Chapter 2—Webinar summary: Important findings for managers

Author: Claudia Regan

Introduction

This chapter summarizes key findings and offers take-home messages of the Future Forest Webinar Series with regard to resource management planning, analyses, and project design. In the wake of the mountain pine beetle (MPB) epidemic, resource managers are especially concerned with developing more resilient forests, providing for the sustainability of wildlife and fish habitat, public safety, and managing our water resources. We attempted to provide information to support these management goals via the series of webinars. More details on the findings of each webinar are presented in the subsequent chapters of these proceedings.

Resilient forests

Resource managers are interested in developing management approaches that contribute to resilient forests in the future.[3] They want to ensure that forests regenerate after a disturbance and maintain their structure and function over the long term. They are also concerned about invasive species and soil erosion that may be exacerbated by beetle-caused tree mortality and subsequent disturbances, including post-epidemic salvage operations.

Figure 2.1. Subalpine forests have recovered from disturbances in the past, including massive MPB epidemics, wildfires, and windfall events (photo by J.M. Miller in 1924 of the Tenaya Ghost Forest in Yosemite National Park showing lodgepole pine regeneration a decade after the MPB and lodgepole needle miner killed overstory trees; Furniss 2007).

Managing for resilience requires knowledge about potential changes in forest conditions with and without management treatments. Subalpine forests evolved with widespread and severe disturbances, and the species dominating these ecosystems are adapted to these conditions (Fig. 2.1). The composition and structure of subalpine forests vary across the

[3] Resilience is the ability of an ecosystem to recover from disturbance (natural or anthropogenic) without shifting to an alternative state (i.e., substantially different structure, composition, and function) (SER 2004).

West. How does this variability contribute to their resilience in the wake of the epidemic? The recent MPB epidemic is unprecedented in terms of its extent, geographic distribution, and longevity, but managers want to know if recovering subalpine forests are on a different trajectory than they might following more characteristic disturbances.

Managing for fire hazards and risks

Resource managers are concerned about the possibility of increased wildfire hazards, especially in the WUI, following the MPB epidemic. They recognize that the widespread death of trees dramatically changes fuel conditions over time, but they are uncertain about potential impacts on fire hazard and behavior. There is an interest in ameliorating short-term effects through fuel treatments and in planning for treatments that might have positive resource outcomes in the future. The webinar *Post-epidemic fire risk and behavior* focused on the fire behavior research of Forest Service researchers and their collaborators (**Chapter 3**), and additional research on MPB and fire interactions were presented during the webinar *Forests in transition: Vegetation structure and composition* (**Chapter 4**).

This research suggests that fire behavior in beetle-killed forests may be more complex than initially expected. Larger safety zones may be required for fire operations during the red stage of the MPB attack due to greater heat release (Fig. 2.2). This may also be true for fire operations in cut areas due to greater surface fuel loads and in uncut stands following massive windthrow events. Firefighters might decline assignments on wildland fires burning in beetle-killed stands given the high hazards involved.

Information on fuel loads and fire behavior in the gray stage is more limited. Predicting fire behaviors under gray stage or future conditions remains an area of uncertainty with conflicting findings. Public safety concerns may call for conservative approaches that would favor management to mitigate future fire concerns.

Management Implications

- The potential for crown fire and fire intensity (heat release) increases as the proportion of red-stage trees in a forest increases.
- Stand structure and the nature of MPB outbreaks in space and time *(i.e.*, low and slow mortality pulses vs. high and fast mortality pulses) affect how MPB outbreaks influence the risk of crown fires.
- Tree removal in post-epidemic forests can result in a three-fold increase in surface fuels for several years after treatment. Higher fuel loads can result in greater flame lengths, potentially decreasing our ability to suppress fires with ground tactics.
- However, uncut stands could have higher fuels loads in the long-term as dead trees fall to the ground.

Figure 2.2. Fire behavior in beetle-killed forests is complex and difficult to predict. Research shows that forests with many red-stage trees have a greater potential for crown fires. Fires in red-stage forests also burn with a higher intensity (greater heat release) than fires in green forests (photo from 2009 Kelly Creek Fire in British Columbia, photo courtesy of B.C. Wildfire Management Branch).

Figure 2.3. Advanced regeneration and new recruitment of tree species are abundant in most post-epidemic stands (photo by Chuck Rhoades, USDA Forest Service).

Current and future stand conditions

The webinar *Forests in transition: Vegetation structure and composition* covered research that is addressing uncertainties about how changing fuel profiles after the MPB epidemic might influence future fire behavior and/or impair fire suppression efforts (**Chapter 4**). We learned that forested landscapes in the future may have different structures and compositions than before the MPB epidemic. Management decisions regarding the removal of beetle-killed trees will influence the types of forests that develop.

We also learned that forests are responding positively to the increased availability of resources (light, nutrients, etc.) with rapid growth of residual trees and new tree recruitment (Fig. 2.3). Simulations of stand development using the Forest Vegetation Simulator suggested that increased growth of residual trees, as well as new recruitment, might return stands to pre-outbreak basal areas

Management Implications	
	• Post-epidemic forests are undergoing extensive regeneration. Tree planting is largely unnecessary to ensure forested conditions in the future. • Recovery of post-epidemic forests will depend on species composition of surviving trees and advanced regeneration. o The abundance of subalpine fir and Engelmann spruce will increase in some stands, especially if the abundance of lodgepole pine declined substantially during the beetle epidemic. o Lodgepole pine will continue to dominant some stands, especially those where pre-epidemic densities of subalpine fir and Engelmann spruce were low. o Aspen abundance is increasing in stands without substantial competition from subalpine fir. • Harvesting beetle-killed trees can promote the recruitment of lodgepole pine or aspen, while subalpine fir recruitment more likely in uncut stands.

within a century. The simulations reveal that lodgepole pine may continue to dominate harvested stands over the next century, while some uncut stands may have larger proportions of subalpine fir.

Sustainability of wildlife habitat

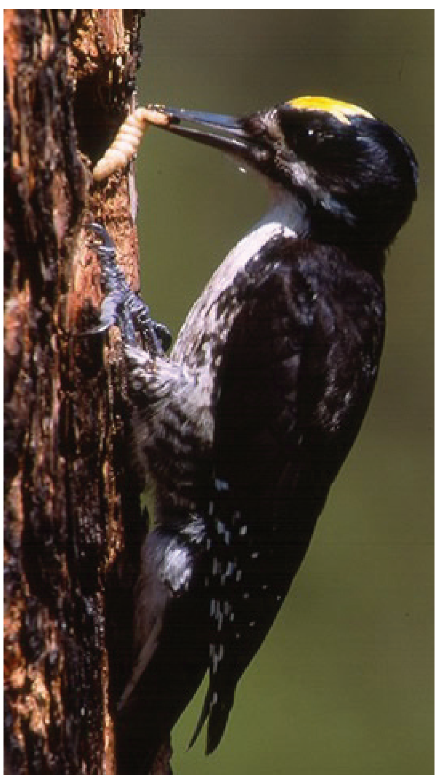

Figure 2.4. Several woodpecker species, including the black-backed woodpecker, forage for MPBs and other bugs under the bark of dead snags (photo courtesy of USDA Forest Service).

Resource managers need information on the consequences of the MPB epidemic for wildlife habitat and wildlife populations. This information will support conservation and recovery efforts and help in prioritizing treatment sites. A team of researchers and resource specialists addressed some of these information needs in the webinar *Ecological consequences of beetle outbreaks for habitats and populations of wildlife* (**Chapter 5**).

A wildlife biologist with the Rocky Mountain Research Station illustrated how life history traits provide clues about the impact of disturbances on different bird species. Cavity-nesting birds, beetle foragers, and bark insectivores (*e.g.*, hairy woodpeckers and American three-toed woodpeckers) often respond positively to MPB outbreaks and fire (Fig. 2.4). This is due to increased availability of snags for nesting and food resources. In contrast, foliage gleaners and canopy-nesting birds (*e.g.*, golden-crowned kinglet) are likely to respond negatively because they prefer dense forest canopies.

Impacts of the MPB epidemic on wildlife habitat will change over time as the forests regrow and snags fall down. Wood-boring insects that colonize MPB-killed trees can serve as a foraging resource for woodpeckers even 4-5 years following a MPB attack.

Management Implications

- Animal species respond differently to disturbances like the MPB epidemic based on their life history traits.
  - Species that utilize snags for feeding and/or nesting (*e.g.,* woodpecker species) often benefit from MPB outbreaks and fires. Habitat suitability for these species can decline over time as snags fall down.
  - Species preferring dense forest overstories (*e.g.,* foliage-gleaning and canopy-nesting birds) often decline following a MPB outbreak, but populations might rebound as forest stands recover.
- Retention of snags for wildlife habitat is an important project consideration for some large-scale salvage operations. Managers should also remember that snag fall rates are highly variable.
  - Research shows that woodpeckers preferentially forage on large-diameter snags.
  - Anywhere from 70-90 percent of snags fall within 5 years of a MPB outbreak. Higher fall rates are generally associated with warmer and wetter conditions.

Webinar presenters also discussed the use of models to evaluate changes in wildlife habitat over time. They found that models are useful tools for predicting habitat suitability under different climate conditions and disturbance regimes. Some models can examine interactions among disturbances (*e.g.,* climate change, wildfires, and MPB outbreaks). Researchers suggested several best practices for using models:

- Determine the appropriate spatial and temporal scale for projections. Projections at landscape scales are necessary for species that have large home ranges or migrate from season to season. If snags are important habitat for the focal species, annual or decadal projections at the stand scale are more appropriate.
- Try linking site-specific research projects with broader monitoring programs to develop multi-scale inferences about habitat suitability.
- The future is not set in stone, so models can help assess the impact of different management decisions under a range of potential conditions (*e.g.,* climate scenarios).
- Understand the assumptions and limitations of models. For example, some datasets are less reliable than others, and this can greatly influence the reasonableness of model predictions.
- Qualitative modeling approaches, such as scenario planning, are often helpful when future conditions are dynamic and largely unknown and/or when quantitative data is not available.

Public safety

Resource managers continue to be concerned about the direct consequences of forest insect epidemics to human safety. They are interested in understanding issues that relate to agency responses to safety concerns. Once the extent and severity of the MPB epidemic became apparent, managers worked to address

Figure 2.5. Trees killed by MPB attacks eventually weaken and fall, posing a serious safety concern for forest users (photo courtesy of USDA Forest Service).

current and future safety of employees, recreation visitors, permittees, and contractors who use the National Forests. In addition, the agency has an interest in addressing the safety of communities in the wildland urban interface (WUI). Dead and dying trees eventually fall, creating imminent and future risks to people and structures (Fig. 2.5). Resulting changes in fuel profiles are seen as potentially influencing fire potential and behavior and impacting suppression responses (**Chapter 3,** discussed earlier).

Management Implications

- Respondents generally support the management of forest conditions to decrease the effects of wildfire that may potentially be influenced by changes in fuel profiles associated with dying, dead, and falling trees.
- Respondents are generally willing to accept the risks of recreating in beetle-killed forests, and they accept that certain activities are restricted or no longer possible.
- There is less agreement among respondents that managers are doing everything they can to respond to tree mortality from MPBs.

Knowing the perceptions, beliefs, and preferences of the public can help land managers identify the issues, communicate better with the public, and improve collaborative efforts. The webinar *Beetles among us: Social and economic impacts of the mountain pine beetle epidemic* drew largely on a survey of public perceptions by researchers at Colorado State University (**Chapter 6**).

Managing water resources

The webinar *Ecosystem and watershed level responses to the mountain pine beetle epidemic* summarized research by forest ecologists and hydrologists at the Rocky Mountain Research Station (**Chapter 7**). Research shows that water yield and quality has not changed in the first years following the MPB epidemic. Stream nitrogen levels remain below those expected to cause problems for human health. Uptake by residual vegetation and new recruits has dampened the loss of nutrients to surface water.

Managers should be aware of how treatments in post-epidemic forests can alter water yields and soil resources. Treatment of slash can have particularly

Figure 2.6. Slash management techniques can impact snow retention, soil nutrient availability, and seedling development. Lop and scatter approaches increase snow retention, often leading to greater soil moisture and enhanced seedling recruitment and growth (photo by Byron Collins, USDA Forest Service).

Management Implications

- Snow retention and associated spring runoff are impacted by post-epidemic management decisions.
  - Removal of trees in large groups can decrease snow retention due to wind scour.
  - Retaining slash in post-epidemic forests increases surface roughness and will help to keep snow on the ground.
- Different methods of treating slash in post-epidemic forests can impact future stand development.
  - Slash retention (*i.e.*, lop and scatter) has positive effects on soil resources and seedling recruitment and growth relative to other options.
  - Burning the very large and numerous slash piles resulting from post-epidemic management can have long-lasting negative impacts (*i.e.*, overs 50 years) on soil nutrients and seedling recruitment.
- Riparian ecosystems are particularly sensitive to management approaches that emphasize hazard tree removal and pile burning.

pronounced effects on snow retention and soil nutrients in forest ecosystems (Fig. 2.6). Additional research is needed to understand impacts of post-epidemic management to riparian ecosystems, but preliminary findings suggest these ecosystems are especially sensitive to mechanical disturbances and pile burning.

Economic feasibility of management actions

The amount of mitigation and hazard removal that managers can undertake in post-epidemic forests is limited by funding and the availability of forest-industry infrastructure. States with robust forest-products infrastructure, such as Montana, can finance at least some of their management costs by selling some or all of the material. In places where such infrastructure is sparser, like in Colorado, the material is often piled and burned in the woods, offsetting none of the costs of treatment. Utilizing woody material for bioenergy, rather than piling and burning it in the forest, also offsets carbon emissions.

There are significant challenges to developing the capacity of private industries to utilize woody biomass. These include:

- Uncertainty in the amount of timber available to investors in the coming decades.
- High transportation costs to haul timber or biomass from infested forests to far-away mills.
- The price that the woody material receives on the market, as well as the price of alternatives. For example, the lower the cost of natural gas, the lower the price purchasers are willing to pay for biomass.

Conclusions

The MPB epidemic has greatly altered the future of forests across the West. The conditions across post-epidemic landscapes are complex and the future is largely uncertain. Implications of the epidemic for public safety, fire hazards, forest vegetation, and wildlife populations are variable across the landscape and will change over time. Management decisions have the potential to steer forests away from an undesirable future, but guidance is needed on how this might be accomplished (Fettig and others 2014).

Navigating through this complex and dynamic situation calls for continual interaction among managers, resource specialists, and scientists (Fig. 2.7). The process of developing, delivering, and implementing scientific information is most effective when it incorporates diverse perspectives, training, and expertise. For example, entomologists understand environmental controls of MPB outbreaks, forest ecologists have insights about forest development over time, and wildlife biologists know which variables are important for habitat suitability. Discussions among scientists and managers can also ensure that research is relevant and focused on the right questions.

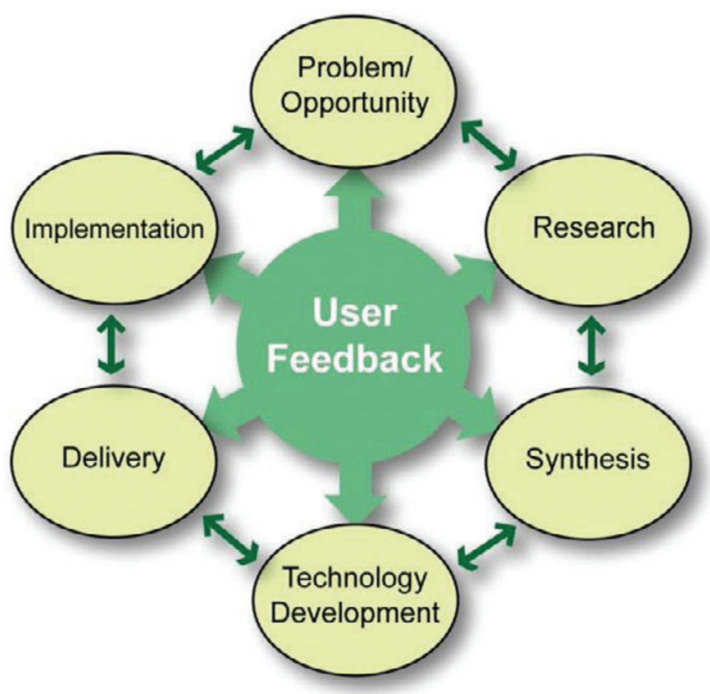

Figure 2.7. A fully collaborative science cycle involves continual interactions among researchers, managers, and other science users. Interactions can familiarize non-scientists with research methods, make researchers aware of information needs, and improve the usability of research results (USDA Forest Service 2009).

The Future Forest Webinar Series helped to kick-start these interactions. Our hope is that the webinar coordinators, presenters, and participants continue working together; there is still much to learn about the future of post-epidemic forests.

Literature cited

Fettig, C.J., K.E. Gibson, A.S. Munson, and J.F. Negrón. 2014. Cultural practices for prevention and mitigation of mountain pine beetle infestations. Forest Science 60. [online] URL: http://dx.doi.org/10.5849/forsci.13-032.

Furniss, M.M. 2007. Forest entomology in Yosemite National Park: Glimpses of forest renewal 1903-1984, and the creation of the Tenaya Ghost Forest. American Entomologist 53(4):202-207.

SER. 2004. The SER international primer on ecological restoration. Society for Ecological Restoration International, Science & Policy Working Group, Washington, DC. [online] URL: https://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration.

USDA Forest Service. 2009. Assessment of technology transfer within the USDA Forest Service: Final report. USDA Forest Service, State & Private Forestry and Research & Development, Washington, DC. Unpublished report. 25 pp.

Meet the chapter author

Claudia Regan is the Regional Ecologist with the Rocky Mountain Region of the Forest Service. She has worked with the agency as a full-time employee for 18 years and in temporary or seasonal capacities for 6 years. Regional Ecologists serve as applied scientists who bridge scientific research with resource management issues and work toward information synthesis, delivery, and application. Claudia has Bachelor's and Master's degrees in Forest Science from Southern Illinois University and a Ph.D. in Ecology from Colorado State University. Reach Claudia at cregan@fs.fed.us; 303-275-5004.