

Protecting wetland habitat in the Cypre Watershed Planning Unit, Clayoquot Sound, Vancouver Island, British Columbia

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Abstract

Harvesting old-growth forest is one of the activities that has strongly shaped the economic, social, and ecological landscapes of Clayoquot Sound on the west coast of Vancouver Island in British Columbia. Clearcutting, which has been the dominant harvesting method, has changed the distribution and natural age classes of forests, altered drainage systems, and affected the visual appearance of the landscape. Growing discontent over the effects of harvesting old-growth forests came to a head in 1993 with widespread public opposition to the Clayoquot Land Use Decision. The provincial government sought an alternative approach to resolving these issues, and so convened the Clayoquot Sound Scientific Panel. The Panel's recommendations for forest planning and practices—including the protection of wetland areas—were adopted, along with British Columbia's Forest Practices Code in 1995. The latter was applied province-wide, whereas the Scientific Panel's recommendations for the protection of coastal ecosystems and First Nations' values were specific to Clayoquot Sound.

In 1999, Iisaak Forest Resources Ltd. undertook planning to harvest timber in Clayoquot Sound. In keeping with the Scientific Panel's principles, Iisaak voluntarily took steps to protect six small, unclassified, temperate rainforest wetlands in one of four cutblocks. The main objectives in protecting the wetlands were to maintain their ecosystem functions and to maintain linkages within and between the wetland areas. To achieve these and other objectives, Iisaak used variable retention and aerial harvesting methods in the summer of 2000.

This paper describes Iisaak's landscape-planning and site-planning procedures, including how planning accounted for drainage patterns, wildlife needs, and habitat connectivity. Spatial maps demonstrate that a continuous reserve network of hydroriparian and wildlife reserves determined the harvesting pattern. Over 75% of the original old-growth forest was retained across the cutblock. This effort is one of the first examples of how the Scientific Panel's guidelines were incorporated into a timber-harvesting regime. The ecological benefits of doing so remain to be seen through effectiveness monitoring.

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Introduction

Role and Importance of Wetlands

The importance of wetland habitats in coastal temperate rainforests is often overshadowed by that of other habitats, like old-growth forest.

Wetlands are extremely rich in plant and animal species, are one of the most productive of all ecosystems, and carry out critical regulatory functions of hydrological processes within watersheds (Banner *et al.* 1988). Regulating water quality, water levels, flooding regimes, and nutrient and sedimentation levels are a few of these processes (Gregory *et al.* 1991). Further, wetlands are dynamic, characterized by fluctuating water, nutrient, and vegetation levels.

Unfortunately, wetlands are susceptible to damage when disturbances occur in the surrounding environment. For example, timber harvesting can directly affect riparian areas and threaten the integrity of wetland ecosystems (see Walls *et al.* 1992; DeMaynadier and Hunter 1996; Aubry 2000). Harvesting-related alterations to watersheds can lead to cumulative changes in hydrological patterns, water quality, and habitat linkages (Richter and Azous 1995). Timber harvesting can alter the frequency, duration, and magnitude of hydrological processes (Richter and Azous 1995; Richter *et al.* 1996). Hydrological change is the best indicator of wetland alteration (Brinson 1988), but is difficult to predict (Mulamootil *et al.* 1996).

Amphibians are especially vulnerable to changes in wetlands. The survival of many species of amphibians requires that they have access to elements from both aquatic and terrestrial habitats. Thus, anything that disrupts or limits their abilities to move between these habitats can threaten their long-term survival. The decline of some amphibian species in the Pacific Northwest has been directly linked to habitat alteration due to timber harvesting (Walls *et al.* 1992; DeMaynadier and Hunter 1996; Aubry 2000). Even small wetlands are extremely important to the conservation of biodiversity because they provide critical breeding habitat where dispersed populations can exchange genetic material, reducing the risks of extinction (Semlitsch and Brodie 1998).

The desire to maintain landscape biodiversity and wildlife habitat underlies the wetland protection and

restoration efforts that are underway in the United States and Canada. Increasingly, forest managers in British Columbia are addressing wetland conservation through strategies that maintain hydrological systems, such as designating riparian reserves¹ (British Columbia Ministry of Forests 1995a; Banner and MacKenzie 2000).

In 1999 Iisaak Forest Resources Ltd. undertook planning to harvest timber in Clayoquot Sound on the west coast of Vancouver Island in British Columbia (Figure 1). Harvesting took place in 2000 and Iisaak chose to use variable retention and helicopter logging methods, in part because one of the objectives of the operation was to protect six small, temperate rainforest wetlands. In light of this objective, this paper describes Iisaak's landscape-planning and site-planning procedures in one of the four cutblocks, including how planning accounted for drainage patterns, wildlife needs, and habitat connectivity.

About the Wetlands in Clayoquot Sound

British Columbia contains some of the largest tracts of old-growth coastal temperate rainforest in the world (Kellogg 1992). Temperate rainforests in Clayoquot Sound usually experience mild climates—including minimal temperature fluctuations, high rainfall, and little significant snowfall—and small-scale land disturbances (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). The infrequency of large-scale natural disturbances (e.g., large wild fires) allows the formation of a structurally complex old-growth forest in which dead emergent trees (or “snags”) and woody debris can persist. Drainage patterns and stream morphology are the major land-building processes because rainfall rates are very high. The terrain varies from the low gradients of the coastal flats to steep glacial valleys further inland.

Wetlands commonly occur on the coastal fringes in Clayoquot Sound. Wetlands in steep-sided watersheds typically develop at high elevations (>500 m above sea level), but wetlands in watersheds with broad floodplains and along the coastal flats develop at lower elevations (<500 m) (Beasley *et al.* 2000).

Nuu-chah-nulth peoples have been resident in Clayoquot Sound for approximately 10 000 years. They use over 200 plant species, including many that grow only in wetland habitats (Turner 1995; Craig and Smith 1997).

¹ Reserve: An area of forest land that, by law or policy, is not available for harvesting. Areas of land and water set aside for ecosystem protection, outdoor and tourism values, preservation of rare species, genetic diversity, wildlife protection, etc.



Protecting the Wetlands

Harvesting old-growth forest is one of the activities that has strongly shaped the economic, social, and ecological landscapes of Clayoquot Sound over the last 50 years. Clearcutting, which has been the dominant harvesting method in the past, has changed the distribution and natural age classes of forests, altered drainage systems, and affected the visual appearance of the landscape. Growing discontent over the effects of harvesting old-growth forests came to a head in 1993 with widespread public

opposition to the Clayoquot Land Use Decision.^{2,3}

Therefore, the provincial government convened the Clayoquot Sound Scientific Panel and set for it the goal “to make forest practices in the Clayoquot not only the best in the province, but the best in the world.”⁴ In general, the Scientific Panel’s recommendations, adopted in 1995, exceeded the Forest Practices Code (FPC) in protecting ecosystems and First Nations’ values in Clayoquot Sound.

The Panel’s objective was to develop an innovative approach to achieve the management of sustainable

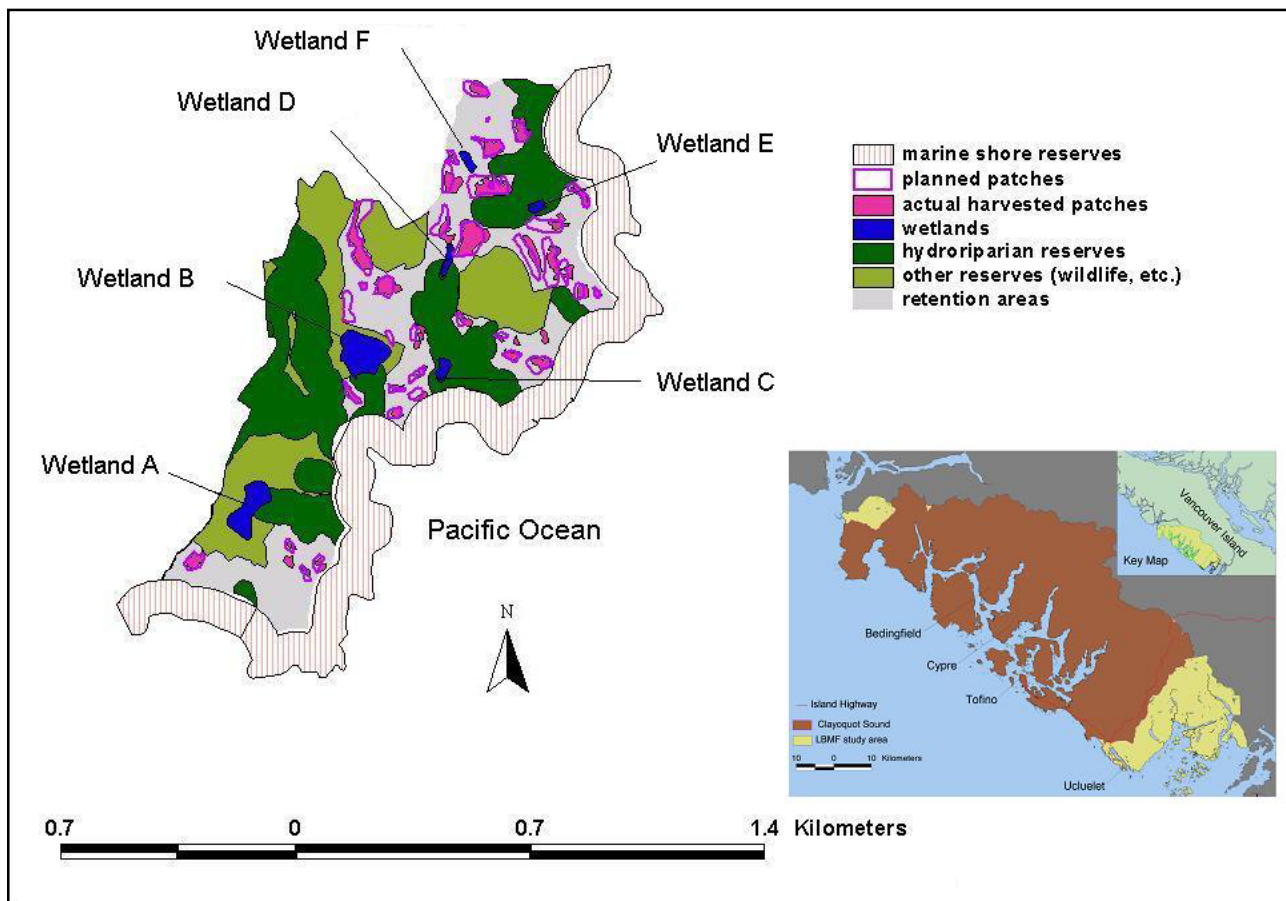


FIGURE 1. Location of wetlands in Cutblock C of the Cypré Watershed Planning Unit, Clayoquot Sound, Vancouver Island, B.C., as identified by Iisaak Forest Resources Ltd.

² The Clayoquot Land Use Decision was issued by the Government of British Columbia in April 1993 in an attempt to integrate resource use with conservation of natural values of the area, and end intense land-use conflicts that had arisen in the late 1980s. The decision protected 34% of Clayoquot Sound, dedicated 45% of the area to sustainable resource use, and placed 17% under special management.

³ While British Columbia’s Forest Practices Code (FPC) established province-wide requirements and guidelines for forest planning and practices, including the protection of wetland areas, it was not in effect in 1993 when the provincial government needed a resolution for the conflict in Clayoquot Sound.

⁴ Premier Mike Harcourt, at a press conference announcing the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, October 22, 1993; as documented in Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995c.

ecosystems in Clayoquot Sound. The Panel recognized the Nuu-chah-nulth's traditional system of resource management called Hahulthi ("stewardship of the land") that is based on the principles of Hishuk ish tw'walk ("everything is one") and Iisaak ("respect") (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995b). Scientists and First Nations representatives produced a series of reports with over 120 recommendations that set the framework for all future harvesting practices (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). The recommendations covered aspects of silvicultural practices; harvesting and transportation systems; scenic, recreational, and tourism values; and ecological monitoring. The Panel recommended a three-tiered planning approach that begins at the landscape level (with subregional and watershed planning units) and evolves to site-level management so that specific features, including wetland areas, may be protected.

Two critical factors in wetland management are:

- maintaining the ecosystem functions of wetlands (Harpley and Milne 1996), and
- maintaining linkages within and between wetlands (Carter 1996).

Alteration of stream processes, such as sedimentation and erosion, can be mitigated by creating riparian reserves (Belt *et al.* 1992). In turn, these strengthen the stream edge and create other habitats, such as shallow undercuts for fish (Poulin *et al.* 2000). Reserves provide animals with passage between wetlands and forests in a fragmented landscape, thereby contributing to retention of biodiversity. Over 70% of all forest-dwelling vertebrate species in Clayoquot Sound use riparian habitat for breeding (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). An inventory of amphibians in Clayoquot Sound in 1997 discovered that 97% of surveyed wetlands were smaller than 0.1 ha, and that a large proportion of amphibians used small wetlands for breeding, including the threatened red-legged frog (*Rana aurora*) (Beasley *et al.* 2000).

The Scientific Panel recommended the establishment of reserves (at the 1:20 000 scale) to protect hydroriparian areas⁵, sensitive soils, terrain, scenic and recreational values, cultural values, forest linkages, red-listed and blue-listed species⁶, forest interiors, late successional forests, and ecosystem representation. Depending on their classification, hydroriparian reserves along stream edges were 20–50 m wide, and marine shore reserves were 100–150 m wide.

Wetlands with low gradient edges (<1%) were allocated reserves that extended to the "limit of the hydroriparian influence." Steeper wetlands were allocated reserves that extended 30 m or as far as the "hydroriparian influence," whichever was greater. Common sense was encouraged in designating reserves so as to avoid creating reserves that were disproportionately larger than the actual wetland. These classification categories were somewhat less well defined in comparison with those in the Forest Practices Code. The FPC describes clear procedures for classification based on soil type, size, biogeoclimatic zone, and whether the wetland is part of a wetland complex. According to the FPC, a wetland within the southern very wet hypermaritime variant of the coastal western hemlock (CWHvh1) biogeoclimatic zone must be greater than 1 ha to be "classified" and allocated a reserve or management zone⁷ around it; i.e., smaller wetlands are unprotected (B.C. Ministry of Forests 1995a). The majority of wetlands in Clayoquot Sound are smaller than 0.1 ha and, therefore, are not protected by the FPC.

Demonstrating the Clayoquot Sound Scientific Panel's Recommendations: Protecting Wetlands in Cutblock C of the Cypre Watershed Area

In August 2000, Iisaak Forest Resources Ltd. harvested approximately 10 000 m³ of timber from four cutblocks (ranging in size from 2 to 73 ha, and totaling 117 ha) in the Cypre Watershed Planning Unit (24 000 ha), which is located 15 km northeast of Tofino on the west coast of Vancouver Island, British Columbia. The entire Unit

⁵ Hydroriparian area: Consists of the entire floodplain of the stream, alluvial fan terraces and, where channels are entrenched, the entire slope that rises immediately from the channel (Clayoquot Sound Scientific Panel 1995a). The Forest Practices Code uses the term "riparian" rather than "hydroriparian". The Scientific Panel emphasized the connections between land and water by using the latter.

⁶ Red-listed species are any indigenous species or subspecies threatened with imminent extinction or extirpation throughout all or a significant portion of their range in British Columbia. Blue-listed species are any indigenous species vulnerable or at risk because of low or declining numbers or presence in vulnerable habitats.

⁷ Management zone: The outer portion of a Riparian Management Area situated adjacent to a stream, lake, or wetland, and established to conserve and maintain the productivity of aquatic and riparian ecosystems when harvesting is permitted (B.C. Ministry of Forests 1995a). Harvesting is allowed within the management zone but constraints are applied.



contained early seral forest (37%) due to previous harvesting, and more than 14 000 ha (58%) of old-growth forest⁸. The cutblocks targeted less than 1% of the total old-growth area (Beasley *et al.* 2002).

Wetland habitat covered approximately 5% of Cutblock C (73 ha) where drainage was impeded by gently sloping terrain near the marine shoreline. Six small wetlands, ranging from 0.1 to 1.4 ha were identified for protection (Figure 1). These wetlands were dominated by dispersed “potholes” of open water surrounded by mats of sphagnum moss (*Sphagnum* spp.), Labrador tea (*Ledum groenlandicum*), sedge (*Carex* spp.), skunk cabbage (*Lysichiton americanum*), and shore pine (*Pinus contorta* var. *contorta*). These plants are typical of the wet soils with poor nutrient regimes that occur in the southern very wet hypermaritime variant of the coastal western hemlock (CWHvh1) biogeoclimatic zone. In 1999 a reconnaissance survey found populations of northwestern salamanders (*Ambystoma gracile*) and red-legged frogs (*Rana aurora*), as well as signs of travel and foraging by black bears (*Ursus americanus*), within these wetlands.

Timber was harvested in patterns of dispersed retention (single tree, group tree selection) and aggregate retention (small patchcuts in a block). More than 75% of the standing timber was retained. This differs from more common applications of variable retention where lone patches of residual trees are left in a cleared block (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). These harvesting patterns and amount of retention were determined through a series of planning steps at both the watershed and site level.

Watershed-Level Planning in the Cypre Watershed

Iisaak first developed an Interim Watershed Plan for the entire Cypre Watershed Planning Unit using information from forest resource inventories that had been mapped by the Clayoquot Sound Planning Committee and Technical Planning Committee in 1999. These maps included proposed permanent reserves for watershed-level hydroriparian areas; sensitive soils and unstable terrain; red-listed and blue-listed plant communities; areas with interior-forest conditions; late successional forests; representative ecosystems; and areas of cultural, scenic, recreational, and tourism value. Using geographic

information systems, these reserves were overlaid on maps, and their locations were visually displayed at 1:20 000 scale. Previous Forest Development Plans developed by the Licensee, MacMillan Bloedel Limited (now Weyerhaeuser Company Limited), were also used to locate streams and wetlands. Combined, this information helped planners set boundaries for the network of reserve areas and delineate harvesting areas.

Site-Level Planning in Cutblock C

Site-level retention of trees was based on protecting small streams, wetlands, wildlife habitats, and features of cultural significance. Locations of these small but important attributes were identified and investigated in detail at the site level because they were missed at the previous 1:20 000 level.

Planning the Locations of Retained Areas

Iisaak surveyed Cutblock C in 2000 to review, identify, and classify each drainage pattern. The location of creeks and the extension of drainage areas were good indicators of the presence of wetlands. Locating small wetlands, and identifying their boundaries, were difficult because the entire cutblock was generally wet with many depressions and bowls. In most cases, boundaries were determined by judgment calls based on vegetative characteristics at each site.

Once wetlands were assessed in the field, they were classified according to the FPC classification system (B.C. Ministry of Forests 1995a). Only one wetland in Cutblock C—Wetland B at 1.4 ha—was greater than 1 ha, and therefore was the only one “classified” according to the FPC criteria, i.e., as “W3”. This wetland was allocated a management zone of 30 m and no reserve under the FPC. In contrast, the Scientific Panel recommended establishment of a reserve extending to the limit of hydroriparian influence (based on understory plant associations or on soil characteristics) on wetlands of all sizes with low gradient edges (<1% slope) (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a).

Five of the six wetlands were too small to be classified according to the FPC guidelines, so their areas of “hydroriparian influence” and protection needs were assessed individually. The time needed to evaluate and carry out the assessment of each wetland and its associated streams varied from a few hours to a few days.

⁸ We define old-growth forest as forest in late successional stages (structural stage class 7 of the Standard for Terrestrial Ecosystem Mapping in British Columbia, in Hamilton 1988).



Wildlife values were identified on site by wildlife experts and engineers. They collected more detailed biological information including sightings and habitat surveys for red-listed and blue-listed species (e.g., bald eagles *Haliaeetus leucocephalus*, marbled murrelet *Brachyramphus marmoratus*), evidence of bear dens (bear scratching), and presence of amphibians (egg masses). Fisheries biologists assessed streams for the presence of fish. Consideration was also given to forest stand characteristics (e.g., tree diameters, species composition, snags) so that retained trees would be representative of the original forest structure.

Many areas that showed signs of use by wildlife were set aside as wildlife reserves. Wildlife Tree Patches were established around some individual trees and around several patches that had special wildlife values as recommended by both the FPC *Biodiversity Guidebook* (B.C. Ministry of Forests 1995b) and the Scientific Panel (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). Trees that had bald eagle nests, for example, were allocated a reserve with a radius of 20 m. In some cases, reserves were extended to include other forest structural attributes of value to wildlife. Another factor that influenced the size of the wildlife reserves was the harvesting prescription. Aggregate harvested patches (small cutpatches) retained less of the forest structure and were considered more vulnerable to natural elements like windthrow. Consequently, Wildlife Tree Patches adjacent to aggregate harvested areas had larger reserves around them than those adjacent to dispersed retention areas. The harvesting pattern also took into account the distribution and location of trees that showed signs of having been used by Nuu-chah-nulth people in the past (culturally modified trees).

Each wetland was considered in context, using maps to determine how, and if, a reserve would be allocated around it. Wetlands connected by streams were given the greatest protection and were given reserves as far as the “hydroriparian influence” extended. This was not a straightforward process because wetland locations and the “hydroriparian influence” were sometimes unclear. A wetland had higher priority for protection if it was determined to be part of an elevational gradient or a link between the headwater of a stream and its sea mouth. Ephemeral wetlands were given lower priority on the basis that they are used by wildlife only periodically. This reflects a general lack of awareness about the importance of ephemeral wetlands as breeding sites for species of amphibians that prefer temporary wetlands without fish

as opposed to permanent ponds (Kats *et al.* 1988). Most wetlands were incorporated into hydroriparian reserves because they were part of the natural flow of streams and drainage systems.

Planning the Locations of Harvested Areas

Steepness of slopes and topography of the surrounding terrain were the two main criteria used to design harvest patterns. Generally, the width of reserves was increased around wetlands if the surrounding terrain was steep and uneven. Only dispersed retention harvesting was considered for areas of steep terrain.

All harvesting was carried out by aerial methods (helicopter logging) because of limitations imposed by the design of the harvesting plans. The use of aerial harvesting allowed Lisaak to avoid potential detrimental effects associated with road construction. Thus, factors such as minimizing the number of stream crossings and evaluating the effects of roads on wetlands did not need to be considered. The helicopter landing pads did not affect visual values because they were located within patchcuts, thus the construction of additional openings was unnecessary.

Each wetland was considered in context. Wetlands connected by streams were given the greatest protection and were given reserves as far as the “hydroriparian influence” extended.

Results

Spatial mapping of hydroriparian and wildlife reserves in Cutblock C confirmed that wetlands were generally well protected and connected by a reserve network (Table 1, Figure 1).

The majority of wetlands were fully surrounded by reserves (Beasley *et al.* 2002). Exceptions were Wetland D, which had only the southern portion protected, and Wetland F, which had no reserve around it. Wetland F was afforded the least protection by reserves because it was not linked with a stream network and had no drainage flowing in or out. The minimum widths of reserves ranged from 0–45 m. The FPC requirements of a 30-m management zone for Wetland B were met with a mini-



TABLE 1. Summary of reserves around six wetlands in Cypre Watershed Planning Unit, Cutblock C.

Wetland ^a	FPC Class	Size (ha)	Min. width of reserves around wetland (m)	Distance to nearest patchcut in 2000 (m)	Connected to hydrosiparian reserve network
A	Unclassified	1.1	45 (surrounded)	108	Yes. West side.
B	Classified W3	1.4	10 (surrounded)	21	Yes. South side.
C	Unclassified	0.2	10 (surrounded)	35	Yes. All sides.
D	Unclassified	0.2	0 min. (southern half surrounded)	0	Yes. South end.
E	Unclassified	0.1	7 (surrounded)	73	Yes. All sides.
F	Unclassified	0.2	0 (no reserve)	10	No.

^a See Figure 1 for locations of wetlands within Cutblock C.

mum reserve of 10 m to protect it from small patchcuts located to the east and southwest. Most wetlands had a “thin” part to the reserves, but wider reserves protected the majority of their perimeters.

Only Wetland D incurred a small amount of harvesting directly on its perimeter. Otherwise, harvesting did not directly affect any other wetland. The main gap in the reserve network appeared to be the lack of reserves between Wetland D and Wetland F, but “unprotected” habitat does not necessarily infer there was no habitat (Figure 1). A variety of other habitat types can exist and be available for organisms to use. “Unprotected” areas in Cutblock C consist of a matrix of old-growth habitat. These areas are available for future harvesting, while habitat in reserves is protected under the current plan.

Conclusions

In keeping with the principles and spirit of the Scientific Panel, Iisaak Forest Resources voluntarily took steps to protect unclassified wetlands in Cutblock C of the Cypre Watershed Planning Unit. The ecological benefits of doing so remain to be seen through future effectiveness monitoring. However, the extent and intensity of moni-

toring will largely depend on obtaining funding to carry out the work. Iisaak has initiated a program with academic partners, through the Clayoquot Biosphere Trust,⁹ to monitor the ecological and socio-economic outcomes of its operations. The commitment to respect the Scientific Panel’s recommendations has helped Iisaak become the first Tree Farm License holder in British Columbia to be certified by the Forest Stewardship Council. This allows Iisaak’s wood products to carry a “SmartWood” label and a FSC certification label.

The landscape-level reserves within the Cypre Watershed Planning Unit are currently under public review as the British Columbia government progresses toward establishing final watershed-level plans for Clayoquot Sound. Iisaak Forest Resources Ltd. plans to return to the Cypre Watershed Planning Unit within the next decade. Their intent is to design any future harvesting around the reserve network. Iisaak will re-evaluate the voluntary site-level reserves it established around Cutblock C’s wetlands before undertaking a second pass of harvesting. Iisaak’s Forest Development Plan states that the company will continue to be guided by the Clayoquot Sound Scientific Panel’s recommendations as the basis for forest management in the rest of its Tree Farm License 57 (87 000 ha).

⁹ The Clayoquot Biosphere Trust is a non-profit society that supports and promotes biodiversity conservation and sustainable development in the Clayoquot Sound UNESCO Biosphere Reserve.



Acknowledgements

The Canadian Forest Service, the Long Beach Model Forest Society, and Iisaak Forest Resources Ltd. provided funding and background information for the analysis. In particular, we thank Rob Volkman of JEDROC Engineer Services Ltd., as well as Eric Schroff (former manager) and Peter Verschoor of Iisaak Forest Resources Ltd., for providing information. Discussions with Elke Wind inspired the writing of this extension note. We appreciate the suggestions of four reviewers and two editors for improving the clarity of the manuscript.

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