TITLE: Composition and structure of limber and whitebark pine stands in the Interior West and the silvicultural implications **INT-B-14-01**

LOCATION: Interior West (R1-R4)

DATE: October 1, 2013

DURATION: Year 1 of 2-year project FUNDING SOURCE: Base EM

PROJECT LEADER:
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PROJECT OBJECTIVES:
Develop silvicultural recommendations addressing the challenges to effective management of whitebark pine and limber pine, represented by mountain pine beetle and white pine blister rust.

Characterize stand structure and species composition and the influence of important environmental factors for whitebark pine and limber pine across the Interior West.

Characterize important variations in stand dynamics for whitebark pine and limber pine.

JUSTIFICATION:
Linkage to FHM program: Forest Health Monitoring is an integral part of the Forest Inventory and Analysis (FIA) program. Many forest health issues, like the threats to whitebark pine, can be analyzed more thoroughly by augmenting traditional FIA/FHM plots with regular production FIA plot.

Significance/Impact of forest health issue: Whitebark pine and limber pine are subjects of high interest because of the ongoing threats from insects, disease, and fire. Limber pine and whitebark pine are the two most important high-elevation five-needle pines in the central and northern Rocky Mountains. Populations of both species face considerable challenges from mountain pine beetle, white pine blister rust, and successional displacement resulting from altered natural disturbance regimes. Restoration treatments have focused primarily on prescribed burning (Keane and Parsons 2010a, 2010b), but these treatments almost universally result in a substantial decrease in seedlings in the short term. In addition, residual trees stressed by prescribed fire can be more susceptible to attack by mountain pine beetle. Some of the trees lost to fire treatment are likely to have resistance to white pine blister rust and therefore be of high value. As a result, there is a need to develop silvicultural treatments that can promote limber pine and whitebark

pine with minimal impact to advance regeneration. The range-wide restoration strategy for whitebark pine (Keane et al. 2012) has as proposed proactive restoration tactics through the diversification of age classes.

Scientific Basis: The properties of data collected under the FIA program are well known to be representative of the dominant conditions found in forests. The systematic sample, coupled with stratification methods, allows extrapolation of analysis results that is not possible with localized or ad-hoc sampling schemes.

Cost/Economic Efficiency: The data used in the proposed analyses conservatively represents approximately $4MM of investment (assuming 4000 plots x $1000 per plot) over a 30-year period. The funding requested in this proposal is to allow accelerated analysis of certain aspects of whitebark and limber pines. The investigators have other analyses in progress that will be informative to the proposed analyses.

Priority Issues: Whitebark pine has recently been given a "warranted by precluded" endangerment listing by the U.S. Fish and Wildlife Service (USFWS), meaning that it has basic protection but no funding available for assessment or recovery. As a result, there is much more demand for information than is possible to produce under regular programmatic funding. Limber pine is not yet listed, but the threats and demand for information are similar to those of whitebark pine and similar analyses can be efficiently applied to both.

DESCRIPTION

Background: In light of the considerable challenges facing the continued functioning of these pine ecosystems (Ellison et al. 2005), a broad range of management alternatives have been suggested. One alternative which should be considered as part of restoration or stand management strategies is appropriate density management in existing stands. Using FIA data, we have constructed a density management diagram (DMD) for whitebark pine and have determined its utility in assessing density-related aspects of this complex system. The whitebark pine DMD can provide important insight concerning interacting thresholds and alternative silvicultural strategies, such as was done for mountain pine beetle in lodgepole pine (Anhold et al. 1996).

DMDs can facilitate effective communication between silviculturists and other resource specialists and stakeholders interested in the restoration of important forest types. The DMD and site index curves developed for whitebark pine were used to explore silvicultural alternatives intended to reduce risk of mountain pine beetle attack yet maintain Clark's Nutcracker presence for seed dispersal. The available literature on mountain pine beetle in whitebark pine stands and the habitat needs of Clark's nutcracker suggests that silvicultural options do exist.

Alternative strategies for both limber pine and whitebark pine need to be examined in the context of white pine blister rust. Both limber pine and whitebark pine occur under diverse environmental conditions and in stands ranging from pure to mixed-species and from single- to multi-cohort. A critical gap in our current understanding of these species is solid insight into stand dynamics, including successional trajectories and age-class distributions, across the spectrum of habitats and stand conditions. Addressing this knowledge gap will be key to the development of sound silvicultural recommendations.

Methods: There are approximately 4000 Forest Inventory and Analysis plots in the Interior West states with a limber pine or whitebark pine component. A large number of tree, stand, and site variables are collected, including height, diameter, age, mortality agent, damaging agent, disturbance, fuel components, and understory vegetation. Some of these plots have been measured in two or more inventory cycles, allowing analysis of changing composition and structure and causal factors. The systematic nature of the FIA plot network allows for estimation of acreage found in various classes of stand condition (e.g., seral vs climax whitebark pine). We will use the available FIA data to analyze the status and trends of limber pine and whitebark pine as they relate to composition, structure, and damaging agents. This information will be translated into a number of quantitative silvicultural tools and development of prescriptions designed to promote limber pine and whitebark pine in stands where they are most at risk.

Products:

1) Characterization of stand structure and species composition as they are influenced by important environmental factors (e.g., elevation, aspect, temperature and precipitation);
2) Silvicultural recommendations for the development of limber pine and whitebark pine stand resistance and resilience to major environmental challenges (e.g., mountain pine beetle, white pine blister rust, stand-replacing fire);
3) DMD and site index curves for limber pine;
4) A report summarizing the results will include alternative silvicultural recommendations.

Schedule of Activities:

- Winter 2013/2014 - Compile data and conduct analysis of stand structure and species composition and associated environmental factors. Construct DMD and site index curves for limber pine.
- Summer 2014 - Present results of this initial analysis at IUFRO white pine conference in Ft. Collins, CO;
- Winter 2014/2015 - Develop alternative silviculture strategies for a range of restoration and management objectives.;
- Spring/summer 2015 - Complete final report and journal article(s).

Progress / Accomplishments: n/a

Relevant Citations:

Anhold, J.A., M.J. Jenkins and J.N. Long. 1996. Management of lodgepole pine stand density to reduce susceptibility to mountain pine beetle attack. West. J. Appl. For. 11:50-53.

Ellison, A.M., Bank, M.S., Clinton, B.D., Golburn, E.A., Elliott, K., ford, C.R., Foster, D.R., Kloeppel, B.D., Knoepp, J.E., Lovett, G.M., Mohan, J., Orwid, D.A., Rodenhouse, N.I., Sobezak, W.V., Stinson, K.A., Stone, J.K., Swan, C.M., Thompson, J., Von Holle, B., and Webster, J.R. 2005. Loss of foundation species: consequences for the structure and dynamics of forested ecosystems. Frontiers in Ecology 3(9):479-486.

Keane, R.E.; Parsons, R.A. 2010a. Management guide to ecosystem restoration treatments: Whitebark pine forests of the northern Rocky Mountains, U.S.A. Gen. Tech. Rep.

RMRS-GTR-232. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 133 p.

Keane, R.E.; Parsons, R.A. 2010b. Restoring whitebark pine forests of the northern Rocky Mountains, USA. Ecological Restoration. 28(1): 56-70.

Keane, R.E.; Tomback, D.F.; Aubry, C.A.; Bower, A.D.; Campbell, E.M.; Cripps, C.L.; Jenkins, M.B.; Mahalovich, M.F.; Manning, M.; McKinney, S.T.; Murray, M.P.; Perkins, D.L.; Reinhart, D.P.; Ryan, C.; Schoettle, A.W.; Smith, C.M. 2012. A range-wide restoration strategy for whitebark pine (*Pinus albicaulis*). Gen. Tech. Rep. RMRS-GTR-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 108 p.

COSTS: < Budget estimates for each year of project.>

	Item	**Requested FHM EM Funding**	**Other-Source Funding**	**Source**
YEAR 1				
Administration	Salary	9,821.00	21,821.00	USU/FIA
	Overhead	4,458.00	6,583.00	USU/FIA
	Travel	1,000.00		
Procurements	Contracting			
	Equipment			
	Supplies			
Total		15,279.00	28,404*	

	Item	**Requested FHM EM Funding**	**Other-Source Funding**	**Source**
YEAR 2				
Administration	Salary	9,821.00	21,821.00	USU/FIA
	Overhead	4,458.00	6,583.00	USU/FIA
	Travel	1,000.00		
Procurements	Contracting			
	Equipment			
	Supplies			
Total		15,279.00	28,404*	

* Other source funding includes USU-supported time equivalent to requested time (i.e., 9,821 + 4,458 each year salary and overhead) and FIA-supported time approximately equivalent to 0.1 FTE (i.e., 12,500 + 2,125 each year salary and overhead).