, because of the influence of other components of the fuel bed. Model projections of 1000-hr fuels indicate that standing structure in all stands would collapse quickly, with the result that unlogged stands would contain two- or three-fold greater masses at 25 and 50 years post-logging, leading to higher consumption rates of fuel in the event of a reburn in the same place. Despite treatment differences in heavy fuel accumulations over time, FVS-FFE predicts no differences among treatments in mortality of young trees due to either moderate or severe fire occurring in the same place at 25 or 50 years post-fire logging. The lack of a reburn effect is in part due to the reliance on flame length (rather than root burning or cambial heating) as the primary mechanism leading to tree death in the fire effect models used by FVS-FFE.

Co – Authors: *Roger Ottmar, USDA Forest Service*

TRACK 10

Friday, November 17, 2006

Invasive Plants

8:00 – 8:15	***Kristen Kaczynski*** ***University of Colorado - Boulder***	Non – Native Plants in Burned Areas as a Function of Burn Severity: A Model for Early Detection Monitoring
8:15 – 8:30	***Steve Sutherland*** ***USDA Forest Service***	Post-fire Patterns of Weed Response in the Northern Rockies
8:30 – 8:45	***Robert Gray*** ***R.W. Gray Consulting***	Invasive Species Diversity and Abundance Trends on Ecosystem Restoration Units in the Wet/Warm Interior Douglas-fir Forests of Southwestern BC
8:45 – 9:00	***Cassie Hebel*** ***Oregon State University***	Interactions between Soil Microbial Communities and Native and Non-Native Invasive Plant Species after Wildfire in the Cascade Range of Oregon
9:00 – 9:15	***Jennifer Potts*** ***University of California - Berkeley***	Nonnative Plant Response to Prescribed Fire and Mechanical Cutting in California Chaparral
9:15 – 9:30	***Peter Rice*** ***University of Montana***	Grassland Plant Community Response to Herbicide Spraying, Prescribed Burning, and Spray and Burn Combination Treatments
9:30 – 9:45	***Bridget Lair*** ***U.S. Geological Survey***	Evaluating Postfire Seeding Treatments to Suppress Cheatgrass (Bromus Tectorum) in Pondersosa Pine Forests on the Shivwits Plateau

Presentation Title: Non – Native Plants in Burned Areas as a Function of Burn Severity: A Model for Early Detection Monitoring

Presenter: *Kristen Kaczynski*
University of Colorado – Boulder
Boulder, Colorado, USA

Abstract: With the potential for aggressive non-native species invasion of disturbed areas after fire, natural forest and woodland recovery may be impaired. Knowing the interaction between non-native species colonization and disturbance dynamics can be an important management tool. This research assesses the degree to which non-native species have colonized burned areas in the wilderness of Yosemite National Park, and what relationship exists between fire severity and invasion. Preliminary work has shown that non-natives do invade these remote areas in Yosemite National Park after fires, but the extent and dynamics of their colonization is unknown. In a managed wildland fire site, which burned during the summer of 2003, sample sites were located using the USGS Burn Severity Map for Yosemite National Park. Sites were randomly chosen in each of the four burn severity levels – unburned, low severity, moderate severity, and high severity. All vascular plant species were sampled in 2006 using modified Whittaker plots for plant cover surveying. Other site data, such as forest density, forest community type, fire severity level, slope and aspect, were also recorded. Analysis of variance and covariance were used to identify correlations between invasion and site factors. Preliminary results suggest a focus on high priority non-native species, such as Cirsium vulgare, Bromus tectorum, and Verbascum thapsus, will be most useful as a predictive management tool.

Co-Authors: *Susan Beatty, University of Colorado - Jan van Wagtendonk, U.S. Geological Survey*

Presentation Title: Post-fire patterns of weed response in the northern Rockies

Presenter: *Steve Sutherland*
USDA Forest Service
Missoula, Montana, USA

Abstract: To test the hypothesis that wildfire promotes weed colonization and expansion, I examined all exotic weeds, all invasive weeds, all noxious weeds, common mullein (Verbascum thapsus), cheatgrass (Bromus tectorum), Canada thistle (Cirsium arvense), bull thistle (Cirsium vulgare), and spotted knapweed (Centaurea maculosa) on 63 burned and 24 unburned plots one and three years after the wildfires of 2000 in western Montana. There was significant colonization of weed-free burned plots by exotic weeds, invasive weeds, and noxious weeds in general; and common mullein, cheatgrass, Canada thistle, bull thistle, and spotted knapweed in particular between 2001 and 2003. In addition, there was an expansion of established exotic weeds, invasive weeds, and noxious weeds in general, and quackgrass, cheatgrass, bull thistle, and spotted knapweed in particular on burned plots during the same time period. The increase in weeds occurred at low, moderate, and high fire severities with the magnitude of the increase significantly smaller for low severity than moderate severity fires. On unburned plots, there was no significant weed colonization but a significant decrease in exotic weedy species and noxious weed species cover and adult spotted knapweed stem density between 2001 and 2003. There was a significant increase in spotted knapweed seedling density over the same period. If an increase in weeds after wildfire is a common phenomenon, then the recent increase in acres burned by wildfire and acres treated for fuels reduction by prescribed fire could result in a significant increase in weedy species. Integrating weed management into burned area recovery plans and fuels treatment plans could reduce this problem.

Presentation Title: Invasive Species Diversity and Abundance Trends on Ecosystem Restoration Units in the Wet/Warm Interior Douglas-fir Forests of Southwestern BC

Presenter: *Robert Gray*
R.W. Gray Consulting
Chilliwack, British Columbia, Canada

Abstract: Ecosystem restoration goals often include the restoration of natural plant community diversity. Our restoration activities, however, can exacerbate pre-existing invasive species problems or create favorable conditions for new invasions. Ground disturbance through either thinning/ground skidding activities or through moderate- to high-severity burning can create ideal bare mineral soil conditions for weed invasion. Invasive species affect restoration goals by displacing native plants and in some cases, such as cheatgrass, by altering fire regimes. The invasive species of concern in the IDFww of southwestern BC are: Sonchus arvensis, Cirsium arvense, Conyza canadensis, and Bromus tectorum. None of these species were inventoried on treatment units prior to restoration activities and were relegated mostly to small roadside populations. Pre-treated stands were considered to be highly depauperate, with low understory species diversity. Invasive species abundance and diversity was monitored on three operational restoration units and four experimental units. Treatments included a range of thinning intensities with both burned and unburned replicates. All burning was carried out within six-months of thinning. Burning was not held up for a year or more to allow drying of larger fuels and duff as is often the practice in other areas. A central objective in these treatments was the retention of as much of the duff layer as possible in order to limit the opportunity for invasive plant germination. Our monitoring efforts, therefore, focused on the relationship between burn severity and invasive species cover and abundance. Three and five year post-burn analysis revealed the highest invasive species abundance on the highest burn severity sites. Trends in invasive species diversity however were less conclusive.

Presentation Title: Interactions Between Soil Microbial Communities And Native And Non-Native Invasive Plant Species After Wildfire In The Cascade Range Of Oregon

Presenter: *Cassie Hebel*
Oregon State University
Corvallis, Oregon, USA

Abstract: Suppression of wildfire for the last 100 years has led to large organic matter accumulations, contributing to high severity wildfires throughout the western United States. Small severely burned areas of soil associated with the consumption of large down wood or stumps in direct contact with the soil, are common after high severity wildfire. Excessive heating and oxidation of the soil matrix changes the top mineral layer to various shades of red. Such soils, largely void of biological activity immediately following a fire, are thought to increase the potential of invasion by non-native plants. We compared the soil microbial community and growth of 3 native and 3 non-native invasive plant species in paired samples of severely burned and less severely burned soils from the 2003 Booth and Bear Butte (B&B) wildfire, east of the Cascade Range of Oregon. Ordination results of phospholipid fatty acid (PLFA) analysis showed that soil microbes were most abundant in the less severely burned soils. Similarly, colonization by arbuscular mycorrhizal fungi (AMF) was greatest in plants grown in the less severely burned soils. Despite dramatic differences in AMF colonization, shoot biomass of several of the native and non-native invasive species did not differ between severely burned and less severely burned soils. Understanding the interactions among burn severity, soil microbial communities, and growth of native and non-native plants will assist forest managers with post-fire recovery.

Co-Authors: *Jane E. Smith, USDA Forest Service*

Presentation Title: Nonnative Plant Response to Prescribed Fire and Mechanical Cutting in California Chaparral

Presenter: *Jennifer Potts*
University of California - Berkeley
Berkeley, California, USA

Abstract: This chaparral fuel reduction project examines the ecological effects of prescribed fire and mastication (mechanical cutting) in Northern California. Specifically, this research investigates plant and bird community response to 1) the type of fuel treatment - prescribed fire or mastication, and 2) the season of treatment - fall, winter or spring. Understanding the ecological impacts of prescribed burning and mastication is critical as we increasingly rely on fuel reduction to protect homes from wildfire. Previous research suggests that both the type and season of fuel reduction can have strong effects on community composition (possibly driving some species to extinction) and can increase the flammability of an already fire-prone vegetation type. We studied five fuel treatment/season combinations including 1) fall fire, 2) winter fire, 3) spring fire, 4) fall mastication, 5) spring mastication, and an untreated control. Each treatment is replicated four times, for a total of 24 research plots and 100 acres of experimental area. Pre and post-treatment plant monitoring began in 2001 and will continue through 2006. Our results show that non-native grass cover and abundance is substantially higher on masticated sites than on burned sites. Non-native grasses have the potential to out-compete native species and increase ecosystem flammability due to their flashy fuel characteristics, earlier curing time, and extensive cover. Important chaparral species may be lost if fires become more frequent due to the presence of these grasses, and chaparral may be converted entirely to annual grasslands if a positive grass/fire cycle ensues. This study clearly demonstrates that fuel reduction choices can have significant influence on chaparral plant composition. This is important news for chaparral managers who rarely have ecological data directly related to fuel treatments. With this new information, we can strike a better balance between our ecological goals and fire safety priorities.

Presentation Title: Grassland Plant Community Response to Herbicide Spraying, Prescribed Burning, and Spray and Burn Combination Treatments

Presenter: *Peter Rice*
University of Montana
Missoula, Montana, USA

Abstract: Western bunchgrass communities were historically exposed to reoccurring fire which kept invading woody species in check, recycled nutrients, and controlled biomass accumulation. Prescribed fire is used currently for similar goals. The presence of nonnative invasive plants makes fire's utility less certain. This study examined the effect of prescribed burning and herbicide spraying on target weeds and the entire plant community over a four year period. Four separate Montana bunchgrass sites with significant presence of spotted knapweed, St. Johnswort, leafy spurge, or dalmatian toadflax were treated with herbicides alone; spring prescribed burning alone, and four different sequential combinations of burning and herbicide spraying. All burns were conducted in early spring while most species were still winter dormant or were just emerging from winter dormancy. The herbicide applications include spring and fall timings. Fuels loads averaged 2,036 lb/ac (low 983, high 3,775) and fuel consumption averaged 64% (low 45%, high 89%). Burning alone did not change target weed abundance relative to untreated controls, and burning plus spraying combinations resulted in weed suppression comparable to the high level obtained by spraying alone. At the community level, responses to burn and spray combination treatments were similar to the shift in community composition from spraying alone, moving towards a potential natural vegetation state. The results indicate that managers can conduct these types of grassland burns without exacerbating infestations of these weeds and they have operational flexibility in scheduling the sequence of spraying and burning combination treatments.

Presentation Title: Evaluating Postfire Seeding Treatments To Suppress Cheatgrass (Bromus Tectorum) In Pondersosa Pine Forests On The Shivwits Plateau

Presenter *Bridget Lair*
U.S. Geological Survey
Henderson, Nevada, USA

Abstract: The interaction between fire and invasive plants is of great concern to land management agencies on the Colorado Plateau. Both prescribed fire and naturally occurring wildfire are increasingly resulting in a dominant understory of the invasive annual grass cheatgrass (Bromus tectorum), which has the potential to create excessively short fire return intervals, and impede the establishment of later successional plant species. There is some evidence that where native perennial grasses such as the cool season grass bottlebrush squirreltail (Elymus elymoides) and the warm season grass blue grama (Bouteloua gracilis) occur naturally after fire, cheatgrass dominance is low and diversity and cover of native perennial grasses, shrubs, and forbs is high. This suggests that native perennial grasses may be competing with and reducing the dominance of cheatgrass. We designed a project to evaluate effects of postfire seeding of bottlebrush squirreltail (3lbs /ac pls) and blue grama (2lbs/ac pls) on dominance by cheatgrass. The study area is located on the Shivwits Plateau on the western edge of the Colorado Plateau. NPS and BLM Fire Management personnel conducted a prescribed fire in a sagebrush meadow in October 2003 in an ongoing program to reintroduce fire into the ponderosa pine ecosystem. In November 2003, seeding, seeding plus raking, and unseeded controls were each randomly applied to 6 replicate treatment plots (n=18 total plots), each 25m x 50m (1,250m2). Immediate post fire vegetation and soil seed bank data were collected in fall 2003 to establish burn severity and baseline plant community data. Three years of post treatment data have been collected in spring of 2004, 2005 and 2006. Sampling will continue for one additional year. The study site will also be maintained by the Lake Mead National Recreation Area as a demonstration site where the long-term effects of the seeding treatments can be observed and the information integrated back into the process of land management planning.

Co – Authors: *Bridget Lair, Matt Brooks, U.S. Geological Survey - Curt Deuser, USDI National Park Service*

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