Species at Risk Act
Management Plan Series
Adopted under Section 69 of SARA

Management Plan for the Haida Gwaii Slug (*Staala gwaii*) in Canada

Haida Gwaii Slug

2023

Government of Canada
Gouvernement du Canada
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For copies of the management plan, 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: © Kristiina Ovaska (12 September 2002; near Port Clements, Graham Island, Haida Gwaii)

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

MANAGEMENT PLAN FOR THE HAIDA GWAII SLUG (*STAALA GWAII*) IN CANADA

2023

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.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Management plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia* (Part 2) under Section 69 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this management plan.

The federal management plan for the Haida Gwaii Slug in Canada consists of two parts:

Part 1 – Federal Addition to the *Management plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia* prepared by Environment and Climate Change Canada.

Part 2 – *Management plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia*, prepared by the British Columbia Ministry of Environment and Climate Change Strategy.

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Part 1 – Federal Addition to the *Management Plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia*, prepared by Environment and Climate Change Canada

Preface

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

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Haida Gwaii Slug and has prepared the federal component of this management plan (Part 1), as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia as per section 66(1) of SARA. SARA section 69 allows the Minister to adopt all or part of an existing plan for the species if the competent minister is of the opinion that an existing plan relating to wildlife species includes adequate measures for the conservation of the species. The Province of British Columbia provided the attached management plan for the Haida Gwaii Slug (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment and Climate Change Canada and the Parks Canada Agency.

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

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

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Management plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia* (Part 2 of this document, referred to henceforth as "the provincial management plan") and/or to provide updated or additional information.

Under SARA, prohibitions regarding the protection of species and their habitat do not apply to species of special concern. Conservation measures in the provincial management plan dealing with the protection of individuals and their habitat are still adopted to guide conservation efforts but would not result in federal legal protection.

1. 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*[3]. 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 (FSDS)[4] goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans 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 management plan itself, but are also summarized below in this statement.

The provincial management plan for the Haida Gwaii Slug contains a section describing the effects of management activities on other species (i.e., Section 8). Environment and Climate Change Canada adopts this section of the provincial management plan as the statement on effects of management activities on the environment and other species. Management planning activities for the Haida Gwaii Slug will be implemented with consideration for all co-occurring species at risk, such that any potential negative impacts to these species or their habitats are mitigated or avoided. Some management actions for the Haida Gwaii Slug (e.g., inventory and habitat protection) may promote

[3] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[4] www.fsds-sfdd.ca/index.html#/en/goals/

the conservation of other species at risk that overlap in distribution and rely on similar habitat attributes.

Part 2 – ***Management Plan for Haida Gwaii Slug (*****Staala gwaii*****) in British Columbia*****, prepared by the British Columbia Ministry of Environment and Climate Change Strategy**

Management Plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia

Prepared by B.C. Ministry of Environment and Climate Change Strategy

BRITISH COLUMBIA

January 2022

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. The Province prepares management plans for species that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events.

What is a management plan?

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that the target species does not become threatened or endangered. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives and recommend approaches appropriate for species or ecosystem conservation.

What's next?

Advice set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

For more information

To learn more about species at risk recovery planning in British Columbia, please visit the B.C. Recovery Planning webpage at:

< http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning >

Management Plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia

Prepared by the B.C. Ministry of Environment and Climate Change Strategy

January 2022

Recommended citation

B.C. Ministry of Environment and Climate Change Strategy. 2021. Management plan for Haida Gwaii Slug (*Staala gwaii*) in British Columbia. B.C. Ministry of Environment and Climate Change Strategy, Victoria, BC. 33 pp.

Cover illustration/photograph

12 September 2002; near Port Clements, Graham Island, Haida Gwaii.

Additional copies

Additional copies can be downloaded from the B.C. Recovery Planning webpage at:

http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning/recovery-planning-documents

Disclaimer

The B.C. Ministry of Environment and Climate Change Strategy has prepared this management plan as advice to the responsible jurisdictions and organizations that may be involved in managing the species.

This document identifies the management actions that are deemed necessary, based on the best available scientific and traditional information, to prevent Haida Gwaii Slug subpopulations in British Columbia from becoming endangered or threatened. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and management approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and species specialists have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies, or the personal views of all individuals involved.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan. The B.C. Ministry of Environment and Climate Change Strategy encourages all British Columbians to participate in the conservation of Haida Gwaii Slug.

ACKNOWLEDGEMENTS

This management plan was prepared by Jennifer Heron (B.C. Ministry of Environment and Climate Change Strategy [ENV]), Dawn Marks (ENV), and Kristiina Ovaska (Biolinx Environmental Research). Funding for this document was provided by Environment and Climate Change Canada – Pacific Region and B.C. Ministry of Environment and Climate Change Strategy. Maps were completed by Greg Amos (ENV). Thoughtful review comments and advice were provided by Alana Phillips (ENV), Alanah Nasadyk (ENV), Karen Stefanyk (ENV), Brenda Costanzo (ENV), Lea Gelling (ENV), Erica McClaren (B.C. Parks), Ross Vennesland (ECCC-PAC), Eric Gross (ECCC-CWS), Holly Bickerton (Parks Canada Agency [PCA]), Grant Bracher (B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development [FLNRORD]), Berry Wijdeven (FLNRORD), Christine Rock (FLNRORD), Kendra Bennett (FLNRORD), Angela Barakat (ECCC – CWS), Kung K_ayangas/Marlene Liddle (Haida Gwaii Natural Resource District, Council of the Haida Nation), and Peter Sinkins (PCA),

EXECUTIVE SUMMARY

Haida Gwaii Slug (*Staala gwaii*) was first documented from Haida Gwaii in 2002 and was scientifically described in 2010. This slug is small (8-17mm adult body length), with an overall body colour of grey or tan to jet black, and is covered with small, often black-tipped projections or papillae. The species is characterized by its visceral hump covered by the mantle, which is often mottled with a darker colouration than its body.

Haida Gwaii Slug was designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2013, and in 2018 it was listed as Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA). In British Columbia, the Haida Gwaii Slug is ranked S2 (imperilled) by the B.C. Conservation Data Centre, and is on the provincial Red list. It represents a recently-described species and genus, and is found nowhere else in the world. It lives mostly in cool, moist microhabitats in the subalpine zone, but it has also been found in a few forested sites. Browsing by introduced Sitka Black-tailed Deer on Haida Gwaii have greatly modified the slug's habitat, and have probably reduced its population. Climate change also threatens to reduce the extent of the slug's preferred subalpine habitat.

Haida Gwaii Slug is one of several species restricted to Haida Gwaii and Brooks Peninsula. There are 13 known sites representing seven subpopulations, three on Moresby Island, three on Graham Island (Haida Gwaii), and one on Brooks Peninsula (Vancouver Island). Much of the potentially suitable alpine and subalpine montane forest habitat has not been surveyed for gastropods, and additional sites and subpopulations of Haida Gwaii Slug may exist.

The slugs are found most in open, subalpine-type habitats characterized by low shrubs, scattered and stunted trees with krummholz formations, and near-saturated ground, often with a moss cover. The life history and habits of the species are poorly known; it likely has an annual life cycle. Population sizes and trends are also unknown; during surveys, the species is documented in low abundance (often one or two individuals/site).

The main threats to Haida Gwaii Slug across the species' range are projected longer-term climate changes from habitat shifting and alteration, droughts, temperature extremes, and an increase in severity from storms and flooding. Ongoing ecosystem changes to slug habitats on Haida Gwaii occur from browsing by introduced Sitka Black-tailed Deer. Introduced deer continue to alter understory vegetation, decrease litter accumulation, and increase exposure of the ground to sun and wind, resulting in lower humidity in micro-sites used by the slugs. Logging is a threat on B.C. public lands and potential habitat on Graham Island and northern Moresby Island.

The management goal is to ensure the redundancy of Haida Gwaii Slug in Canada by addressing human-caused threats that are contributing to a decline in the area, extent, and quality of suitable habitat to known subpopulations (including any additional subpopulations that may be identified in the future).

The management objectives for Haida Gwaii Slug are:

1. to protect known (and newly documented) subpopulations of Haida Gwaii Slug throughout the species' British Columbia range by managing human-caused threats to the species.

2. to confirm the distribution of Haida Gwaii Slug including new locations by inventory of suitable habitat for additional subpopulations with the purpose of preventing the inadvertent losses.
3. to assess and mitigate threats to extant subpopulations, and more broadly to potential habitats; and
4. to monitor trends in population size and distribution at known sites for the purpose of collecting additional ecological data, including information on population size and recruitment.

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1 COSEWIC SPECIES ASSESSMENT INFORMATION

Assessment Summary: May 2013
Common Name: Haida Gwaii Slug
Scientific Name: *Staala gwaii*
Status: Special Concern
Reason for Designation: This small slug is a relic of unglaciated refugia on Haida Gwaii and on the Brooks Peninsula of northwestern Vancouver Island. It represents a recently described species and genus and is found nowhere else in the world. It lives mostly in cool, moist microhabitats in the subalpine zone, but it has also been found in a few forested sites. Grazing and browsing by introduced deer on Haida Gwaii have greatly modified the species' habitat and have probably reduced its population; this grazing is apparently increasing at higher elevations. Climate change also threatens to reduce the extent of the slug's preferred subalpine habitat.
Criteria: Not applicable.[a]
Occurrence: British Columbia
Status History: Designated Special Concern in May 2013.

COSEWIC = Committee on the Status of Endangered Wildlife in Canada.
[a] See COSEWIC (2019) Table 2: Quantitative criteria and guidelines for the status assessment of wildlife species.

2 SPECIES STATUS INFORMATION

Haida Gwaii Slug[a]		
Legal Designation:		
Forest and Range Practices Act:[b] No	B.C. *Wildlife Act*:[c] No	*Species at Risk Act*:[d] Yes
Oil and Gas Activities Act:[b] No		Schedule 1 Special Concern (2018)
Conservation Status[e]		
B.C. List[f]: Red	B.C. Rank: S2? (2015)	National Rank: N2? (2015)	Global Rank: G2? (2016)
Other Subnational Ranks:[g] Not applicable		

[a] Data source: B.C. Conservation Data Centre (2021) unless otherwise noted.
[b] No = not listed in one of the categories of wildlife that requires special management attention to address the impacts of forestry and range activities on B.C. public land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on B.C. public land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).
[c] No = not designated as wildlife under the B.C. *Wildlife Act* (Province of British Columbia 1982).
[d] Schedule 1 = found on the List of Wildlife Species at Risk under the *Species at Risk Act* (SARA; Government of Canada 2002).
[e] Blue: Includes any native species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia.
[f] S = subnational; N = national; G = global; 2 = imperilled; NA = not applicable; ? = denotes inexact or uncertain delineation between number ranks (falls 80-95% within S2 criteria but slightly into S3 for example).
[g] Data source: NatureServe (2021).

3 SPECIES INFORMATION

3.1 Species Description

Haida Gwaii Slug (*Staala gwaii*) is a small (8-17 mm adult body length) grey or tan to jet black slug covered with small, often black-tipped projections or papillae. Like jumping-slugs (*Hemphillia* spp.), the visceral cavity is elevated into a hump (Ovaska *et al.* 2010; Figure 1). Unlike that of jumping-slugs, the mantle completely covers the dome-shaped calcareous shell plate. A full description is available in Ovaska *et al.* (2010) and the COSEWIC status report (COSEWIC 2013).

The species may be a relic of unglaciated Pleistocene refugia in the Haida Gwaii archipelago and on Brooks Peninsula of northwestern Vancouver Island (COSEWIC 2013). It is primarily known from moist, cool microhabitats in the subalpine/alpine zones, but has also been found in lower-elevation forested sites (COSEWIC 2013). Small juveniles have been detected from July-September, and adults from September-October. The generation time is probably one year (COSEWIC 2013).

Figure 1. Photo of Haida Gwaii Slug (11 Oct 2003, Yatza Mountain, Moresby Island).

3.2 Species Population and Distribution

The global distribution of Haida Gwaii Slug is confined to northwest Vancouver Island and the Haida Gwaii archipelago (formerly Queen Charlotte Islands), British Columbia (B.C.) (Figure 2). In Haida Gwaii, the species has been documented from Graham and Moresby islands; on Vancouver Island, it is known only from Brooks Peninsula. The estimated extent of occurrence is 16,262 km^2, which is reduced to 3,453 km^2 when the ocean is excluded (COSEWIC 2013). The area of occupancy is 52 km^2 (using 2 x 2 km grid cells; COSEWIC 2013). Haida Gwaii Slug was first documented in 2002 and was only recently described (Ovaska *et al.* 2010), so there are no historical distribution or abundance data available.

As of May 2021, 13 sites of Haida Gwaii Slug are known, representing seven subpopulations[1] (B.C. Conservation Data Centre 2021) (Table 2). Survey coverage is incomplete, and the species could easily be overlooked due to its small size. Undocumented sites probably exist, especially in

[1] Haida Gwaii occurrence information in the COSEWIC (2013) status report and mapped with the B.C. Conservation Data Centre (2021) show results for Haida Gwaii Slug sites and subpopulations using different formats; both sets of information are presented in Table 2.

subalpine and alpine areas which are difficult to access in coastal British Columbia (COSEWIC 2013).

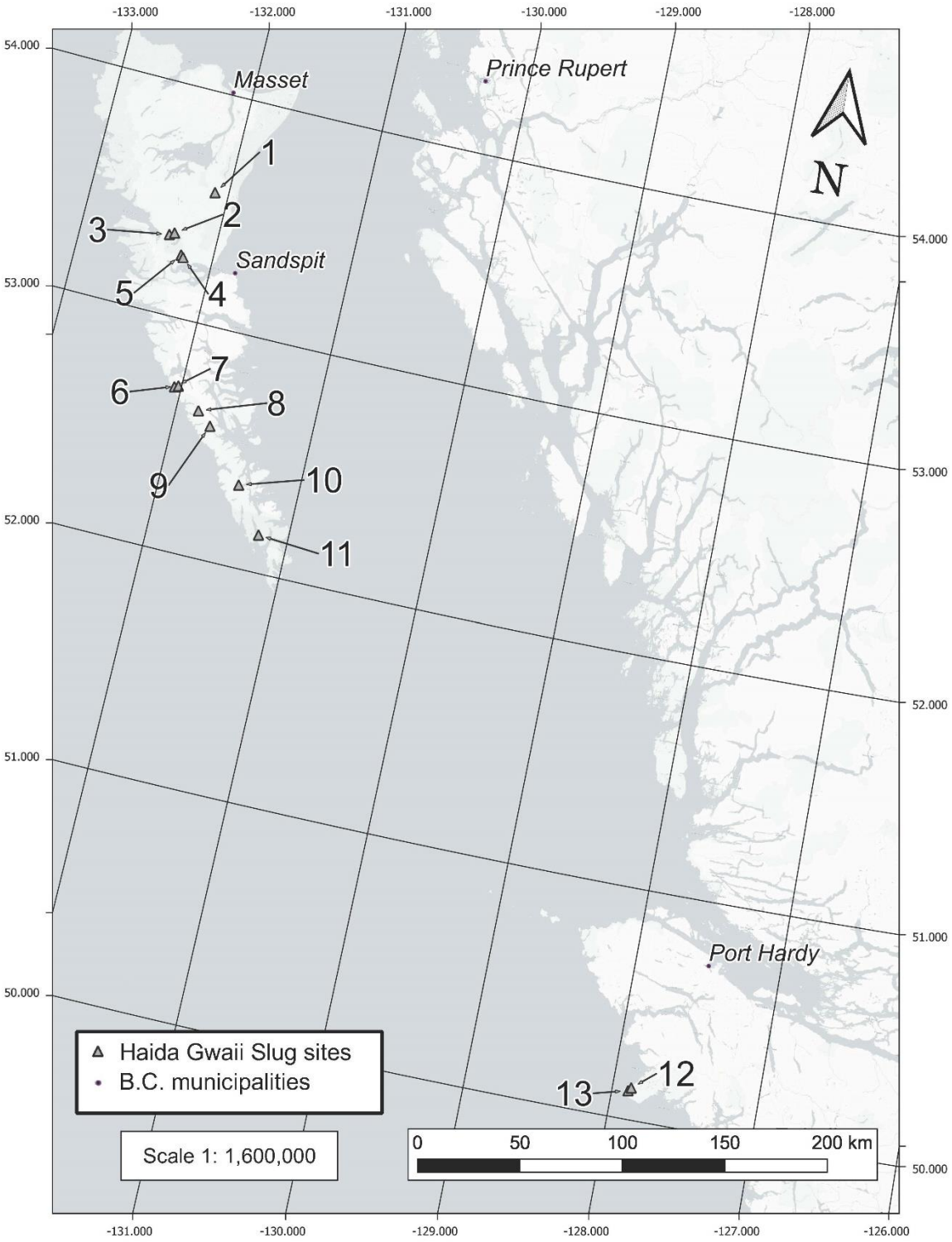

Figure 2. Global and Canadian distribution of Haida Gwaii Slug (based on records in Table 1).

Table 1. Status and description of Haida Gwaii Slug subpopulations in British Columbia.

Map Number (Figure 2) and Site Name	**B.C. CDC Element Occurrence# / COSEWIC (2013) Status Report Subpopulation name**	**Status[a]**	**Description (from COSEWIC 2013)**	**Land tenure**
Map #1 Juskatla; Graham Island	EO 8 COSEWIC site #1 COSEWIC Subpopulation: Queen Charlotte Lowlands	Extant	Mature second-growth coniferous forest (naturally regenerated with patches of old growth); pre-logging: found in 6 plots, including 2 plots slated for logging. 1-2 years post-logging: found in 4 plots: uncut control (1 plot) and tree retention patches (3 plots), but not in clearcut plots.	Provincial; B.C. public land
Map #2 Yakoun Lake, 2.5 km northwest of; Haida Gwaii	EO 13 COSEWIC site #2 COSEWIC Subpopulation: Rennel Ridge	Extant	Old growth forest with Western Redcedar (*Thuja plicata*) and Western Hemlock (*Tsuga heterophyla*) and an understory of huckleberry	Provincial; B.C. public land
Map #3 Yakoun Lake, 5 km northwest of; Haida Gwaii	EO 12 COSEWIC site #3 COSEWIC Subpopulation: Rennel Ridge	Extant	Old growth forest with Sitka Spruce (*Picea sitchensis*) and Western Hemlock and an understory of huckleberry (*Vaccinium spp*.)	Provincial; B.C. public land
Map #4 Mount Genevieve, mid-slope; Graham Island	EO 7 COSEWIC site #4 COSEWIC Subpopulation: Mt. Genevieve	Extant	Old growth forest with Western Hemlock and Western Redcedar and an understory of huckleberry	Provincial; B.C. public land
Map #5 Mount Genevieve, Summit; Graham Island	EO 9 COSEWIC site #5 COSEWIC Subpopulation: Mt. Genevieve	Extant	Alpine meadow with ground cover of heather, grass, and moss	Provincial; public land
Map #6 Mount Oliver; Moresby Island	EO 2 COSEWIC site #6 COSEWIC Subpopulation: San Christoval	Extant	Subalpine habitat with stunted trees and swales of grasses, heather, crowberry; very moist; slugs found under stick, in grass on krummholz, under junipers & on dead herbaceous plant.	Federal; Gwaii Haanas National Park Reserve and Haida Heritage Site

Table 1. Status and description of Haida Gwaii Slug subpopulations in British Columbia.

Map Number (Figure 2) and Site Name	**B.C. CDC Element Occurrence# / COSEWIC (2013) Status Report Subpopulation name**	**Status[a]**	**Description (from COSEWIC 2013)**	**Land tenure**
Map #7 Mount de la Touche; Moresby Island	EO 3 COSEWIC site #7 COSEWIC Subpopulation: San Christoval	Extant	Subalpine habitat with stunted trees and swales of grasses, heather (*Cassiope spp*.), crowberry; very moist; found under rock on grassy slope	Federal; Gwaii Haanas National Park Reserve and Haida Heritage Site
Map #8 Sunday Inlet, Unnamed Mountain; Moresby Island	EO 4 COSEWIC site #8 COSEWIC Subpopulation: San Christoval	Extant	Subalpine habitat with stunted trees, swales of grasses, heather, Crowberry (*Empetrum nigrum*); very moist; slugs found within Crowberry/grass mat on krummholz and under rock	Provincial; public land
Map #9 Kostan inlet, Unnamed Mountain; Moresby Island	EO 5 COSEWIC site #9 COSEWIC Subpopulation: San Christoval	Extant	Subalpine habitat with stunted trees and swales of grasses, heather, Crowberry; very moist; slug found under rock on seepage slope	Federal; Gwaii Haanas National Park Reserve and Haida Heritage Site
Map #10 Yatza Mountain; Moresby Island	EO 1 COSEWIC site #10 COSEWIC Subpopulation: Mt. Yatza	Extant	Subalpine meadow; scattered stunted trees; Shore Pine (*Pinus contorta*), Mountain Hemlock (*Tsuga mertensiana*), Western Redcedar; grass & moss ground cover; most slugs found under rocks but a small juvenile slug within moss.	Federal; Gwaii Haanas National Park Reserve and Haida Heritage Site
Map #11 Louscoone Inlet; Moresby Island	EO 6 COSEWIC site #11 COSEWIC Subpopulation: Louscoone Inlet	Extant	Transition zone coniferous forest with Sitka Spruce, Yellow-cedar (*Callitropsis nootkatensis*), Western Redcedar, Western Hemlock, and Shore Pine; understory of Red Huckleberry (*Vaccinium parvifolium*) and False Azalea (*Menziesia ferruginea*) (ca. 30% coverage) and scattered Deer Fern (*Struthiopteris spicant*); slug found on underside of fallen Salal (*Gaultheria shallon*) leaf along bank of small creek.	Federal; Gwaii Haanas National Park Reserve and Haida Heritage Site
Map #12 Vaccinium	EO 11	Extant	Open seepage area with moss and small pools and krummholz	B.C. Parks

Table 1. Status and description of Haida Gwaii Slug subpopulations in British Columbia.

Map Number (Figure 2) and Site Name	B.C. CDC Element Occurrence# / COSEWIC (2013) Status Report Subpopulation name	Status[a]	Description (from COSEWIC 2013)	Land tenure
Lake, 1.8 km southwest of	COSEWIC site #12[b] COSEWIC Subpopulation Brooks Peninsula		vegetation; stunted trees (<1 m tall Mountain Hemlock, Yellow-cedar and Shore Pine), shrubs (Salal), and ground vegetation including blueberry (*Vaccinium*), Crowberry, Deer-cabbage (*Nephrophyllidium crista-galli*) Bog Adder's-mouth Orchid (*Malaxis paludosa*); rushes in moist depressions	($M^{q}uq^{w}$in/ Brooks Peninsula Park)
Map #13 Cape Cook; Brooks Peninsula	EO 10 COSEWIC site #12[b] COSEWIC Subpopulation: Brooks Peninsula	Extant	Windswept ridge with krummholz formations; moist depressions with stunted Mountain Hemlock and Yellow-cedar (from <1 m to 5 m tall), shrubs (Salal, False Azalea, blueberry); decomposing wood (e.g., hemlock branches) and moss.	Provincial; $M^{q}uq^{w}$in/ Brooks Peninsula Provincial Park

a Extant: occurrence has been recently verified as still existing. Historical: used when there is a lack of recent field information verifying the continued existence of the occurrence. Generally, if there is no known survey for 20 years it should be considered historical (NatureServe 2002).
b When this subpopulation was mapped at the B.C. CDC the separation distance between these observation points was a distance greater than the separation distance delineation standards set by NatureServe (2002). This warranted two separate element occurrences.
c Map Number = the number on the map in Figure 2.
d Site Name = the name the B.C. CDC assigns this element occurrence of Haida Gwaii Slug. An Element Occurrence (EO) is an area of land in which a species is, or was, present. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population (e.g., long distance dispersers) or a group of nearby populations (e.g., metapopulation). Occurrences greater than 1 km separation distance are considered separate subpopulations.
e COSEWIC Subpopulation Name = the subpopulation name in the Haida Gwaii Slug COSEWIC (2013) status report.

3.3 Habitat and Biological Needs of Haida Gwaii Slug

3.3.1 General Habitat

Ecosystem scale habitat

The habitat needs of the Haida Gwaii Slug are described at two scales: ecosystem or stand scale (open subalpine habitats and shaded moist forests) and at a site-specific scale (seepage slopes, rocks, coarse woody debris, grass, and moss). Haida Gwaii Slug is mainly associated with cool, moist microhabitats in the subalpine zones, but also occurs in a few lower-elevation forested sites. In subalpine-type habitats (#5, 6, 7, 8, 9, 10), the slugs have been found in open areas with scattered, stunted trees, swales of low shrubs and grasses, and moss (COSEWIC 2013). These habitats are generally at elevations between 600 – 800 m asl (above sea level) on Haida Gwaii but also occur as low as approximately 200 m asl (e.g., Yatza Mountain). On Brooks Peninsula (#12, 13), the krummholz habitat (stunted windblown trees near the tree line on mountains) where Haida Gwaii Slug was found was along a ridge top at elevations of 300 – 450 m asl (COSEWIC 2013).

The slugs have also been found in higher elevation forest dominated by Yellow-cedar (*Callitropsis nootkatensis*) and Mountain Hemlock (*Tsuga mertensiana*). Although, one site on Graham Island (#1) is in lowland (100m asl) coastal forest dominated by Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*) and Western Redcedar (*Thuja plicata*).

Most search efforts for gastropods have focused on lowland forests, both in Haida Gwaii and Vancouver Island, but Haida Gwaii Slug has only been rarely found in these habitats, and is only found in lowland forests in Haida Gwaii. To gain a better understanding of how often this species occurs in mid-to-high-elevation forests in both Haida Gwaii and Vancouver Island, additional surveys are needed (COSEWIC 2013).

Microhabitat requirements of Haida Gwaii Slug include cool, moist conditions and suitable cover. Substrate moisture and low understory vegetation retain moisture and provide shelter, which offers protective cover against variation in both temperature and moisture (summarized in Prior (1985) for gastropods in general). Cover used by the slugs includes coarse woody debris in forested sites, and rocks and moss mats at alpine sites (COSEWIC 2013).

Table 2. Summary of essential functions, features, and attributes of Haida Gwaii Slug habitat in British Columbia.

Life stage	Function[a]	Feature(s)[b]	Attributes[c]
Eggs	Incubation	Unknown but likely under or within decaying wood, under rocks, or in moss-covered crevices between rocks.	High humidity is needed to prevent the eggs from drying out, stable temperature, and refuge from predators; no quantitative information is available.
Juvenile and adult slugs	Feeding, foraging, dispersal, refuges during activity season, overwintering and aestivation	Large partially-decomposed logs, piles of sloughed-off bark, crevices along tree roots or at the base of stumps; crevices under and between rocks; deep moss mats or dense low ground vegetation, such as on krummholz hummocks; leaf litter in moist depressions (secondary), subterranean crevices and cracks in decaying logs or between rocks.	High humidity and refuge from predators; no quantitative information is available. Below frostline (overwintering); high humidity, stable temperature, and refuge from predators; no quantitative information is available.

[a] Function: a life-cycle process of the species (e.g., include either animal or plant examples: spawning, breeding, denning, nursery, rearing, feeding/foraging, and migration; flowering, fruiting, seed dispersing, germinating, seedling development).
[b] Feature: the essential structural components of the habitat required by the species.
[c] Attribute: the building blocks or *measurable* characteristics of a feature.

Haida Gwaii Slug has three life stages: egg, juvenile, and adult. Limited information is available on the specific habitat features required of each life stage.

Oviposition (egg laying) and egg development habitat

Site-specific requirements, including the depth Haida Gwaii Slug adults lays eggs and the depth at which the eggs develop, is unknown. Although these microsites are likely under thick moss, sloughed bark or in crevices and/or surface debris, if available. Surface debris includes the wet moss, dead, and friable leaf and litter that has fallen from trees, shrubs, and other plants as well as the mosses and bryophytes that form part of the cryptogamic[2] soil crust.

Juvenile and adult habitat

Juveniles and adults likely require similar habitats (

[2] A thin biological crust covering the soil made up of mosses, lichens, algae, and bacteria.

Table 2), but little information is available. As with other terrestrial gastropods in northern climates, Haida Gwaii Slug likely hibernates during cold winter months and aestivates (retreats into dormancy under soil or other cover to retain moisture) during hot and dry summer months. Hibernation and aestivation are expected to occur in protected moist microsites, such as underground crevices, under or within downed wood, or possibly within thick moss mats. The slugs use the same habitats year-round.

There are a few juvenile observations recorded in B.C. Unknown factors that could also influence egg development, emergence and juvenile habitat include resting sites, optimal activity temperatures, and refuge sites (i.e., from predators and weather).

3.4 Ecological Role

In general, gastropods contribute to decomposition processes on the forest floor and help build healthy soil through the turnover of organic matter (Mason 1970; Richter 1979). Haida Gwaii Slug probably feeds on dead and live vegetation and fungi, as observed in captivity, but no data are available in the wild (COSEWIC 2013). These habits may assist promotion of ecosystem health through dispersal of fungal spores of mycorrhizal species that form beneficial associations with tree roots, and dispersal of seeds of understory plants, as documented for other slugs (Richter 1980; Gervais *et al.* 1998; McGraw *et al.* 2002). Conversely, slugs are prey for various invertebrate and vertebrates including carabid beetles, small mammals, birds, and amphibians. Although ecological interactions and specifics of the ecological role of Haida Gwaii Slug have not been studied, it is likely that the species plays similar roles. Haida Gwaii Slug seems to be most abundant in habitats where few or no other gastropods are found (COSEWIC 2013).

3.5 Limiting Factors

Limiting factors are generally not human-induced, and include characteristics that make the species less likely to respond to management and/or conservation efforts. Potential limiting factors for Haida Gwaii Slug include:

Habitat availability. Haida Gwaii Slug is found in scattered localities in the Mountain Hemlock and Alpine Tundra biogeoclimatic zones; these two zones make up only 6% of the land area of Haida Gwaii and are present in a naturally patchy distribution (COSEWIC 2013). On Vancouver Island, the species has been found only on Brooks Peninsula, a presumed glacial refugium within the Western Hemlock biogeoclimatic zone. The species is probably more widespread on the peninsula than documented, and may also occur in additional similar habitats. Haida Gwaii Slug does not appear to be habitat-limited at this time.

Moisture, microhabitat, and soil conditions. Haida Gwaii Slug is associated with cool, moist microhabitats. Moisture and other microhabitat features (i.e., soil organic matter content, bryophyte layers, understory vegetation, coarse woody debris, and relative humidity) are limiting factors for many gastropods; influencing activity, reproductive success, foraging and persistence in a habitat. When the forest floor becomes exposed to wind and sunlight, and there is less vegetation in the understory, terrestrial molluscs become more vulnerable to

dehydration (Prior 1985) and experience high rates of evaporative water loss through their skin (review in Prior 1985). Brief exposure to drying conditions can have lasting cellular effects on slugs, and cause intensive physiological stress. Soil mineral content (including magnesium and calcium) and pH may play an important factor in gastropod microhabitat preference (Wareborn 1969; Hylander et al. 2005).

Limited dispersal ability and small home range. The geographic isolation of the known sites and the poor dispersal ability of Haida Gwaii Slug limit its expansion to other areas (COSEWIC 2013). Slugs are slow-moving, and there are no known passive dispersal mechanisms or animal vectors. The present distribution of the species may reflect the survival and subsequent dispersal from glacial refugia (COSEWIC 2013).

Competition and predation. Haida Gwaii slug is only rarely found in productive, low-elevation forests on Haida Gwaii, where there is a higher diversity and abundance of both gastropod and other invertebrate predators and competitors. The species' expansion into these habitats may be limited by predation and competition (COSEWIC 2013). Interactions with potential competitors and predators may become more prevalent as climate change proceeds and allows them to encroach on Haida Gwaii Slug's subalpine habitats.

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) (adapted from Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered. 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*. 2012). Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats is presented in Description of Threats (4.2). Threats presented here do not include limiting factors[3], which are presented in Section 3.5.

For the most part, threats are related to human activities, but they can also be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., introduction of invasive species). Effects of natural phenomena (e.g., avalanches or landslides) may be especially important when the species is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2012). As such, natural phenomena are included in the definition of a threat, though they should be considered cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its ability to recover. In such cases, the effect on the population would be disproportionately large compared to the effect experienced historically (Salafsky *et al.* 2008).

[3] 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 management/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation).

4.1 Threat Assessment

The threat classification below is based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification system (Version 2.0). The IUCN-CMP Threats Classification system is consistent with methods used by Environment and Climate Change Canada, COSEWIC, and the B.C. Conservation Data Centre, and adopts an international standard. For a detailed description of the threat classification system, see the Conservation Standards website (Conservation Standards 2019). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2012) and table footnotes for details. Threats for Haida Gwaii Slug were assessed for the entire province (Table 3).

Table 3. Threat classification table for Haida Gwaii Slug in British Columbia.

Threat No.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Sites[f]
1	***Residential & commercial development***	**Negligible**	**Negligible (<1%)**	**Negligible (<1%)**	**Moderate (Possibly in the short term, <10 yrs/3 gen)**	
1.1	Housing & urban areas					Not applicable
1.2	Commercial & industrial areas					Not applicable
1.3	Tourism & recreation areas	Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, <10 years/3 gen.)	Although numerous sites are within protected areas, this threat is not applicable.
2	***Agriculture & aquaculture***					
2.1	Annual & perennial non-timber crops					Not applicable
2.2	Wood & pulp plantations					Not applicable
2.3	Livestock farming & ranching					Not applicable
2.4	Marine & freshwater aquaculture					Not applicable
3	***Energy production & mining***	**Negligible**	**Negligible (<1%)**	**Extreme – Serious (31-100%)**	**High (Continuing)**	
3.1	Oil & gas drilling					Not applicable
3.2	Mining & quarrying	Negligible	Negligible (<1%)	Extreme – Serious (31-100%)	High (Continuing)	#1, 2, 3, 4
3.3	Renewable energy					Not applicable
4	***Transportation & service corridors***	**Negligible**	**Negligible (<1%)**	**Slight (1-10%)**	**Unknown**	
4.1	Roads & railroads					Logging Roads accounted for in 5.3
4.2	Utility & service lines					Not applicable
4.3	Shipping lanes					Not applicable
4.4	Flight paths					Not applicable
5	***Biological resource use***	**Low**	**Restricted (11-30%)**	**Moderate (11-30%)**	**High (Continuing)**	

Table 3. Threat classification table for Haida Gwaii Slug in British Columbia.

Threat No.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Sites[f]
5.1	Hunting & collecting terrestrial animals					Not applicable
5.2	Gathering terrestrial plants					Not applicable
5.3	Logging & wood harvesting	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	#1, 2, 3, 4, 8 & potential habitat
5.4	Fishing & harvesting aquatic resources					Not applicable
6	***Human intrusions & disturbance***	**Negligible**	**Restricted (11-30%)**	**Negligible (< 1%)**	**High (Continuing)**	
6.1	Recreational activities	Negligible	Restricted (11-30%)	Negligible (<1%)	High (Continuing)	#4, 5, 11
6.2	War, civil unrest, & military exercises					Not applicable
6.3	Work & other activities					Not applicable
7	***Natural system modifications***	**Medium - Low**	**Pervasive (71-100%)**	**Moderate – Slight (1-30%)**	**High (Continuing)**	
7.1	Fire & fire suppression					Not applicable
7.2	Dams & water management/use					Not applicable
7.3	Other ecosystem modifications	Medium - Low	Pervasive (71-100%)	Moderate – Slight (1-30%)	High (Continuing)	#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 (Sitka Black-tailed Deer)
8	***Invasive & other problematic species, genes & diseases***	**Unknown**	**Restricted (31-70%)**	**Unknown**	**High (Continuing)**	
8.1	Invasive non-native/alien species/diseases		Restricted (11-30%)	Unknown	High (Continuing)	All sites; considers invertebrate predators/ competitors. Sitka Black-tailed Deer scored in 7.3
8.2	Problematic native species/diseases					Not applicable
8.3	Introduced genetic material					Not applicable
8.4	Problematic species/diseases of unknown origin					Not applicable
8.5	Viral/prion-induced diseases					Not applicable

Table 3. Threat classification table for Haida Gwaii Slug in British Columbia.

Threat No.[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]	Sites[f]
8.6	Diseases of unknown cause					Not applicable
9	***Pollution***	Unknown	Unknown	Unknown	Moderate (Possibly in the short term, <10 yrs/3 gen)	
9.1	Domestic & urban wastewater					Not applicable
9.2	Industrial & military effluents					Not applicable
9.3	Agricultural & forestry effluents	Unknown	Unknown	Unknown	Moderate (Possibly in the short term, <10 yrs/3 gen)	#1, 2, 3, 4, 8
9.4	Garbage & solid waste					Not applicable
9.5	Air-borne pollutants					Not applicable
9.6	Excess energy					Not applicable
10	***Geological events***	**Low**	**Restricted (11-30%)**	**Slight (1-10%)**	**High (Continuing)**	
10.1	Volcanoes					Not applicable
10.2	Earthquakes/tsunamis					Not applicable
10.3	Avalanches/landslides	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	#5, 6, 7, 8, 9, 10, 12, 13
11	***Climate change & severe weather***	**Medium**	**Large (31-70%)**	**Moderate (11-30%)**	**High (Continuing)**	
11.1	Habitat shifting & alteration	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	High elevation #5, 6, 7, 8, 9, 10, 12, 13; less at low elevation #1, 2, 3, 4, 11
11.2	Droughts	Medium - Low	Large (31-70%)	Moderate – Slight (1-30%)	High (Continuing)	High elevation #5, 6, 7, 8, 9, 10, 12, 13; less at low elevation #1, 2, 3, 4, 11
11.3	Temperature extremes	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	High elevation #5, 6, 7, 8, 9, 10, 12, 13; less at low elevation #1, 2, 3, 4, 11
11.4	Storms & flooding	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	High elevation #5, 6, 7, 8, 9, 10, 12, 13; less at low elevation #1, 2, 3, 4, 11

Note: a description of the threats included in this table are found in Section 4.2.

[a] Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).
[b] **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. The median rate of population reduction for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75%), 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 time (e.g., timing is insignificant/negligible [past threat] or low [possible threat in long term]); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.
[c] **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%).
[d] **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. For this species a 10-year timeframe was used. Severity is 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%).
[e] **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.

4.2 Description of Threats

The overall province-wide threat impact for this species is High.[4] This overall threat considers the cumulative impacts of multiple threats. The threats are summarized from the COSEWIC (2013) status report and, when available, supplemented with additional information. Details are discussed below under the threat headings. Primary threats include ongoing ecosystem modifications from browsing by Sitka Black-tailed Deer (*Odocoileus hemionus sitkensis*), which are not native to Haida Gwaii (Threat 8.1), logging and wood harvesting, including new road construction (Threat 5.3), and impacts from climate change (Threat 11) (Table 3).

Threat 1. Residential & commercial development (Negligible threat impact)

1.3 Tourism and recreation areas (Negligible)
The Haida Gwaii archipelago attracts thousands of tourists each year, and there is increased pressure to expand services for tourists. Infrastructure development within some protected areas could include new recreational trails, toilet facilities, interpretive centres, camp sites, and other accommodation structures. Both national and provincial parks and conservancies consider impacts to species at risk during any infrastructure development, and Haida Gwaii Slug would be considered during the planning process. This threat does not apply to sites within Gwaii Haanas National Park Reserve, as there is currently no plan to expand any recreational facilities at these sites (#6, 7, 9, 10, 11), and no infrastructure development is anticipated now or in any future timeframe. This threat is also considered negligible at provincial protected areas (#5) and does not apply to sites within Brooks Peninsula Provincial Park (#12, 13).

Threat 3. Energy production & mining (Negligible threat impact)

3.2 Mining and quarrying (Negligible)
Small-scale quarrying is possible in Haida Gwaii habitats, particularly for construction of logging roads on Graham Island. Impacts on the slugs would accrue from habitat loss and disturbance, including damage to the substrate and refuge sites.

Threat 5. Biological resource use (Low threat impact)

5.3 Logging and wood harvesting (Low)
Logging and wood harvesting, including logging roads, are included in this category. Logging affects five known sites, in addition to potential habitat within lower elevation, unprotected areas of Graham Island and northern Moresby Island. All known sites on Moresby Island are within a protected area. Brooks Peninsula is a provincial park and not subject to logging. However, extensive logging has occurred east of the peninsula outside the park boundary, including higher elevation forests.

[4] The overall threat impact was calculated following Master *et al.* (2012) using the number of Level 1 Threats assigned to this species where timing = High or Moderate, which included 1 Medium, 1 Medium-Low, and 2 Low (Table 3). The overall threat impact considers the cumulative impacts of multiple threats.

Approximately 25% of known sites are affected by logging. On Graham Island, there has been previous logging at five sites (#1, 2, 3, 4, 8). One site (Site 1 in Figure 3) was logged in 2003 – 2004, and residual effects on the species will extend into the future. Opening of the canopy alters microclimates on the forest floor by exposing the ground to wind and sun. Logging also drastically alters habitat structure at ground level, including distribution and replenishment of coarse woody debris. Movements of slugs are probably curtailed. In addition, both existing and new logging roads pose potential barriers to movements, increasing habitat fragmentation and isolation of subpopulations.

The responses of gastropods and other forest floor invertebrates to logging depend on forest type, size of cut area, and distribution of remaining trees (Matveinen-Huju *et al*. 2006; Prezio *et al*. 1999). In general, higher levels of tree retention have been found to better maintain pre-harvesting patterns of abundance for many species of gastropods (Hawkins *et al*. 1997; Prezio *et al*. 1999; Huggard and Vyse 2002; Ovaska *et al.* (2016). In their study, Ovaska *et al.* (2016) examined the responses of terrestrial gastropods to various spatial patterns of logging at experimental forestry sites in western B.C; one of the sites was on Graham Island, and the rest were on Vancouver Island and the Sunshine Coast on the mainland. Haida Gwaii Slug was found at the Graham Island experimental site, but the small sample size precluded statistical analysis (14 slugs at 6 of 20 plots). After 2 years from logging, the slugs persisted within the three tree-retention patches (approximately 0.5 ha) and the single sampling plot in the control area where they were previously found; they were not found in the two survey plots in the clearcut where they occurred before logging (Ovaska and Sopuck 2008). Longer-term persistence of the species at the site is unknown, but the cut areas probably curtail movements.

Threat 6. Human intrusions & disturbance (Negligible threat impact)

6.1 Recreational activities (Negligible)
Recreational activities occur at approximately 15% of the known sites. In particular, the Sleeping Beauty Trail on Mt. Genevieve is a popular hiking trail in the vicinity of Queen Charlotte City. The trail is rugged and not conducive to motorized traffic. Hiking is considered to result in no or minimal impact on the Haida Gwaii Slug and its habitat at its current or expected level.

Threat 7. Natural system modifications (Medium – Low threat impact)

7.3 Other ecosystem modifications (Medium – Low)
Sitka Black-tailed Deer were introduced to Haida Gwaii repeatedly in late 1800s and 1925 and are now widespread throughout the islands. Deer are commonly found throughout Graham and Moresby islands, including subalpine and alpine areas, as well as on the outer islands. Deer are profoundly modifying ecosystems across the islands (Pojar 2008). Effects of deer or their sign were noted at all sites where the Haida Gwaii Slug was found, including subalpine and alpine areas (pers. obs. by K. Ovaska and L. Sopuck *in* COSEWIC 2013).

Deer browsing may impact Haida Gwaii Slug by decreased accumulation of shrub leaves in the litter layer and increased exposure of the ground to sun and wind, resulting in lower humidity in micro-sites used by the slugs. On the outer islands of Haida Gwaii, terrestrial gastropod abundance decreased on islands subjected to long-term (>50 year) presence of deer (Allombert *et*

al. 2005). Studies elsewhere have also reported negative effects of ungulate browsing on terrestrial gastropods (Suominen 1999) and on the litter layer (Wardle *et al*. 2001).

The Council of the Haida Nation and Parks Canada are implementing removal of introduced deer on six small islands within Gwaii Haanas National Park Reserve and Haida Heritage Site.

Deer are native to Vancouver Island, and likely present within the Brooks Peninsula habitats (#12, 13). The habitats where slugs were found on Brooks Peninsula didn't appear impacted from deer, there were abundant shrubs and forbs growing in these habitats, and no visual indication that deer browse was impacting this habitat. However, no formal assessment has been completed.

Threat 8. Invasive and Other Problematic Species (Unknown threat impact)

8.1 Invasive non-native species (Unknown)
Introduced gastropods and other invertebrates that can compete or prey on Haida Gwaii Slug are present sporadically in Haida Gwaii, primarily in human use areas, but may be expanding their distribution with increased logging and recreational activities. Habitat shifts associated with climate change may allow for them to encroach into Haida Gwaii Slug's subalpine and alpine habitats. Ovaska and Sopuck (2005) noted that Gwaii Haanas National Park Reserve and Haida Heritage site was remarkably free of introduced gastropods, with concentrations only around some human use areas. No introduced gastropods were encountered on the ridge at sites where species was detected on Brooks Peninsula.

Threat 9. Pollution (Not applicable)

9.3 Agricultural and forestry effluents (Not applicable)
Herbicides are not used on public forestry lands on Haida Gwaii, as per a Haida Nation House of Assembly resolution. Herbicides are not used in the habitats where Haida Gwaii Slug occurs in national or provincial parks.

Threat 10. Geological events (Low threat impact)

10.3 Avalanches/landslides (Low threat impact)
Landslides occur frequently in Haida Gwaii, particularly on steep slopes, and probably also on Brooks Peninsula. The frequency and size of landslides is likely to increase in logged landscapes and with the increasing frequency and intensity of severe storms predicted under human-caused climate change, resulting in more serious habitat loss. Landslides could alter or eliminate Haida Gwaii Slug's habitat patches. High-moisture habitats where the species occurs are prone to landslides, particularly at higher elevations (Sites #5, 6, 7, 8, 9, 10, 12, 13 and potential habitat).

Threat 11. Climate change & severe weather (Medium threat impact)

11.1 Habitat shifting & alteration (Medium threat impact)
Climate change is predicted to profoundly alter ecosystems in B.C. by the end of the 21st century; some effects consistent with climate change have already been documented (Gayton

2008). Alpine ecosystems are deemed particularly at risk from climate change as the tree line shifts upwards (Hebda 1997; Krannitz and Kesting 1997; Gayton 2008).

Alpine and subalpine zones in Haida Gwaii occur at relatively low elevations and would therefore experience rapid shrinking. Haida Gwaii Slug is most abundant, and its distribution is most continuous in subalpine and alpine habitats (~2/3 of known sites), and it will probably be adversely affected both by predicted habitat shifts and increased competition and predation as ranges of forest invertebrates extend upwards. The Mountain Hemlock biogeoclimatic zone, also inhabited by the Haida Gwaii Slug, will similarly shrink as Western Hemlock stands expand upslope (Hebda 1997). Populations may decrease in size and become more isolated if the slugs are forced to retreat to remaining suitable habitats in higher elevations.

11.2 Droughts (Medium – Low threat impact)

For coastal regions of B.C., the predictions are for decreased summer and increased winter precipitation (Pacific Climate Impact Consortium 2012). Increase in winter precipitation in the form of rain instead of snow will decrease the annual snowpack, leading to reduced water supply in spring and summer. As a result, it is expected that summer drought will occur on the Coastal Region's south coast, due to higher summer temperatures and decreased summer precipitation by the 2080s (B.C. MFLNRO 2016a; 2016b). Summer droughts will threaten ecosystems and possibly lead to greater fire risk, both of which will decrease the habitat available for Haida Gwaii Slug. As well, drought can lead to canopy dieback from direct or indirect mortality, which would also affect humidity.

Haida Gwaii Slug occurs in habitats with very high moisture. Droughts are expected to reduce the length of the activity season, foraging opportunities, and availability of moist refuges on the forest floor, potentially leading to desiccation and mortality. The cumulative effect of a series of prolonged droughts are expected to be particularly deleterious.

11.3 Temperature extremes (Low threat impact)

Haida Gwaii has evolved under cool, harsh environmental conditions and probably tolerates a wide range of ambient temperatures provided that cool, moist refuges are available. However, rapid temperature changes or long periods of extreme temperatures (either high or low) will be potentially deleterious, especially if availability of suitable moist refuges is simultaneously reduced due to droughts.

11.4 Storms & flooding (Low threat impact)

Severity and frequency of storms and flooding events are predicted to increase under climate change scenarios. Haida Gwaii Slug's habitats at higher elevations and on steep slopes are particularly susceptible to damage from such events, including precipitation of landslides (see Threat 10.3 Avalanches/landslides).

5 MANAGEMENT GOAL AND OBJECTIVES

5.1 Management Goal

The management goal is to ensure the redundancy[5] of Haida Gwaii Slug in Canada by addressing human-caused threats that are contributing to a decline in the area, extent, and quality of suitable habitat to known subpopulations (including any additional subpopulations that may be identified in the future).

5.2 Rationale for the Management Goal

Haida Gwaii Slug has a restricted range in Canada, and apparently low densities at all known sites. There are 13 extant subpopulations of Haida Gwaii Slug in Canada. These records are the result of targeted searches over many years. Preventing habitat loss and degradation at known subpopulations reduces the likelihood that thresholds for Threatened/Endangered will be reached. There are a limited number of glacial refugia in Canada, these habitats are not easily restored nor easily created, and the ability for one subpopulation of Haida Gwaii Slug to recolonize another is unlikely (i.e., slugs move slowly). Preventing habitat loss and degradation at habitats with extant subpopulations ensures the number of subpopulations stays above thresholds that may otherwise warrant consideration for uplisting the species. Historical abundance and distribution information for this species is not available; the species was only recorded in 2003 and there are no historical museum records.

There is little information on Haida Gwaii Slug foraging or dispersal distance in habitats. Specific subpopulation targets cannot be quantified at this time because subpopulation information for Haida Gwaii Slug is limited. Haida Gwaii Slug is not commonly found and surveys within known sites usually result in only one or two individuals being recorded. Consequently, there is little information with which to measure abundance trends, or to complete a minimum subpopulation viability analysis. Life span, dispersal, and recolonization capabilities are unknown, and detailed habitat requirements are unclear. Fulfilling these knowledge gaps will provide important information that will help maintain the abundance of known subpopulations and will allow the management goal to be quantified in the future.

It is unlikely that suitable habitat for Haida Gwaii Slug was more widespread in the past, due mainly to the specificity of the species' habitat requirements. Furthermore, because there is currently no information or evidence from historical sampling to suggest that the species' range was more widespread in the past, a management goal of actively increasing the number of subpopulations through translocation or other techniques is not recommended at this time. If additional naturally-occurring subpopulations are recorded, they will be included in management planning.

[5] Redundancy refers to the number of (sub) populations and/or the degree to which the species is widespread (the relevant metric of redundancy will depend on the circumstance). A species that has multiple (sub) populations or locations, or a distribution that is very widespread, is more likely to persist over the long term because of reduced risk of catastrophic loss or extirpation from a single, local event. If one (sub) population becomes destroyed, others may be able to act as a source population.

5.3 Management Objectives

The management objectives for Haida Gwaii Slug are:

1. to protect[6] known (and newly documented) subpopulations of Haida Gwaii Slug throughout the species' British Columbia range by managing human-caused threats to the species.
2. to confirm the distribution of Haida Gwaii Slug including new locations by inventory of suitable habitat for additional subpopulations with the purpose of preventing the inadvertent losses.
3. to assess and mitigate threats to extant subpopulations, and more broadly to potential habitats; and
4. to monitor trends in population size and distribution at known sites for the purpose of collecting additional ecological data, including information on population size and recruitment.

6 APPROACHES TO MEET OBJECTIVES

Actions classifications in Section 7.1 and threats classifications in Section 4.1 are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website (Conservation Standards 2019).

6.1 Actions Already Completed or Underway

B. Enabling Condition Actions

Action 7 Legal & Policy Frameworks

Action 7.2 Policies & Guidelines

Compile Status Report (complete)

- COSEWIC report completed (COSEWIC 2013).

Send to COSEWIC (complete)

- Haida Gwaii Slug assessed as Special Concern (COSEWIC 2013). Re-assessment due 2023.

Planning (in progress)

- B.C. Management Plan completed (this document, 2021).

[6] Protection can be achieved through various mechanisms including voluntary stewardship agreements, conservation covenants, sale of private lands by willing vendors, land use designations, and protected areas.

6.2 Recommended Management Actions

Actions are characterized in Table according to the objective, what actions are identified for meeting the objective, how actions could be measured to meet the objective, what threat the action addresses and the priority of the action (e.g., necessary, essential, beneficial).

Table 4. Recommended management actions for Haida Gwaii Slug.

Objective	Action #[a]	Actions Classifications	Actions to meet objectives	Performance measures	Threat[b] addressed	Priority[c]
	A[d]	**Target Restoration/Stress Reduction Actions**				
	1	***Land/Water Management***				
3	1.1	Site/Area Stewardship	Assess and categorize (e.g., using considerations such as cost, access, and other factors) the feasibility of control of non-native Sitka Black-tailed Deer at all sites on Haida Gwaii. Ensure partners are involved in this assessment and prioritization exercise. Where feasible, encourage the reduction of deer populations at these sites.	Effects on Haida Gwaii Slug habitats from deer browsing have been investigated and, where feasible, the threat is reduced through mitigative actions at some sites	8.2 7.3	Necessary
3, 4	1.2	Ecosystem & Natural Process (Re)Creation	Develop a long-term habitat monitoring plan that documents change in habitat in relation to 1) Sitka Black-tailed Deer abundance at Haida Gwaii sites and 2) climate change at all sites (i.e., both Haida Gwaii and Brooks Peninsula sites).	Habitat changes over time are documented at slug sites and related to identified threats. Information then used to adapt threat mitigation actions to meet management objectives.	8.2 7.3 11.1 11.2 11.3 11.4	Essential
	B	**Behavioural Change/ Threat Reduction Actions**				
	3	***Awareness Raising***				
1, 2	3.1	Outreach & Communications	Develop and implement a strategy for communicating with land managers/stewards about the slug and recovery activities, as required.	Land users, resource professionals, Indigenous Nations and stewards overlapping the species known sites are contacted.	1.3 5.3 6.1 9.5	Beneficial

Table 4. Recommended management actions for Haida Gwaii Slug.

Objective	Action #[a]	Actions Classifications	Actions to meet objectives	Performance measures	Threat[b] addressed	Priority[c]
				A provincial species fact/identification sheet developed for the slug. Training workshops conducted to land managers on identifying gastropods.		
C		**Enabling Condition Actions**				
	6	***Conservation Designation & Planning***				
1, 3	6.1	Protected Area Designation &/or Acquisition	Ensure protection measures are in place for all known sites (and newly documented sites). • Recommend specific management measures are incorporated into provincial park management plans and parks Master Plans. • Recommend that any necessary measures for protection and recovery of Haida Gwaii Slug are considered in national park planning documents.	Haida Gwaii Slug habitat and population management measures are incorporated into B.C. parks and national parks planning documents by 2026. Best management practices are provided to landowners, land managers and land stewards and have been applied by 2026.	1.3 5.3 6.1 8.2	Essential
All	6.4	Conservation Planning	Determine appropriate measure(s) to protect habitat with an ecosystem-level approach (conservancies or Indigenous Protected Areas). Develop or refine site specific management plans for protected areas to reduce or remove threats to populations and habitats.	Best management practices are provided to landowners, land managers and land stewards and have been applied by 2026. All land managers within the species' potential range are contacted and provided with education and outreach material by 2026.	1.3 5.3 6.1 8.2	Essential
	7	***Legal & Policy Frameworks***				
1, 3, 4	7.1	Laws, regulations & Codes	Recommend Haida Gwaii Slug to be listed as Identified Wildlife under B.C.	Haida Gwaii Slug recommended for listing as Identified Wildlife under the	3.2 5.3	Essential

Table 4. Recommended management actions for Haida Gwaii Slug.

Objective	Action #[a]	Actions Classifications	Actions to meet objectives	Performance measures	Threat[b] addressed	Priority[c]
			Forest and Range Practices Act and *Oil and Gas Activities Act*.	B.C. *Forest and Range Practices Act* and *Oil and Gas Activities Act* and draft Identified Wildlife Species Account written by 2022.	6.1	
1, 3, 4	7.2	Policies & Guidelines	Work with the lands managers to use environmental protection tools and prepare best management practices guidelines. Prepare best management practices (BMP) guidelines that include recommendations specific to different land managers/ land stewards, local conservancy groups and other landowners that may contain undocumented sites. Seek involvement from all these groups such that BMPs are suitable for their needs. Include options for managing habitat for forest-floor invertebrates under different land-use practices. When the species is recorded on B.C. public lands, initiate protection measures under existing government policy (e.g., conservancies and protected areas for older forests).	Existing policy-based protection measures in place for all Crown land sites. Best management practices are provided to landowners, land managers and land stewards and have been applied by 2026.	1.3 5.3 6.1 7.3 9.5	Essential
	8	***Research & Monitoring***				
1, 2, 3, 4	8.1	Basic Research & Status Monitoring	Complete a habitat suitability/population occupancy model using geographic information systems (GIS) and other tools; use model outputs to prioritize habitats for inventory.	Increased knowledge of the Canadian range extent, number of known sites, spatial occupancy information to help guide protection decisions and habitat information for the slug. Timeline is ongoing.	All	Essential

Table 4. Recommended management actions for Haida Gwaii Slug.

Objective	Action #[a]	Actions Classifications	Actions to meet objectives	Performance measures	Threat[b] addressed	Priority[c]
			Complete inventory at these prioritized habitats, especially in areas outside of the species known range (e.g., in other glacial refuges that have not had past inventory). Determine the area of occupancy of known sites, and spatially define the habitat polygon at each site. Create standard protocol for gathering habitat and threat information at each site.	The persistence of Haida Gwaii Slug has been maintained at all extant sites (and any new sites).		
3	8.2	Evaluation, Effectiveness Measures & Learning	Research on threats mitigation and population demographics.	Impact of the threats to the populations at all sites has been investigated by 2024 and threats have been reduced (population numbers remaining stable or increasing in size at these sites) by 2026. Research projects on population demographics have been initiated by 2026.	All	Beneficial
	9	***Education & Training***				
All	9.1	Formal Education	Encourage inclusion of gastropod species at risk in post-secondary education curriculum.	Curriculum outline developed and available for use by instructors by 2024.	All	Beneficial
All	9.2	Training & Individual Capacity Development	Contact land managers for all sites and engage their cooperation to establish habitat protection on these sites using tenure appropriate tools for the species.	Land managers within the species' potential range are contacted and provided with education and outreach material (ongoing).	1.3 5.3 6.1	Essential
	10	***Institutional Development***				

Table 4. Recommended management actions for Haida Gwaii Slug.

Objective	Action #[a]	Actions Classifications	Actions to meet objectives	Performance measures	Threat[b] addressed	Priority[c]
All	10.3	Alliance & Partnership Development	Create new and maintain existing partnerships with both government and non-government organizations and staff, focused on coordinating conservation implementation, knowledge generation & sharing	Further develop existing relationships and explore new relationships with both government and non-government organizations within the species' known range	All	Essential
All	10.4	Financing Conservation	Encourage independent research on and stewardship projects for Haida Gwaii Slug.	Research and stewardship projects initiated for Haida Gwaii Slug by 2026.	All	Beneficial

[a] Action numbers according to the IUCN-CMP Actions Classifications 2.0.
[b] Threat numbers according to the IUCN-CMP Threats Classifications 2.0.
[c] Essential = urgent and important, needs to start immediately; Necessary = important but not urgent, action can start in two to five years; or Beneficial = action is beneficial and could start at any time that was feasible.
[d] Black rows denote "Level 0" hierarchical classifications of actions under the CMP Actions Classification. Under the classification system it is the highest-level actions can be grouped into, and creates a logical way of grouping related actions.
[e] Note that including these actions in the standardized classification explicitly does NOT constitute an endorsement of these tactics.

6.3 Narrative to Support Management Actions Table

Recommended actions have been categorized by the IUCN-CMP Conservation Actions Classification system.

6.3.1 Action 1 Land/Water Management

Action 1.1 Site/Area Stewardship

Managing threats to known sites will reduce risk and arrest or reverse threat impacts. The cumulative and long-term impacts from Sitka Black-tailed Deer have likely led to long-term habitat changes and a decline in subpopulation abundance of Haida Gwaii Slug. The number of deer and removal costs present challenges to managing this threat in Haida Gwaii Slug habitat. The Council of the Haida Nation and Parks Canada have implemented the removal of introduced deer on six islands within Gwaii Haanas National Park Reserve and Haida Heritage Site. It is unknown if Haida Gwaii Slug occurs within these same sites.

This recovery action (i.e., to reduce deer abundance on Haida Gwaii) should focus on determining the feasibility of removal of deer in collaboration with partners, and implementing removals where determined to be feasible.

As more information is gained (e.g., through surveys and natural history studies), should a Haida Gwaii Slug be found in a high density or hotspot, the feasibility of erecting an exclosure around the habitat could be explored to prevent deer browsing to the area, and thus degrading slug habitat.

Action 1.2 Ecosystem & Natural Process (Re)Creation

A long-term habitat and subpopulation abundance monitoring plan will enable documenting changes in habitat in relation to Sitka Black-tailed Deer abundance, logging, and climate change at Haida Gwaii Slug sites. The monitoring would consist of a geographic information systems (GIS) exercise, using available habitat mapping and climate modelling to examine historical and predicted future trends in habitat availability. Existing information on deer abundance at all sites would also provide useful information. On-the-ground monitoring of deer abundance, particularly at remote subalpine sites, is needed and would provide data regarding the extent to which this threat impacts these remote sites.

6.3.2 Action 3 Awareness Raising

Action 3.1 Outreach & Communications

Raising awareness of Haida Gwaii Slug is critical for empowering those who work most closely with its habitat to participate fully in recovery actions, and to increase support for conservation and recovery among the public. A strategy for communicating with land managers/stewards about the slug and recovery activities will be developed and implemented.

The strategy includes contacting land users and stewards overlapping known Haida Gwaii Slug sites. Ensuring that the locations are known to landowners, land managers (including tenure holders), Indigenous Peoples and providing identification sheets and workshops could better equip them to minimize and manage threats, and to report possible additional occurrences. Outreach materials include the development of a provincial species fact/identification sheet for the species, and training workshops for landowners and habitat stewards, as needed. Blog posts, articles, iNaturalist species profiles, and public lectures have potential to reach a greater audience, prompting more people to consider issues related to terrestrial gastropod conservation while pursuing their own interests and activities, and inspiring early-career individuals to pursue studies and develop skills that benefit this and other at-risk terrestrial gastropods in the future. Where possible, training needs will be incorporated into a multi-species approach for conservation and management.

6.3.3 Action 6 Conservation Designation and Planning

Action 6.1 Protected Area Designation &/or Acquisition

Listing Haida Gwaii Slug as Identified Wildlife under FRPA would enable the designation of protected areas, and would mitigate the threat of forest, range, and oil and gas activities through the establishment of Wildlife Habitat Areas. Evidence of recent or past logging was noted at five Haida Gwaii Slug sites on provincial crown land (# 1, 2, 3, 4, 8) as well as in potentially suitable habitat. Legal designations to prevent resource harvesting or extraction and associated infrastructure at known sites (as well as those of any additional subpopulations that may be found) reduce the need to develop and implement new practices and the number of risks requiring active management at a recovery site.

Action 6.4 Conservation Planning

Conservation planning through the development or refinement of site-specific protected area management plans will reduce or remove threats to subpopulations and habitats (e.g., #5 [Yaaguun Suu Conservancy], #12, 13 [Brooks Peninsula], and #6, 7, 9, 10 and 11 [Gwaii Haanas National Park Reserve and Haida Heritage Site]). Ensuring that Haida Gwaii Slug is considered in existing and updated management plans is important. If Haida Gwaii Slug is found on private lands, stewardship activities with landowners need to be initiated to protect the species' habitat. Haida Gwaii Slug will be considered by Parks Canada Agency in an upcoming revision to the site-based action plan for Gwaii Haanas National Park. This will determine where Parks Canada Agency can make its greatest contributions to protection and recovery of at-risk species. No additional species-specific actions are currently underway to protect Haida Gwaii Slug in British Columbia.

6.3.4 Action 7 Legal & Policy Frameworks

Action 7.1 Laws, Regulations & Codes

Apply Legal Land Use Tools

The five sites on Graham Island are on unprotected provincial public lands (#1, 2, 3, 4, 8) and there are opportunities for legal land designations to increase habitat protection.

The successful recovery of this species on public land includes applying the appropriate land use tool. The two main legal instruments applicable to the species protection include the *Land Act* (Province of British Columbia 1996a) to protect against further land dispositions and the *Forest and Range Practices Act* (FRPA) to address timber harvesting.

These statutes do not restrict the activities of other resource industries such as oil/gas extraction and mining [e.g., designation of a Cultural Heritage Resource under the *Mineral Tenure Act* (Province of British Columbia 1996b)]. In some cases, other statutes such as the *Greenbelt Act* (Province of British Columbia 1996c) may be more appropriate to protect sensitive public land areas within or near communities.

Potentially applicable administrative (land use) instruments under the *Land Act* include:

- Notations of Interest which record the interest of another provincial ministry in the Crown Land Registry (Crown Land Registry, 2021). It does not preclude the acceptance of land applications or disposition of B.C. public land.
- Section 10.1 Ministerial Orders (*Land Act*) (Province of British Columbia 1996a) restricting new B.C. public land applications for a period.
- Land Act Reserves:
    - Section 15 designation is a full withdrawal from disposition for the long-term conservation of land in the public interest (established by Order in Council).
    - Section 16 designation to temporarily withdraw or withhold B.C. public land from alienation for all purposes under the *Land Act* (e.g., for a term up to 30 years).
    - Section 17 designation is a conditional withdrawal which designates a portion of B.C. public land for the conservation of natural resources (e.g., for a term up to 30 years).

The process to implement the above land use tools under the *Land Act*[7] are described in the following policies and procedures:

- Form of Crown Land Allocation Policy (Province of British Columbia 2011a),
- Reserves, Notations, Withdrawals and Prohibition Policy (Province of British Columbia 2011b), and, in particular,
- Procedure for Management of Crown Lands for Conservation Purposes (Province of British Columbia 2015).

Wildlife Habitat Areas could be considered for Haida Gwaii Slug within the range of occurrences on B.C. public land outside Haida Gwaii where capacity for WHAs has been met. Under the *Forest and Range Practices Act* (FRPA) (Province of B.C. 2002), the Minister responsible for the *Wildlife Act* (Province of B.C. 1982), the Minister of Environment and Climate Change Strategy, can establish categories of wildlife that require special management to address impacts of forest and range activities on B.C. public land. Identified Wildlife are managed through the establishment of wildlife habitat areas (WHAs) and the implementation of

[7] Note: land designations and the establishment of land use objectives are also described in section 7.1 of the *Land Act* (s. 93.1 to 93.4) and on the following B.C. government website: https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning

general wildlife measures (GWMs) and wildlife habitat area objectives, or through other management practices specified in strategic or landscape-level plans (B.C. MWLAP 2004).

The authority to establish WHAs and associated general wildlife measures or objectives is enabled through sections 9 and 10 of the Government Actions Regulation (Province of B.C. 2004). At present, Haida Gwaii Slug is not listed as Identified Wildlife under FRPA.

Discussions about adding protection measures for the Haida Gwaii Slug through the Haida Gwaii Land Use Order Objectives are an option that requires involvement of the Haida Gwaii Management Table. The Haida Gwaii Land Use Objectives Order is established by the Haida Gwaii Management Council under section 4(1) of the *Haida Gwaii Reconciliation Act* (Province of B.C. 2014).

Legislative options that could be further examined as options to protect habitat are included in Table 5.

Table 5. Legal Land Use Tools that may afford habitat protection for Haida Gwaii Slug.

Existing mechanisms that afford habitat protection	Threat[a] addressed	Site/Map #
Wildlife Act (s. 108)	5.3, 6.1	1, 2, 3, 4, 8
Land Act (s.10.1, s.15, s.16, s.17, s. 93.1-93.4[not in force], and/or s.66)		
Forest and Range Practices Act (s.149.1)		12, 13
Haida Gwaii Reconciliation Act (s.4(1))	5.3, 6.1	1, 2, 3, 4, 8

[a] Threat numbers according to the IUCN-CMP classification (see Table 3 for details).

Action 7.2 Policies & Guidelines

Prepare best management practices (BMP) guidelines that include recommendations specific to different land managers/ land stewards, partners, local conservancy groups and other landowners that may contain undocumented sites. Seek involvement from all these groups such that BMPs are suitable for their needs. Include options for managing habitat for forest-floor invertebrates under different land-use practices. Best management practices are provided to landowners, land managers and land stewards and have been applied by 2026.

When the species is recorded on B.C. public lands, initiate protection measures under existing government policy (e.g., conservancies and protected areas for older forests). Existing policy-based protection measures in place for all B.C. public land sites (see Action 7.1).

6.3.5 Action 8 Research & Monitoring

Action 8.1 Basic Research & Status Monitoring

Basic research on the life history, habitat use, and monitoring of known sites are critical to conserving Haida Gwaii Slug in B.C. Additional inventory in areas likely to be inhabited, but outside of the currently known range, is also needed. The following activities are of highest priority and are essential to the species recovery:

- Confirm the continued presence and obtain information on area of occupancy and relative abundance of Haida Gwaii Slug at known sites.
- Describe habitat characteristics at known sites, and provide quantitative estimates of features of macro- and micro-habitat to the extent possible (without experimentation).
- Prepare a habitat suitability map using knowledge of macro- and micro-habitats at known sites; map (using geographic information systems tools) and iteratively refine the distribution of potentially suitable habitat. This includes other nunatak areas (unglaciated areas that were above the ice sheets) within coastal B.C.
- Conduct inventory within the habitat modeled (above) to address knowledge gaps around the species distribution, abundance, and range in B.C.
- Prioritize sites with most imminent potential threats, and survey identified potential habitat for possible additional occurrences and subpopulations.
- Conduct or collaborate in scientific research to address knowledge gaps on the life history, biological requirements, and limiting factors for the species;
- Model the effects of climate change to identify subpopulations at most imminent risk and, for proactive planning, areas that may support Haida Gwaii Slug in the future.
- Monitor known subpopulations to determine long-term population and distribution trends.

Action 8.2 Evaluation, Effectiveness Measures & Learning

Evaluating the ongoing research on the natural history, monitoring of impacts from Sitka Black-tailed Deer and climate change, as well as other threats to the populations at all sites need investigation (see Section 8.1 for research and status monitoring). The need for evaluating all aspects of the research process includes writing or reviewing proposals, developing protocols and methods, collecting data, analyzing data, peer reviewing results, and sharing and disseminating findings.

6.3.6 Action 9 Education & Training

Action 9.1 Formal Education

Incorporating gastropods, including Haida Gwaii Slug, into species at risk programs and modules in colleges and university will build support and long-term capacity for conservation. Developing curriculum content for elementary and secondary students on species at risk, including less known fauna such as gastropods, will contribute to overall appreciation for terrestrial molluscs as part of ecosystems. Special workshops, sessions, or guest lectures on terrestrial mollusc diversity and identification are encouraged.

Action 9.2 Training & Individual Capacity Development

Developing and delivering non-academic training opportunities will benefit Haida Gwaii Slug by increasing the pool of knowledge and skills available to contribute to recovery. There is focus on capacity development of landowners, park staff, and local residents, however general and specific experience relating to conservation of Haida Gwaii Slug should be targeted to each audience. For example:

- Hands-on targeted workshops to teach practitioners, land stewards, ecologists, and other resource professionals. Workshops include field visits, how to recognize potential habitat, conduct searches, report rare species, identify terrestrial gastropods, and identify this species with confidence.
- Presentations to the public and to interested groups (e.g., residents of Haida Gwaii, nature clubs, tourist groups) that highlight the needs and challenges of terrestrial mollusc conservation, including this species.
- Submit photographic entries in iNaturalist and confirmation of species identification by gastropod specialist, such that species recognition software and provide reliable information to the natural history community, should they encounter this species
- Field trips with naturalist clubs, lands managers and stewards (e.g., parks staff, Indigenous nations, local biologists), and others interested to discover field terrestrial malacology and identify terrestrial gastropods.

Like most taxa, terrestrial molluscs require specialized knowledge and techniques for surveys and identification. There are few available experts and identification resources, and mainstream interest is largely undeveloped. Community-supported data collection and threats management for at risk terrestrial molluscs depend on building this capacity.

6.3.7 Action 10 Institutional Development

Action 10.3 Alliance & Partnership Development

There is need to form partnerships and stewardship opportunities that will facilitate the sharing and generation of biological, ecological and conservation knowledge, and the coordination of conservation efforts of Haida Gwaii Slug with other species of conservation concern on Haida Gwaii. Partnerships between governments (e.g., federal, provincial, Indigenous) and non-government organizations are necessary to protect the species.

Raising awareness of the species is promoted by offering an identification workshop focusing on survey methods and identification of Haida Gwaii Slug, and how to report locations to the B.C. Conservation Data Centre. Partnerships with land managers, Indigenous groups, naturalist clubs, and local conservation organizations is important in furthering information dissemination. Performance measures include establishment of working relationships with land managers of 50% of known sites, and delivery of at least one outreach activity to land managers/landowners/ Indigenous groups. Identification page for Haida Gwaii Slug is created and posted by regional staff.

7 MEASURING PROGRESS

Performance indicators provide a way to define and measure progress toward achieving the management goals and objectives. Performance indicators have been integrated into the Recommended Management Action Table 4 in Section 6.2.

8 EFFECTS ON OTHER SPECIES

Management actions for Haida Gwaii Slug 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. Habitat protection for Haida Gwaii Slug will also protect other flora and fauna that reside in the same habitats, including numerous plants, lichens and wildlife. Other species at risk potentially near occurrences of Haida Gwaii Slug include Drooping-leaved Beard-moss (*Oxystegus recurvifolius*), Corrupt Spleenwort (*Asplenium adulterinum*), Dalton's Moss (*Daltonia splachnoides*), Dotted Saxifrage (*Micranthes nelsoniana* var. *carlottae*), Haida Gwaii Avens (*Geum schofieldii*), and Haida Gwaii Twinflower Violet (*Viola biflora* var. *carlottae*) (B.C. CDC 2021).

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