Vertebrate Responses to Bark Beetles: Symposium Summary

On April 5 and 6, 2012, researchers and managers convened a special symposium to address fish and wildlife-related issues in response to the ongoing bark beetle epidemic in the Rocky Mountains. The symposium took place on the University of Wyoming campus in Laramie, WY; approximately 45 academic, state, and federal agency scientists and managers attended at some time over the two-day event. Sessions included an overview of bark beetle epidemics from entomological, forest, wildlife, aquatic, and land management perspectives; presentations of recent and ongoing work investigating vertebrate responses to the bark beetle epidemic in the Rocky Mountain region; and breakout groups that identified key information gaps and research needs in understanding fish and wildlife responses to the epidemic, wildlife considerations for land management activities, opportunities for monitoring, and potential for future collaboration to improve our understanding of vertebrate responses.

Monitoring:

1. The Integrated Monitoring in Bird Conservation Regions (IMBCR) approach could be employed to support monitoring efforts. Thus, Robert Skorkowsky and Jennifer Blakesley would be key individuals in guiding decisions on monitoring protocols. This spatially-balanced sampling design already exists for monitoring avian populations and could be adapted to monitor other aspects of forest systems relevant to the effects of the bark beetle epidemic such as vegetation characteristics, mammals; however, available GIS layers, data on tree mortality from forest monitoring flights, and the current avian sampling frame are likely insufficient to quantify germane vegetation covariates. Sampling efforts specific to monitoring vegetation characteristics may require a different spatial scale than sampling units used for avian monitoring. Acquisition of any vegetation data from a sample-based approach, however, may benefit understanding of how species respond to new landscape mosaics.
2. Using a geo-spatial product rather than relying on field data collection from multiple crews will be beneficial for monitoring efforts. However, it will be very important to identify specific questions and objectives to help frame monitoring efforts and define sampling frames. Monitoring should be extensive and include multiple sites to incorporate variation in forest type, landscape impacts, and management, but there may be a need to monitor a subset of sites more intensively. The current sampling frame used by IMBCR is flexible enough to accommodate intensified sampling on specific management units, but these data can also be incorporated into much broader spatial scales. However, funding and logistics will likely constrain the extent of monitoring efforts.
3. Monitoring of multiple taxa within this framework is possible, and could include many species of vertebrates. Sampling frames could be adjusted as necessary to address specific management monitoring needs (e.g., lynx), and post-stratification could be used to help address questions. A list of covariates or specific attributes to be captured would

first need to be developed along with clear definitions of management monitoring objectives so that the approach is appropriate to address specific questions.

4. There may be a role for the Landscape Conservation Cooperatives (LCC) to play in developing coordinated monitoring or research efforts. LCCs may serve as an organizational impetus, or may be able to leverage funding to assist in integrated monitoring. However, the extent of the bark beetle epidemic encompasses at least two LCC boundaries (Great Northern and Southern Rockies), which would require coordination between them.
5. It may be useful to engage the public in coordinated citizen science efforts. This model could facilitate data collection over broad spatial scales and still be cost-effective. Citizens could assist with monitoring vegetation or bird populations most easily, but other responses may be included. This approach would require a small investment and would engage the public, presumably increasing public stake-holding in the bark beetle issue; however, coordination would be critical.
6. There should be representation of all relevant forest types and conifer species that are affected by bark beetles in both monitoring and research efforts. Specifically, whitebark (*Pinus albicaulis*) and bristlecone pine (*Pinus* spp.) systems should be included given their limited distributions and current susceptibility to multiple stressors (e.g., white pine blister rust; *Cronartium ribicola*).
7. Advance notification of the location of management actions would be useful in structuring monitoring frames, so that effects of those actions could be assessed. An emphasis was placed on the idea that all monitoring efforts would need to be highly coordinated so that data can be compiled and analyzed jointly.
8. Although different agencies tend to have varying conservation priorities, new technologies can be utilized (e.g., Decobar) that allow data collection to be streamlined over broad spatial extents.

Research

1. Although information on wildlife response to the current bark beetle outbreaks is growing, we lack a thorough understanding of wildlife communities in these forest types prior to the current insect epidemics. Completing a thorough literature review of terrestrial vertebrate and invertebrate communities in the affected forest types would provide a better baseline to assess potential impacts to wildlife communities and responses to the current epidemics.
2. Assumptions made regarding tree mortality and regeneration made at the onset of the current bark beetle outbreaks tended to overestimate (overstory) tree mortality and underestimate regeneration, and need to be revisited. Quantitative vegetation data has been collected to some extent throughout the area affected by the current epidemics, and a thorough, synthetic analysis of impacts of the current epidemic on existing vegetation

and response to the epidemic is needed to better inform management and projections of future forests.

3. No comprehensive assessment of current landscape condition following the past decade of insect impacts has been assembled, and the absence of a reliable regional base layer hinders opportunities to model future landscapes, strategically monitor wildlife response, and thoroughly integrate wildlife considerations into land management planning. The Forest Service conducts annual aerial detection surveys to map forest insect and disease activity and these surveys provide a good assessment of areas impacted by insects and disease, but generally do not provide resolution needed for detailed wildlife habitat analysis. Other widely available GIS data (e.g., LANDFIRE) are generally not updated to reflect mortality, regeneration, and other aspects of stand composition and structure. Developing a consistent, regional GIS data layer that depicts these factors and can be updated in a cost-efficient manner would provide important information for modeling wildlife habitat and population response to insect outbreaks.
4. To better understand wildlife response, there is a need to identify / test mechanistic responses to bark beetle epidemics. For many species, responses are assumed based on functional ecosystem roles. These relationships need to be tested in post-beetle landscapes and projections to facilitate accurate modeling / prediction wildlife distribution following bark beetle epidemics. Similarly, the value of guild approaches or similar species aggregations as a means to simplify potential wildlife response has generally not been tested in post-beetle landscapes for many species.
5. Some of the research examining wildlife response to beetle epidemics has focused on presence / absence metrics. Although this approach provides valuable data in a cost-effective manner, there will be a need to conduct research examining fitness metrics for certain species. The variability of beetle impacts across the region may result in source sink dynamics, and identification of demographic refugia can provide insights to future landscape conditions beneficial and/or detrimental to certain species.
6. Spatially intensive research into wildlife response will benefit from replicated studies conducted based on environmental gradients site variability, latitude, etc.
7. Assumptions regarding efficacy of different management approaches to mitigating bark beetle spread need to be tested as possible. To what extent has past management affected bark beetle impacts? How can this information be applied in other areas not yet impacted by bark beetles and in designing future landscapes?
8. Will other existing and emerging stressors (e.g., climate change) impact regeneration and forest succession in a manner that creates novel ecosystems?

Management

1. A previous workshop was held in 2006 in Region 2 at which forest design criteria and management opportunities relevant to the developing bark beetle epidemic was discussed. Doreen Summerlin has minutes from that workshop and suggested they be

shared with all those interested. This information should be reviewed to evaluate whether it is still valid, and to determine whether any management strategies that were implemented were effective. Additional items could be added based on information from ten years of bark beetle effects and newly-acquired information.

2. Information needs identified that are relevant for management included:
    a. Identifying current conditions regarding tree mortality rates to be used as a baseline for future management decisions.
    b. Identifying alternate habitat refugia – which (if any) alternate stand types can lodgepole-dependent species use as refugia and where are they?
    c. Evaluate utility of forest design criteria for wildlife (e.g., use of snags, retention trees, slash piles, riparian buffers, etc.)
    d. Improved understanding of wildlife-habitat relationships, in terms of both basic life history requirements and relative to post-bark beetle forest conditions.
    e. Identifying thresholds of tree mortality relevant to different species. Are there thresholds in tree mortality that facilitate immigration or emigration for a species?
    f. Identify similarities and differences between recovery of lodgepole pine stands after bark beetle epidemic versus fire. Resources included in this evaluation should be both terrestrial and aquatic.
3. Compilation of information on post-bark beetle forest conditions would be useful. It could be incorporated into available databases (e.g., GIS, lynx habitat maps, etc.) and be made accessible to managers.
4. Management opportunities for wildlife-based projects included:
    a. Patch cuts could be implemented within un-harvested beetle-killed stands to stimulate lodgepole pine regeneration and create heterogeneous forest structure. Results should be monitored.
    b. In appropriate habitats, management could be geared toward aspen regeneration or meadow expansion.
    c. Travel management may need to be re-evaluated if there is an interaction between use and patterns of beetle kill.
    d. Opportunities to facilitate future lodgepole pine old growth development may be to implement larger live tree retention areas, and include a buffer around live tree patches to avoid blowdown.
    e. Other minor accommodations in projects can result in important habitat benefits for wildlife; the feasibility of implementation of these should be considered, as they could be conducive to timber sales.
    f. Wildlife biologists should be involved early in the planning process for projects so that their recommendations can be incorporated; project managers should be engaged in post-project monitoring to assess effects of projects on wildlife.
    g. Current assumptions regarding efficacy of management and design criteria should be tested.

5. Landscape considerations should be incorporated into design criteria rather than strict emphasis on small-scale, site-specific project areas. Species conservation should be considered at a biologically-relevant spatial scale, which will vary by species. A beneficial approach may be to assess species conservation at a landscape scale, then implement locally.

Next Steps

In response to what we learned from participants at the symposium, suggestions for future activities include:

1. To continue communication regarding the bark beetle epidemic and vertebrate responses, we should take advantage of professional networking sights (*e.g.*, Linked-In), along with a Dropbox account so participants can share documents. A website could also be hosted by USFS Region 2 for information to be shared with the public.
2. A need seemed apparent for subsequent gatherings similar to this. Two possible meetings, both occurring in 2014, seemed like reasonable potential venues for an update on vertebrate responses to bark beetles: a joint meeting of the Colorado and Wyoming State Chapters of The Wildlife Society in Ft. Collins, Colorado or the North American Ornithological Congress meeting in Estes Park, Colorado. The possibility for a symposium on vertebrate responses to bark beetles to be held in conjunction with one of these meetings should be explored.
3. Opportunities need to be explored for creating buy-off and commitment by those in leadership positions in order to facilitate action. The group should consider following the Colorado Forest Restoration Institute model, or partnering with said organization to bring information regarding the current bark beetle epidemic and its implications for fish and wildlife to bear on decision makers.
4. Opportunities for coordinated research and monitoring and technology transfer might be enhanced through the creation of a network or working group and could be modeled after the Joint Fire Science Network or the Bark Beetle Technical Working Group steering efforts.