National Fire Plan
Research and Development Projects Funded
FY 2001

TOPIC C (Fuels and Risk): $10,098,000 (out of $10,000,000 planned)

Optimizing Fuel Reductions in Time and Space Using Spatial Models
NC-2.2.4 Ci $325,000

Ground-based support for fuel and fire hazard mapping to implement treatment strategies at the national, regional, and local scale
PNW-7 Ci $500,000

Characterization of Fuels and Fire Behavior in the Central Hardwoods Forest
NE-15 Ci $500,000

Assessing wildfire risk for forested ecosystems and human populations across the eastern United States
SRS-4852-1 Ci $341,000

Impacts of Exotic Weeds on Fuel Loading and Fire Regimes in Shrub Steppe Communities and Development of Technology and Plant Resources for Their Restoration
RMRS-BOI-4 Ci $100,000

Hazardous fuels reduction through harvesting underutilized trees and forest undergrowth and producing three-dimensional structural products
FPL-36 Cii $250,000

Utilization of cull and small diameter timber for use in laminated structural members through development of specific sawing, laminating, and drying processes
FPL-32 Cii $500,000

Quantifying the ecological and economic tradeoffs of fire and fire surrogate options Piedmont and Southern Appalachian Mountains
SRS-4104-4 Ciii $500,000

Quantifying the tradeoffs of fire and fuels management options. -- Longleaf and Slash Pine ecosystems of the Atlantic and Gulf Coastal Plain Provinces
SRS-4104-3 Ciii $500,000

An Integrated System for Mechanical Reduction of Fuel Loads at the Wildland/Urban Interface in the South
SRS-4104-5 Ciii $250,000

Fire and Herbicide Combinations to Reduce the Threat of High Intensity/Severity Fires
SRS-4104-8 Ciii $500,000

Fuel and Fire Risk Reduction in the Wildland Urban Interface
SRS-4XXX-3 Ciii $250,000

Impact of Fuel Management Treatments on Fire Behavior and Forest Vegetation
RMRS-MCW-1a Ciii $500,000

Impact of Fuel Management Treatments on Forest Soil Erosion and Productivity
RMRS-MCW-1b Ciii $500,000

Development of Management Alternatives for Fire-Prone and Fire-Dependent Ecosystems in Colorado and the Black Hills
RMRS-FTC-6 Ciii $500,000

Improved Guidelines for Fuels Management in Southwestern Ponderosa Pine and Pinyon-Juniper Forests in Wildland-Urban Interface Areas
RMRS-FLG-2 Ciii $500,000

Evaluation of Restoration Techniques in Subalpine Communities Using Prescribed Fire and Silvicultural Techniques for Fuels Management Including Dynamics and Biocontrol of Exotic Weeds in the Northern Rockies
RMRS-MSO-15 Ciii $500,000

Effects of Fuel Reductions on Stream Ecosystems: Southern Sierra Nevada, California
PSW-4202-2 Ciii $400,000

Effectiveness of alternatives to fire in reducing fuels in shrublands within California's coniferous forest
PSW-4155-1 Ciii $300,000

Fire-Related Erosive Processes in Southwestern Ecosystems
PSW-4403-4 Ciii $500,000

Integrating Focal Species and Ecosystem Perspectives to Assess the Effects of Wildland Fire and Landscape-level Fuels Treatments on Wildlife III: California Spotted Owl Component
PSW-4355-5 Ciii $425,000

Fuel reduction and forest restoration strategies that also Sustain Key Habitats, Species, and Ecological Processes in Fire-Prone Ecosystems in the Interior Northwest
PNW-14 Ciii $500,000

Use of Remote Sensing to Examine the Effect of Diseases, Insects, and Other Disturbances on the Incidence and Spread of Wildfire
RMRS-FTC-2 Civ $125,000

Riparian Ecosystem Dynamics in Relation to Fire in Southern and Northern Rocky Mountains
RMRS-ABQ-2 Civ $500,000

Managing the risk of fire on human and ecological communities in the wildland-urban interface
NC-3.1 Civ $332,000

Station: North Central Research Station

Proposal code NC 2.2.4

Topic(s): **C-i Reducing hazardous fuels and fire risk, assessment; C-iii Reducing hazardous fuels and fire risk, treatments; C-iv Reducing hazardous fuels and fire risk, ecological interactions; D-i Working with communities, social and economic systems.**

Proposal title: **Optimizing Fuel Reductions in Time and Space Using Spatial Models.**

Other proposals to which this is linked **(Proposal code)**: **NC 1.4, 2.2.1, 2.5, 3.2.1, 3.2.2, 3.3**

Research Work Units : **RWU NC-4101, Northern Forest Silviculture, Grand Rapids, MN; RWU NC-4153, Landscape Ecology, Rhinelander, WI; RWU NC-4803, Social and Economic Dimensions of Ecosystem Management, St. Paul, MN; RWU SO-4106, Managing Upland Forest Ecosystems in the Mid-South, Monticello, AR.**

Description: Research or Development, Question, Issue, or Need: **An important goal of the fire management initiative is to reduce hazardous fuels and thus reduce fire risk. Two fundamental questions emerge related to this goal: (1) when and where should fuel reductions be applied in order to obtain the greatest reductions in fire risk at the lowest costs? (2) what are the ecological and social consequences of these treatments? These questions are best addressed at the landscape scale in which both time and space are considered within an analytical framework provided through remote sensing, GIS, and mathematical modeling.**

Scientists within the North Central Research Station have conducted research to understand landscape-scale forest ecosystem dynamics in the northern Lakes States region. Advances in computer technology and scientific understanding have resulted in the creation of improved forest dynamics models. Two such models are LANDIS and NORTHWDS. LANDIS is a stochastic, spatially explicit model of forest landscape disturbance and succession. It simulates succession semi-quantitatively as tree age classes. LANDIS has been developed to analyze changes in landscape structure in response to various combinations of fire and windthrow disturbance regimes as well as with their interaction with forest management treatments such as those aimed at fuel reductions. The Northern Woodland Dynamics Simulator (NORTHWDS) was designed to model forest pattern and process for the northern Lake States at multiple spatial scales. This model represents a new conceptual approach to simulating forest dynamics by incorporating spatial attributes, multiples spatial and temporal scales, and by utilizing a hierarchical design to model development and application. Because processes such as tree regeneration, growth, and mortality as well as biogeochemical and carbon cycling have been incorporated into NORTHWDS, the ecological consequences of various fuel reduction strategies can be evaluated.

The probability of fire at any geographic site is a function of both the physical environment and related biotic factors. Abiotic factors include macroclimate, physical firebreaks, topography, soil texture, and physiographic features. Biotic factors include flammability of the vegetation, pattern of the vegetation, and the influences related to human activities (fire

ignition, suppression). Our *objective* is to better understand the interrelationships among these factors as it relates to fire risk and fuel reductions in actual landscapes using LANDIS and NORTHWDS.

Research Issue: **Changing land uses and fire suppression during the last century have greatly altered the "fire-probability pattern." Because of these changes, the most efficient strategies for deploying fuel reduction strategies are uncertain. Scientists at the North Central Station propose to use LANDIS and NORTHWDS to better understand the effects of past and current land use and fire suppression on fire regimes and organic-matter accumulation in a variety of forested ecosystems in the region. Specifically, the models will be used to (1) study the spatial and temporal patterns of fire occurrence and forest composition over the last 150 years in order to better understand fire risk as a function of landscape condition, disturbance ecology, land use, and fire suppression and (2) evaluate alternative fuel reduction strategies in real landscapes representing different levels of perceived fire risk.**

Research and Development approach**: Initial efforts to develop efficient fuel reduction strategies using LANDIS and NORTHWDS will focus primarily on areas affected by the July 1999 windstorm in Minnesota. Due to this windstorm, the fire probability for forests in northern Minnesota has dramatically increased. A concurrent study of fire behavior and fuel loading using the models will be conducted in the shortleaf-loblolly pine forest of the Mid-south. This work will be conducted by SO-4106 (Managing Upland Forest Ecosystems in the Mid-South) as part of an ongoing study on restoring mature shortleaf-loblolly pine ecosystems in southern Arkansas. Other northern and southern forest ecosystems will be considered in future applications.**

Published information (e.g., Heinselman. 1973. Fire in the virgin forests of the boundary waters canoe area, Minnesota. Quaternary Research 3:329-382) as well as information available from the Great Lakes Assessment will be used to parameterize LANDIS and NORTHWDS. As part of this proposed project, a fire module will be added to NORTHWDS. In addition, the existing fire module in LANDIS will be improved. In addition to the ecological assessment proposed here, the involvement of social scientists is critical in evaluating alternative strategies for reducing fuel loads. In conjunction with NC 2.5, the costs associated with deploying a strategy as well as the social acceptability of a strategy will be considered. In their current form, LANDIS and NORTHWDS are research tools. New spatial models are needed to aid management and planning decision making.

Outcomes or products:

The approach provides a spatial and temporal perspective for evaluating fire risk. This perspective allows more effective evaluation of alternative management strategies for reducing fuel loads and, therefore, for reducing fire risk. By applying NORTHWDS and LANDIS in concert with ongoing field studies, deliverables can be provided early in the funding cycle. Strategies (both generic and specific) for optimizing fuel reductions will be provided.

First year: **Apply LANDIS to the Minnesota blowdown and publish the results as a case study.**

Second year: **Using the improved fire module in LANDIS and a newly added "generic disturbance" module in NORTHWDS, apply these models to evaluate strategies to reduce fuel loads in pine and oak barren ecosystems. Publish general strategies for dealing with fuel reductions in fire prone ecosystems.**

Three to five years out: **Provide guidelines for reducing fuel loads that are based on information about the ecological consequences of treatments, their costs of implementation, and the social acceptability of the treatments. Produce a new spatial model for planning and management.**

Staffing needs: **GS-12/13 Quantitative Ecologists, GS-7/9 GIS Technician**

Description of skills required:

Funding requested: **$325,000**

Leveraging: **Builds on previous development of spatially explicit forest landscape models.**

Team Leader(s): **Thomas R. Crow (NC-4101)**
Phone: 218-326-7110
Email: tcrow@fs.fed.us

Station: **PNW**

Proposal code**: PNW-7**

Topic(s): C-i

Proposal title**: <u>Ground-based Support for Fuel and Fire Hazard Mapping to Implement Treatment Strategies at the National, Regional, and Local Scale</u>**

Other proposals to which this is linked: PNW-1,2,3,4,10; and several RM (MSFL) and PSW (RFSL) for which we do not yet know the codes.

RWU (or Program or Team) and location(s):
Managing Disturbance Regimes Program (4577)
Fire and Environmental Research Applications Team (FERA) (Seattle and Corvallis)

Description:

- Research or development question, issue, or need**:**

Fuels are the key elements to assessing the hazard risk or effects associated with wildland fire. The Cohesive Strategy builds on this premise and suggests reducing fuel levels to restore healthy, resilient ecosystems, sustain natural resources, and better protect people. Mapping fuels by remote sensing requires a strong ground-level effort to validate and refine assignment of fuel characteristics. Fire models developed at RM, PSW and SO will benefit from nationally consistent, reliable fuel characterization.

Little or no knowledge exists of fuel amounts, distribution, or arrangement in many fuelbed types where wildland fire is expected. This development project serves four main purposes: (1) develop and apply field measurement techniques and sampling protocols for managers to assess and monitor spatial and temporal distribution of fire severity, fire hazard, air pollutant emissions, and other fire effects; (2) provide a second-generation capability for mapping fuel characteristics, potential biomass consumption, and carbon release for all ecosystems in the United States; (3) to provide high resolution ground truth data for remote sensing and landscape scale model applications and for large area fuels assessments; and (4) to provide additional fuels data for Fuel Characteristic Class System development, support for ongoing national and regional fuel related research project such as the Joint Fire Science Program-funded Fire Surrogate Study, and improvement in large national condition class mapping.

- Research and development approach:

All efforts described in this proposal are to be strongly linked with all Research Stations that provide fire research. Our research and development approach will be to: (1) provide specialized and end-result inventory techniques such as a photo series, for assessing fuels across the landscape; (2) facilitate the implementation of Fuel Characteristic Classes into important national fire behavior, fire effects, tradeoff, and ecological (biogeography) models in close collaboration with RMRS and PSW Fire Labs, Southern and Northeast Stations; (3) provide other FCC

linkages that will be established for national, regional, and local fire hazard mapping; and (4) provide ground truth data for FCC validation and improvement, remote sensing of vegetation characteristics including leaf area index and crown structure of all fuelbed strata, and for modeled or interpolated projections of vegetation cover and fire hazard or conditions.

- Outcomes or products:

  - First year**: Assess fuelbed types that need a photo series or field data collected to improve the Fuel Characteristic Class System; provide ground truth data for remote sensing applications. Begin data collection and photo series development. Assess what critical fire behavior and effects models need immediate linkage with the Fuel Characteristic Class System.**

  - Second year**: Begin linking Fuel Characteristic Class System with critical fire behavior and fire effects models. Develop fuel measurement protocols and fuelbed constants for new fuel types where increased wildand fire is expected. Complete three photo series fuelbed types. Initiate photo series inventory tools for individual fuelbed strata. Begin compiling remote sensing and other pertinent data for the national mapping of fuel characteristic classes, fuel consumption, fire risk, and air pollutant emissions.**

  - Three to Five years out**: Provide fuels assessment protocols, photo series for new fuelbed types, and linkages to critical fire behavior and fire effects models. Provide a national fuel characteristic, potential fuel consumption, fire risk, and air pollutant emissions map using a quality-assured combination of remote sensing and locally obtained information.**

Staffing needs **(Scientist years, technician years, etc) by series and grade: Our current capacity is limited for addressing additional research projects. To increase our capacity, we will need to:**

- **Fire Ecologist GS-460-12 (1SY/yr) Postdoc Conversion**
- **Forester GS-0408-9 Field Crew Supervisor, New**
- **Data analyst/statistician (GS-343-12), New**
- **Fire Scientist (GS-460-14), Existing (.2 FTE)**

In addition, 3 term forestry technicians and 4 temporary 6-month appointment forestry technicians will be hired. Finally, some contracting will be required through the competitive bidding process for specific needs such as software design and development.

Description of skills required**: Ph.D. Fire Ecology; statistical expertise; field experience; fire qualifications; GIS training**

Confirmed Partners:

- **USDA Forest Service (WO, R6, R3, R9, R10, and R8)**
- **Department of the Interior (BLM, NPS, BIA, USFWS)**
- **The Nature Conservancy**
- **Department of Defense**

- **Several state forestry and natural resources departments**
- **Pacific Southwest, Rocky Mountain, Northeast, and Southern Research Stations**
- **NWCG**
- **Alaska Wildfire Coordinating Group**
- **EPA**
- **Specific consulting firms**

Funding requested: $500,000 per year

Team Leader**:** **David V. Sandberg**
Phone**:** **Office 541-750-7265; cell 541-740-7396**
E-mail: **dsandberg@fs.fed.us**

Station: **Northeastern Research Station**

Proposal code**: NE-15**

Topic(s) (from attached list, e.g. A-i) **A-ii, C-i, C-iv**

Proposal title: **Characterization of fuels and fire behavior in the Central Hardwoods forest**

Other proposals to which this is linked (Proposal code): **NE-01, NE-02, NE-05, NE-06, NE-20**

RWU (or Program or Team) and location(s): **NE-4153, National Fire and Fire Surrogate study team, Delaware, OH; Pennsylvania Bureau of Forestry Oak Regeneration Research: Preharvest Seedling Development as Influenced by Light and Competition, Moshannon State Forest, Clearfield, PA, in cooperation with NE-4557, Morgantown, WV; Eastern Fire Effects Research Team, EFERT (consisting of scientists of NE-4153, -4558, -4152, -4353, SRS-4351)**

Description:

- Research or development question, issue, or need: **Under fire suppression, the forests of the Central Hardwood region are undergoing succession to a more mesic forest type. Resistant to fire but relatively slow-growing seedlings and saplings are typically out-competed when fire is excluded by faster growing but fire-sensitive competitors, particularly red maple, tulip poplar, and cherry. Presently the most spatially extensive forest type in the United States, the oak-hickory forest and the smaller, but more sensitive, Appalachian coniferous forest are not self-sustaining under present conditions, and will persist only in limited, dry sites in a species-depauperate form. Forest structure has changed from a low density, open-canopied form to a high density, closed-canopy form. The fire regime before fire suppression was short interval (3-5 years), low in intensity, small in extent, and occurred during the dormant season, primarily the spring (75%) and autumn (22%). It is thought that fuel management, by thinning and/or fire treatment, will contribute toward restoring the composition and structure of the oak-hickory forests. Land managers, considering the use of prescribed fire to restore structure, composition, and function to oak ecosystems, are faced with a paucity of information on fire behavior and fire weather in central hardwood and Appalachian coniferous forests. Fuels, fire behavior, and fire effects research for the Central Hardwoods Region (which includes the Appalachian coniferous forests) are not characterized well, compared to those of coniferous forests in the south and the west. Therefore, the nationally used BEHAVE modeling system produces questionable predictions for this region. The distribution of fuel in hardwood systems is entirely different from those in coniferous systems. Recent research indicates that fire effects are driven by fire behavior, which is a function of fuels and short-term weather, but little is known about fire behavior. Although loss of personal property due to prescribed burning is of low risk in this region, any fire will be within one mile of a road and smoke management becomes a significant safety issue.**

- Research and development approach: **In conjunction with ongoing long-term prescribed fire and fire and thinning studies (NE-4153, -4558, -4505, -4557, -4152, -4353, SRS-4351, RMRS-4151), the Fire Behavior Scientist will study the effects of fire weather, fuels, and topography on fire behavior and smoke management in the central hardwoods and Appalachian coniferous forests. This scientist will work closely with researchers currently involved with the studies and the proposed landscape ecologist, wildlife ecologists, regeneration silviculturist, soil microbiologist, and an invasive species ecologist (proposals from NE-4153, -4558, -4152, -4353, SRS-4351) who are investigating the effects of fire and/or thinning on regeneration, vegetation dynamics, wildlife habitat, and belowground processes. Together, models of fire behavior and species-specific fire effects will be developed to better understand how fire and/or thinning may be used to restore fire-dependent ecosystems.**

Outcomes or products:

First year: Staffing of the EFERT including the fire behavior specialist, and development of an integrated regional study program of ecosystem restoration using prescribed fire and thinning.

Second year: Integration of fire behavior specialist into existing national and regional studies; comparison of methods to characterize fuels and fire behavior in the Central Hardwoods Region; installation of the new EFERT integrated regional study program

Three to Five years out: Peer reviewed articles updating the fuel models for the region. Modifications enabling the BEHAVE model to produce usable results.

Staffing needs (Scientist years, technician years, etc) by series and grade:
1 GM-460-12, Scientist FTE; **1 GS-462-5, Technician FTE**

Description of skills required:

- **Ability to quantify large-scale patterns of fire behavior using appropriate technologies**
- **Ability to model fire behavior and to integrate fire behavior research with fire effects research.**
- **Ability to communicate research results effectively to a wide variety of customers, including the public, scientists, and resource managers.**

Potential Partners (universities, federal agencies and labs, national forests, states, private companies, etc): **Ohio State, Ohio, and Penn State Universities; Mead and Westvaco paper corporations, Wayne, Allegheny, and Monongahela National Forests**

Funding requested: **$500,000/year**

Team Leader: **Daniel Yaussy**
Phone: **740-368-0101**
E-mail: **dyaussy@fs.fed.us**

Station: SRS
Proposal code: SRS-4852-1
Topic: C.i. Develop methods for assessing the conditions of fuels and values at risk at various scales of analysis.

Proposal title: Assessing wildfire risk for forested ecosystems and human populations across the eastern United States.

Other proposals to which this is linked (Proposal code): NC1.1, NC1.4, NE-4104-1

RWU and location: SRS-4852, Raleigh, NC

Description:
Research or development question, issue, or need:

The wildfires that burned 2.8 million hectares this year have demonstrated that fuel loading has become a hazard to life, property, and ecosystem health as a result of past fire exclusion policies and practices. The President's National Fire Plan is concerned that fuel loads are reaching hazardous levels that can lead to widespread catastrophic wildfires in forest ecosystems and the forest/urban interface. Land managers need tools to enable them to classify, estimate, and monitor fuel loading, and to predict wildfire risk and behavior based on inputs of fuel, weather, and topography for a specific location. Land managers will then be better able to allocate limited resources to minimize the potential for catastrophic fire and protect the American public

Existing wildfire risk assessments are based on behavior models. These can be improved with additional remotely sensed vegetation data and regional modeling of live and dead woody biomass. Spatially and temporally explicit estimates of vegetation land cover, canopy density, tree height, and biomass need to be assessed to improve wildfire risk assessments. Forest fuel loading biomass estimates can be spatially displayed across the landscape of the eastern U.S. to identify areas of low to high wildfire risk. Large-scale synoptic atmospheric circulation, temperature, and moisture patterns conductive to severe wildfire must be considered with fuel loads in assessing the potential for medium-term (4-8 weeks) predictions of severe wildfires across the eastern U.S. Additionally, forest productivity modeling provides projections of future forest biomass across the landscape that enables land managers to identify forest units with the highest need for fuel reductions.

Research and development approach:

Vegetation modeling – Live and coarse woody debris forest biomass estimates will be modeled for the eastern U.S. Live biomass will be estimated using the forest productivity model PnET-II, FIA data, species specific forest allometric biomass equations, and 30 m resolution remotely sensed land cover. Live tree biomass will be augmented with estimates of coarse woody debris modeled from available FIA variables. Diameter-based forest biomass equations (including prediction error capability) will be used to estimate total forest carbon for the eastern U.S. from the FIA database and from National Resource Inventory (NRI) data (n=723,283). SRS-4852 has a MOA with NRCS to access confidential national natural resource inventory data.

Remotely sensed data – Satellite imagery composed of Landsat Thematic Mapper data and USGS digital elevation models for the eastern U.S. will be used to assess vegetation land cover, forest canopy parameters, and topography from the 30 m to 1 km^2 resolution. FIA data will provide additional forest cover parameters and remotely sensed data validation.

Live biomass and coarse woody debris estimated from FIA and NRI point data will be spatially characterized and displayed across the eastern U.S. by major forest types for slope, aspect, and elevation at 30 m resolution and scaled for forest management applications.
Fire risk assessments **-** Atmospheric interactions with fuel loads and wildfire occurrence will be used to assess severe wildfire potential across the region for medium- and long-term forest management applications. Remotely sensed land cover at 30 m resolution will be used in conjunction with fuel loads in high wildfire risk areas to assess and map likely forest fire corridors and urban and suburban areas at risk from fire and/or smoke.
Human populations at risk – High resolution census data will be used in conjunction with landcover and fuel load data to identify areas where risk of fire is likely to coincide with communities.

Outcomes or products:
First year*:* A 30 m to 1 km^2 resolution maps of live and coarse woody debris biomass for eastern U.S. forests.
Second year: A 30 m to 1 km^2 resolution real time (current) maps of fire risk for eastern U.S. forests.
Three to Five years out: a) A 1 km^2 resolution maps of future (4-8 weeks) forest fire risk for the eastern U.S.; b) A field version, 30 m resolution real time (current) modeling system designed to project the spread of forest fires within the eastern U.S. based on climate, forest and management control measures; c) Contingent on funding, forest biomass estimates and wildfire risk ratings will be expanded for the continental U.S.

Staffing and skill needs: David C. Chojnacky, Forest Inventory Enterprise Unit, will provide four months of work on the project to model estimates of coarse woody debris and total forest carbon biomass from FIA data. A research ecologist (GS-11/12) is needed for forest modeling and remote sensing/GIS analysis. A technician (GS-9) will to assist in data collection and analysis. A computer programmer (GS-11) for algorithm encoding and model integration. Additional computer workstations and associated data storage capacity will be purchased for forest modeling, electronic and hard copy data and map displays, and data storage.

Partners: The following individuals and organizations have agreed to serve as collaborators. Letters of collaboration available upon request.

- Dr. Ann Bartuska, Forest Management National Forest Systems, will provide fuel loading related to management practices on National Forest lands.
- Dr. Alan Lucier, National Council for Air and Stream Improvement, will provide fire risk linkages to forest management and fire suppression practices on timber industry lands.
- Dr. Roger Dahlman, U.S. Department of Energy, will provide fire risk linkages to DOE facilities and terrestrial carbon inventories.
- Dr. Chris Geron, U.S. Environmental Protection Agency, will link forest carbon inventory and area with emissions from wildfires.
- Drs. Alisa Gallant and Zhiliang Zhu, U.S. Geological Survey EROS Data Center, will link forest biomass with USGS remotely sensed forest canopy density, height, and wildfire burn area.

Annual funding requested: $340,000 funded for $341,000
Contact: Dr. Steven McNulty; Phone: (919)515-9498; Fax: (919)513-2978; E-mail: steve_mcnulty@ncsu.edu

Station: **RMRS**

Proposal code: **RMRS-BOI-4**

Topic(s): **B.i, C.i, B.ii, C.iv**

Proposal title**:** ***Impacts of exotic weeds on fuel loading and fire regimes in shrub steppe communities and development of technology and plant resources for their restoration.***

Other proposals to which this is linked: **RMRS-PRV-1 and 2B (McArthur), RMRS-RNO-1, 2, and 3 (Tausch, Chambers)**

RWU location: **RMRS 4353, Boise, Idaho**

Description:

- **Research or development question, issue, or need: The cycle of wildfires and annual weed invasion has altered millions of acres of western shrublands and grasslands, disrupted ecosystem functioning, increased wildfire size and frequency, reduced plant and animal diversity, and set the stage for invasion by secondary perennial weeds that are even more difficult to control. Our poor understanding of the susceptibility of functional and at risk native systems to weed invasions and the impacts of weeds on fire regimes and seasonal fuel loading limits our ability to manage these systems. Criteria are needed to determine when post-fire seeding to restore native vegetation is appropriate. Reestablishing native communities necessitates the use of effective methods for controlling competitive weeds and the availability of reliable seed supplies and seed transfer guidelines for a larger suite of revegetation species, particularly native forbs.**

- **Research and development approach: Augment cooperative work in the following areas: 1. Quantify seasonal fuel loading in sagebrush steppe communities in functional and degraded condition, derivatives of these communities infested with primary or secondary weeds, and exotic grass seedings; 2. Assess the susceptibility of intact and degraded sagebrush steppe communities to invasion by the secondary perennial weeds, Russian knapweed and rush skeletonweed (1 and 2 are cooperative with RWUs 4252 and 4253, study sites are in four states); 3. Examine the effects of smoke on the germination ecology of native and invasive plant species; 4. Evaluate new approaches for enhancing establishment of seeded species including carbon applications to increase nitrogen sequestration by microorganisms, use of competitive remnant native germplasms surviving on sites dominated by invasive exotics, and quantification of microsite requirements for seedling establishment; and 5) Develop seed production practices and seeding technology for selected native forb populations in Utah, Nevada, and Idaho to increase the availability and use of commercial seed supplies (cooperative with RWU 4253).**

- **Outcomes or products: Results will be disseminated to land managers, commercial seed growers, and private and public revegetation specialists in journal articles, plant release notices, seeding guides, web sites, and related outlets. Native forb releases will be provided to seed growers as Site Identified or Selected Class germplasms. Research results will allow land managers of the shrub steppe to better assess fuel loading and susceptibility of**

at risk sites to weed invasion when developing management strategies. The research will also provide them with new tools and plant resources for reestablishing and protecting biological diversity.

- **First year*:* Complete or expand ongoing studies. Initiate new studies, locate study sites, and select native species for study through consultations with users. Develop and test methodology, collect data, and prepare reports. Develop a web site to describe ongoing work with native forbs. Provide consultations and organize workshops and field days.**

- **Second year: Analyze data and prepare publications for completed studies. Collect data for new studies, work with collaborators to prepare reports and presentations. Continue to provide consultations, workshops, and field days.**

- **Three to Five years out*:* Plan subsequent studies, prepare publications and presentations, organize tours and workshops, develop seeding guides and plant release notices, and work with State Seed Certification Agencies to make native forb seed available to private seed growers.**

Staffing needs: **Existing Workforce: Research Botanist 0430-GS-13, Professional Botanist 0430-GS-11, Range Technician 0455-GS-09.**
New position(s)*:* Professional Weed or Restoration Ecologist 0408-GS-7/9.

Description of skills required: **A research botanist with skills to assess the impacts of fire and invasive species on shrub steppe communities, examine native plant establishment and affecting factors, and develop native plant resources and transfer guidelines for restoration of native communities; a professional botanist and ecologist to conduct fire ecology, invasive weed, and plant establishment work; and technical support.**

Potential Partners: **RMRS 4253 (Provo: McArthur), RMRS 4252 (Reno: Tausch, Chambers), USDA-FS Boise National Forest, University of Idaho, University of Wyoming, USDA-ARS Northwest Watershed Research Center, Utah Division of Wildlife Resources, USDI BLM-ID. Ongoing work with listed cooperators is partially funded by the USDI BLM-WO, USDA CSREES-NRI, and USDI National Fire Sciences Program.**

Funding requested: **$100,000/year**

Contact: **Nancy L. Shaw**
Phone: **208.373.4360**
E-mail: **nshaw@fs.fed.us**

Station: **Forest Products Laboratory**

Proposal code: FPL-36

Topic: C-ii

Proposal title: **Hazardous fuels reduction through harvesting underutilized trees and forest undergrowth and producing three-dimensional structural products.**

Other proposals to which this is linked: None

RWU and locations: **FPL-4706, -4851, Madison, WI; FS-SRS-4701, Pineville, LA; Big Horn National Forest; R02-SPF-CF-EAP; and Genesis Laboratory.**

Description:

- **Research or development question, issue, or need:** The President's Fire Plan points to the need for reducing hazardous fuels as one of the four strategic elements of fire mitigation in forested lands. Excessive forest undergrowth, consisting of small trees and other forest biomass, has a relatively high combustibility and provides one of the principal sources of hazardous fuels. Forest fires are frequently initiated and rapidly spread in the forest undergrowth, because of its relatively high combustibility. Fire risk could be greatly diminished through the controlled reduction of the forest undergrowth. Additional reductions in fire risk could be obtained by controlled-clearing of trees that have no commercial value and will not normally be harvested. In order to preserve high-value timber, protect our landscape, and protect our forest communities from the dangers of fire, the research question that will be addressed herein is how to best manage the forest undergrowth and underutilized standing timber.

- **Research and development approach:** The proposed approach is to develop an economically viable product and process for a three-dimensional fiber molded material that can utilize the lignocellulosic fiber contained in the forest undergrowth and in underutilized timber. In this way, thinning or clearing of these components of the forest can be encouraged by the private sector, dangerous fuels can thereby be removed, and costs to the federal government for fire mitigation can be minimized.

  The proposed product consists of a new structural core material that has been shown to be manufacturable from a wide range of inexpensive underutilized fiber sources, including recycled fiber, wood residues, and agricultural biomass. The new core material is referred to as "Trusscore." Trusscore is molded into a specially engineered form through continuous hot pressing of lignocellulosic fiber between rigid mold elements. Continuous hot pressing produces strong inter-fiber bonds and a correspondingly strong core material, even using relatively low-quality fiber. When the structural core is bonded to exterior skins, a novel three-dimensional sandwich panel is formed that exhibits a high level of strength and stiffness. Plans call for construction of large panels in order to accurately determine additional structural properties. The proposed technology has promising uses in the construction of pallets, bulk bins, heavy duty boxes, shipping containers, packaging supports, wall panels, roof panels, cement forms, partitions, displays, reels, desks, caskets, shelves,

tables, and doors. The size of these potential markets is enormous. For example, according to 1996 statistics published in the Annual Survey of Manufacturers, the pallet industry has annual sales in the U.S. of over $3 billion, wood office furniture is a $2.4 billion market, wood partitions and fixtures are a $3.7 billion market, and wood doors account for $2.2 billion of the total door market. It has been estimated that panels will have greatly improved performance-relative-to-cost compared to commercially produced paper-honeycomb cores, foam cores, and other core materials.

In order to apply the technology a means of fiberizing forest undergrowth and underutilized timber will be required. Time on fiberizing equipment called the Tornado will be purchased to process sufficient quantity and types of material. Because the fibrous material will be from various species and types we also propose to conduct basic research using near-infra-red (NIR) spectroscopy to monitor process conditions in the fiberizing equipment. In the literature, NIR spectral data from pulp has been used to predict strength properties of paper. This technology will help quality control with the various fiber types. Expertise on the use of NIR spectral data will be obtained through cooperation with RWU FS-SRS-4701. A NIR spectroscopy unit will be purchased and installed on the equipment, $70,000. Fiber analysis will be made at FPL to assess the effects of fiber types, fiber quality, and fiber variability. Core material will be hot-pressed on specially designed 3D platens. Cores will be produced from various fiber sources to assess the range of strength that can be attained. Fiber sources include tops, chips, bark, and other thinning biomass not used for structural lumber .FPL will conduct a timber demand and technology assessment of the process.

Panels produced in the pilot facility will be tested at FPL and sent to a variety of commercial producers for evaluation to demonstrate marketability for the purpose of attracting private enterprise.

- Outcomes or products:
  - First year: **1st – 3rd qtrs. equipment purchase, fabrication, and installation, 4th qtr product fabrication and testing as a demonstration at FPL.**
  - Second year: **Information sent to rural communities to locate a pilot production facility constructed near a national, state, or private forest.**
  - Three to Five years out: **Full production facility(ies) located near a national, state, or private forest.**

Staffing needs by series and grade: **2 SY – GS-12 or higher, 2 TY – GS-5 or higher, 2 Student or Graduate Student Year.**

Description of skills required: **Mechanical Engineer, Chemical Engineer, Physics, Engineering Mechanics, Economics**

Potential Partners: **see above list**

Funding requested: **$250,000**

Team Leader: **John Hunt**

Station: **Forest Products Laboratory**
Proposal code: **FPL-32**
Topic: **C-ii**

Proposal title: **Utilization of cull and small diameter timber for use in laminated structural members through development of specific sawing, laminating, and drying processes.**

Other proposals to which this is linked: **FPL-9**

RWU and locations: **FPL-4706; -4719; -4851; R02-SPF-CF-EAP; Big Horn National Forest; Wyoming State Forester; University of Wyoming, Laramie, WY; Wyoming Sawmills, Sheridan, WY; and Genesis Laboratories, Batavia, IL.**

Description:

- Research or development question, issue, or need: **There is a need to develop new processing methods to better utilize cull and small diameter trees for structural lumber. In Wyoming alone, it is estimated there are 12.6M tons in cull trees, which represents 10% of the total dry material.**

- Research and development approach: **The goal of the research is to develop a value added use for cull and small diameter material that should be removed to maintain a healthy and sustainable forest. Currently, much of this type of material is felled and left on the ground, chipped, or burned, because most mills are not equipped to handle this material.**

  Several technologies will be combined to determine if this material could be utilized to produce a value added structural product(s). First, sawing equipment will need to have the ability to "follow" the shape of the logs and process small diameter logs. There is a commercial saw, HewSaw, that handles 2.5 to 14 inch diameter curved logs. If a log is curved it physically straightens the log while cutting, but the cut material springs back and is still curved after it's cut. Second, curved material causes significant problems during drier stacking. If a curved piece is dried in the stack, some of the curvature is reduce, but it may still be too curved and prevents its use as a structural member. The yield and quality of lumber can be improved by press drying and efficiency improved by microwave drying. In this scenario, the curved lumber is straightened in a press while microwaves are applied to the constrained lumber. High-temperature steam pressure forms internally, softening the inter-fiber bonds and relieving internal stresses. Once dry, the lumber holds its straightened shape, with only a small amount of spring-back. Genesis Laboratory has developed and demonstrated the technical feasibility of microwave press drying under a USDA SBIR Phase II grant, number 94-33610-0901. Third, the material needs a commercial outlet for use. While microwave press drying may reduce much of the curvature, there may still be residual curvature. A new method for utilizing low grade or curved material was developed by Wyoming Sawmill, called Lam Lumber. The Lam Lumber process bond low-grade stud material and then resaws this larger "billet" into a laminated structural lumber piece. The advantage of this process is lower grade material is sandwiched together to create a stronger and higher-value laminated structural member. The other members

restrain curved pieces when the adhesive is cured. Fourth, the equipment must be able to handle large volumes of small diameter material for the process to be economical.

For this proposal, the partners will work in cooperation to conduct a mini-trial to process and assess the engineering and economic feasibility for utilizing this material. In summary, several truck loads of cull and small diameter material will be cut from the Big Horn National forest. We will cut the material using a currently installed HewSaw located at a sawmill in the Pacific Northwest. A prototype microwave press-drier will be fabricated that will be large enough to dry a minimum of 8-foot long material and will be instrumented to gather process and efficiency data. The dried material will be laminated and resawn using Wyoming Sawmill's existing Lam Lumber equipment. The FPL will conduct a timber demand and technology assessment of the process. University of Wyoming will provide structural testing of material made from this process. Any trim waste will be segregated for use in possible other application such as chips for pulp and paper and saw dust for wood pellets.

If successful, the research could be broadened to include other species and lower quality trees.

Propose capacity that will address the fire problem as a national issue: **If such a system could be efficiently developed it is estimated that an additional 8.5 to 17M board feet per year of structural laminated lumber could be removed from the forest per unit location using this type of equipment.**

- **Outcomes or products:**
  - First year: **1st and 2nd qtr. - Fabricate microwave drier; 3rd and 4th qtr. - cut timber, dry boards, fabricated structural members, test strength properties, assess technical and economic feasibility.**
  - Second year: **Refinement of the technique and present findings to other local communities.**
  - Three to Five years out: **Multiple locations being able to process small diameter and cull timber. Explore using the technology with other species.**

Staffing needs by series and grade: **2.5 SY – GS-12 or higher, 2 TY – GS-5 or higher, 2 Student or Graduate Student Year.**

Description of skills required: **Wood selection, sawing technology, microwave technology, structural testing, economics, rural development, and forester**

Potential Partners: **See above list.**

Funding requested: **$500,000**

Team Leader: **John Hunt**
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Station: SRS
Proposal code: SRS-4104-4
Topic (from list): **C-i, C-iii, C-iv**

Proposal Title: **Quantifying the ecological and economic tradeoffs of fire and fire surrogate options. -- Piedmont and Southern Appalachian Mountains**

Other proposals to which this is linked**: This work will augment the existing National Fire and Fire Surrogate Study (FFSS) and is linked at the national level to proposals by Weatherspoon (PSW) and by SRS-4104-03. All local research designated by FFSS protocols is covered by this proposal with the exception of small mammals and herpetofauna, which are proposed by Greenburg (SRS-4101-02). Research in addition to the FFSS protocols will be conducted on smoke dispersion modeling (SRS-4104-02), bat ecology (SRS-4201-02), rare and endangered plants (SRS-4201-01), and hydrology (SRS-4351-01). This proposal will share data with projects proposed for stand structure (SRS-4111-01), wildlife diversity models (SRS-4251-01), and fuel loading (Brose NE-4152 and existing Great Smoky Mountains fuels project).**

RWU (or Program and Team) and location(s): **Disturbance & Management of Southern Pine Ecosystems (SRS-4104), Athens, GA and Clemson, SC**

Description:
Research or development question, issue, or need: **Widespread fuel reduction treatments are needed throughout the United States to restore ecological integrity and reduce the risk of destructive wildfires. Of particular concern in the South are the rapidly growing urban/wildland interfaces of the Coastal Plain and Southern Appalachian Mountains. Prescribed burning has only recently been attempted in the Southern Appalachians because of the perceived dangers of erosion and the inability to control fires on steep slopes. Recent dendrochronology studies show that these mountains burned with frequent low-intensity fires for centuries until the late 1940's. Since then, fuel loads have increased dramatically, largely due to the development of a thick understory of mountain laurel and rhododendron. At issue are adverse air quality and transportation safety impacts from smoke and the potential for property losses if burns escape in the wildland-urban interface. Alternative fuel reduction treatments are attractive but the appropriate balance among cuttings, mechanical fuel treatments, herbicides, and prescribed fire is often unclear.**

The Southern Research Station is cooperating in the National Fire and Fire Surrogate Study. This study compares the effects of three fuel reduction treatments on numerous ecological and sociological variables in 11 ecosystems across the country. However, only two FFSS sites are in the South (Piedmont pine-hardwood and Florida flatwoods). Additional study sites in other ecosystems and additional treatments and disciplines on existing sites are needed to provide resource managers with a full array of information about the ecological, economic, and social consequences of alternative fuel reduction practices.

Research and development approach: **The Fire and Fire Surrogate study provides the basic framework to answer many questions about fuel reduction but is limited in the numbers of treatments and ecosystems being studied. We propose to build on work underway by**

expanding the treatments and disciplines at the established study site in the Piedmont, and by adding a study site in the hardwood-pine ecosystem of the Southern Appalachian Mountains. The study design addresses numerous questions across broad disciplinary areas, including vegetation, fuels, fire behavior, ecosystem structure, soil compaction, nutrient cycling, forest floor dynamics, mammals, herpetofauna, avifauna, entomology, pathology, treatment costs and utilization economics. Each treatment area is sufficiently large to incorporate all variables on all plots, thus allowing an examination of interactions that cannot be considered in small-scale designs. Treatment effects (for prescribed burning, mechanical removal, burning + mechanical, and control) are compared for each individual discipline using rigid protocols established for all study sites. Data from individual studies will be combined in multivariate analyses to learn how fuel reduction treatments affect ecosystem function at the local level. Local data will be incorporated into a national database for meta-analysis.

New funding will allow treatments of local interest to be added to the Piedmont site, including use of herbicide and a combination of herbicide and burning. Use of herbicide and combination herbicide/burn treatments will help to complete the set of options available to land managers. A new site in the Southern Appalachians will address numerous questions that have not been studied in the past. Basic data on fuel loading, fire behavior, and fire effects are essentially unavailable. Other variables measured by FFSS protocols have never been addressed in the Southern Appalachians

Outcomes or products:
First Year: **Study site selection and installation of grid points (as per Fire Surrogate protocols) and measurement of all variables for vegetation, fuels, wildlife, entomology, pathology, and soils.**

Second Year: **Thinning, burning, and herbicide treatments would be applied. First-year post treatment data would be collected. Data would be integrated into the national database. At this point each national discipline will have summarized core variable information from each site and have the opportunity to compare and contrast patterns across sites and with other disciplines.**

Three to Five years out: **Within this time frame a wide range of ecological and economic consequences of fire and fire surrogate treatments will emerge. Several types network products will be produced, including a range of models elucidating ecosystem structure and function. Relevance of the research results to resource managers will be emphasized and successively refined recommendations for ecosystem management will be provided as appropriate. This information will be documented and provided to users in publications, workshops, and a variety of other technology transfer modes.**

Staffing needs: **GS-12 460/408 Research Forester/Ecologist; GS-11 460/408 Forester/Ecologist (site manager); two GS-7 460/404 Forester/Biological Scientist; two GS-5 462/404 Forestry/Biological Science Technicians**.

Description of skills required: **Forest and fire ecology, wildlife ecology, seedling physiology, soil science, entomology, pathology, economics and utilization, database management and statistical modeling.**

Partners**: Various components of this project will be conducted as graduate student research at Virginia Polytechnic and State University, Clemson University, the University of Tennessee, and the University of Georgia. Identified partners for study site locations include the Bent Creek Experimental Forest and the Blue Ridge Parkway National Park. Potential partners include the Great Smoky Mountains National Park, R-8 NFS, and the North Carolina Wildlife Resources Commission. Limited support will be provided by state land management agencies, state Heritage Trust programs, the Nature Conservancy, Tall Timbers Research Station, U.S. Fish and Wildlife Service, and the USGS Biological Resources Division.**

Funding requested: **$500,000/year. Includes scientist and support salary, equipment, travel, and cooperative agreements with university partners. If a fire ecologist cannot be recruited, the study would provide opportunities to train one or more Ph.D. students at any of the cooperating universities.**

Team Leader: Tom Waldrop
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Station: SRS
Proposal code: SRS-4104-3
Topic (from list): **C-iii, C-iv**

Proposal Title: **Quantifying the tradeoffs of fire and fuels management options. -- Longleaf and Slash Pine ecosystems of the Atlantic and Gulf Coastal Plain Provinces**

Other proposals to which this is linked: **This work will augment the existing National Fire and Fire Surrogate Study (FFSS) and is linked at the national level to proposals by Weatherspoon (PSW) and by SRS-4104-04. All local research designated by FFSS protocols are covered by this proposal. Research in addition to the FFSS protocols will be conducted on smoke dispersion modeling (SRS-4104-02).**

RWU (or Program and Team) and location(s):
Disturbance & Management of Southern Pine Ecosystems (4104), Clemson, SC and Athens, GA

Research or development question, issue, or need:
Widespread fuel reduction treatments are needed throughout the United States to restore ecological integrity and reduce the risk of destructive wildfires. Of particular concern in the South are the rapidly growing urban/wildland interfaces of the Coastal Plains. Prescribed burning has been used for decades in the Coastal Plain to reduce fuel loads, but now is under regulatory pressure. At issue are adverse air quality and transportation safety impacts from smoke of prescribed burning and the potential for property losses if these burns escape in the wildland-urban interface. Alternative fuel reduction treatments are attractive but the appropriate balance among cuttings, mechanical fuel treatments, herbicides, and prescribed fire is often unclear. The Southern Research Station is cooperating in the National Fire and Fire Surrogate Study, funded by the Joint Fire Sciences Program. This study compares the effects of three fuel reduction treatments on numerous ecological and sociological variables in 11 ecosystems across the country. However, only two of these sites are in the South. Southern study sites include Piedmont pine-hardwood and Florida flatwood ecosystems. Additional study sites in other ecosystems are needed to provide resource managers with information about the ecological, economic, and social consequences of alternative fuel reduction practices to the ecosystems they manage.

Research and development approach:
The Fire and Fire Surrogate study provides the basic framework to answer many questions about fuel reduction but is limited in the numbers of treatments and ecosystems being studied. We propose to build on work underway by expanding the treatments and disciplines at the established study site in the Florida flatwoods, and by adding a study site in the longleaf pine ecosystem of the Coastal Plain. The study design addresses numerous questions across broad disciplinary areas, including vegetation, fuels, fire behavior, ecosystem structure, soil compaction, nutrient cycling, forest floor dynamics, mammals, herpetofauna, avifauna, entomology, pathology, treatment costs and utilization economics. Treatment effects (for prescribed burning, mechanical removal, burning + mechanical, and control) will be compared for each individual discipline. Data from these individual studies will be combined in multivariate analyses to learn how fuel reduction treatments affect

ecosystem function. New funding will allow treatments of local interest to be added to the Florida site, including use of herbicide and combination herbicide/burn. Smoke emissions and dispersal have not been included in the original study but would be added to both flatwoods and longleaf sites. An additional study site in the longleaf pine ecosystem is important to address major concerns in the region. A site in the longleaf ecosystem would allow us to explore techniques to reverse understory compositional changes and give fuel complexes once again dominated by grasses and forbs and not saw palmetto and woody shrubs with ericaceous leaves.

Outcomes or products:
First Year: **Study site established and publicized via web page, posters and brochure.**

Second Year: **Publication of initial starting conditions for wildlife, fuels, and vegetation.**

Three to Five years out: **Publication of treatment effects for individual disciplines including vegetation, fuels, soils, wildlife, economics etc. Publication of tradeoffs and cross discipline interactions at the site allowing managers to compare impacts of different treatments from an economic and an ecological standpoint. Comparison to other sites across the nation in the national level publications. On site demonstrations and workshops for land managers and interested publics illustrating different treatments and their outcomes.**

Staffing needs:
GS-12 460/408 Research Forester/Ecologist; GS-11 460/408 Forester/Ecologist (site manager); two GS-7 460/404 Forestry/Biological Science Technicians; two GS-5 462/404 Forestry/Biological Science Technicians.

Description of skills required:
Forest and fire ecology, seedling physiology, soil science, database management and statistical modeling

Potential Partners: Region 8, NFS; University of FL, FL A&M University, LA State Univ., Miss. State Univ., University of Mississippi, Auburn Univ., Univ. of GA, Clemson Univ., NC State Univ., State natural resource management agencies and Heritage Trust programs, Joseph W. Jones Ecological Research Center, Georgia Pacific, The Nature Conservancy, Tall Timbers Research Station, Department of Defense, U.S. Fish and Wildlife Service, USGS Biological Resources Division, all RWUs participating in the Pine Productivity and Southern Appalachian CCTs.

Funding requested: **$500,000/year. Includes scientist salary, support, equipment, travel, and cooperative agreements with university partners**

Team Leader: Kenneth W. Outcalt
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Station: SRS
Proposal code: SRS-4104-5
Topic (from list): **C-iii, C-iv**

Proposal Title: An Integrated System for Mechanical Reduction of Fuel Loads at the Wildland/Urban Interface in the South

Other proposals to which this is linked**: FPL-32, SRS-4104-3, SRS-4104-4, SRS-4701-1, SRS-4703-1, SRS-4106-01**

RWU and location: **SRS-4104, Disturbance & Management of Southern Pine Ecosystems, Clemson, SC and Athens, GA; SRS-4703, Biological/Engineering Systems and Technologies for Ecological Management, Auburn, AL; SRS-4701, Utilization of Southern Forest Resources, Pineville, LA; SRS-4802, Evaluation of Legal, Tax, and Economic Influences on Forest Resource Management, New Orleans, LA**

Description:
Research or development question, issue, or need: **Prescribed fire is used routinely in the South to reduce fuel loading and decrease the risk of catastrophic wildfires; to improve forest health; and to manage threatened and endangered species. With rapid human population growth, and increasing urban/wildland interface, the ability to use prescribed fire in essentially suburban environments is practically impossible. Nevertheless, fuel reduction treatments still are needed in fire-dominated "urban woodlands." Alternatives to prescribed burning may involve mechanical reduction of current fuel loads and maintenance of low-risk understory through herbicides. Techniques are needed that can effectively reduce fuel loads through mechanical means, and are acceptable to homeowners. Additionally, utilization scenarios need to be identified for this class of raw material to make removal economically attractive to operators.**

Research and development approach: **We propose to develop and validate an integrated system of managing fuel loads in urban woodlands through mechanical means. Three aspects of this research and development project include: (1) developing a vegetation management system that reduces current fuel loading by removal of small diameter, understory material and converts understory vegetation to low risk vegetation such as grasses; (2) validates the effectiveness of this system in reducing risk of catastrophic wildfire; (3) demonstrates the economic viability of the system by using low-cost harvesting methods and developing uses for the removed material; and (4) tests homeowner acceptance of the system by using focus groups in system design and by demonstrating the system in selected suburban areas in the South.**

Outcomes or products:
First Year:

- **Prototype silvicultural and harvesting system, developed under forested conditions**
- **Economic criteria for a profitable system specified**
- **Focus groups of landowners, land-use planners, county emergency management officials held**

- **Alternative products for small-diameter material, including composite wood products development begun**

Second Year:

- **Prototype system tested against simulated wildfire conditions**
- **Demonstration sites located and installed**
- **Composite products evaluated from small diameter material**
- **Website on-line presenting results**

Three to Five years out:

- **Demonstration sites used to transfer technology to landscaping firms, city and county officials, and extension agents**
- **Print and electronic media campaign**
- **Manufacturing agreements developed under CRADAs**
- **Efficacy of herbicides for long-term maintenance tested**

Staffing needs: One GS-460-12 Research Forester, one GS-460-9/11 Forester, one GS-460-12 Research Forester (Economist/Management/Engineer Tech Transfer Specialist)

Description of skills required: **Forest and fire ecology, forest engineering, microeconomic evaluation, polymer chemistry**

Potential Partners: Region 8, S&PF; University of FL, Auburn Univ., Univ. of GA, Clemson Univ., Washington State University, National Renewable Energy Laboratory, State natural resource management agencies

Funding requested: **$500,000/year. Includes scientist salary, support, equipment, travel, and cooperative agreements with university partners. Funded for $250,000**

Team Leader: John Stanturf
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Station: SRS
Proposal code: SRS-4104-8
Topic (from list): **Ciii.**

Proposal title: **Fire and Herbicide Combinations to Reduce the Threat of High Intensity/Severity Fires**

Other proposals to which this is linked (Proposal code): **SRS-4104-3, SRS-4104-4, SRS-4104-5, SRS-4505-1, SRS-4703-1**

RWU (or Program and Team) and location(s): **Disturbance and Management of Southern Pine Ecosystems (4104), Fire Management Team, Athens, GA and Clemson, SC; SRS-4105, Integrated Vegetation Management for Sustaining Southern Forests & Longleaf Pine Ecosystems, Auburn, AL.**

Description:
Research or development question, issue or need: **In the wake of the '98 Florida wildfires, SRS-4104 staff were funded by the JFSB to assess the effects of prescribed burning, partial harvest and herbicides on fire behavior and overstory mortality. That study showed prescribed fire was best for immediate reduction in potential fireline intensity and severity but had to be reapplied every few years. Partial harvest also resulted in immediate benefits but could not be efficiently reapplied at a short-enough time interval. Herbicides had a roughly 2-year lag time after which they provided a substantial reduction in potential fireline intensity for at least 6 years. Fire suppression within 2 years of herbicide application has raised considerable firefighter safety concern from a fire behavior standpoint and answers to this concern are deemed high priority by the Florida Division of Forestry. Moreover herbicide treatment has little effect on forest floor depth (fire severity) so fires during drought periods still result in substantial overstory mortality due to root kill. The Florida industrial forest model currently excludes prescribed fire (threat of litigation, growth loss due to overstory foliage scorch, and nitrogen loss after fertilization), instead relying exclusively on herbicides. Many industrial plantations are adjacent to the rapidly expanding wildland-urban interface resulting in adjacent landowner apprehension regarding wildfires.**

Research and development approach: **Proposed research will build on results of the JFS-funded study. The approach will involve both establishment of study plots where different treatments will be applied, and post-wildfire documentation of herbicide treated stands. Treatments will include up to 3 common herbicides (primarily GARLON), rates of application, and intervals (including season of year) between treatment application and fire. JFS study results suggest an additional treatment, not currently used, might be effective that combines prescribed fire and herbicide. This facet of the study will involve field plots in plantations where prescribed fire will be applied at the time of crown closure, just prior to N fertilization, followed by herbicide application. If a large enough array of wildfires does not occur within the first two years in herbicide-treated plantations, we will negotiate with our industrial partners to install study plots in herbicide treated plantations and burn them under selected conditions to gather the data necessary to evaluate fire behavior.**

Outcomes or products:
First year: **Study plan written, cooperator study sites identified, study plots installed, and treatment application begun. Recent wildfires in herbicide-treated stands investigated.**
Second year: **Complete treatment applications. Begin Analysis of forest floor/soil N losses from prescribed fire-fertilizer treatments. Continue to investigate pertinent wildfires.**

Three to five years out: **Continue to investigate pertinent wildfires. Install additional plots in herbicide-treated industrial cooperator plantations and apply fire treatments. Continue to analyze N losses over time. Begin analysis and interpretation of data, and begin publishing results. Make recommendations to industry on efficacy of combined prescribed fire–herbicide treatment.**

Staffing needs (Scientist years, technician years, etc) by series and grade: (a) = new position, (b) = existing position, (c) = Wade replacement: **(a) GS-11 460/408 Forester/Ecologist (study manager), one GS-7 and one GS-5 462/404 Forestry/Biological Science Technicians; (b) portion of GS-14 460/Research Forester; and (c) portion of GS12-14 460/408 Research Forester/Ecologist.**

Description of skills needed: **qualified prescribed burner, fuels specialist, fire behavior analyst, soil scientist, ecologist, botanist, certified herbicide applicator,**

Potential partners (universities, federal agencies and labs, national forests, states, private companies, etc): **Florida Division of Forestry Bureaus of Forest Management and Fire Control, SRS-4105, GP –The Timber Company, ITT Rayonier, RM-4401, Auburn University, University of Florida, Joseph Jones Ecological Center**

Funding requested: **$500,000/year. Includes scientist and support salaries, equipment, travel, cooperative agreements with university partners and reimbursement to study site cooperators for value of any fire-killed crop trees.**

Project Leader: **John Stanturf**
Team Leader: **Dale Wade**
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Station: SRS
Proposal code: SRS-4XXX-3
Topic(s): **Ci, Cii, Ciii, Dii**

Proposal title: Fuel and fire risk reduction needs of smaller forested land ownerships in the southern wildland-urban interface

Other proposals to which this is linked: **SRS-4XXX-1; SRS-4XXX-2; SRS-4XXX-4; SRS-4104-3; SRS-4104-4; SRS-4104-5; SRS-4104-6; SRS-4104-8; SRS-4104-12**

RWU and location: **SRS-4XXX, Human Influences on Southern Forest Ecosystems: Research in the Wildland-Urban Interface, Proposed new research work unit in Gainesville, FL**

Description:
RD&A Issue and Need: **This research project will address fire and fuel risk reduction needs of smaller land ownerships in the wildland-urban interface. As the wildland-urban interface expands, forested land ownerships are becoming increasingly smaller. Each year there are approximately 150,000 new forest landowners, who own an average land size of 24 acres. By the year 2010, it is predicted that 150 million acres of forested land will be held in pieces of 100 acres or smaller, with an average size of just 17 acres. This has important implication for forest and fire management in the interface, especially in the South where private forest lands are most common. More people will be living in and near forests than ever before, hence traditional methods of reducing fuel loads for larger land parcels may not apply. Prescribed fire remains an important tool for reducing hazardous fuel loads, but it is not the only choice that communities have to manage natural areas. With the use of prescribed fire, fire managers may face complaints from residents from ashes settling in their swimming pools and smoke penetrating their homes. Hence, fuel treatment methods for interface areas, such as mechanical, biological, chemical, and manual methods, and fuel treatment combinations, such as fire and herbicide, must be tested for their effectiveness and permanency. This is particularly important for the South, where fuel loads may grow back to pre-treatment levels within a few years. Additionally, as part of the fuel reduction process, there is a need to identify and evaluate potential markets for biomass fuels.**

Testing of different fuel treatments and fuel treatments combinations for smaller land ownerships within the interface would allow development of guidelines for reducing fuel loads that would aid both fire managers and private land owners. Additionally, the small landowner must have practical tools for assessing and mitigating fire risk around their homes. In addition to recommended fuel treatments, small landowners lack guidelines for assessing and mitigating risk that include defensible space requirements and flammability of landscape plants based on southern conditions. Though the national Fire Wise message has been important for assessing and mitigating risk, it was developed primarily from the western experience – little research has been conducted to adapt these guidelines to southern conditions. There is also a need to evaluate landscape characteristics in post-fire conditions to determine which mitigation methods were most successful at deterring fire.

RD&A Approach: **The main objective of this research, development and application project is to develop practical fuel and fire risk reduction tools for small landowners in the wildland-urban interface. This includes: (1) development of appropriate strategies for reducing fuel loads for smaller land ownerships in the wildland-urban interface areas, including effectiveness and permanency of fuel treatment and removal combinations; and (2) development of guidelines that small landowners can use for assessing and mitigating risk on their properties and around their homes. This project will be accomplished through a combination of applied and basic research, involving Forest Service scientists and cooperative agreements with universities and other research institutions. Development of guideline materials and trainings will be accomplished by hiring a technology transfer specialist and through grants with the cooperative extension service, state forestry agencies, and other natural resource agencies.**

RD&A Outcomes/Products:
First year:

1) **(a) Identify and install plots for evaluation of fuel treatments in a variety of WUI fuel complexes; (b) Measure baseline conditions on plots; (c) Complete first set of treatments on plots.**
2) **(a) Assess/evaluate currently available guidelines for assessing and mitigating risk (for small landowners), determine risk factors for southern conditions; (b) Identify and establish partnerships for developing hazard risk and mitigation guidelines, such as Project Impact and FireWise Communities.**

Second year:

1) **(a) Measure first year response of fuel treatment plots; (b) Retreat plots with multiple treatments or treatment combinations; (c) Identify and evaluate potential markets for biomass fuels.**
2) **(a) Organize and conduct public participation forums for developing risk mitigation opportunities; (b) Research FireWise landscape properties for evaluating and mitigating the vulnerability of homes, such as: (1) flammability of plants; (2) defensible space requirements; (3) fire-safe construction techniques.**

Three to five years out:

1) **(a) Measure responses on all fuel treatment plots and retreat plots requiring a third treatment; (b) Measure regrowth and fuel responses on all plots; (c) Initiate pilot trials of utilization of biomass; (d) Develop an economic analysis of biomass utilization (d) Complete research of FireWise landscape properties.**
2) **(a) Develop guidelines for interface residents for fuel treatment options in different interface fuels/conditions; (b) Develop training materials and conduct trainings based on fire risk and mitigation guidelines.**

Staffing needs by series and grade: **One GS-401/408/460-12/13 Fire ecologist**

Description of skills required: **fire ecology, current research findings and technological advances in fire and fuels management, fuels management, and fire behavior.**

Potential partners: Positive expressions of interest in collaborating in wildland-urban interface research and technology transfer have already been discussed with several organizations. The University of Florida has laid plans for the establishment of a wildland-urban interface center for the South, with budget proposals that would leverage these Forest Service funds. Other potential collaborators are the Southern Group of State Foresters, State & Private Forestry, National Forests, Southern Wildland Interface Fire Team (SWIFT), FireWise Communities Program, Project Impact (FEMA), state departments of natural resources, park departments, state fire management/prescribe fire teams, cooperative extension service, local units of government, homeowner associations, private landowners, The Nature Conservancy (Disney Wilderness Preserve), FL Center for Wildland Fire and Forest Resource Management, and the Tall Timbers Research Station.

Funding requested: $500,000 Funded for $250,000

Team Leaders: **Pete Roussopoulos** **Ed Macie**
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Station: **RMRS**

Proposal code: **RMRS-MCW-1a**

Topic(s): **C-iii, C-iv**

Proposal title: ***Impact of fuel management treatments on fire behavior and forest vegetation***

Other proposals to which this is linked: RMRS-MCW-1b

RWU and location(s): **RWU-4155, Moscow, Idaho**

Description:

- **Research or development question, issue, or need: We need to produce new knowledge on the interactions among fuel management, forest growth, and forest health; and understand how these affect fire behavior. With this knowledge, we can develop a modeling system to predict the effects of fuel management on:**
- **Forest growth, mortality, and regeneration**
- **Wildfire and prescribed fire.**

A companion proposal (RMRS-MCW-1b) deals with soil erosion, soil productivity, microbial processes, and below-ground decomposition of wood.

- **Research and development approach: The three RWU's in Moscow will create an inter-project team to address a new shared RWUD problem on fuel management practices in forest ecosystems of the northern Rocky Mountains. The wildfires of 2000 provide an opportunity to install replicated study designs, which we can use in a combination of retrospective and prospective studies. The first priority will be to choose stands within burned areas that were combinations of tree sizes and densities before the fire, using stratified random sampling. The combinations of tree sizes and densities would primarily be the result of management (e.g., silvicultural treatments such as thinnings and various regeneration harvests) or, secondarily, natural stand structures. Retrospective examination of selected stands will determine stand structures that reduced the catastrophic consequences of wildfires. This knowledge will be used to develop silvicultural prescriptions to reduce the damaging consequences of fire. Prospectively, these same randomly selected stands will be a designed experiment for secondary succession (shrub and forb growth, tree regeneration, invasive species, mortality, decomposition, and response of surviving trees), and the stands will also be used for studies in RMRS-MCW-1b. Other designed experiments include silvicultural treatments to enhance decomposition of surface fuels (manipulate stand structure to optimize moisture and temperature regimes), and silvicultural treatments to reduce the risk of and damage done by reburns (eventual reburn of trees killed by crown fires can cause baking of the soil, volatilization of nutrients, and high rates of erosion). We will also create dynamic linkages between the Fire and Fuels Extension of the Forest Vegetation Simulator**

(FFE-FVS) being developed by RWU-4155 (Crookston), Elliot's Water Erosion Prediction Project (WEPP) model for forest applications (RWU-4702), and Dumroese's wood decomposition models (RWU-4552). The combined modeling system will represent a broad set of processes -- fire behavior, fire effects, mortality, decomposition, erosion, revegetation, tree regeneration, and forest growth -- and the dynamic linkages between these processes. Land managers can use the modeling system to test prescriptions and develop fuel management programs. For example, a land manager can compare leaving coarse woody debris on the site for increasing soil health and productivity to the risk of wildfires that volatilize nutrients and increase soil erosion.

- **Outcomes or products:**
- **First year: Develop a shared RWUD problem analysis among Moscow RWU's 4155, 4702, and 4552; write comprehensive study plans; coordinate studies with partners; build a database from which to conduct stratified random samples; choose study sites and begin retrospective samples; and begin linking FFE-FVS with WEPP.**
- **Second year: Plot installation to measure fire effects; first measurement of growth following fire; implement the other designed experiments; and finish linking FFE-FVS with WEPP.**
- **Three to Five years out: Incorporate findings from these studies into the linked FFE-FVS/WEPP; and continue long-term designed experiments.**

Staffing needs by series and grade:

Existing workforce: **2.0 SY (1.0 FTE GS-12, 0.4 FTE GS-13, 0.6 FTE GS-14).**
1.0 professional (0.4 FTE GS-9, 0.4 FTE GS-12, 0.2 FTE GS-13).

New position(s): **0.5 SY, PFT, silviculture/ecologist with an interest in soils, GS-460-12 (the other 0.5 SY will be shared with the RMRS-MCW-1b proposal).**
1.0 Operations Research Analyst, GS-1515-9/11, 4-year term.
6-7 summer field crews.

Description of skills required: **Silviculture, forest ecology/dynamics, computer programming, statistics, and forest growth modeling.**

Potential Partners: **Primary partners are Moscow RWU's 4702 and 4552, as described in RMRS-MCW-1b. Potential partners are RMRS-RWU-4401 (Fire Behavior) in Missoula, RMRS-RWU-4403 (Fire Effects) in Missoula, Forest Management Service Center in Ft. Collins, University of Idaho, Forest Products Laboratory, and RMRS-RWU-4151 (Forest Ecology) in Missoula.**

Funding requested: **$500,000/per year**

Team Leader: **Dennis Ferguson**
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E-mail: **deferguson@fs.fed.us**

Station: RMRS

Proposal code: **RMRS-MCW-1b**

Topic(s): **C-i, C-iii, B-i, B-ii,**

Proposal title*:* ***Impact of fuel management treatments on forest soil erosion and productivity***

Other proposals to which this is linked: RMRS-MCW-1a

RWUs and location: **RWU-4702 and RWU-4552, Moscow, Idaho**

Description:

- **Research or development question, issue, or need: We need new knowledge on the interactions of fuel management practices with soil compaction, soil erosion, soil productivity, and microbial processes. This new knowledge will be incorporated into the computer-aided management system being developed in proposal RMRS-MCW-1a.**

- **Research and development approach: The three RWU's in Moscow propose to create an inter-project team to address a new shared RWUD problem on the interacting relationships of fuel management practices on forest vegetation and soils. Impacts of fuel management treatments including thinning, salvage logging, microbial decomposition, prescribed fire, and wild fire will be studied in several northern Rocky Mountain ecosystems. These impacts include onsite soil disturbance and erosion and loss of soil productivity, onsite forest health, especially in relation to disease-causing pathogens, and offsite sedimentation and lowering of water quality. A series of studies using paired-watersheds in wet and dry forest conditions will be developed to compare runoff and sediment delivery from different fuel management treatments, similar to current studies carried out by Robichaud (RMRS-4702). Soil wood decomposition studies using standard wooden stakes and established protocols which are similar to ongoing studies by RWU-4552 will be carried out for a range of fuel management treatments. Forest health and soil quality will be assessed using standard protocols developed by McDonald (RMRS-4552), collaborator Jurgensen (Mich. Tech. Univ.) and others. Impacts of fuel management activities on vegetation are addressed in Proposal RMRS-MCW-1a.**

  We will collaborate with RMRS-4155 to link Crookston's work on the Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS) to Elliot's Water Erosion Prediction Project (WEPP) model forest applications from RMRS-4702, and incorporate the results of our fuel management studies as they become available. The combined modeling system will represent a broad set of processes associated with fuel management– fire behavior, fire effects, mortality, decomposition, erosion, revegetation, tree regeneration, and forest growth – and the dynamic linkages between these processes.

- **Outcomes or products:**

    - **First year: Identify proposed watersheds for fuel management activities, and instrument a set of paired watersheds to compare treatments. Identify plots within the study areas. Establish baseline soil and health conditions prior to treatment.**
    - **Second year: Carry out the fuel management treatments on the watersheds. Measure onsite soil impacts, and continue watershed monitoring. Initiate decomposition stake studies on treated sites. Install a second set of paired watersheds.**
    - **Three to Five years out: Carry out second set of treatments. Install a third set of paired watersheds. Continue monitoring watershed processes, decomposition rates, and soil conditions.**

Staffing needs by series and grade:
Existing workforce: Two -0.25 PFT GS 12/13 scientists,
Two -0.25 PFT GS 7/9/11 technician/professional
New position(s): 0.5 SY PFT silviculture/ecologist with an interest in soils,
GS-460-12 (the other 0.5 SY will be shared with the RMRS-MCS-1a proposal)
1.0 GS 9/11 professional soil scientist or hydrologist, 4-year term.

Description of skills required:
Soil science, hydrology, mycology, model development

Potential Partners: **Primary partner is RMRS-4155 (Ferguson) in Proposal RMRS-MCS-1a. Other collaborators include R1 and R4 forests for research sites, Steve Reutebuch, (PNW, Seattle), Bob Rummer (SRS-4703) and Emily Carter (SRS-4703) for thinning operations analysis and site impacts, Kurt Pregitzer (NC 4108) for soil impacts, Marty Jurgenson (Michigan Tech.) for soil impacts and microbial decomposition, University of Idaho.**

Funding requested: **$500,000/year**

Team Co Leaders:	**William Elliot**	**Deborah Page-Dumroese**
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Station: **RMRS**

Proposal code: **RMRS-FTC-6**

Topic(s): **C[i,iii,iv]; A[ii]; B[i,ii]**

Proposal title: ***Development of Management Alternatives for Fire-prone and Fire-dependent ecosystems in Colorado and the Black Hills***

Other proposals to which this is linked: RMRS-FTC-2, 3, 4, 7

RWU and location(s): **RWU4451, Ft. Collins, CO**

Description:

- **Research or development question, issue, or need:**

Human influences have altered the way Rocky Mountain terrestrial ecosystems respond to fire, insects, disease, and other stressors. Throughout Colorado, fire suppression and exclusion has been implicated in the conversion of fire-dependent Ponderosa pine stands to fire-sensitive Douglas-fir stands, in the retrogression of pure aspen stands to mixed conifer-aspen or pure conifer stands, and the increasing incidence of insects and diseases. In the Black Hills, the ponderosa pine ecosystems have been intensively managed for many years. Fire suppression and exclusion throughout the Central Rocky Mountain ecosystems has resulted in conditions that are poorly understood in terms of their ecology. In many of these western ecosystems, risk of catastrophic natural disturbances has become probable. Knowledge is, therefore, needed on the ecological and environmental consequences of management alternatives for treating the current high fuel levels in these fire-prone ecosystems, on the climate-vegetation conditions under which these management alternatives would be effective, and on the interaction of fire and fuel treatment management with other disturbance processes such as insects and disease.

- **Research and development approach:**

RWU4451 scientists are actively working to understand the role of the disturbances of insects, disease, air pollution, climate change, and silvicultural management activities on Front Range and Black Hills ecosystems. The addition of a fire ecologist would help integrate knowledge of how fire interacts with these disturbances. Specially, RWU4451 proposes to develop information and knowledge (1) on the role of natural disturbances and forest management activities in maintaining healthy forests ecosystems in the West; (2) on the ecological response of these fire-suppressed ecosystems to natural disturbances of insects, disease, and timber management treatments, including regeneration patterns, seedling establishment, endemic levels of insects and disease, and responses in the forests' nutrient and carbon dynamics; (3) to develop effective and cost-efficient vegetation manipulation techniques to mimic the fire disturbances when fire is not a viable alternative by establishing benchmarks for the current ecosystem processes, determining the direction of change in these ecological processes, and the development and testing of management treatments to maintain a broader spectrum of ecological conditions along the Front Range

and Black Hills and (4) to develop and test where possible, management techniques that make fire a viable option for resource management.

- **Outcomes or products:**
  - **First year:**

Establish fire ecology studies with RM4451 scientists on the role of natural disturbances and forest management activities in maintaining healthy forests ecosystems and on the ecological response of these fire-suppressed ecosystems to natural disturbances of insects, disease, and timber treatments, including regeneration patterns, seedling establishment, endemic levels of insects and disease, and responses in the forests' nutrient and carbon dynamics.

  - **Second year:**

Report on interaction of natural disturbances, fire, and vegetation treatments in maintaining healthy forest ecosystems and in fire-suppressed ecosystems.

  - **Three to Five years out:**

Develop effective and cost-efficient vegetation manipulation techniques to mimic fire disturbances when fire is not a viable alternative. Develop management treatments to maintain a broader spectrum of ecological conditions along the Front Range and Black Hills. Identify environmental conditions and management techniques for the appropriate use of fire as resource management in fire-adapted and fire-prone ecosystems.

  - **Five to Ten years out:**

Knowledge gained under this research is fundamental in the development of guidelines for sustainable land management of Western fire-prone and fire-dependent ecosystems.

Staffing needs:

Existing workforcee: RM4451 Silviculturist, Physiological Ecologist, Entomologist, Plant Pathologist

New position: GS 12-14 Fire Ecologist; GS 7-11 Technician

Description of skills required: **Ability to quantify the impact of fire on ecology of forests; ability to quantify interactions between fire and other disturbance processes; ability to work within an interdisciplinary team (plant physiology, entomology, silviculture, meteorology, micrometeorology, plant pathology)**

Potential Partners: **RWU4451 and RMRS scientists; scientists working in Front Range and Black Hills ecosystems (e.g., Manitou and Black Hills Experimental Forests); NFS managers**

Funding requested: **$500,000/year**

Team Leader: **Linda Joyce**
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Station: **RMRS**
Proposal code: **RMRS-FLG-2**
Topic(s): **C.iii., C.iv., B.ii., B.i.**

Proposal title: ***Improved guidelines for fuels management in southwestern ponderosa pine and pinyon-juniper forests in wildland-urban interface areas***

Other proposals to which this is linked: RMRS-FLG-1,3,4,5; RMRS-FTC-6,7; SRS-4703-1, PSW-4403-3

RWU and location(s): RMRS-4156, 4251, 4651, 4152, 4302

Description:

- **Research or development question, issue, or need: This proposal builds on previously developed research program plans for fuels management and forest health restoration in the Southwest by focusing on improved silvicultural guidelines for ponderosa pine forests and extending into pinyon-juniper forests. The Southwest has experienced unprecedented human population growth in forested areas during the past 20 years. Since 1992, large wildland fires have consumed 2,900,0000 acres in Arizona and New Mexico with many fires resulting in significant property damage and impacts to municipal watersheds. Management approaches for forest restoration and fuels reduction currently under study are being challenged due to unacceptable changes in forest character, lack of understanding of cumulative effects of treatments, and potential for adverse effects on wildlife habitat. If fuels management treatments are to move forward in the Southwest, new publicly supported and sound silvicultural fuels management strategies that sustain human, forest ecosystem and resource values, and maintain or restore forest productivity and resilience to disturbance are needed.**

- **Research and development approach: We propose a two-phase approach that first involves a comprehensive regional assessment of past vegetation and fuels management practices in areas which have burned during the past decade to examine successes in modifying wildfire behavior, effects on invasive species, and beneficial mosaic landscape patterns of wildfires (linked to proposal RMRS-FLG-1). Vegetation management and prescribed burning treatments that show promise in meeting management objectives for interface areas from the first phase will be documented and prescriptions refined for implementation, demonstration, analysis, and evaluation in the second phase in collaboration with National Forest System managers, community based sustainable forestry partnerships, and environmental activist organizations willing to participate. Experimental implementation will be structured to be compatible with the national study of Fire and Fire Surrogate Treatments supported by in part by the Joint Fire Science Program but at larger scales more compatible with management implementation. These treatment areas will provide laboratories for studies of fire behavior (in proposal RMRS-FLG-6), and studies of forest operations by SRS, treatment feasibility by PNW, and product potential by FPL. This phase will focus on response of overstory and understory vegetation, fuels, and interactions with forest insect pests and pathogens to fuels and**

vegetation management alternatives and will be linked to related investigations of threatened, endangered, and sensitive wildlife populations and habitat (proposal RMRS-FLG-4), exotic and invasive plants and invertebrates (proposal RMRS-FLG-5), soils and watershed condition (proposal RMRS-FLG-3).

- **Outcomes or products: The objective is to provide resource managers with the scientific basis for adaptive management at landscape scales.**
  - **First year: A comprehensive regional assessment of past vegetation and fuels management practices in areas which have burned during the past decade to document the effects of those practices and forest stand conditions on fire severity and effects. A web site will be developed to ensure this information is readily available.**
  - **Second year: Develop, review, and refine fuels and vegetation management prescriptions tailored to wildland-urban interface areas. Select suitable areas for implementation of treatments, initiate inventories of pre-treatment conditions and treatment implementation in areas with completed environmental analyses.**
  - **Three to Five years out: Complete pre-treatment inventories, treatment implementation, and post-treatment monitoring. Provide improved adaptive guidelines for fuels management including refined uneven-aged management, timing and intensity of prescribed burns. Transfer technology to resource managers through workshops, field trips, consultations, and publications. Participate in public tours of study areas for demonstration and education.**

Staffing needs by series and grade:
Existing workforce: GS-408 (Moir, Sieg), GS-414 (Clancy, Lynch), GS-434 (Geils), GS-460 (Edminster, Gottfried), GS-470 (Neary, Overby), GS-486 (Block, Ganey, Grubb, Reynolds) New position(s): 1 SY GS-460-13,14 Research Forester (Silviculturist), 3 TY equivalents, GS-462-7,9 Forestry Technicians.

Description of skills required: **Research Forester and technical support with a background in silviculture, fire ecology, fuels management and forest stand dynamics in southwestern forests.**

Potential Partners: **Research collaborators - Universities: Arizona, Northern Arizona, Arizona State, New Mexico, New Mexico State, Colorado State, Fort Lewis, Stephen F. Austin State; DOE Los Alamos National Laboratory, USGS Biological Resources Division, Forest Products Laboratory, Fire Science Labs at Missoula and Riverside, SRS, PNW, PSW, The Nature Conservancy. Partners include Regions 2, 3, 4 NFS and FHP, BLM, BIA, USFWS, NPS, NRCS, Four-Corners Sustainable Forests Partnership, Grand Canyon Forests Partnership, Southwest Forest Alliance, Forestry Divisions in Arizona, New Mexico, Utah, and Colorado.**

Funding requested: **$500,000/year**

Team Leader: **Carl Edminster, Research Forester/Project Leader, RMRS-4156**
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Station: **RMRS**

Proposal code: **RMRS-MSO-15**

Topic(s): **Ciii, iv; Bii;**

Proposal title**:** ***Evaluation of restoration techniques in subalpine communities using prescribed fire and silvicultural techniques for fuels management including dynamics and biocontrol of exotic weeds in the Northern Rockies***

Other proposals to which this is linked: RMRS-MSO-9, RMRS-MSO-8, MSO-13

RWU and location: **RMRS-4151, Bozeman, MT**

Description:

- **Research or development question, issue, or need: With nearly 15 million acres of commercial forests in the Rocky Mountains and more than 4.8 million in Montana alone, lodgepole pine is the fourth most extensive timber type west of the Mississippi River and the third most extensive in the Rocky Mountains. Contrary to the leading paradigm that lodgepole pine forests result almost exclusively from stand-replacement wildfire, there is strong evidence that many lodgepole pine forests in the interior West were historically in a multi-aged stand structure, implying that natural disturbances do not necessarily result in total consumption and subsequent replacement of entire stands. Currently, however, many lodgepole pine stands are in late-successional stages containing high fuel loading; these stands are at high-risk to catastrophic-scale fires such as occurred in 2000. For example, much of the area burned along the east side of the Bitterroot Valley in western Montana was in these late-seral, lodgepole pine forests. There is critical need for developing and assessing techniques that restore stand structure and species composition to mimic or facilitate natural processes. However, such activities may also render these landscapes susceptible to invasion by weedy species.**

- **Research and development approach: The recently-implemented Tenderfoot Research Project on the Tenderfoot Creek Experimental Forest provides a unique opportunity to evaluate innovative silvicultural treatments that address current National Forest system management goals of sustaining healthy forest ecosystems through the use of prescribed fire. Questions include: 1) What are the ecological and biological effects of prescribed fire in lodgepole pine stands, under two levels of shelterwood treatments and in non-treated stands on fuel loading, vegetation development (regeneration, understory development, noxious weeds, and tree growth), and hydrologic responses? 2) What are the effects of prescribed fire on damaged reserve trees and what is the longevity of snags? 3) Are current hydrologic, vegetative, and fuel-dynamic models adequate for lodgepole pine types? 4) What is the rate and extent of weedy invasion, and the utility of biocontrol techniques on these invaders?**

- **Outcomes or products:**
  - **First year: Implement prescribed fires; develop demonstration sites for internal and external-public education; write publications describing pre-treatment conditions, climate and hydrologic characteristics. Survey existing and new weed populations and biocontrol agents; develop herbarium collections of weed species.**
  - **Second year: Monitor postfire conditions; write publications and develop professional and lay presentations describing mixed-severity fires in treated subalpine forests; control effort recommendations to prevent establishment and spread of exotic species via workshops with managers; GIS databases of geo-located weed populations**
  - **Three to Five years out: Continue monitoring; write publications and develop professional and lay presentations describing watershed-level effects of logging and prescribed burning on water quantity and quality and vegetation response, and aggressiveness of weed species. Workshops and publications communicating recommendations on fuels reduction treatments, minimizing weed seed transport/establishment.**

Staffing needs by series and grade:
Existing workforce: 1 SY GS-460-13 Research Forester, 0.25 GS-435-12 Research Plant Physiologist, 0.75 TY GS-401-11 Biologist, 0.5 PY GS-460-11 Forester
New position(s): 1 SY GS-408-12 Research Ecologist; 1 TY GS-460-7 Forester, 1 TY; two (0.3 TY) GS-460-5 Forester or GS-401-5 Biologist, temporaries

Description of skills required:
New scientist GS-408-12; Ecologist with expertise in plant communities, to scale up knowledge of stand-level vegetation response to the landscape level and develop successional pathways for vegetation modeling under varying disturbance regimes and management scenarios. Research Forester to coordinate project as a whole, and Research Physiologist to assess physiological status (health) of trees. Additionally, technicians and professionals with forestry background with field experience and ability to organize and supervise field crews, as well as assist with data entry and analysis.

Potential Partners: **Colin Hardy and Steve Sutherland, RM-4403, Missoula; University of Montana, Don Potts and Robert Pfister; Bitterroot Ecosystem Management Research Project; USFS Northern Region (R1) – Lewis and Clark National Forest; The Natural Resources Conservation Service (NRCS) – Jerry Beard; USGS Mississippi River Basin Carbon Project.**

Funding requested: **$500,000/year**

Team Leader: **Ward McCaughey/George Markin, Bozeman, MT**
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**********8

Station: **Pacific Southwest Research Station (PSW)**

Proposal Code: **PSW-4202-2**

Topic: **C.iv**

Proposal Title: **Effects of Fuel Reductions on Stream Ecosystems: Southern Sierra Nevada, California**

Other proposals to which this is linked: **PSW-4251-2**

RWU: **4202, Montane Ecosystems in the Sierra Nevada Mountains, Fresno, CA**

Description:

Research or Development Question, Issue, or Need: **The proposed research will address two general needs identified by the National Fire Plan. Determine the magnitude and duration of effects from fuels treatments on stream ecosystem health and environmental quality. Characterization of interactions between fire, land management treatments and climate variability on forest stream ecosystems. In 1996 the Sierra Nevada Ecosystem Project stated, "Aquatic/riparian systems are the most altered and impaired habitats of the Sierra." While some data exist on the effects of wildfire on stream ecosystems, almost no information exists for prescribed fire effects. Whether prescribed fire should be allowed in riparian zones is currently being debated under the Sierra Nevada Framework Project. No landscape scale watershed experiment exists in the Sierra Nevada with its moisture-stressed forests. Ideally there should be a northern and southern set of watershed sites. The lack of integrated and long-term ecosystem studies has limited the ability of research to supply answers to forest managers. In 1998 the Pacific Southwest Research Station requested the addition of a hydrologic study to the Kings River Sustainable Forest Ecosystem Project (KRP), so planning for the Kings River Experimental Watershed started. However, funds are needed for a long-term replicated study. The requested funds would ensure the establishment of an experimental watershed in the Sierra Nevada with at least three treatment groups. To determine whether forested ecosystems can be managed to maintain essential components and still support a variety of uses, the Pacific Southwest Research Station teamed in 1994 with the Sierra National Forest in an adaptive management Administrative Study. Initial research addressed California spotted owl demographics, small mammals, and forest birds on the KRP (61,000 ha). Recently research on Pacific fisher, stream ecosystems, and remote sensing of forest structure was added. The KRP seeks to perform holistic, integrated ecosystem research at the landscape scale. Geographic co-location of studies and team planning of treatments facilitates integrated research addressing effects of fuels treatment on terrestrial and aquatic ecosystems. We know that wildfire increases sulfate, nitrate, and sometimes ammonium concentrations in stream water and soils. Fire can cause decreases in soil extractable phosphorus, however, because of precipitation with calcium released from fuels after fire. No such mechanism for phosphorus immobilization should occur after thinning. Thus we hypothesize that levels of stream sulfate will increase and nitrate, ammonium, and phosphate will decrease immediately after prescribed fire whereas after thinning treatments nutrients will likely**

increase. We also expect that concentrations in streams will return to baseline levels after a few years; however, we are unsure if there will be any cumulative effects over time. Whether these chemical changes will affect stream organisms is unknown but will be evaluated with invertebrates and periphyton. Inclusion of measurements on additional species such as frogs and salamanders would be both cost effective and integrative so interdisciplinary collaboration is being encouraged on the experimental watershed. State and industry involvement is also being sought.

Research and Development Approach: **A long-term, paired watershed study design is proposed to determine the magnitude and duration of effects from prescribed fire and mechanical treatment (possible fire surrogate) on forest stream ecosystems. Each treatment group consists of four watersheds: a control watershed, a prescribed fire treatment watershed, a mechanical treatment watershed, and a combined mechanical and prescribed fire treatment. The fire treatments will burn through riparian areas. One of the strengths of the KRP is the scale of the landscape treatments: 100- to 200-ha watersheds. Results can be compared for soils and, where measured, stream chemistry with the 4-ha plots on the adjacent Teakettle Experimental Forest, the Fire Surrogate Study sites in the Sierra Nevada (J. McIver), and the 0.4-ha plots at a new Lake Tahoe Basin site (D. Johnson). A minimum of three years of pre-treatment data will be collected, and 7 to 10 years of post-treatment data will be collected. Each stream will have flumes and automated sampling for stream discharge, nutrients and other water chemistry, and turbidity. Weather data will be collected for each treatment group. Changes in soil nutrients and chemistry will be monitored with resin and vacuum lysimeters located through each watershed. Bedload sediment will be measured with sediment basins. Stream invertebrates and periphyton will serve as biological indicators. Pre-treatment and post-treatment fire modeling will be used for design and analysis of results. Three instrumented treatment groups (4 watersheds each) in the southern Sierra Nevada is the initial goal. The ability to locate all three groups in the KRP is being investigated now; other locations could include the Stanislaus or Sequoia National Forests. The Sierra National Forest and Southern California Edison approved one group location, and a pilot project to evaluate instruments and designs is ongoing for two watersheds in 2000. Results from the pilot will guide additional instrument decisions and study design.**

Outcomes or Products:

First Year: **Complete instrumentation of treatment group 1**

Second Year: **Complete instrumentation of group 2, first year data collection**

Three to Five Years Out: **Summarize data and evaluate fuels treatment differences, continue to determine long-term effects and extend studies to additional sites.**

Staffing Needs: **GS-1315-11 Hydrologist and GS-7 Hydrology technician**

Description of Skills Required: **(1)**

Potential Partners: **Sierra National Forest and Region 5 (Kings River Administrative Study); Southern California Edison (J. Mount); University of California, Santa Barbara (S. Cooper), existing agreement for design of stream invertebrate research; University of Nevada, Reno (D. Johnson), existing agreement for design of soil research; California State University, Fresno; PSW, Redwood Sciences Lab (hydrology and sediments), Riverside Lab (water chemistry and fire modeling), Redding Lab (fire modeling)**

Funding requested: **$400,000**

Team Leader: **Dr. Carolyn T. Hunsaker**
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Station: **Pacific Southwest Research Station (PSW)**
Proposal Code: **PSW-4155-1**
Topic: **B-ii**

Proposal Title: **Effectiveness of alternatives to fire in reducing fuels in shrublands within California's coniferous forest.**

Other Proposals to which this is Linked:

RWU: **PSW-4155, Ecology & Mgmt of Western Forests Influenced by Mediterranean Climate, Redding, CA**

Description:

Research or Development Question, Issue, or Need: **Woody shrubs and noxious weeds invading following fire create immense fuel problems in wildland/urban interface regions of the west and delay the return of forest cover. Fuel reduction strategies using fire prescriptions exacerbate the problem (these plants are fire-adapted and most resprout) and result in substantive losses in ecosystem carbon and nitrogen through combustion. Further, air quality concerns will reduce the use of prescribed fire in the future. Alternatives are needed that reduce fuel risk while maintaining or improving the capacity of the site to store carbon.**

Research and Development Approach: **A series of sites currently supporting shrubfields with scattered conifers have been identified on the Klamath, Shasta-Trinity, and Tahoe National Forests (Goosenest, Mt. Shasta, and Sierraville Ranger Districts), and many other sites also are available. Proposed treatments will (a) reduce fuel levels, (b) retain site organic carbon, (c) enhance soil properties such as nutrient- and water-holding capacities relative to tree growth. Treatments applied to operational-scale plots include:**

1. **Control (no perennial shrub treatment. Carbon retained in living biomass)**
2. **Hand removal of perennial shrubs (living carbon removed, detritus retained on the site)**
3. **Chemical elimination of perennial shrubs followed by prescribed fire (carbon volatilized)**
4. **Mastication of perennial shrubs (carbon retained as a chipped, surface mulch)**
5. **Fine mastication of perennial shrubs, and incorporation into surface soil.**

Treatment 5 (above) is particularly innovative, and carries the added benefit of improving soil organic matter (for longer carbon sequestration, better physical and chemical properties, and enhanced nutrient cycling). A prototype of this treatment has been installed on the Sierra National Forest, and in the southern pine region of the U.S.

The proposed sites are typical of forest shrublands that dominate the forest/urban interface. There, fuel control through prescribed fire often is impractical. Yet, the rapid buildup of fuels creates a strong threat to the public safety and to reforestation success. Therefore,

findings from this study of alternatives to fire will have immediate value and broad application. Scientific applications concern carbon sequestration or release under alternative fuel management strategies.

Outcome or Products: **Manuscripts within the first 6 years will include the following:**

First Year: **Cost effectiveness of fuel reduction and subsequent control of vegetation, including noxious weeds.**

Three to Five Years Out: **Growth response of released trees; soil response in terms of organic carbon, nitrogen and nitrogen availability, microbial and soil faunal dynamics including respiration; relative value of N-fixing shrubs; and treatment effects on soil erosion. Collaborative work planned with the Desert Research Institute will include the role of N-fixing shrubs in soil carbon and nitrogen accretion.**

Staffing Needs: **Plant Ecologist GS-408-12/13. Funds for cooperative agreements with the Desert Research Institute (Dr. Dale Johnson) and the University of California (Dr. William Horwath) will support collaborative research in N fixation and soil carbon and nitrogen dynamics. Funds for cooperative agreements with Chico State University (Dr. Samuel Beattie) will support phospholipid fatty acid and ergosterol soil analyses. Full support is needed for two GS-5 and GS-7 summer employees, one GS-9 term employee. Partial support is needed either for two GS-9 permanent, part-time employees or one full-time GS-9.**

Description of Skills Required: **Strong background in vegetation dynamics and soil science (esp. nutrient cycling, soil microbiology, soil entomology). This expertise currently exists at PSW. Technical support in the field and laboratory is needed. Adequate laboratory facilities are available.**

Potential Partners: **Desert Research Institute and University of California**

Funding Requested: **$300,000**

Team Leader: **Dr. Robert F. Powers, PSW, Silviculture Laboratory, Redding, CA**
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Station: **Pacific Southwest Research Station (PSW)**

Proposal Code: **PSW-4403-4**

Topic: **C iii**

Proposal title: **Fire-Related Erosive Processes in Southwestern Ecosystems.**

Other Proposals to which this is Linked: RMRS-FLG-3, PSW-4403-2

RWU: **4403, Prescribed Fire and Fire Effects, Riverside, CA**

Description:

Research or Development Question, Issue, or Need: **The southwestern U.S. is prone to significant post-fire soil erosion that has annually resulted in millions of dollars of damage and cleanup costs. Local agencies routinely manage the eroded sediment with engineering works (debris basins and retention structures) to minimize the impact of post-fire catastrophic erosion on life, property, and infrastructure. Other approaches to manage sediments in semiarid steeplands may be possible. The use of prescribed fire has been suggested as a sediment management tool, but this idea has never been rigorously tested and evaluated. Prescribed fire may be a low cost alternative to the current catchment program or it might be used to lengthen the time between and reduce the costs of debris basin cleanouts. The impact of other fuel treatment methods on erosion and sedimentation processes is also unknown.**

Research and Development Approach: **Soil erosion and transport in drylands consists of quasi-continuous hillslope erosion and episodic transport of the accumulated material through channel systems. Fire greatly accelerates soil erosion and sediment transport, and may be the disturbance event to which the physical landscape is adjusted. We will develop an understanding of the entire progression of sediment production and hydrologic transport before, during, and after fire events. Understanding the time dependence of the processes will enable us to develop guidelines for using prescribed fire to manage sediment. Laboratory and field-scale experiments in areas such as experimental forests and where opportunities arise will be used to understand and quantify the physical processes of post-fire sediment production and transport. The empirical data will be used to test existing theoretical models of erosion, routing, and sediment yield and adapt them to semiarid steeplands. The data and model outputs can be included in various fire planning and other economic models to determine cost-effectiveness.**

Outcomes or Products:

First Year: **Synthesis of existing knowledge and data related to sediment production and transport in southern California ecosystems. Development and installation of studies to quantify post-fire sediment production and channel transport in selected watersheds (such**

as the San Dimas Experimental Forest). Measurement of established study sites to determine time dependence of post-fire erosion processes.

Second Year: **Development of preliminary sediment management guidelines using 1st year data synthesis. Economic analysis of existing data and preliminary management guidelines.**

Three to Five Years Out: **Improved understanding of sediment production and transport for test sites. Analysis and framework for the theoretical modeling of these processes. Guidelines for use of prescribed fire to manage sediment that incorporates both the ecological and economic impacts.**

Staffing Needs: **GS-1350/0470-12- Geomorphologist/Geologist/Soil Scientist, 1 SY/yr; GS-7 Physical Science Technician, 1 TY/yr; GS-1315-12 Hydrologist, 1 SY/yr; GS-1315-7 Hydrologic Technician, 1 TY/yr.**

Description of Skills Required: **For geomorphologist--knowledge of how fire, landform, parent material, and soil structure influence hillslope erosion processes in dryland systems. Ability to analyze data and develop or adapt physically based models of hillslope erosion processes. Understanding of hydrologic processes sufficient to integrate hillslope models with channel transport models developed by hydrologist. For hydrologist-- knowledge of how fire, landform, parent material, soil structure, and hydrologic processes influence channel transport in dryland systems. Ability to analyze data and develop or adapt physically based models of channel transport processes. Understanding of hillslope erosion processes sufficient to integrate channel transport models with hillslope erosion models developed by geomorphologist.**

Potential Partners: **PSW-4402, UC Berkeley, UC Riverside, S. Cal. NFs, USGS, NPS, BLM, RMRS**

Funding requested: **$500,000/yr**

Project Leader: **David R. Weise**
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Station: Pacific Southwest Research Station (PSW)

Proposal Code: **PSW-4355-5**

Topic: **C.iii**

Proposal Title: **Integrating Focal Species and Ecosystem Perspectives to Assess the Effects of Wildland Fire and Landscape-level Fuels Treatments on Wildlife III: California Spotted Owl Component**

Other Proposals to which this is Linked: PSW-4355-3,4,6

RWU: **4355, Davis, CA; 4202, Fresno, CA;**

Description:

Research or Development Question, Issue, or Need: **A lack of basic understanding about the effects of wildland fire and alternative fuels treatment strategies on forest ecosystems and species introduces substantial uncertainty into management decisions that must address multiple resource objectives. This problem is particularly acute in bioregions, such as the Sierra Nevada, where controversy and direct conflict exists between potential fire risks to human life, property, and wildlife habitat versus potential deleterious effects of stand and landscape-scale treatments on TES wildlife species. The objective of this proposal package (this proposal and related proposals – D.Lee, J.Keane, B.Zielinski) is to provide critical pieces of the foundational information needed to evaluate the effects of fire and fuels treatment strategies on forest species and ecosystems. Development of comprehensive fire management strategies to meet multiple resource objectives will need to be based on an understanding of how treatments affect key forest ecosystem processes, structure, and ecological interactions, and in turn, how these factors influence the distribution, abundance, and population dynamics of focal predators.**

Research and Development Approach: **This proposal is part of a comprehensive package that advocates integration of the focal species concept with an ecosystem perspective. The California spotted owl is one of four focal species that will be addressed in this proposal package (see proposal JKeane-1) due to their association with old forest conditions, large-spatial requirements, and the uncertainty that exists regarding the effects of fire and fuels treatments (e.g., DFPZs, Area Treatments, Thinning) on their habitat and populations. The previous proposal (JKeane-1) addresses the effects of fire and fuels treatments on a select group of prey utilized by California spotted owls and other focal predators. This proposal focuses on direct studies of fire and fuels treatments on California spotted owl and populations. The specific objectives of this proposal are to address how fire and fuels treatments affect: 1) habitat use patterns of California spotted owls at the stand and landscape scales; and 2) demographic parameters and habitat quality at the home range and landscape scales. For example, how do fuels treatments (e.g., prescribed fire, thinning) affect California spotted owl nesting habitat and quality? How does fire and fuels treatments affect California spotted owl populations at the landscape scale? Together the**

information garnered from this research, in conjunction with the research proposed in the comprehensive proposal package, will help inform management decisions about how to apply fuels treatments to achieve safety and ecosystem goals while at the same time minimizing potential negative effects on focal species and the species on which they depend.

All aspects of the research will be fully integrated with efforts to develop an integrated framework for assessing fire and fuels treatment risk (D. Lee proposal) and will be designed to assess treatment effects through coordination with existing and proposed experimental projects (Weatherspoon proposal) and land management activities occurring in the Sierra Nevada (e.g., Herger-Feinstein Act, Sierra Nevada Framework Project EIS).

Outcomes or Products:

First Year: **The integrated sampling design and preliminary modeling should be developed and ready for testing in the Sierra Nevada within 6-12 months. Tasks 1-2 will be conducted within 5 years.**

Staffing Needs: **GS-0486-12/13 Wildlife Biologist; 2 technician years (Grades 9/11) per year for at least 5 years; seasonal technicians (Grades 3/5/7) for at least 5 years.**

Description of Skills Required: **Lead scientist must have broad-based ecological knowledge and experience with raptors, study design, data analysis, and modeling. Technicians must be proficient in field sampling methodologies, GIS, and data analysis.**

Potential Partners: **NFS Regions 5, PSW, RMRS, various universities (University of California Davis and Berkeley, Colorado State University, Oregon State University), California state agencies, and Department of the Interior researchers.**

Funding Requested: **A number of economies of scale could be realized if all components of the proposal package (I-IV) are funded. If this were the case, funding for TMIS component would be about $300,000/yr. Alternatively, if this project were funded independently the cost would be about $425,000/yr.**

Team Leader: **John Keane**
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Station: **PNW**
Proposal code: **PNW-14**
Topic(s): **C-iii**

Proposal title: **Fuel Reduction and Forest Restoration Strategies that also Sustain Key Habitats, Species, and Ecological Processes in Fire-Prone Ecosystems in the Interior Northwest**

Other proposals to which this is linked (Proposal code): PNW-13, RMRS-BOI-3

RWU (or Program or Team) and location(s):
Managing Disturbance Regimes Program (PNW-4577)
Eastside Forest Health Restoration Team, Wenatchee WA

Description:

- Research or development question, issue, or need: **Although the effects of past forest management practices on altering fire regimes are relatively well know, new management treatments to alleviate those problems and their potential effects on key habitats and species are not well understood. Information is needed to design treatments, and to determine the effects of treatments alternatives, including no treatment, on key ecological processes and elements of biodiversity, particularly late-successional forests, keystone species such as woodpeckers, and T&E species.**

Late-successional forest (LSF) and associated species, such as woodpeckers and the northern spotted owl, are critical ecological components of fire-prone landscapes, and drive much of the controversy over land management tactics and strategies. Management needs both to maintain and restore those habitats, but landscapes with altered fire, insect and pathogen disturbance regimes make that task risky and success uncertain. Managers need to know what, how, and where to be successful, so we need to study (1) where those habitats are most sustainable, (2) the stand and landscape habitat needs of dependent wildlife, and (3) the effects of alternate management treatments at stand and landscape scales.

- Research and development approach: **There are 2 components of this program: (1) Research as the basis for designing appropriate treatments; and, (2) Development and testing of those treatments. A basic research component will provide knowledge for understanding ecological pattern and process for designing viable stand and landscape management strategies. We will: (A) Study the stand dynamics (i.e., succession and disturbance) of LSF to understand microhabitat development (e.g., large trees, snags, woody debris), and macrohabitat landscape dynamics; (B) Develop models for predicting locations of historical fire refugia of late-successional forest (i.e. where most sustainable) in the interior Northwest, primarily using the extensive landscape dataset from the Interior Columbia Basin Ecosystem Management Project; and, (C) Study habitat relationships, population dynamics, and ecological function of LSF-associated species.**

The second component of research will develop and apply those basic data to the development and analysis of management strategies. We will help NFS develop fuel and

stand treatment options. We will do experimental and retrospective analyses of the effects of wildfire, prescribed burning, thinning, combined thinning and burning, and no treatment on biotic patterns and processes of vegetation and wildlife. Short-term retrospective studies across the region (and Stations) will provide immediate information, especially for conditions or practices that cannot be manipulated experimentally (e.g., wildfire). Longer-term experimental studies in collaboration with NFS, other Stations (RMRS and PSW in particular), and universities will be conducted. For example, PNW currently has 2 of the 11 study sites in the national Fire and Fire Surrogates Study of the Joint Fire Sciences Program, with others in Montana (1), California (3), Arizona (1), New Mexico(1), Ohio (1), South Carolina (1), and Florida (1). Other local examples on the Okanogan and Wenatchee National Forests, and elsewhere, can be cited.

- Outcomes or products:
  - First year: **(1) Develop study plan in conjunction with RMRS-Boise (V. Saab) for regional (WA, OR, ID, MT) retrospective study of wildfire, prescribed fire, and no-fire effects on vegetation and wildlife. (2) Expand current basic studies of disturbance and successional dynamics of late-successional forests in the eastern WA Cascades to the rest of the region, and further develop landscape models for predicting the best locations for maintaining or restoring LSF in dry forests. (3) Leverage current wildlife studies or existing NFS adaptive management studies without a wildlife component to collect, analyze, and publish additional wildlife ecology data; (4) Build capacity by converting current term research forester, GIS analyst, and staff ecologist positions to permanent.**
  - Second year: **(1) Develop experimental study plans to validate currently planned adaptive management projects that are part of the Dry Forest Management Strategy of the Okanogan and Wenatchee National Forests (OWNF). Attempt to extend that work to the Colville and other regional NFs. (2) Implement retrospective study and continue basic studies from first year. (3) Develop and test late-successional forest prediction models. (4) Publish leveraged wildlife studies.**
  - Three to five years out: **(1) Finish retrospective fire strategy study and publish findings. (2) Implement collaborative research management studies with OWNF planned in 2nd year. (3) Publish on late-successional forest disturbance ecology and predictive models, and integrate models in decision analysis models. (3) Publish leveraged wildlife studies.**

Staffing needs (Scientist years, technician years, etc) by series and grade:

- 1.5 scientist-year (75% new Research Forester, 25% existing Research Wildlife Ecologist), GS13/14;
- 1 staff-year professional/technician GS-11 split between ecologist and geographer/spatial analyst;
- Field technicians.

Description of skills required:

- **<u>Scientists</u>: Vegetation/silviculture scientist (new), wildlife ecologist.**
- **<u>Professional/technicians</u>: GIS analyst (new) and wildlife ecologist (new)**

Potential Partners: **Okanogan and Wenatchee National Forests; Colville National Forest; RMRS RWU-4353 (Boise, V. Saab); University of Washington (James Agee); University of Montana (Paul Fiedler, Scott Mills); WA Dept. of Fish and Wildlife; WA Dept. Natural Resources; Yakama Indian Nation.**

Funding requested: **$500,000 per year**

Team Leader: **John Lehmkuhl (Ann Camp)**
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Station: **RMRS**

Proposal code: **RMRS-FTC-2**

Topic(s): **C[i,iv]; A[ii]**

Proposal title: ***Use of remote sensing to examine the effect of diseases, insects, and other disturbances on the incidence and spread of wildfire***

Other proposals to which this is linked: RMRS-FTC-6

RWU and location(s): **RWU4451, Ft. Collins, CO**

Description:

- **Research or development question, issue, or need: Wildfires change a forest landscape in ways that often influence the occurrence, distribution, and epidemiology of forest diseases, insect pests and other small-scale disturbances. Different disturbances, in turn, commonly cause characteristic patterns of mortality across the forest landscape that influence ignition potential, rate and direction of spread, and intensity of wildfires. This reciprocal relationship is well recognized, but has never been well studied, primarily because quantitative tools to characterize such interactions are lacking.**

- **Research and development approach: Our research approach involves adapting and expanding methods that Lundquist and colleagues have developed in a series of recent studies. These published studies have focused on estimating hazard of diseases and other disturbances with multivariate predictors, quantifying interactions between diseases and other disturbances using spatial models based on remote sensing, and assessing impact on non-timber and timber resources using landscape scale metrics. We have worked closely with line managers to ensure that outcomes of these research studies have been appropriate and useful, and expect to continue and expand this association in the studies proposed here. The first two years of this work will be conducted in ponderosa pine forests in the Black Hills, focusing on the recent Jasper Fire west of Custer, and will expand during the next 3 years to include additional western coniferous forest types in the Boise, Payette, Wallowa-Whitman, Medicine-Bow, Uncompahgre, and Colville National Forests in Idaho, Oregon, and Washington, where we currently have on-going studies.**

  More specifically, our research approach will involve developing a method of spatially modeling fuel loading at a 25 m resolution using digital analyses of satellite images coupled to field measurements and existing forest inventory data. We recently developed a similar spatial model using satellite imagery to predict diversity of migratory birds in the Black Hills, and propose to adapt this method to assess the effects of various tree mortality agents on fuel loading, fire incidence, and spread. The relative importance of various disturbances in determining distribution of hazard and spread of wildfire will be estimated using a structural equation modeling procedure we recently published in

Forest Science for quantifying interactions of root diseases in complex systems. We will apply a multivariate method of simulating expert opinion, called profiling, to establish desired conditions and quantify impact on recreation, wildlife habitat, scenic beauty, and other non-timber resources. We developed profiling specifically to help line managers make operational decisions about forest condition based on suitability for various management objectives, and it was recognized in the Fiscal Year 1999 Monitoring Evaluation Report of the Routt National Forest Land and Resource Management Plan as a potentially useful way of monitoring changing forest condition.

- **Outcomes or products:**

  - **First year: A spatial modeling method for predicting the distribution of fuels at a 25 m resolution that is based on satellite imagery, and linked to existing GIS layers and stand inventory data for the entire Black Hills.**

  - **Second year: A method of estimating the relative importance of different disturbances on magnitude and distribution of wildfire fuel. An operational method of estimating reference conditions and impacts of wildfire and other disturbances on non-timber resources.**

  - **Three to Five years out: An ARCINFO/ARCVIEW-based system for assessing changes in fuel loading associated with the action of various disturbances that can be displayed graphically and numerically in annual Forest Plan Monitoring Reports. Adaptation and application of the above methods to additional western forest types in the Boise, Payette, Wallowa-Whitman, Wenatchee, and Colville National Forests.**

Staffing needs by series and grade:
Existing workforce: 3/5 SY GS13/14 Plant Pathologist/yr, 1/3 technician Y/yr
New position(s): 1/5 SY proposed GS 12/13/14 Fire Ecologist/yr, 1 year student help/yr

Description of skills required: **Knowledge of remote sensing, GIS, spatial statistics, wavelet analysis, fires ecology, plant pathology, diagnosis of disturbance agents.**

Potential Partners: **RWU4451 and RMRS scientists, CSU, proposed Fire Ecologist**

Funding requested: **$125,000/year**

Team Leader: **John Lundquist**
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Station: **RMRS**
Proposal code: **RMRS-ABQ-2**
Topic: **C-iv**

Title: ***Riparian Ecosystem Dynamics in Relation to Fire in Southern and Northern Rocky Mountains***

Other Proposals to which this is linked: **RMRS-ABQ-3, ABQ-4**

RWU**: RM-4351, 4652, 4853, Albuquerque. RM-4151, Missoula, MT.**

Description

- **Research or development question, issue, or need:**
  1) **What were the historic conditions, including historic fire frequency patterns, of riparian zones in the northern and southern Rocky Mountains, and how do they compare with current riparian conditions and fire patterns?**
  2) **How do contemporary effects of fire in riparian zones vary by latitude (e.g., Montana versus New Mexico), altitude, plant species composition (shrubs versus trees, natives vs. exotics), and surrounding vegetation?**
  3) **How can resulting data on historic fire patterns and current fire conditions and effects be used to restore riparian zones to conditions that support riparian species and appropriate fire intervals and reduce fire risk?**

- **Research & Development Approach: Throughout the Rockies, many riparian zones are undergoing succession to either coniferous species or exotic woody species in the absence of flooding and fire. Changes in riparian plant species composition have altered ecosystem dynamics, reducing the system's potential for maintaining a variety of species associated with riparian zones and increasing risk of uncharacteristically severe fire. Research is needed in New Mexico and Montana to define past and current conditions and frequencies of fire, determine ecosystem responses and conditions resulting from recent burns in riparian areas, and evaluate direct fire effects (e.g., from fire in riparian zones themselves) and indirect effects (e.g., from fires in uplands). Numerous wildfires burned in riparian zones in New Mexico and Montana in 2000, presenting opportunities to evaluate fire effects on a suite of riparian types. Geographic Information Systems databases of topography, stand inventories, treatment history, fire history, and ecological information have been compiled for Montana sites to stratify and choose potential study areas. Similar GIS data need to be compiled for riparian sites in New Mexico.**

  Several threatened, endangered, and state-listed fish, bird, and bat species occupy riparian ecosystems in both states, including bull trout, cutthroat trout (Inland, Rio Grande, West Slope, Yellowstone), Gila trout, Gila chub, Rio Grande silvery minnow, bluntnose shiner, southwestern willow flycatcher, yellow-billed cuckoo, *Myotis* bats, to name a few. Habitat surveys, especially in "critical" (FWS-designation) habitats, in parallel with population surveys will be conducted of these species in burned and non-burned riparian sites in MT and NM to determine if fires damaged habitats or altered water resources. Recruitment success of native broadleaved plant species such as cottonwoods, willows and re-establishment of invasive conifers and exotic woody plants

(especially salt cedar, Russian olive) will be monitored. Water quality of streams and water quantity at burned and nonburned sites will also be measured. Sites suitable for recovering suites of TES species will be evaluated and restored using research treatment targets identified in species recovery plans. Research results will supply guidance for restoring riparian zones to conditions suitable for maintaining riparian plant and animal species, with appropriate fire frequency intervals, and for averting catastrophic fire damage in riparian zones.

- **Outcomes or products:**
  - **First year: Compilation of GIS data, data collection, year-end report, cooperators workshop, memorandum of agreement, study plan, biometrical review of study plan.**
  - **Second year: Refereed publications comparing past and current conditions & fire intervals, NEPA analysis completed if required. Grant proposals. Web site established.**
  - **Three to Five years out: Model Distribution and Application, Demonstrations and Workshops. Refereed publications. Summary GTR. Databases available on line.**

Staffing Needs by series and grade**:**

Existing workforce: ¼ scientist year Wildlife Biologist Deborah Finch/Alice Chung-MacCoubrey; 1/4 scientist year Biologist Elaine Kennedy Sutherland; 1/4 scientist year Archaeologist Richard Periman, ¼ scientist year Fish Biologist Mike Young, ¼ scientist year Forest Physiologist Ronni Korol, plus postdocs Jeff Kelly and Scott Stoleson

New position: Albuquerque: 1 scientist yr. Convert GS-12 Ecologists Burt and Rose Pendleton, from ½ time to full-time, or hire new Research Fish/Wildlife/Habitat Ecologist, GS-12/13. Missoula: GS-11 Research Ecologist, postdoctoral position.

Description of skills needed**: Ph.D. botany, ecology, fisheries, wildlife science, landscape ecology, biological sciences, natural resources, range science, forestry, archaeology, geomorphology, or history. New postdoctoral position in Missoula with research emphasis in plant community ecology and spatial analysis, to assist in determining pattern as a function of landscape and disturbance regime. Experience in preparing maps, managing large databases, and developing and managing GIS capability. Strong team & interdisciplinary skills.**

Potential Partners: **Region 1 (Bitterroot, Lolo, and Flathead National Forests), Region 3 (Santa Fe, Cibola, Gila, Carson, and Lincoln National Forests), University of Montana, University of New Mexico, Natural Resources Conservation Service, The Nature Conservancy, U.S. Fish & Wildlife Service, State Forestries, State Game & Fish.**

Funding Requested**: $500,000 (RWU 4351: 200K; RWU 4652: 100K; RWU 4151: 100K; RWU 4853: 100K)**

Team Leaders**: Deborah Finch/Elaine Kennedy Sutherland**
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Station: North Central Research Station

Proposal code NC-3.1

Topic(s): **C-iv Reducing hazardous fuels and fire risk, ecological interactions; C-i Reducing hazardous fuels and fire risk, assessment B-i Restoring landscapes and rebuilding communities, post-fire treatments.**

Proposal title: **Managing the risk of fire on human and ecological communities in the wildland-urban interface.**

Other proposals to which linked **(Proposal code)**: **NC-1.1, 1.3, 2.1, 2.2.1, 3.2, 3.3, 3.4**

Research Work Units: **RWU NC-4153, Landscape ecology Unit, Rhinelander, WI**

Description: Research or Development, Question, Issue, or Need: **The President's Fire Plan calls for research to investigate the relationships between land management practices and the occurrence and intensity of fires. The Plan also calls for research on the effectiveness and consequences of various treatment efforts. Because vegetation treatments, natural disturbance, and the increased presence of people in forested landscapes interact to determine how fires spread across landscapes, it is critical to understand these interactions in a spatial context. Treating individual stands without considering spatial context will be less effective. Treatments may also have unintended consequences if interacting phenomena are not considered.**

Our objective is to develop a sophisticated process model integrating human activities (land management treatments and human community development), natural disturbances (insects, disease, blowdowns), and wildfire that will allow the study of interactions among these phenomena. This mandates an integrated approach involving scientists from many disciplines, and is a logical extension of NC's Integrated R&D Program focused on Landscape Change. We will investigate how land management and land use changes affect the impact of fire on the human and ecological communities forming the landscape mosaic. We will produce risk maps and management guidelines to help policy-makers and land managers understand how changes in the spatial configuration of vegetation management and human community development can be used to reduce the risk of catastrophic fire.

Research and Development Approach: **We propose to study the interactions between fire, land management treatments, human settlements and other disturbances by linking the results of empirical studies within a common modeling framework. The empirical work is described in more detail in linked proposals. These proposals focus on several phenomena interacting to affect fire susceptibility and spread: vegetation management (treatments (including post-fire), their effects on microclimate) (NC-2.1, 2.2.1), insect and disease outbreaks (NC-3.4), effects of blowdown events (NC-1.1, NC-2.2.1), and land use change (including changes in human populations, infrastructure and road networks) (NC-3.3). These empirical studies will provide data and relationships to improve an existing landscape disturbance and forest succession simulation model (LANDIS). LANDIS is a sophisticated process model featuring empirically derived, reciprocal relationships between forest development and disturbances.**

Strategic monitoring of fuel loadings and fire potentials in US forests (NC-1.3) will provide important data on initial conditions for the model. As these processes interact within the model, the impact of fire management strategies and land use change can be assessed for human communities, ecosystem health, and wildlife population viability (NC-3.2).

The NCRS and a cooperator have invested a decade in the development of LANDIS, and the forest succession (species dispersal, establishment and competition), windthrow disturbance and the vegetation management components have been tested and are very robust. However, to achieve the objectives of this proposal, significant additional development is required. More sophisticated fire spread algorithms must be incorporated, and the insect and disease module must be improved. New development of functions to model microclimate (moisture) effects of treatments, and relationships related to human development will be required.

The integrated, comprehensive modeling framework will feature a sophisticated fire ignition and spread algorithm operating at landscape scales (10^4 – 10^7 acres). The model represents landscapes as a grid of cells, and the ignition and spread of fires from cell to cell will be controlled by the condition of the forest on each cell and proximity to roads. This condition can change as a consequence of forest growth and succession, vegetation management, insect and disease outbreaks, wind damage, and human development. The model will provide the integration needed to study the reciprocal interactions among treatments, disturbance, land use change and fire behavior at landscape scales. For example, treatment recommendations for specific forest types and stand conditions will be simulated in a spatially explicit way using the vegetation management module of the model, and their effects on fire ignition rates and fire spread and intensity can be studied. However, the proposed treatments may also affect the extent of insect outbreaks, resulting in non-linear treatment effects. Furthermore, human community development may change both the treatment options that are socially acceptable and ignition rates near roads. Because the behavior of each module will be developed somewhat independently, the nature of the interactions will be an emergent property of the simulations. The model will produce predictions that can in turn be tested empirically. LANDIS can be parameterized for other ecosystems, and we are confident this approach can be extended to other parts of the country.

This proposal complements proposal NC-3.2. We will focus on studying interactions in northern hardwoods/mixed boreal forests, and will develop the insect and disease module and the human community development module. We will jointly develop enhanced fire algorithms in collaboration with RWU-4154. RWU-4154 will focus on central hardwoods fire-adapted systems and will develop the ability to evaluate LANDIS outputs to predict wildlife viability. The scope and integration of the processes proposed for these modeling efforts greatly surpass any existing capabilities.

Outcomes or products:

First year: **Prepare manuscript describing the effects of vegetation management alternatives on the susceptibility to fire ignition and spread using an existing input dataset for the Chequamegon NF (WI), including potential impacts on recreational opportunities and risk of loss of infrastructure on the National Forest. Fire risk maps under Forest Plan alternatives will be generated and disseminated to the Chequamegon NF.**

Second year: **Implementation of new algorithms in LANDIS (fire, insects & disease, human community development). Assess fire risk to public and private infrastructure within the Superior NF under alternative vegetation treatment plans. Publish effects of human development on fire risk; quantify benefits and risks of generic treatment options to wildlife and ecosystem health.**

Three to five years out: **Determine the relative importance of each of the interacting factors studied (e.g., treatments, insects and disease, human development) on fire risk, and publish guidelines for decision makers seeking to maximize the effectiveness of limited resources. Publish management guidelines for evaluating tradeoffs among fire risk mitigation strategies in various ecological Sections throughout the East. Produce a white paper describing findings of our study of interactions, with policy recommendations. Produce maps of fire risk under alternative land management and land use scenarios for each National Forest in the NC region. Generate risk maps of human infrastructure loss and long-term ecosystem condition predictions for specific alternative plans on real landscapes near NFs. Design adaptive management empirical tests of the alternative shown by the model to best mitigate fire risk. Improve LANDIS user interface and train NFS personnel to evaluate vegetation and fire management alternatives.**

Staffing needs: **1 permanent scientist (GS-408-12/13) – disturbance ecologist / modeler. Both RWUD problems have a disturbance component. 1 technician / C++ programmer (GS-334-9/11). Unit currently has inadequate model and programmer support.**

Description of skills required: **The disturbance ecologist must have experience in spatial modeling, GIS, spatial statistics, landscape ecology. The technician must have experience in GIS, C++ programming; spatial statistics background desirable.**

Potential Partners: **Dr. David J. Mladenoff, Univ. of Wisconsin; Dr. Hong He, Univ. of Missouri; Wisconsin, Minnesota and Michigan NFs.**

Funding requested: **Funding to RWU-4153 of $332,000 per year. Includes funding for 1-2 RJVAs over 5 years.**

Leveraging: **Builds on earlier development of LANDIS.**

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