PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Seaside Bone Lichen (*Hypogymnia heterophylla*) in Canada

Seaside Bone Lichen

2016

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

Cover illustration: Curtis Björk

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[1] http://www.registrelep-sararegistry.gc.ca

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 recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment is the competent minister under SARA for the Seaside Bone Lichen and has prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Department of National Defence (DND), and the Province of British Columbia (B.C.).

Success in the recovery 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 strategy and will not be achieved by Environment Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Seaside Bone Lichen and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When the recovery strategy identifies critical habitat, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within federal protected areas be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. For critical habitat located on federal lands outside of federal protected areas, the Minister of the Environment must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies. For critical habitat located on non-federal lands, if the Minister of the Environment forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, and not effectively protected by the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to extend the prohibition against destruction of critical habitat to that portion. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

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

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Development of this recovery strategy was coordinated by Kella Sadler (Environment Canada, Canadian Wildlife Service - Pacific and Yukon Region), with the assistance of Jamie Leathem, Matthew Huntley, and Meaghan Leslie-Gottschligg. Stuart Crawford and Trevor Goward prepared the first draft of this recovery strategy under contract with Environment Canada. The photograph of the species was provided by Curtis Björk. Specimens were provided to Trevor Goward for species confirmation by David Giblin from the University of Washington herbarium, Rick Phillippe and Andrew Miller from University of Illinois herbarium, Leslie Landrum from the Arizona State herbarium, and Dieter Wilken and Shirley Tucker from the Santa Barbara Botanical Gardens herbarium. Andrea Schiller (Natural Resources Canada) provided additional information on recent observations. Leah Westereng (B.C. Ministry of Environment), and Rachel McDonald and Tracy Cornforth (both Department of National Defence) provided helpful comments on the manuscript.

Executive Summary

Seaside Bone Lichen (*Hypogymnia heterophylla*) is currently listed as Threatened under the *Species at Risk Act*. There are seven known populations of Seaside Bone Lichen in Canada, all of which are located within approximately 40 km of each other on the southern coast of Vancouver Island. The total known population size is thought to be around 2000 to 3000 individuals.

Seaside Bone Lichen is a foliose (leafy) lichen that grows on trees and resembles a small (5-8 cm) bush of pale grey and finely branched lobes. Its inflated lobes (branches) are hollow, pliable and dark brown inside, and often covered in small black dots (agents of vegetative reproduction called pycnidia). The lichen's disc-shaped fruiting bodies, or apothecia, are brown and raised on short stalks. In Canada, Seaside Bone Lichen has a very narrow range. All known populations occur within about 100 m of the ocean in the driest subzones of the Coastal Western Hemlock Biogeoclimatic Zone and the neighbouring Coastal Douglas-fir Zone. Here it characteristically colonizes the branches of young to mid-seral Shore Pine, especially on rocky, windswept ledges.

The main threats to Seaside Bone Lichen are climate change and removal of, or damage to, its host trees. All populations face the risk of destruction or damage of host trees via the increasing severity and frequency of winter storms predicted with climate change. Three of the seven populations are located in areas frequented by visitors who could potentially damage trees. One of these also faces the risk of tree removal. The remaining three populations are located on a military reserve, where trees potentially could be damaged by efforts to improve habitat for vascular plant species at risk, and/or by military exercises. The species is limited by its extremely narrow habitat requirements.

Feasibility of recovery is unknown at this time as specific impacts of climate change on this species are not known, and it is unknown whether these impacts can be avoided or mitigated.

The population and distribution objective for Seaside Bone Lichen is to maintain the distribution, and to maintain or (where appropriate) increase the abundance of all extant populations of this species in Canada, including any extant populations which may be identified in the future.

Broad strategies to address other threats to the survival and recovery of Seaside Bone Lichen are presented.

Critical habitat is partially identified for each of seven currently known extant populations. A schedule of studies is included to complete critical habitat identification where accurate occurrence data is lacking.

One or more action plans for the Seaside Bone Lichen will be posted on the Species at Risk Public Registry by 2020.

Recovery Feasibility Summary

Based on the following four criteria that Environment Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of Seaside Bone Lichen. In keeping with the precautionary principle, a recovery strategy has been prepared as would be done when recovery is determined to be feasible.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

   Yes. At least five of the seven known Canadian populations have abundant individuals, and at least two of those populations contain all age classes, indicating that they are capable of reproducing.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

   Yes. There is sufficient suitable habitat to support the existing populations in Canada.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

   Unknown. While the most immediate threat to this species is the inadvertent destruction of the trees that provide its growing substrate, this can be successfully mitigated. However, severe weather associated with climate change is the ongoing primary threat. The specific impacts of climate change on this species are not known, and it is unknown whether these impacts can be avoided or mitigated.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

   Unknown. Recovery techniques such as public communication and promotion of stewardship and restoration can help avoid or mitigate human activities causing direct damage to the species and its habitat. However, climate change is a primary threat to this species. It is unknown whether recovery techniques can be developed to mitigate impacts of climate change within a reasonable timeframe.

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1. COSEWIC* Species Assessment Information

Date of Assessment: April 2008

Common Name (population): Seaside Bone Lichen

Scientific Name: *Hypogymnia heterophylla*

COSEWIC Status: Threatened

Reason for Designation: This lichen is endemic to the Pacific Coast of North America, and southwest Vancouver Island represents the northern limit of its range. The species' survival depends on early to intermediate seral shore pine forests along the sea coast. The populations appear to be stable, but have a restricted occurrence and the species is known from only four locations. Severe winter storms, which are anticipated to increase, are the main threat to the species.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1996. Status re–examined and designated Threatened in April 2008.

* COSEWIC: Committee on the Status of Endangered Wildlife in Canada.

Three additional populations of Seaside Bone Lichen have been discovered since the 2008 COSEWIC species assessment, therefore there are currently seven known locations. The species was added to SARA Schedule 1 with the common name "Seaside Bone Lichen", and it is listed as such on the Species at Risk Public Registry.

2. Species Status Information

Legal Designation: SARA Schedule 1 (Threatened) (2010)

Table 1. Conservation status ranks for Seaside Bone Lichen (NatureServe 2013, BC Conservation Framework 2013, B.C. Conservation Data Centre 2013)

Global (G) Rank	National (N) Rank	Sub-national (S) Rank	COSEWIC Status	B.C. List	BC Conservation Framework
G3 (1998)	Canada: N2 (2011)	British Columbia: S2 (2011)	T (2008)	Red	Priority 2 (out of 6) for Goals 1 and 3**
	United States: NNR	Washington: S3			
		Oregon and California: SNR			

*Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; NR – status not ranked; U – unrankable
**The three goals of the BC Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems

Within Canada, Seaside Bone Lichen is found exclusively in coastal British Columbia, where it is at the northern edge of its range. The majority of this species' range is within Oregon and California, with a few occurrences in Washington. It is estimated that less than 1% of the range of Seaside Bone Lichen is within Canada.

3. Species Information

3.1 Species Description

Seaside Bone Lichen is a foliose (leaf) lichen averaging 5–8 cm across. The inflated lobes or branches are hollow, pliable, and variable in width from 1–3 (–6) mm, often within the same lobe. The lobes are loosely overlapping and sparsely fork-branched to more often irregularly side-branched, and have narrow lobules that are perpendicular to the lobe margins and constricted at the base. The pale grey upper surface is strongly convex and usually has numerous small black dots (pycnidia). [3] The inside of the hollow lobe is dark brown throughout. The lower surface is black, shiny and wrinkled. *Trebouxia* is the green alga partner of this lichen. Soredia and isidia (other agents of vegetative reproduction) are absent, but apothecia[4] (disc-shaped fruiting bodies) are common. The discs are brown, raised on short stalks, and 5–10 mm wide when mature. Seaside Bone Lichen can be differentiated from other species of *Hypogymnia* by its long, narrow, laterally branched lobes; dark brown medullary cavity; lack of soredia; and lichen medulla chemical spot test of PD+ red. More detailed technical descriptions can be found in Pike and Hale (1982), Goward et al. (1994), and Brodo et al. (2001).

3.2 Population and Distribution

Seaside Bone Lichen is endemic to the coast of western North America. Most populations occur between Santa Barbara County California in the south to Tillamook County Oregon in the north. A few populations are found farther north, ranging northwards into coastal Washington and southern British Columbia. The locations of all known records of Seaside Bone Lichen are shown in Figure 1.

Seaside Bone Lichen has an unusually narrow range, occurring exclusively in proximity to the ocean; in Canada, this species is only found within 100 m of the ocean. Populations in Washington occur within 1 km of the ocean, and those in Oregon within 5 km. In southern California, Seaside Bone Lichen can grow up to 30 km inland. A few isolated populations of Seaside Bone Lichen have been noted even farther inland, but these individuals appear to be highly stressed (Goward pers. obs. 2013).

[3] Pycnidia are microscopic tissues that can break off and form new individual lichen bodies genetically identical to the original. They represent one of the means by which lichens reproduce vegetatively (i.e. asexually).

[4] Apothecia facilitate sexual reproduction of the lichen by producing spores of the fungal partner. When the spores disperse they must come in contact with the appropriate algal partner (*Trebouxia*) before a new Seaside Bone Lichen individual can form.

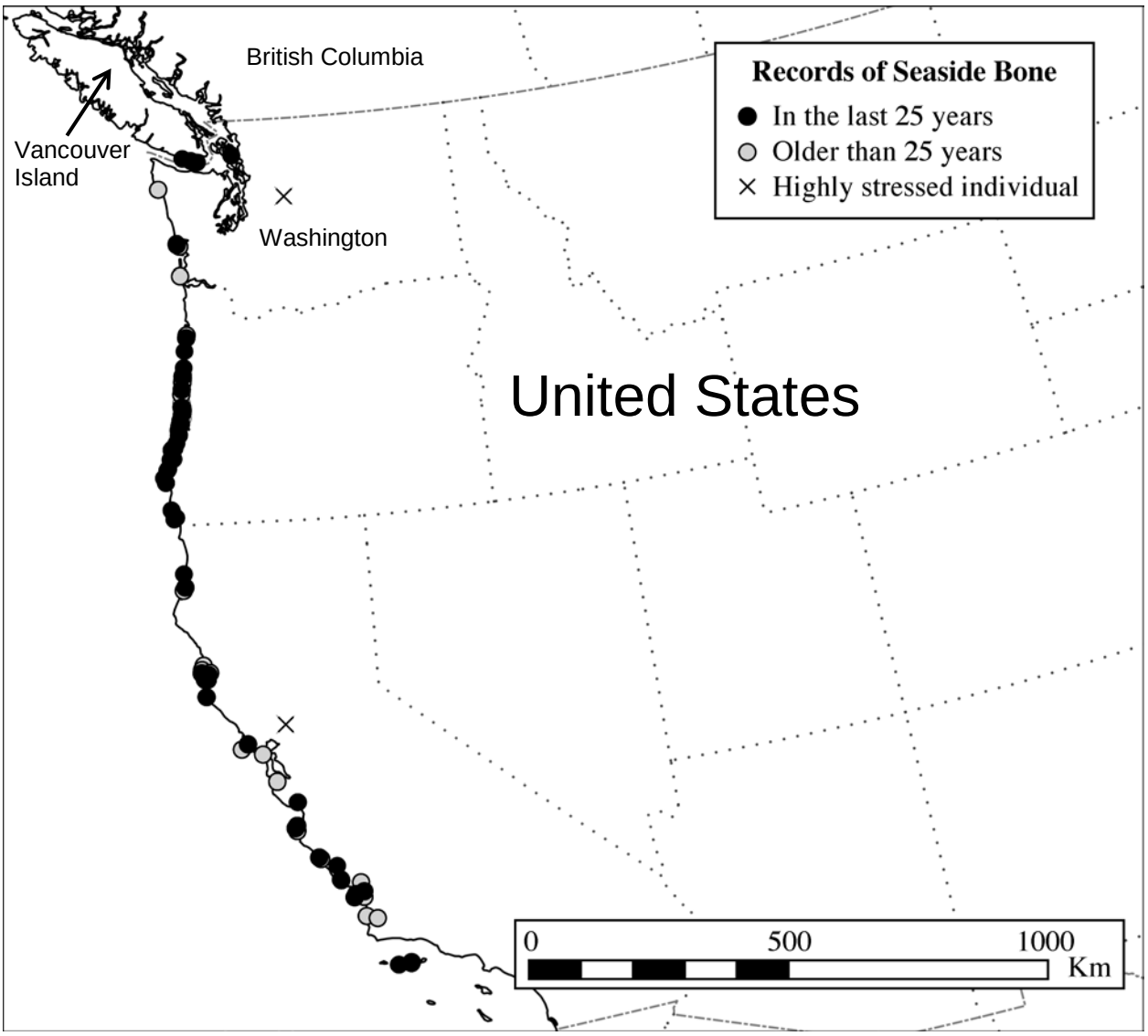

Figure 1. Global distribution of Seaside Bone Lichen.

Currently this species is known in Canada exclusively from coastal British Columbia, where it is restricted to the southern tip of Vancouver Island (Figure 2). The seven known populations[5] of Seaside Bone Lichen in Canada all occur within approximately 40 km of each other. Information for these populations is summarized in Table 2. Three of these populations represent new records since the Seaside Bone Lichen COSEWIC Status Report (2008): (1) Christopher Point , (2) Church Point (Department of National Defence, Marsh 2012), and (3) Albert Head (Natural Resources Canada 2014).

[5] Separate populations are individuals or groups of individuals separated by >1 km; a population may include any number of subpopulations, or groups of individuals separated by <1 km and confined to a geographically or ecologically distinct area in which a single threatening event could rapidly affect all individuals.

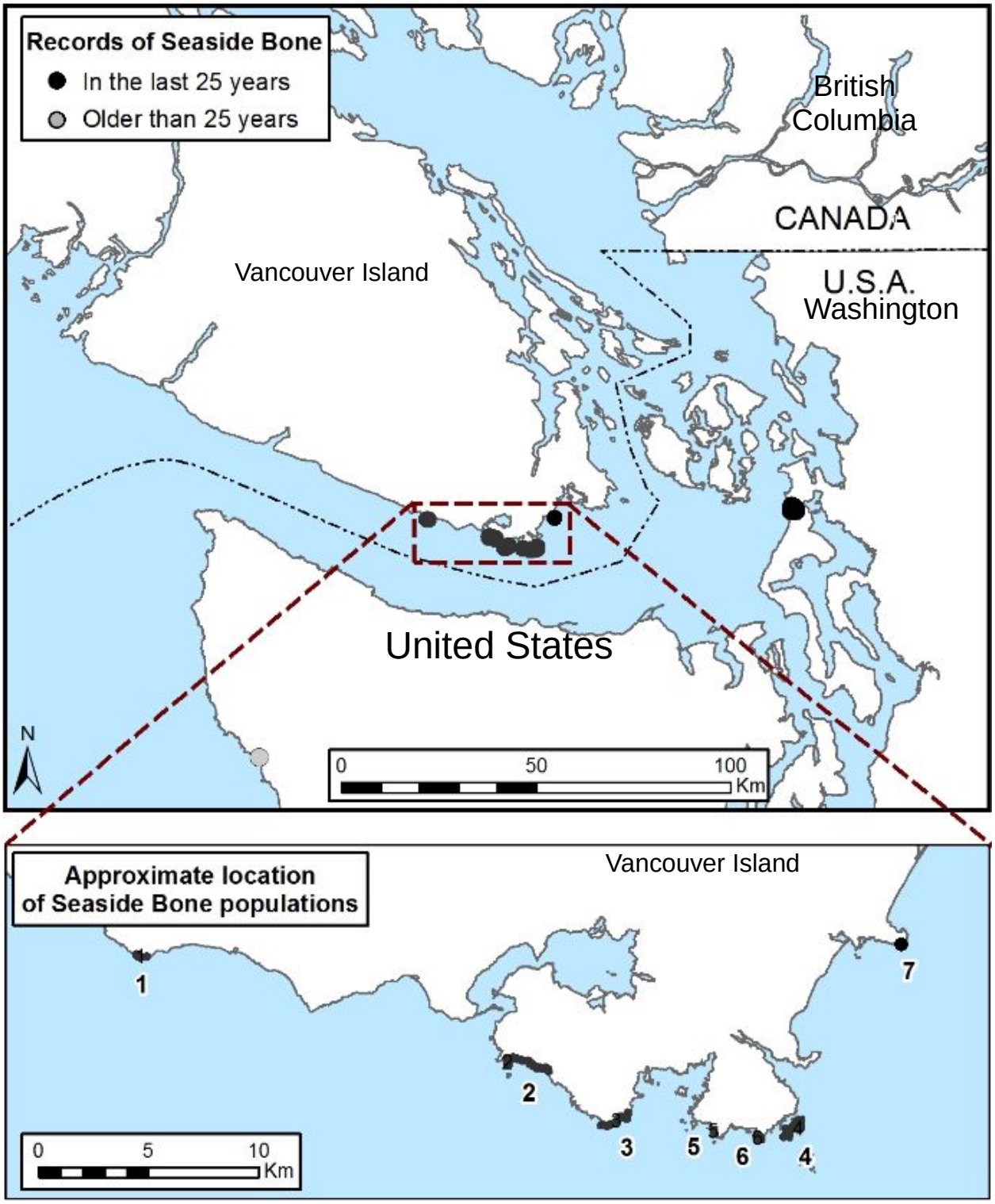

Figure 2. Distribution of Seaside Bone Lichen populations in Canada.

Table 2. Known Seaside Bone Lichen populations in Canada. Populations (Popn) are numbered after Fig. 2, and subpopulations (Subpopn) whose precise locations are known are also listed (e.g. 2.01, 2.02).

Popn #, Subpopn #	Location	Land tenure	Population data (Year observed: # of thalli[6])	Population Status
1	Sheringham Point[7]	Federal land, Non-federal land	1975: First recorded; abundance unknown 2006: ≥100 thalli	Presumed extant; partially unknown
2	Iron Mine Bay[8]	Non-federal land	1991: First recorded; abundant with all age classes present 2006: ≥300 thalli	Presumed extant; partially unknown
2.01			2006: ≥100 thalli	
2.02			2006: ≥100 thalli	
2.03			2006: ≥100 thalli	
3	Alldridge Point[9]	Non-federal land	1991: First recorded; abundant with all age classes present 2006: ≥200 thalli	Presumed extant; partially unknown
3.01			2006: ≥100 thalli	
3.02			2006: ≥100 thalli	
4	Bentinck Island[10]	Federal land	1993: First recorded; numbers unknown 2006: ≥310 thalli 2012: 500–1000 thalli	Presumed extant
4.01			2006: ≥100 thalli; 2012: 2 thalli	
4.02			2006: ≥100 thalli; 2012: 2 thalli	
4.03			2012: 170 thalli	
4.04			2012: 3 thalli	
4.05			2012: 50–300 thalli	
4.06			2006: ≥10 thalli; 2012: 1 thallus	
4.07			2012: 1 thallus	
4.08			2012: 7 thalli	

[6] The "plant body" or vegetative part of an individual lichen is called a thallus (plural = thalli). Seaside Bone Lichen is a foliose lichen, meaning its thallus generally forms flat, leaf-like lobes.

[7] A 1975 collection labeled “Sheringham Point,” had coordinates that indicate a point about 2 km to the northwest of the Sheringham Point Lighthouse, within French Beach Provincial Park. A portion of French Beach was surveyed for Seaside Bone Lichen in 2006, and none was found (COSEWIC 2008). Individuals found at Sheringham Pt. in 2006 may or may not have been from the population recorded in 1975. Moreover, the area has undergone residential development so the persistence of this population must be confirmed.

[8] The three subpopulations observed in 2006 are all to the east of the subpopulations observed in 1991. The precise locations of the subpopulations observed in 1991 are not known.

[9] The two subpopulations observed in 2006 are both to the west of the subpopulation observed in 1991. The precise location of the subpopulation observed in 1991 is not known.

[10] There are several discrepancies between the 2006 and 2012 geographic locations recorded for subpopulations at this locality. Despite cross-checking and correcting to the extent possible, some uncertainties remain. Four subpopulations of the Bentinck Island population (#4) were found in the 2006 surveys, and abundance estimates were recorded. The 2012 survey of Bentinck Island was comprehensive, resulting in 10 new subpopulations on the island in addition to the original 4 subpopulations. Abundance estimates were recorded for all 14 subpopulations. Thus, four of the Bentinck Island subpopulations have abundance estimates recorded in 2006 and again in 2012. However, abundance estimates for these four Bentinck Island subpopulations differ dramatically between 2006 and 2012, with two subpopulations (4.01 and 4.02) declining from ≥100 thalli to 2 thalli, another (4.06) from ≥10 thalli to 1 thallus and one subpopulation (4.09) increasing from ≥10 thalli to >160 thalli. It is not known whether these discrepancies represent fluctuations in population numbers or survey error.

Popn #, Subpopn #	Location	Land tenure	Population data (Year observed: # of thalli[6])	Population Status
4.09			2006: ≥10 thalli; 2012: >160 thalli	
4.10			2012: 50–300 thalli	
4.11			2012: approx. 20 thalli	
4.12			2012: approx. 20 thalli	
4.13			2012: 11–50 thalli	
4.14			2012: 4 thalli	
5	Church Point	Federal land	2012: First recorded; >1150 thalli	Presumed extant
5.01			2012: 11–50 thalli	
5.02[11]			2012: 37 thalli	
5.03			2012: >1000	
5.04			2012: 50–300	
5.05			2012: 50–300	
6	Christopher Point	Federal land	2012: First recorded; approx. 100	Presumed extant
6.01			2012: 36 thalli	
6.02			2012: 60 thalli	
6.03			2012: 6 thalli	
6.04			2012: 3 thalli	
7	Albert Head	Federal land	2013: First recorded; 6 thalli	Presumed extant

It is difficult to determine if the Canadian Seaside Bone Lichen populations have changed in abundance since first observation, as population and location data is lacking for many subpopulations and most were only observed once (see Table 2 footnotes).

In 2004–2006, a survey for lichens including Seaside Bone Lichen (Harris, pers. comm. 2007, in COSEWIC 2008a) was conducted at other locations in the region including Saltspring Island, Tofino and the Shore Pine forest to the south, Ucluelet coast, Mt. Washington, Cathedral Grove, Cowichan Bay Canyon, Sechelt Peninsula, Campbell River/Elk Falls and other areas on the south centre and east coast. Targeted surveys were also conducted for Seaside Bone Lichen in 2006 at various locations along the coast of southern Vancouver Island as well as French Beach Provincial Park and the Qualicum coast area. No populations of Seaside Bone Lichen were found (COSEWIC 2008a). However, it is likely that additional populations and/or subpopulations will be discovered with further survey effort, especially in areas near known occurrences.

3.3 Needs of the Seaside Bone Lichen

Habitat requirements

Seaside Bone Lichen is restricted to the branches and terminal twigs of conifers, and occasionally woody shrubs, in exposed seaside habitats along the Pacific coast of temperate North America. It primarily occurs on trees growing on rocky, windswept

[11] The location of this subpopulation is uncertain due to UTM discrepancy in records.

ledges, in early to intermediate seral Shore Pine (*Pinus contorta* var. *contorta*) forests. The trees in these locations are somewhat stunted and prone to branch destruction and damage from offshore winds and winter storms. Seaside Bone Lichen appears to be excluded from less exposed sites by other arboreal lichen species (Goward 1996).

Shore Pine is the most common host tree for Seaside Bone Lichen in Canada. However, this species has also been found on Douglas-fir (*Pseudotsuga menziesii*) (Goward and Knight 1991; Marsh 2012), Sitka Spruce (*Picea sitchensis*) (Noble 1975), and Oceanspray (*Holodiscus discolor*) (Goward and Knight 1991). It is usually found on live branches, but occurs frequently on dead branches as well (Marsh 2012).

Seaside Bone Lichen grows in close proximity to the coast, and in Canada is found within 100 m of the ocean (Goward 1996). This may indicate a requirement for salts associated with sea spray, as hypothesized for other coastal arboreal lichens (Glavich 2003). Alternatively it may point to pronounced sensitivity to subfreezing winter temperatures. Proximity to the ocean has a strong moderating influence on temperature, as seen at the Victoria Gonzales Heights climate station, 20 km northeast of the easternmost Seaside Bone Lichen population. From 1991–2000, freezing temperatures occurred on 13.8 days per year, and there were only 2.4 days per year where the temperature stayed below freezing all day (Environment Canada 2013). This weather station is situated 230 m from the ocean at an elevation of 70 m; presumably the frequency of subfreezing temperatures at the seaside localities actually inhabited by Seaside Bone Lichen is even less.

In Canada, Seaside Bone Lichen occupies the driest subzones of the Coastal Western Hemlock Zone (CWH xm1 and xm2) and the nearby Coastal Douglas-fir Biogeoclimatic Zones (CDF mm) (Meidinger and Pojar 1991), in a region of rainshadow-induced Mediterranean climate. Precipitation occurs predominantly in the winter months between October and March with a mean annual precipitation of 121 cm at the Victoria Marine weather station (Environment Canada 2013). Drought conditions often occur in the summer months with a mean monthly rainfall of 2.3 cm in July. Seaside Bone Lichen is generally absent from areas of the Pacific Coast that lack summer drought (e.g. Washington), indicating that it may be a requirement for this species (Goward 1996). Conditions are generally quite windy, and the desiccating effects of wind on Seaside Bone Lichen may be a physiological advantage in maintaining the wetting and drying cycle required by this and other lichens (Goward 1996).

Limiting factors

Seaside Bone Lichen has extremely narrow habitat requirements, as described above. In Canada it appears to be restricted to rocky headlands along the outer coast of southern Vancouver Island. The fact that such sites are relatively uncommon compared with the intervening sandy/gravelly beaches could itself constitute a limiting factor for this species.

While physiologic studies are lacking, Seaside Bone Lichen could be further limited in Canada by an inability to withstand subfreezing winter temperatures. While this species occurs within 100 m of the ocean in southern B.C., it extends up to 30 km inland in the

southern portions of its range (as per Section 3.2: Population and Distribution). Proximity to the moderating influence of the ocean thus appears to be less important where mean minimum winter temperatures are higher.

Additional evidence for sensitivity to subfreezing temperatures comes from Glavich et al. (2005), who examined the ecological amplitudes of 15 species of rare epiphytic lichens in the Pacific Northwest. Although Seaside Bone Lichen was not included in the study, three of the species that were included (*Bryoria pseudocapillaris, Bryoria spiralifera* and *Heterodermia leucomela*) were usually accompanied by Seaside Bone Lichen, and may thus have similar ecological requirements. For all three of these species, a mean minimum winter temperature above freezing was the most important environmental variable for identifying suitable habitat.

It has been suggested that Seaside Bone Lichen is generally restricted in Canada to southwest-facing shores because it requires direct exposure to strong winds (Marsh 2012). However, it appears this species is found on both southwest- and southeast-facing shores. It is possible the species has a habitat preference for south-facing shores over north-facing shores, but this is difficult to determine as north-facing shores are relatively uncommon on the south end of Vancouver Island; however, Seaside Bone Lichen was absent from north-facing shores on Bentinck Island (Marsh 2012). This may be a result of the increased insolation of south-facing slopes raising the minimum winter temperatures.

Seaside Bone Lichen reproduces by spores, which are well adapted to long distance dispersal by wind. However, successful reproduction by spores requires the spore to locate and associate with a compatible *Trebouxia* alga in order to resynthesize a lichen thallus. Because the spores of Seaside Bone Lichen are very small, they have very little nutritional reserves to support a young lichen. Reproduction is therefore limited to locations where compatible *Trebouxia* alga partners are readily available, and the environmental conditions are suitable for resynthesis of the lichen thallus.

4. Threats

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky et al. 2008). For purposes of threat assessment, only present and future threats are considered.[12] Threats presented here do not include biological features of the species or population which are considered limiting factors.[13]

[12] Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master et al. 2009).

[13] It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts.

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (International Union of Nature–Conservation Measures Partnership) unified threats classification system. This IUCN-CMP threat assessment system is currently used by the B.C. Conservation Framework and the B.C. Conservation Data Centre. For a detailed description of this classification scheme, see the Conservation Measures Partnership website[14] (CMP 2010).

Table 3. Threat assessment summary for Seaside Bone Lichen in Canada.

Threat #	Threat description	Impact[15]	Scope[16]	Severity[17]	Timing[18]	Causal Certainty[19]
1	Residential and commercial development	Low	Small	Moderate	High-Moderate	Medium
1.1	Housing and urban areas	Low	Small	Moderate	High	Medium
1.3	Tourism and recreation areas	Low	Small	Moderate	Moderate	Medium
6	Human intrusions and disturbance	Low	Restricted	Moderate	High-Moderate	Medium
6.1	Recreational activities	Low	Restricted	Moderate	High	Medium
6.2	War, civil unrest, and military exercises	Low	Restricted	Moderate	Moderate	Low
7	Natural system modifications	Low	Restricted	Moderate	Moderate	Medium
7.3	Other ecosystem modifications	Low	Restricted	Moderate	Moderate	Medium
11	Climate change and severe weather	Medium	Pervasive	Moderate	High-Moderate	Medium
11.3	Temperature extremes	Unknown	Pervasive	Unknown	High-Moderate	Low
11.4	Storms and flooding	Medium	Pervasive	Moderate	High-Moderate	Medium

[14] http://cmp-openstandards.org/using-os/tools/threats-taxonomy/

[15] ***Impact –*** *The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.*

[16] ***Scope*** *– Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).*

[17] **Severity –** *Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).*

[18] ***Timing*** *– High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.*

[19] ***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

Following the methods of Master et al. (2009), the overall threat impact for Seaside Bone Lichen was calculated as High[20], meaning the species is currently facing, or is expected to face, in the medium-term, a median rate of population decline of 40%. Note that the generation time of this lichen is about 15 years, hence the medium-term (defined as three generations for purposes of IUCN threat assessment) is 45 years. The threats for this species are described below, with the greatest threats identified as climate change and severe weather, natural system modifications, human intrusions and disturbance, and residential and commercial development (Table 3).

IUCN Threat 11. Climate change and severe weather

Climate change may be a significant threat to all populations of Seaside Bone Lichen in Canada over the medium to long term. In coastal British Columbia, climate change can be expected to cause wetter winters and drier summers, increased fire risk, an increase in temperature extremes, more frost-free days, and higher storm intensities (Spittlehouse 2008). The environmental specificity of Seaside Bone Lichen is very narrow in Canada, where it occurs at the extreme northern edge of its range. Both factors increase its intrinsic vulnerability to climate change. The relatively warm, summer-dry climate of southeast Vancouver Island and the Gulf Islands has favoured its establishment well north of its main range in coastal Oregon and California. The precise physiological requirements of Seaside Bone Lichen are unknown, as are the precise predicted effects of climate change on local microclimate, making it impossible to know exactly how climate change will affect each occurrence. Notwithstanding, overall medium/moderate impacts and severity of damage are expected.

As noted above (Section 3.3), Seaside Bone Lichen likely requires a very specific set of environmental conditions to reproduce sexually, which it does via fungal spores. Therefore, small climatic changes could also have a significant impact on recruitment of new individuals of Seaside Bone Lichen, though the nature of this impact is unknown.

Canadian populations of Seaside Bone Lichen are at the northern limit of their species range and likely limited from northward expansion by sensitivity to subfreezing temperatures. Therefore, it is possible that the increased minimum winter temperatures predicted for the region could promote an increase in Canadian range.

IUCN Threat 11.3 Temperature extremes

It is likely that Seaside Bone Lichen is intolerant of minimum winter temperatures below freezing, and that this is a significant limiting factor in its range extent (as per Section 3.3). While average winter temperatures in south coastal British Columbia are predicted to increase (Werner 2011), greater temperature extremes are also predicted

[20] The overall threat impact was calculated following Master et al. (2009) using the impact rating from each Level 1 Threat assigned to this species where Timing = High or Moderate. In this case that includes 0 Very High, 1 Medium, 3 Low, and 0 Unknown (Table 3).The overall threat impact considers the cumulative impacts of multiple threats.

(Spittlehouse 2008). Coastal freezing events could negatively affect Seaside Bone Lichen populations. Conversely, as mentioned above, Seaside Bone Lichen is at the northern edge of its climatic tolerance in Canada, and even a small increase in average winter temperatures over the next 45 years may be sufficient to increase the amount of suitable habitat for this species in Canada, potentially expanding its range northward, at least in areas that are in close proximity to the coast.

IUCN Threat 11.4 Storms and flooding

The frequency and severity of storms also appear to have a significant impact on Seaside Bone Lichen habitat. The severe winter storms of 2006/2007 damaged many of the coastal trees within its habitat (COSEWIC 2008a). It is inferred that storms will continue to be a threat, with medium/moderate impact and severity of damage over time. Although all known impacts from this threat are currently negative, more research is needed to assess long-term population dynamics in relation to storms, and the continued availability of suitable substrate for Seaside Bone Lichen in mid-successional forests.

IUCN Threat 7.3. Other ecosystem modifications

Seaside Bone Lichen on Bentinck Island (population 4), Church Point (population 5), Christopher Point (population 6), and Albert Head (population 7) occur in military reserve areas. In some of these areas, Shore Pines that have recently colonized maritime meadows are threatening populations of vascular plant species at risk. Management of these areas has included removal of Shore Pines in the past. However, only a relatively small portion of the species population in Canada would be affected by a conflict between vascular plant SAR and Seaside Bone Lichen at the DND sites. Currently (2015) DND has suspended these activities; further tree and/or branch removal would only be done following an assessment of the pros and cons to all affected co-occurring species at risk, as authorized under a SARA permit.

IUCN Threat 6.1. Recreational activities

Seaside Bone Lichen occurs at East Sooke Regional Park (populations 2 and 3), which is managed by the Capital Region District. This area has a management plan that ensures the habitat will not be intentionally violated, but inadvertent damage could occur due to the passage of hikers, cyclists and dogs along trails through the Shore Pine stands. At Sheringham Point (population 1) there is a public beach access to the area in the form of a right-of-way between federal lands and the private property to the west. Some of this area includes steep cliffs unlikely to be disturbed by visitors. However, the exact location of this population is unknown, and trees supporting Seaside Bone Lichen subpopulations could potentially be damaged by visitors (i.e. climbing trees) or by landscaping.

IUCN Threat 6.2 Military exercises

Seaside Bone Lichen on Bentinck Island (population 4), Church Point (population 5), Christopher Point (population 6), and Albert Head (population 7) occur in military reserve areas where direct and/or indirect damage through military exercises is a possibility. However, the National Defence liaison with Environment Canada is aware of the locations of Seaside Bone Lichen (as of 2015). DND has reported that demolition exercises only occur on Bentinck Island, and the range is 200 m from the closest Seaside Bone Lichen. At Albert Head there is a grenade range 150 m from the Seaside Bone Lichen. Church Point and Christopher Point are not located close to any areas where demolition exercises occur.

IUCN Threat 1 Residential and commercial development

The extent and exact locations of the subpopulation(s) in population 1 at Sheringham Point are unknown, but it is very likely some occur on the private land on either side of the Sheringham Point Light Station and will be impacted by residential development and/or introduction of new trails or beach access for improved recreation. The coastline immediately to the west of the light station is subdivided into 21 oceanfront residential lots, most of which were developed prior to 2006. The land to the east of the light station was likewise subdivided into 16 oceanfront residential lots in 2009, some of which now have houses and all of which have had trees removed to clear potential building sites. The remaining trees, which may provide habitat for Seaside Bone Lichen, could be damaged by residential development through removal for building, recreation, and/or aesthetic reasons. Lichens and/or trees could also be impacted by the environmental/atmospheric change resulting from the general vegetation removal and landscape modifications associated with residential and commercial development.

5. Population and Distribution Objectives

The population and distribution objective for this species is:

To maintain the distribution, and to maintain or (where appropriate) increase the abundance of all extant populations of this species in Canada, including any populations which may be identified in the future.

Rationale:

There are currently seven known populations of Seaside Bone Lichen in Canada, all of which are located within approximately 40 km of each other on the southern coast of Vancouver Island. Seaside Bone Lichen is naturally rare within Canada, and the historic range extent of this species within Canada is very limited. In order for this species to remain viable within Canada, it is important to maintain the known extant populations, as well as any additional populations that may be discovered.

There is no evidence that this species was previously more widespread in Canada, therefore an objective to deliberately increase populations and/or target down-listing of the species to Special Concern is not appropriate.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Habitat stewardship and conservation (in progress)

- Populations 2 and 3 are in East Sooke Regional Park which is managed by the Capital Regional District. Although the park's Management Plan is not specific to Seaside Bone Lichen, it does address the conservation of natural habitats.
- Populations 4, 5, 6, and 7 are located on a military reserve that is used for training purposes. The National Defence liaison with Environment Canada is aware of the locations of Seaside Bone Lichen (as of 2015). These locations are mapped and communicated to site users. Range standing orders prohibit the cutting of trees. DND has undertaken proactive inventory work to ensure that knowledge of Seaside Bone Lichen locations are incorporated into decision making about removal of conifer trees to protect co-occurring vascular plant species at risk.
- Parts of population 1 may be excluded from future residential development if the 4.5 hectares of DFO land around the lighthouse are transferred to the Sheringham Point Lighthouse Preservation Society under the *Heritage Lighthouse Protection Act*. However, if the Society's request for heritage status is denied, the land could potentially be sold to private interests.

6.2 Strategic Direction for Recovery

Table 4. Recovery Planning Table for the Seaside Bone Lichen in Canada.

Threat or Limitation	Priority[21]	Broad Strategy to Recovery	General Description of Research and Management Approaches
11.4 Storms and flooding	High	Public outreach and education	Raise awareness of park managers to leave downed trees where they fall in order to support existing lichens.
6.1 Recreational activities			Raise awareness of park visitors and encourage caution in critical habitat.
7.3 Other ecosystem modifications		Stewardship and conservation	Continued communication with the Department of National Defence (DND) to promote conservation of populations on their land.
1.1 Housing and urban areas	Medium	Stewardship and conservation	Communicate with landowners and developers to promote conservation of populations on their land.
1.3 Tourism and recreation areas			Communicate with DFO/Sheringham Point Lighthouse Preservation Society to promote conservation of populations on their land.
6.2 War, civil unrest, and military exercises			Continued communication with DND to promote conservation of populations on their land.
Knowledge gaps: Population and distribution; physiological requirements and population dynamics	Medium	Research and inventory	Obtain accurate occurrence data for all subpopulations and address knowledge gaps in distribution information. Monitor the possible expansion of the range extent of this species due to climate change.

[21] "Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

7. Critical Habitat

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. This recovery strategy identifies critical habitat to the extent possible, based on the best available information for Seaside Bone Lichen. More precise boundaries may be mapped, and additional critical habitat may be added in the future if additional research supports the inclusion of areas beyond those currently identified. Considerations in the identification of critical habitat are the amount, quality, and locations of habitat required to achieve the population and distribution objectives.

Critical habitat can only be partially identified at this time. Critical habitat cannot yet be completely identified for populations at Sheringham Point, Iron Mine Bay, or Alldridge Point, because of inadequate location information. Accurate occurrence data is lacking for several subpopulations within these populations, i.e., subpopulations which have location uncertainty distance of greater than 100 m and/or which have not been observed within the past 25 years (details of missing information is described in Table 2). Critical habitat cannot yet be completely identified at Rocky Point (the generalized area covering Bentinck Island, Church Point, and Christopher Point locations) because distribution information is unavailable. Is it is very likely that populations extend further along coastlines, and farther inland, than is currently documented (S. Crawford pers. comm.); as of 2012 the coastline areas between Rocky Point populations have not been surveyed, and surveys at known sites have only extended 30 m inland.

The critical habitat identified in this recovery strategy is necessary, but not sufficient to achieve the Population and Distribution objectives of Seaside Bone Lichen in Canada. A schedule of studies (section 7.2) has been developed to provide the information necessary to complete the identification of critical habitat.

7.1 Identification of the Species' Critical Habitat

Geospatial location of areas containing critical habitat

Critical habitat for Seaside Bone Lichen is identified to the extent possible, for the seven known extant populations on south Vancouver Island, B.C. (Figures 3-8):

- Sheringham Point
- Iron Mine Bay
- Alldridge Point
- Bentinck Island (Rocky Point area)
- Church Point (Rocky Point area)
- Christopher Point (Rocky Point area)
- Albert Head

The geospatial areas containing critical habitat for Seaside Bone Lichen are identified to include:

1. The area occupied by individual thalli or patches of thalli, for all records that meet accuracy and age criteria (i.e., have location uncertainty distance of less than 100 m and have been observed within the past 25 years).
2. An additional distance around the area of occupancy to accommodate the associated potential location error from GPS units (maximum 100 m, as above).
3. A minimum critical function zone[22] of 50 meters beyond the area of occupancy and the associated potential location error from GPS units.
4. Additional/associated area to 100 m inland from the coast
5. Connective coastline habitat is maintained between subpopulations, i.e., occurrences within 1 km of each other)

Biophysical Attributes of Critical Habitat

Within the area containing critical habitat (as described above), critical habitat is identified wherever the following biophysical attributes occur:

- Areas with high exposure to wind and sunlight, and
- Early to intermediate seral stage shoreline forest habitat, including one or more known host trees and shrubs: Shore Pine, Douglas-fir, Sitka Spruce, Oceanspray

Areas which do not meet the description of the above biophysical attributes (for example highly sheltered areas, non-treed areas, gravel/sand beaches, roads, and buildings) are not identified as critical habitat.

In total, 85.32 ha of area containing critical habitat for Seaside Bone Lichen is presented in Figures 3-8. Critical habitat for Seaside Bone Lichen in Canada occurs within the shaded yellow polygon(s) (unit(s)) shown on each map where the critical habitat criteria (i.e., biophysical attributes, as described above) are met. The 1 km x 1 km UTM grid overlay shown on these figures is a standardized national grid system that highlights the general geographic area containing critical habitat, for land use planning and/or environmental assessment purposes. A detailed critical habitat identification methodology is archived in a supporting document.

[22] Critical function zone distance has been defined as the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., critical light, moisture, humidity levels necessary for survival). Existing research provides a logical basis for including a minimum critical function zone distance of 50 m as part of critical habitat for rare plant species occurrences.

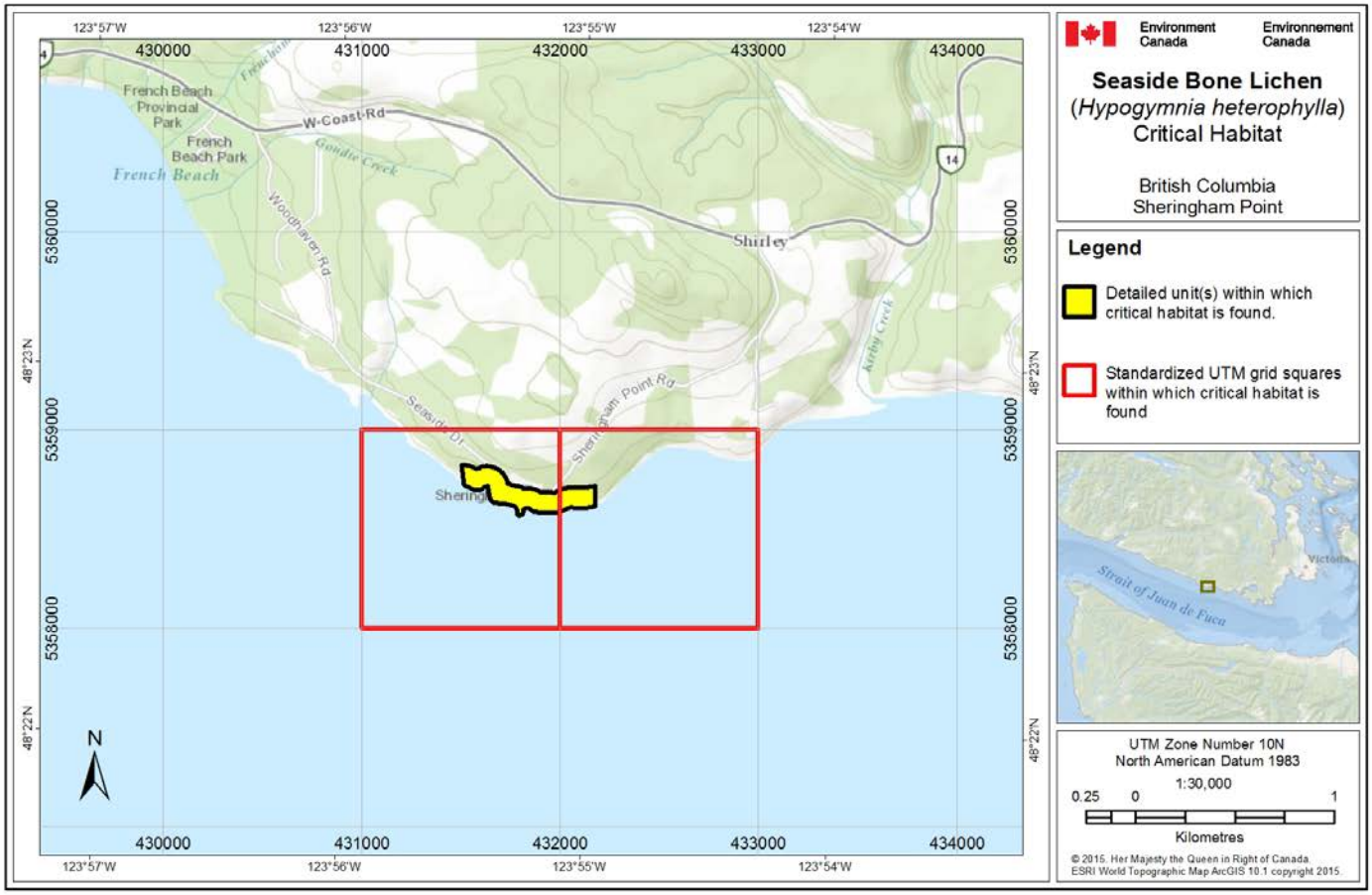

Figure 3. Critical habitat for Seaside Bone Lichen at Sheringham Point, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

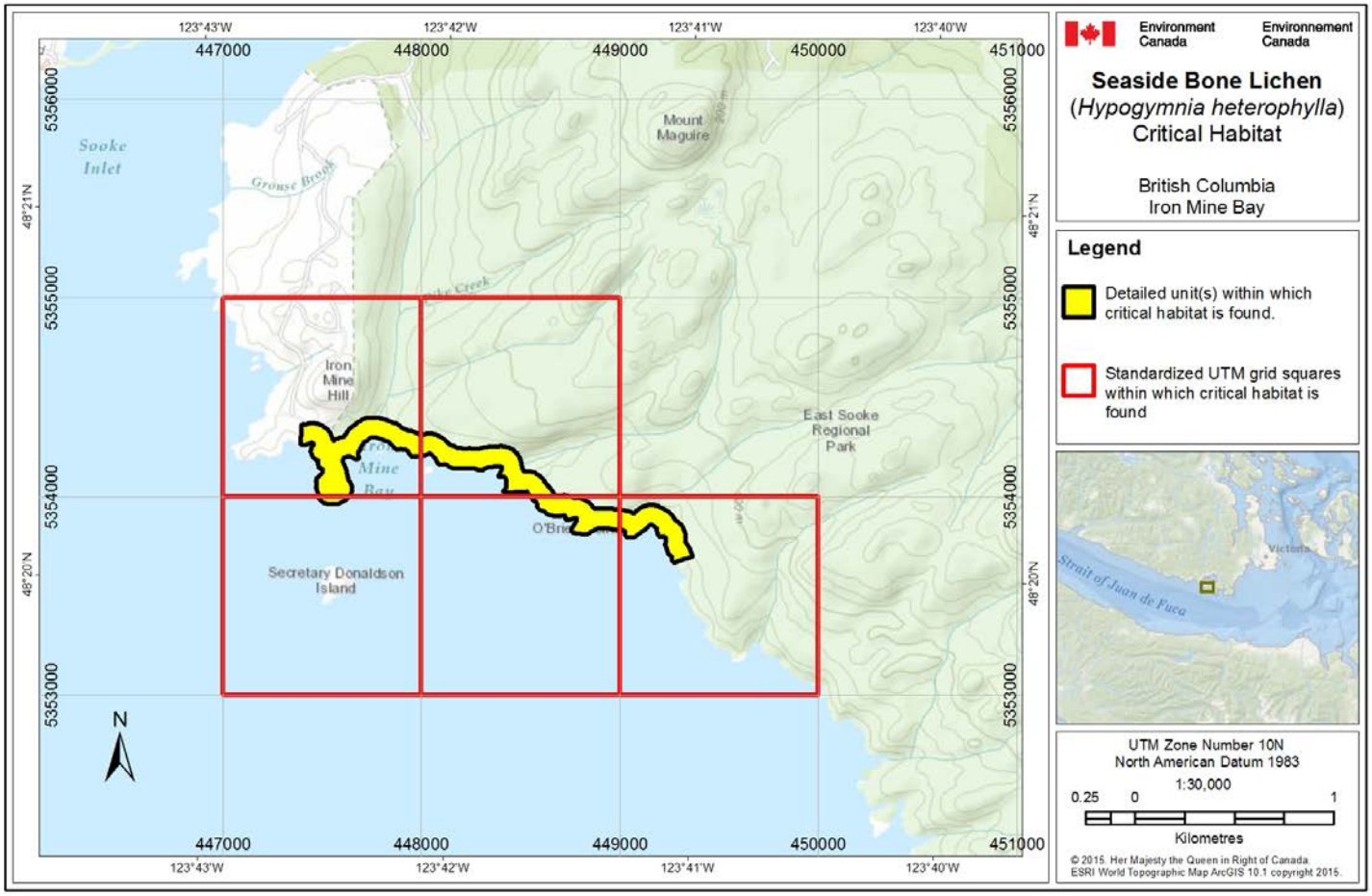

Figure 4. Critical habitat for Seaside Bone Lichen at Iron Mine Bay, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met.
The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

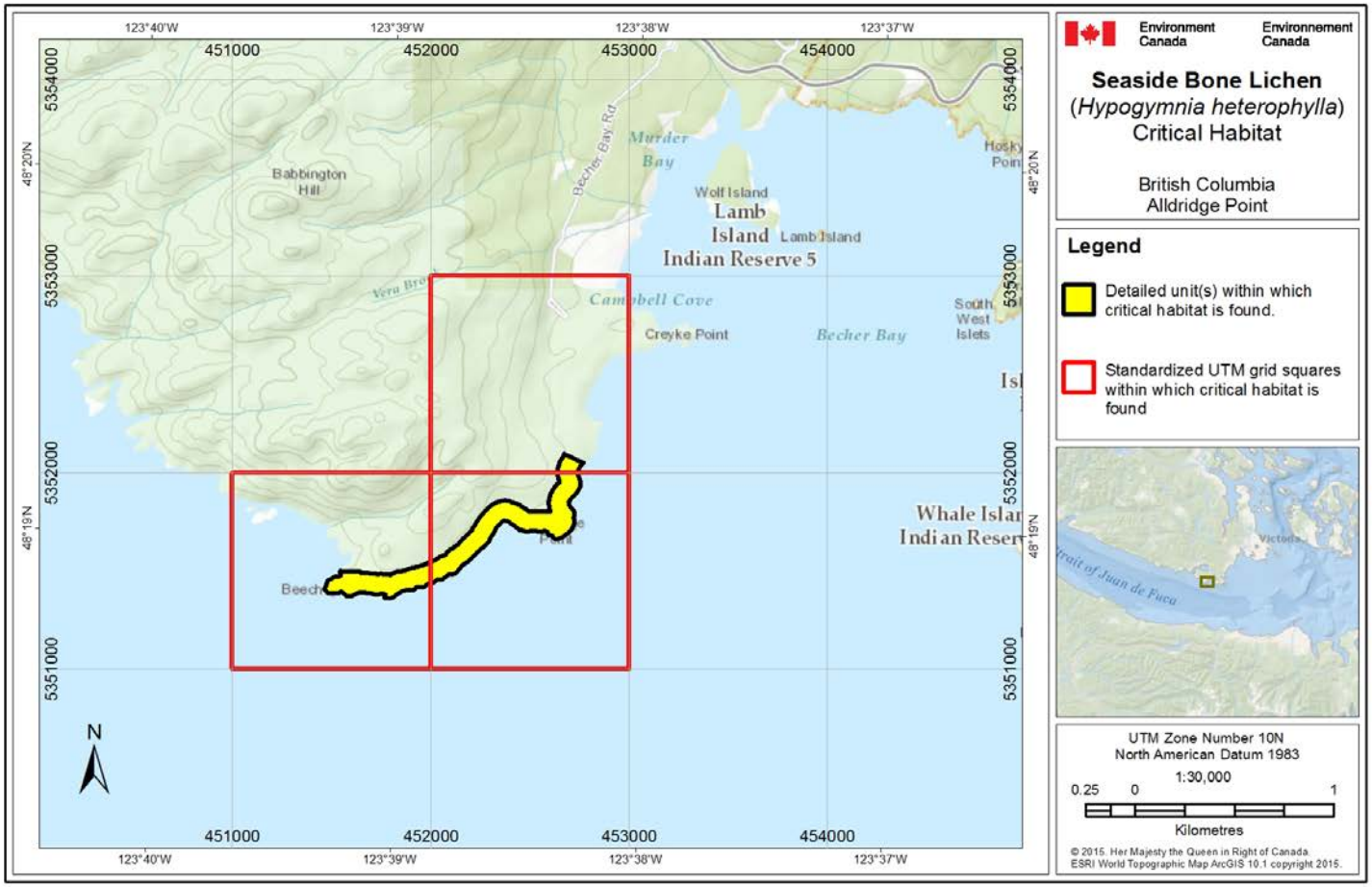

Figure 5. Critical habitat for Seaside Bone Lichen at Alldridge Point, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met.
The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

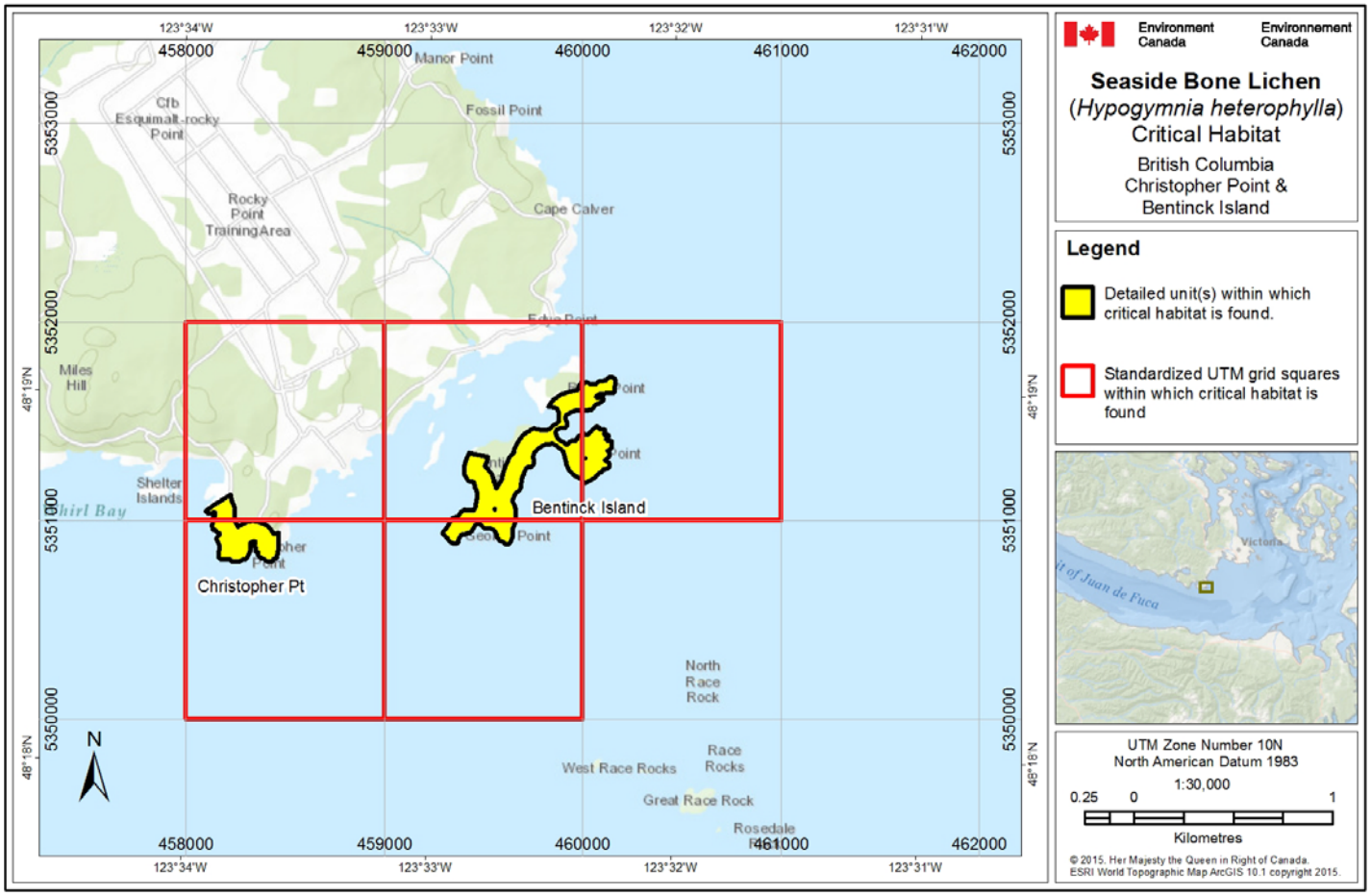

Figure 6. Critical habitat for Seaside Bone Lichen at Christopher Point and Bentinck Island, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

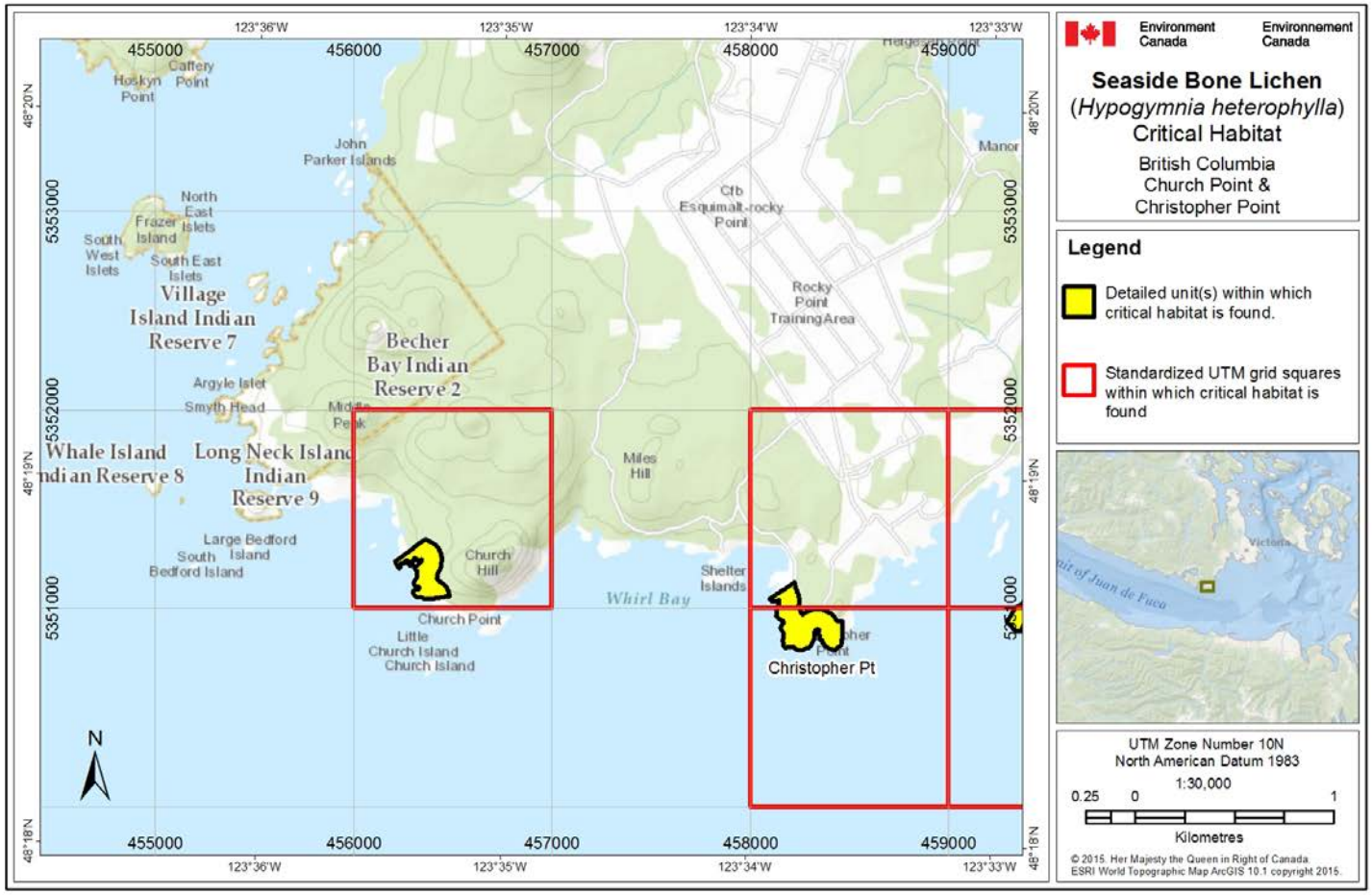

Figure 7. Critical habitat for Seaside Bone Lichen at Church Point and Christopher Point, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

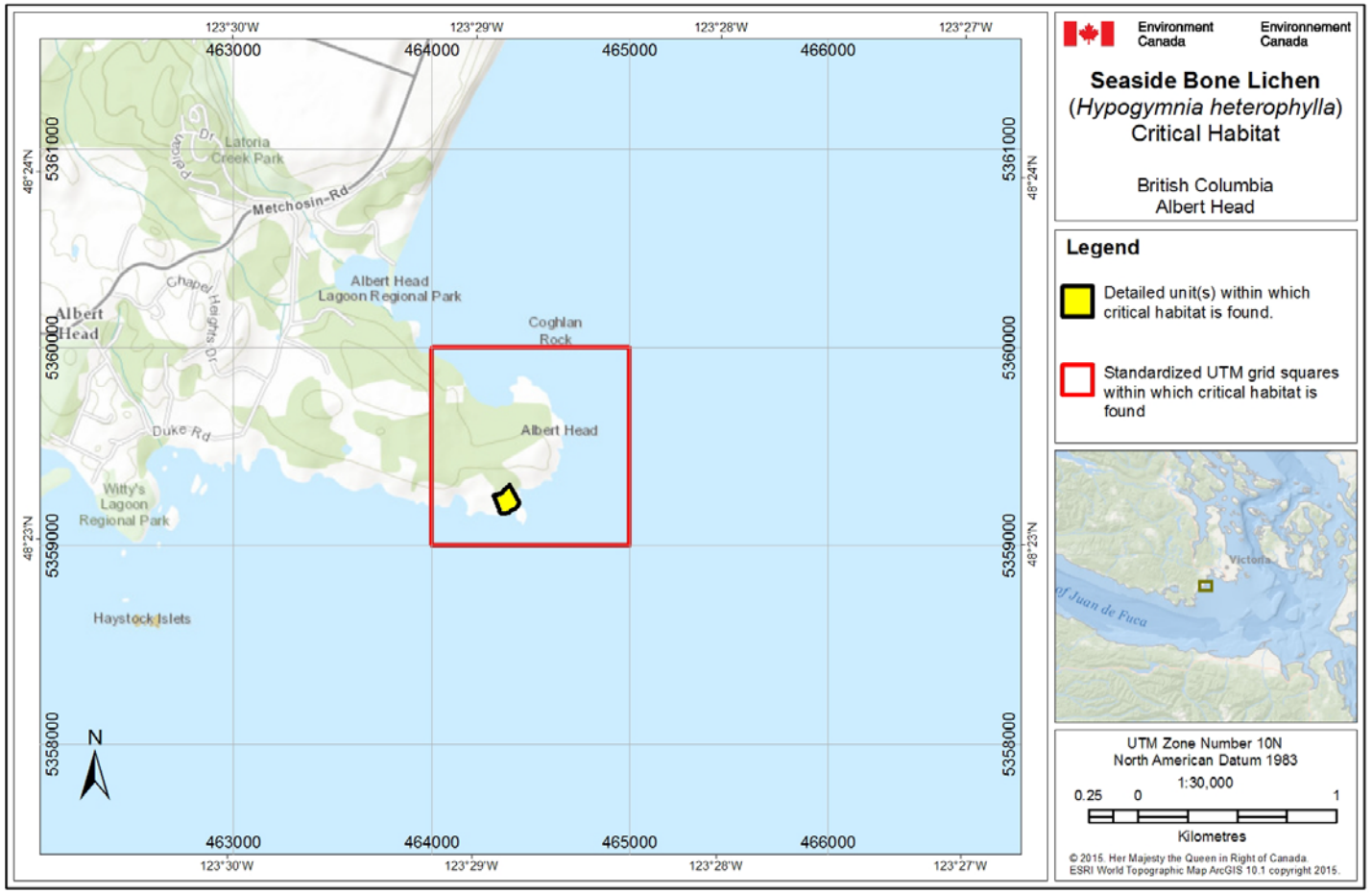

Figure 8. Critical habitat for Seaside Bone Lichen at Albert Head, B.C. is represented by the shaded yellow polygons (units) where the criteria and methodology set out in Section 7.1 are met.
The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

7.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies is required to complete the identification of critical habitat for Seaside Bone Lichen.

Table 5. Schedule of Studies to Identify Critical Habitat.

Description of Activity	Rationale	Timeline
Survey at Sheringham Point and French Beach	A record from 1975 identified as coming from Sheringham Point had contradictory coordinates locating it at French Beach to the west (Noble pers. obs. 1975). A population was found at Sheringham Point in 2006, though the exact location remains uncertain, and whether it is the same population from 1975 is unknown. The area requires a complete survey including geographic references so that critical habitat can be identified for all populations and subpopulations.	2016-2021
Survey at Iron Mine Bay and Alldridge Point	Accurate location information is missing for the subpopulations of Seaside Bone Lichen observed at Iron Mine Bay and Alldridge Point in 1991, and the subpopulations found in 1991 were different from those observed in 2006. These areas require complete surveys including geographic references so that critical habitat can be identified for all subpopulations.	2016-2021
Survey remainder of Rocky Point area (the generalized area covering Bentinck Island, Church Point, and Christopher Point locations)	Seaside Bone Lichen was found in an exceptionally high percentage of the areas surveyed at Rocky Point, but only a small portion of that coastline has been surveyed, and only to within 30 m of the ocean. The entire coastline area in this location requires a complete survey including geographic references so that critical habitat can be identified for all subpopulations.	2016-2021

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 6 include those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

Table 6. Examples of activities likely to result in the destruction of critical habitat of Seaside Bone Lichen in Canada. IUCN Threat numbers are in accordance with the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system (CMP 2010).

Description of activity	Description of effect in relation to function loss	Details of effect and related IUCN threats
Habitat loss by conversion of natural landscape, e.g.: - Residential development - Recreational or tourism development Habitat loss or degradation by intrusions and disturbance, e.g.: - Recreation activities - Military exercises - Conservation activities for other species	Removal of host trees or shrubs, and/or activities that cause inadvertent damage to their (living or dead) branches will reduce the amount of growing substrate for lichen, therefore destroying critical habitat.	Loss of growing substrate has a direct impact; one occurrence of loss could destroy critical habitat; must occur within critical habitat boundary to cause destruction; applicable at all times of year. Related to IUCN Threat # 1.1, 1.3, 7.3 Potential removal of habitat containing trees or shrubs may occur at population 1, 2, and 3 by landscape development for residential and/or recreational purposes. Related IUCN Threat # 6.1, 6.2, 7.3 Damage to trees may occur at populations 2 and 3 in East Sooke Regional Park due to the passage of hikers, cyclists and dogs along trails through Shore Pine stands. Damage to trees at population 1 may occur depending on nature of use, as there is public beach access at this site. Damage or destruction to trees and shrubs owing to military exercises and/or thinning of trees to reduce woody encroachment and promote co-occurring vascular plant species at risk is possible at sites 4, 5, 6, and 7.

8. Measuring Progress

Every five years, success of recovery strategy implementation will be measured against the following performance indicators, which provide a way to define and measure progress toward achieving the population and distribution objectives.

- Continued persistence of all extant populations of Seaside Bone Lichen, and any additional populations that may be discovered;
- The total Canadian population of Seaside Bone Lichen is maintained at, or has increased from, 2015 levels.

9. Statement on Action Plans

One or more Action Plans for the Seaside Bone Lichen will be posted on the Species at Risk Public Registry by 2021.

10. References

BC CDC (Conservation Data Centre). 2013. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria, British Columbia. Web site: http://a100.gov.bc.ca/pub/eswp/ [accessed March 2013].

BC Conservation Framework. 2013. Conservation Framework Summary: *Hypogymnia heterophylla*. B.C. Ministry of Environment. Web site: http://a100.gov.bc.ca/pub/eswp/ [accessed March 2013].

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven. 795 pp.

CMP (Conservation Measures Partnership). 2010. Threats Taxonomy. Web site: http://www.conservationmeasures.org/initiatives/threats-actions-taxonomies/threats-taxonomy [accessed March 2013].

COSEWIC. 2008a. COSEWIC assessment and update status report on the Seaside Bone Lichen *Hypogymnia heterophylla* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 20 pp.

COSEWIC. 2008b. Appendix 1 to the COSEWIC (2008a) status report provided by COSEWIC on 20-Feb-2013. [Different than the online version]. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1p.

CRD (Capital Regional District). 2010. Official Community Plan for Shirley/Jordan River. Bylaw No. 1, 2010.

CRD (Capital Regional District). 2014. Minutes of a Meeting of the Juan de Fuca Electoral Area Parks and Recreation Advisory Commission Held March 25, 2014. Otter Point, British Columbia.

Environment Canada. 1983. Principal Station Data, Victoria Gonzales Heights A: A summary of hourly weather observations, climate normals and extremes for Canadian principal climate stations. Canadian Climate Program publication PSD-21. Canadian Government Publishing Centre, Supply and Services Canada: Ottawa, Canada.

Environment Canada. 2013. Canadian Climate Normals 1971-2000. Web site: http://www.climate.weatheroffice.gc.ca/climate_normals/index_e.html [accessed March 2013].

Environment Canada. 2007. Guidelines on identifying and mitigating threats to species at risk [August 2007 draft]. Environment Canada, Ottawa, Ontario. 29 pp.

Glavich, D.A. 2003. The distribution, ecology, and taxonomy of *Bryoria spiralifera* and *B. pseudocapillaris* on the Samoa Peninsula, Humboldt Co., coastal northern California. Bryologist 106: 588-595.

Glavich, D.A., L.H. Geiser and A.G. Mikulin. 2005. Rare epiphytic coastal lichen habitats, modeling, and management in the Pacific Northwest. Bryologist 108(3):377-390.

Government of Canada. 2009. *Species at Risk Act* Policies, Overarching Policy Framework [Draft]. Ministry of Environment. Web site: http://dsp-psd.pwgsc.gc.ca/collection_2009/ec/En4-113-2009-eng.pdf [accessed March 2013].

Goward, T. 1996. Status report on the Seaside Bone Lichen, *Hypogymnia heterophylla*, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. 36 pp.

Goward, T. and H. Knight. 1991. Specimens collected on 21-Sep-1991 and accessioned at the University of British Columbia herbarium and the Canadian National Herbarium. Accession nos. UBC L26165; CANL 120024; UBC L26674; UBC L26684; CANL 113386; UBC L26673; UBC L26696; CANL 113387.

Goward, T., B. McCune, and D. Meidinger. 1994. The lichens of British Columbia: illustrated keys. Part 1 — Foliose and squamulose species. British Columbia Ministry of Forests Special Report Series 8:1–181.

Marsh, J. 2012. Seaside Bone lichen (*Hypogymnia heterophylla* L Pike) survey at Rocky Point, BC, May 23, 2012. Prepared for Natural Resources Canada, Canadian Forest Service, Federal Lands Program.

Marsh, J., pers. comm. 2013. Email correspondence to S. Crawford and K. Sadler. April 2013. Vegetation Consultant, Okotoks, Alberta.

Master, L., D. Faber-Langendoen, R. Bittman, G.A. Hammerson, B. Heidel, J. Nichols, L. Ramsay, and A. Tomaino. 2009. NatureServe conservation status assessments: factors for assessing extinction risk. NatureServe, Arlington, VA. <http://www.natureserve.org/publications/ConsStatusAssess_StatusFactors.pdf>

Meidinger, D. and Pojar, J. 1991. Ecosystems of British Columbia. British Columbia Ministry of Forests. 330 pp. Web site: http://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/SRseries.htm [accessed March 2013].

Ministry of Environment. 2009. Conservation Framework: Conservation priorities for species and ecosystems. Web site: http://www.env.gov.bc.ca/conservationframework/documents/CF_Primer.pdf [accessed March 2013].

Natural Resources Canada. 2014. Lichen Inventory of Albert Head, Vancouver Island British Columbia. Technical report prepared for NRCan by C. Bjork, R. Batten, & Trevor Goward.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1, last updated October 2012. NatureServe, Arlington, Virginia. Web site: http://explorer.natureserve.org [accessed March 2013].

Noble, W. J. 1975. Specimen collected on 20-Jun-1975 and accessioned at the University of British Columbia herbarium. Accession no. UBC L38940.

Paperboard Packaging Council. (2008, July 9). Meeting of the PPC Board of Directors. Archives of the American Forest Products Association, Washington, DC.

Pike, L. and M.E. Hale. 1982. Three new species of *Hypogymnia* from western North America (Lichenes: Hypogymniaceae). Mycotaxon 16:157-161.

Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22:897–911.

Spittlehouse, D.L. 2008. Climate Change, impacts, and adaptation scenarios: climate change and forest and range management in British Columbia. B.C. Ministry of Forest and Range, Research Branch, Victoria, B.C. Technical Report 045. Web site: http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr045.htm [accessed March 2013].

Werner, A.T. 2011. BCSD Downscaled Transient Climate Projections for Eight Select GCMs over British Columbia, Canada. Pacific Climate Impacts Consortium, University of Victoria, Victoria, BC. 63 pp.

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*[23]. 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 any of the Federal Sustainable Development Strategy's[24] (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also 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 strategy itself, but are also summarized below in this statement.

Recovery approaches outlined in this strategy focus primarily on increasing our knowledge of Seaside Bone Lichen, conserving the species' natural habitat, and public education. The recommended habitat conservation will indirectly benefit other lichen species that require the same microhabitat as Seaside Bone Lichen, such as other lichen species that grow on Shore Pine branches including *Hypogymnia enteromorpha, H. inactiva, H. physodes, H. imshaugii, Melanelixia subaurifera, Parmelia sulcata, Platismatia herrei, Ramalina farinacea, R. menziesii, Tuckermannopsis orbata, Usnea cavernosa, U. ceratina* and other *Usnea* spp.

Recovery efforts for Seaside Bone Lichen may potentially conflict with recovery approaches for plant species at risk in Garry Oak ecosystems. Seaside Bone Lichen depends on early to intermediate seral Shore Pine forests; however, encroachment by woody plants is an identified threat to vascular plants of Garry Oak maritime meadows. Currently, maritime meadows at Rocky Point and Bentinck Island face serious threats from expansion and infilling of Shore Pine. An important component of recovery action planning will be multi-jurisdictional planning to anticipate and monitor potential collateral effects (both positive and negative) on non-target species, communities, and ecological processes. Recovery planning activities for Seaside Bone Lichen will be implemented with consideration for all co-occurring species at risk, such that there are no negative impacts to these species or their habitats.

[23] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[24] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1