Marbled Murrelet Nesting Habitat Conservation Plan for the Nimpkish Valley, North Central Vancouver Island

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Abstract: Canadian Forest Products Ltd.'s Tree Farm Licence (TFL) 37 is within the marbled murrelet's (*Brachyramphus marmoratus*) nesting range on Vancouver Island, British Columbia. Suitable nesting habitat on west and north Vancouver Island is generally considered to occur within forests that are > 250 years old, > 28.5 m tall, < 900 m elevation, and < 30 km from saltwater. The Nimpkish Defined Forest Area, which includes TFL 37, is certified under the national Sustainable Forest Management System standard (CAN/CSA-Z809-96). One component of this standard is that a public advisory group representing local interests must be formed and maintained to guide the certification process. The Nimpkish Woodlands Advisory Group was formed and identified values, objectives, indicators, and targets of sustainable forest management within the Nimpkish Defined Forest Area. A quantifiable indicator of sustainable forest management identified by the group was the amount of area maintained as marbled murrelet nesting habitat. As a result, Canadian Forest Products Ltd. invested significant resources over four years to collect data to develop a science-based conservation plan for marbled murrelet habitat. The management objective of the plan is to ensure that sufficient habitat (based on population size) is maintained over time and space in the Nimpkish Defined Forest Area to ensure the long-term persistence of a marbled murrelet breeding population.

Low-level helicopter reconnaissance was used to classify the land base into six habitat classes. Dawn audiovisual and radar data were used to identify key watersheds in which to focus conservation efforts. Most watersheds with high detections of murrelets were 'L'-shaped and/or had a high degree of topographic diversity.

The management plan incorporated marbled murrelet habitat within the nonharvestable land base, such as protected areas, ungulate winter ranges, unstable terrain, Queen Charlotte goshawk (*Accipiter gentilis laingi*)[1] Wildlife Habitat Areas and Old Growth Management Areas, wherever possible, to minimize socio-economic impacts. A total of 21,566 ha of marbled murrelet potential nesting habitat will be conserved under this plan. A total of 6978 ha are located in protected areas, 7219 ha are in Marbled Murrelet Conservation Areas, 1758 ha are within Old Growth Management Areas that are not part of the conservation areas, and 7603 ha are in incidental retention areas. This total represents 50.4% of the available Class 1–4 (2002) nesting habitat. A total of 134 conservation areas have been identified as potential Wildlife Habitat Areas under the

[1]The BC Species and Ecosystems Explorer (April 2005) lists the Queen Charlotte goshawk as northern goshawk, *laingi* subspecies.

Forest and Range Practices Act (plus one additional conservation area has been approved as a Wildlife Habitat Area for marbled murrelets). The average size of the potential Wildlife Habitat Areas is 73.8 ha, although patch size varies from 14 to 316 ha. The impact to the timber harvesting land base is estimated at 988 ha (-0.99% of total timber harvesting land base). Subject to funding, biannual long-term radar monitoring of marbled murrelet populations will be conducted at a minimum of 10 sites on or adjacent to TFL 37 to determine the effectiveness of the habitat conservation plan.

Key Words: marbled murrelet, *Brachyramphus marmoratus,* nesting habitat, conservation plan, British Columbia

Introduction

Marbled murrelets (*Brachyramphus marmoratus*) nest in trees in old-growth forests along the west coast of North America. Populations are believed to be declining in some areas due to indirect threats from the loss of old-growth nesting habitat to timber harvesting and to direct threats associated with oil spills, gill nets and predation (Kaiser et al. 1994; Beissinger 1995; Nelson 1997; Hull 1999; Burger 2002; McShane et al. 2004). Timber harvesting reduces the availability of preferred nesting habitat by converting old-growth forests to shorter-rotation (i.e., younger), managed stands that lack the vertically complex canopies with many gaps and large mossy nesting platforms that murrelets seem to prefer (Bahn and Newsom 2002; Waterhouse et al. 2002). Loss and fragmentation of habitat to the harvesting of old-growth forests and degradation of habitat as a result of even-aged forest stand management is widely regarded as a significant long-term threat to viable populations of marbled murrelets throughout the Pacific Northwest (Burger 2002). Predation is considered to be one of the most significant causes of nest failure among marbled murrelets, and is also an important cause of adult mortality (Burger 2002). There is potential for increased nest predation where habitat fragmentation associated with timber harvesting results in increased edge effects (Raphael et al., in press). Red squirrels (*Tamiasciurus hudsonicus*) and Steller's jays (*Cyanocitta stelleri*) are the most commonly observed potential predators of marbled murrelets within the Nimpkish Defined Forest Area on Vancouver Island, British Columbia (B.C.) (Harper et al. 2004b).

The marbled murrelet is listed as a Threatened species under Schedule 1 of the federal *Species at Risk Act* (SARA) (CWS 2003). It is also included in the list of Species at Risk Schedule 1 under the Identified Wildlife Management Strategy (IWMS) and the provincial *Forest and Range Practices Act* (Province of British Columbia 2004a). Additionally, the marbled murrelet is red-listed in British Columbia (Fraser et al. 1999), and U.S. populations outside of Alaska are designated as Threatened under the U.S. *Endangered Species Act* (USFWS 1992, 2004).

The size of the marbled murrelet population in British Columbia is not known with certainty, but current numbers from at-sea and radar counts are estimated at between 55,000 and 78,000 (median estimate 66,000 birds or 56,000 adults if 85% are mature adults) (Burger 2002).

Under B.C.'s Identified Wildlife Management Strategy, version 2004, the primary objective of establishing conservation areas for marbled murrelets is to maintain suitable nesting habitat and to complement protected areas and areas that are unlikely to be harvested (Province of British Columbia 2004b). The Canadian Marbled Murrelet Recovery Team (2003) and the IWMS (Province of British Columbia 2004b) define habitats considered most likely to provide suitable nesting habitat in the West and North Vancouver Island Conservation Region as being

- 0.5–30 km from saltwater;
- age class 9 forest (> 250 years) and height class 4–7 (> 28.5 m tall);
- 0–900 m range in elevation;
- Class I and II site index productivity classes;
- canopy closure class 4, 5, and 6; and
- vertical canopy complexity: moderately uniform, non-uniform, and very non-uniform.

Under the Forest Practices Code, habitat conservation for the marbled murrelet has taken place at the strategic or landscape planning level (Forest Practices Board 2003). Wildlife Habitat Areas (WHAs) are usually established as a result of consultations between the B.C. Ministry of Water, Land and Air Protection, the B.C. Ministry of Forests, and the affected forest licensees. Current government direction points out the "opportunity to establish OGMAs[2] on the timber harvesting land base that address joint priorities of conservation of biological diversity and marbled murrelet nesting habitat" (Pedersen et al. 2004). Unfortunately, by linking these two processes, delays and difficulties in getting OGMAs approved could also increase the time required to establish marbled murrelet WHAs. Another potential delay identified by the Forest Practices Board (2003) is the imposition of a 1% limit on impacts incurred on mature timber supply impact, which creates a requirement to evaluate each proposed WHA for the cumulative impact on timber supply at all levels.

Canadian Forest Products Ltd.'s (Canfor's) Tree Farm Licence (TFL) 37 is within the marbled murrelet's (*Brachyramphus marmoratus*) nesting range on Vancouver Island. The Nimpkish Defined Forest Area (DFA), which includes TFL 37, is certified under the national Sustainable Forest Management System standard (CAN/CSA-Z809-96). An essential element of the certification process is the development, implementation, and monitoring of a Sustainable Forest Management Plan. Conservation and management of species at risk habitat is part of the plan in the Nimpkish DFA (Deal and Manning 2002). Formal public input on sustainable forest management is also part of the plan, and this is accomplished through Canfor's public advisory group, the Nimpkish Woodlands Advisory Committee. This group has identified the amount of area managed for marbled murrelet nesting habitat as a quantifiable indicator of sustainable forest management. The objective associated with this indicator is "Maintain ≥ 10% of the original suitable marbled murrelet habitat by LU[3]. Develop strategy by December 2004." As a result,

[2]Old Growth Management Areas (OGMAs)
[3]Landscape Unit (LU)—refers to the draft Lower Nimpkish and Upper Nimpkish Landscape Units

Canfor invested significant resources over four years to collect data to develop this science-based conservation strategy for marbled murrelet habitat.

Study Area

The Nimpkish DFA includes TFL 37 and the associated parks and protected areas in the draft Lower Nimpkish and Upper Nimpkish Landscape Units (Fig. 1). TFL 37 is located immediately south of Port McNeill on Vancouver Island and encompasses Nimpkish Lake, the Nimpkish River, Woss Lake, Vernon Lake and the upper reaches of the Tsitika River. The total land base of TFL 37 is 188,745 ha, of which 153,607 ha (81%) is considered productive forest. The Nimpkish DFA is located within the West and North Vancouver Island Conservation Region (CMMRT 2003), which is the region with the largest estimated population of marbled murrelets in Canada.

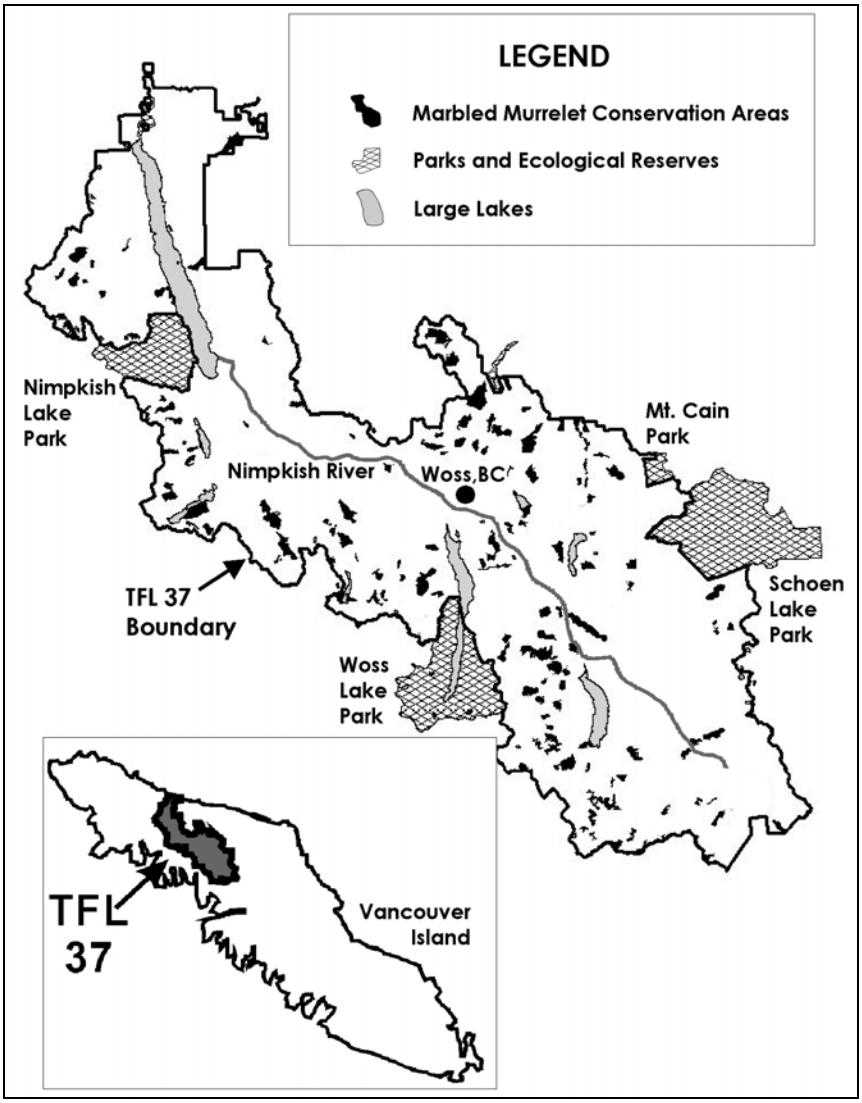

Figure 1. Spatial distribution of 134 Marbled Murrelet Conservation Areas (black) in the Nimpkish Defined Forest Area (DFA) on northern Vancouver Island.

Inventory and Monitoring

Nesting Habitat Classification

Low-level aerial reconnaissance mapping was conducted in 2002 (Deal and Smart 2004). These aerial surveys checked for the presence and relative abundance of the important microhabitat features for nesting murrelets that are not detectable from air photos, maps, or GIS databases (Burger 2004). Approximately 197,000 ha were classified for nesting habitat potential (Table 1). A total of 46,107 ha of Class 1 to Class 4 habitat were identified. Classes 1 through 4 were selected to represent potential marbled murrelet nesting habitat based on an analysis of large tree (≥ 80 cm dbh) nesting platform densities from surveys conducted between 1999 and 2003 (Harper et al. 2001a, 2002, 2004a). This analysis indicated that there was a significant difference between the mean densities of potential nesting platforms per hectare in Class 1 habitat (Very High: 459/ha) vs. Class 2 habitat (High: 277/ha), and Class 2 was significantly different from Class 3 habitat (Moderate: 130/ha); however, there was no significant difference in mean platform density between Class 3 and Class 4 habitats (Low: 126/ha).

Table 1. Area summary of potential marbled murrelet nesting habitat by class within TFL 37 and protected areas within the Nimpkish Defined Forest Area (DFA) (Class 1 to 4 potential habitat in bold).

Marbled murrelet nesting habitat class	*Area of marbled murrelet nesting habitat class within TFL 37 (ha)*	*Area of protected areas within the DFA (ha)*	*Total area (ha)*
1 (Very high)	**1050**	**1282**	**2332**
2 (High)	**8856**	**3152**	**12,008**
3 (Moderate)	**17,410**	**1849**	**19,260**
4 (Low)	**11,815**	**693**	**12,509**
5 (Very low)	35,494	5191	40,686
6 (Nil)	104,235	6005	110,240
Total area	178,862	18,174	197,036

Correlations between helicopter-based habitat assessments and ground measurements were higher than correlations between ground measurements and a predictive habitat model developed for the same area (Table 2) (Harper et al. 2004a). The predictive habitat model was driven primarily by forest age and tree height but was also modified by forest productivity and biogeoclimatic subzone/variant (Harper et al. 2001b).

Table 2. Spearman Rank correlation coefficients (R^2) for helicopter-based habitat assessments, detailed ground measurements, and predictive habitat modeling for marbled murrelet nesting habitat suitability in TFL 37 (Harper et al. 2004a).

Data sources compared	*Variables compared**		
	platform density	*large tree (≥ 80 cm dbh) platform density*	*on-the-ground habitat suitability rating*
Helicopter-assessment and ground measurements	$R^2 = 0.46$	$R^2 = 0.51$	$R^2 = 0.44$
Predictive habitat model and ground measurements	$R^2 = 0.29$	$R^2 = 0.28$	$R^2 = 0.30$

*An R^2 value of 1.0 indicates a perfect correlation between two variables; 0.0 indicates no correlation.

Forest Surveys for Nesting Habitat

Between 1999 and 2003, a total of 96 transects (1.0 ha each) and 32 plots (0.2 ha each) were established according to provincial standards (RISC 2001) within the Nimpkish DFA to estimate potential nesting platform densities (Harper et al. 2001a, 2002, 2004a). There were no differences in marbled murrelet nesting potential among different land use classifications in the Nimpkish Valley. For example, within the CWHvm1 variant of the Lower Nimpkish Landscape Unit, the timber harvesting land base, ungulate winter range (as defined in 2000), and steep inoperable sites had platform densities that averaged 234, 234, and 178 large tree (≥ 80 cm dbh) platforms per hectare, respectively (Harper et al. 2001a). There were also no statistically significant differences in density of large trees per hectare or potential nesting platform densities among these land use designations in the Upper Nimpkish Landscape Unit (Harper et al. 2002). Generally, the better marbled murrelet nesting habitat was located at low to mid elevations (but not on southerly slopes). The tree species with the best nesting characteristics was amabilis fir (*Abies amabilis*), which had the highest number of potential platforms per tree and the highest epiphyte cover score (Harper et al. 2001a, 2002).

Audiovisual Surveys for Nesting Occupancy

A total of 190 dawn audiovisual surveys were conducted in or near potential Marbled Murrelet Conservation Areas between 2001 and 2003. Over these three years, there were 1793 total detections and 227 'occupied' detections (below canopy flights indicative of breeding activity within the forest stand). Occupied behaviors were observed at 10 of 22 study sites in 2001, 12 of 19 study sites in 2002, and 12 of 13 study sites in 2003 (Cooper et al. 2002; Harper et al. 2003, 2004b).

By examining the maximum number of single-site, single-day detections, the following watersheds were identified as a priority for marbled murrelet planning: Tlakawa (123 detections);

Fool's (90); Kiyu (74); Pinder (68); Fiddle (56); Yookwa (50); Gold (42); Atluck (40); Kelsey (39); and McIver (35). In addition, because sites in the Kilpala and Emerald watersheds were designated as occupied early in the season, and surveys ceased prior to peak activity periods, these two drainages were also considered a priority for planning. Most watersheds with high audiovisual detections were 'L'-shaped (e.g., Kiyu) and/or had a high degree of topographic diversity (e.g., Tlakawa).

Radar Surveys to Monitor Population Trends

Marine surveillance radar monitoring is a proven technique for estimating population numbers of murrelets entering large landscape units (Burger 1997, 2001; Schroeder et al. 1999; Manley 2000; RISC 2001; Cooper et al. 2001; Cooper and Hamer 2003). Radar surveys were conducted from mid-May to late July in 2002, 2003, and 2004. In 2002, 25 morning surveys at 19 different radar stations recorded 1148 detections using a 5-kW untilted radar unit (Harper and Chytyk 2003). In 2003, 32 morning surveys at 19 radar stations generated 4610 detections of 4999 targets (birds) using a 10-kW tilted radar scanner (Harper and Schroeder 2004). In 2004, 31 morning surveys at 15 radar stations recorded 6808 detections of 7497 targets (birds) with the same radar scanner used in 2003 (Harper et al. 2005). The largest numbers of detections were made at the mouth of the Artlish River (> 500 detections per survey).

The Conservation Plan

The Marbled Murrelet Conservation Plan for the Nimpkish DFA is designed around five major programs or initiatives: protected areas, Old Growth Management Areas, the provincial Identified Wildlife Management Strategy, the federal *Species at Risk Act* (SARA), and the national Sustainable Forest Management System.

Goals and Objectives

The goals for marbled murrelet conservation within the Nimpkish DFA are to

- conserve important nesting habitats through the establishment of Wildlife Habitat Areas under the Forest Practices Code;
- monitor the distribution and abundance of marbled murrelet nesting habitat in the TFL; and
- monitor the long-term distribution and abundance of marbled murrelets at the landscape level, subject to funding.

These objectives are consistent with the Canadian Marbled Murrelet Conservation Assessment which recommends using a multi-pronged approach that includes identifying and

tracking nesting habitat and monitoring population numbers (CMMRT 2003). More specifically, a murrelet conservation strategy, ideally, should include a combination of the following measures:

- Identification of suitable nesting habitat in each region by developing and refining habitat algorithms, air photo interpretation, and other methods
- Mapping and estimates of the areas of suitable habitat, taking into account variations of habitat quality
- Tracking of projected changes in the area and quality of nesting habitat
- Monitoring of selected populations using radar at appropriate locations throughout the DFA

Landscape-level Habitat Conservation

Protected areas that were identified as core areas were greater than 3000 ha in size and provided a minimum of 900 ha of suitable nesting habitat (i.e., Class 1–4). Three protected areas qualified for this designation: Nimpkish Lake Provincial Park, Woss Lake Provincial Park, and Schoen Lake Provincial Park. Smaller protected areas (e.g., Lower Nimpkish Provincial Park, Claude Elliot Provincial Park, Claude Elliott Creek Ecological Reserve) also provide some potential nesting habitat. Within all protected areas there is a total of 6978 ha of Class 1–4 marbled murrelet habitat (as rated by helicopter survey). This represents 15% (6978 of 46,107 ha) of the 2002 suitable habitat within the DFA (Table 3).

Consistent with government's direction (Pedersen et al. 2004), one of the primary considerations in selecting OGMAs was species at risk so as to manage marbled murrelet habitat through the OGMA process first and then through the IWMS. OGMAs captured 7105 ha (15.4% of the 2002 habitat) of Class 1–4 habitat across the TFL (Table 3). Some of these OGMAs became part of the Marbled Murrelet Conservation Areas, as described below.

A total of 134 Marbled Murrelet Conservation Areas were identified on TFL 37 (Fig. 1). One area identified as a conservation area was approved as a marbled murrelet WHA (1-014) by the Ministry of Water, Land and Air Protection on 27 March 2002. All of the remaining conservation areas meet the criteria for a WHA under the *Forest and Range Practices Act*, and will be managed as if they are WHAs until government decides on their final status.

The total area of the Marbled Murrelet Conservation Areas is 9740 ha. Of this, 7219 ha were classified as potential nesting habitat (i.e., Class 1–4 habitat) (Table 3). The intent was to build on existing constrained areas (nonharvestable land base) and utilize the timber harvesting land base where it was most appropriate in priority watersheds with high marbled murrelet detections and high marbled murrelet nesting habitat potential. This approach minimized the impact to the mature timber harvesting land base.

Table 3. Summary of nesting habitat classification based on helicopter reconnaissance within protected areas, Old Growth Management Areas, Marbled Murrelet Conservation Areas, and incidentally retained areas within the Nimpkish DFA.

Nesting habitat conservation mechanism	*Habitat Class* 1 (ha)*	*Habitat Class 2 (ha)*	*Habitat Class 3 (ha)*	*Habitat Class 4 (ha)*	*Total Habitat Class 1–4 (ha)*	*Habitat Class 5 (ha)*	*Total Habitat Class 1-5 (ha)*	*% potential nesting habitat (Class 1–4)*
Protected areas	1282	3153	1850	694	6978	5191	12,170	57%
Old Growth Management Areas	301	1823	3045	1936	7105	6893	13,998	51%
Marbled Murrelet Conservation Areas	274	2146	3345	1454	7219	1456	8675	83%
Incidentally retained areas	225	1501	2975	2902	7603	14,883	22,486	34%
Total	2082	8623	11,215	6986	28,906	28,423	57,329	50%

*Ground-measured transects (1 ha) within a sample of habitat polygons (n = 86) had a mean average of potential nesting platforms as follows: Class 1—459 platforms per hectare, Class 2—277 platforms per hectare, Class 3—130 platforms per hectare, Class 4—126 platforms per hectare, and Class 5—86 platforms per hectare (Harper et al. 2004a).

OGMAs were the main mechanism to conserve marbled murrelet nesting habitat, and they formed the basis of all or part of 103 of the 134 Marbled Murrelet Conservation Areas within the Nimpkish DFA. The conservation areas comprise 5347 ha of habitat within the OGMAs (i.e., the OGMAs provide a net 1758 ha of potential nesting habitat).

The average size of the conservation areas is 73.8 ha, although patch size varies from 14 ha to 316 ha. Table 4 shows a patch size analysis for the conservation areas by landscape unit. In the Lower Nimpkish, 13% of the patches are less than 40 ha compared to 14.6% in the Upper Nimpkish. The distribution of larger patches (> 100 ha) is quite similar between landscape units (51.6% of the total area in the Lower Nimpkish compared to 50.7 % in the Upper Nimpkish).

Table 4. Distribution of patch size classes of Marbled Murrelet Conservation Areas in TFL 37 by landscape unit.

Landscape Unit	*Patch size class (ha)*	*Area (ha)*	*% of total area*
Lower Nimpkish	≤ 40	412	13
	40.1–100	1122	35
	100.1–200	1155	37
	> 200	478	15
Upper Nimpkish	≤ 40	956	15
	40.1–100	2269	35
	100.1–200	2200	34
	> 200	1119	17

An additional 7603 ha or 16.5% of the Class 1–4 2002 habitat is located within the nonharvestable land base (i.e., incidentally retained areas) within TFL 37 and is not included in protected areas, OGMAs, or Marbled Murrelet Conservation Areas (Table 3). These areas include riparian reserve areas, inoperable areas, terrain class IV and V, karst, and nonproductive sites.

Through all of the conservation mechanisms listed in Table 3, a total of 50.4% of the Class 1–4 2002 potential nesting habitat or 28,906 ha has been conserved across the DFA. Over 70% of the available Class 1 (Very High) habitat and nearly 60% of the available Class 2 habitat has been conserved (Fig. 2).

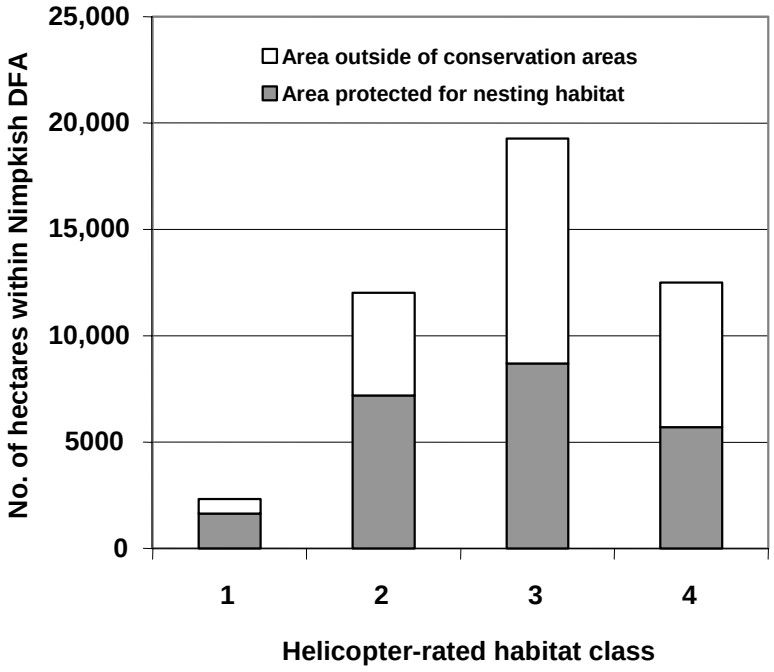

Figure 2. Proportion of available marbled murrelet nesting habitat (2002) protected within the Nimpkish Defined Forest Area (DFA).

Stand-level Habitat Conservation

Consistent with the scale at which marbled murrelets utilize forested habitats for breeding purposes, the primary focus of habitat conservation within the plan is at the landscape level; however, stand-level habitat conservation measures are also important and will be applied to areas outside of the Marbled Murrelet Conservation Areas where an active nest is located. For the purposes of this conservation plan, the term 'residence' is defined as a nesting tree that has been identified as being in active use. The term does not include stands where occupied detections of below canopy flight behaviors or inactive nest trees have been observed. If an active marbled murrelet nest is encountered during active falling, falling and yarding operations will cease within 200 m of the active nest, and the nest will be protected under the provisions for protecting the residence of a species under SARA. Falling and yarding may resume when the nest has been shown to be inactive, or on 1 September of that year.

Timber Supply Impacts

The impact to the timber harvesting land base as a result of the conservation areas is 988 ha. A recent aspatial timber supply analysis indicated a reduction of 0% in the short-term cut levels, 2% in the mid-term levels, and 1% in the long-term levels (Deal and Mahony 2004).

Monitoring Strategies

There are a number of standardized methods that can be applied to measure indicators of conservation area effectiveness at both landscape (e.g., watershed) and stand (local or WHA) scales. Methods for conducting nesting habitat, dawn audiovisual, and radar surveys will follow protocols described in the Resources Inventory Standards Committee (RISC) manual *Inventory Methods for Marbled Murrelets in Marine and Terrestrial Habitats*, version 2.0 (RISC 2001). It is recognized that monitoring populations of marbled murrelets is not the responsibility of forest companies; however, Canfor is willing to partner with government and academia to monitor populations.

Radar surveys for marbled murrelets have successfully been used on both Vancouver Island (Burger 1997, 2001; Harper and Chytyk 2003; Harper and Schroeder 2004) and the coastal British Columbia mainland (Schroeder et al. 1999; Cullen 2002; Steventon and Holmes 2002). Researchers at the University of British Columbia and elsewhere have proposed a broad-scale long-term monitoring program to estimate marbled murrelet population trends coast-wide using radar surveys to answer key questions about the roles of natural variation in the ocean environment and forest harvest as causes of population change (Arcese et al. 2005). Long-term radar monitoring of marbled murrelet populations will be conducted at a minimum of 10 sites on or adjacent to TFL 37 to determine the effectiveness of the conservation plan. These 10 sites will be monitored a minimum of every second year, subject to funding.

During the breeding season, audiovisual surveys are the most widespread method used for assessing the presence and relative abundance of murrelets in various habitats. In the future, subject to funding and partnerships with government and/or academia, RISC standard dawn audiovisual surveys will be used to determine presence, absence, or breeding occupancy at selected sites to determine WHA effectiveness. The ultimate objective is to determine if WHAs continue to be occupied by breeding murrelets, to determine the extent of occupancy, and to use that information to evaluate current WHAs and propose potentially new WHAs, as appropriate.

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