

Post-Disturbance Management of Biodiversity in BC Forests

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Abstract

Biodiversity is a key component of forested ecosystems. It should be preserved not only for its own sake, but because biodiverse ecosystems are resilient and better able to respond to changing conditions. This extension note is a condensed version of a full synthesis paper and provides some background on how biodiversity can be managed and enhanced in the wake of natural and man-made disturbances.

KEYWORDS: forest biodiversity; post-disturbance; salvage harvesting

Introduction

Biodiversity is a key attribute of forested ecosystems. It should be preserved not only for its own sake, but also because biodiverse ecosystems supply a wide range of goods and services and are better able to respond to changing conditions. This extension note is a condensed version of a full synthesis paper and provides some background on how biodiversity can be managed and enhanced in the wake of natural and man-made disturbances. The full synthesis report is available in FORREX Series 28.

The dominant natural disturbance types, as well as their frequency, intensity, and scale, vary substantially across the province of British Columbia. Most of these natural disturbance processes have been significantly altered by human activity; such is the case in the dry, historically fire-maintained forests of the Southern Interior. By suppressing fires, we have shifted many of these ecosystems into an infrequent, stand-replacing fire regime. Another example are the lodgepole pine forests of the Central Interior, where fire suppression combined with harvesting practices created large tracts of even-aged, over-mature and beetle-prone stands. In both cases, changes to the disturbance pattern had negative ecological consequences.

While this document focuses on post-disturbance management, it is important to note that the most effective way to promote biodiversity and ecosystem resilience is to maintain or restore natural disturbance regimes where possible, and to emulate them in our forest harvesting activities.

Climate change is not considered a disturbance, but rather a “stressor.” Climate change will have a direct impact on ecosystems at the population level through changes in temperature and precipitation regimes; it will also have indirect impacts, by way of al-



terations to disturbance patterns. As the climate warms, the fire season in most regions will become longer. Similarly, tree mortality from enhanced forest pest activity and drought stress is expected to increase, and to combine with longer dry periods to produce more intense wildfires in some regions. There will be increased variability in temperature and precipitation, as well as more extreme weather events, such as droughts and floods. Forest insects and diseases may benefit from warmer winters, and invasions of alien plant, animal, and microbial species are predicted to increase as the climate changes.

Restoring and emulating contemporary natural disturbance regimes while facing future climate change may seem counterintuitive; however, climate change operates at an incremental, multi-decadal scale, whereas enhancing ecosystem resilience by restoring and emulating natural disturbance regimes can be achieved within shorter time frames.

A key task for managers is to implement forest management policies and practices that increase the capacity of ecosystems to adapt (“resilience”) to changes in disturbance regimes as the climate changes. One of the most effective ways of doing this is to encourage heterogeneity, at both the stand and landscape scale. Heterogeneity can be incorporated into all phases of forest management: harvest block size, amount of green tree retention, species mix, prescribed burn size and intensity, amount of coarse woody debris retained, connectivity, age-class distribution, etc. The maintenance and enhancement of heterogeneity of the forest landscape should be an overarching management goal, recognizing that there will always be tradeoffs between ecological and economic benefits.

Post-disturbance harvesting and silviculture practices

Medium and large-scale salvage logging can have significant impacts on forest biodiversity, wildlife habitat, and ecological processes. Salvage logging may have greater impact than other harvest methods, such as clearcutting, in live forests. Salvage harvesting affects forest canopy cover, vertical structure, ground cover, coarse woody debris, soil and duff layer condition, and tree age class distribution. The biggest impact is on mature forest features, which are required by many species. Medium- and large-scale salvage logging operations can also impair natural vegetation recovery, and facilitate invasion by alien species. All of these impacts have direct or indirect effects on biodiversity and the ability of ecosystems to recover after any given disturbance.

Monitoring forest biodiversity

Measures of biodiversity are important components of any set of sustainable forest management indicators. Given the limited resources for monitoring, indicators should be chosen carefully. Monitoring is most effective when it targets umbrella species or “species functional groups” (a guild of different species that have similar roles), rather than attempting to catalogue all species. A series of monitoring protocols are currently being developed under the FREP Monitoring and Evaluation Strategy.

Forest birds are an important group to monitor, as they contribute to the preservation of native biodiversity, provide food sources, and contribute to nutrient cycling. Small mammals play roles in forest regeneration and nutrient cycling, and are prey for forest predators. Monitoring methodologies for these two groups of organisms are well established. Arthropods (insects, spiders, and mites) represent 60-70% of biodiversity in forests. Ground beetles (Carabidae) have been identified as useful forest biodiversity indicators, but monitoring techniques for this group are not yet operational.



Setting forest retention goals

Retention goals can range from preserving an intact forest community, to retaining a particular species, or retaining a higher proportion of intact forest species relative to those invading from surrounding habitats. The impact of harvesting can be lessened by feathering clearcut edges and by retaining more coarse woody debris, particularly near the edges of the disturbed area. Two “rules of thumb” that have emerged from the research are: a) the amount of habitat available is more important than the spatial arrangement of that habitat; and b) the availability of habitat structure (snags, diseased trees, coarse woody debris, understory vegetation, etc.) is more important than stand age.

Landscape-level management recommendations

- Maintain areas of old forest or late-successional habitat across managed landscapes.
- Explore alternative management strategies that maintain forest species’ composition similar to that of the natural forest. Specific concerns include mixedwood or uneven-aged forests.
- Where possible, maintain habitats derived from fire events or insect/disease infestations.
- Develop management scenarios that promote habitat variability at a landscape scale.
- Explore opportunities to manage the forest age class structure and species composition so they more closely resemble that of a natural forest.
- Maintain benchmark, non-harvest areas or superior quality habitats (special sites).
- Consider creating south-to-north and upslope species migration corridors, to facilitate ecosystem reorganization as the climate changes.

Recommendations for clearcut harvest systems

- Maintain residual forest as individual trees or in patches. The residuals should include both live trees to provide future snags in regenerating forests, and snags or dying trees to provide mature/disturbed forest habitat elements.
- Retained snags and live trees should be variable in diameter, but with a strong emphasis on large trees. They should be representative of the species found in the harvested area prior to logging, and be in different stages of decay.
- Maintain a mixture of large and small retention patches, both within and between harvest areas.
- Consider trade-offs between levels of retention and harvest extent.

Recommendations for thinning

- Provide a range of habitat by varying thinning intensity across the landscape and by leaving unthinned patches.
- Retain snags, dying trees, and deciduous species, where possible.
- In dry Douglas-fir types, retain patches of shrubland and grassland habitat.

Recommendations for riparian buffers

Riparian buffer regulations are mainly for the protection of water resources, but also serve wildlife and biodiversity. The utility of buffer areas for providing habitat is related to the structure of the riparian forest, the buffer width, and the character of adjacent habitats. Forest managers could consider the following when designing riparian buffers to optimize their biodiversity value:

- Be aware of the habitat requirements of wildlife species, particularly those of local or regional concern.



- Implement existing riparian buffer width requirements for water quality protection.
- Consider making certain riparian buffer zones wide enough that they provide habitat for forest interior species.
- Combine riparian buffers with adjacent intact stands to enhance connectivity at the landscape scale.

Post-wildfire considerations

Steep or severely burned-over areas are prone to soil erosion. Invasive alien species frequently colonize burned-over areas. Aerial or hand seeding of grass mixes can help to retard soil erosion and alien species invasions. The grass mix should be chosen carefully, however, as some agronomic species can become invasive. If the burn area is large, and knapweed or Dalmatian toadflax are present, biocontrol agent collection and release in the centre of the burn area may retard or further help control an infestation. Burned areas are prone to reburns because of the amount of dry fuels available. Burned areas near communities may need fuel manipulation (thinning, piling, prescribed burning, etc.) to reduce the hazard of reburn.

Recommendations for post-burn salvage logging

- Set aside areas within large burns that will remain unsalvaged.
- In areas where burned habitat is rare, salvage harvests should be avoided.
- Leave good-quality snags within salvage areas.
- Delay salvaging where possible so that the important immediate post-burn ecological recovery processes can begin.

Post-disturbance salvage harvesting impact on forest birds

Forest birds—in particular, woodpeckers—are important ecological indicators. BC Interior woodpeckers require a mosaic of burned and unburned areas, as well as a cohort of large standing snags for cavity nesting and feeding. Snag retention during post-disturbance salvage logging is generally deficient compared to species' needs. Nest survival for some species of cavity-nesting birds could be improved if unlogged reserves are located centrally in post-fire forests, distant from unburned habitats that potentially serve as sources of nest predators. Burned forest patches of at least 20 ha and composed mainly of mature and old-growth forests should be maintained during post-disturbance harvesting to provide future availability of high-quality habitat for deadwood-dependent species, such as the black-backed woodpecker. The first few years after fire are considered the most critical in terms of the contribution that recent burns can make to bird biodiversity.

Harvesting after beetle outbreaks yields different outcomes than harvesting after wildfire. A bird community similar to the natural range of variation can be obtained by choosing single-pass harvest treatments, harvesting 66–88% of the timber in the planning unit, and retaining 5–19% of the disturbance area as live residual patches, with 50% of harvests having at least 9% of the area in residuals. Unlike the common post-fire salvage logging operations, carefully managed selective harvesting prescriptions after beetle outbreaks can be suitable for generating logging revenue without compromising avian ecological values.

Partial cut treatments with low levels of retention (<50%) become distinct from the uncut forest from a bird habitat perspective, and some species may be impacted. The amount of partial cutting and the state of the ecosystem are both relevant factors in the response observed in avian communities. As an example, old lodgepole pine forests have



a fairly simple bird community composed of generalist species that adapt well to a range of habitats; in these areas, partial cutting with retention as low as 60% is allowable.

The benefits of partial cutting treatments with low retention levels (i.e., 10-20%) are small, and such low retention treatments cannot be justified from an avian diversity perspective. Higher retention levels (50%, 75%) provide greater biodiversity advantages; however, monitoring of reproductive activity (versus mere presence) should be undertaken in order to assess whether these treatments do actually offer productivity advantages over lower retention levels. Patches of both dead and live trees should be retained in clearcuts in order to contribute to the conservation of habitat attributes that are required by various species.

Some general post-disturbance management recommendations regarding woodpeckers and other cavity nesters:

- Some areas should be set aside within large burns and should remain unsalvaged.
- Avoid salvaging areas of burned forests adjacent to unburned forests, as the burned forest is good foraging habitat for birds that do not nest there.
- Consider prescribed burns after partial harvests have been conducted.
- In areas where burned habitat is rare, salvage harvests should be avoided.
- Leave snags representing a variety of sizes and decay classes within salvage areas; consider creating living snags in snag-deficient areas.
- Retain living, large-diameter unhealthy trees as candidate wildlife trees for cavity nesters.
- Delay salvaging where possible so that the important immediate post-burn ecological values can persist.
- Retain fire as an ecological force in forested landscapes.
- Some BC Interior forests may have ample coarse woody debris (CWD) and dead snags as climate change enhances fire and beetle mortality; emphasis may then need to shift to the maintenance of large live trees across the landscape.

Post-disturbance effects on small mammals

Small mammals, such as the flying squirrel, red-backed vole, deer mouse, meadow vole, and Northwest chipmunk, are also important to forest biodiversity. Single tree selection and small patch cuts (up to 1.6 ha) preserve small mammal habitat in dry Douglas-fir forest types; however, the impact of different disturbances on the abundance of small mammals (i.e., positive or negative) is quite species-specific. The presence of downed woody material, live residual trees, and standing dead wood are considered to facilitate the convergence of small mammal communities to a pre-disturbance state for both harvested and burned sites. BC researchers recommend using a combination of residual tracts of old growth forest and small size clearcuts (< 20 ha) of various ages as a strategy to maintain natural levels of small mammal abundance and diversity over time in northern conifer forests.

Summary of key management principles to avoid further loss of biodiversity

- Ecosystems have a remarkable ability to recover on their own. Wherever possible, avoid interfering with natural recovery processes and always be aware of the potential cumulative effects of coupled human and natural disturbances.
- Allow for the ecological role of natural disturbance where and when feasible. Incorporate fuel management and prescribed burning into fire suppression strategies.



- Manage for structural diversity, habitat diversity, and landscape connectivity (e.g., stand structural complexity and species composition in managed stands; promote post-disturbance interventions that facilitate rapid replacement of critical habitat features; provide habitat for a wide range of species through the maintenance of within and between stands heterogeneity).
- Increase forest retention levels at the stand level and, more importantly, at the landscape level (e.g., through careful planning prior to salvage logging in order to maintain and recruit adequate live tree and quality deadwood habitats to support native wildlife in future forested landscapes; by following the Chief Forester's guidance to conduct cooperative, long-term, large-scale, spatially explicit planning of what will be harvested and what will be retained during salvage harvesting; by updating land use plans across BC; and by considering the use of alternative harvesting/silviculture techniques and practices that increase retention levels, such as variable retention, partial cutting, larger residual tree patches, wildlife tree areas, riparian buffer areas, etc.).

(Consult full document in FORREX Series 28 for complete list of references)

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Article Received: December 16, 2011 • Article Accepted: February 21, 2012

Production of this article was funded, in part, by the British Columbia Ministry of
Forests, Lands and Natural Resource Operations.

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Test Your Knowledge

How well can you recall the main messages in the preceding article?
Test your knowledge by answering the following questions.

Post-Disturbance Management of Biodiversity in BC Forests

1. What is the single most effective method of preserving forest biodiversity?
 - a) create landscape-scale heterogeneity in harvesting operations
 - b) preserve or emulate natural disturbance regimes
 - c) leave a variety forest structure elements when doing salvage harvesting
2. From a bird habitat perspective, what is the threshold level of tree removal that makes a partially harvested stand different from an uncut stand?
 - a) 15% removal
 - b) 30% removal
 - c) 50% removal
3. Which of these three biodiversity objectives is the highest priority in planning post-disturbance salvage harvests?
 - a) retain a representative tree species mix
 - b) preserve any remaining old growth patches
 - c) preserve coarse woody debris and snags

