

Implementation Plan for the Recovery of Marbled Murrelet (*Brachyramphus marmoratus*) in British Columbia



Prepared by the British Columbia Ministry of Forests, Lands,
Natural Resource Operations and Rural Development



February 2018

About British Columbia Implementation Plans

The Province prepares implementation plans to meet its commitments to manage and/or recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada–British Columbia Agreement on Species at Risk*. Species at risk management and/or recovery is the process by which the decline of an endangered, threatened, or extirpated species is reduced, arrested, or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is an implementation plan?

An implementation plan outlines the response of the provincial government to the need to manage species at risk for which management and/or recovery in British Columbia may have significant socio-economic implications. Implementation plans guide and prioritize management actions that are required to meet objectives and goals identified through government decisions. Such government decisions are informed by science and technical information but are also made with consideration of socio-economic factors.

What's next?

Directions set out in this implementation plan are intended to involve governments, communities, land users, and other interested parties in cost-effective implementation of conservation activities that build towards managing and/or recovering the species.

For more information

To learn more about species at risk recovery in British Columbia, please visit the B.C. Recovery Planning webpage at: <<http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning>>

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Preface

This implementation plan outlines the direction provided by the government of British Columbia to manage Marbled Murrelet in British Columbia. This direction reflects the potentially significant socio-economic implications associated with management of this species. The British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development, as the agency responsible for managing wildlife in British Columbia, has been charged with leading the implementation of government's commitments for the management of Marbled Murrelet, through the development of this implementation plan with the support of other provincial agencies.

This document identifies the terrestrial management actions that are deemed necessary, based on the best available scientific and technical information and considering socio-economic values, to halt the decline of the Marbled Murrelet population and the area of its nesting habitat and ensure Marbled Murrelet have a high probability of persistence across their range. Implementation of the management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. It may also be necessary to modify these actions, while respecting their intent, to accommodate new science resulting from effectiveness monitoring of management actions and continuing research on habitat requirements, to address socio-economic objectives of Marbled Murrelet management, and/or to meet direction provided by the government of British Columbia.

Success in the management and recovery of this species depends on the commitment and cooperation of many different parties that may be involved in implementing the directions set out in this plan.

ACKNOWLEDGEMENTS

This implementation plan was prepared by the British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNR) and builds on many elements of the Environment Canada's 2014 federal recovery strategy for Marbled Murrelet. Many members of the Marbled Murrelet Recovery Team contributed to the approaches and development of the federal recovery strategy.

Steve Gordon and Darryn McConkey (FLNR) led completion of this document. Leah Westereng and Karen Stefanyk (B.C. Ministry of Environment and Climate Change Strategy [ENV]) coordinated its posting to the recovery planning website. Tom Ethier, Kevin Kriese, and Craig Sutherland (FLNR), and Kaaren Lewis, Jennifer McGuire, and Mark Zacharias (ENV), provided guidance and oversight during plan development and review. Allan Lidstone, Charlie Short, and Chris Ritchie (FLNR), and Alec Dale and James Quayle (ENV), provided strategic leadership during plan development. Scott Allen, Lew Greentree, Linda Sinclair, Dan Sirk, and John Sunde (FLNR) provided geographical information system and analytical assistance. Janice Anderson, Greg George, Karen Stefanyk, Josh Malt, and Melanie Wilson provided review comments. Sinclair Tedder, Cameron Woodbridge, and Alex Barnes (FLNR), and Michele MacIntyre and Rob Dorling (ENV), provided analyses in support of the plan.

Engagement coordination was led by Laura Body (FLNR). District resource managers and staff assisted with venue coordination and logistics. Engagement participants provided valuable feedback on management approaches that helped guide plan development.

EXECUTIVE SUMMARY

The Marbled Murrelet is a small seabird that spends most of its time at sea, usually within 0.5 km of shore. Marbled Murrelets nest as solitary pairs at low densities almost exclusively in old-growth forests, typically within 30 km of the ocean. In Canada, the Marbled Murrelet is found along the Pacific coast. The current Canadian population is estimated at 99 100 birds, which equates to about 28% of the estimated global population. The Marbled Murrelet was assessed as “Threatened” in 2012 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is Blue-listed (Special Concern) in British Columbia.

The main terrestrial threats to Marbled Murrelets include historic and ongoing loss and fragmentation of old-growth nesting habitat, resulting in insufficient functional nesting habitat, increased predation risk, and adverse changes to microclimate near forest edges.

The Marbled Murrelet is a protected migratory bird under the federal *Migratory Birds Convention Act*. Environment Canada posted a draft recovery strategy for the Marbled Murrelet in January 2014; the final recovery strategy, posted in June 2014, includes the partial identification of nesting critical habitat. Future amendments will include the identification of marine critical habitat.

The federal recovery strategy sets short- and long-term population and distribution objectives and identifies nesting critical habitat in British Columbia without consideration of socio-economic implications. The federal *Species at Risk Act* gives provincial governments first opportunity to effectively protect critical habitat under their jurisdiction. This implementation plan is key to demonstrating provincial leadership and progress on Marbled Murrelet recovery, including the provision of effective critical habitat protection.

The federal recovery strategy considers management measures for the marine environment, while this implementation plan addresses terrestrial nesting habitat and contains habitat management commitments for provincial Crown lands. In addition, British Columbia’s provincial government is committed to encouraging shared stewardship of Marbled Murrelet habitat on non-Crown lands, such as private lands (e.g., Private Managed Forest Land), First Nation lands, and municipal government lands.

Implementation plan objectives involve maximizing conservation efforts to benefit the Marbled Murrelet and supporting future recovery efforts while providing resource development opportunities. This vision provides certainty in maintaining socio-economic and environmental values that are important to both the people of British Columbia and the wider global community.

Recovery focuses on addressing immediate threats to Marbled Murrelet terrestrial habitat by halting its decline and fragmentation; the long-term goal would ensure the species has a high probability of persistence across its provincial range. The following short- and long-term population and distribution objectives are endorsed by the provincial government and will guide implementation efforts within British Columbia.

Short-term Population and Distribution Objective

The short-term (i.e., next 15 years) population and distribution objective for Marbled Murrelet recovery is to halt the decline of the British Columbia population related to terrestrial threats. Specifically, over the 30-year period 2002–2032 (three generations), any decline of the provincial population and area of its nesting habitat will have slowed to a halt and the total population and area of nesting habitat will have stabilized above 70% of 2002 levels, with areas of nesting habitat in the seven conservation regions sufficient to support population objectives.

For six of the seven conservation regions, the following short-term recovery objectives have been adopted from the Canadian Marbled Murrelet Recovery Team (2003) recommendations and the federal recovery strategy.

- Southern Mainland Coast Conservation Region – the retention of at least 85% of 2002 populations by retention of proportionate amounts of 2002 nesting habitat.
- Haida Gwaii, Northern Mainland Coast, Central Mainland Coast, and West and North Vancouver Island conservation regions – the retention of at least 68% of 2002 populations by retention of proportionate amounts of 2002 nesting habitat.
- Alaska Border Conservation Region – the retention of at least 70% of 2002 populations by retention of proportionate amounts of 2002 nesting habitat.

Recent (2017) analysis in the East Vancouver Island Conservation Region indicates that the amount of nesting habitat is below the Canadian Marbled Murrelet Recovery Team (and federal) recommendation to retain 90% of 2002 habitat. For this region, the short-term recovery objectives is as follows:

- East Vancouver Island Conservation Region – the retention of 100% of currently suitable nesting habitat.

Long-term Population and Distribution Objective

The long-term population and distribution objective for the recovery of the Marbled Murrelet is to ensure the species has a high probability of persistence after 2032 across its range. This will be achieved by maintaining sufficient nesting habitat within each conservation region to stabilize the Canadian population. The East Vancouver Island Conservation Region is the only region where recruitment of nesting habitat is required to achieve the minimum habitat threshold over the long term.

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1 SCOPE OF THE IMPLEMENTATION PLAN

This implementation plan is limited to the terrestrial (nesting) habitat for Marbled Murrelet in British Columbia and represents direction provided by the provincial government to manage this species. Marine habitat elements and issues are excluded from this plan, although it is recognized that recovery of this species will require addressing all threats.

1.1 Associated Documents

This implementation plan was informed by the following references and scientific information on Marbled Murrelet in British Columbia.

- Canadian Marbled Murrelet Recovery Team Conservation Assessment Part A (Burger 2002) and Part B (Canadian Marbled Murrelet Recovery Team 2003)
- Accounts and Measures for Managing Identified Wildlife –Accounts V. 2004. Marbled Murrelet (*Brachyramphus marmoratus*) (B.C. Ministry of Water, Land and Air Protection 2004)
- Committee on the Status of Endangered Wildlife in Canada Assessment and Status Report on the Marbled Murrelet *Brachyramphus marmoratus* in Canada (COSEWIC 2012)
- Recovery Strategy for the Marbled Murrelet (*Brachyramphus marmoratus*) in Canada (Environment Canada 2014)

2 ENGAGEMENT

In January 2016, engagement was initiated on the proposed provincial management approaches for Marbled Murrelet to seek feedback that would inform a senior government decision on these approaches.

Between January and March 2016, 34 engagement sessions were conducted in 12 coastal locations with First Nations and key stakeholders, including the forest sector, local governments, and environmental organizations. Over 30 formal responses were received from session participants, in addition to extensive feedback recorded at the engagement sessions.

The provincial government continues to encourage First Nations and stakeholders to conduct shared stewardship of Marbled Murrelet and to develop implementation mechanisms to achieve the management direction in this plan along with recovery goals, while minimizing potential impacts to resource values.

3 SUMMARY OF SPECIES INFORMATION

Basic species assessment and status information from the status report (COSEWIC 2012) and the federal recovery strategy (Environment Canada 2014) are adapted and presented in this section. For more detailed information about Marbled Murrelet in British Columbia, please refer to these documents and the other associated documents (Section 1.1).

3.1 COSEWIC* Species Assessment Information

Assessment Summary: May 2012

Common Name: Marbled Murrelet

Scientific Name: *Brachyramphus marmoratus*

Status: Threatened

Reason for Designation: This small seabird is largely dependent on old-growth coastal forests in British Columbia for nesting. Habitat loss has been estimated at over 20% for the past three generations. Future threats including ongoing habitat loss, coupled with increased threats from proposed shipping routes in the core of the species' range, increased fragmentation from a variety of proposed and recently initiated developments, fisheries bycatch and changing at sea conditions have resulted in projected population losses exceeding 30% over the next three generations.

Occurrence: British Columbia

Status History: Designated Threatened in April 1990. Status re-examined and confirmed in November 2000 and May 2012.

* Committee on the Status of Endangered Wildlife in Canada.

3.2 Species Status Information

The Marbled Murrelet is listed as Threatened, both in Canada under the federal *Species at Risk Act* (Government of Canada 2002) and in the United States under the *Endangered Species Act* (1973) for California, Oregon, and Washington states. Loss rates of old-growth forest nesting habitats is the main cause for species listings in both countries (COSEWIC 2012).

Marbled Murrelet^a
Legal Designation
FRPA : Category of Species at Risk ^b Wildlife Act : ^c No SARA : ^d Schedule 1 –Threatened (2003)
OGAA : Species at Risk ^b
Conservation Status^e
B.C. List: Blue (Special Concern) B.C. Rank: S3B, S3N (2015)
Subnational Ranks : ^f State: Alaska (S3), California (S1), Oregon (S2), Washington (S3) Global Rank: G3 (2013)

^a See B.C. Conservation Data Centre (2017) for species summary.

^b Species at Risk = a listed species that requires special management attention to address the impacts of forestry and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).

^c No = not designated as wildlife under the British Columbia *Wildlife Act* (Province of British Columbia 1982).

^d Schedule 1 = found on the List of Wildlife Species at Risk under the *Species at Risk Act* (SARA; Government of Canada 2002).

^e S = Subnational; N = National; G = Global; T = infraspecific taxa (subspecies or varieties); B = Breeding; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable.

^f Data source: NatureServe (2017).

3.3 Species Life History

The Marbled Murrelet is a small seabird found along the Pacific coast in Canada. Marbled Murrelets spend most of their time at sea, returning to land only for breeding, nesting, and rearing of young. They do not begin breeding until 2–3 years of age and have low reproductive output. They nest as solitary pairs at very low densities, typically within 30 km of the sea, but nests have been located up to 65 km inland (Ralph [eds.] 1995; Burger 2002; Lank *et al.* 2003; Piatt 2007). Old-growth forest stands with a well-developed epiphytic moss component are preferred for nesting habitat (Burger 2002). No nest is constructed but a single egg is laid, generally in a depression on a moss-covered branch. Throughout the range of the Marbled Murrelet, nests are typically found in old-growth coniferous trees, but a small number of nests have been found on cliff ledges, deciduous trees, and on the ground in alpine areas (Bradley and Cooke 2001; Barbaree *et al.* 2014). Nest site fidelity is not well understood, but Burger *et al.* (2009b) found 18% ($n = 143$) of nest trees had multiple nests and suggested that, particularly where suitable habitat is limited because of forest harvesting, suitable forest stands may be repeatedly used for nesting. Both parents alternate incubation of the egg for about 30 days, and provide the chick with food for an additional ~30 days on the nest. Parents commute between ocean and the nest at high speeds (usually over 80 km/h) to shift incubation duties and to deliver fish during dark twilight at dawn and dusk. The nestling is fed at least once and sometimes twice per day or night until it fledges in approximately 28 days. Fledglings fly directly from the nest to the ocean.

Murrelets eat small schooling fish and large pelagic crustaceans (Burger 2002). They forage by diving, using their wings for underwater propulsion. Most murrelets forage in relatively shallow water (less than 30 m deep), either in sheltered seas or within 500 m of exposed shores. Adults eat a range of prey types but select larger fish (e.g., mature sand lance) to carry back to the nestling (Kuletz 2005). Proximity to good foraging sites is linked to increased breeding propensity and success (Lorenz *et al.* 2017), and is associated with higher use of inland nesting stands (Meyer *et al.* 2002). Most nests have been found within 50 km of the ocean, although breeding murrelets are known to commute up to 200 km to feed at prey concentrations (Whitworth *et al.* 2000; Hull *et al.* 2001; Burger 2002; Lorenz *et al.* 2017).

3.4 Population and Distribution

3.4.1 Distribution

The Marbled Murrelet is found in coastal waters and adjacent inland areas from the Aleutian Islands, south along the coast to central California (Figure 1).

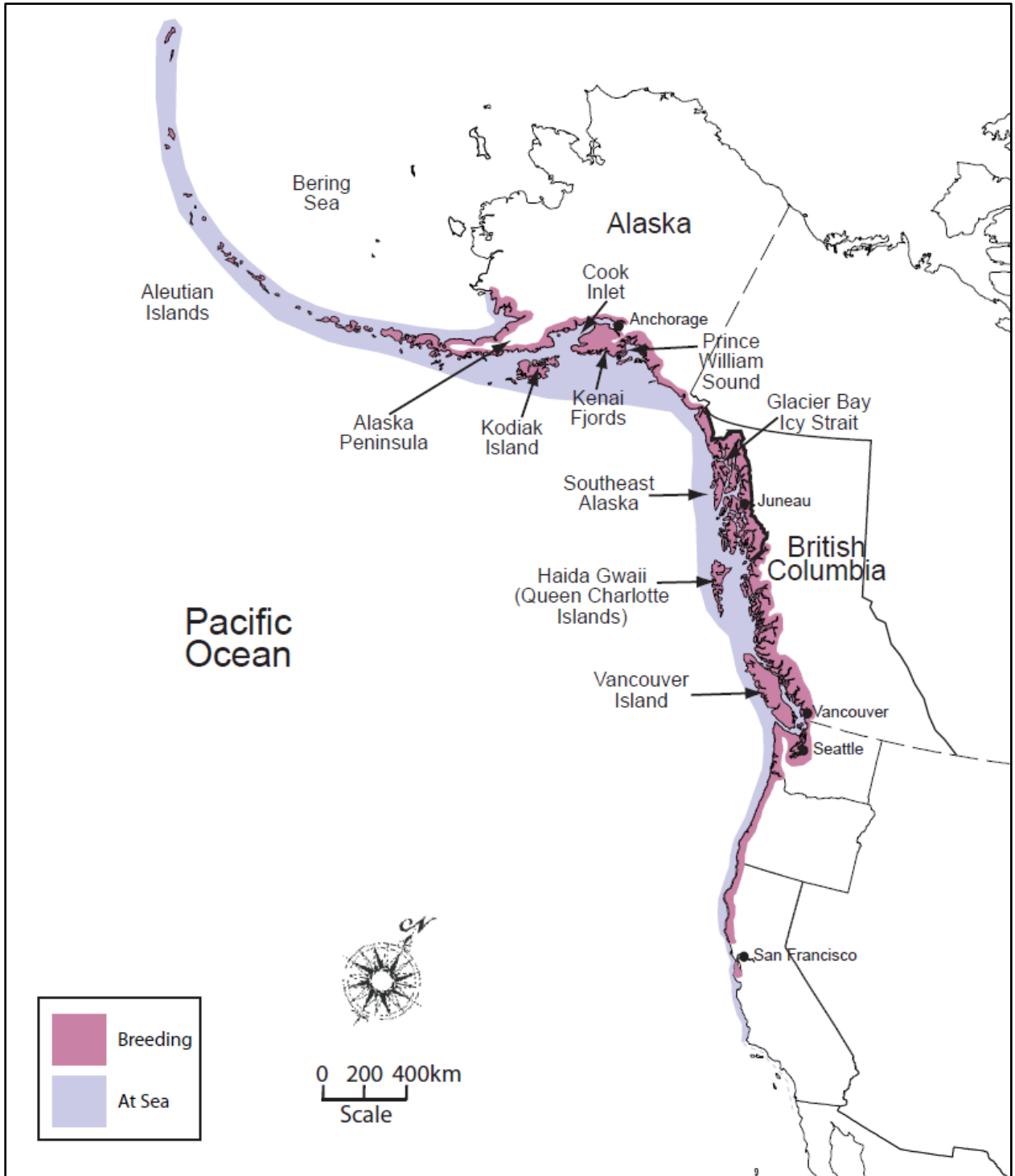


Figure 1. Global distribution of Marbled Murrelets (from Piatt *et al.* 2007).

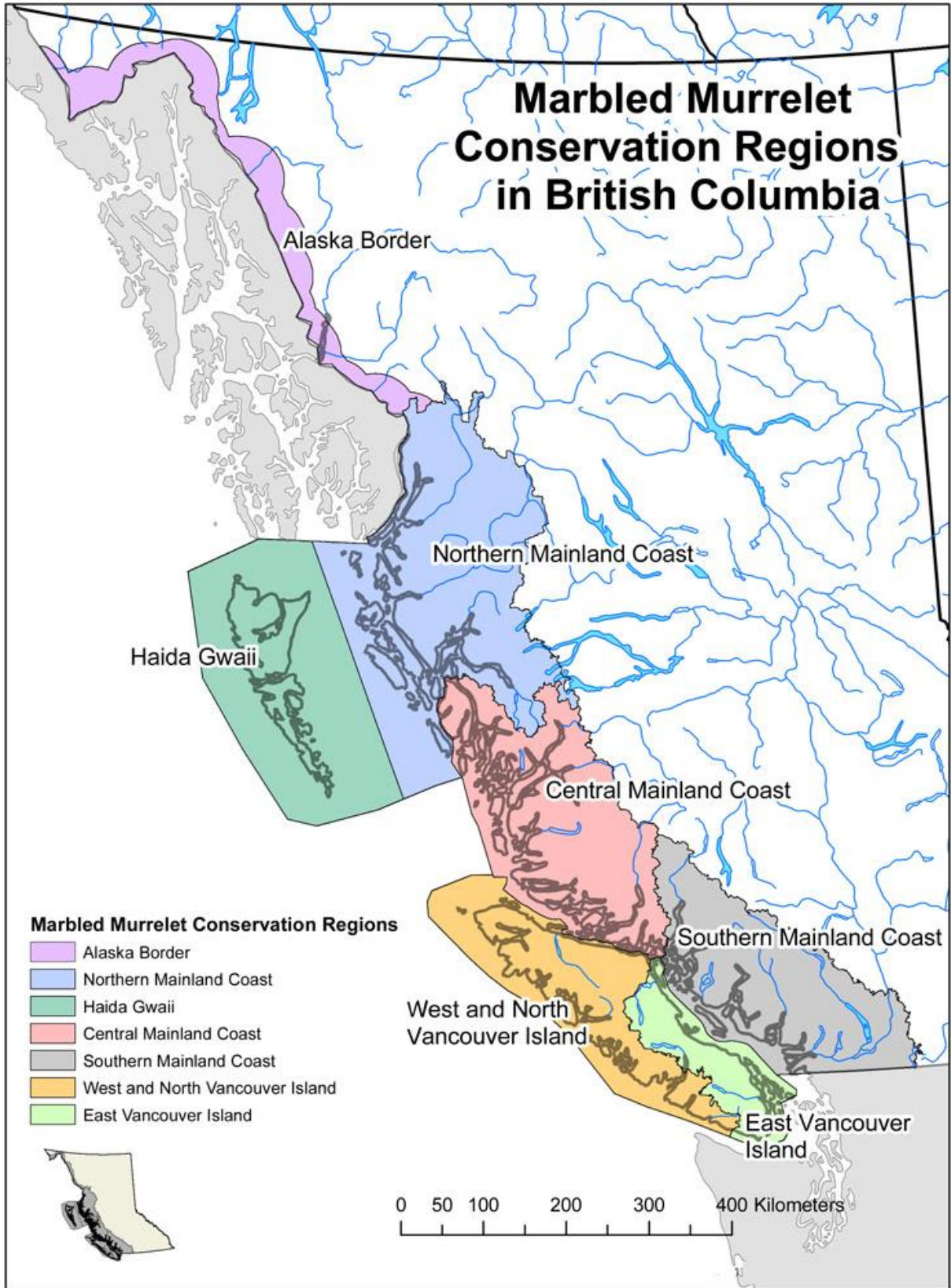


Figure 2. Map of the seven Marbled Murrelet conservation regions in British Columbia.

3.4.2 Population Estimates

Estimates of the Canadian population of Marbled Murrelets range from 72 600 to 125 600 birds, with a median point of 99 100 birds (Bertram *et al.* 2007). Table 1 shows the estimated populations for each of the six primary conservation regions. These population estimates should be used with caution since they are, in all regions, based on incomplete data (at-sea and radar counts), and include assumptions, extrapolations, and expert opinion (Burger 2002; Piatt *et al.* 2007; Environment Canada 2014).

Table 1. Marbled Murrelet population estimates in each British Columbia conservation region.

Conservation region	Population estimate (range)	Mid-point
Northern Mainland Coast	18 400–26 000	22 200
Haida Gwaii	8500–25 000	16 750
Central Mainland Coast	20 000–42 000	31 000
Southern Mainland Coast	6000–7000	6500
West and North Vancouver Island	18 700–23 600	21 150
East Vancouver Island	1000–2000	1500
Alaska Border	Not available	Not available
Total		
All birds	72 600–125 600	99 100
Mature adults (rounded)	54 500–94 200	74 300

The numbers given are for birds of all ages; about 75% of these birds could be considered mature adults (COSEWIC 2012). Data from Environment Canada (2014), Bertram *et al.* (2007), and D. Bertram (unpubl. data).

3.4.3 Population Trends

Bertram *et al.* (2015) suggested that a negative overall population trend of –1.6% per year indicated moderate evidence for a coast-wide decline, although trends varied strongly among the six conservation regions. Significant negative annual trends were detected in the East Vancouver Island (–9% per year) and South Mainland Coast (–3% per year) conservation regions.

3.5 Habitat Protection

The federal recovery strategy (Environment Canada 2014) sets a population objective that requires retention of nesting habitat at 70% (or greater) of 2002 amounts by 2032 province-wide. Distribution objectives are achieved through identification of different levels of habitat retention and minimum habitat thresholds for each of the seven conservation regions.

The government of British Columbia is committed to maintaining specified amounts of nesting habitat on provincial Crown land within each conservation region (Table 2). These amounts are likely to change as improved habitat mapping and other information becomes available. A commitment has also been made to continually improve the identification of nesting habitat and

regularly update the suitable nesting habitat spatial layer as new information becomes available. Often, as habitat mapping improves, the amount of habitat in a conservation region will change, resulting in the need for updated calculations of minimum habitat thresholds.

Table 2. Marbled Murrelet suitable habitat in British Columbia.^a

Conservation region	2002 suitable habitat (ha)	Habitat retention threshold (%) ^b	2016 suitable habitat (ha)	Minimum habitat threshold (all lands; ha)	Minimum habitat threshold (Crown lands; ha)	Protected suitable habitat (hard and soft reserves ^c ; ha)
Alaska Border	27 180	70	27 180	19 026	19 022	4821
Northern Mainland Coast	432 065	68	420 480	293 804	266 344	190 330
Haida Gwaii	221 071	68	209 894	150 328	148 542	155 331
Central Mainland Coast	335 823	68	316 283	228 359	227 738	193 643
Southern Mainland Coast	122 083	85	115 865	103 771	97 653	70 721
West and North Vancouver Island	246 320	68	211 220	167 498	160 966	120 054
East Vancouver Island	76 019	90	67 586	68 417	23 520	21 962
Total	1 460 561	70	1 368 508	1 031 203	943 784	756 863

^a Analysis by Ministry of Forests, Lands, Natural Resource Operations and Rural Development (October, 2017).

^b Percentage of 2002 suitable habitat to be retained.

^c Includes several types of conservation designations established under varying legislation with varying degrees of protection.

3.5.1 Marbled Murrelet Suitable Nesting Habitat

Suitable nesting habitat for the Marbled Murrelet is mapped across its range using the methods described below (most accurate to least accurate). The most accurate data layer available is used for a given area; however, all mapping methods have some degree of inaccuracy.

Low-level Aerial Surveys

Low-level aerial surveys, conducted from a helicopter by qualified observers, assess forest stand attributes associated with Marbled Murrelet nesting habitat (e.g., presence of nest platforms, large trees, and canopy structure). These surveys map nesting habitat using a six-class ranking system (1 = very high to 6 = nil), where classes 1–3 are considered “suitable” (Burger 2004; Burger *et al.* 2009a).

Air Photo Interpretation

Air photo interpretation uses a standardized approach to identify forest structure attributes from high-resolution aerial photographs of areas associated with Marbled Murrelet nesting habitat. This method also uses a six-class ranking system (1 = very high to 6 = nil), where classes 1–3 are considered “suitable” nesting habitat (Burger 2004; Burger *et al.* 2009a).

The British Columbia Model

This method uses provincial forest cover data (e.g., tree height and age), regional habitat models (e.g., Clayoquot Sound [Bahn and Newsom 2002]), and baseline thematic mapping, as well as landscape-level attributes (e.g., elevation, distance from ocean) to map polygons that are classified as either “suitable” or “not suitable” Marbled Murrelet nesting habitat (Mather *et al.* 2010). This model, although considered the least accurate method of mapping, is the only method that maps habitat to the 2002 baseline year.

3.5.2 Minimum Habitat Thresholds for Crown Land

Minimum habitat thresholds for Crown land represent the minimum amount of suitable habitat to be retained in each conservation region (Table 2). At present, the amount and location of suitable habitat has been updated to 2016; however, because recovery objectives relate to retention of proportions of habitat that existed in 2002, an estimate is required of the amount of suitable habitat in each conservation region in that year.

To obtain this estimate, forest harvest depletions up to 2016 were applied to the British Columbia model to calculate the proportion of habitat loss since 2002. This proportion was then applied to the suitable habitat in 2016 to derive the amount of suitable habitat in 2002 for each conservation region. Habitat retention thresholds were then applied to this amount to derive the minimum habitat thresholds for all lands in the conservation region (i.e., Crown lands and other lands). The minimum habitat threshold for all lands represents a proportion of the total amount of suitable habitat in 2016. This proportion is applied to the total amount of suitable habitat on Crown land in 2016 to derive the minimum habitat threshold for Crown land in each conservation region (Table 2).

3.5.3 Existing Habitat Protection

Through various types of conservation designations (e.g., parks and protected areas, *Land Act* reserves, old growth management areas, wildlife habitat areas, and ungulate winter ranges), Marbled Murrelet nesting habitat already receives considerable protection in coastal British Columbia. Additional nesting habitat will be protected on provincial Crown land when existing land use planning and other conservation measures are fully implemented on the Coast and the boundaries of reserves are legalized (e.g., old growth management areas and wildlife habitat areas on Vancouver Island and the South Coast, and landscape reserves in the Great Bear Rainforest). Although the exact contribution of these future designations to the conservation of Marbled Murrelet nesting habitat is currently unknown, the best available information has been used to estimate the amount of nesting habitat likely to receive protection. This estimate has been combined with the currently protected habitat on all lands, including non-provincial Crown land, such as national parks and municipal government lands (Figure 3 and Table 2).

Outside protected areas, additional Marbled Murrelet nesting habitat on Crown land will be maintained if it is located outside the timber harvesting land base. This is the area considered operable for timber harvest, contributing to the allowable annual cut and thus having a high

probability of future harvest (i.e., no prohibitions exist on harvest in these areas). Lands outside this area are currently considered inoperable and excluded from the harvestable inventory because of environmental concerns (unstable slopes and riparian reserves), low productivity (low site index), or economic issues (steep slopes and low volume). As such, the definition of the timber harvesting land base will change over time; however, at the conservation-region scale, the total amount of unprotected nesting habitat outside this area on Crown land has a relatively low probability of harvest. Figure 3 shows the area of unprotected suitable nesting habitat both within and outside this area on Crown land.

Haida Gwaii is the only conservation region in which the amount of habitat currently protected exceeds the minimum habitat threshold. When compared to the minimum habitat thresholds for Crown land in each conservation region, results of the existing protection analysis shown in Figure 3 indicate two distinct situations between northern conservation regions (excluding Haida Gwaii) and southern conservation regions. In the northern regions (i.e., Alaska Border, Northern Mainland Coast, and Central Mainland Coast), minimum habitat thresholds for Crown land can be achieved through a combination of nesting habitat that is (or will be) protected through existing land use planning, in addition to nesting habitat that is outside the timber harvesting land base. In the southern regions (i.e., East Vancouver Island, West and North Vancouver Island, and Southern Mainland Coast), the combination of nesting habitat that is (or will be) protected through existing land use planning, plus nesting habitat that is outside the timber harvesting land base, does not achieve the minimum habitat threshold and habitat within the harvestable lands is required to achieve these thresholds for Crown land.

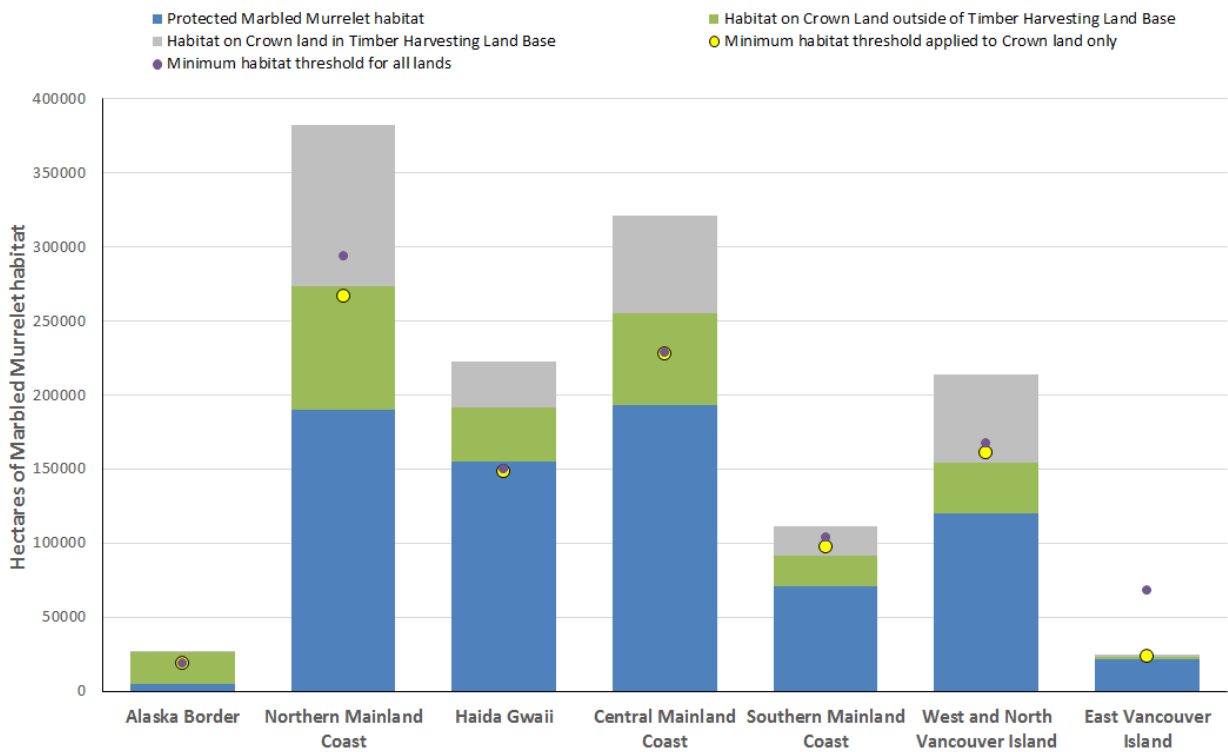


Figure 3. Estimated existing protection and operability of Marbled Murrelet nesting habitat by conservation region.

3.6 Threat Assessment

Threats for Marbled Murrelet are summarized in the federal Recovery Strategy for the Marbled Murrelet (Environment Canada 2014). The primary terrestrial threat to Marbled Murrelet is the loss and fragmentation of old-growth nesting habitat.

4 IMPLEMENTATION ACTIONS

This implementation plan (e.g., population and distribution goals, habitat protection, threat mitigation, and other management actions) is influenced by past and current industrial activities, current resource development commitments, and socio-economic considerations (e.g., future revenues from industrial development).

4.1 Population and Distribution Objectives

The following short- and long-term population and distribution objectives are endorsed by the government of British Columbia and will guide implementation efforts within the province.

The short-term population and distribution objective for the recovery of Marbled Murrelets over the period 2002–2032 (three generations) is to halt the decline of the British Columbia population, by maintaining at least 70% of the 2002 amount of nesting habitat, across the coast. The amount of allowable decline varies by conservation region (see Table 2). The short-term focus on halting the rate of decline in suitable habitat explicitly addresses a key COSEWIC criterion that led to the Marbled Murrelet’s designation as “Threatened” and subsequent listing under the *Species at Risk Act* in 2003. The long-term population and distribution objective (15+ years) for the recovery of Marbled Murrelets is to ensure sufficient nesting habitat is available so that the species has a high probability of persistence across its range in the province.

British Columbia supports a shared stewardship approach to Marbled Murrelet recovery that requires the commitment and cooperation of many different parties to achieve the population and distribution objectives. Recovery actions mainly focus on retention of nesting habitat on Crown land to achieve the identified minimum habitat thresholds for lands over which the province has direct jurisdiction (Table 2). See Section 4.5.5 for a description of actions to support Marbled Murrelet recovery on private and non-provincial Crown lands.

In the northern conservation regions (Alaska Border, Haida Gwaii, Northern Mainland Coast, and Central Mainland Coast), the government is committed to monitoring the availability of suitable nesting habitat over time, including the amount protected, to ensure suitable habitat availability exceeds the minimum habitat threshold for Crown lands.

In the southern conservation regions (East Vancouver Island, West and North Vancouver Island, and Southern Mainland Coast), a land use objectives regulation order will be implemented to maintain the minimum habitat thresholds for Crown land (Table 2). A spatial habitat management approach will also be developed and implemented to ensure at least 80% of minimum habitat

threshold amounts will be spatially protected (i.e., mapped). The remaining habitat ($\leq 20\%$) will be managed but not mapped.

4.2 Rationale for the Population and Distribution Objectives

The decline in provincial Marbled Murrelet populations appears related to historic and ongoing loss of old-growth forest nesting habitat (COSEWIC 2012; Bertram *et al.* 2015). The greatest terrestrial threat to the long-term persistence of these populations is from further decreases in, and fragmentation of, this habitat (Ralph *et al.* 1995; Burger 2002).

Bertram *et al.* (2015) noted moderate evidence for a coast-wide population decline of -1.6% per year, although trends varied strongly among the six conservation regions. Negative annual population trends were detected for the East Vancouver Island (-9%) and Southern Mainland Coast (-3%) conservation regions. These findings support the need to manage Marbled Murrelet populations across their range with habitat management objectives tailored to each conservation region.

In the northern conservation regions (Alaska Border, Haida Gwaii, Northern Mainland Coast, and Central Mainland Coast; Table 2), population and distribution objectives can be achieved without changes to existing land use planning regimes. In addition, Figure 3 indicates that up to 70 000 ha of nesting habitat in these regions will likely be maintained above the minimum habitat thresholds over the long term, providing a high level of confidence that population and distribution objectives will be realized.

In the southern conservation regions (East Vancouver Island, West and North Vancouver Island, and Southern Mainland Coast), analyses indicate that, without additional management and protection of nesting habitat, habitat availability is at risk of decreasing to levels below the minimum habitat thresholds (Figure 3). To address this, implementation of a land use objectives regulation order under the provincial *Land Act* will ensure that habitat amounts exceed the minimum habitat thresholds for these regions; however, because of the extent of habitat loss in the East Vancouver Island Conservation Region, nesting habitat is below the minimum habitat threshold for all lands and Crown land. Therefore, all remaining nesting habitat on Crown land, plus second-growth, long-term recruitment areas, will be required to achieve the minimum habitat threshold for this region.

4.2.1 Spatial and Aspatial Habitat Management

At least 80% of the minimum habitat threshold for Crown land will be spatially protected (mapped) in the West and North Vancouver Island and Southern Mainland Coast conservation regions. This spatial habitat management approach is intended to increase certainty on the land base and to improve the likelihood that remaining nesting habitat will continue to function, unaffected by forest fragmentation and negative edge effects. To provide some resource management flexibility, the specific locations of the remaining habitat ($\leq 20\%$) will not be mapped. The success of this aspatial management approach will require robust monitoring efforts to ensure that this habitat is maintained. To increase the likelihood that remaining habitat in the

East Vancouver Island Conservation Region is functional, in addition to maintaining all currently suitable habitat on Crown land, opportunities to spatially designate habitat will be explored.

4.3 Implementation Objectives

This implementation plan sets a nesting habitat objective for provincial Crown land that requires maintaining 70% overall of the nesting habitat that existed in 2002, with specific proportions identified for each of the seven conservation regions in British Columbia (Figure 1 and Table 2). In addition, habitat management objectives include both spatial and aspatial approaches.

The following implementation objectives provide measurable targets for action and evaluation.

1. By October 2018, issue a land use objectives regulation order under the provincial *Land Act* to maintain minimum habitat thresholds for provincial Crown land in the southern conservation regions (East Vancouver Island, West and North Vancouver Island, Southern Mainland Coast; Table 2).
2. By December 2020, spatially protect a minimum of 80% of the minimum habitat threshold in the West and North Vancouver Island and Southern Mainland Coast conservation regions.
3. By December 2020, establish priority old growth management areas containing Marbled Murrelet nesting habitat in the southern conservation regions.
4. Continue to improve the identification of suitable nesting habitat in priority areas where uncertainties in habitat mapping exist and where habitat availability is approaching the minimum habitat thresholds, as new tools and information becomes available.
5. As new habitat mapping and protection occurs, update nesting habitat availability, estimates of existing protection, and minimum habitat thresholds in all conservation regions at least every 2 years.
6. By June 2018, develop a population monitoring plan and implement this plan in 2019.
7. Return to Senior Government in 2020 with a project update.

4.4 Actions and Performance Measures

Table 3 summarizes the actions required to meet the implementation objectives outlined in Section 4.3, and presents associated performance measures.

Table 3. Implementation actions for Marbled Murrelet management.

Threat^a or concern addressed	Objective	Priority^b	Actions	Range^c	Performance measures^d	Participating agencies^e (lead agency in bold type)	Status
Loss of nesting habitat	Stabilize amount of available nesting habitat above minimum habitat thresholds	Essential	Engage key stakeholders to inform habitat management implementation approach for a land use objectives regulation order for Crown land	Southern conservation regions	Land use objectives regulation order recommendation developed by May 2018	FLNR , ECCC, First Nations, forest sector	In progress
Loss of nesting habitat	Stabilize amount of available nesting habitat above minimum habitat thresholds	Essential	Implement land use objectives regulation order to retain minimum habitat thresholds on Crown land	Southern conservation regions	Land use objectives regulation order is established by October 2018	FLNR	Not initiated
Loss of nesting habitat	Stabilize amount of available nesting habitat above minimum habitat thresholds	Essential	Implement existing land use planning objectives by mapping and legalizing priority old growth management areas	Southern conservation regions	Landscape unit planning is complete and priority old growth management areas are established by December 2020	FLNR , forest sector	In progress

Threat^a or concern addressed	Objective	Priority^b	Actions	Range^c	Performance measures^d	Participating agencies^e (lead agency in bold type)	Status
Loss of nesting habitat	Stabilize amount of available nesting habitat	Essential	Engage key stakeholders to inform development of a spatial habitat management approach	Southern conservation regions	Spatial habitat management approach recommendation developed by May 2018	FLNR , ECCC, First Nations, forest sector	In progress
Loss of nesting habitat	Stabilize amount of available nesting habitat	Essential	Implement spatial habitat management to protect 80% of minimum habitat thresholds	Southern conservation regions	80% of minimum habitat thresholds is spatially protected by December 2020	FLNR , forest sector	In progress
Loss of nesting habitat	Stabilize amount of available nesting habitat	Essential	Update minimum habitat thresholds using the best available information	Range-wide	Minimum habitat thresholds are re-calculated annually as habitat mapping improves	FLNR	In progress
Monitor habitat trends	Monitor nesting habitat amounts and trends through time	Essential	Monitor ongoing nesting habitat availability, protection and loss	Range-wide	Nesting habitat analysis (estimates of existing protection, availability and loss) is updated at least bi-annually	FLNR	In progress
Population monitoring	Monitor Marbled Murrelet population trends	Essential	Engage key stakeholders to develop population monitoring plan	Range-wide	Population monitoring plan is developed by June 2018	FLNR , First Nations, ECCC, MMRT	In progress
Population monitoring	Monitor Marbled Murrelet population trends	Essential	Population monitoring plan is implemented	Range-wide	Population monitoring plan is initiated by 2019	FLNR , First Nations, ECCC, MMRT	In progress
Loss of nesting habitat	Improve understanding of nesting habitat locations	Necessary	Conduct low-level aerial surveys to improve habitat mapping	Southern conservation regions	Low-level aerial survey mapping is complete in priority areas by December 2020	FLNR , forest sector	In progress

Threat^a or concern addressed	Objective	Priority^b	Actions	Range^c	Performance measures^d	Participating agencies^e (lead agency in bold type)	Status
Loss of nesting habitat and habitat fragmentation	Conduct effectiveness monitoring of nesting habitat reserves	Necessary	Effectiveness monitoring of spatial habitat protection	Southern conservation regions	Effectiveness monitoring protocols are developed and initiated by June 2019	ENV, FLNR , forest sector	Not initiated
Loss of nesting habitat and habitat fragmentation	Investigate utility of acoustic recording units and other tools for monitoring and spatial habitat management	Necessary	Continue research on utility of audio recording units for use in monitoring and management	Range-wide	Continue funding and implementation of existing acoustic recording unit research project	FLNR	In progress
Loss of nesting habitat	Investigate utility of LIDAR (light detection and ranging) for nesting habitat identification and management	Beneficial	Build on existing LIDAR research to further investigate potential utility of this technique for habitat identification and management	Range-wide	Funding is secured and partners developed by December 2018 to continue research on use of LIDAR to identify nesting habitat	FLNR , academia, forest sector	Not initiated

Note: Actions and timelines in this table may be modified based on the priorities and budgetary constraints of participatory agencies and organizations.

^a Threats are based on the International Union on the Conservation of Nature–Conservation Measures Partnership unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014).

^b Essential (urgent and important); Necessary (important but not urgent); or Beneficial.^c Southern conservation regions: East Vancouver Island; West and North Vancouver Island; Southern Mainland Coast.

^d Performance measure for objectives and other implementation activities.

^e ECCC – Environmental and Climate Change Canada; ENV – Ministry of Environment and Climate Change; FLNR – Ministry of Forest, Lands, Natural Resource Operations and Rural Development; MMRT – Marbled Murrelet Recovery Team;

4.5 Narrative to Support Action and Performance Table

This section provides additional information to support the understanding of implementation actions identified in Table 3 for Marbled Murrelet management.

4.5.1 Habitat Protection

Across the species range of Marbled Murrelet, nesting habitat is conserved under various designations, such as national parks, provincial parks, ecological reserves, conservancies, and wildlife management areas. On the Coast, additional nesting habitat is, or will be, protected under higher-level land use plans in areas such as Clayoquot Sound, Haida Gwaii, and the Great Bear Rainforest. In addition, nesting habitat is, or will be, protected on provincial Crown land under other designations such as ungulate winter ranges, wildlife habitat areas, and old-growth management areas.

Nesting habitat will also be maintained on Crown forest lands outside the timber harvesting land base, through provisions such as riparian management, stand-level wildlife tree retention, visual quality objectives, and areas of low operability. Mitigating the impacts associated with forestry activities includes establishing no-harvest reserves (e.g., wildlife habitat areas) that protect high-priority nesting habitat, and setting habitat retention thresholds for old-growth nesting habitat on provincial Crown land in each conservation region across the range of Marbled Murrelet. In the southern conservation regions, this will be accomplished via a land use objectives regulation order under the *Land Act* to ensure the availability of suitable nesting habitat in perpetuity.

To support the commitment to maintain 80% of the minimum habitat threshold in the southern conservation regions, a spatial habitat management approach will be developed with First Nations and key stakeholders to guide the design and implementation of spatial reserves with the goal of maintaining functional nesting habitat and minimizing socio-economic impacts.

4.5.2 Planning

A land use objectives regulation order under the *Land Act* will maintain the amount and distribution of old-growth nesting habitat represented by the minimum habitat thresholds for provincial Crown land in the southern conservation regions.

Planning for spatial designation of key habitats for Marbled Murrelet will continue as part of the *Identified Wildlife Management Strategy* (Province of British Columbia 2004), with designation of wildlife habitat areas, or equivalent reserves, in the southern conservation regions. The 80% habitat commitment will be guided by a spatial habitat management approach developed with key stakeholders to guide the design of spatial reserves. This will provide a framework for identifying priority areas for spatial reserves with consideration of both biological and socio-economic factors. Biological factors relate to maximizing the likelihood reserves will provide viable nesting opportunities over the long term. Socio-economic factors relate to minimizing impacts to timber supply and potentially affected parties (e.g., *Forest Act* agreement holders).

4.5.3 Habitat Restoration and Recruitment

Because Marbled Murrelets depend on old-growth forest structure for nesting (i.e., large-diameter limbs and mossy platforms high in the forest canopy), habitat recruitment opportunities are considered limited as these structural attributes take a long time to develop. Maintaining currently suitable habitat is thus the highest management priority.

Habitat recruitment is an objective only if the remaining amount of habitat is below the minimum habitat threshold, such as in the East Vancouver Island Conservation Region where historic forest harvesting has been extensive. Less than 1% of original old-growth forests remain in the entire Coastal Douglas-fir biogeoclimatic zone (Madrone Environmental Services 2008), and most of the land base is privately owned and thus outside direct provincial jurisdiction; however, several protected areas in this region contain mature forests that, over time, may develop the structural attributes Marbled Murrelets require for nesting. As part of a recruitment strategy, four Marbled Murrelet wildlife habitat areas have been established in this conservation region to date.

4.5.4 Species and Population Management

Actions to address non-habitat-related threats, such as at-sea bycatch, net entanglement, predator management, and marine prey availability, are outside the scope of this implementation plan. Based on a linear relationship between Marbled Murrelet populations and amounts of available habitat (reviewed in Burger and Waterhouse 2009), population objectives should be achieved by maintaining adequate amounts of suitable nesting habitat in all conservation regions. In addition, measures will be in place to increase the likelihood that some remaining habitat is functional and not affected by forest fragmentation and negative edge effects.

4.5.5 Private and Non-Crown Land Stewardship

Marbled Murrelet habitat management efforts in British Columbia are focused on the provincial Crown land. To achieve Marbled Murrelet recovery objectives, the provincial government is committed to encouraging shared stewardship of Marbled Murrelet nesting habitat on non-provincial Crown lands. The commitment to engage non-Crown land holders includes raising awareness of the importance and uniqueness of Marbled Murrelets and their nesting habitat, discussing provincial management approaches, and encouraging stewardship and retention of old-growth nesting habitat on non-Crown lands.

As part of the process to confirm the management approaches for Marbled Murrelet, the provincial government undertook significant engagement with non-Crown land owners, including First Nations, private managed forest land holders, environmental non-governmental organizations, and local governments.

Some Marbled Murrelet habitat on non-provincial Crown land has been protected in national parks. In addition, some municipal government lands are managed to protect watersheds that supply drinking water and are considered protected for the purposes of this implementation plan (Figure 3). These include the Greater Vancouver Regional District watersheds and lands in the

Capital Regional District. Improving habitat mapping in some of these areas is a high priority to increase our understanding of how these areas contribute to population and distribution objectives.

Significant tracts of private managed forest land occur in the East Vancouver Island Conservation Region. British Columbia is committed to engaging private managed forest land owners to encourage stewardship of Marbled Murrelet nesting habitat, including information-sharing to understand habitat availability, and potential mechanisms for stewardship of these lands.

The British Columbia's provincial government and the Canadian federal government are actively engaged in treaty and reconciliation discussions with several First Nations on the Coast; the provincial government will continue to raise the importance of stewardship of Marbled Murrelet nesting habitat during these discussions.

5 MONITORING

To ensure that habitat availability in the southern conservation regions exceeds the minimum habitat thresholds, management of Marbled Murrelet nesting habitat will occur at smaller spatial scales. A habitat management approach developed with key stakeholders will determine the scale of habitat management and how habitat retention will occur across the conservation regions. Much of the provincial Crown land on the Coast contains various natural resource tenures (e.g., forestry). This approach will determine how the habitat retention requirements are dispersed across these tenure holders in a fair and equitable manner, to the extent that the distribution of habitat permits. Tracking and measuring progress towards objectives will be required to ensure the availability of habitat exceeds the minimum habitat thresholds.

Because recognized uncertainties exist in current mapping of suitable habitat, ongoing improvements to the identification of this habitat are a priority. As habitat mapping improves and forest depletions occur, regular updates to habitat availability and loss, estimates of existing protection, and the minimum habitat thresholds will be required in all conservation regions.

A population monitoring plan will be developed and implemented to identify objectives and priorities for Marbled Murrelet populations at the provincial, regional, and sub-regional scales.

Effectiveness monitoring of reserves will inform whether management actions and the spatial habitat management approach are achieving the desired results. Compliance monitoring of reserves will also occur to ensure management actions are implemented as expected.

The provincial government will also facilitate research on the development of tools and technology, such as acoustic recording units and LIDAR (light detection and ranging), which may assist future monitoring efforts.

The following performance indicators will be used to measure progress toward achieving the population and distribution objectives:

1. Habitat retention across the provincial range is greater than 70% of the estimated 2002 area of suitable nesting habitat.

2. Except for East Vancouver Island, habitat availability in all conservation regions exceeds the minimum habitat thresholds.
3. Habitat availability in the East Vancouver Island Conservation Region is stable and growing over the long term.
4. 80% of the minimum habitat thresholds in the West and North and Southern Mainland Coast conservation regions is spatially protected.
5. 30-year (three generations) trend estimates for the provincial population based on radar counts and other reliable census methods are available.
6. 30-year trend estimates for the areas of suitable nesting habitat across British Columbia indicate that adequate habitat is being conserved in all conservation regions.

6 UNCERTAINTY

Some uncertainty is associated with translating the best available science for Marbled Murrelet into management objectives. Uncertainty also surrounds how Marbled Murrelets will respond to management actions and whether these actions will achieve recovery goals. Some uncertainty underlies the information used to support recovery goals but this will be reduced over time through improvements to the body of literature for Marbled Murrelets. These include improving: the identification of nesting habitat; the understanding of known locations of Marbled Murrelet nest sites; the understanding of factors, such as patch size, distribution, and habitat quality, related to functional habitat; and the estimate of existing protection. The provincial government will foster research that fills key knowledge gaps to inform management objectives and will apply knowledge from other regions and jurisdictions to Marbled Murrelet management in British Columbia. Implementation of actions in this plan will further reduce uncertainty through effective adaptive management.

7 ADAPTIVE MANAGEMENT

Adaptive management is an iterative process that seeks to reduce uncertainty by monitoring the outcomes of management actions and adjusting them where required. Adaptive management acknowledges the uncertainty inherent in the outcomes of implementing management actions. This uncertainty is associated with the amount of information available to develop management strategies and the likelihood that these strategies achieve desired outcomes. Considerable uncertainty is associated with external factors, such as climate, land use management policies, and funding availability. To accommodate these uncertainties, the provincial government will adaptively manage Marbled Murrelets by monitoring and adjusting implementation actions as necessary to achieve the population and distribution goals. Actions may be added, removed, or changed to best achieve the goals. This plan may also be revised if the science supporting management objectives significantly improves or if significant changes occur to other strategic government goals (e.g., cumulative effects management, endangered species legislation).

Future minor amendments to this plan may be approved by the Assistant Deputy Minister of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development's Resource

Stewardship Division. If, in their opinion, proposed amendments are substantive or major, then the amendment will be referred to the Deputy Minister's Committee on Natural Resources for a decision.

8 EFFECTS ON OTHER SPECIES

The potential benefits of additional habitat protection for Marbled Murrelet is focused in areas such as Vancouver Island outside of Clayoquot Sound and the South Coast, where management approaches represent a significant change to existing land use planning. In other areas of the Coast, such as Haida Gwaii and the Great Bear Rainforest, Marbled Murrelet habitat requirements are expected to be met by existing land and resource management objectives (e.g., ecosystem-based management). Implementing the management approaches for Marbled Murrelet will increase protection of old-growth forests. This will have potential benefits to species who use coastal old-growth forests for their life requisites, including: Northern Spotted Owl, *caurina* subspecies (*Strix occidentalis caurina*); Northern Goshawk, *laingi* subspecies (*Accipiter gentilis laingi*); Great Blue Heron (*Ardea herodias*); Dromedary Jumping-slug (*Hemphillia dromedarius*); and Coastal Tailed Frog (*Ascaphus truei*)

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