

TITLE: Effects of Mountain Pine Beetle (MPB) Outbreaks on Fuels, Carbon, Stand Structure and Composition, and the Availability and Suitability of Snags for Salvage in the Intermountain West

LOCATION: Colorado, Idaho, Montana, Utah, Wyoming

DATE: 26 September 2013

DURATION: Year 1 of 3-yr project

FUNDING SOURCE: Fire

PROJECT LEADER: Chris Fettig, Team Leader, Pacific Southwest Research Station; 530-759-1708; cfettig@fs.fed.us

COOPERATORS (Co-PIs): Carl Jørgensen, Entomologist, FHP (Boise); Steve Munson, Group Leader, FHP (Ogden); Jose Negrón, Research Entomologist, RMRS (Fort Collins); Justin Runyon, Research Entomologist, RMRS (Bozeman); Brytten Steed, Entomologist, FHP (Missoula); Ken Gibson, Entomologist, Retired (Missoula); Leif Mortenson, Forestry Technician (Research)/FIA, PNW (Placerville, CA)

FHP SPONSOR/CONTACT: Steve Munson; 801-476-9720 (ext. 219); smunson@fs.fed.us

PROJECT OBJECTIVES: This proposal expands on monitoring executed across a network of 120 plots under INT-EM-F-10-03 titled “Quantifying the short- and long-term impacts of mountain pine beetle (MPB) outbreaks on forest fuels and other stand attributes in the Intermountain West”. The objectives of INT-EM-10-03 were to document residual stand structure and composition associated with ground, surface and aerial fuel loads; tree age, size and species diversity; regeneration; invasive weeds; fall rates and snag composition over multiple years. The objectives covered by this proposal include those of INT-EM-F-10-03 in addition to documenting changes in carbon, and wood quality and quantity.

JUSTIFICATION:

a. **Linkage to FHM program:** This proposal expands on INT-EM-F-10-03*, which reported reductions in live pine volume ranged from ~50% (ID) to 70% (MT) during 2004-2012.

**A subsequent proposal was submitted to FHM-EM in FY2013, but was not selected for funding. As a result, R1/4 funded this work directly in FY13 due to their perception of its importance to managers in these regions.*

b. **Significance/Impact of forest health issue:** The scope of this work encompasses areas where the majority of MPB-caused tree mortality has occurred in the U.S. To that end, about 8% of U.S. forests are classified at risk to insect and disease outbreaks, and MPB is ranked most damaging of all disturbance agents considered (Krist et al. 2007).

MPB outbreaks modify stand structure and composition by causing tree mortality, and impact timber and fiber production, fuel conditions, fire risk and severity, water quality and quantity, fish and wildlife populations, recreation, grazing capacity, real estate values, human safety, biodiversity, carbon pools, aesthetics, endangered species and cultural resources. Forests that were once carbon sinks may become carbon sources as large amounts of CO₂ are released when forests experience high levels of tree mortality and are converted to structures that have relatively small carbon pools. Alternatively, resilient forests have the potential to assimilate,

accumulate, and sequester large amounts of carbon from the atmosphere, thus reducing one of the primary drivers of climate change.

MPB outbreaks have also had a significant economic impact to U.S. producers. Recent legal actions highlight the importance of procuring additional information related to changes in wood quality and quantity that occur as a result of tree death attributed to MPB attack (e.g., checking; Fettig 2012), which influence the availability of trees (snags) for commercial salvage, and affect carbon cycling, fuels management and the economic welfare of affected communities, among other factors.

c. **Scientific basis:** All methods are commonly recognized in the scientific literature and informed by previous work associated with FHM-EM. Our team has a strong track record of providing deliverables in a timely manner, including those originating from work previously funded by FHM-EM.

d. **Cost/economic efficiency:** Costs are reduced through use of an existing network of FHM-EM plots, and significant in-kind contributions (see Costs).

e. **Priority issues:** Several Fire Plan EM priorities are addressed: (1) climate change – effects, (2) fire risk and fuel loading, and (3) invasive species (i.e., plants). Base EM priorities are addressed as well.

DESCRIPTION:

a. **Background:** MPB causes extensive tree mortality in coniferous forests of the western U.S. and plays an important role in the disturbance ecology of these ecosystems. Episodic outbreaks are a common occurrence, but the magnitude of recent outbreaks has exceeded the range of historic variability triggering concerns about short- and long-term impacts. However, limited information is available that fully defines these impacts. For example, although it is widely believed by land managers and the public that MPB outbreaks set the stage for severe wildfires (reviewed by Jenkins et al. 2014), until recently few scientifically- and statistically-sound studies have been published on this and related topics. Page and Jenkins (2007) concluded the net result of MPB outbreaks in northern Utah and central Idaho was a highly altered fuels complex in which litter and fine fuels increase during current outbreaks and live surface fuels and large dead woody fuels dominate post-outbreak stands. A thorough examination of the fate of fuels during and after MPB outbreaks has never been conducted within the same stands over a large geographic area (proposed in this study), which will assist in understanding these relationships and whether or not management of aerial or downed (dead) fuels is warranted. Furthermore, resource managers often question if lodgepole pine will remain the dominant overstory tree following outbreaks of MPB and how snag retention and timber volumes will be affected.

b. **Methods:** All measurements will be conducted on 25 permanent plots in each of five western states (see INT-EM-F-10-03), except in Idaho where five plots were lost to wildfire in 2012. Each tree ≥ 3 in. dbh is permanently tagged and the species, dbh, height, height to the base of the live crown, crown position, status (live or dead), presence and impact of insect and disease agents, bark retention, and number of checks (cracks) visible on the tree will be recorded. We will estimate the total amount of carbon lost based on Pearson et al. (2007).

Downed woody debris will be recorded along three modified Brown's planar transects radiating from plot center (Brown 1974). Litter, duff and fuel bed depth will be measured at the end of each fuel transect. Volume loss and rate of tree fall will also be recorded. Within each plot, tree regeneration and other flora will be recorded on a 1/100th acre subplot surrounding plot center

and at the end of each Brown's transect. Invasive plants will be surveyed on the entire plot. Stand and fire histories will be reconstructed.

c. **Products:** Findings will be delivered in a timely manner in both verbal and written formats.

- FHM Working Group presentations (three poster presentations as per RFP)
- Bark Beetle Technical Working Group presentations (informal updates to colleagues)
- Western Forest Insect Work Conference (presentation)
- Three papers describing effects on (1) fuels and carbon, (2) stand structure and composition, and (3) snag demographics and degrade.

d. **Schedule of Activities:**

<u>Research Activity</u>	<u>Date</u>
1. Re-measure all variables (including fuels) across the network	June-Sept. 2014
2. Collate data; prepare progress report/poster	Fall 2014
3. Prepare and submit publications on changes in (1) fuels and carbon, (2) stand structure and composition, and (3) snag demographics and degrade	2014-2015
4. Monitor levels of tree mortality, fall rates and tree degrade across the network	June-August 2015
5. Collate data; prepare progress report/poster; analyze data	Fall 2015
6. Monitor levels of tree mortality, fall rates and tree degrade across the network	June-August 2015
7. Collate data; prepare progress report/poster; analyze data	Fall 2016

e. **Relevant Citations:**

Brown, J.K. 1974. Handbook for inventorying downed woody material. GTR-INT-16. USDA Forest Service, Ogden UT.

Fettig, C.J. 2012. Expert report of Christopher J. Fettig in the London Court of International Arbitration No. 111790 in the Matter of Arbitration between The United States of America (claimant) and Canada (respondent).

Jenkins, M.J., Runyon, J.B., Fettig, C.J., Page, W.G., Bentz, B.J. 2014. Interactions among the mountain pine beetle, fires, and fuels. *For. Sci.*, early online.

Klutsch, J.G., Negrón, J.F., Costello, S.L., Rhoades, C.C., West, D.R., Popp, J., Caissie, R. 2009. Stand characteristics and downed woody debris accumulations associated with a mountain pine beetle (*Dendroctonus ponderosae* Hopkins) outbreak in Colorado. *For. Ecol. Manage.* 258:641-649.

Krist F.J. Jr., Sapio F.J., Tkacz, B.M. 2007. Mapping risk from forest insects and diseases. FHTET Report 2007-06. USDA Forest Service, Washington, DC.

Page, W.G., Jenkins, M.J. 2007. Mountain pine beetle-induced changes to selected lodgepole pine fuel complexes within the Intermountain region. *For. Sci.* 53:507-518.

Pearson, T.R.H., Brown, S.L., Birdsey, R.A. 2007. Measurement guidelines for the sequestration of forest carbon. GTR-NRS-18. USDA Forest Service, Newton Square, PA.

COSTS:

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR - <u>2014</u>				
Administration	Salary		143,250	³
	Overhead			
	Travel	31,500 ¹		
Procurements	Contracting			
	Equipment		16,000	⁴
	Supplies			
Total		31,500	159,250	

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR - <u>2015</u>				
Administration	Salary		122,250	³
	Overhead			
	Travel	15,750 ²		
Procurements	Contracting			
	Equipment		8,000	⁴
	Supplies			
Total		15,750	130,250	

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR - <u>2016</u>				
Administration	Salary		107,300	³
	Overhead			
	Travel	15,750 ²		
Procurements	Contracting			
	Equipment		8,000	⁴
	Supplies			
Total		15,750	115,300	

¹\$140/d X 45 d (5 persons X 2 wk) X 5 states. All others contributed by FHP, PSW and RMRS.

²\$140/d X 22.5 d (5 persons X 1 wk) X 5 states. All others contributed by FHP, PSW and RMRS.

³Salaries (cost-to-government) contributed by FHP, PSW and RMRS.

⁴Vehicles and mileage contributed by FHP, PSW and RMRS.