USDA Forest Service
PNW Research Station

Fire Research in Support of Ecosystem Management in the Pacific Northwest

December 2002

Issue

Managing forests to restore and maintain ecosystem health, particularly the management of fire and other natural disturbances, has become a central focus of ecosystem management in the past decade. The 2002 wildland fire season, burning twice the 10-year average of forest acres burned and costing $1.3 billion, emphasizes the importance of fire in ecosystem management. Managers of Western ecosystems plan to multiply fire use several-fold within the next few years, a strategy that has been endorsed by a wide spectrum of interest groups and political leaders as well as through agency appropriations. Fire management is strongly dependent on the application of new concepts, knowledge, and products derived through basic and applied research. Scientifically credible knowledge needs to be generated and made accessible to inform and improve management and policy decisions.

Response

Understanding and managing wildland fire and other ecological disturbance has been a long-standing priority for the Pacific Northwest Research Station (PNW Research Station). It has maintained a close and formal partnership with the Pacific Northwest Region and the Bureau of Land Management for over 30 years to provide decision support for fire management. Substantial knowledge to answer integrated biophysical and socioeconomic questions has been generated through several large syntheses and augmented by significant, ongoing fire-related research. In response to national and regional fire issues, participation in the National Fire Plan Research Program, and input from our clients, the Station's overall program in fire research has increased about sixfold in the past 3 years from about $2 million per year to over $12 million, engaging 20 scientists, in 2002. As a result of our efforts, we have significantly expanded our institutional capacity in fire research.

Strategic Vision

PNW Research Station fire-related research and development is being planned, coordinated, and implemented within an ***integrated framework*** whereby fire and ecosystem managers in the Pacific Northwest, Alaska, and the rest of the world are professionally supported by knowledge and information systems that allow them to predict, prevent, and recover from wildland fires and to anticipate and manage this essential natural disturbance that is critical to the restoration and sustainability of ecosystems.

Key Efforts

Following are some of the key efforts that represent a major portion of the Station's efforts in fire-related research. A variety of other kinds of studies are also underway.

Fire and air quality. Air quality related to wildland fires and prescribed fires is a very sensitive environmental issue in the Northwest. The PNW Research Station's fire and environmental applications team is a world leader in development of smoke management strategies and in providing online tools that assist federal and state resource managers with safe prescribed burning that reduces air pollution. Several state-of-science Web-based products (for example, VCIS, FCAMMS, and BlueSky) provide thousands of users with daily information and forecasts for local weather conditions, ventilation of smoke, and potential for damaging air quality. The information is key in "go-no go" decisions for burning at hundreds of locations in the Pacific Northwest and beyond. Other decision report tools include health risk assessments, emission inventory systems, and air pollution forecasts during large wildfires.

Wildland fuels science. Forest and rangelands exhibit a variety of fuelbeds with characteristics and conditions that explain the wide variability in fire danger, fire behavior, and fire effect on ecosystems, the environment, and public safety. The PNW Research Station produces state-of-the-art inventory and classification systems to map and analyze wildland fuelbeds and immediate fire effects. The Photo Series' and Fuel Characteristic Classification (FCC) system, package the world's largest database of physical fuelbed properties into accessible and expandable systems that can be used to support fire management, emission inventory, or biomass assessments.

Climate change, wildland fire, and ecosystem sustainability. Wildfires are expected to be larger and more frequent as the climate continues to warm, playing a major role in the restructuring and redistribution of ecosystems and increasing difficulty in managing natural resources. We are helping advance knowledge and management options for sustaining ecosystems and sequestering carbon through the management of wildland fires and prescribed fires. The same products that estimate biomass inventory, flammability, consumption, fire severity, and emission production for fire and air quality management are well-suited to provide inputs to regional assessments of global biomass emissions and the role of fire in the distribution and stability of ecosystems affected by global change. Our new synthesis and integration teams add expertise in fire ecology and spatial analysis for broad-scale assessments.

Globally consistent fire-effects models. We provide predictive models applicable in all climate zones and ecosystems by experimentation and testing in a global laboratory concept spanning the Americas from Alaska and Hawaii; through 30 of the contiguous states; to Mexico, Bolivia, and Brazil. Models and hypotheses are field tested across this compact global laboratory known as the "Transect of the Americas," which include all the world's fire and climate regimes. PNW Research Station partners in this effort with major universities, particularly the University of Washington, and other research institutes worldwide and in the Pacific Northwest.

Landscape management. Fire is an integral part of Pacific Northwest forest landscapes with variable frequency and severity across the region and over the decades. This temporal and geographic variability has important implications for policy and management. Landscape management approaches modeled to some extent from the historical fire regime may be a more workable approach to species conservation than species-by-species approaches. The PNW Research Station and Willamette National Forest are implementing and testing such a landscape-management approach, the Blue River Landscape Plan, in the Central Cascades Adaptive Management Area designated under the Northwest Forest Plan. Over 25 years of work on fire history in western Oregon and Washington have other applications with growing recognition of the roles of fire in sustaining old-growth attributes in forests prone to moderate and low-severity fire, the common retention of live trees through fire disturbance in parts of the region (now mimicked in part through the "green-tree retention" cutting practices in matrix of the Northwest Forest Plan), and the levels of natural forest fuels conditions that would be expected in different parts of the region.

Evaluation of fire hazard reduction. The PNW Research Station is assessing the need, costs, and potential benefits of prescribed fire and mechanical treatments to reduce fire hazard in the interior West at the stand and landscape level. We also are developing ways to conduct economic evaluations of tradeoffs involved in various treatment approaches by using different harvest systems. These projects will enable us to better assess the economic and ecological costs and benefits associated with different harvesting practices and regionally based utilization opportunities. They also will help managers and operators better evaluate in-woods decisionmaking regarding tree selection, residuals left on site, product suitability, and market opportunities.

Communities and their perception of risk. Much of the focus of the Healthy Forests Initiative is how it impacts communities that are near federal lands. To date, the ability of these communities to both assess and manage risks has largely been taken for granted resulting in some cases in community actions that are not as effective as they potentially could be. We are assessing how communities form risk perceptions and take actions in response to forest-related risks and also the communities' propensity to use collaborative efforts. This work is being done on the Kenai Peninsula and will have implications elsewhere. By better understanding how communities deal with risk, we can better deliver assistance.

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USDA Forest Service
Pacific Northwest Research Station
Fire Research

December 2002

Understanding and managing wildfire has been a long-standing priority for the Pacific Northwest (PNW) Research Station. The PNW Station is providing current knowledge and technology to help decisionmakers and the public reduce fire risk and restore areas after fire. The Station is addressing future fire-related research and development to reflect changing environmental and social conditions. The following framework provides a way to plan, coordinate, implement, and integrate our current fire-related work and help identify information gaps and research capacity needs. The framework addresses knowledge-generation issues at varing spatial and temporal scales. Issues have the following focus:

Atmospheric systems. Assessment of risk from climate variability, weather extremes, and air quality impacts

Terrestrial and ecosystems. Vegetation, wildlife habitat and populations, watershed function, fuels, insects, and disease, as mediated by natural disturbances, other inherent ecological processes and applied management over time

Aquatic ecosystems: Water quality and quantity, aquatic habitat, fisheries, and riparian zones and wetlands, as mediated by natural disturbances, other inherent ecological processes, and applied management over time

Social, political, and economic dimensions. Societal needs, values and issues related to wildland fire and ecosystem conditions, community attitudes and actions, and their economic and land management policy ramifications

Integrated systems. Information gained in the above areas must be effectively integrated, both among areas of knowledge generation and application, to address wildland fire questions in a meaningful and comprehensive way

These knowledge-generation issues have National Fire Plan components and defined application for prediction, prevention, and recovery as shown in table 1. Capabilities, emphasis research, and opportunities within this framework are described in table 2. Current projects are listed in table 3.

Table 1—Overview of integrated framework for fire research, USDA Forest Service, Pacific Northwest Research Station

Knowledge Generation	National Fire Plan Issues Components	Application[1]		
		Prediction	Prevention	Recovery
A. Atmospheric Systems	Preparedness	X	X	
	Fuels and Fire Risk	X	X	
	Restoration/Rehabilitation	X	X	X
	Communities	X	X	
B. Terrestrial Ecosystems	Preparedness	X	X	
	Fuels and Fire Risk	X	X	X
	Restoration/Rehabilitation		X	X
C. Aquatic Ecosystems	Preparedness	X	X	
	Restoration/Rehabilitation		X	X
D. Social, Political, and Economic	Preparedness	X	X	
	Fuels and Fire Risk	X	X	
	Restoration/Rehabilitation		X	X
	Communities	X	X	X
E. Integrated Systems	Preparedness	X	X	
	Fuels and Fire Risk	X	X	X
	Restoration/Rehabilitation		X	X
	Communities	X	X	X

[1] **Prediction.** for improved *prediction and assessment* of fire risks, issues, and effects (both ecological and socioeconomic) that cause or contribute to burn history and disturbance regimes.

Prevention. to develop and evaluate *prewildfire* management practices and decision-support systems for reducing probabilities of undesirable fire effects and promoting restoration.

Recovery. to develop and evaluate improved *postwildfire* management practices and decision-support systems accelerating and directing ecosystem recovery following wildfire.

Table 2—Capabilities, current emphases, and identified needs and opportunities for fire-related research within integrated fire research framework, USDA Forest Service, Pacific Northwest Research Station

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
A. Atmospheric Systems	**1. Research Capabilities**	Characterization, analysis, and process and predictive modeling of smoke generation, dispersal, and interrelationships with atmospheric processes and conditions (including weather)		
		Characterization, analysis, and process and predictive modeling of inter-relationships among fire, fire risk, and climatic factors (including climate variability and change)		
	2. Current Research Emphases	Characterizing, predicting, and assessing smoke and haze production from wild and prescribed fires, and impacts on air quality and visibility		
		Seasonal prediction of fire risks based on climatic factors, including precipitation, temperature lightning, and impacts		
		Interrelationships between fire and climatic variability		
		Real-time, web-based modeling, display, and prediction of regional mesoscale meteorology, smoke production, and air quality impacts		
		Real-time meteorological support for fire management operations		
	3. Identified Research Needs and Opportunities	Improved fire weather and fire season forecasts: Increasing predictive reliability and defining uncertainties for decision support at multiple scales		
		Health risks of smoke exposure: Risk assessment for community and fire-fighter exposure to smoke from fires		
		Changes in fire climates over the course of the 21st century		
B. Terrestrial Ecosystems	**1. Research Capabilities**	Disturbance ecology and management: understanding interrelationships among disturbance regimes (fire, insects, disease, climate change, ungulate herbivory), forest conditions and values, and resource sustainability		
		Development and application of forest inventory and monitoring technology relevant to comprehensive assess-ments of status, trends, and prospective futures of forests		
		Effects of fire and fire management on nutrient cycling, including biogeochemistry of burned areas and discharge from ecosystems and watersheds to streams		

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
		Analysis and modeling of short-and long-term dynamics of terrestrial ecosystem components, conditions, patterns, and processes as mediated by fire, management, and other natural disturbances, at varying spatial scales		
			Development and evaluation of management strategies, practices/tools, and technologies for maintaining or restoring health in fire-prone ecosystems, with emphasis on vegetation, wildlife, insects, disease, and watershed function	
			Understanding productivity of forest ecosystems, and development of management tools and operational systems (including silvicultural) that enhance production of wood products and other resource values	
		Modeling, characterization, analysis, and management systems for forest fuels		
			Autecological, synecological, and landscape ecological relationships and responses of terrestrial plants, wildlife, domestic herbivores, insects, and microbiota to fire, in forested and rangeland environments	
		Landscape ecology and analysis at varying temporal scales		
	2. Current Research Emphases	Estimating range and variation of historical vegetation and landscape patterns and disturbance (including fire) regimes, and their interrelationships		
		Fuels characterization, consumption, classification, and mapping, including models and predictions of fire risk and hazard		
		Invasive plant species: Responses to fire and fire management (including fuel reduction) practices; interrelationships with native species as mediated by fire and fire management; impacts on postfire recovery; and assessment and prediction of risks associated with fire and fire management		
			Effects of fuels-reduction and forest-restoration practices on key wildlife habitats	
			Effects of fuels-reduction treatments on ecosystem structure and function, including vegetation, soils, watershed, insect, and fungal attributes	
				Evaluation of postwildfire emergency rehabilitation and restoration treatment effects on ecosystem recovery
		Long-term vegetation dynamics and ecosystem productivity as influenced by disturbances, including historical and reintroduced fire regimes		

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
		Nutrient cycling in watersheds, ecosystems, and landscapes (including microbial communities and processes) as mediated by fire and fire management		
	3. Identified Research Needs and Opportunities			Impacts of postfire product recovery on ecosystem recovery
		Risk assessment techniques for prioritizing fire management techniques (including fuels treatments), including effects on key terrestrial species and their habitats		
				Impacts of fire on threatened and endangered and other key species, and their postfire recovery Impacts of fire on fungal diversity, below-ground processes, and nutrient cycling and their postfire recovery
			Postfire evaluation of effects of prefire management techniques (including fuels reduction) on ecosystems and in reducing fire risks (including analysis of burned and treated and burned and untreated areas)	
			Pre and postfire evaluation of effects of fire management (including fuels) and recovery treatments on invasive species	
		Develop improved techniques and technologies for remote sensing of fire-relevant ecosystem attributes (including satellite imagery)		
				Remeasurement of burned FIA plots for comparison to preburn conditions
			Evaluate adaptablity of genetic tree stock for prefire restoration and postfire recovery efforts	
C. Aquatic Ecosystems	**1. Research Capabilities**	Understanding effects of natural processes, natural disturbances (including fire), and human activities on inter-interactions between aquatic and terrestrial ecosystems		
			Understanding effects of land management practices, including fire management, on watershed processes (including hydrologic function)	
			Understanding and managing freshwater aquatic ecosystems (lakes, rivers, and streams) and their component biota	
			Understanding and managing terrestrial-aquatic ecotonal systems (riparian, wetland, and estuarine ecosystems) and their component biota	

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
	2. Current Research Emphases		Effects of fuels-reduction treatments on water quality, aquatic habitats, and moisture-dependent animal species	
		Process-based classification and disturbance (including fire) relationships for interior PNW watersheds		
	3. Identified Research Needs and Opportunities	Risk assessment techniques for prioritizing fuel treatments to protect key aquatic species and habitats		
			Responses of watersheds of varying morphologies to fire management practices (including fuels reduction)	
				Fire effects on and post-fire recovery of threatened and endangered aquatic species
			Water cycling processes and streamflow generation in semiarid areas as influenced by fire, fire management, and postfire recovery	
				Evaluating effects of seeding and other postfire rehabilitation treatments on watersheds and aquatic systems
D. Social, Political and Economic Dimensions	**1. Research Capabilities**	Understanding the social and economic perceptions, values, and issues associated with natural resource conditions, that influence management decisions and practices, and that govern societal and policy responses to forest conditions and management		
		Predictive and operational analyses of forest management options (including fire management) in terms of economic feasibility, costs, benefits, and potential impacts on society and natural resources		
			Development and socioeconomic analyses of forest product, production, or marketing systems targeted to enhance forest values, conditions, or both	
	2. Current Research Emphases		Assessing need; economic opportunities, costs/benefits, and feasibility; and economic impacts of biomass removal and other fuels reduction treatments	
			Decisionmaking on wood utilization opportunities to lower costs of fuels-reduction treatments	

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
		Predicting economic feasibility and impact of applying landscape-scale fuel reduction treatments for biomass-based products (including energy)		
		Social perceptions, acceptance, and responses to fire risks and fuels-reduction treatments		
		Characterization of wildland and urban interfaces, and implications to wildland fire management		
	3. Identified Research Needs and Opportunities	Risk assessment techniques for prioritizing wildland and urban interface fire management techniques (including fuel reduction)		
		Predicting extreme fire events that pose catastrophic risk to life, property, and ecosystems		
				Economic impacts of postfire product recovery on communities
			Effects of water quality standards (e.g., TMDL's) associated with fire management and postfire recovery on communities	
			Implications of the "restoration" forest management paradigm on communities and community risk	
			Design and evaluation of appropriate mechanical fuels-reduction systems	
E. Integrated Systems	**1. Research Capabilities**	Understanding and integrating effects of natural processes, natural disturbances (including fire), and human activities (including management) on interactions among terrestrial, aquatic, and atmospheric ecosystems and ecosystem components; socioeconomic systems; and natural resource policies		
		Integrated (i.e., interdisciplinary) predictive and process modeling of natural ecosystem pattern, structure, function, and response dynamics to disturbances and management (including fire and fire management)		
		Integrated natural resource planning and decision-support systems		
		Landscape ecology, management, and integrated landscape-scale assessment and analysis at varying temporal scales		
	2. Current Research Emphases	Modeling, predicting, and assessing the effects of large-scale disturbance processes (including fire) on watershed, ecosystem, and landscape patterns, conditions, and processes at varying spatial and temporal scales		
		Development of analytical tools and decision-support systems applicable to ecosystem management (including fire management dimensions) at varying spatial and temporal scales		
		Development of systems to concurrently evaluate human needs, ecological conditions, and fire threats to forests		
		Role, impacts, and management of fire in tropical ecosystems		

Knowledge-Generation Issues	PNW Research Station	Foci of Knowledge Application		
		Prediction	**Prevention**	**Recovery**
	3. Identified Research Needs and Opportunities			Integration of economic impacts of postfire product recovery on communities, with ecological impacts on recovering ecosystems
			Integration of USDA FS and fire recovery management with those on non-USDA FS lands	
		Development of integrated protocols for analyzing risks of fire disturbances and from fire management alternatives in natural and managed landscapes		
		Integration of atmospheric and terrestrial ecosystem factors to improve techniques for predicting catastrophic fire		
		Improving fire-effects prediction: Field and laboratory research to improve models of fire consumption, flammability thresholds, and immediate fire effects on ecosystems and society		

Table 3—Current specific fire-related research projects and areas of inquiry within Integrated Fire Research Framework, USDA Forest Service, Pacific Northwest Research Station

Knowledge-Generation Issues	Project Title or Area of Inquiry	PNW Lead Scientist(s)	Program, Team, and Lab	Funding Source	Relevant Foci of Knowledge Application		
					Prediction	Prevention	Recovery
A. Atmospheric Systems	A Modeling Framework for Real-Time Prediction of Cumulative Smoke Impacts	S. Ferguson and D.L. Peterson	MDR-FERA; Seattle Lab	NFP[1]	X	X	
	Seasonal Prediction of National Fire Risks and Impacts	R. Neilson	MDR-MAPSS; Corvallis Lab	NFP	X		
	Predicting Lightning Risk	S. Ferguson	MDR-FERA; Seattle Lab	JFSP[2]	X		
	Implementation of an Improved Emission Production System	S. Sandberg	MDR-FERA: Corvallis Lab	JFSP	X	X	
	Fire and Climatic Variability in the In land Pacific Northwest: Integrating Science and Management	S. Ferguson	MDR-FERA; Seattle Lab	JFSP	X	X	
	Assessing Values of Air Quality and Visibility at Risk from Wildland Fires	S. Ferguson	MDR-FERA; Seattle Lab	JFSP	X		
B. Terrestrial Ecosystems	Simulating the Range and Variation Presettlement-Era Forest Landscape Patterns and Disturbance Processes	P. Hessburg	MDR-EFHR; Wenatchee Lab	Base	X	X	
	Assessing Value of Mesoscale Models in Predicting Fire Danger	S. Ferguson	MDR-FERA; Seattle Lab	JFSP	X	X	
	Predicting Spread of Invasive Species After Fuels-Reduction Treatments and Postfire Disturbance	E. DePuit, C. Parks, N. Vance, and M. Hemstrom	MDR-EFHR and DEM; RMP-BCFP; Wenatchee, La Grande and Corvallis Labs	NFP	X	X	X
	Fuel Reduction and Forest Restoration Strategies That Sustain Key Habitats and Species in the Interior Northwest	J. Lehmkuhl	MDR-EFHR; Wenatchee Lab	NFP		X	X

[1] National Fire Plan
[2] Joint Fire Science Program

Knowledge Generation Issues	Project Title or Area of Inquiry	PNW Lead Scientist(s)	Program, Team, and Lab	Funding Source	Relevant Foci of Knowledge Application		
					Prediction	Prevention	Recovery
	Response of Native and Invasive Plants to Fire- and Fuel-Reduction Treatments in the Interior Pacific Northwest	C. Parks and N. Vance	MDR-DEM; RMP-BCFP; LaGrande and Corvallis Labs	NFP		X	X
	Effects of Reintroducing Fire in East-side Ponderosa Pine Forests	A. Youngblood	MDR-DEM; LaGrande Lab	Base		X	
	Fuel Moisture Mapping and Combustion Limits	S. Sandberg	MDR-FERA; Corvallis Lab	NFP	X	X	
	Ground-Based Support for Mapping Fuel and Fire Hazard	R. Ottmar	MDR-FERA; Seattle Lab	NFP	X	X	
	Fire and Fire Surrogate Study: Hungry Bob Site and National Project Coordination	J. McIver, A. Youngblood, C. Niwa, and J. Smith	MDR-DEM, BCEID; ECOP-FM; LaGrande and Corvallis Labs	JFSP		X	
	Fire and Fire Surrogate Study: Mission Creek Site	J. Lehmkuhl	MDR-EFHR; Wenatchee Lab	JFSP		X	
	Photo Series for Major Natural Fuel Types of the United States	R. Ottmar	MDR-FERA; Seattle Lab	JFSP		X	
	Modification and Validation of Fuel Consumption Models for Shrub and Forested Lands	R. Ottmar	MDR-FERA; Seattle Lab	JFSP	X	X	
	Application of a Fuel Characterization System for Major Fuel Types of the Contiguous United States and Alaska	S. Sandberg and R. Ottmar	MDR-FERA; Seattle and Corvallis Labs	JFSP	X	X	
	Evaluation of Post Wildfire Emergency Rehabilitation Treatments: Deer Point Fire	D.W. Peterson	MDR-EFHR; Wenatchee Lab	Base/NFP			X
	Use of Lidar and Other Remote-Sensing Techniques in Evaluating Fire Risk	S. Reutebuch	RMP-WSO; Seattle Lab	JRSP	X		

Knowledge-Generation Issues	Project Title or Area of Inquiry	PNW Lead Scientist(s)	Program, Team, and Lab	Funding Source	Relevant Foci of Knowledge Application		
					Prediction	Prevention	Recovery
	Regional Fuel Mapping	J. Ohmann and J. Fried	FIA-RA; ECOP-FLE; Portland and Corvallis Labs		X	X	
	Long-term ecosystem productivity in burned and unburned areas	B. Bormann	ECOP-SEP; Corvallis Lab	Base	X		X
	Effects of Spring and Fall Prescribed Fires on Plant and Fungal and Insect Community Dyamics	C. Niwa, W. Thies, B. Kerns, and J. Smith	MDR-BCEID, EFHR; ECOP-FM; Corvallis Lab	JFSP	X		
	Nutrient Cycling in Watersheds, Ecosystems, and Landscapes, including Responses to Fire	M. Bormann, T. Spies, F. Swanson, and M. Walker	ECOP-SEP, FM, BECRU; Corvallis and Fairbanks Labs	Base,	X	X	X
	Soil Microbial Communities and Processes	R. Molina and M. Bormann	ECOP-SEP, FLE, BECRU; Corvallis and Fairbanks Labs	Base	X		X
	Vegetation Dynamics Following Disturbance	M. Bormann, T. Spies, F. Swanson, M. Walker, T. Hanley, and A. Carey	ECOP-SEP, FLE, FM, BECRU; Corvallis and Fairbanks Labs	Base		X	X
	Visualization of Down Fuels in Stand Visualization Systems	R. McGaughey	RMP-WSO, Seattle Lab	RMRS-WO	X	X	
	Appropriate Technologies for Harvest and Transport of Small-Diameter materials	S. Reutebuch	RMP-WSO, Olympia Lab	Base		X	
C. Aquatic Ecosystems Issues	Evaluating the Effects of Prescribed Fire and Fuels Treatments on Water Quality and Aquatic Habitat	S. Wondzell	ALI-LWIWS; Olympia Lab			X	
	Effects of Fuel Reduction Thinning on Ground-Dwelling, Moisture-Dependent Species	G. Reeves	ALI-AE; Corvallis Lab			X	

Knowledge-Generation Issues	Project Title or Area of Inquiry	PNW Lead Scientist(s)	Program, Team, and Lab	Funding Source	Relevant Foci of Knowledge Application		
					Prediction	Prevention	Recovery
	Guidelines for Fuels Reductions in Rare-Uncommon Salamander Habitats	G. Reeves	ALI-AE; Corvallis Lab			X	
	Process-Based Classification of Interior Columbia Basin Watersheds	P. Hessburg and P. Bisson	ALI-LWIWS; Wenatchee and Olympia Labs	Base	X	X	
D. Social, Political and Economic Dimensions	Assessing the Need, Costs, and Potential Benefits of Prescribed Fire and Mechanical Treatments to Reduce Fire Hazard In Montana and New Mexico	J. Barbour, R. Fight, and S. Alexander	HNRI-ESPFR and JPLM; Portland Lab	JFSP		X	
	Fire and Fire Surrogates Study: Evaluation of Financial Feasibility of Treatments and Tradeoffs	J. Barbour et al.	HNRI-ESPFR; Portland Lab	JFSP		X	
	Economic Impacts of Biomass Removals to Mitigate Wildfire Damage: Interpreting FFS Data and Defining Small Wood Products Boundaries	J. Barbour, R. Fight	HNRI-ESPFR and JPLM; Portland Lab	JFSP		X	
	In-woods Decisionmaking of Utilization Opportunities to Lower Costs of Fire Hazard Reduction Treatments	E. Lowell	HNRI-ESPFR; Portland Lab	JFSP		X	
	Development of FIA BioSum to Evaluate Feasibility and Impact of Landscape-Scale Fuel Treatments for Biomass-Based Energy Generation	J. Fried, J. Barbour, S. Willits, R. Fight, and S. Reutebuch	FIA-RA; HNRI-ESPFR and JPLM; FSD; RMP-WSO; Portland and Seattle Labs	NFP, Extram., Base	X	X	
	Community Perceptions of and Response to Fire Risks, Kenai Peninsula, Alaska	R. Haynes	HNRI-Portland Lab	R10, S&P	X	X	
	Characterization of Wildland-Urban Interfaces in California, Oregon, and Washington	J. Fried, V. Radeloff	FIA-RA; Portland Lab		X	X	
	Social Acceptance of Fuel Treatments	G. Winter and J. Fried	FIA-RA; Portland Lab			X	

Knowledge-Generation Issues	Project Title or Area of Inquiry	PNW Lead Scientist(s)	Program, Team, and Lab	Funding Source	Relevant Foci of Knowledge Application		
					Prediction	Prevention	Recovery
E. Integrated Systems Issues	Brasilfire: Fire Research and Development in Tropical Ecosystems	S. Sandberg	MDR-FERA; Corvallis and Seattle Labs	Extram.	X	X	X
	Modeling Large-Scale Disturbance Processes in Forest Watersheds: Long-Term Influences on Watershed Health and Aquatic Productivity	P. Hessburg	MDR-EFHR; ALI-LWIWS; Wenatchee and Olympia Labs	NWFP-SMS	X	X	X
	Interior Northwest Landscape Analysis System (INLAS)	J. Barbour, J. Hayes, et al.	FSD & MDR; Portland and La Grande Labs	NFP, Base	X	X	X
	Evaluation Systems Accounting for Human Needs, Ecological Conditions of Forests and Fire Threat (CAPS Project)	J. Barbour (+ co-leads from NC and RM Stations)	FSD; HNRI-JPLM; Portland Lab	S&P Forestry	X	X	
	Assessing Large-Scale Disturbance Processes at the Watershed, Eco-System, and Landscape Level	T. Spies, and F. Swanson	ECOP-FLE; Corvallis Lab	Base	X		
	Predicting Visibility Impacts from Prescribed and Wildland Fires During the Next Half Century	D. McKenzie and S. Sandberg	MDR-FERA; Seattle and Corvallis Labs	NFP	X	X	
	Synthesis and Integration of Physical and Ecological Fire Research	D.L. Peterson	MDR-FERA; Seattle and Corvallis Labs	Base, NFP	X	X	X
	Transect of the Americas: Fire Ecology and Management Systems in the Americas	S. Sandberg	MDR-FERA; Seattle and Corvallis Labs	Extram.	X	X	X
	Air Quality Management Systems	S. Sandberg, S. Ferguson	MDR-FERA; Seattle and Corvallis Labs	Base, R6	X	X	
	Decision Support for Prescribed Fire and Fuels Management	R. Ottmar	MDR-FERA; Seattle and Corvallis Labs	Base, R6	X	X	X