AWFCG Fire Research Needs 2011

AWFCG - Alaska Wildland Fire Coordinating Group, Fire Research Development and Application Committee

The following list of fire research topics and questions were generated by personnel from agencies and organizations within AWFCG during 2010 Fall Fire Review and through other solicitations. The topics were initially ranked by the AWFCG Fire Research, Development and Application Committee (FRDAC) based on 3 criteria: direct management application, data needs, and use to multiple agencies. AWFCG reviewed the rankings and made some minor adjustments. The list below is sorted by highest priority (1 through 25). The Research-ID is a unique identifier that can be used to refer to the topic.

Category	General Topic	**Description** (why needed/more detail)	Research Questions/Needs	Priority	Research ID
Fire Behavior	Fire Behavior Models: Validation and Application	Research is needed to improve the knowledge of fire behavior and appropriate fuel models for Alaska. More information on the 40 Fuel Models and the Canadian Forest Fire Behavior Prediction (FBP) Fuel Models is needed on a spatial scale and in relation to fire behavior modeling. Fire modeling tools are currently utilized by Alaska fire managers (e.g. Fire Spread Probability [FSPro] in the Wildland Fire Decision Support System [WFDSS]). However the confidence level of model outputs from the tools is unknown. Efforts have been made to relate LANDFIRE ecotypes to Alaskan Fuel Models. However, questions remain about the accuracy of the LANDFIRE vegetation classifications and crosswalks between LANDFIRE and Alaskan fuel types. There is a need for research that will improve the knowledge of fire behavior and appropriate fuel models for several unique fuel types; wetlands, shrublands, and tundra ecosystems as well as in forested ecosystems with insect and disease damage. Additionally, fuel models and fire behavior in early successional post-fire forest types are also of particular interest since shortened fire return intervals are occurring and recent burned areas are no longer acting as fuel breaks.	• Fire behavior validation of the 40 Fuel Models and Canadian Fuel Models used in Alaska. • Are fire behavior modeling tools accurately reflecting drought conditions? How well do the models correlate with CFFDRS indices, fuel moisture, and observed fire behavior? • Landscape-level landcover classifications and fuels maps need to be updated to incorporate succession within recent burns before modeling application. • How accurate are the LANDFIRE vegetation classifications? How accurate are the crosswalks between LANDFIRE and Alaskan fuel types? • Which fuel models should be used for non-forested tundra ecosystems, early successional post-fire forests and forested ecosystems with insect and disease damage? Validate fuel models against actual fire behavior. • What climatic, weather and fuels conditions allow fires to burn into recently burned areas?	1	2010-29
Fire Danger	CFFDRS Fire Weather Indices: Evaluation and Calibration	In Alaska, fire planners, fire managers, and firefighters heavily utilize the CFFDRS indices for prescribed burn planning, daily resource availability and allocation, operational strategies and suppression tactics. The CFFDRS Fire Weather	• Evaluate CFFDRS fire weather indices and drying trends throughout Alaska. Are there variations across regions? • Evaluate relationships between CFFDRS indices and: 1) probability of ignition, 2) rate	2	2010-04

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		Indices are based on empirical data from eastern red and jack pine stands. Further empirical studies are needed to determine if Alaskan fuels should have modified algorithms to better relate observed data to the CFFDRS indices. Specifically, there is a strong need for calibration of the CFFDRS indices for Alaskan boreal fuel types to ensure accurate representation of seasonal changes in duff moisture. Also needed is a mechanism for standardization of spring start-up values for the CFFDRS indices to adequately reflect the effects of over-winter drought conditions, snowmelt date, and soil thaw on fire danger.	of spread, 3) fire duration and 4) depth of organic fuel consumption. • Are indices calculated from remote automated weather stations (RAWS) accurately representing duff moisture? Do they adequately reflect the effects of over-winter drought conditions, snowmelt date, and soil thaw? • Should over-winter drying values or default startup values be utilized for drought codes, particularly in relation to the occurrence of fires that overwinter? Can these codes be tied to early season fire danger predictions? • How does soil moisture fluctuate throughout spring melts and summer drying? How accurately are these fluctuations represented by the moisture codes?		
Climate Change	Climate Impacts on Fire Regimes: Past, Present, and Future	Fire and land managers, along with policy-makers, seek research which will provide a clearer understanding of: 1) climate linkages to past and present natural fire regimes and 2) current and future departures from historic conditions. A concerted effort is needed to document and model future fire regimes in response to climate change across all vegetation cover types in Alaska. Resulting possible scenarios will be used to inform fire and land managers on potential changes in fire intervals, fire extent, seasonality, and severity. Knowledge of expected change will allow for a planned response to predicted changes in fire activity. Recent syntheses, which incorporate records from the last decade and historical data, have improved our understanding of past and present fire regimes but are not yet comprehensive, are limited in scale, and do not clearly illustrate potential for future regime shifts.	• What are the historical departures from current fire regimes? • What changes in fire size, return interval, intensity, severity and seasonality can we expect under a changing climate? How will changes in these elements differ between vegetation types? • What are historic fire regimes for Alaska tundra ecotypes and what are predicted responses to climate change? • What are potential feedback mechanisms which could alter the probability of future fires? • How will possible changes in future fire regimes impact management strategies and suppression tactics?	3	2010-16

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Fuels Treatment	Fuels Treatments: Short- and Long-term Effectiveness	Information on fuel treatment effectiveness continues to be a top research priority. Specifically, evaluation of the continued effectiveness of existing fuels treatments in various ecotypes and in different stages of recovery is needed. Monitoring of existing fuel breaks needs to continue beyond treatment implementation to determine short-term and long-term effectiveness in reducing fire risk and smoke emissions. Also, post-treatment vegetation recovery could affect fuel loading and lead to seasonal variations in fire risk. It is essential for managers and planners to understand vegetative succession within fuel treatments to avoid promotion of undesirable species, insect infestations, and highly flammable surface fuels.	• How long are various fuels treatments effective, what types of fuels regenerate, and what are associated fire risks? • What are the financial costs of maintaining effective fuels treatments? • What alternative treatments should be tested to maintain fuel breaks (e.g., domestic livestock foraging of grass regeneration, planting/seeding of desirable species)? • Should post-fuels treatment reforestation be considered? What landscapes would be most suitable? • Should desirable vegetation establishment be considered in planning operations? • What treatment methods and timing can be used to minimize bark beetle infestations? • Are fire risk and smoke emissions reduced by fuels treatments?	4	2010-18
Fire Effects	Post-Fire Vegetation Succession Pathways	An improved understanding of vegetation successional pathways can provide managers with better planning tools for assessment and predictions of fire effects and flammability. Although recent studies have been conducted on successional trajectories in black spruce forests, there is limited information on pathways for tundra, shrublands, tree-line forests, and other fuel types. Managers are also interested in: 1) the impacts of permafrost degradation on fire incidence and succession, 2) how future climate change scenarios will influence pathways, and 3) how shortened fire return intervals are affecting fuels and vegetation regeneration (particularly where recently burned areas in the early stages of succession are no longer acting as fuel breaks and burning again).	• What are the successional pathways, based on fire severity and seasonality, for different primary vegetation types (e.g. white spruce, broadleaf, shrub, and tundra)? How will climate change impact these pathways? • What characteristics result in post-fire conversion, especially from forest to grasslands, in future fire/climate scenarios? • How does fire effect permafrost degradation and what are the subsequent impacts on vegetation species composition and structure? • In light of recent fire seasons where past burn scars are no longer acting as fuel breaks, how are shorter fire return intervals impacting fuels, flammability, and vegetation regeneration/succession? • What are the characteristics (age, fuel load, vegetation type, moisture, etc.) that allow some older fires to act as fuel breaks for new fires?	5	2010-05

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Fire Effects	Invasive Plant Species	Recent investigations indicate that fires, even low severity burns, can be vectors for invasive plant colonization. Research suggests that 10-to 20-year-old fires in black spruce forests may be most susceptible to colonization by invasive plants. Species spread may also occur through movement of suppression personnel and equipment contaminated with seeds or propagules. Therefore, it has been recommended that exotic species management should be considered for all recent burns.	• Do fire events and fire suppression activities increase the potential for introduction and spread of non-native plant species? • What is the potential for spread once invasive plants are established? • What are the best strategies for post-fire inventory and monitoring of non-native, invasive species? • What preventative measures can be implemented to reduce introduction or expansion of these species?	6	2010-15
Weather	Fire Weather Forecasting	There is a strong need for better weather and lightning prediction models. Good long-range fire management decisions are not possible when weather predictions are limited to a few days. More accurate and longer-term information on trends in lightning activity, weather patterns and the interactive effects of weather and lightning activity on fire activity would greatly benefit fire managers in Alaska.	• More research is needed to improve fire weather predictions in Alaska. • What are long-term trends in lightning activity? • What are predictions about future lightning activity?	7	2010-27
Climate Change	Climate Change Effects on Fire Effects	Little is known about the potential effects of a changing climate on various fire effects. For example, how could a warming climate impact fire regimes, successional pathways, fuel consumption, burn depth and duration, severity, ecosystem type conversions, animal habitats, pathogens and disease? More information about potential climate impact on fire effects for all Alaskan ecotypes is needed, especially for tundra, shrubland, and tree-line forests.	• How could climate change impact consumption/burn duration and ultimately succession and fire effects? • What are the effects of deeper- and longer-burning fires on successional pathways? • Develop models to provide background information necessary for climate change scenario planning. • Determine whether fire management options or definition of resources at risk need to be changed in relation to predicted changes.	8	2010-01
Fire Effects	Burn Severity: Detection and Trends	Burn severity influences vegetation succession, permafrost, nutrient cycling, water quality, and water availability. We need improved methods to document burn severity at landscape and local levels. In addition, we need methods to determine changes or trends in burn severity over time.	• How can burn severity maps be improved for better monitoring of burn severity trends? • Are there current changes in levels of burn severity? • How does fire history influence severity? • Develop fine scale but expansive remote sensing severity method.	9	2010-06

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Fire Effects	Hydrology, Wetlands, and Permafrost Features	Baseline data on the impact of fire on hydrology, wetlands and permafrost features is needed. For instance, more information on fire effects on water-related topics (e.g. water budgets, thermokarsting, sediment loading, water chemistry, debris, subsidence, nutrients and aquatic organisms) would provide valuable insights for managers. These data could also be integrated to fish, wildlife and climate change studies to respond to subsistence and resource concerns. An ultimate goal would be to develop a predictive tool of how wetlands may change under different climate scenarios and fire regimes.	• How does fire alter hydrological processes, wetland dynamics (e.g. drying), and permafrost features (e.g. thermokarst)? • What are the relative effects of altered wetland dynamics and permafrost features on fish, wildlife, and habitat? • How does burn severity influence permafrost, nutrient cycling, water quality, and water availability?	10	2010-07
Fire Effects	Human Subsistence Livestyles	People practicing a subsistence lifestyle must constantly adapt to changes in resource distribution, including changes caused by disturbance events. With rising costs of transportation fuel, concerns are frequently raised at public meetings about how fire will affect subsistence resources on public lands near communities (e.g. fish, wildlife, edible plants, fuel, timber). There is a need for more study of fire impact on human communities in Alaska. Recommended studies include: 1) retrospective studies (sample resources in burns of different age and interview subsistence users relative to fire history), 2) contemporary studies (establish monitoring program), or 3) predictive (forecast future conditions based on present paradigms). Results from these types of investigations could be invaluable to land owners and managers facing with decisions about prescribed fire or fire suppression near communities.	• How does fire history and spatial distribution affect subsistence resource (e.g. fish, wildlife, edible plants, fuel, and timber) abundance and accessibility by humans? • How should land owners and managers respond to fire impacts on subsistence resources?	11	2010-09
Fuels Treatment	Utilization of Fuels Treatment Byproducts	It is possible to reduce hazard fuels treatment costs and increase the use of woody biomass residuals (thus reducing post-treatment fuel loading) in an environmentally and economically sound manner by allowing rural community residents access to treatment residues However, more research on the appropriate treatment applications and rotations is needed.	• What are potential uses of fuels treatment residuals (woody biomass) in bio-energy (chips, pellets) or other applications? • What are the relative energy values and appropriate rotations of biomass harvests? • Is specialized equipment required for handling and processing small diameter wood?	12	2010-19

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Tactics	Fire-line Rehabilitation Effectiveness	Post-fire rehabilitation of hand and mechanical fire-lines is implemented with the objectives of soil stabilization and minimal water pollution, thus helping to meet the goal of preserving the sustained productivity of treated areas. Few studies have addressed either the need for, or success of, rehabilitation efforts in Alaska.	• Previously implemented fire-line rehabilitation efforts (esp. dozer lines) should be monitored to determine success in boreal forest and tundra ecotypes. • What is the most effective way of rehabilitating fire-lines?	13	2010-25
Weather	Fire Season Weather Forecasting	Fire season planning, including preparedness and staffing levels, are dependent on accurate fire season forecasts. It is essential that these forecasts are available to fire managers early in the fire season.	• More accurate forecasts of regional and sub-regional fire season potential. • Good fire season predictions available early in the season (by May 15th). • Continued improvement of existing climate and circulation models.	14	2010-22
Tactics	Current Fire Management Option Application Effectiveness	The Alaska Interagency Wildland Fire Management Plan was established in the 1980's with the acknowledgement that fire suppression was not always cost effective (net financial benefit) or ecologically beneficial for desired resources (e.g., subsistence foods) or purposes (natural disturbance). Under the plan land owners and managers were provided with four Fire Management Options. It may be necessary to re-evaluate the application of these Fire Management Options in light of; 1) changes in ecological knowledge about fire effects on the landscape, 2) cost of suppression and value of resources protected in Alaska and 3) climate change.	• If less severe, early-season fires were allowed to burn would there be less impact on permafrost and reduced carbon release? • Should the Modified option be removed, allowing fires to burn earlier in the fire season? • What are the landscape level implications of removing some areas from the Limited Management Option to protect development (e.g. oil and gas infrastructure) and other interests (e.g., carbon sequestration, use of small diameter timber for bio-energy production [chips, pellets])? • Should the Limited Management Option be utilized during drought conditions? If resources are not directly at risk in Limited, what is consequence of suppression during drought on remaining fuels and future fire potential?	15	2010-24
Socio, Education, and Information	Fire Outreach and Public Awareness Effectiveness	The boreal forest surrounds interior Alaskan communities, rendering them islands susceptible to wildland fire. Because of this reality, a need to educate Alaskans about the natural role of fire, fire management and Firewise concepts exists. A number of agencies have been actively working to address this need for education. However, there remains a need to assess the effectiveness of current fire education and awareness efforts.	• Are social media, online updates (Inciweb), and press releases reaching target audiences? • Are agency managers' perceptions of public understanding of fire information messages accurate? • What are criteria to define the adequate level of outreach; (e.g., how much is "enough" or what is "effective" or	16	2010-30

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			"successful?") • Is "human dimensions research" on public response to fire information 1) delivery methods and 2) message content needed for better outreach success?		
Fire Effects	Fish Habitat and Populations	Fish habitat, especially spawning areas, can be affected by post-fire changes in overstory canopy, increased erosion or ash flow, sedimentation, turbidity, and nutrient dynamics, buildup of leaf litter, and woody debris. The extent to which these changes alter fish population dynamics and thus availability for harvest and wildlife forage is unknown. The impacts of fire on hydrological parameters that could affect fisheries requires more study.	• What are fire effects on fisheries resources? What impacts to aquatic ecosystems occur as a result of fires, potentially including decreased stream channel stability, discharge, altered coarse woody debris delivery and storage, increased nutrient availability, higher sediment delivery and transport, and increased solar radiation and altered water temperature regimes? And how do these impact fisheries?	17	2010-13
Smoke and Carbon Emissions	Smoke Models and Human Impacts	There is evidence that wildfire smoke can hurt people's eyes, irritate the respiratory system and worsen chronic heart and lung disease. There is a need for more research on smoke effects on human health and how fire managers can predict, address and/or mitigate these effects.	• What are smoke impacts on public health? Do perceived health impacts differ from actual impacts? • What are possible mitigations of smoke impacts on public health? • Can accuracy of emission factors for Alaska fuels be improved? • There is a need for improved models for predicted smoke plume trajectories to predict impacts on communities.	18	2010-23
Tactic	Fire Suppression Method Effectiveness	A variety of fire suppression methods are employed by fire managers in Alaska including various combinations of resources (e.g. aircraft, personnel, and specialized equipment). More information is needed on the relative effectiveness of these methods.	• Better information is needed on the effectiveness of suppression method applications	19	2010-26
Fire Effects	Bird Habitat and Populations	Alaska provides breeding grounds for a substantial proportion of North America's migratory waterfowl and passerine species, however little is known about fire effects on most species and their habitat. There is some evidence that fire can provide good habitat for a subset of migratory and non-migratory bird species in Alaska. Other species require mature older-successional habitat. A climate-change induced increase in early season fire activity could have a detrimental effect on nesting migratory birds	• What are long-term impacts of fire on birds in Alaska, especially neotropical migrant passerine and waterfowl species? • Are fire-related changes in boreal forest dynamics affecting forage and nest- site availability and distribution of birds? • What are the potential effects of increased early-season fire activity on nesting bird species populations?	20	2010-11

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		which arrive in Alaska during April and May.			
Fire Effects	Ungulate Habitat and Populations	Additional research is needed on the effects of fire on ungulates (moose, caribou, Dall sheep and muskoxen) and their habitat in Alaska. Shifts in ungulate habitat in response to fire may alter ungulate species distributions and population sizes, predator/prey relationships, and subsistence hunting patterns. More information is needed about how fire-induced changes in forage nutritional quality affect ungulate distribution.	• How does fire affect ungulate ecology in Alaska? • What specifically are the effects of fire on ungulate spatial distribution and forage nutrition?	21	2010-10
Smoke and Carbon Emissions	Carbon Sequestration	The cold, organic soils of boreal and arctic ecosystems have served as a carbon reservoir for millennia, but these regions may transition into global sources of carbon in response to climate change and altered disturbance regimes. Research is needed to determine how fire activity and fire management strategies in northern systems affect the global balance of greenhouse gases.	• What is the concentration of greenhouse gas emissions generated by wildfire and suppression activities in Alaska? • How do vegetation type and burn severity influence emissions? • Do fuels treatments reduce emissions of greenhouse gases during subsequent wildfires? • Does carbon uptake by post-fire vegetation growth exceed carbon levels released by burning? • How is carbon uptake related to vegetation type and stand age? • How might future carbon sequestration patterns in Alaska affect fire management strategies, carbon balance, and natural diversity?	22	2010-31
Fire Effects	Furbearer and Small Mammal Habitat and Populations	Small mammals (especially microtines) and snowshoe hares are an important component of the ecosystem, serving as a prey base for numerous species of wildlife and influencing vegetative patterns through foraging, digging, and stashing of seeds. Furbearers are a primary predator on small mammals and are also important to subsistence lifestyles.	• What are fire effects on furbearer and small mammal populations?	23	2010-12
Fuels	Decomposition Rates of Woody Debris	Site characteristics and climatic conditions control the relative importance of fire and decomposition in release of nutrients. Cold, dry environmental conditions limit biological decay which allows for accumulation of plant debris. Warm, wet conditions	• What are post-fire coarse woody debris decomposition rates in Alaska's boreal forests? • How would coarse wood debris from past fires be assessed (directly or remotely) as a	24	2010-28

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		are conducive to biological decay. Coarse woody debris loading directly impacts fire behavior and fire regime.	fuel type at the landscape scale for use in fire management decisions?		
Fire Effects	Wild Berry Productivity and Availability	Berries are food for some wildlife species and humans. Berry production can vary with pre-burn site characteristics, burn severity and time since fire. Further information on berry production in relation to fires could benefit human subsistence activities and provide more information on wildlife habitat quality.	• How does fire affect berry production?	25	2010-14