A Case Study of Habitat Conservation Plans and the Protection of Snags and Coarse Woody Debris on Industrial Forest Lands[1]

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Abstract

Forest practices on private industrial timberlands have steadily progressed to incorporate many of the issues and approaches currently in use on public forests. One of the most significant advances for protecting wildlife habitat on private lands has been the development of Habitat Conservation Plans (HCP). Originally developed as a planning process for landowners to mitigate for the incidental status of threatened and endangered species, HCPs have expanded to become long-term, multi-species landscape plans designed to address many aspects of wildlife and fish management. Plum Creek completed a 50-year HCP for 64,751 hectares of company land in Washington's central Cascades Mountains in June 1996. The HCP addresses the biological needs of all vertebrate species, including anadromous fish and cavity-dependent wildlife.

Introduction

The recognition of snags and coarse woody debris as important wildlife habitat elements and their retention on the landscape has been one of the most dramatic changes to commercial forest practices in recent years. Similarly, Habitat Conservation Planning as authorized under the Endangered Species Act has recently provided the opportunity for industrial landowners to develop innovative land management plans with the federal government. These plans provide not only substantive habitat protections for fish and wildlife resources but also regulatory predictability for private landowners. This paper discusses the development and implementation of Plum Creek's Cascades Interstate-90 (I-90) Habitat Conservation Plan (HCP; Anonymous 1996a), with particular emphasis on how the plan addresses habitat needs for wildlife associated with snags and coarse woody debris.

Landowner Considerations

The content and configuration of landowners' properties is an important determinant to landscape planning. A major portion of Plum Creek's ownership in the Cascades Mountains of Washington is in the I-90 corridor near Snoqualmie Pass,

[1] An abbreviated version of this paper was presented at the Symposium on the Ecology and Management of Dead Wood in Western Forests, November 2-4, 1999, Reno, Nevada.

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96 kilometers east of Seattle. The region supports many important resources and potentially conflicting land uses, such as roadless and motorized recreation, agriculture, water storage, highways, powerline and railroad routes, ski areas, communities, and recreational development. The intense and growing public use of this area places commercial forestry in a highly visible operating arena.

Another feature of Plum Creek's property in the region is the "checkerboard" pattern of intermingled ownership with the USDA Forest Service. This ownership pattern stems from the railroad land grants of the late 1800s and presents a challenge for both public and private land managers. Despite the completion of land exchanges to resolve this dilemma, the pattern continues to exist in many areas and requires landowners to coordinate and communicate closely on protection of public resources.

Lessons Learned from Past Management

Over the past 20 years, a major paradigm shift has occurred in commercial forest management. Driving this paradigm shift is the realization that forest practices intended to protect wildlife and fish habitat were actually having the opposite effect. For instance, dispersing clearcuts was thought to be good for habitat diversity but now increases the risk of forest fragmentation. Mandatory stream cleanout to remove logging debris was considered prudent to avoid debris dams; however, we now know that this practice removed the large wood essential for bank stability and fish habitat. Finally, increased use of dead and defective trees and removal of "danger trees" was considered efficient years ago but has been shown to contribute to reduction in habitat for cavity-dependent wildlife.

The listing of the northern spotted owl *(Strix occidentalis)* in 1990 created yet another force for changing paradigms on private lands. Experiments with "New Forestry" concepts of retaining structural components from older forests laid the groundwork for this paradigm on Plum Creek lands (Hicks 1991, Kohm and Franklin 1997). Silvicultural experiments to extract high-value timber while retaining functional spotted owl habitat confirmed that spotted owls could use post-harvest stands that normally would have been clearcut and regenerated under conventional practices.[3] Moreover, silvicultural alternatives that focused on retention of down logs, standing snags, and residual large green trees provided habitat for a wide variety of wildlife species (Stofel 1993).

The need for a new paradigm was both biological and economic. Federal and state regulations (Anonymous 1991, 1992, 2000) to address spotted owl habitat required the designation of 2.9 kilometer radius circles around spotted owl nest sites and the retention of 40 percent (approximately 1,052 hectares) of the area within the circle as owl habitat. In 1994, Plum Creek had 107 owl protection circles affecting its ownership in the I-90 corridor.

Incentives for Habitat Conservation Planning

The voluntary Habitat Conservation Planning process, added to the Endangered Species Act (ESA) in 1982, was little understood and seldom used by private landowners until recently (Anonymous 1995). Increased interest in HCPs stems in

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part from the desire to lessen the economic impact resulting from the ESA's prohibition and from the U.S. Department of Interior's policies offering regulatory incentives. These incentives, including pre-listing agreements, multi-species permits, the No Surprises policy, and Safe Harbor agreements, provide valuable regulatory certainty to the private landowner willing to commit the resources to complete an HCP (Anonymous 1996b).

For a private landowner like Plum Creek in the Pacific Northwest, the incentives to do an HCP include the following:

- Social—People's changing expectations for forestry.
- Scientific—Ecosystem management; assure sustained production of all forest resources.
- Political—Approval and implementation of the Northwest Forest Plan (Anonymous 1994) on Federal lands and checkerboard ownership patterns.
- Legislative—Endangered Species Act mandates the HCP process.
- Economic—Owl circles and associated costs.

Description of Plum Creek's Cascades HCP

Plum Creek's Cascades HCP currently covers seven listed species under the incidental take permit: spotted owl, marbled murrelet, grizzly bear, gray wolf, Canada lynx, steelhead salmon, and bull trout. The plan also identifies over 280 other unlisted vertebrate species in the Implementation Agreement. The planning period of 50 years can be extended to 100 years if certain conditions are met at the end of the first 50-year period. The plan was based on both a habitat and species-specific approach.

The HCP was developed as an ecosystem management plan designed to complement the Northwest Forest Plan for Federal lands. Approaches and strategies in the HCP are tiered to those in the Northwest Forest Plan, such as the protection of spotted owl sites near Late Successional Reserves and the extension of a riparian reserve network onto the company's lands.

The HCP is based on a forest stand classification system that describes forest conditions from stand initiation to old-growth. Conditions were mapped across all ownerships in the 169,162 hectare planning area. Two hundred and eighty-five species of animals known in the HCP area were grouped into guilds based on their life history requirements. These guilds, termed "Lifeforms," were then associated with one or more forest stand types of the classification system to identify their suitable breeding habitat. These forest stand structures and habitats are "grown" into the future using forest growth models that integrate differing harvest levels among State, Federal, and private landowners. At any point in the future, the amounts and locations of these forest stand types and habitats can be estimated.

Since riparian areas are important to many fish and wildlife species, a riparian management strategy was developed. These areas not only provide the necessary protection of elements important for in-stream habitat conditions, such as large woody debris, temperature moderation, nutrient input, and erosion control, but these areas also provide habitat and dispersal routes for upland species. A network of riparian habitat areas forms the core of the HCP's wildlife habitat protection strategy.

In addition, 38 mitigation measures were developed to provide species-specific protection or add to general wildlife and fisheries conservation. Examples of these mitigation measures include:

- Completing comprehensive watershed analyses for the majority of the planning area.
- Maintaining a minimum of 6 percent of the company's ownership as spotted owl nesting, roosting, and foraging habitat.
- Deferring from harvest 751 hectares of owl habitat for 20 years at key owl sites.
- Surveying 104 hectares of suitable marbled murrelet habitat.
- Employing a variety of management practices to provide secure grizzly bear habitat in the North Cascades Recovery Zone.
- Delaying operations near active spotted owl and northern goshawk nest sites until after the breeding season.
- Adjusting operations to reduce potential disturbance to gray wolves and their den sites.
- Maintaining forested wetlands and buffer zones surrounding cave entrances and talus slopes.

How Snag and Course Woody Debris Issues Were Addressed in the HCP

Mitigation measures in the HCP established desired density levels for defective trees, recruitment trees, and course woody debris (CWD) for post-harvest conditions (e.g., three wildlife reserve trees, three green recruitment trees, and two down logs for each acre harvested). Wildlife reserve trees are defined as defective or deformed live trees or dead snags that are observably sound, not hazardous to workers, and can be retained during the harvest (Anonymous 2000). Green recruitment trees are live trees that could serve as wildlife reserve trees in the future. The abundance and density of these structural elements are also measured in the forest stands representing structural classes to validate the wildlife-habitat associations made during modeling. Snag and CWD issues were also addressed indirectly during analysis of fuel loading and insect damage potential across the landscape through time. Forest health issues that were considered in the HCP development are also discussed.

Modification of Snag-dependent Wildlife Guilds and Modeling

The snag-dependent wildlife guilds, Lifeforms 13 and 14, were modified during the HCP peer review process. Lifeform 13 contains the primary cavity excavators, and Lifeform 14 contains the secondary cavity users. Species within these Lifeforms vary with regard to the size of snags required for life history needs. To better associate these species with the appropriate forest stand structures that could supply the necessary snag sizes, these Lifeforms were each separated into subgroups based

on species' snag requirements. Lifeform 13 contains species such as hairy and downy woodpeckers and included some of the younger forest types (e.g., pole timber and dispersal forests) as part of their habitat associations. Lifeform 13a contains species such as pileated, white-headed, and Lewis's woodpecker (which have more stringent requirements for large diameter snags or defective trees) and are associated with mature and older forest structure stages for modeling and impact analyses. Lifeform 14 contains species such as chestnut-backed chickadees and red-breasted nuthatches. Lifeform 14a contains species such as the fisher and flammulated owl.

In addition to subdividing these guilds, we recognized that due to a change in forestry regulations, older harvest units might not contain as many snags and therefore should be weighted accordingly in the Lifeform modeling and impact analyses. Some of the previous harvested units did not have snag and leave tree requirements that are in effect today. Therefore, during modeling, the previously harvested units were not considered to provide suitable habitat until they reached a stand age of 10 to 20 years old.

Forest Health Modeling

In order to assess the impacts of HCP implementation on forest health, models were constructed based on fuel loading and insect damage potential relative to stand age, average diameter, and tree species composition. Output from these models were intended to broadly estimate how the landscape would respond to the assumptions made for varying harvest levels among the different landowners and vegetative conditions across the HCP area. Results were mapped to depict the variability in these risk factors on the landscape and to show the change of these risks over the 50-year HCP. The implications for species dependent on snags and CWD are that habitat potential is closely linked to conditions that increase the likelihood for fire and insect outbreaks. The modifying effect of wildfire on the density and distribution of habitat structural elements over the landscape is of course hard to predict, but could be a factor in the amount of suitable habitat available to these species in the future. Updating of the forest stand structure inventory and growth modeling on a periodic basis will assess any significant changes in the landscape as they occur. Plum Creek used this information to display and minimize the tradeoffs between provision for late successional habitat and economic risks due to forest health. The analysis also provided an opportunity to evaluate the cumulative benefits of conservation through a combination of Plum Creek's HCP and the Federal Northwest Forest Plan.

Increase of Snag Retention Targets on the Eastside of the Cascades Mountains

One mitigation measure in the HCP was to increase the snag retention targets within timber harvest units on the eastside Cascades. State forestry regulations recognize that eastside managed forests typically have a greater variety of selective harvests, compared to westside even-aged management. Selective harvests, combined with the greater natural snag recruitment potential of eastside forests due to fire, insects and disease, reduced the need for greater regulatory requirements for snag retention. Under the HCP, Plum Creek will increase the retention target above the state's requirement for these Eastside forests because much of Plum Creek's

ownership provides transitional forest habitat between east and westside Cascades wildlife species.

Another feature of the HCP that increases snag retention on the landscape is the requirement that post-harvest snag levels be calculated excluding leave trees left within the designated riparian habitat areas along fish-bearing and perennial streams. This requirement ensures that snags are left in the upland portions of the landscape and are not allocated only to riparian areas.

Development of Sampling Techniques for Snags and CWD in the HCP Area

A mitigation measure was developed in the HCP to increase our knowledge of wildlife habitat elements within the various forest stand structures on the HCP landscape. An inventory field procedure was developed to collect data on snags, CWD, and understory vegetation during timber inventory updating on the company's lands. This information provides data on the abundance and density of snags and CWD in various size classes and decay stages. Understory vegetation data is taken in the form of percent cover for the three plant groups of shrubs, forbs, and grasses, in addition to specific berry and seed producing species. This information on specific habitat elements will be used to validate the assumptions (associations between the Lifeforms and the structural elements of forest stands) used in developing the HCP habitat approach.

Snag and CWD Opportunities in the HCP

In addition to the specific mitigation measures for snags and CWD, the HCP also contains mitigation measures for other species that benefit snag and CWD-dependent or associated species. These additional measures are generally in the form of timber harvest prescriptions and leave areas that contain snags and CWD.

The riparian strategy in the HCP was developed to not only protect and maintain the aquatic resources but also to provide habitat for those species that might use these areas as part of their life history and dispersal functions. The vegetative condition of these riparian areas in terms of canopy cover, tree size, and density are maintained as suitable northern spotted owl habitat. If these conditions are met or exceeded, some level of harvest in the outer zones of the riparian areas is permitted, but entry is generally limited and leads to retention of many of the snags and defective trees. Mitigation measures also address the maintenance of forested wetlands and protection of springs and seeps by retaining trees along their banks for erosion control and temperature moderation.

Timbered buffers are also provided in the HCP for talus slopes that maintain the biological integrity of the site for temperature moderation and a source of future CWD *(fig. 1)*. Screening buffers are also maintained along open roads within the North Cascades Grizzly Bear Recovery Zone to decrease bear disturbance and mortality associated with human use of open roads. These screening buffers are maintained at a tree density adequate to obscure a grizzly bear within 100 feet of an open road**.** *Figure 2* shows a recently harvested unit that implemented a forested wetland prescription in combination with a grizzly bear screening buffer along a road that must be kept open to public use.

Figure 1—Post-harvest aerial photo of a talus slope buffer prescription from the Plum Creek's Cascades Habitat Conservation Plan. This mitigation measure provides upland snag and course woody debris retention widely distributed across the landscape.

Figure 2—Post-harvest aerial photo of a forested wetland buffer and grizzly bear visual screening cover along open public roads in the Plum Creek's Cascades Habitat Conservation Plan area. Retention of habitat structure in these settings provides additional benefits to cavity-dependent wildlife.

Larger protected areas are provided in the plan at specific spotted owl and northern goshawk nesting areas to support foraging areas near the nest or allow for dispersal and connecting corridors to adjacent USDA Forest Service lands designated as late-successional forest reserves. Some of these HCP protection areas will not be entered for timber harvest for 20 years as the surrounding areas on Forest Service ownership grow into more suitable owl habitat. Other areas can be selectively harvested, but vegetative conditions again must meet the canopy cover, tree size, and density criteria for suitable spotted owl dispersal habitat. Commitments to the U.S. Fish and Wildlife Service are to increase the percentage of spotted owl habitat on Plum Creek lands in the HCP area from 29 percent in 2006 to 55 percent in 2045.

All of these buffers and habitat areas provide the potential for additional snags and CWD in the landscape distributed among riparian areas and uplands.

Monitoring

Snag and CWD values are being evaluated in three areas. First, habitat conditions presently found in the landscape is evaluated. Second, post-harvest achievement of desired future conditions relative to snag and down log density is monitored. Lastly, the wildlife guilding assumptions used to relate wildlife species to HCP forest stand classes is being assessed.

Existing habitat conditions are being sampled across all forest stand focusing on snags, CWD, and understory vegetation. These data are being used to evaluate the presence of structural elements in the eight forest stand types described in the HCP area. Preliminary analyses indicate that this information will be useful in describing how these elements are distributed in the landscape by forest stand type *(tables 1, 2)*.

Table 1—*Preliminary data from an ongoing timber stand inventory update project describing snag characteristics of stands in Plum Creek's Cascades Habitat Conservation Plan area, central Cascades, Washington.*

Stand structure[1]	No. of stands	Mean number of snags per hectare	Mean snag height (m)	Mean snag diameter at breast height (cm)	Pct hard snags[2]	Pct soft snags[2]
Stand initiation	17	1.6	6.4	56	39	61
Shrub sapling	68	0.8	4.6	53	5	95
Young forest	144	2.4	6.4	46	37	63
Pole timber	96	4.0	7.0	43	56	44
Dispersal forest	89	7.7	9.5	41	43	57
Mature forest	91	8.1	11.3	41	47	53
Managed old growth	7	4.8	11.3	38	37	63
Old growth	3	4.8	10.1	53	43	57

[1] Stand structures follow a successional sequence and are defined in Plum Creek's Cascade Habitat Conservation Plan (Anonymous 1996a).

[2] Hard snags are defined as decay classes 1 through 3, and soft snags are decay classes 4 and 5 (following the classification scheme developed by Cline and others 1980).

Table 2—*Preliminary data from an ongoing timber stand inventory update project describing down wood characteristics of stands in Plum Creek's Cascades Habitat Conservation Plan area, central Cascades, Washington.*

Stand structure[1]	No. of stands	Tons of down wood per hectare	Mean piece diameter at transect intersection (cm)	Pct hard logs[2]	Pct soft logs[2]
Stand initiation	17	15.8	25	17	83
Shrub sapling	68	18.6	25	13	87
Young forest	144	17.0	28	9	91
Pole timber	96	13.8	28	7	93
Dispersal forest	89	10.5	28	11	89
Mature forest	91	11.3	28	17	83
Managed old growth	7	8.5	31	26	74
Old growth	3	13.8	38	19	81

[1] Stand structures follow a successional sequence and are defined in Plum Creek's Cascade Habitat Conservation Plan (Anonymous 1996a).
[2]Hard logs are defined as decay classes 1 through 3, and soft logs are decay classes 4 and 5 (following the classification scheme in Maser and others 1979).

Post-harvest stands are sampled to determine if expectations with regard to the numbers of retained snags and down logs are being met. A random selection of harvest units is sampled by consulting foresters to quantify the leave trees retained in harvest units, following HCP guidelines. Results to date indicate that HCP implementation is meeting or exceeding targets. Compliance checks are also performed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service, along with State agencies as part of state forestry monitoring.

The assumptions used in guiding wildlife species to the various forest stand types in the HCP landscape is being evaluated. A Plum Creek/University of Washington project is investigating bird use of HCP forest stand types by using point counts, territory spot-mapping techniques, and nesting/productivity indication indices. This research will help verify the habitat associations for permanent resident birds and neotropical migrants that use forest stands in the HCP area.

Summary

The Plum Creek's Cascades HCP is one of the most complex and comprehensive HCPs approved. The HCP is a landscape level ecosystem plan that was designed to work in concert with the Northwest Forest Plan for Federal lands to address multiple wildlife habitat issues across a large area of intermingled ownership. After 5 years of implementation, valuable data on species occurrence and habitat relationships are being collected. All this information is provided to Federal and State

agencies and can be used by public managers and private landowners interested in developing HCPs or other landscape planning efforts.

Current knowledge and research in snag dynamics and cavity-dependent wildlife was used during development of the HCP. In addition to specific mitigation measures targeting snag and CWD issues, there are many ancillary benefits to species associated with these structural elements from other mitigation measures designed to address the needs of other species or habitats. Implementation, monitoring, and model testing are providing opportunities to work with Federal and State biologists to improve the HCP where needed.

HCPs provide substantive and meaningful incentives to private landowners to address a wide range of wildlife issues (including snags and course woody debris) while providing the long-term regulatory predictability needed for forest management. These plans also provide opportunities to improve knowledge and further our understanding of landscape processes.

Acknowledgments

We would like to thank Mike Collins, Jeffrey Light, and an anonymous reviewer for their helpful comments that improved this manuscript.

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