

Recovery Strategy for the Seaside Centipede Lichen (*Heterodermia sitchensis*) in Canada

Seaside Centipede Lichen



February 2007



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About the Species at Risk Act Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is “*to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.*”

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species’ persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What’s next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the Species at Risk Act and recovery initiatives, please consult the SARA Public Registry (<http://www.sararegistry.gc.ca/>) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

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DECLARATION

Under *the Accord for the Protection of Species at Risk* (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act* (S.C. 2002, c. 29) (SARA) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Minister of the Environment presents this document as the recovery strategy for the Seaside Centipede Lichen as required under SARA. It has been prepared in cooperation with the jurisdictions responsible for the species, as described in the Preface. The Minister invites other jurisdictions and organizations that may be involved in recovering the species to use this recovery strategy as advice to guide their actions.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide further details regarding measures to be taken to support protection and recovery of the species. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this strategy. In the spirit of the *Accord for the Protection of Species at Risk*, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the species and of Canadian society as a whole. The Minister of the Environment will report on progress within five years.

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PREFACE

This Recovery Strategy addresses the recovery of the Seaside Centipede Lichen. In Canada, the species range is restricted to the west coast of Vancouver Island in British Columbia. All occurrences are on federal (Pacific Rim National Park Reserve of Canada) and provincial lands.

The Parks Canada Agency led the preparation of this recovery strategy with the members of the Seaside Centipede Lichen Recovery Team, and in cooperation with the Province of British Columbia, Environment Canada/Canadian Wildlife Service, Department of Fisheries and Oceans, and First Nations.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

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*. 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.

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 on non-target species or habitats. The results of the SEA are incorporated directly in the strategy itself, but are also summarized below.

The Recovery Strategy for the Seaside Centipede Lichen (*Heterodermia sitchensis*) in Canada underwent a strategic environmental assessment (SEA) review in accordance with the 2004 *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*.

Impact assessment methodology focussed on identification and assessment of actions capable of generating environmental effects. Positive and negative impacts were considered. Scope of the assessment included review and evaluation of all actions proposed in the Recovery Strategy for the Seaside Centipede Lichen in Canada. Proposals thought to have potential to generate significant environmental effects were assessed and documented in greater detail. Results of the assessment are briefly discussed here. Please consult the Strategic Environmental Assessment of the Recovery Strategy for the Seaside Centipede Lichen in Canada, for detailed environmental assessment documentation.

The Recovery Strategy identified current threats to the Seaside Centipede Lichen and its habitat. Knowledge gaps were also identified. Recovery objectives and actions clearly focus on resolving specific threats and information gaps. Actions proposed in the recovery strategy have little potential to produce significant adverse environmental effects. The majority of actions are innocuous by nature. Actions involving fieldwork (inventory, monitoring, research) have the greatest potential to generate negative environmental effects. All fieldwork impacts are avoidable or can be fully mitigated with known technology.

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 recovery strategy and SEA therefore assessed the potential for the strategy to inadvertently produce adverse effects on other species. Results indicate likely benefits to the Seaside Centipede Lichen and other species occupying the same habitat. Recovery strategy implementation is expected to result in increased retention of coastal old-growth forest, and improved knowledge and understanding of Seaside Centipede Lichen ecology in Pacific Northwest coastal environments. An improved ecological understanding of the species is beneficial, as it will help to focus current and subsequent recovery planning actions for the species and improve the probability for successful recovery. The net environmental effect of the recovery strategy is expected to be positive to both the species and the habitat in which it exists.

Some proposals described in the recovery strategy are conceptual. It is not possible to fully evaluate the environmental effects of these initiatives at this time. As more detailed information becomes available, projects will be assessed pursuant to the provisions of the *Canadian Environmental Assessment Act (CEAA; S.C. 1992, c. 37)*. The Parks Canada Agency is a Responsible Authority under the *CEAA*. The Agency will not undertake any project prior to preparing an environmental assessment and deciding on a course of action to approve, not approve, or refer the project for additional EA review.

EXECUTIVE SUMMARY

Background

The Seaside Centipede Lichen (*Heterodermia sitchensis* Goward and Noble) was described in the mid 1980s from the west coast of Vancouver Island, British Columbia (Goward 1984). It received official status in 1996 as Endangered in Canada on the basis of its highly restricted global distribution, its endemic status in Canada, its specialized ecological requirements, and its extreme vulnerability to habitat degradation. The known population in Canada numbers 212 thalli, almost 90 percent of these in only five localities. Repeated surveys indicate a declining population at many sites.

Biological limitations and threats

Some important biologically limiting factors for Seaside Centipede Lichen include the following: It is known only from near the high tide zone, the majority in old Sitka Spruce trees with a cylindrical canopy. It only reproduces asexually and appears to be a poor disperser. It is only found in regions of very high moisture and fog. It may be limited to sites offering some protection from full exposure to maritime conditions. It prefers sites with basic rather than siliceous bedrock. It is benefited by and requires secondary nutrient enrichment at most sites where it occurs. Key threats for Seaside Centipede Lichen include natural or anthropogenic climate changes, increased severity of weather patterns, habitat loss through forest harvesting, foreshore development, branch collection, pruning or other disturbance, and disruption of natural patterns of nutrient distribution.

Recovery feasibility

Based on the four feasibility criteria, recovery is considered feasible: First, there are a number of individuals still extant. Second, there is habitat available to support the species. Third, it appears that many threats can be mitigated or avoided. Fourth, there has not been enough study into recovery techniques for this species; therefore, their effectiveness is unknown.

Recovery goals and objectives

The overall goal for the recovery of Seaside Centipede Lichen is to maintain a self-sustaining population within its historic range in Canada that would enable COSEWIC to recommend downlisting the species from Endangered to Threatened. This goal will be achieved by habitat protection, suitable site management, public education, further research, monitoring, and reporting. No critical habitat, as defined under the federal *Species at Risk Act*, is proposed for identification at this time. A Recovery Action Plan (RAP) for Seaside Centipede Lichen will be completed by January 2010.

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SPECIES INFORMATION

Common Name: Seaside Centipede Lichen

Scientific Name: *Heterodermia sitchensis*

COSEWIC Status: Endangered

Reason for designation: This is a foliose lichen restricted to shoreline Sitka Spruce trees on the west coast of Vancouver Island. It has been documented from only ten locations in Canada, 11 worldwide. It requires high levels of nitrogen, so is restricted to sites subject to nitrogen enrichment, for example, sea lion haul-out sites and bird nest sites. The species may have poor dispersal abilities. It is highly vulnerable to tsunamis, and intensified winter storm activity associated with global warming.

Canadian Occurrence: BC

COSEWIC Status History: Designated Endangered in April 1996. Status re-examined and confirmed in May 2000 and in April 2006. Last assessment based on an update status report.

1 BACKGROUND

1.1 Species Description

Seaside Centipede Lichen is a semi-erect, cushion-forming, foliose lichen to about 2 cm across. The lobes are short to elongate, 1–2 mm wide, and furnished with long thin "eyelashes" (cilia). The upper surface is pale greenish and often bears scattered whitish "spots". Mature specimens usually have urn-shaped apothecia near the lobe tips, these with prominent rims bearing ring-shaped soralia on their inner surface. The thallus is white and cottony (noncorticate) below and bears long, blackish marginal cilia. A more detailed description is given in Goward (1984).

1.1.1 Distribution¹

Seaside Centipede Lichen is endemic to the Pacific Northwest of North America. At the time of its description in the mid 1980s, it was known from only two sites on the west coast of Vancouver Island. The first of these was Schooner Cove in Pacific Rim National Park Reserve and the second was near Ucluelet on the Ucluth Peninsula. Unfortunately, it disappeared from the latter locality in the early 1990s as a result of clearcut logging for subdivision development (Goward 2001). Since then intensive surveys have located it at a number of locations in Canada (Table 1) and two specimens have been reported from Cape Lookout in Oregon (McHenry and Tónsberg 2002). Seaside Centipede Lichen is ranked S2S3 (imperilled to vulnerable) in BC and G2G3 globally (NatureServe 2005).

¹ In the discussion on distribution, the term "site" is used to refer to occurrences of *H. sitchensis* on the scale of a single tree or a few adjacent trees. "Locality" designates an assemblage of more or less neighbouring sites.

After four years of search effort (2001–2004) the known population in Canada numbers 212 thalli (based on the most recent counts at each site; Goward and Wright 2003, Wright 2004). Almost 90 percent of these are restricted to five localities: Florencia Island, Wouwer Island, Folger Island, Lawrence Islets, and the Spring Island area. Elsewhere the occurrence of this species is highly localized.

Table 1: Seaside Centipede Lichen (*Heterodermia sitchensis*) occurrences in Canada (PRNPR = Pacific Rim National Park Reserve, BC = Province of British Columbia Crown land). Table is organized by observation year.

Site description	Observation year	Jurisdiction	Status, if known	Thalli #
Schooner Cove A	1983	PRNPR		15
Ucluth Peninsula A	1983	Town of Ucluelet		5
TOTAL OBSERVED THALLI – 1983				20
Schooner Cove A	1991	PRNPR	Stable	15
TOTAL OBSERVED THALLI – 1991 (Status Report prepared in 1994 based on this data)				15
Ucluth Peninsula A	NA	Town of Ucluelet	Extirpated in early 1990's	
Schooner Cove A	2001	PRNPR	Declining	1
Florencia Bay North	2001	PRNPR		3
Wickaninnish South	2001	PRNPR		2
Wickaninnish S - Village	2001	PRNPR		1
Florencia Island	2001	PRNPR		60
Ucluth Peninsula B	2001	BC		2
Wouwer Island	2001	PRNPR		42
Small Islet near Wouwer Island	2001	PRNPR		2
Dicebox Island	2001	PRNPR		1
Lawrence Islets	2001	BC		1
TOTAL OBSERVED THALLI - 2001				115
Florencia Island	2002	PRNPR		27
Lawrence Islets	2002	BC		21
Schooner Cove A	2002	PRNPR	Declining	1 thallus dying
East of Schooner Cove A	2002	PRNPR	Declining	3 (2 thalli dying)
Wouwer Island	2002	PRNPR	Declining	12
Folger Island	2002	BC		18
Benson Island	2002	PRNPR		1
TOTAL OBSERVED THALLI - 2002				83
Spring Island (Kyuquot Sound)	2004	BC		6
Unnamed Island (Kyuquot Sound)	2004	BC		48
TOTAL OBSERVED THALLI - 2004				54

Global range

Seaside Centipede Lichen is only known from the west coast of Vancouver Island in British Columbia, Canada and from one site on the Oregon coast. The latter site, Cape Lookout in Coastal Oregon (McHenry and Tønsberg 2002), is a narrow peninsula jutting 2 km into the Pacific Ocean.

Canadian range

Approximately 20 locations on the west coast of Vancouver Island are currently known. The majority of these occur within Pacific Rim National Park Reserve (Table 1). In 2002, new occurrences located outside the park were on Folger Island and Lawrence Islets. Folger Island is located near Bamfield between the Broken Group Island Unit and the West Coast Trail Unit of Pacific Rim National Park Reserve. Lawrence Islets are located north of Pacific Rim National Park Reserve between Vargas and Bartlett islands in Clayoquot Sound. The Canadian range was extended approximately 130 km to the northwest in 2004 when two sites were found in Kyuquot Sound.

Percent of Global Distribution in Canada

Almost 100% of the global distribution occurs in Canada. Seaside Centipede Lichen is known from only one site outside Canada.

1.1.2 Population Sizes and Trends

Some previously known sites, including Schooner Cove in Pacific Rim National Park Reserve, have been resurveyed (Table 1). The Schooner Cove locality has been in decline for several years, in 2002 significantly fewer thalli were observed and the remaining thalli were noted to be in poor condition. Other sites resurveyed in 2002 showed a similar trend of declining thalli numbers and health from the previous year. It is believed that inordinately severe winter storms during the winter of 2001/2002 resulted in the loss of specimens and reduced vigour at many sites. Longer-term comparisons from the Schooner Cove locality suggest that Seaside Centipede Lichen is short-lived and must frequently colonize new sites. It is not known whether Seaside Centipede Lichen has been significantly affected by human activities or whether its abundance is similar to historic levels.

1.1.3 Description of the species' needs

Biological needs and limiting factors

Seaside Centipede Lichen is a pioneer lichen largely confined to small twigs. It reproduces asexually. As with other pioneer lichens it tends to be short-lived, enduring perhaps 10 to 15 years until such time as it is out-competed by more aggressive lichens and bryophytes. This observation may be key to understanding its status as a rare species; while Seaside Centipede Lichen has adopted a life strategy based on a requirement for frequent dispersal and colonization, it also appears to be a poor disperser. The life history of Seaside Centipede

Lichen suggests a particular sensitivity to habitat modification and a strong dependence on the maintenance of robust coastal ecosystems.

Seaside Centipede Lichen appears to lead a very precarious existence as a site must satisfy many peculiar conditions for successful colonization and growth. For instance, the frequent association of Seaside Centipede Lichen with the perch branches of birds suggests this species is not stable at most sites; though the host trees themselves may be long-lived, the branches supporting Seaside Centipede Lichen are likely to be relatively ephemeral.

Ecological Role

Seaside Centipede Lichen is not known to serve a critical or keystone ecological function, no other species are known to be dependant upon it. It appears to have a very complex life history, but this does not translate into important ecological function for other species or ecosystem processes. It does play a role in trapping marine-derived nutrients in a terrestrial system. We anticipate that further research into nutrient cycles on the Pacific coast will reveal more species and processes which demonstrate sea to shore cycling to be a very important function in coastal terrestrial environments.

It is well known that lichens are important sentinels of environmental change. Seaside Centipede Lichen and associated lichen species may fit well into environmental monitoring strategies as indicators of environmental change and/or degradation.

Habitat needs

Seaside Centipede Lichen is a tree-dwelling lichen found to date only on Sitka Spruce (*Picea sitchensis*). Seaside Centipede Lichen is not distributed at random, rather this species exhibits several clear and to a large extent predictable patterns of distribution. Some of the important habitat features required by Seaside Centipede Lichen include the following (Goward 2001, Goward and Wright 2002):

- It is known only from Sitka Spruce branches within several metres of the high tide zone. Existing evidence suggests that Seaside Centipede Lichen may be more abundant in the lower portions of the Sitka Spruce canopy (however, see Section 1.5). A majority of Seaside Centipede Lichen finds were made on old trees having a more or less cylindrical canopy structure (young regenerating trees with more conical canopies rarely support this species). Seaside Centipede Lichen is found on bark in defoliated portions of young branches.
- It is only found in regions of very high moisture such as those exposed to frequent fog banks or spindrift.
- It may be limited to sites offering some protection from full exposure to maritime conditions such as leeward sides of bays, inlets, islands, and islets and the sheltered portions of capes, headlands, spits, and peninsulas.
- It is benefited by and requires secondary nutrient enrichment at most sites where it occurs. Key factors associated with the requirement for nutrient enrichment include basic bedrock geology (calcium rich rock: limestone, dolomites, etc.) and/or secondary nutrient enrichment. Observed sources of this nutrient enrichment include—

- wildlife attracted to certain shoreline sites (islands, capes, headlands, spits, and peninsulas),
- bird droppings beneath frequently used bird perches,
- aerosols from breath and scat of sea lions on haul-outs and wintering grounds,
- fecal bombing from seabirds flying to or from a colony,
- aboriginal midden sites.

In general four broad factors largely predict the presence of this species: ocean proximity, old or slow growing Sitka Spruce, partly defoliated branches, and nutrient enrichment (Goward and Wright 2002). The specific habitat requirements of Seaside Centipede Lichen result in a limited supply of suitable habitat.

In addition, suitable habitat may be further restricted to old-growth forests. Few ecologically and geographically restricted epiphytic lichens are known to occur in second-growth forests (Goward 1994b). By virtue of their structural homogeneity and especially their environmental instability, second-growth forests are unsuited to colonization by most lichens growing at or near the ecological limits of their range (Goward 1994a). In contrast, old-growth forests are structurally much more heterogeneous and environmentally more stable (Franklin et al. 1981), and so permit colonization by a much wider assortment of species including those with poor dispersal abilities (Goward 1993, 1994 a and b).

It is perhaps useful to also describe habitats that tend not to support Seaside Centipede Lichen. Localities lacking a fringe of Sitka Spruce are one such habitat. The general scarcity of Sitka Spruce in the inner islands of the Broken Group reduce the chances that Seaside Centipede Lichen will be found there at any level of abundance. Sites supporting only young spruce trees usually lack Seaside Centipede Lichen. Young trees generally have a conical growth form not conducive to enrichment by perching birds or dripzone effects. Finally, as already suggested, mainland localities support Seaside Centipede Lichen at much lower levels of abundance than their island counterparts.

1.2 Threats

The following points are the primary natural or human-induced threats that have been observed to impact Seaside Centipede Lichen population and habitat.

1.2.1 Habitat loss

Much of the known information on the biology of this species indicates that it would be extremely vulnerable to elimination of a portion of its range. Its suspected vulnerability is based on an apparently short lifespan, poor dispersal ability, highly specific habitat requirements, the ephemeral nature of its preferred habitat, and limited suitable habitat availability (details in Section 1.1.3).

Habitat loss through activities such as foreshore development, forest harvesting, pruning, branch collection, or other disturbance are a major threat to Seaside Centipede Lichen. One of two Seaside Centipede Lichen sites discovered in 1983 has been lost due to site clearing for

subdivision development. This effect is site-specific. Site restoration after host tree loss would take at least 50 years and probably much longer for a suitably sized Sitka Spruce tree to develop.

Significant populations of Seaside Centipede Lichen occur mostly in the lower branches of Sitka Spruce trees. Site clearing by homeowners or other land stewards to gain better access to the coast or improve the view of the ocean can involve removal of these lower branches and loss of Seaside Centipede Lichen and/or its habitat. Furthermore, collection of the easily accessible lower branches for firewood could lead to significant habitat loss.

Forest harvesting is a threat if harvesting occurs near sites with Seaside Centipede Lichen. Harris (1984) suggests that a buffer strip of trees would have to be at least 60 metres wide to preserve the highly specific microclimatic conditions required by more sensitive epiphytic lichens.

1.2.2 Disruption of natural patterns of nutrient distribution

This species depends on localized nutrient enrichment, often mediated by local wildlife. Any change in patterns of use on sea lion haul-outs, a reduction in raptor or seabird populations, or seabird colony disruption poses a threat to existing Seaside Centipede Lichen populations. Many factors including foreshore development, loss of bird perches, and food availability can influence numbers of seabirds, raptors, and marine mammals. Other activities or effects that can potentially alter ecosystem processes, degrade Seaside Centipede Lichen habitat, and impact the ability of Seaside Centipede Lichen to maintain a self-sustaining population include pollution, climate change, human population growth, urbanization, logging, and tourism.

It is unknown what impacts coastal development may have on the distribution of raptors, seabirds, and marine mammals which all appear to play a critical role in the nutrient enrichment requirements of Seaside Centipede Lichen.

1.2.3 Increased severity of weather patterns

Some of the warmest years recorded since weather records have been kept occurred in the last decade or two; this pattern of warming seems to be accompanied by an increase in the frequency and severity of storm events. An increased severity of winter storms can result in branches hosting Seaside Centipede Lichen to be repeatedly sprayed with salt water and violently washed by breaking waves. All populations would be expected to suffer to some degree by deteriorating winter weather conditions. However, due to specific geography of the coast and predominant fetch, specific populations may be devastatingly impacted by storm events. Some Seaside Centipede Lichen populations will be afforded a relatively high degree of protection from severe winter storm events due to their occurrence on the leeward side of islands. The effects of severe winter weather patterns were apparent during the field study conducted in June 2002 (Goward and Wright 2003). The effects of wave action were clearly evidenced on affected branches, and several specimens had died or were in poor vigour.

1.2.4 Natural or anthropogenic climate changes

Natural or human-influenced drying conditions could be precipitated if global warming trends prove to be a longer-term phenomenon. This could adversely affect all populations of Seaside Centipede Lichen.

1.3 Critical Habitat

1.3.1 Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* [s2], is proposed for identification at this time.

While much has been learned about the habitat of the Seaside Centipede Lichen, more definitive work must be completed before any specific sites can be formally proposed as critical habitat. It is expected that critical habitat will be proposed within one or more recovery action plans following consultation and development of stewardship options with affected landowners and organizations and completion of outstanding work required to quantify specific habitat and area requirements for the species.

Notwithstanding the above, information on the current state of knowledge regarding habitat needs and sites of occupation are included in this recovery strategy. This section describes, to the extent possible, the occupied and potential habitat, examples of activities which are likely to destroy critical habitat, and a schedule of studies required to define critical habitat.

Occupied Habitat

All known sites (Table 1), as well as sufficient dispersal habitat, and important ecosystem functions should be considered during the process of critical habitat identification—it is likely that critical habitat identification will need to occur on a site by site basis and consider metapopulation² dynamics.



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Potential Habitat

This recovery strategy endorses the retention of existing habitat for the survival of Seaside Centipede Lichen and is not suggesting recovery of degraded habitat where the species was present historically.

² The assemblage of discrete local populations in an area connected by dispersal or migration.

1.3.2 Examples of activities likely to result in destruction of critical habitat

- Foreshore development, forest harvest, branch collection for firewood, branch pruning or tree clearing, and logging of old- or older-growth coastal fringe forests all have the potential to directly affect individuals and habitat by removal of Sitka Spruce trees or lower branches.
- Human induced changes in nutrient distribution patterns which are often mediated by local wildlife could be caused by pollution, human population growth, urbanization, and tourism and would impact the species by altering, reducing, or eliminating nutrient enrichment in otherwise suitable habitats.
- Human induced atmospheric modifications resulting in climate change could have a variety of effects including a drying trend and increased storm severity either of which would degrade or eliminate current habitat.

1.3.3 Existing and recommended approaches to habitat protection

The core of the known range of Seaside Centipede Lichen is within Pacific Rim National Park Reserve (10 of 15 extant sites) where it is afforded protection under the regulations of the *Canada National Parks Act* (S.C. 2000, c. 32) and the *Species at Risk Act*. Regulations under the *Canada National Parks Act* prohibit collection of plant material including tree branches. *National Park General Regulations* state, “No person shall remove, deface, damage or destroy any flora or natural objects in a Park except in accordance with a permit issued under subsection 11(1) or 12(1).” Habitat availability should remain relatively constant within Pacific Rim National Park Reserve.

The land tenure of the remainder of the known Seaside Centipede Lichen range (5 of 15 sites) is uncertain. Once land tenure has been established, appropriate mechanisms will be used to protect Seaside Centipede Lichen critical habitat, including possibly other legislations as appropriate.

1.3.4 Schedule of studies to identify critical habitat

Survey Requirements

- Identify and field survey suitable habitat for Seaside Centipede Lichen on the west coast of Vancouver Island between Tofino and Nootka Island. Assess the size of any discovered populations and record their coordinates. Completion date: 2007.
- Survey the central British Columbia coast for Seaside Centipede Lichen. Completion date: 2008
- Continue to survey Pacific Rim National Park Reserve and environs for new Seaside Centipede Lichen occurrences and other rare lichen species. Through 2006—2010.

Biological/Ecological Research Requirements

- Continue research on pH and microelement requirements of Seaside Centipede Lichen and associated lichen species. This research should include an analysis of lichen communities

occurring under environmental conditions dissimilar to those required by Seaside Centipede Lichen. Completion date: 2007.

- Investigate dispersal and recruitment in order to estimate the amount and configuration of occupied and unoccupied habitat needed to achieve the recovery program objective of a self-sustaining healthy population of Seaside Centipede Lichen. Completion date dependant on the outcome of studies.

1.4 Actions Already Completed or Underway

- In 2001 and 2002 research was undertaken by Parks Canada to improve knowledge about Seaside Centipede Lichen and other rare lichens in the Pacific Rim National Park Reserve region (Goward 2001, Goward and Wright 2003). Results have increased the known occurrences from one site to more than 20 and indicate a need for nitrogen enrichment. Also, it appears that Seaside Centipede Lichen is intolerant to heavy salt water spray and that unusually intense storms can cause high mortality. This research provided valuable information and should be continued.
- In 2003 the Queen Charlotte Islands were surveyed for the presence of Seaside Centipede Lichen, but no thalli were found (Goward 2004). The majority of habitat surveyed was inappropriate and appropriate habitat didn't appear to support Seaside Centipede Lichen. The investigators postulate that the severe climate is unsuitable for the species. Future surveys should focus on other areas.
- Kyuquot Sound and the Broughton Archipelago off Vancouver Island were investigated (Wright 2004). Seaside Centipede Lichen was found on Spring Island and an adjacent unnamed island in Kyuquot Sound. No Seaside Centipede Lichen thalli were found in the Broughton Archipelago. Surveys in British Columbia should continue because this species is likely to have a wider range and larger population than currently known.

1.5 Knowledge Gaps

This initial recovery strategy for Seaside Centipede Lichen focuses on conservation of identified Seaside Centipede Lichen sites while research improves our understanding of the range, distribution, life history, and ecology of the species. This section lists several knowledge gaps that must be filled in order to further refine recovery strategy goals in the next planning iteration and improve Seaside Centipede Lichen conservation.

- It will take several years of further study before the amount of habitat needed to maintain the current population size can be determined.
- It is not known whether Seaside Centipede Lichen has been significantly affected by human activities or whether its abundance is similar to historic levels.
- How widespread is Seaside Centipede Lichen in coastal British Columbia? A survey of pre-selected sites on the central mainland coast should be undertaken, including localities used by ground-nesting and tree-nesting birds. Unsurveyed sections of Vancouver Island between Tofino and Nootka Island should also be investigated for Seaside Centipede Lichen occurrences.
- In order to reassess its Endangered status additional study is needed on phenology and ecology of Seaside Centipede Lichen.

- Can Seaside Centipede Lichen be supported in the long term by localized nodes of enrichment created by perching birds?
- Several questions basic to the life history of Seaside Centipede Lichen remain unanswered. For example, is nutrient-enrichment required only for the establishment phase of this species, or must an elevated pH be maintained throughout its life? Again, is endogenous nutrient enrichment (nutrient transfer mediated through the roots of trees) sufficient to promote colonization by Seaside Centipede Lichen, or is exogenous enrichment (nutrient transfer from defecating birds, etc.) also required?
- Further study of Seaside Centipede Lichen distribution within spruce canopies is needed. While recent research indicates that Seaside Centipede Lichen tends to preferentially occupy the lower branches of Sitka Spruce trees, this may be an artifact of sampling. Field studies in 2002 did find occurrences of Seaside Centipede Lichen much higher in the canopy than previously known.
- Propagating Seaside Centipede Lichen has not been tried.
- More information is required to determine the relative risk that threats such as severe winter storms, increased frequency and severity of warming and drying events, and human-caused impacts such as firewood collection have on Seaside Centipede Lichen populations.

2 RECOVERY

2.1 Recovery feasibility

In consideration of the criteria for determining feasibility (Table 2)—

- Individuals capable of reproduction are currently available;
- Sufficient habitat is likely available and more could be created if necessary via habitat management or restoration—though restoration would be a long term (> 50 year) option;
- While many threats can be dealt with, it is unknown if all threats can be avoided or mitigated. It should be possible to mitigate threats posed by firewood collection, trail building, and seaside development through the establishment and enforcement of forest management and foreshore development guidelines intended to conserve critical habitat. However, potential impacts due to human-influenced weather or climate change are beyond the scope of this recovery strategy and require major social and economic change on a global scale;
- There has not been enough study into specific recovery techniques, such as propagation of this species, and their effectiveness is unknown.

Table 2: Feasibility criteria for determining the feasibility of recovery (Environment Canada *et al.* 2005)

Feasibility Criteria	Evaluation
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	Yes
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	Yes
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	Unknown
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	Unknown

There are significant knowledge gaps pertaining to this species. However, recovery decisions should consider the preservation of biodiversity and the principle that a lack of full scientific certainty is not reason to postpone cost-effective measures to prevent the reduction or loss of a species which faces threats of serious or irreversible damage. To act in accord with the assumption that mitigation will assist Seaside Centipede Lichen's continued presence in Canada may save the species. To assume and act otherwise risks the potentially preventable loss of a component of world biodiversity. Recovery is considered feasible.

2.2 Recovery goal, objectives and corresponding approaches

2.2.1 Recovery Goal

The overall goal for the recovery of Seaside Centipede Lichen is to maintain a self-sustaining metapopulation within its historic range in Canada. Quantitative targets are impossible to set because the current population size, distribution, and dynamics are poorly understood. However, a short term goal of no net loss of habitat or population viability should be adopted in the interim while further study is conducted.

2.2.2 Recovery Objectives

Recovery objectives for Seaside Centipede Lichen over the next five years are presented in Table 3.

Table 3: Recovery objectives: 2007–2011, inclusive.

Recovery Objective	Threat addressed	COSEWIC criteria addressed ^a
1. Protect ^b habitat at all known occurrences of Seaside Centipede Lichen throughout its Canadian distribution.	Habitat loss	B, D
2. Implement appropriate site management at all protected occurrences.	Habitat loss and disruption of natural patterns of nutrient distribution	B, D
3. Protect ecosystem processes critical to Seaside Centipede Lichen.	Disruption of natural patterns of nutrient distribution	D
4. Fill knowledge gaps.		B, D

^a These are the criteria used by COSEWIC to assess a species' risk of extinction or extirpation. An explanation of the criteria can be found on COSEWIC's website: <http://www.cosewic.gc.ca>.

^b Protection includes a variety of mechanisms including stewardship and other voluntary means.

2.2.3 Broad strategy to be taken to address threats

Table 4 lists the broad strategies, general steps, and anticipated effects for recovery of Seaside Centipede Lichen. None of the measures listed in Table 4 should be postponed due to a lack of full scientific certainty. The threat of climate change is not discussed because it requires major social and economic change beyond the scope of this recovery strategy.

Table 4: Table of broad strategies, general steps and anticipated effects for recovery of Seaside Centipede Lichen (*Heterodermia sitchensis*).

Priority	Obj. No.	Broad Approach / Strategy	Threat Addressed	General Steps	Outcomes or Deliverables (identify measurable targets)
Highest	1	<ul style="list-style-type: none"> ▪ Protect habitat. 	<ul style="list-style-type: none"> ▪ Habitat loss. ▪ Increased severity of winter storms. 	<ul style="list-style-type: none"> ▪ Determine ideal protection strategy and secure currently unprotected sites through stewardship and other mechanisms. ▪ Give higher priority to protecting sites which provide greater protection from winter storms. 	<ul style="list-style-type: none"> ▪ Long term retention of critical habitat.

Table 4: Table of broad strategies, general steps and anticipated effects for recovery of Seaside Centipede Lichen (*Heterodermia sitchensis*).

Priority	Obj. No.	Broad Approach / Strategy	Threat Addressed	General Steps	Outcomes or Deliverables(identify measurable targets)
Highest	3	<ul style="list-style-type: none"> ▪ Maintain a healthy coastal ecosystem in proximity to Seaside Centipede Lichen sites. ▪ Educate the public. 	<ul style="list-style-type: none"> ▪ Changes in nutrient distribution patterns. 	<ul style="list-style-type: none"> ▪ Work toward adequate protection and enforcement for areas such as sea lion haul-outs and seabird colonies. ▪ Encourage careful consideration of development and resource extraction so as not to impair key ecosystem processes at Seaside Centipede Lichen sites. ▪ Educate the public regarding the importance of all species and their interactions. 	<ul style="list-style-type: none"> ▪ Retention of nutrient enrichment processes required by Seaside Centipede Lichen. ▪ Increased public awareness and sensitivity to the interconnectedness of healthy ecosystems.
Medium	2	<ul style="list-style-type: none"> ▪ Manage protected sites. ▪ Public education. 	<ul style="list-style-type: none"> ▪ Habitat loss. ▪ Changes in nutrient distribution patterns. 	<ul style="list-style-type: none"> ▪ Assess threats at all sites. ▪ Develop material on best management practices for Seaside Centipede Lichen sites. ▪ Manage known occurrences of Seaside Centipede Lichen in a manner that minimizes human impact on this species. ▪ Develop an interpretive display including pamphlets at Pacific Rim National Park Reserve. ▪ Implement camping and/or fire restrictions in Pacific Rim National Park Reserve and BC Crown lands such as Spring Island. 	<ul style="list-style-type: none"> ▪ Better knowledge of threats leading to more effective management. ▪ Retention of coastal vegetation and host Sitka Spruce trees. ▪ Leaving Sitka Spruce trees in their natural form without pruning. ▪ Reduce mortality due to branch collection. ▪ Improved awareness leading to a reduction in habitat and population loss. ▪ Less disturbance of wildlife integral to nutrient distribution.

Table 4: Table of broad strategies, general steps and anticipated effects for recovery of Seaside Centipede Lichen (*Heterodermia sitchensis*).

Priority	Obj. No.	Broad Approach / Strategy	Threat Addressed	General Steps	Outcomes or Deliverables(identify measurable targets)
Medium	4	<ul style="list-style-type: none"> ▪ Inventory 	<ul style="list-style-type: none"> ▪ N/A 	<ul style="list-style-type: none"> ▪ Further define the known range and population distribution of Seaside Centipede Lichen in coastal British Columbia. ▪ Collaborate with others interested in pursuing population studies in Pacific coast states particularly Washington, Oregon, and Alaska. 	<ul style="list-style-type: none"> ▪ More accurate population assessment. ▪ Improved ability to assess level of rarity and risk (reassessment based on more data).
Medium	4	<ul style="list-style-type: none"> ▪ Research 	<ul style="list-style-type: none"> ▪ N/A 	<ul style="list-style-type: none"> ▪ Study the environmental requirements and life history of Seaside Centipede Lichen. Particular attention must be paid to better understanding the role of nutrient enrichment, longevity, and requirements for successful re-colonization. 	<ul style="list-style-type: none"> ▪ Improved understanding of species vulnerability and critical habitat (including characteristics). ▪ Improved ability to mitigate threats.
Medium	All	<ul style="list-style-type: none"> ▪ Monitoring 	<ul style="list-style-type: none"> ▪ N/A 	<ul style="list-style-type: none"> ▪ Develop and implement standardized monitoring protocol. ▪ Conduct annual monitoring of known Seaside Centipede Lichen populations to identify and further evaluate population and habitat threats. ▪ Submit all data to the BC Conservation Data Centre. 	<ul style="list-style-type: none"> ▪ Improved management through better information on inter-annual and long-term population trends as well as improved knowledge of threats. ▪ Allow a determination of how effective established protective measures have been. ▪ Adapt management in response to observed results.

Table 4: Table of broad strategies, general steps and anticipated effects for recovery of Seaside Centipede Lichen (*Heterodermia sitchensis*).

Priority	Obj. No.	Broad Approach / Strategy	Threat Addressed	General Steps	Outcomes or Deliverables(identify measurable targets)
Lowest	All	<ul style="list-style-type: none"> ▪ Reporting 	<ul style="list-style-type: none"> ▪ N/A 	<ul style="list-style-type: none"> ▪ Report on management actions and outcomes. ▪ Prepare a revised Status Report as required. 	<ul style="list-style-type: none"> ▪ Allow a determination of how effective established protective measures have been. ▪ Consolidate known information on Seaside Centipede Lichen and allow a re-evaluation of status.

2.2.4 Effects on other Species

Recovery procedures emphasize habitat protection and are thus unlikely to have a negative effect on other species; in fact, protection of Seaside Centipede Lichen habitat is likely to benefit other species. Furthermore, Seaside Centipede Lichen is largely dependant on ecosystem processes mediated by other species and thus requires the protection of those species to maintain a robust and intact coastal ecosystem. Proposed measures will permit natural processes to proceed unimpeded by human activity. The overall potential environmental effect of the proposal after opportunities for mitigation have been incorporated will be positive. Results of implementation of the recovery strategy are expected to yield positive environmental benefits due to retention of coastal old-growth, improved understanding of the ecology of lichens and lichen communities in the Pacific Northwest, and the recovery of Seaside Centipede Lichen.

2.2.5 Evaluation

Performance measures to determine effectiveness of plan implementation are listed in Table 5.

Table 5: Performance measures for Seaside Centipede Lichen (*Heterodermia sitchensis*) recovery strategy.

Objective #	Broad Approach/Strategy	Evaluation measures
1	Protect habitat	<ul style="list-style-type: none"> ▪ Number of Seaside Centipede Lichen sites destroyed. ▪ Number of Seaside Centipede Lichen sites appropriately protected by legal designations. ▪ Percent of old-growth coastal fringe forests remaining and protected. Change in number of thalli at known sites.

Table 5: Performance measures for Seaside Centipede Lichen (*Heterodermia sitchensis*) recovery strategy.

Objective #	Broad Approach/Strategy	Evaluation measures
2	Site management	<ul style="list-style-type: none"> ▪ Site Management Guidelines developed and distributed to landowners. ▪ Number of landowners and managers employing appropriate management practices for Seaside Centipede Lichen. ▪ Suitable campfire and camping restrictions implemented within PRNPR and BC Crown land. ▪ Number of site specific threat assessments.
2	Public education	<ul style="list-style-type: none"> ▪ Interpretive displays installed at PRNPR. ▪ Number of pamphlets handed out/taken. ▪ Public support for protection of the species.
3	Maintain a healthy coastal ecosystem	<ul style="list-style-type: none"> ▪ Continued presence of seabird colonies, sea lion haul-outs, and raptors at healthy population levels.
4	Inventory	<ul style="list-style-type: none"> ▪ Proportion of the British Columbia coast suitable for Seaside Centipede Lichen that has been inventoried for Seaside Centipede Lichen. This measure will provide an estimate of the Canadian population, density, and distribution. ▪ Field-testing the reliability of models developed for predicting the occurrence of Seaside Centipede Lichen will indicate relative success of investigations into the ecological and life history requirements of Seaside Centipede Lichen.
All	Research	<ul style="list-style-type: none"> ▪ Number of knowledge gaps addressed. Further information on species ecology especially relating to nutrient enrichment requirements and life cycle. ▪ Ability to more accurately define recovery goals and objectives.
All	Monitoring	<ul style="list-style-type: none"> ▪ Annual population estimates with determination of trends and threats. ▪ Estimates of habitat trends. ▪ Management has adapted in response to observed results.
All	Reporting	<ul style="list-style-type: none"> ▪ Completion of status report and re-evaluation.

2.3 Recommended Approach for Recovery

The single species approach was chosen for recovery of Seaside Centipede Lichen due to its distinct habitat requirements and threats. Also, Seaside Centipede Lichen is the only COSEWIC-listed lichen in this area.

The core of the known Seaside Centipede Lichen range is within Pacific Rim National Park Reserve managed by the Parks Canada Agency under the *Canada National Parks Act*. A key provision of this Act states that “Maintenance or restoration of ecological integrity, through

the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks.”

The Province of British Columbia is a partner on the recovery team and will be responsible for ensuring sound management practices on Provincial Crown land.

The Department of Fisheries and Oceans has not been a participant on the recovery team but requirements under the Federal *Oceans Act* (S.C. 1996, c. 31) and *Fisheries Act* (R.S., 1985, c. F-14) demand that marine resource harvesting be conducted in a sustainable manner.

2.4 Action Plans

A Recovery Action Plan (RAP) for Seaside Centipede Lichen will be completed by January 2010. The RAP is expected to include direction on management of human caused threats, critical habitat identification, a multi-year research strategy to fill key knowledge gaps, monitoring activities and protocols, an education and outreach program, and habitat protection guidelines for Seaside Centipede Lichen.

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APPENDIX A: GLOSSARY

Apothecia—Plural. Apothecium Singular. A fruiting body of lichens in which spores are produced. Can be a variety of shapes.

Endogenous—Originating from inside; internal.

Exogenous—Originating from outside; external.

Soralia—Plural. Singular Soralium. A group of sordia in lichens.

Soredia—Plural. Singular Soredium. A asexual reproductive structure in lichens, in which fungal strands surround a cluster of algal cells.

Thallus—Singular; Thalli plural. A plant body that is not differentiated into true leaves, stems, or roots.