PROPOSED

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Management Plan Series

Management Plan for the Ancient Murrelet (*Synthliboramphus antiquus*) in Canada

Ancient Murrelet

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PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed species of special concern and are required to report on progress five years after the publication of the final document on the SAR public registry .

The federal Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers under SARA for the Ancient Murrelet and have prepared this management plan as per section 65 of SARA. To the extent possible it has been prepared in cooperation with the Province of British Columbia, and the Council of the Haida Nation.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Environment Canada, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Ancient Murrelet and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=6B319869-1%20

EXECUTIVE SUMMARY

The Ancient Murrelet (*Synthliboramphus antiquus)* is a small (about 25 cm long) seabird in the Alcidae family. It was assessed in April 1993 as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It was re-examined in 2004 and confirmed as Special Concern due to introduced mammalian predation on the breeding islands. The species was listed on Schedule 1 of the *Species at Risk Act* (SARA) in 2006.

The Ancient Murrelet ranges from the north of China, along the Pacific Rim, to Baja California. Breeding colonies exist in China, Korea, and Japan, Russia, Alaska and Canada. In Canada, Ancient Murrelets breed on the islands of Haida Gwaii, British Columbia, with approximately half of the world's breeding birds nesting on 31 island colonies. On the Canadian colonies, Ancient Murrelets nest in burrows dug in the soft soil under the forest canopy, usually within 400 m of the shoreline. The diet of Ancient Murrelet mainly consists of zooplankton and small schooling fish.

The main threat to Ancient Murrelets in Canada is predation on the breeding colonies as a result of introduced mammalian predators. Black Rats (*Rattus rattus),* Norway Rats *(R. norvegicus)* and Common Raccoons (*Procyon lotor)* have been linked to multiple colony population declines and extirpations. Recent research has also indicated that a reduction in juvenile at-sea survival, and therefore a reduction in the recruitment to the breeding population, probably also contributed to population declines. Other threats include oil spills, both chronic and catastrophic, impacts from tourism and recreation, fisheries bycatch, fishing of prey species and oceanographic change. Windthrow events and forestry are also considered threats, but are currently considered to be lower levels of concern.

The objectives of this management plan are:

1) To maintain or increase the current breeding population of Ancient Murrelet within the known Canadian range.
2) To otherwise augment the international population numbers in Canadian waters by reducing at-sea mortality for Ancient Murrelets.

Broad strategies and measures to achieve the management objectives are presented in the section entitled Broad Strategies and Conservation Measures.

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1. COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2004

Common Name (population): Ancient Murrelet

Scientific Name: *Synthliboramphus antiquus*

COSEWIC Status: Special Concern

Reason for Designation: This burrow–nesting seabird is impacted by mammalian predators that have been introduced to its breeding islands. Predators have been removed from some islands but populations have not increased as a result. About half of the world population nests in Haida Gwaii, formerly known as the Queen Charlotte Islands, British Columbia; the Canadian population is thought to be declining.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1993. Status re-examined and confirmed in November 2004.

*COSEWIC – Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

Globally, the rank assigned to the Ancient Murrelet is G4 (apparently secure; NatureServe 2013). Within British Columbia, however, the species is listed as vulnerable to imperiled (Table 1).

Table 1. List and description of various conservation status ranks for the Ancient Murrelet (from NatureServe 2013, B.C. Conservation Data Centre 2013, B.C. Conservation Framework 2013).

	Global (G) Rank	National (N) Rank	Sub-national (S) Rank	COSEWIC Status	B.C. Conservation Status
Ancient Murrelet	G4	Canada: N2N3B, N4N U.S.A.: N4B, N4N	British Columbia (S2S3B, S4N)	SC (Special Concern)	Blue List (B.C. CDC) Conservation Framework Priority 1 under Goal 3[1]

G/N/S 1: Critically Imperiled; 2: Imperiled; 3: Vulnerable; 4: Apparently Secure; 5: Secure; B: Breeding; N: non-breeding;
B.C. CDC: British Columbia Conservation Data Centre
[1] *Goal 3: Maintain the diversity of native species and ecosystems. Priority 1 Highest priority.*

3. SPECIES INFORMATION

3.1. Species Description

The Ancient Murrelet is a small (about 25 cm long) auk (in the Alcid seabird family). Males and females look very similar. The adults are dove-gray above and white below, with dark slate flight feathers, a yellow-tipped bill and a black chin, nape, and throat. During the breeding season, adults have more white around the crown and upper back. For more detailed information, see the COSEWIC status reports (COSEWIC 2004) and Gaston (1994a).

3.2. Population and Distribution

The species ranges along the northern Pacific rim, from north of China to Baja California (COSEWIC 2004; Figure. 1). About half the world's breeding population, an estimated 256,000 pairs, nests on 31 islands in Haida Gwaii, British Columbia, Canada (previously known as the Queen Charlotte Islands; Rodway 1991; Gaston 1992; Vermeer et al. 1997; Figure. 2). The Alaskan breeding population is estimated at around 200,000 pairs; although population estimates are incomplete. The number of murrelets that nest in China, Japan, and Korea are thought to be no more than a few thousand individuals (COSEWIC 2004). The largest colonies in Russia, located on Talan Island and Starichkov Island, support an estimated 22,000 and 13,000 individuals, respectively (USFWS 2003). During the non-breeding season, the at-sea distribution of Ancient Murrelets extends from the Bering Sea, west to the Sea of Japan, Strait of Korea and east coast of Japan and south to Baja California (Gaston 1992; Gaston and Jones 1998; Harfenist 2004). For a more detailed account of the global population and distribution refer to COSEWIC 2004.

The Canadian breeding population is concentrated mainly in two areas of Haida Gwaii. Three large breeding colonies on the west coast of Graham Island in the north support approximately 49% of the breeding population, and 17 colonies on the east coast of Moresby Island to the south, in Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve and Haida Heritage Site ("Gwaii Haanas"), support approximately 44% of the breeding population (Lemon and Gaston 1999). Islands off the west coast of Moresby Island support the remaining 7% (Rodway 1991). A single incubating adult was found on the Moore Islands on the northern mainland coast in 1970, but a later survey in 1988 found no evidence of breeding (Campbell et al. 1990; Rodway and Lemon 1991). Carter and Sealy (2008) confirmed breeding on Triangle Island in the Scott Islands chain off northwest Vancouver Island, based on two egg sets collected in 1949, and presented possible evidence for Ancient Murrelet on Lanz and Cox Islands, also in the Scott Islands chain, in 1950[3]. All three islands belong to the

[3] Environment Canada is planning work to confirm the breeding assemblage of these islands that existed prior to the introduction of mink and racoon in the 1930s.

Scott Islands off the northwestern tip of Vancouver Island. However, mammalian predators introduced to Lanz and Cox Islands (Carl et al. 1951; Rodway et al. 1990) and reduced prey availability attributed to fluctuating sea surface temperature (Hipfner 2008) may have caused local extirpation.

Declines of up to 23% during the 1980s and 1990s occurred at Haida Gwaii colonies where predators had been introduced (COSEWIC 2004). Introduced rats have been blamed for declines or extirpations on Langara, Lyell, Kunghit, Cox, Lucy, Murchison, and Bischof Islands in Haida Gwaii (Bertram and Nagorsen 1995; Harfenist and Kaiser 1997). Declines on Helgesen, Saunders and Limestone Islands have been attributed to Common Raccoons (*Procyon lotor)* (Gaston and Masselink 1997). Eleven other small colonies were extirpated in the 1970s and 1980s (Summers 1974; Rodway *et al*. 1988; Rodway *et al.* 1990). Of those eleven small colonies, several now have well established raccoon populations (M. Lemon pers. comm. 2011). The predator-free colonies at Reef, Ramsay, and George Islands showed increases in the number of nesting burrows during the 1990s and 2000s, while numbers on Rankine Island appeared to be stable (Regehr et al. 2007; Gaston *et al*. 2009; Rodway and Lemon 2011). Lihou and Frederick Islands, two colonies without known introduced predators, have shown signs of recent declines (Gaston unpublished data 2011; H. Major pers. comm. 2011).

In 1995, rats were eradicated from Langara Island after Ancient Murrelet numbers had dropped from a historic estimate of 200,000 breeding pairs to fewer than 20,000 pairs by 1993 (Harfenist 1994; Kaiser et al. 1997; Taylor et al. 2000). In 1999, Ancient Murrelet numbers were still estimated at a low 10,000 – 15,000 pairs. However, the estimated number of breeding pairs on Langara almost doubled from 1999 to 2004, with an estimated 20,000-30,000 breeding pairs in 2004 (Regehr et al. 2007).

The size and distribution of the Canadian non-breeding population is not well defined, although many at-sea bird surveys have recorded Ancient Murrelets along the coast of British Columbia during the non-breeding season.

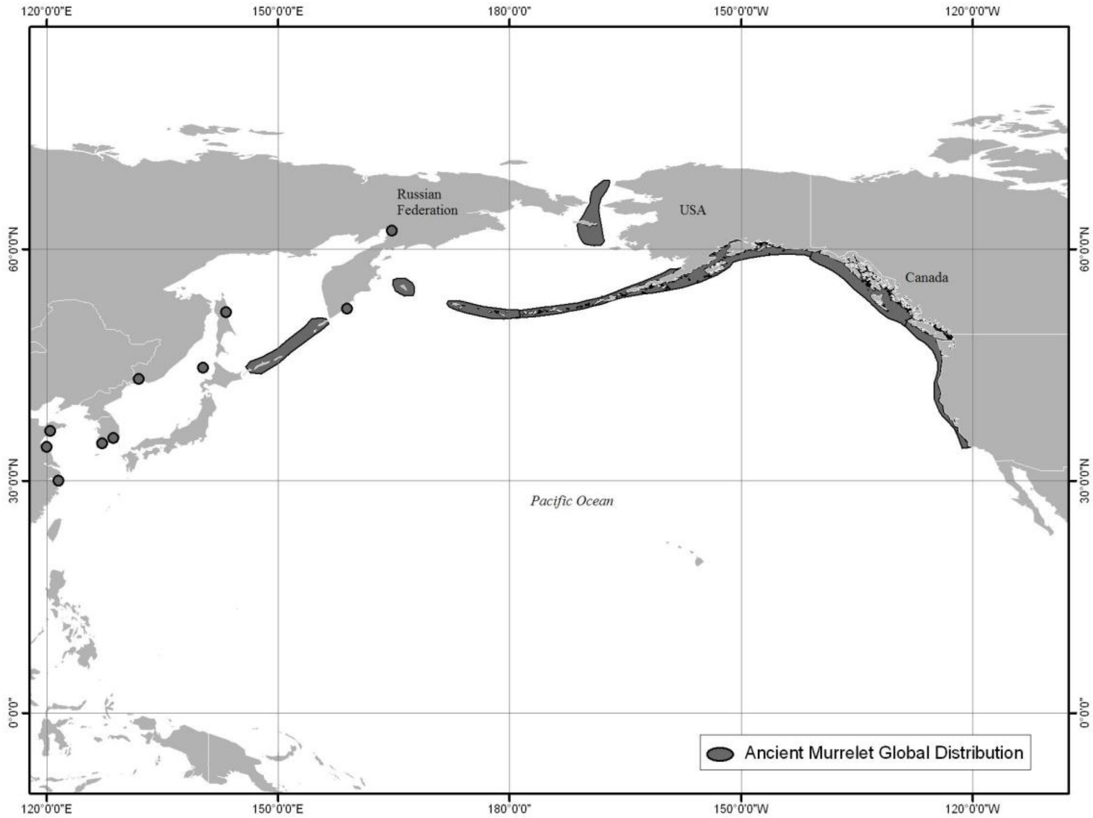

Figure 1. Global Distribution of Ancient Murrelet (Source: Environment Canada. Adapted from COSEWIC 2004 and Ridgely *et al*. 2003).

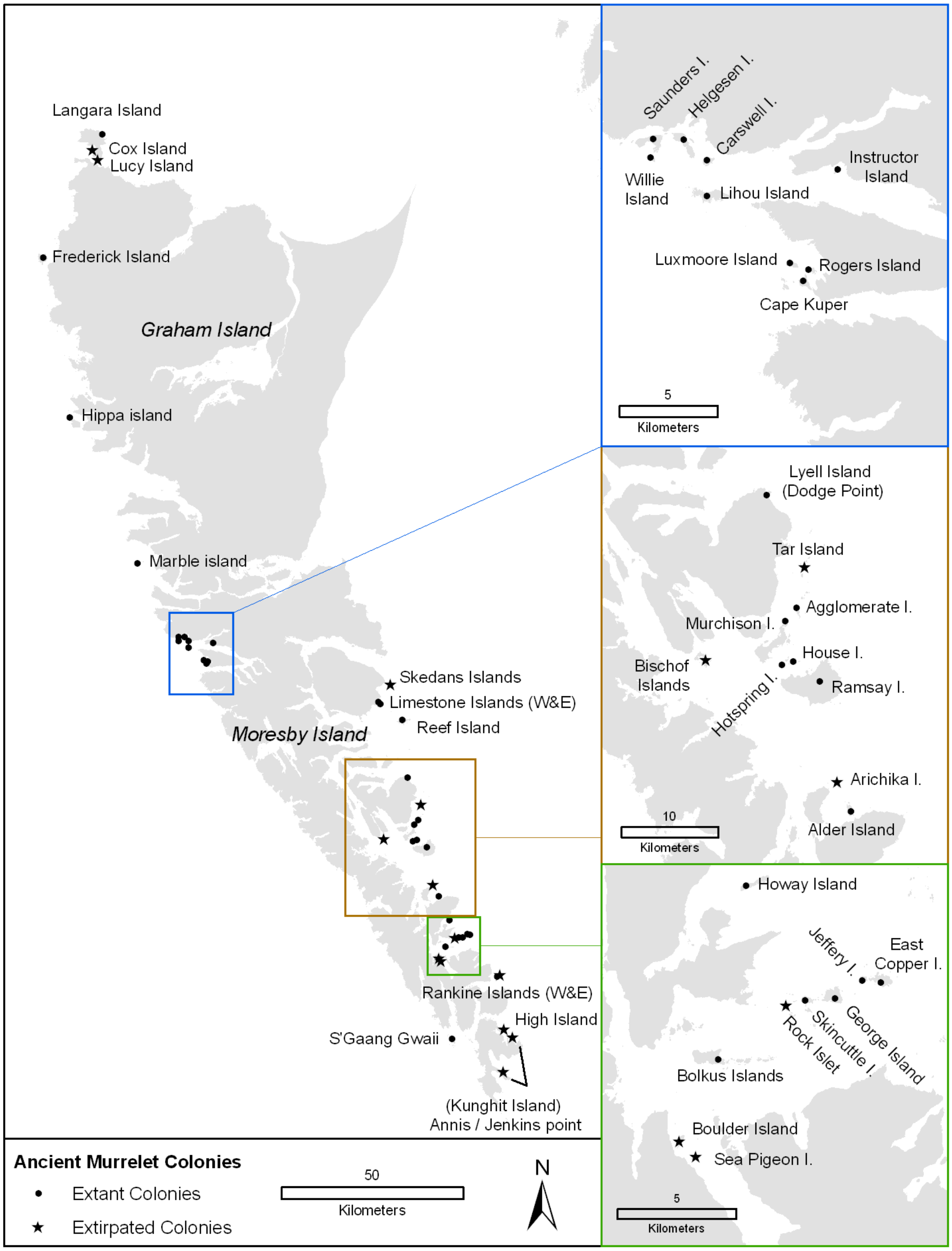

Figure 2. Currently occupied (extant) and extirpated Ancient Murrelet colonies in Haida Gwaii, British Columbia, 2014.

3.3. Needs of the Ancient Murrelet

In Canada, Ancient Murrelets breed on forested islands between 20 and 12,000 ha in size (Gaston 1994b; H. Major pers. comm. 2011). Ancient Murrelets nest under forest canopy, but will use treeless islands if forested islands are not available. On the islands of Haida Gwaii, they dig burrows in soft soil, usually under tree roots, stumps, or fallen logs (COSEWIC 2004) and most burrows are situated within 300 to 400 m of the ocean (Rodway et al. 1988; Rodway et al. 1990; Rodway et al. 1994). Other than islands where River Otters (*Lutra canadensis*) occur, Ancient Murrelets do not successfully nest where terrestrial mammalian predators are found (Gaston 1992).

In Canada, Ancient Murrelets return to Haida Gwaii colonies in early March (Gaston and Jones 1998). The tendency of young to return to the colony of their birth is low in Ancient Murrelets (Gaston and Adkins 1998; Pearce et al 2002). Clutch completion occurs between mid-April and early May (Gaston and Jones 1998). There is a 6-day delay in breeding with every 1^{o} C decrease in mean April sea-surface temperature close to the colony (Gaston 1992). Variation in timing of breeding between colonies may be dependent on when availability of food for the chicks is highest, or when predation risk for adults is at its lowest (Gaston 1997).

Ancient Murrelets are distributed throughout the temperate North Pacific, primarily in areas where the annual sea surface temperatures are between 5 and 15^{o} C (Kitano 1981). During the breeding season, they are found primarily over the continental shelf with the highest densities near the shelf break (Vermeer *et* al. 1985) as well as occasionally 100s of km offshore (Kenyon et al. 2009) and in inshore waters (Gaston 1992). In the early evening and near dawn birds use waters adjacent to breeding colonies as gathering grounds (Harfenist 2004). While it is not clear where Ancient Murrelets spend the late summer/early fall (Campbell et al. 1990), during winter, they may be found over the continental shelf and slope (Harfenist 2004) or in protected waters such as in Hecate Strait, the Strait of Juan de Fuca or passages adjacent to the southern Gulf Islands (Kenyon et al. 2009, K. Morgan pers. comm. 20014). Ancient Murrelets commonly forage in water over the shelf break where upwellings concentrate prey items and force them to the surface (Vermeer et al. 1985; Gaston 1994a).

The diet of Ancient Murrelets is believed to be composed primarily of large zooplankton (krill species *Euphausia pacifica* and *Thysanoessa spinifera*), small schooling fish (primarily Pacific Sandlance (*Ammodytes hexapterus)*, juvenile Rockfish (*Sebastes* spp.) and juvenile Pacific Herring (*Clupea pallasi*)) (COSEWIC 2004). The composition of the diet varies by season, age, location and availability (Sealy 1975; Vermeer et al. 1985; Gaston 1994a). For more detailed information, see the COSEWIC status report (COSEWIC 2004).

Ancient Murrelets in Canada do not appear to be limited by the availability of breeding habitat within a colony (Major et al. 2012), except at a few colonies where burrow density is high and all high quality habitat is occupied (COSEWIC 2004). The number of potential colony locations may be limited by prey availability, sea surface temperature, and/or the presence of mammalian predators (H. Major pers. comm. 2011).

Ancient Murrelets are known to have low recruitment potential. Survival of breeding adults (about 77%) is low compared to other alcids, and survival is likely lower for immature birds (Gaston 1990, Gaston and Descamps 2011). Breeding success is in the range of 1.44-1.69 chicks/pair (high compared to other alcids); however, juvenile survival could be low because relatively few birds banded as chicks have been documented returning to their natal colony to breed (Gaston 1992, 1994a, b). If the young are not returning to their natal colony, it is suggested that colony population size is dependent on recruitment from the larger meta-population. Threats to new recruits, both at the local colony and within the source populations, may play a larger role in influencing population growth rates than adult survival does (Gaston and Descamps 2011). This suggests the importance of maintaining multiple colonies throughout its range.

4. THREATS

4.1. Threat Assessment

Table 2. Threat Assessment Table

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Exotic, Invasive or Introduced Species						
Introduced Mammalian Predators	High	Widespread	Historic, Current, Anticipated	Continuous	High	High
Pollution						
Oil Spills - Chronic	Medium	Localized	Current, Anticipated	Recurrent	High	Medium
Oil Spills - Catastrophic	Medium	Localized	Historic, Anticipated	Recurrent	High	High
Disturbance or Harm						
Tourism and Recreation	Medium	Localized	Current, Anticipated	Recurrent	Moderate	High
Changes in Ecological Dynamics or Natural Processes						
Oceanographic Change	Medium	Widespread	Anticipated	Continuous	High	Medium
Windthrow Events	Low	Localized	Historic, Current, Anticipated	Recurrent	Moderate	Medium
Accidental Mortality						
Fisheries Bycatch	Low	Localized	Historic, Current, Anticipated	Recurrent	Low	Low
Habitat Loss or Degradation						
Forestry	Low	Localized	Historic	Recurrent	Moderate	Medium
Other						
Fishing of Prey Species	Low	Widespread	Anticipated	Continuous	Unknown	Low

[1] Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the conservation of the species, consistent with the management objectives. This criterion considers the assessment of all the information in the table.
[2] Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).
[3] Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).

4.2. Description of Threats

1) *Introduced Mammalian Predators*

Introduced mammalian predators pose the most serious immediate threat to nesting Ancient Murrelets in Haida Gwaii (COSEWIC 2004). Black Rats (*Rattus rattus),* Norway Rats *(R. norvegicus)* and Common Raccoons are suspected to have caused Ancient Murrelet population declines on several islands and their extirpation on others (COSEWIC 2004).

In Haida Gwaii, rats are considered to be a major predator of Ancient Murrelets (Drever and Harestad 1998); and have been documented on 18 islands in the archipelago (Bertram and Nagorsen 1995). Rats are responsible for declines or extirpation of colonies on Kunghit, Langara, Lyell, Cox, Lucy, Murchison and Bischof Islands (Harfenist and Kasier 1997). The 90% decline in the Ancient Murrelet population on Langara is thought to be a result of rat predation (Bertram 1995). On Lyell Island, the population declined by 25%, from 10,656 breeding pairs in 1982 to 8,332 pairs in 1992 (Lemon 1993). The area of the Ancient Murrelet colony on Kunghit Island contracted from 35 hectares in 1986 to 11 hectares in 1993. Population declines were noted for parts of the colony, but an accurate comparison for the entire colony is not available (Rodway et al. 1988, Harfenist 1994). The contraction in colony area was attributed to rats (Harfenist 1994). A third survey of Kunghit in 2004 suggests that Ancient Murrelets have been extirpated from this site (Canadian Wildlife Service unpublished data; Regehr et al. 2007). Rats can reach colonies on commercial or pleasure boats or by shipwreck (Kaiser *et* al. 1997), but are less likely than raccoons to swim between islands (Harfenist 2004). Fishing lodges on Langara Island and along the West Coast of Haida Gwaii, and the vessels that service them, pose a risk for rat introductions (Kaiser et al. 1997).

Introduced raccoons have been documented on several islands with Ancient Murrelet colonies: Helgesen, Limestone, Ramsay, Skincuttle, Saunders and George and Adler islands (Bertram and Nagorsen 1995; Harfenist and Kaiser 1997; Harfenist et al. 2002; Laskeek Bay Conservation Society 2011a; Harfenist unpublished data; A. Gaston pers. comm. 2011; M. Hipfner pers. comm. 2011). Raccoons can cause substantial losses in seabird colonies and are the likely cause of declines on Limestone, Saunders and Helgesen Islands (COSEWIC 2004). For example, on East Limestone Island in 1991, three adult raccoons killed at least 11% of the Ancient Murrelet breeding population and were implicated in reducing the number of chicks that departed the colony by 35% (Gaston 1991; Gaston 1992). After the raccoons were removed in 1992, the number of departing chicks increased by 20% and adult mortality decreased by almost 80% (Gaston and Lawrence 1993). On Helgeson Island, with 8 to 15 raccoons present, the breeding population of Ancient Murrelets declined by 80% over a 7-year period (Gaston and Masselink 1997). Half of the colonies in the Haida Gwaii archipelago are vulnerable to raccoon invasion because of raccoons' propensity to swim between islands (Lemon and Gaston 1999; Gaston and Masselink 1997; Hartman and Eastman 1997).

2) Oil Spills

In British Columbia, the federal moratorium on offshore oil and gas exploration extends to offshore oil and gas activities, but does not include oil tanker traffic. Currently, the Tanker Exclusion Zone (TEZ), a voluntary tanker routing measure, is in effect in the coastal waters of B.C., but it applies only to loaded crude oil tankers in transit from Alaska to California (Canadian Coast Guard 2011). Coastal shipping of oil and condensate is projected to dramatically increase in the next decade with exportation to Asia and liquid natural gas development in northern B.C. (National Energy Board 2011; National Energy Board and Canadian Environmental Assessment Agency 2011). Increased oil transport by tanker or pipeline significantly increases the possibility of chronic oil spills and a catastrophic oil spill (COSEWIC 2004; Harfenist and Kaiser 1997).

a) Chronic Oil Spills: Because of their biology and foraging behaviour, pelagic seabirds are vulnerable to chronic oil pollution. It has been a demonstrated cause of mortality in areas of Atlantic Canada (Wiese and Robertson 2004; O'Hara and Morandin 2010). Even small quantities of oil on the feathers can reduce survival through reductions in buoyancy and the ability to thermoregulate (Levy 1980; Morandin and O'Hara 2014). In B.C., Ancient Murrelets, Cassin's Auklets (*Ptychoramphus aleuticus*), Rhinoceros Auklets (*Cerorhinca monocerata*), and Marbled Murrelets (*Brachyramphus marmoratus*) are considered to be especially vulnerable to chronic oil spills due to their tendency to congregate during the breeding season (O'Hara and Morgan 2006). Despite their vulnerability, there is little direct evidence that Ancient Murrelets are impacted on a regular basis in either their breeding or non-breeding ranges. Results from the British Columbian Beach Bird Surveys (BBS) indicate that between 1986 and 2010 two Ancient Murrelets washed ashore with oiled plumage (Burger 2002; Bird Studies Canada unpublished data). It must be cautioned that BBS routes do not cover large portions of the Ancient Murrelet range and that wind and tide action along the coast of British Columbia often generates conditions that take bird carcasses offshore rather than depositing them on beaches. It is very likely that the occurrence of oiled birds is higher than suggested by the BBS results (O'Hara and Morgan 2006; P. Davidson pers. comm. 2012).

b) Catastrophic Oil Spills: It is well established that catastrophic oil spills can lead to large scale population effects on marine birds, both through immediate mortality and long term effects due to persistence of oil in the ecosystem (Rodway et al. 1989; Peterson et al. 2003; Wiens 2007). For example, it was shown for Harlequin Ducks (*Histrionicus histrionicus*) that negative effects lasted up to 20 years following the Exxon Valdez oil spill in 1989 (Iverson and Esler 2010; Esler et al. 2010). The presence of oil tankers moving through marine areas important to Ancient Murrelets poses a serious potential threat.

While the breeding distribution is well known, it will be critical to better understand the non-breeding season distribution of Ancient Murrelets in Canadian waters to inform conservation and management decisions.

3) Tourism and Recreation

Disturbance of nesting or foraging Ancient Murrelets by tourists or other human activities is an ongoing concern (COSEWIC 2004). Recreational camping can damage habitat and injure or kill chicks and adults (Harfenist et al. 2002). Shoreline campfires near breeding colonies are a major concern as birds (adults and departing chicks) often become disoriented and will fly or run directly into the fire. Lights around campsites and on boats (both recreational and commercial) can also lead to disorientation and may lead to collisions with the light source (Harfenist et al. 2002; A. Gaston pers. comm. 2011).

4) Oceanographic Change

There is evidence that oceanographic changes could have long-term impacts on Ancient Murrelet populations (COSEWIC 2004). Correlations between oceanographic change in Hecate Strait and inter-annual changes in Ancient Murrelet breeding biology between 1983 and 1999 demonstrated that long-term changes in ocean conditions could impact on the health of the population (Gaston and Smith 2001; Shoji et al. 2011). It is suggested that warmer ocean temperatures shift the window of prey availability out of synch with the provisioning period of breeding Ancient Murrelets. During the strong El Nino – Southern Oscillation event of 1997-1998, Ancient Murrelets experienced reduced breeding success (Gaston and Smith 2001).

5) Windthrow Events

Recent evidence suggests that large scale windthrow events have impacts on nesting habitat at the breeding colonies. During the winter of 2010/2011, several large storms toppled trees on the seabird colonies in Laskeek Bay. Aerial surveys noted extensive windthrow on Limestone Island (East), Reef Island, and the Skedans Islands. On Limestone Island the windthrow events affected approximately half of the island, and entire portions of the Ancient Murrelet colony were completely destroyed. In regions of the colony that were destroyed, chick departure was not noted in 2011. In areas of the colony that were not destroyed, chick departures were the second lowest recorded. It is uncertain what the long term effects of the event are for Limestone Island (Laskeek Bay Conservation Society 2011b; T. Gaston pers. comm. 2011).

6) Fisheries Bycatch

a) Gillnet Fisheries Bycatch:

Smith and Morgan (2005) predicted that between 1,129 and 24,002 seabirds were killed by gillnets in B.C. each year, with Common Murres (*Uria aalge*) and Rhinoceros Auklets being the most heavily impacted. While the impact of gillnets on seabirds is well established, there is minimal direct evidence that Ancient Murrelets are caught in the commercial salmon gillnet fishery in B.C. (Smith and Morgan 2005; L. Wilson pers. comm. 2011).

Between 2001 and 2006, a total bycatch of 640 seabirds from B.C. commercial salmon gillnet fisheries were entered into Fisheries and Oceans' Fishery Operations System (FOS) database. Of those entered, only one was identified as an Ancient Murrelet, and most (621) were listed as "unknown species" (D. Bertram unpubl. data). Although there is minimal direct evidence in the FOS data of Ancient Murrelets being killed in gillnet fisheries in Canada there remains significant uncertainty in the accuracy of that data. The uncertainty arises from the limited number of at-sea observers monitoring seabird bycatch events, the probable under-reporting of bycatch events, and low proportion of birds identified to species. Additionally, a variety of gillnet fisheries are exempt from FOS, contributing to the overall uncertainty of the effects on gillnet bycatch on Ancient Murrelet (Smith and Morgan 2005; L. Wilson pers. comm. 2011; D. Bertram pers. comm. 2011).

There is anecdotal evidence that bycatch from commercial gillnet fisheries around Langara Island, Haida Gwaii, resulted in high breeding season mortality of Ancient Murrelets in the 1950s and 1960s (Vermeer et al. 1984), and may have been one of the contributing factors to declines on that colony (Bertram 1995). While gillnet fishery effort has been reduced around the many protected areas on Haida Gwaii (H. Brekke pers. comm. 2012), a detailed analysis of the impacts of gillnet bycatch (outside of the FOS) has not been completed there (L. Wilson pers. comm. 2012).

Preliminary analysis of geolocator archival tags recovered from a small number of adults breeding on Haida Gwaii (2 tags from Susk Gwaii, 2 tags from George Island) suggest some birds overwinter in the north Pacific Rim. Further efforts are needed to better understand Ancient Murrelet bycatch rates in north Pacific Rim net fisheries (both in terms of total numbers and age classes of individuals affected).

b) Commercial Groundfish Hook and Line Fisheries Bycatch:

In an assessment of Pacific Canada's commercial groundfish hook and line fisheries (for 2006 through 2009), it was predicted that the average bycatch was 421 seabirds each year (range 156 - 759, Fisheries and Oceans 2012).

Although unidentified birds accounted for more than 40% of the predicted average bycatch, there was no evidence to suggest that Ancient Murrelets were taken in the fisheries examined (K. Morgan pers. comm. 2014).

7) Forestry

Logging activity can directly affect Ancient Murrelet breeding activity by reducing habitat quality, both through the removal of the forest canopy, which is preferred by the birds, and through compaction of the soil, which makes burrowing more difficult (COSEWIC 2004). The logging activity taking place on Langara Island may be compromising the recovery of this colony (M. Chutter pers. comm. 2004).

However, because most sites where logging may occur are protected or are proposed protected areas (Harfenist 2004; A. Cober pers. comm.), logging is currently not considered to be a significant threat to this species (Gaston 1994b).

8) Over Fishing of Prey Species

Fishing of prey species may reduce the availability of these species for Ancient Murrelet. It is suspected that overfishing of prey species may impact prey availability for seabirds that depend on them (Harfenist et al. 2002).

5. MANAGEMENT OBJECTIVES

The management objectives for Ancient Murrelet in Canada are:

1) To maintain or increase the current breeding population of Ancient Murrelet within the known Canadian range.
2) To otherwise augment the international population numbers in Canadian waters by reducing at-sea mortality for Ancient Murrelets.

Rationale for the management objective:

This species is listed as Special Concern due to observed population declines and local extirpations (primarily because of introduced predators). It is acknowledged that the colony-specific data has highly variable survey effort and accuracy, and that breeding individuals do not show high colony fidelity. Consequently, setting individual colony targets is not considered to be prudent. Rather, progress towards the management objective will be measured using the overall Canadian breeding population. The Canadian breeding population was estimated at 256,000 breeding pairs (512,000 individuals) in the 2004 COSEWIC Status Report. Appendix B summarizes the survey data used in the COSEWIC determination, as well as colony data collected since then, and indicates that *there have been declines within a number of colonies, potentially suggesting a decrease in the overall breeding population.*

6. Broad Strategies and Conservation Measures

6.1. Actions Already Completed or Currently Underway

- During the late 1990s and early 2000's the Working Group on Raccoon-Seabird Interactions managed a program that monitored and researched raccoon activities on seabird colonies, controlled raccoon activity on a subset of affected colonies, and increased public awareness of this conservation issue on Haida Gwaii. The working group was made up of representatives from the Archipelago Management Board (Council of the Haida Nation and Government of Canada); British Columbia Ministry of Environment, Lands and Parks, and Environment Canada.

- The Gwaii Haanas project entitled SGiN Xaana Sdiihltl'lxa (Night Birds Returning) is currently working with a number of local and international partners (Island Conservation Canada, Environment Canada - Canadian Wildlife Service, Laskeek Bay Conservation Society, a research group on introduced species, and Simon Fraser University) to eradicate introduced rats from seabird nesting islands within Gwaii Haanas. The project will include post-eradication monitoring. Efforts will be made to increase awareness of Gwaii Haanas protection and monitoring programs, including outreach and education about ecological integrity and the impacts, both cultural and ecological, of introduced species. This project began in 2009 and is proposed to be carried out through 2014.

- In Canada, 16 of 31 active breeding colonies are found in Gwaii Haanas National Park Reserve, and are subject to public use restrictions. The remaining active breeding colonies are currently zoned to restrict access and assess all acceptable land uses on the islands. The zoning is an outcome from the land use planning process between the Council of the Haida Nation and the Province of British Columbia. The planning process has led to the development of the Daawuuxusda (Council of the Haida Nation and B.C. Parks 2011a), Duu Guusd (Council of the Haida Nation and B.C. Parks 2011b), and K'uuna Gwaay (Council of the Haida Nation and B.C. Parks 2011c) management plans. These management plans classify the three corresponding regions as Haida Heritage Sites and British Columbian Conservancies and have zoned all seabird colonies as Management Unit Type 4, which aims to maintain natural biodiversity and ecological processes.

- Fisheries and Oceans Canada has programs in place to limit bycatch in net fisheries. They regulate the time and location of fisheries openings, target species, the type of nets used and how long these nets remain in the water. These measures are aimed at reducing mortality of non-target species, including seabirds. Additionally, there is an at-sea observer program for salmon fisheries and trawl fisheries, although coverage varies considerably. Some net fisheries remain exempt from these programs.

- Environment Canada and Fisheries and Oceans Canada have established a Pacific coast seabird bycatch working group; the purpose of which is to better understand the extent and nature of seabird bycatch and to work together, along with industry to find ways to more effectively monitor and mitigate seabird bycatch.

- The 24 years of citizen science by the Laskeek Bay Conservation Society has promoted Ancient Murrelet conservation and biological research through local community outreach, and an education and volunteer program. The long-term banding and population monitoring program of Ancient Murrelets has provided critical information on the demography of the species, highlighting the role of immigration in the dynamics of individual colonies (Gaston and Descamps 2011), as well as demonstrating a decline in breeding success over the period since 1990. These results have been linked to the effect of oceanographic changes on Ancient Murrelet breeding biology (Shoji et al. 2012). Declines during 1990-1995 (especially during 1990-1991) were probably due to raccoon predation (Hartman et al. 1997; Gaston and Descamps 2011).

- Environment Canada has maintained permanent colony monitoring plots on Rankine, George, and Ramsay islands since 1986. These colonies are surveyed on a 5 year rotational basis. Intermittent surveys have been carried out at other colonies as opportunities arise.

- A variety of ship-based surveys have collected data that will help identify at-sea areas of importance to Ancient Murrelets. Surveys include, but are not limited to, work done by Bird Studies Canada, the Pacific WildLife Foundation, Environment Canada, Laskeek Bay Conservation Society, and the Raincoast Conservation Society.

- Major (2011) and Laskeek Bay Conservation Society (2011a) have tested call-playback methods that successfully attract prospecting Ancient Murrelets to abandoned colonies. These prospectors are thought to use vocal cues to investigate potential breeding sites. Investigation of additional cues will be important if these techniques are to succeed at convincing prospectors to re-colonize abandoned colonies (or abandoned areas on active colonies).

- Environment Canada is conducting a project deploying geolocators on breeding adults at 4 colonies in Haida Gwaii (Susk Gwaii, Hippa, George, Reef) to document their migration routes and wintering areas. This information will help understand the impacts of threats faced at sea.

- Continuation of a study reporting winter long-line bycatch in the waters off Japan and Korea (Pacific Seabird Group 2014) along with development of bycatch mitigation measures with International buy-in. Given recent data showing Ancient Murrelets from Canadian breeding colonies wintering off the coast of Japan further understanding of bycatch patterns in International waters is pertinent.

6.2. Broad Strategies

While sections 4.1 and 4.2 describe both anthropogenic threats and natural threats, the management actions recommended in this document will focus on anthropogenic threats.

The broad strategies to achieve the management objective for the Ancient Murrelet are as follows:

1) Develop restoration plans for key colonies.
2) Develop and support programs aimed at reducing threats to Ancient Murrelet.
3) Undertake research and monitoring.
4) Increase public awareness.

Rationale for the broad strategies:

1) Develop restoration plans for colonies in key regions.

Development of restoration plans for specific groupings of colonies will ensure that threat management and monitoring is done consistently and collaboratively across the Canadian range of Ancient Murrelets and that resources are targeted appropriately. It is suggested that plans be developed for colonies that fall within existing administrative boundaries of participating agencies and attempt to align to relevant management activities currently underway.

2) Develop and support programs aimed at reducing threats to Ancient Murrelet.

Introduced Mammalian Predators

The eradication of introduced predators from both active and extirpated breeding colonies will prevent future extirpation and allow for re-colonization. Establishment of a rat-ready bait-station program in collaboration with the fishing lodges is warranted at Langara Island.There are many existing examples of predator control programs that should serve to inform current and future work.

Tourism and Recreation

Currently all of the Ancient Murrelet breeding colonies located in Haida Gwaii fall within either Gwaii Haanas or the provincial conservancies/Haida Heritage Sites outlined in the Daawuuxusda, Duu Guusd, and K'uuna Gwaay management plans. It will be important that the existing measures to restrict the impact of visitors to the colonies are implemented and demonstrated as effective.

Oil Spills

In the context of chronic oil spills it is important that existing oil spill deterrence programs be supported and appropriate legislative mechanisms be considered to reduce chronic oil discharge within both the breeding and non-breeding range of Ancient Murrelets in Canada.

In the context of catastrophic oil spills it is important that all appropriate legislative mechanisms be considered in order to minimize tanker traffic in both the breeding and non-breeding range of Ancient Murrelets.

Gillnet Fisheries Bycatch

Because there is still a high degree of uncertainty with respect to the species and numbers of birds taken in net fisheries in BC, it will be important to develop and implement a mandatory program to reduce the impacts of bycatch on seabirds in all net fisheries in B.C. and potentially abroad. It will also be important to support and improve existing programs aimed at further quantifying and studying the impact of bycatch on seabirds, including Ancient Murrelet, and encourage creative measures of monitoring and mitigating, if warranted.

3) Undertake research and monitoring

Additional research is required to address knowledge gaps related to attracting prospecting breeders to colonies, the effects of oceanographic change on reproductive success, the spatial-temporal distribution of Ancient Murrelets during all stages of the annual cycle (terrestrial, pelagic, and inshore waters) and causes of reduced juvenile at-sea survival as indicated by Gaston and Descamps (2011).

Monitoring active and restored colonies will help to determine whether populations are being maintained or increased (as per the management objective), to determine if colony restoration has been successful, and to detect and quickly eradicate any newly introduced predators. The development of corresponding baseline monitoring techniques and the implementation of regular monitoring programs will be required for both the breeding colonies and non-breeding areas of importance.

4) Increase public awareness

Increasing public awareness of actions that can reduce threats to seabirds will help further the successful management of Ancient Murrelets.

6.3. Conservation Measures

Table 3. Conservation Measures and Implementation Schedule

Conservation Measure	Priority[1]	Threats or Concerns Addressed	Timeline
Broad Strategy: Develop restoration plans for key colonies			
Develop restoration plans for the four suggested administrative areas (Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve and Haida Heritage Site, Daawuuxusda, Duu Guusd,and K’uuna Gwaay).	High	Introduced Mammalian Predators, Tourism and Recreation	ongoing
Broad Strategy: Develop and support programs aimed at reducing threats to Ancient Murrelet			
Prioritize and implement predator eradication projects at Ancient Murrelet colonies throughout the Canadian breeding range. The initial focus will be on high priority colonies, with an eventual shift to lower priority colonies. Past and present projects should serve as guidance to future work (Example: Night Birds Returning program - Gwaii Haanas).	High	Introduced Mammalian Predators	ongoing
Ensure that zoning and public land use restrictions currently in place for Ancient Murrelet colonies are actively monitored and enforced. Existing restrictions are outlined in the Gwaii Hanaas management plans and the Daawuuxusda, Duu Guusd, and K’uuna Gwaay management plans.	High	Introduced Mammalian Predators, Tourism and Recreation	ongoing
Collaborate with the National Aerial Surveillance Program (NASP) and the Integrated Satellite Tracking of Polluters (ISTOP) to ensure that oiling deterrence measures and oil hotspot mapping are implemented in areas important to Ancient Murrelet, including Haida Gwaii.	Medium	Oil spills - Chronic	ongoing

Ensure that existing information related to the Ancient Murrelet range is considered in the environmental assessments of projects that will elevate the risk of catastrophic oil spills.	Medium	Oil Spills - Catastrophic	ongoing
Collaborate with appropriate jurisdictions to support and improve existing bycatch reduction measures. This may include: placing at-sea observers on boats, exploring opportunities to introduce electronic monitoring systems, and encouraging the investigation of innovative bycatch reduction techniques.	Low	Gillnet Fisheries Bycatch	ongoing
Expand and support the CWS seabird bycatch program and encourage further quantification of seabird bycatch in all fisheries to better understand the impacts on Ancient Murrelet. Particular attention should be given to the fisheries around Haida Gwaii.	Medium	Gillnet Fisheries Bycatch	ongoing
Broad Strategy: Undertake research and monitoring			
Establish baseline monitoring protocols to assess population size and status at each colony location, both active and historic, and implement those protocols at regular intervals to track changes in the species' population and distribution. In the short term, particular attention should be paid to the large west coast colonies, some which have not been re-surveyed since the 1980s.	High	Knowledge Gaps	ongoing
Investigate and implement cost-effective introduced predator monitoring techniques to track predator activity and ensure that predators are not re-introduced in restored colonies. Collaborate with Provincial partners on responsibility.	High	Knowledge Gaps, Introduced Mammalian Predators	2020
Conduct further research on attraction and retention of prospecting adults at vacant breeding colonies using social cues.	Medium	Knowledge Gaps	ongoing
Expand collaboration, research, and monitoring to address information knowledge gaps regarding location and movement of Ancient Murrelets during the non-breeding season. Little is known about the non-breeding ecology of the species in both the pelagic and inshore waters of coastal British Columbia. Establishing spatial-temporal areas of importance for Ancient Murrelet will help understand the impacts of threats faced at sea.	Medium	Knowledge Gaps, Gillnet Fisheries Bycatch, Oil spills	2020

Conduct further research to assess and monitor the effects of oceanographic changes on colonies other than those currently covered by the Laskeek Bay Conservation Society.	Medium	Knowledge Gaps	2022 and beyond
Broad Strategy: Increase public awareness			
Develop and distribute pro-active and targeted educational material on the risks of mammalian predator introduction during supply runs to fishing lodges and research camps, and the risks associated with nocturnal lights near seabird colonies (both land based structures and anchored vessels).	Medium	Introduced Mammalian Predators and Tourism	ongoing

[1] Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for species. Medium priority measures may have a less immediate or less direct influence on reaching the management population and distribution objectives, but are still important for management of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the management objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

7. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the management objective. Every five years, success of management plan implementation will be measured against the following performance indicators:

1) The breeding population of Ancient Murrelet has been maintained or increased within the known Canadian range.

2) Mortality of Ancient Murrelet has been reduced through threat reduction.

More specifically:

- Restoration plans have been developed for the four key areas
- Key programs aimed at threat reduction have been supported, or developed and implemented
- Appropriate monitoring programs have been developed and implemented
- Ongoing research has been supported and incorporated into management activities
- Educational materials have been developed and distributed

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9. PERSONAL COMMUNICATIONS

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Appendix A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[4]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy[5]'s (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans may inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the management plan itself, but are also summarized below in this statement.

It is unlikely that the eradication of introduced mammalian predators from Ancient Murrelet colonies will have negative effects on any other species. Restoration and increased protection of Ancient Murrelet habitat will likely have beneficial effects on other species that inhabit these areas, such as; Cassin's Auklet, Rhinoceros Auklet, Leach's Storm Petrel *(Oceanodroma leucorhoa)*, Fork-tailed Storm Petrel *(Oceanodroma furcata)*, Black Oystercatcher *(Haematopus bachmani)*, Pigeon Guillemot *(Cepphus columba)* and a variety of Gull species. An increase in Ancient Murrelet populations will likely also benefit Peregrine Falcon *pealei* subsp. (*Falco peregrinus pealei)*, as it acts as an important prey source for this species (Beebe 1960). Work towards limiting oil spill threats would also benefit a wide range of marine life, including seabirds, marine mammals, fish and a variety of invertebrates.

The extent to which Ancient Murrelets affect the populations of their aquatic prey species is not known.

[4] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[5] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Appendix B: ANCIENT MURRELET BREEDING COLONY NUMBERS ON HAIDA GWAII (QUEEN CHARLOTTE ISLANDS)*.

Colony	1977	1980	1981	1982	1983	1984	1985	1986	1988	1989	1992	1993	1995	1996	1998	1999	2000	2003	2004	2005	2006	2011	Latest Count (Nest Pairs)	References
(Kunghit Island) Annis point								8000				3550							0				0	1,8,14
(Kunghit island) Jenkins point								800				11							0				0	1,8,14
(Lyell Island) Dodge point				10700							8300												8300	1,9,12
Agglomerate Island							2200																2200	1
Alder Island							14400																14400	1
Arichika Island							0																0	1
Bischof Islands							0																0	1
Bolkus Islands							9900																9900	1
Boulder Island							0																0	1
Cape Kuper								10															10	2
Carswell Island								1700															1700	2
Cox Island			0																				0	4
East Copper Island							4400											6050					6050	1,11
Frederick Island		68000													85900					31300			31300	3,4,HM
George Island							11600							17400									17400	1,10,12
Helgesen Island								7700				1150							1150			500	500	2,7,12,AG
High Island							0																0	1
Hippa Island					40000																		40000	4
Hotspring Island						6																	6	1
House Island						2600																	2600	1
Howay Island							300																300	1

Colony	1977	1980	1981	1982	1983	1984	1985	1986	1988	1989	1992	1993	1995	1996	1998	1999	2000	2003	2004	2005	2006	2011	Latest Count (Nest Pairs)	References
Instructor Island								760															760	2
Jeffrey Island							1000																1000	1
Langara Island			25500						24000			18200				13000			24000				24000	1,4,8,13,15
Lihou Island								6500				12100										2150	2150	2,7,12,AG
Limestone Islands East					1500					1600			1300								500		500	1,42
Limestone Islands West					100																		100	1
Lucy Island			0																				0	4
Luxmoore Island								1000															1000	2
Marble Island	1000																						1000	4,5
Murchison Island						20																	20	1
Ramsay Island						18200																	18200	1
Rankine Island East							0																0	1
Rankine Island West						26000											26000						26000	1,ML
Reef Island							5000						6600										6600	6,12
Rock Islet							0																0	1
Rogers Island								1700															1700	2
Saunders Island**								50														0	0	2,AG
Sea pigeon Island							0																0	1
S'Gaang Gwaii							200																200	2
Skedans Islands					0																		0	1
Skincuttle Island							2200																2200	1
Tar Islands							0																0	1
Willie Island								10															10	2
Grand Total																							**220106**	

*These numbers should be recognized as best guesses based on the limited, sporadic, and methodologically varied monitoring work that has been done on ANMU breeding colonies since 1977. The actual population size could be significantly larger or smaller than indicated, depending on the current status of colonies that have not been visited recently. In order to derive a reliable population estimate and realistically infer overall population trend, a broad standardized monitoring strategy would need to be implemented.

** A recent (2011) survey of Saunders Island did not reveal any signs of seabirds. Despite the lack of evidence to support the presence of a seabird colony it must be noted that the survey was a wandering search carried out over a few hours. A more robust survey would be required to conclude that the colony is fully extirpated.

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