

Recovery Strategy for the Sharp-tailed Snake (*Contia tenuis*) in Canada

Sharp-tailed Snake



2017



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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1)¹.

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¹ <http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1>

RECOVERY STRATEGY FOR THE SHARP-TAILED SNAKE (*Contia tenuis*) IN CANADA

2017

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 *Recovery Strategy for the Sharp-tailed Snake (Contia tenuis) in British Columbia* (Part 2) under Section 44 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 recovery strategy.

The federal recovery strategy for the Sharp-tailed Snake in Canada consists of two parts:

Part 1 – Federal Addition to the *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia*, prepared by Environment and Climate Change Canada

Part 2 – *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia*, prepared by the Sharp-tailed Snake Recovery Team for the British Columbia Ministry of Environment

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Part 2 – *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia*, prepared by the Sharp-tailed Snake Recovery Team for the British Columbia Ministry of Environment

Part 1 – Federal Addition to the *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia*, prepared by Environment and Climate Change Canada

Preface

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

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency (PCA) is the competent minister under SARA for the Sharp-tailed Snake and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia and affected stakeholders as per section 39(1) of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Province of British Columbia provided the attached recovery plan for the Sharp-tailed Snake (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.

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

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

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

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

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area³ be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgements

Development of this recovery strategy was coordinated by Eric Gross, Megan Harrison, and Matt Huntley (Environment and Climate Change Canada, Canadian Wildlife Service – Pacific Region (ECCC CWS-PAC)). Christian Engelstoft (Biolinx Environmental Research Limited (Biolinx)), Kari Nelson (British Columbia Ministry of Environment (B.C. MoE)), Purnima Govindarajulu (B.C. MoE), Peter Fielder (B.C. MoE), Trudy Chatwin (B.C. Ministry of Forests, Lands and Natural Resource Operations (B.C. FLNRO)), Orville Dyer (B.C. FLNRO), Kym Welstead (B.C. FLNRO), Nicole Kroeker (Parks Canada Agency (PCA)), Conan Webb (PCA), Andrea Schiller (Natural Resources Canada), Paul Johanson (ECCC CWS – National Capital Region (NCR)), and Véronique Lalande (ECCC CWS-NCR) provided helpful editorial advice and comment. Katrina Stipek (B.C. Conservation Data Centre) and Laura Matthias (Saltspring Island Conservancy) provided supporting data. Kristiina Ovaska, Lennart Sopuck, and Christian Engelstoft (Biolinx) drafted and contributed expertise to a preliminary version of this document. Danielle Yu and Douglas Hrynyk (ECCC CWS-PAC) provided additional assistance with mapping and figure preparation.

³ These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Bird Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

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 *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia* (Part 2 of this document, referred to henceforth as “the provincial recovery plan”) and/or to provide updated or additional information.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery plan referring to protection of survival/recovery habitat may not directly correspond to federal requirements. Recovery measures dealing with the protection of habitat are adopted; however, whether these measures will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

1. Species Population and Distribution

This section replaces the information summary for known populations of Sharp-tailed Snake in Canada (section 3.2.2 of the provincial recovery plan).

The information summary below (Table 1) describes the updated distribution of populations in Canada, all occurring in southwestern British Columbia (B.C.). Since publication of the provincial recovery plan, an additional population has been included from occurrences near Reginald Hill (Population #17) on Saltspring Island (L. Matthias pers. comm. 2016). Excepting this additional population, all population numbers in this section align with those provided in the provincial recovery plan.

Of the 17 currently recorded Sharp-tailed Snake populations, 13 are considered extant⁴, 3 are considered historical (not observed for > 20 years), and one is of unknown status. Population #10 (Saltspring Island, Northeast; unknown status) has not been verified and location details are lacking.

2. Critical Habitat

This section replaces section 7 “Species Survival and Recovery Habitat” in the provincial recovery plan.

Section 41(1)(c) of SARA requires that recovery strategies include an identification of the species’ critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. A primary consideration in the identification of critical habitat is the amount, quality, and locations of habitat needed to achieve the population and distribution objectives. The provincial recovery plan includes a description of the known biophysical features and attributes of the species’ habitat.

⁴ A population was deemed ‘extant’ if it was located/reconfirmed in the last 20 years.

ECCC has used this description as the basis for critical habitat identification in the federal recovery strategy with modification (as follows) to address specific requirements of SARA; additional information on geospatial locations within which critical habitat is found also is provided. More precise boundaries may be mapped, and additional critical habitat may be added in the future if additional information supports the inclusion of areas beyond those currently identified.

Table 1. Populations of Sharp-tailed Snake in Canada.

Population Name	Population Number ^a	Population Status ^b	Land Tenure	
			Federal	Non-federal
Metchosin, Mary Hill – Galloping Goose	1	Extant	Mary Hill, ND ^c	√
Metchosin, Sooke Road	2	Extant	-	√
Langford, Mount MacDonald	3	Extant	-	√
Langford, Mill Hill	4	Extant	-	√
Sooke, Mount Peden	5	Extant	-	√
Highlands-Saanich	6	Extant	Heal's Rifle Range, ND ^c	√
Saanich, Observatory Hill	7	Extant	Dominion Observatory, NRC ^d	√
Saltspring Island, Mount Tuam	8	Extant	Mount Tuam VOR, TC ^e	√
Saltspring Island, Northwest	9	Extant	-	√
Saltspring Island, Northeast	10	Unknown	-	-
Saltspring Island, Reginald Hill	17	Extant	-	√
South Pender Island	11	Extant	Gulf Islands National Park Reserve, PCA ^f	√
North Pender Island, Magic Lake	12	Extant	-	√
North Pender Island, Port Washington	13	Historical	-	-
Galiano Island	14	Historical	-	-
Pemberton	15	Extant	-	√
Chase	16	Historical	-	-

^a Population number corresponds to that used in the provincial recovery plan (2015) except for population 17 which is a new occurrence (2016) recorded in the Reginald Hill area of Saltspring Island.

^b The status of Sharp-tailed Snake populations is as follows: Extant – population has been verified recently (<20 years); Historical – recent information verifying the continued existence of the population

is lacking (i.e., records are >20 years); Unknown – recent observation but occurrence details are lacking.

^c National Defence

^d National Research Council Canada

^e Transport Canada

^f Parks Canada Agency

2.1 Identification of the Species' Critical Habitat

Geospatial location of areas containing critical habitat

Critical habitat for Sharp-tailed Snake is identified for the 13 verified⁵ extant⁶ populations in Canada (Table 1):

- Metchosin, Mary Hill – Galloping Goose (Population #1; Figure 1)
- Metchosin, Sooke Road (Population #2; Figure 1)
- Langford, Mount MacDonald (Population #3; Figures 1 & 2)
- Langford, Mill Hill (Population #4; Figure 2)
- Sooke, Mount Peden (Population #5; Figure 1)
- Highlands-Saanich (Population #6; Figure 2)
- Saanich, Observatory Hill (Population #7; Figure 2)
- Saltspring Island, Mount Tuam (Population #8; Figure 3)
- Saltspring Island, Northwest (Population #9; Figure 3)
- Saltspring Island, Reginald Hill (Population #17; Figure 3)
- South Pender Island (Population #11; Figure 4)
- North Pender Island, Magic Lake (Population #12; Figure 4)
- Pemberton (Population #15; Figure 5)

NatureServe (Hammerson 2004) suggests an 'inferred minimum habitat extent' of 200 m for small colubrid⁷ snake species such as Sharp-tailed Snake. This is supported by multi-year studies showing that Sharp-tailed Snakes appear to confine their seasonal activities to relatively small areas (i.e., 10s or 100s of metres) (COSEWIC 2009). The furthest known recorded movement is greater than 125 m during one active season on Observatory Hill, B.C. (C. Engelstoft pers. comm. 2015). Thus, areas containing critical habitat attributes for Sharp-tailed Snake were delineated around all verified occurrences since 1995⁸, each encompassed by an area with a 200 m radius.

⁵ A record was deemed 'verified' if it was either reported or confirmed by an individual trained in the species' identification (e.g., biologist/naturalist) and its spatial uncertainty was <200 m.

⁶ A population was deemed 'extant' if it was located/reconfirmed in the last 20 years.

⁷ A member of the snake family, Colubridae, which typically are non-venomous, lack of a pelvic girdle and vestigial hind limbs, and have an absent or greatly reduced left lung.

⁸ The British Columbia Conservation Data Centre and NatureServe databases define "extant" as all observations made within the last 20 years, provided the habitat has not been substantially altered or degraded.

The critical habitat identified above is recognized as insufficient to achieve the population and distribution objectives for Sharp-tailed Snake. There are historical and/or spatially uncertain records in three areas that could represent up to three additional populations. Critical habitat was not identified for occurrences of Sharp-tailed Snake from Saltspring Island, Northeast (#10) due to location uncertainty. Additionally, critical habitat was not identified for five sightings from 1949-1951 on North Pender Island, Port Washington (#13) and one from 1981 on Galiano Island (#14) because the species has not been reconfirmed at these locations in the last 20 years. Furthermore, detailed location information for some known populations is not available to ECCC. Should populations be verified as extant at these locations or the data made available, ECCC will work with the applicable organizations and/or parties to complete the identification of critical habitat on those lands. A historical report exists for a site near Chase, B.C., (#16) but recent habitat assessments/surveys in that area suggest that a population could no longer be supported because the habitat likely is unsuitable (COSEWIC 2009). In addition, in order to ensure long-term persistence of populations, it is likely necessary to establish corridor/dispersal habitat between disjunct occurrences. However, currently there is insufficient information on longer distance dispersal by Sharp-tailed Snakes on which to base such a delineation. Finally, it is presently suspected that Sharp-tailed Snakes use additional closed forest habitat adjacent to the open-canopied forests and openings where they have been documented, but this use has not yet been adequately defined. The schedule of studies (section 2.2) outlines the activities required to identify additional critical habitat necessary to complete the identification of critical habitat in support of the population and distribution objectives. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

Biophysical attributes of critical habitat

Critical habitat for Sharp-tailed Snake must provide sites for thermoregulation, egg laying, incubation, and inactive phases (overwintering/hibernation and summer inactivity/aestivation) as well as foraging opportunities. Sharp-tailed Snakes are generally found within open canopy forest, dominated by Douglas-fir [*Pseudotsuga menziesii*], Arbutus [*Arbutus menziesii*], and/or Garry Oak [*Quercus garryana*], which provides the mosaic of shaded/cool/moist and open/warm patches required for the snakes to carry out their lifecycle. Within open forest habitat, specific biophysical attributes are summarized as follows. Critical habitat is identified wherever these biophysical attributes occur:

- Sparsely forested or treeless rocky openings (~10 m diameter and greater⁹) with warm (southerly) aspects; which:
 - provide for thermoregulation (warming);
- Within 20 m of the openings, open canopy forest habitat (20-60% closure; following Wilkinson et al. 2007), which:

⁹ C. Engelstoft pers. comm. 2016

- supports prey populations (e.g., slugs), and
 - provides thermoregulation (cooling); and
- Within these openings and the adjacent open canopy forest, 3-dimensional features composed of rock (e.g., talus slopes or patches, or fissures in rock outcrops) or coarse woody debris (including large decaying logs or stumps with sloughing bark) that provide microhabitats which:
 - provide temperature regimes for thermoregulation (warming and cooling),
 - retain moisture to support inactive phases and prey species for foraging,
 - provide locations for egg-laying and adequate moisture and temperature regimes for incubation, and
 - provide cover/shelter during active and inactive phases.

Spatial information on critical habitat

The areas containing critical habitat for Sharp-tailed Snake total 550.18 ha (Figures 1-5). Critical habitat for Sharp-tailed Snake in Canada occurs within the detailed yellow polygons (critical habitat units) shown on each figure, wherever the biophysical attributes described in this section occur. Unsuitable habitats, such as existing infrastructure, including roads, parking lots, buildings, and other anthropogenic features (e.g., lawns, and compost and wood piles), do not possess the attributes required by Sharp-tailed Snakes and, therefore, are not identified as critical habitat. The 1 km x 1 km UTM grid overlay shown on these figures is a standardized national grid system that highlights the general geographic area containing critical habitat for land use planning and/or environmental assessment purposes.

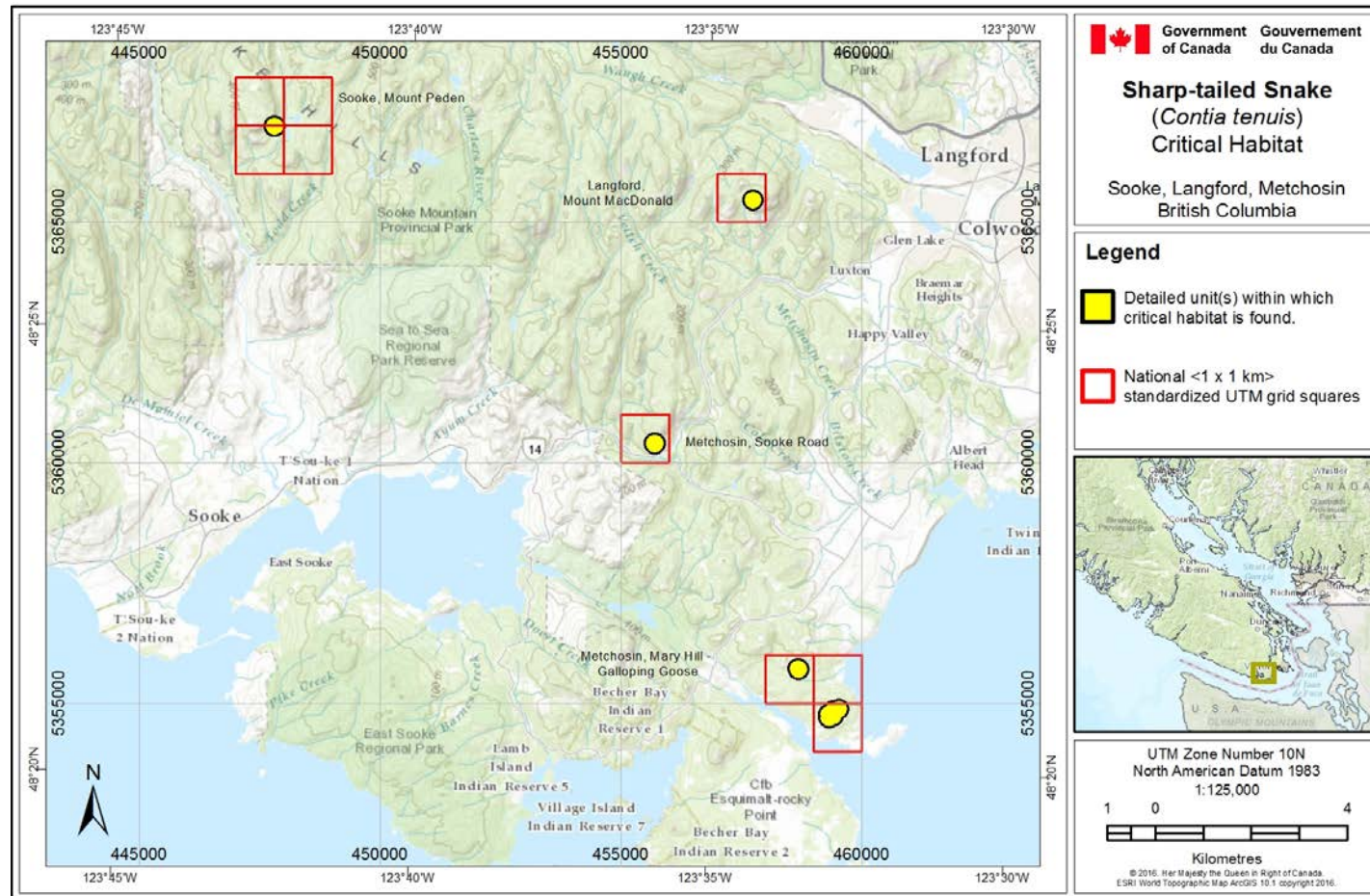


Figure 1. Areas containing critical habitat for Sharp-tailed Snake are represented by the yellow shaded polygons (units), in accordance with the criteria and methodology set out in section 2.1. The detailed polygons delineate the areas at Sooke, Mount Peden (12.57 ha), Langford, Mount MacDonald (12.57 ha), Metchosin, Sooke Road (12.57 ha), and Metchosin, Mary Hill – Galloping Goose (38.29 ha), B.C. The 1 km x 1 km standardized UTM grid overlay shown on this figure is part of a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

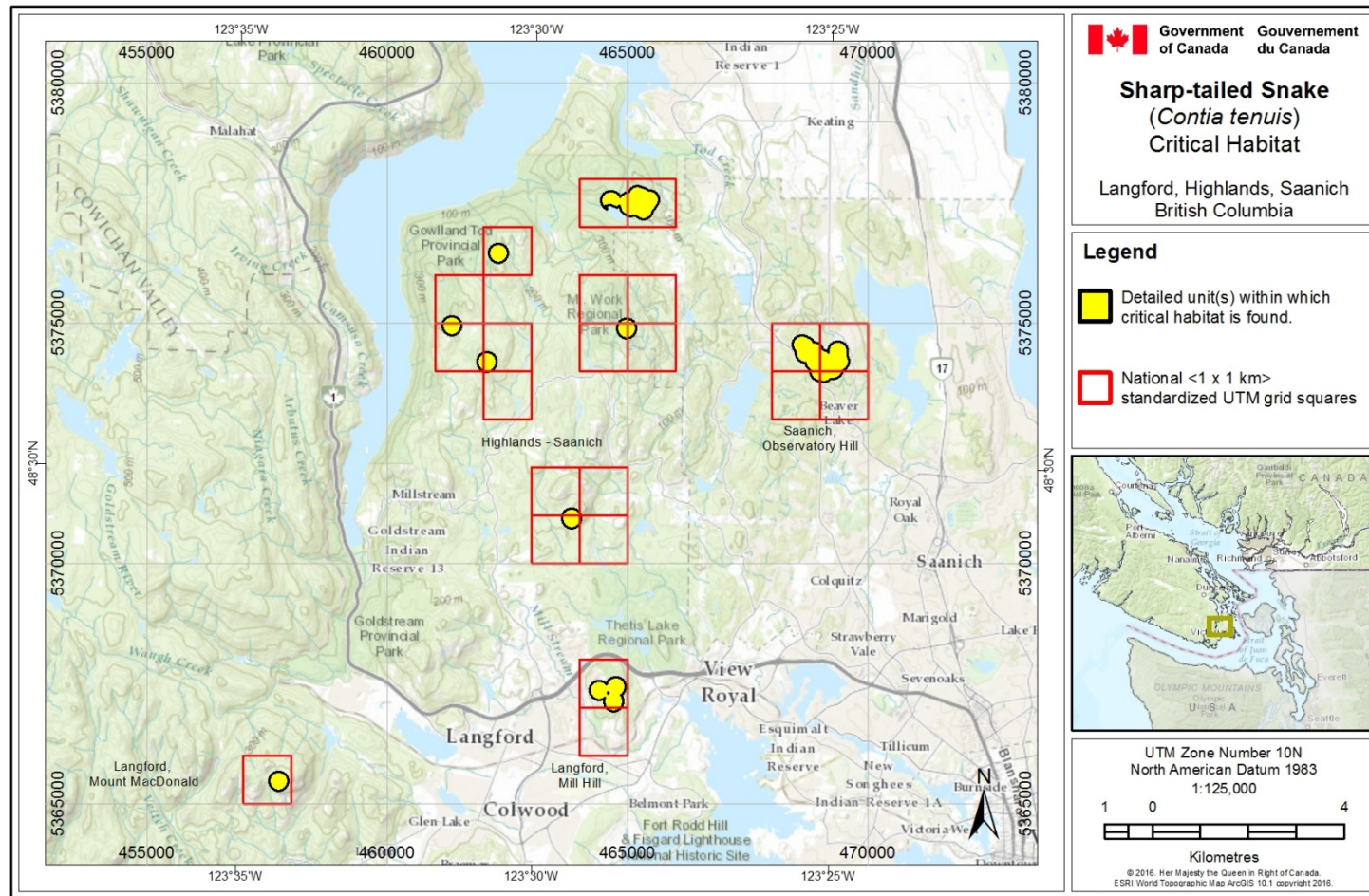


Figure 2. Areas containing critical habitat for Sharp-tailed Snake are represented by the yellow shaded polygons (units), in accordance with the criteria and methodology set out in section 2.1. The detailed polygons delineate the areas at Highlands-Saanich (6 polygons; 115.53 ha), Saanich, Observatory Hill (72.49 ha), Langford, Mill Hill (35.63 ha), and Langford, Mount MacDonald (12.57 ha), B.C. The 1 km x 1 km standardized UTM grid overlay shown on this figure is part of a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

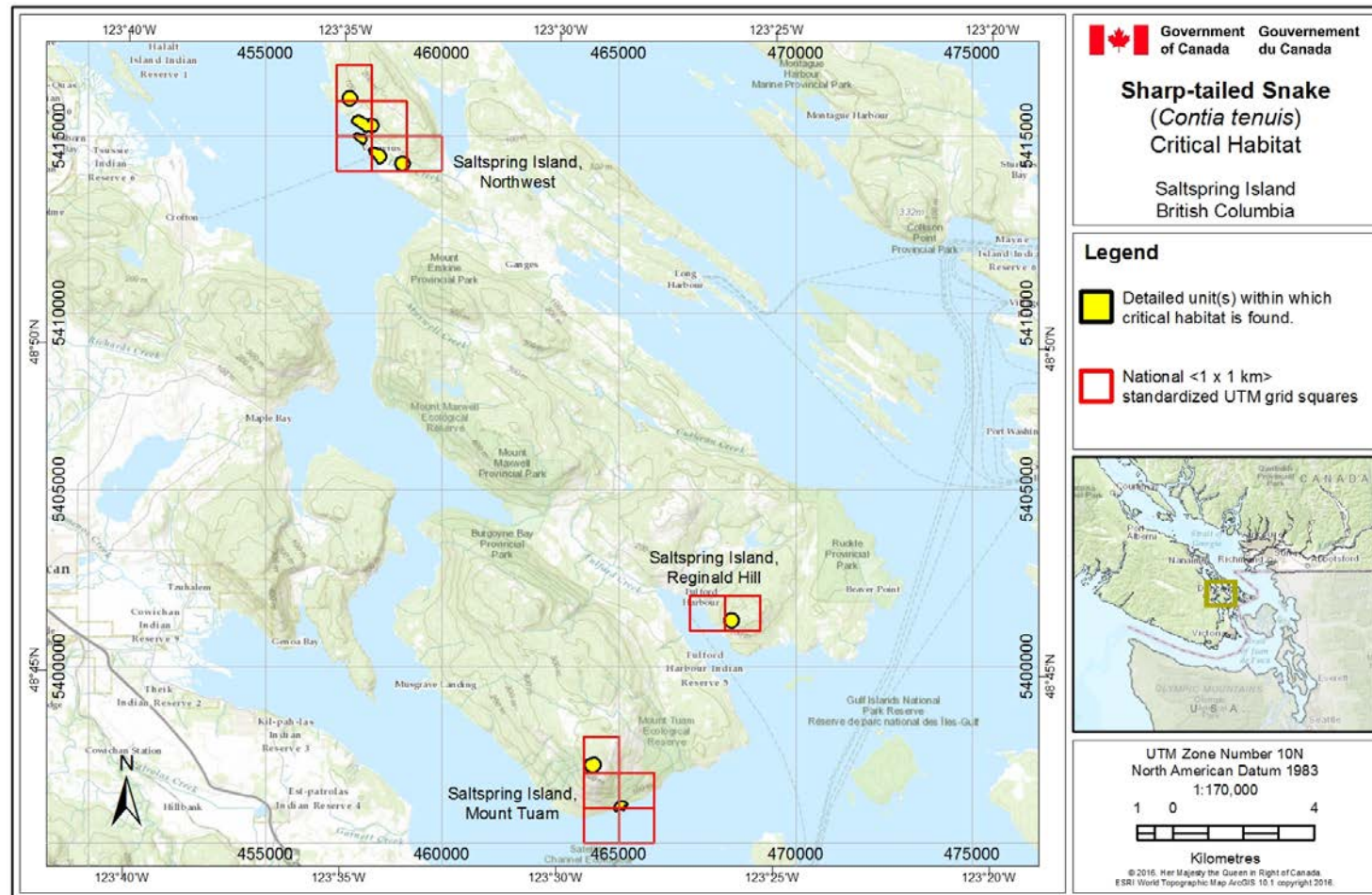


Figure 3. Areas containing critical habitat for Sharp-tailed Snake are represented by the yellow shaded polygons (units), in accordance with the criteria and methodology set out in section 2.1. The detailed polygons delineate the areas at Saltspring Island, Northwest (70.54 ha), Saltspring Island, Reginald Hill (12.57 ha), and Saltspring Island, Mount Tuam (20.90 ha), B.C. The 1 km x 1 km standardized UTM grid overlay shown on this figure is part of a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

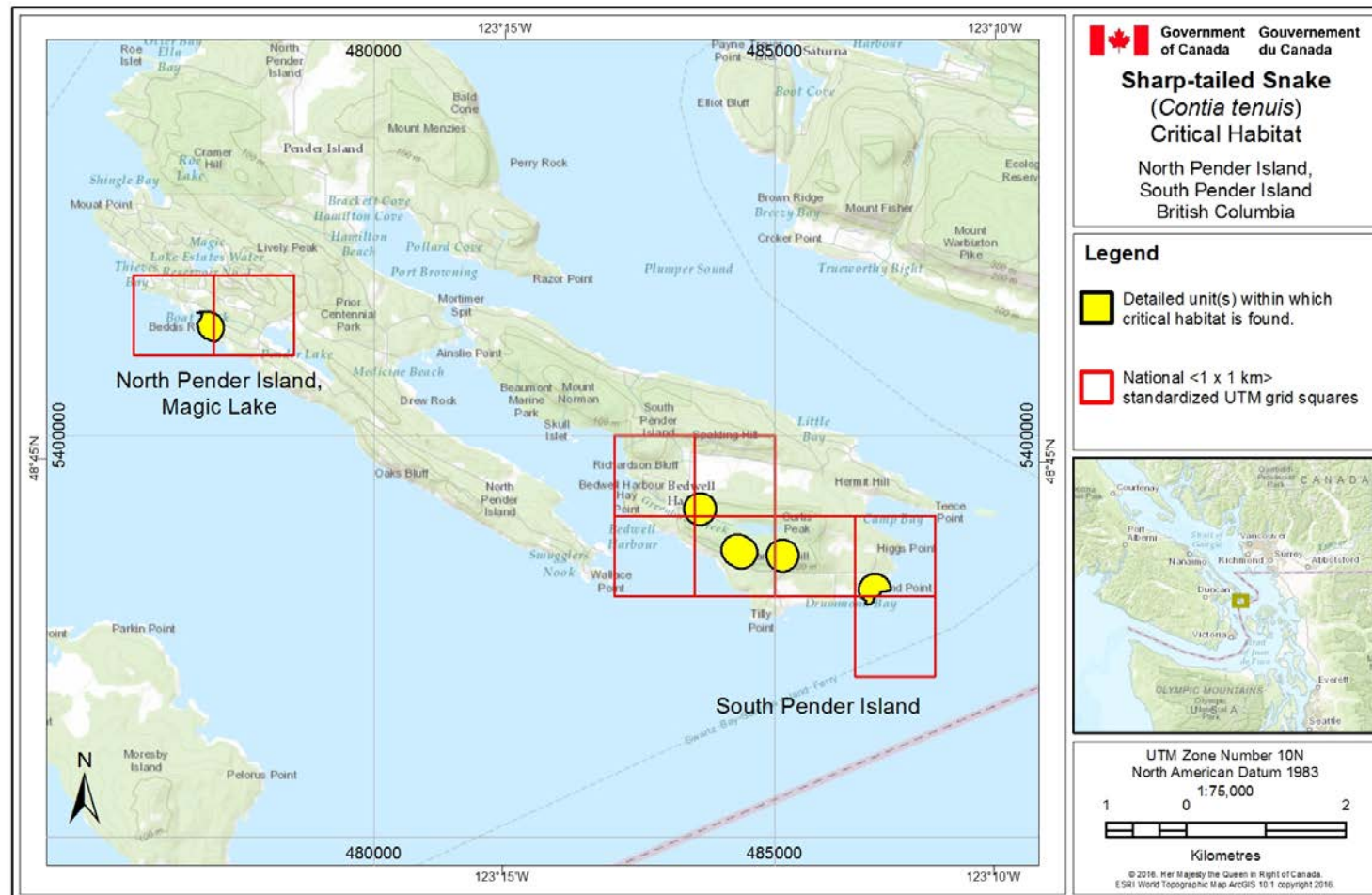


Figure 4. Areas containing critical habitat for Sharp-tailed Snake are represented by the yellow shaded polygons (units), in accordance with the criteria and methodology set out in section 2.1. The detailed polygons delineate the areas at North Pender Island, Magic Lake (9.34 ha) and South Pender Island (49.32 ha), B.C. The 1 km x 1 km standardized UTM grid overlay shown on this figure is part of a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

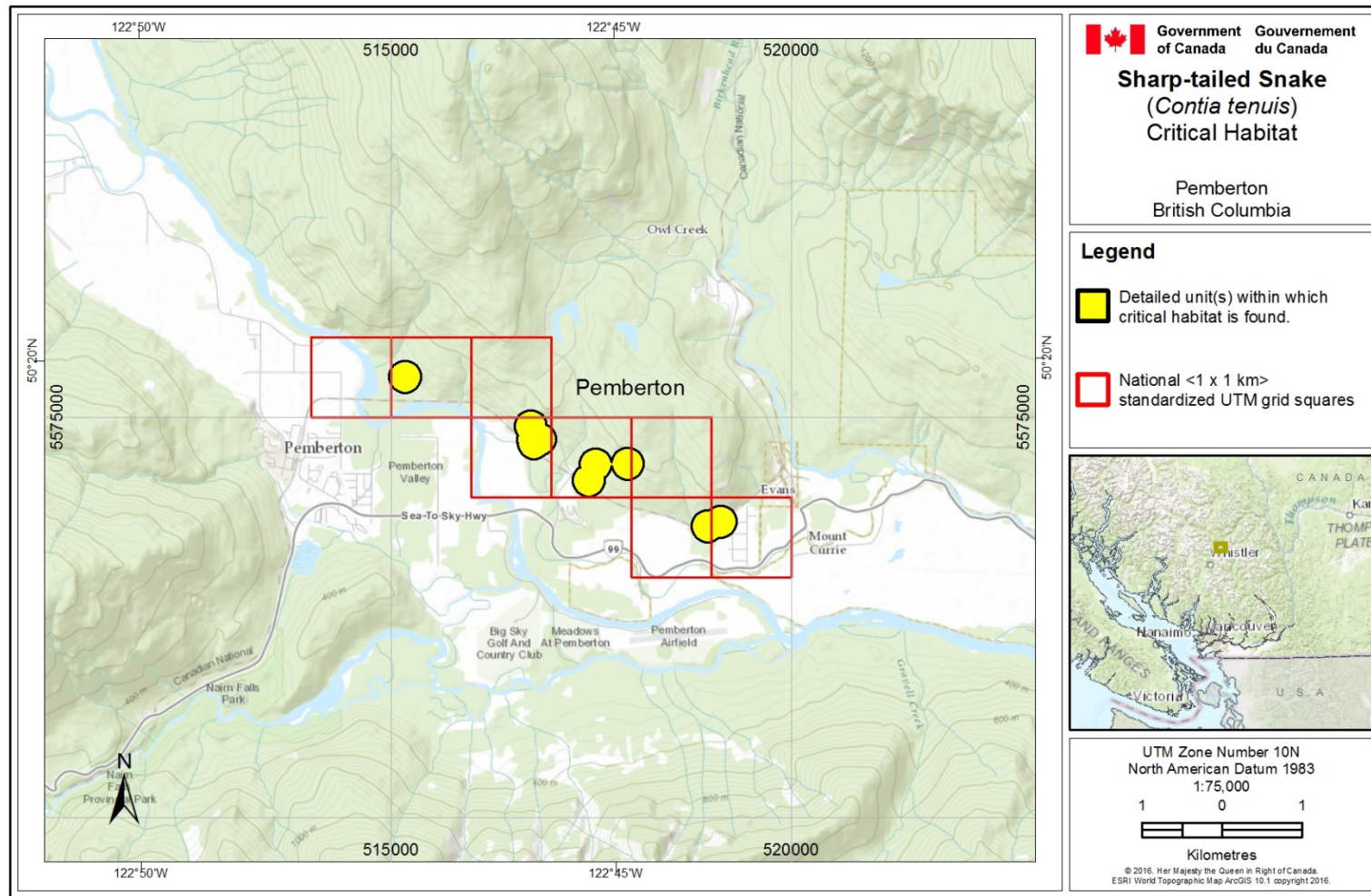


Figure 5. Areas containing critical habitat for Sharp-tailed Snake are represented by the yellow shaded polygons (units), in accordance with the criteria and methodology set out in section 2.1. The detailed polygons delineate the areas at Pemberton (88.24 ha), B.C. The 1 km x 1 km standardized UTM grid overlay shown on this figure is part of a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

2.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies (Table 2) outlines the activities required to complete the identification of critical habitat for Sharp-tailed Snake in Canada; populations align with those provided in section 3.2.2 of the provincial recovery plan.

Table 2. Schedule of studies to identify critical habitat for Sharp-tailed Snake.

Activity	Rationale	Timeline
Comprehensively survey sites with historical records (Galiano Island (#14) and North Pender Island (#13), Port Washington) or of unknown status (Saltspring Island, Northeast (#10)) to reconfirm and identify any additional Sharp-tailed Snakes occurring in remaining patches of suitable habitat.	This activity is required such that sufficient critical habitat is identified to meet the population and distribution objectives.	2017-2022
Obtain data sharing agreements permitting access to known, but not yet available, detailed location information for Sharp-tailed Snake occurring at Saltspring Island, North Pender Island, South Pender Island, and Pemberton.	Additional information is needed to complete the identification of critical habitat for these populations.	2017-2022
Identify connecting/dispersal habitat used by Sharp-tailed Snakes.	This activity is required for the identification of critical habitat for dispersal, which is needed to ensure maintenance of populations.	2017-2022
Identify the extent to which adjacent closed canopy forest habitat is used by Sharp-tailed Snakes.	This activity is required for the identification of critical habitat beyond the currently-identified warm openings and open canopy forest habitats which is needed to support populations.	2017-2022

2.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 3 include those likely to cause destruction of critical habitat for Sharp-tailed Snake; destructive activities are not limited to those listed.

The provincial recovery plan contains a section describing threats to Sharp-tailed Snake habitat (Part 2, section 4.2). This science advice was used to inform the description of activities likely to result in the destruction of critical habitat in this federal recovery strategy.

Table 3. Activities likely to result in the destruction of critical habitat for Sharp-tailed Snake. IUCN Threat numbers are in accordance with the IUCN-CMP (International Union for Conservation of Nature – Conservation Measures Partnership) unified threats classification system (CMP 2010).

Description of Activity	Rationale	Additional Information
Land conversion for human development (e.g., residential, commercial, industrial, recreational, agricultural, or transportation developments) in critical habitat.	Results in the loss of all biophysical attributes of critical habitat.	Related IUCN-CMP Threat #1, 2, 3, and 4
Deliberate damage or removal of 3-dimensional features composed of rock/talus or large woody debris, such that there is a net loss of those features within an 'opening' and the adjacent (<20 m) 'open canopy forest'. Such activities can include site clearing, construction of new or expansion of existing residential/industrial/recreational/transportation developments, or off-road operation of motorized vehicles.	Eliminating 3-dimensional features removes necessary cover/shelter, foraging opportunities, and egg-laying sites as well as limiting the ability of snakes to thermoregulate.	Related IUCN-CMP Threat #1.1, 4.1, 6.1, 6.3, and 7.1. Destruction only results from these activities if these 3-dimensional features are removed/destroyed and not replaced by a biologically-appropriate substitute.
In 'open canopy forest' within 20 m of an 'opening', activities resulting in a net loss of trees such that there is <20% canopy closure overall within the habitat' (e.g., logging, site clearing, construction of new or expansion of existing residential/industrial/recreational developments or transportation).	Removal of the canopy to a point where there is <20% closure can impact thermoregulation (loss of shaded areas for cooling) and make the habitat too dry to support moisture-dependent prey species.	Related IUCN-CMP Threat #1.1, 4.1, 5.3, 6.1, 6.3, 7.1
In 'open canopy forest' within 20 m of an 'opening', activities resulting in a net increase in trees/dense vegetation such that there >60% canopy closure overall within the habitat (e.g., the intentional planting of trees or introduction of invasive plants).	Closing the forest and understory canopy (>60% closure) limits light infiltration needed to support thermoregulation (loss of warm/open areas).	Related IUCN-CMP Threat #7.1, and 8.1
Within an 'opening', activities resulting in the filling in of the opening such that it is no longer greater than 10 m in diameter (e.g., planting of trees or introduction of invasive plants).	Eliminating openings limits light infiltration needed to support thermoregulation.	Related IUCN-CMP Threat #8.1

3. Measuring Progress

The performance indicators presented below provide a way to define and measure progress towards achieving the population and distribution goal set out in the provincial recovery plan.

- Sharp-tailed Snake populations are stable or increasing in abundance.
- Sharp-tailed Snake populations are well-distributed across the species' range in British Columbia.

In addition to these performance indicators, the performance measures set out in the provincial recovery plan (Part 2, Table 3) will provide pertinent information to assess interim progress towards achieving the ultimate population and distribution goal.

4. Statement on Action Plans

One or more action plans will be posted on the Species at Risk Public Registry by 2022.

5. 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](#)¹⁰. 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](#)'s¹¹ (FSDS) goals and targets.

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

The strategies outlined in this document are expected to conserve a number of ecosystem components and species associated with the Coastal Douglas-fir biogeoclimatic zone, which is an ecosystem at risk in British Columbia. Some of the SARA-listed species that are likely to benefit from recovery actions for Sharp-tailed Snake may include Western Screech-Owl, *kennicottii* subspecies (*Megascops kennicottii kennicottii*; Special Concern), Blue-grey Tailedropper (*Prophyaon coeruleum*; Endangered), Deltoid Balsamroot (*Balsamorhiza deltoidea*; Endangered), Purple Sanicle (*Sanicula bipinnatifida*; Threatened), Howell's Triteleia (*Triteleia howellii*; Endangered), White-top Aster (*Sericocarpus rigidus*; Special Concern), and Rigid Apple Moss (*Bartramia stricta*; Endangered). Recovery planning activities for Sharp-tailed Snake will

¹⁰ www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1

¹¹ www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

be implemented with consideration for co-occurring species, such that negative impacts to these species or their habitats are minimized.

Snake surveys could disturb habitat if carried out carelessly, but adverse effects can be eliminated or minimized by taking proper precautions. These risks can be minimized by replacing, exactly as it was, all natural cover searched, avoiding disturbance to unstable talus slopes, and consulting a botanist before placing artificial cover-objects in sensitive habitats, such as within Garry Oak ecosystems, to avoid disturbing rare plants.

6. References

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Part 2 – *Recovery Plan for the Sharp-tailed Snake (Contia tenuis) in British Columbia*, prepared by the Sharp-tailed Snake Recovery Team for the British Columbia Ministry of Environment

Recovery Plan for the Sharp-tailed Snake (*Contia tenuis*) in British Columbia



Prepared by the Sharp-tailed Snake Recovery Team



July 2015

About the British Columbia Recovery Strategy Series

This series presents the recovery documents that are prepared as advice to the Province of British Columbia on the general approach required to recover species at risk. The Province prepares recovery documents to ensure coordinated conservation actions and to meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada* and the *Canada–British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a provincial recovery document?

Recovery documents summarize the best available scientific and traditional information of a species or ecosystem to identify goals, objectives, and strategic approaches that provide a coordinated direction for recovery. These documents outline what is and what is not known about a species or ecosystem, identify threats to the species or ecosystem, and explain what should be done to mitigate those threats, as well as provide information on habitat needed for survival and recovery of the species. This information may be summarized in a recovery strategy followed by one or more action plans. The purpose of an action plan is to offer more detailed information to guide implementation of the recovery of a species or ecosystem. When sufficient information to guide implementation can be included from the onset, all of the information is presented together in a recovery plan.

Information in provincial recovery documents may be adopted by Environment Canada for inclusion in federal recovery documents that the federal agencies prepare to meet their commitments to recover species at risk under the *Species at Risk Act*.

What's next?

The Province of British Columbia accepts the information in these documents as advice to inform implementation of recovery measures, including decisions regarding measures to protect habitat for the species.

Success in the recovery of a species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this document. All British Columbians are encouraged to participate in these efforts.

For more information

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

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

Recovery Plan for Sharp-tailed Snake (*Contia tenuis*) in British Columbia

Prepared by the Sharp-tailed Snake Recovery Team

July 2015

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Photo by C. Engelstoft

Additional copies

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

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

Disclaimer

This recovery plan has been prepared by the British Columbia Sharp-tailed Snake Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The B.C. Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada* and the *Canada–British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies and actions that are deemed necessary, based on the best available scientific and traditional information, to recover Sharp-tailed Snake populations in British Columbia. Recovery 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 recovery approaches may be modified in the future to accommodate new findings.

The responsible jurisdictions and all members of the recovery team 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 on the recovery team.

Success in the recovery 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 plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the recovery of the Sharp-tailed Snake.

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Members of the Sharp-tailed Snake Recovery Team, past and present, have participated in the preparation of this or previous versions of the recovery plan. Kristiina Ovaska and Christian Engelstoft drafted and revised this plan, shared their unpublished data, and provided updates on distribution, habitats, and stewardship efforts. Habitat Acquisition Trust and Salt Spring Island Conservancy summarized confidential data. The threats assessment was done by the Sharp-tailed Snake Recovery Team in November 2013 and revised in October 2014. The recovery team extends a special thank you to all the landowners and partners who have taken an interest in protecting this species and its habitat.

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EXECUTIVE SUMMARY

The Sharp-tailed Snake (*Contia tenuis*) is a small, non-venomous snake endemic to western North America. Adults are slender (about the thickness of a pencil), usually about 20–30 cm in total length. The back is reddish brown and the underside has characteristic black and white barring. A pointed, thorn-like scale at the end of the tail gives the species its common name.

The Sharp-tailed Snake was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to its small, fragmented range; few scattered populations; and threats to its habitats. It is listed as Endangered in Canada on Schedule 1 of the *Species at Risk Act* (SARA). In British Columbia, the Sharp-tailed Snake is ranked S1S2 (imperiled to critically imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks the Sharp-tailed Snake as a priority 1 under Goal 3 (maintain the diversity of native species and ecosystems). It is protected from capture and killing, under the B.C. *Wildlife Act*. Recovery is considered to be biologically and technically feasible.

The Canadian distribution of the Sharp-tailed Snake is confined to southwestern British Columbia, where it has been documented from the Capital Regional District on Vancouver Island, the southern Gulf Islands (North and South Pender, Saltspring, Galiano), and near Pemberton on the mainland; an unverified historical record exists from another area on the mainland, near Chase. As of August 2014, 14 populations with recent records are known.

Residential and commercial development is deemed to be the main threat to the Sharp-tailed Snake. The snakes occur within relatively densely populated areas of B.C., where their habitats are threatened by expanding urbanization, including housing developments and associated infrastructure. The loss of oviposition (egg-laying) and hibernation habitats is of particular concern; rocky slopes with a southern exposure in small forest openings are thought to be important habitat features for these functions.

Suitable habitats for the species are naturally fragmented, and road building and increased traffic continue to accentuate this fragmentation, exposing snakes to accidental mortality, including road kill. Heavily fragmented landscapes may also constrain movements and access to essential habitat components, such as foraging areas or hibernation sites. Other threats include human activities such as landscaping and off-trail recreation; spread of invasive species, such as Scotch broom that form monocultures and degrade habitat; and logging that disturbs substrates. The impacts of these threats are thought to be low, and many uncertainties are associated with the responses of snakes.

The goal of this recovery strategy is to ensure that Sharp-tailed Snake populations are stable or increasing in abundance and are well distributed across the species' natural range in Canada.

The following are the recovery objectives:

1. maintain or enhance habitats important for the Sharp-tailed Snake's survival and recovery at each occupied site;
2. increase habitat connectivity within populations and, where possible, between those populations that are close to each other;

3. investigate the existence of additional populations throughout the species' Canadian range, including suitable habitats outside the known range;
4. reduce gaps in our knowledge of the species' seasonal movements, dispersal, habitat requirements, demographic trends, and population ecology and clarify threats to improve protection, habitat management, and threat mitigation measures; and
5. engage landholders and land managers in stewardship and increase public awareness of the Sharp-tailed Snake and its habitats.

This recovery plan addresses the above objectives and responds to identified threats, while building on existing and ongoing work. The main thrust is to ensure that further loss and fragmentation of habitats of the Sharp-tailed Snake are prevented, and habitat connectivity is maintained or enhanced. Protection measures are to focus on habitats at known sites and surrounding areas. Possible new populations are to be incorporated into the process as they are discovered.

RECOVERY FEASIBILITY SUMMARY

The recovery of Sharp-tailed Snake in B.C. is considered technically and biologically feasible based on the following four criteria that Environment Canada uses to establish recovery feasibility:

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

Yes – Several populations of the Sharp-tailed Snake, containing mature individuals capable of reproduction, are known, and additional populations may be found with more survey effort. Individuals may live a decade or more and populations can thus potentially withstand several years of adverse conditions and low recruitment. Population sizes are unknown.

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

Yes – Suitable habitat for this species exists on southern and eastern Vancouver Island and the Gulf Islands, and the species was recently discovered near Pemberton on mainland B.C. Some of these habitats with known populations are within protected areas (regional, provincial, or national parks, or on federal land). Surveys of apparently suitable habitat continue to result in new sites.

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

Yes – The primary threat to this species is habitat loss and fragmentation, which can be avoided or mitigated. These snakes require relatively little space and can coexist with humans, provided that certain precautions are taken and key habitat features are protected.

To date, collaborations with several landowners and managers and stewardship measures have proven successful in protecting and restoring habitat.

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

Yes –Various efforts to secure habitats, such as stewardship activities on private lands, are already successful. Standard techniques required to survey and monitor the species are available.

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1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Assessment Summary – November 2009

Common Name: Sharp-tailed Snake

Scientific Name: *Contia tenuis*

Status: Endangered

Reason for Designation: This tiny snake is confined to a handful of isolated, small populations in southeastern Vancouver Island and the southern Gulf Islands of British Columbia. Most of these populations are threatened by development and may not be viable. Increased search effort since the last assessment has found three previously undiscovered populations. Despite this, it is likely that overall numbers are decreasing and threats continue unabated. Major threats include ongoing development, increasing human populations, off-trail recreation, fragmentation by roads, and stochastic effects on small populations.

Occurrence: B.C.

Status History: Designated Endangered in April 1999. Status re-examined and confirmed in October 1999 and November 2009.

* Committee on the Status of Endangered Wildlife in Canada.

2 SPECIES STATUS INFORMATION

Sharp-tailed Snake ^a		
Legal Designation:		
FRPA : ^b No	B.C. <i>Wildlife Act</i> : ^c Schedule A	SARA : ^d Schedule 1 – Endangered (2003)
OGAA : ^b No		
Conservation Status ^e		
B.C. List: Red	B.C. Rank: S1S2 (2012)	National Rank : ^f N1N2 (2012) Global Rank: G5 (2010)
Other Subnational Ranks : ^f California (S5), Oregon (S4), Washington (S3)		
B.C. Conservation Framework (CF) ^g		
Goal 1: Contribute to global efforts for species and ecosystem conservation.		Priority: ^h 4 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.		Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.		Priority: 1 (2009)
CF Action Groups : ^g	Compile Status Report; List under <i>Wildlife Act</i> ; Send to COSEWIC; Species and Population Management; Planning; Private Land Stewardship; Habitat Restoration; Habitat Protection	

^a Data source: B.C. Conservation Data Centre (2014b) unless otherwise noted.

^b No = not listed in one of the categories of wildlife that requires special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).

^c Schedule A = designated as wildlife under the B.C. *Wildlife Act*, which offers it protection from direct persecution and mortality (Province of British Columbia 1982).

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

^e S = subnational; N = national; G = global; T = refers to the subspecies level; B = breeding; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable.

^f Data source: NatureServe (2014).

^g Data source: B.C. Ministry of Environment (2010).

^h Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

3 SPECIES INFORMATION

3.1 Species Description

The Sharp-tailed Snake, *Contia tenuis*, is a small, harmless snake endemic to western North America. Adults are slender (about the thickness of a pencil), usually about 20–30 cm in total length. The back and sides are brown or reddish brown and the underside has characteristic black and white barring; juveniles are typically more brightly coloured than adults. The short tail ends in a small thorn-like scale, which gives the species its common name.

3.2 Populations and Distribution

3.2.1 Global Distribution and Abundance

The range of the Sharp-tailed Snake extends from southwestern British Columbia (B.C.) south through Washington and Oregon to central California (Figure 1). Populations occur at scattered localities in the northern portion of the species' range in B.C. and Washington (Leonard and Ovaska 1998), whereas the distribution is more continuous and populations appear to be larger in Oregon and California (Cook 1960; Hoyer *et al.* 2006). Based on morphological and genetic evidence (Feldman and Spicer 2002), Sharp-tailed Snakes were recently split into two species with the description of the Forest Sharp-tailed Snake (*Contia longicauda*) from coastal areas of California and parts of southern Oregon (Feldman and Hoyer 2010). The wider-ranging species that occurs in B.C. retained the name *C. tenuis*. At the species level, specimens from B.C. are genetically similar to those from Washington and Oregon, based on analysis of a few samples from the province (M. Blouin, pers. comm., 2001; C. Feldman, pers. comm., 2008).

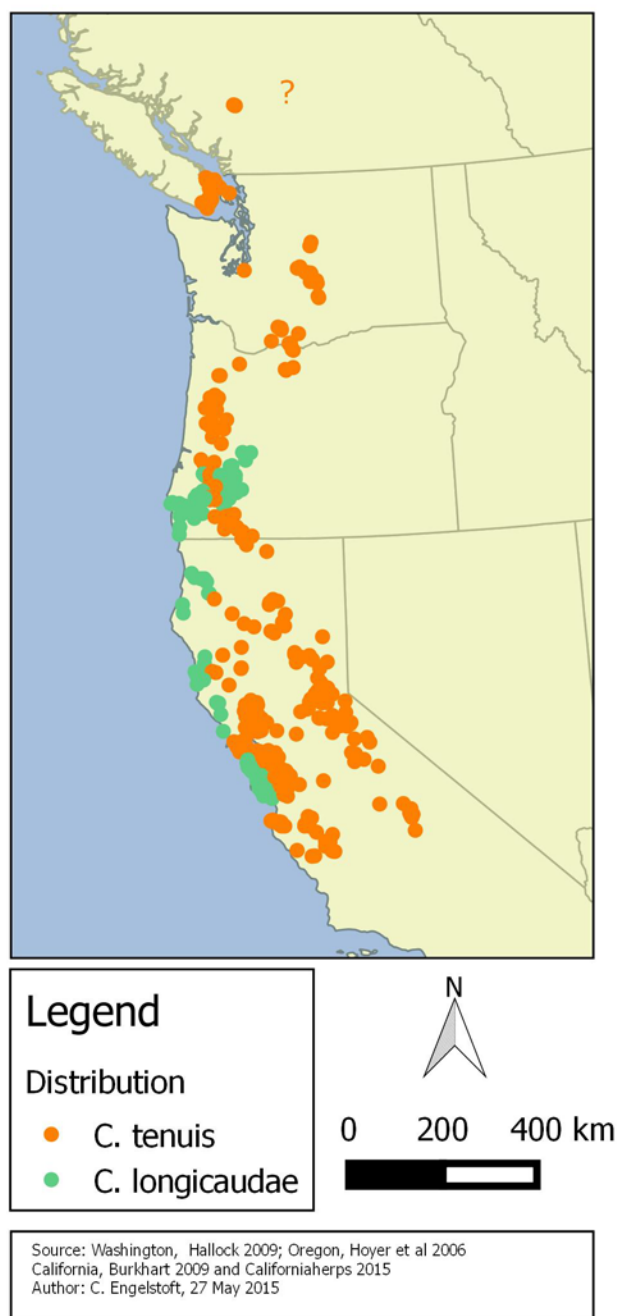


Figure 1. World distribution of the Sharp-tailed Snake (*C. tenuis*) and the Forest Sharp-tailed Snake (*C. longicaudae*). Dots represent approximate locations. ? indicates the location of a historical collection of Sharp-tailed Snakes that has not been verified.

3.2.2 B.C. Distribution

The Sharp-tailed Snake is known from scattered localities in southwestern B.C. Although these populations represent a small proportion of the world distribution (< 5% in terms of range is in B.C.), they may be important reservoirs of genetic variability and may contain unique ecological adaptations due to their occurrence at the northern limits of the species' distribution. With large-scale environmental changes the populations at the margins of a species' distribution may become increasingly important (Furrow and Armijo-Prewitt 1995); the general pattern of range collapse of many terrestrial vertebrates has been towards the periphery rather than towards the centre of their distributions (Lomolino and Channell 1995, 1998).

In B.C., the Sharp-tailed Snake has been reported from the southern tip of Vancouver Island, four Gulf Islands, and near Chase and Pemberton on the mainland (Spalding 1993, 1995; COSEWIC 2009; B.C. Conservation Data Centre 2014a). With increased search effort, new records continue to be found. Of particular interest is the discovery of the Sharp-tailed Snake near Pemberton in 2011. As of fall 2013, there were 15 records from 10 sites¹ at this locality (Anthony 2013; L. Anthony, pers. comm., 2014). The validity of a previous mainland record from near McGillivray Lake, near Chase (Tanner 1967) has been questioned (Leonard and Ovaska 1998; COSEWIC 2009). The species is known from only one sight record from Galiano Island, in 1981 (Spalding 1993, 1995), the validity of which is also unconfirmed.

Where occurrences² are separated by dispersal barriers such as major waterbodies, or by distances of more than 5 km, they are considered to represent different populations (NatureServe 2014). In total, since the 1940s, the species has been recorded from 16 areas in southwestern B.C., which are considered here separate populations (Figures 2 and 3):

1. Metchosin, Mary Hill – Galloping Goose
2. Metchosin, Sooke Road
3. Langford, Mount McDonald
4. Langford, Mill Hill
5. Sooke, Mount Peden
6. Highlands-Saanich
7. Saanich, Observatory Hill
8. Saltspring Island, Mount Tuam
9. Saltspring Island, Northwest
10. Saltspring Island, Northeast
11. South Pender Island
12. North Pender Island, Magic Lake
13. North Pender Island, Port Washington
14. Galiano Island (unconfirmed)
15. Pemberton
16. Chase (unconfirmed)

Within all known populations, the area occupied by the species appears to be relatively small. The index of the area of occupancy, calculated by placing a grid of 2 x 2 km cells on known

¹ Within this document, site is used to refer to clusters of observations within a population. Some populations may consist of only one site; other populations may contain multiple sites (see Appendix 1).

² An area in which a species is, or was, present.

populations, is 132 km² (33 grid cells) as of September 2014 (Appendix 1). The area of occupancy is difficult to estimate accurately because of the snakes' secretive habits, low densities, and paucity of information on their movement patterns. These characteristics also make it problematic to confirm the extent of occurrence of the Sharp-tailed Snake in B.C.

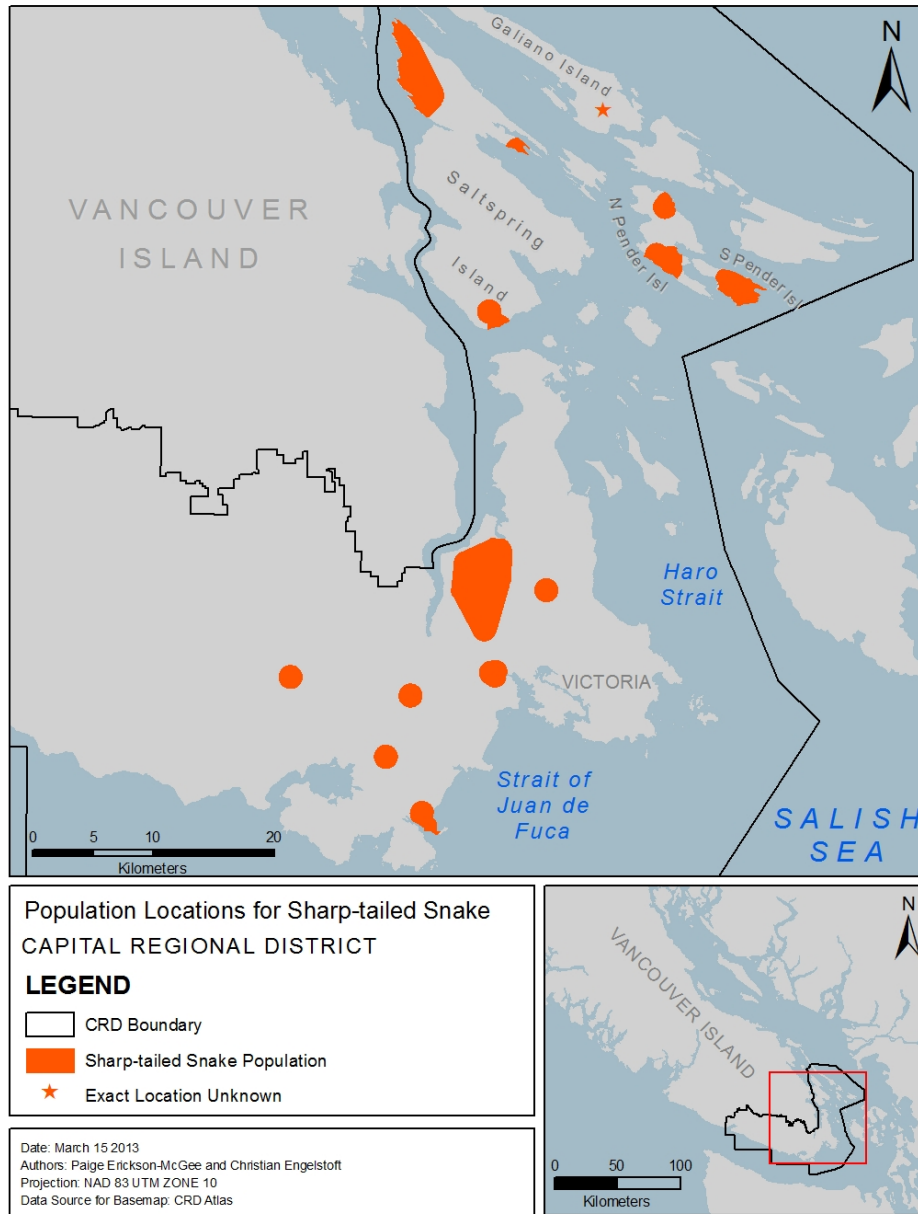


Figure 2. Distribution of the Sharp-tailed Snake on Vancouver Island and the Gulf Islands.

Irregular polygons denote populations with observations from multiple points, while circles denote populations with observations from single points. Star denotes a historical observation with exact locality unknown. CRD – Capital Regional District.

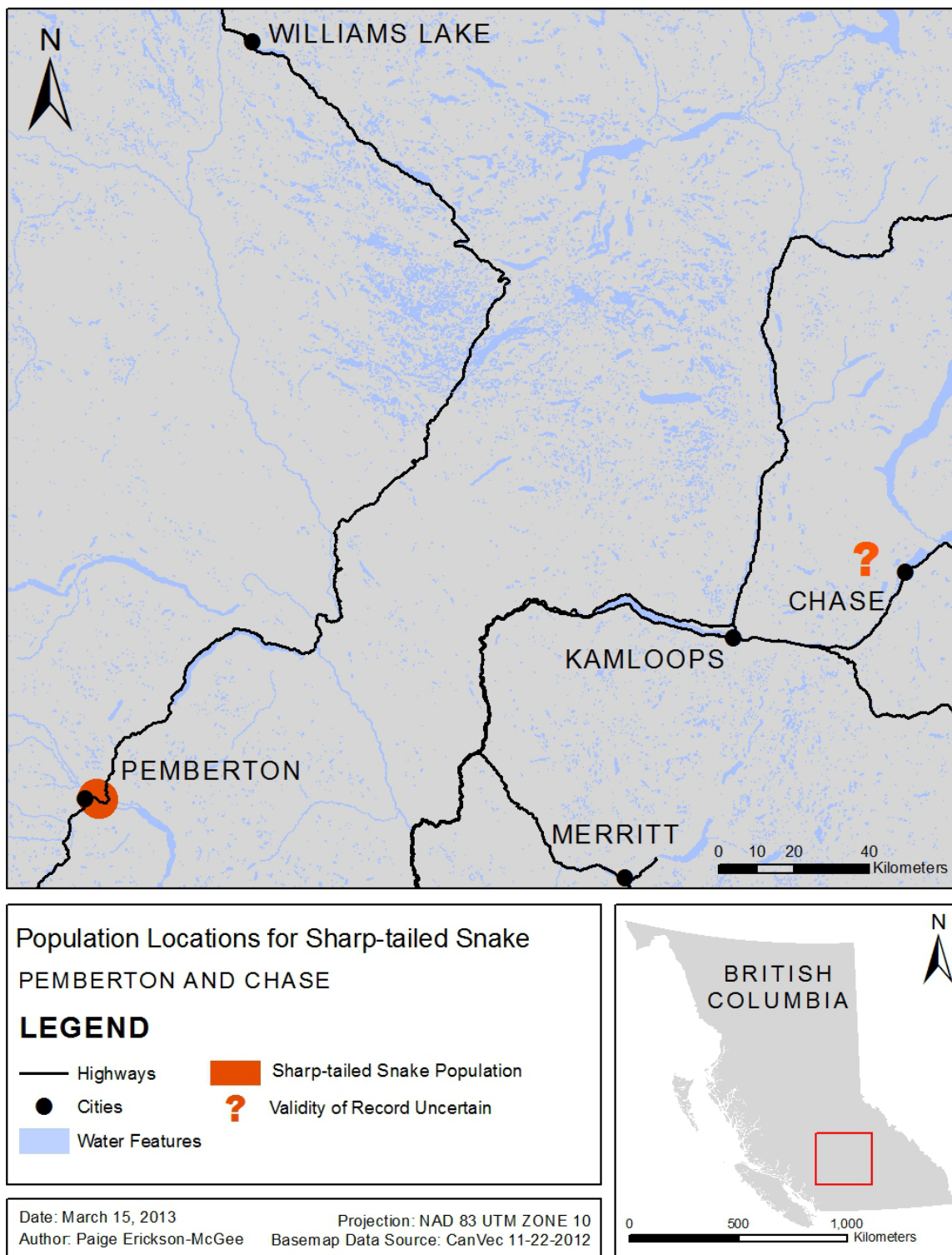


Figure 3. Distribution of the Sharp-tailed Snake (STS) in mainland British Columbia.

3.2.3 B.C. Abundance

Population sizes and trends are poorly known and difficult to study due to the secretive habits of these snakes and their localized distribution patterns. At four sites where the species has been studied through capture-recapture studies over several years (one site each on Saltspring and North Pender; two sites on Vancouver Island), the number of individual snakes detected have ranged from 13 to 80. This variation reflected both sampling effort, including duration of study, and the size of the areas surveyed. Recapture data from several monitored sites suggest relatively large populations, based on low recapture rates. For example at the two sites monitored for several years on Vancouver Island, 67% and 71% of snakes, respectively, were captured only once (Engelstoft and Ovaska, unpubl. data). Analysis of capture-recapture data at a North Pender site resulted in a mean population estimate of 49 snakes and mean density of 0.067 snakes/m² (670 snakes/ha; Govindarajulu *et al.* 2011). Generalized over larger areas, this value is most likely an overestimate, as the snakes are unevenly distributed over the landscape. Over a 6-year period, from 1997 to 2002, this population was estimated to be stable or slightly declining (Govindarajulu *et al.* 2011). Long-term monitoring is in progress at another site/population (Observatory Hill) where the snakes appear to be thriving, although the site is isolated from other suitable habitat within an approximately 40-ha area by a busy road. Much of the site is deemed high-quality habitat for the species, and low recapture rates indicate a relatively large population (Engelstoft *et al.* 2013, 2014).

3.3 Habitat and Biological Needs of the Sharp-tailed Snake

All distribution records for the Sharp-tailed Snake from Vancouver Island and the Gulf Islands are from the Coastal Douglas-fir (CDF) biogeoclimatic zone, which encompasses a narrow strip of land on the southeast coast of Vancouver Island and adjacent Gulf Islands, and also includes a fringe of the mainland coast (Meidinger and Pojar 1991). The records from Pemberton are within the Coastal Western Hemlock (CWH) zone, abutting the Interior Douglas-fir (IDF) zone but are located within a dry variant of this zone with a moisture regime similar to that of the CDF zone (Anthony 2013). The Chase (McGillvray Lake) locality is within the IDF zone. Herpetologists who have visited the Chase locality since the original report (in 1963; Tanner 1967) have noted general unsuitability of the habitat (closed forest) for the Sharp-tailed Snake (COSEWIC 2009).

In B.C., areas where the Sharp-tailed Snake has been found consist of woodlands and forest openings with abundant shelter, such as talus, coarse woody debris, and/or fissures in rock (COSEWIC 2009). On Vancouver Island, known sites have a warm aspect, relatively shallow soil and litter cover, and high rock cover (Wilkinson and Gregory 2005). At two Vancouver Island sites with intensive survey effort (Observatory Hill, Highlands-Saanich), the species is usually found on southern or western, rarely eastern, slopes of the hillsides (Engelstoft and Ovaska 2010; Engelstoft *et al.* 2013, 2014). After four years of intense surveys (354 artificial cover objects checked 133 times from 2011 to 2014) on Observatory Hill, 40% of all Sharp-tailed Snake observations or 28% of all identified snakes were found at two points, suggesting that the snakes congregate in particular areas (Engelstoft *et al.* 2014 and unpublished data). In Pemberton, the Sharp-tailed Snake sites are on a south-facing slope (Anthony 2013). A mosaic of openings and forest is thought to provide Sharp-tailed Snakes access to a variety of thermal

environments which allows snakes to adjust their body temperature as appropriate for daily activities.

Proximity to the forest and moist foraging areas is also thought to be important, but this aspect of the species' habitat requirements is poorly understood. The snakes feed on small invertebrates, primarily slugs (Cook 1960; Leonard and Ovaska 1998); they require proximity to areas where slugs are abundant, such as moist depressions, seepages, and forest edges. At the two intensively studied sites on Vancouver Island, Sharp-tailed Snakes have been found in woodlands and forest within approximately 20 m from rocky openings (Engelstoft *et al.* 2013, 2014, and unpubl. data). There is some evidence that snakes show seasonal shifts in habitat use and move away from these openings into forest edges in early summer; observations in spring and fall are mostly from rocky openings, whereas those in early summer include forest edges (Engelstoft *et al.* 2013, 2014, and unpubl. data). Studies at several sites on southern Vancouver Island and the Gulf Islands indicate that individual snakes confine their movements to relatively small areas (typically < 30 m in diameter), and show fidelity to particular sites in rocky openings (COSEWIC 2009). Two tracking methods both with short detection ranges³ have been used to study their movements, and both have revealed small activity areas and short movements (typically < 30 m; the longest movement recorded was 93 m for one snake) (Engelstoft *et al.* 1999, 2013, 2014). Only a few snakes have been tracked to date. It is unknown whether tagged snakes that periodically disappeared moved away from the study areas or retreated underground. Seasonal habitat use remains poorly understood.

Suitable habitats for the Sharp-tailed Snake must provide thermoregulation, oviposition (egg-laying), overwintering/hibernation, and summer inactivity (possibly aestivation) sites, as well as foraging opportunities in a spatial pattern that is within the movement capabilities of individual snakes. COSEWIC (2009) suggests that rocky, south-facing slopes in small forest openings provide suitable oviposition sites. Brodie *et al.* (1969) suggested that a paucity of suitable exposed southern slopes, especially those with talus, was responsible for the concentration of reptiles, including the Sharp-tailed Snake, at a communal egg-laying site in Oregon. No eggs of this species have been found in B.C., but observations of hatchling-sized young at rocky slopes on Saltspring Island (Engelstoft and Ovaska 1999), Observatory Hill (Engelstoft *et al.* 2013), and in the Pemberton area (L. Anthony, pers. comm., 2013) support the suggestion that such habitats are important for reproduction. In addition to oviposition sites, rocky slopes probably provide suitable thermoregulation and overwintering/hibernation sites for the snakes (COSEWIC 2009). At Vancouver Island sites, snakes have been captured in rocky openings in spring and fall, while they often disappear from the captures or are found along forest edges in summer (Engelstoft *et al.* 2013, 2014). In the Pemberton area, hibernation sites appear to be in talus and fractured rock (L. Anthony, pers. comm., 2013). Sharp-tailed Snakes may hibernate communally at Pemberton, where winters are much colder than on Vancouver Island and the Gulf Islands. In contrast, along the coast where winters are milder, more hibernation opportunities may be available for the snakes, and they may overwinter individually or in small groups. The period of hibernation varies with local conditions. On Vancouver Island, Sharp-tailed Snakes have been found active during all months of the year, including mild periods in winter and after rains in summer.

³ < 30 cm for Passive Integrated Transponder (PIT) tags (Engelstoft *et al.* 2014); < 2 m for harmonic direction finder (Engelstoft *et al.* 1999).

The availability of shelter appears to be important for all activities, as the snakes are seldom found in the open, away from cover-objects. A three-dimensional habitat provided by rock outcrops and patches of talus, especially those with smaller rock sizes (pebbles and cobbles < 20 cm diameter), appears to be particularly important (COSEWIC 2009; Engelstoft *et al.* 2013). Sharp-tailed Snakes have been found under and within decaying logs (COSEWIC 2009).

Sharp-tailed Snakes can coexist with humans, provided that sufficient cover and other habitat features are retained. In California and Oregon, many observations are from backyards and other disturbed areas within or near urban areas (Cook 1960; Hoyer *et al.* 2006). In B.C., the snakes have been found in compost heaps, borders of gardens, woodpiles, and other human-modified structures within low-density residential areas, and they readily use artificial cover-objects constructed of wood, metal, or asphalt roofing (Engelstoft and Ovaska 1999; Ovaska and Engelstoft 2008).

Key habitat features for different life history functions for Sharp-tailed Snakes are summarized in Table 1. Quantitative information on these features is largely lacking. Whether the snakes require thresholds values for the abundance of these features in the environment is also unknown.

Table 1. Characteristics of habitat required by the Sharp-tailed Snake for different life history functions.

Life stage	Function ^a	Feature(s) ^b	Attributes ^c
Adult	Foraging	Forest edge within about 20 m of rocky openings, and patches of forest within or adjacent to such openings	Moist microhabitats, which support prey populations, notably slugs that are considered the main prey, and also other invertebrates that might be consumed, such as worms and insects
Adult	Foraging	Seepages and moist depressions within forest gaps or small openings on rocky slopes	Moist microhabitats, which support prey populations, notably slugs that are considered the main prey, and also other invertebrates that might be consumed, such as worms and insects
Juvenile	Foraging	Unknown, likely same as above for adults	Availability of small prey of suitable (but unknown) size, close to hatching sites ^d
Adult	Thermoregulation	Surface cover objects, such as rocks or slabs of bark, in forest openings or gaps	Microsites with suitable dimensions that also provide shelter: sufficiently large to cover the snake, and thin (flat) enough to warm up relatively quickly and provide heat to the snake through conduction ^e
Adult	Thermoregulation	Talus that contains smaller rock sizes (pebbles or cobbles); other multi-layered substrate, such as large decaying logs or stumps with sloughing-off bark	Structure of substrate that enables snakes to make fine-scale adjustments to body temperature (cool in hot environments; warm in cooler environments); best quality talus contains a proportion of pebbles (diameter < 7.5 cm) and/or cobbles (diameter 7.5–20 cm).

Life stage	Function^a	Feature(s)^b	Attributes^c
Adult	Thermoregulation	Openings with warm aspects (other than northern) within or adjacent to woodland	<ul style="list-style-type: none"> • Solar radiation reaching the forest floor, which allows snakes to quickly warm up; many populations are on hillsides, and there is some evidence that southern and western aspects are preferred. • Opportunities to move into cooler microhabitats (e.g., shade in forest patches).
Juvenile	Thermoregulation	Same as for adults, but scale may differ	Shelter, solar radiation, and opportunities to move into cooler sites; juveniles may be able to take advantage of smaller microhabitats, such as small cover-objects and sun spots.
Adults and juveniles	Overwintering / Hibernation	Den sites in fractured rock and talus patches or slopes; possibly large coarse woody debris on the coast	Sheltered underground sites that provide suitable moisture and thermal conditions. As for other snakes, den sites need to be above the water line and below the frost line, but specific attributes are unknown for this species.
Adults and juveniles	Summer inactivity, possibly aestivation	Fractured rock and talus patches; possibly large coarse woody debris	Attributes for aestivation sites are expected to be similar to thermoregulation sites but are likely deeper underground or within large diameter decaying logs, as snakes may disappear from the surface for many months during prolonged dry periods in summer.
Adults and juveniles	Refuges	Rocks; fractures in bedrock; talus; coarse woody debris	<ul style="list-style-type: none"> • Surface cover-objects of various sizes for shelter during daily activities. • Interstitial spaces between rocks in talus or other 3-dimensional habitats; substrates with various sizes of rocks, including small ones, seem to be preferred. • Coarse woody debris of various sizes and stages of decay; piles of sloughed-off bark might be attractive as they provide 3-dimensional habitat.
Eggs	Oviposition (egg-laying)	Poorly known; talus slopes or patches in openings	<p>Poorly known, as no eggs have been found in B.C. The following attributes are thought to be important:</p> <ul style="list-style-type: none"> • suitable (unknown) thermal and moisture conditions for incubation • warm aspect and exposure of the substrate to solar radiation • substrates that provide cover but still allow for heat to penetrate, such as interstitial spaces in talus
Adults, juveniles	Seasonal movements and dispersal	Unknown	Suitable (unknown) thermal and moisture conditions and shelter

^a A characteristic of habitat that corresponds to a biological need or requirement of the species (e.g., breeding, rearing, feeding and migration).

^b Structural components of the species' habitat.

^c Attributes describe how the identified features support the identified functions.

^d Movements of small young are probably limited.

^e Snakes will readily use artificial cover objects made of different materials.

3.4 Ecological Role

The snakes are important in the food web both as predators of slugs and other invertebrates and as prey for various vertebrates. They are thought to be beneficial to humans as they feed mainly on slugs, including introduced garden pests (Zweifel 1954; Cook 1960).

3.5 Limiting Factors

Limiting factors are generally not human induced and include characteristics that make the species less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation).

The Sharp-tailed Snake occurs within woodland ecosystems that are widely scattered and relatively rare in southwestern B.C. As a consequence, the distribution of the snakes is naturally patchy. Small Canadian range and localized distribution pattern of the Sharp-tailed Snake are probably largely due to past climatic conditions and historical factors rather than to human activities (COSEWIC 2009). In B.C., climate probably limits northward range expansion of the Sharp-tailed Snake. The most northerly known population is near Pemberton, where temperatures regularly drop below freezing in winter. Other factors, such as the availability of suitable warm microhabitats for incubation of eggs and nursery grounds, might be more important.

The Sharp-tailed Snake is the only native egg-laying (oviparous) snake in coastal B.C. In reptiles, incubation temperatures influence both developmental rates and phenotypic traits of offspring, which in turn can affect survival (Burger 1998). The availability of egg-laying sites with appropriate thermal conditions thus plays an important role in determining the distribution of oviparous species (Shine 2004), and probably limits the distribution of the Sharp-tailed Snake to habitats with suitable seasonally warm conditions within the southern part of the province (COSEWIC 2009).

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 sub-national) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered. Threats do not include limiting factors, 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., fire, flooding) 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 resilience. In such cases, the effect on the population would be disproportionately large compared to the effect experienced historically (Salafsky *et al.* 2008).

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014). 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 the Sharp-tailed Snake were assessed for the entire province (Table 1).

Table 2. Threat classification table for Sharp-tailed snake in British Columbia.

Threat # ^a	Threat description	Impact ^b	Scope ^c	Severity ^d	Timing ^e	Population(s)
1	Residential & commercial development	Medium	Restricted	Serious	High	
1.1	Housing & urban areas	Medium	Restricted	Serious	High	Langford, Mill Hill; North Pender Island, Magic Lake; South Pender Island; Saltspring Island (Mount Tuam, Northwest, and Northeast); Pemberton
1.3	Tourism & recreation areas	Negligible	Negligible	Slight	High	Unknown
2	Agriculture & aquaculture	Negligible	Negligible	Serious	High	
2.1	Annual & perennial non-timber crops	Negligible	Negligible	Serious	High	Highlands-Saanich; Saanich, Observatory Hill; Saltspring Island, Northwest; South Pender Island
3	Energy production & mining	Negligible	Negligible	Extreme	High	
3.2	Mining & quarrying	Negligible	Negligible	Extreme	High	Pemberton; Metchosin, Sooke Road
4	Transportation & service corridors	Medium-Low	Large	Moderate-Slight	High	
4.1	Roads & railroads	Medium-Low	Large	Moderate-Slight	High	North Pender Island (Magic Lake and Port Washington); South Pender Island; Saltspring Island (Mount Tuam, Northwest, and Northeast); possibly Highlands-Saanich and Saanich, Observatory Hill
4.2	Utility & service lines	Negligible	Negligible	Moderate	High	Pemberton
5	Biological resource use	Low	Small	Slight	High	
5.1	Hunting & collecting terrestrial animals	Negligible	Negligible	Slight	Unknown	All populations
5.3	Logging & wood harvesting	Low	Small	Slight	High	South Pender Island; Pemberton

Threat # ^a	Threat description	Impact ^b	Scope ^c	Severity ^d	Timing ^e	Population(s)
6	Human intrusions & disturbance	Low	Large	Slight	High	
6.1	Recreational activities	Low	Large	Slight	High	Metchosin, Sooke Road; Highlands-Saanich; Langford (Mill Hill and Mount McDonald); Pemberton
6.2	War, civil unrest, & military exercises	Low	Small	Slight	High	Metchosin, Mary Hill
6.3	Work & other activities	Medium-Low	Large	Slight	High	North Pender Island (Magic Lake and Port Washington); South Pender Island; Saltspring Island (Mount Tuam, Northwest, and Northeast); Metchosin, Mary Hill; Highlands-Saanich
7	Natural system modifications	Unknown	Pervasive	Unknown	High	
7.1	Fire & fire suppression	Unknown	Pervasive	Unknown	High	All populations
8	Invasive & other problematic species & genes	Low	Pervasive	Slight	High	
8.1	Invasive non-native/alien species	Low	Pervasive	Slight	High	All populations
9	Pollution	Unknown	Restricted - Small	Unknown	High	
9.3	Agricultural & forestry effluents	Unknown	Restricted - Small	Unknown	High	Unknown
11	Climate change & severe weather	Unknown	Pervasive	Unknown	Unknown	
11.1	Habitat shifting & alteration	Not a Threat	Pervasive	Neutral or Potential Benefit	Unknown	All populations
11.2	Droughts	Unknown	Pervasive	Unknown	Unknown	All populations

^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% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment 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 generation time of 10 years was used resulting in severity being scored over a 30-year timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

^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 combined impacts of multiple threats. Major threats are expansion of housing and urban areas (Threat 1.1), which results in habitat loss and degradation, and roads, which fragment habitat, constrain movements, and can result in roadkill (Threat 4.1) (Table 2). Details of the threats are discussed below under the Threat Level 1 headings starting with those threats with a low or medium impact, followed by threats assessed with having a negligible impact or where the impact of the threat is unknown.

Additional information on threats and how their associated activities may affect the species’ habitat features and attributes such that they might not be able to serve their function are provided in Appendix 2.

4.2.1 Threat with Impacts

IUCN-CMP Threat 1. Residential & commercial development (threat impact “medium”)

The Sharp-tailed Snake occurs within relatively densely populated areas of B.C., where its habitats are threatened by expanding urbanization, including housing developments and associated infrastructure. Several known sites are within urban landscapes, where the expansion of housing projects is of concern (see below). However, other known sites are within areas protected from development, such as in parks and federal lands (Appendix 1). In addition to the known sites, suitable potential habitat where the species might occur but is yet to be detected occurs within areas under development pressure. All these considerations contribute to the scope of the threat, which is assessed as “restricted” (11–30% of the population is affected).

While the snakes can coexist with humans to some degree, high density developments result in habitat loss and fragmentation and are expected to lead to loss of Sharp-tailed Snake populations. Sharp-tailed Snakes have specific habitat requirements within localized areas, and because of their limited dispersal capabilities (see Section 3.3), they are not readily able to avoid habitat disturbance by moving to other areas. Loss of habitat features that support important functions (foraging, thermoregulation, overwintering/hibernation, summer inactivity, refuge, oviposition, and seasonal movements and dispersal) would have serious consequences, even if the area affected is small. If the area affected is large, or developed intensively, connectivity within and between populations would be lost. Therefore, where it occurs, the severity of this threat was assessed as serious (31–70% population decline over three generations).

The Coastal Douglas-fir biogeoclimatic zone, where most of the Sharp-tailed Snake’s range occurs, is one of the most modified ecosystems in the province (MacKinnon and Eng 1995), and land conversions and development of remnant forest habitats continue at a rapid rate. Most of

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 0 Very High, 0 High, 2-1 Medium, # Low, and 3-4 Unknown (Table 1). The overall threat impact considers the cumulative impacts of multiple threats.

eastern Vancouver Island and the adjacent Gulf Islands (92.1%) consists of urban or rural landscapes or forests less than 100 years old (Ward *et al.* 1998), reflecting the extent of disturbance. The pressure on the remaining natural areas within the Capital Region is intense due to increased human population growth (Capital Regional District 2013).

Similarly, the area of mainland B.C. where the species occurs is experiencing population growth. Reflecting this growth, the human population of the town of Pemberton increased by 33.5% from 1996 to 2006 (Pemberton & District Chamber of Commerce 2009–2013). The completion of the Sea-to-Sky Highway has facilitated access from Vancouver, and the population of the area is expected to continue to grow.

Threats from urban developments may be compounded with natural sources of mortality due to predation or adverse climatic conditions, especially in small habitat patches. Small isolated populations are inherently vulnerable to disturbances and chance events.

IUCN-CMP Threat 4. Transportation & service corridors (threat impact “medium – low”)

Most of the Sharp-tailed Snake’s range in B.C. is intersected by networks of roads, but larger areas of habitat away from roads exist in some areas of Vancouver Island, such as in the Highlands and Sooke districts. The scope is assessed as “large,” meaning that 31–70% of the B.C. population of snakes is potentially exposed to this threat. Increased fragmentation exposes snakes to accidental mortality, including roadkill, and in heavily fragmented landscapes might constrain movements and access to essential habitat components, such as foraging areas or hibernation sites. Suitable habitats for the species are naturally fragmented, but road building and increased traffic on existing roads continue to accentuate this fragmentation.

Snakes are vulnerable to road mortality when moving within or between their seasonal habitats in fragmented landscapes. However, site fidelity, small home ranges, and relatively short seasonal movements documented for the Sharp-tailed Snake (< 100 m; see Section 3.3) alleviate the potential for roadkill to some degree. Reports exist of Sharp-tailed Snakes found dead on roads on the Gulf Islands (North Pender, South Pender, Saltspring) (Spalding 1995; Engelstoft and Ovaska 1999; COSEWIC 2009). One Sharp-tailed Snake site is near a seasonally busy ferry terminal on Saltspring Island. Another site on Vancouver Island is bisected by a popular recreational trail, and mortality from collisions with bicycles is a possibility although undocumented for this species. Barriers posed by busy roads are probably a more important threat than roadkill for this species.

Increased habitat fragmentation due to roads might constrain seasonal movements by removing attributes that provide refuge and cover, and by limiting access to habitat features that support essential functions such as foraging or hibernation. Suitable habitats for the species are naturally fragmented, but road building and increased traffic on existing roads continue to accentuate this fragmentation. Road building may also result in direct loss of key habitat features such as overwintering, oviposition and refuge sites.

There are many uncertainties associated with the effects of this threat on Sharp-tailed Snakes, which is reflected in the severity rating of “moderate to slight” (1–30% population decline in affected areas within the next three generations).

IUCN-CMP Threat 5. Biological resource use (threat impact “low”)

This threat accrues mostly from logging but also includes land clearing associated with the expansion of and construction of transmission lines. The scope is assessed as “small,” meaning that 1–10% of the snakes are exposed to this threat. The rating for the scope reflects mainly ongoing logging in the Pemberton area, which comprises approximately 12% of the area of occupancy of the Sharp-tailed Snake in B.C. (Appendix 1); up to 50% of this area may be subjected to logging in the next 10 years. Some small-scale logging also is ongoing on woodlots at or near other occupied sites in the Gulf Islands.

Tree removal is not necessarily harmful to the Sharp-tailed Snake, and small-scale or selective logging may even benefit the snakes by creating forest openings and increasing basking opportunities. However, heavy machinery can disturb and destroy habitat features that support functions such as oviposition and hibernation. Larger-scale logging disrupts the mosaic pattern of woodlands favoured by Sharp-tailed Snakes, and may affect features important for summer inactivity, refuges, thermoregulation and foraging. The severity of direct effects of logging on the Sharp-tailed Snake depends on the type of logging and size of areas disturbed. Overall, balancing both negative and positive effects, the severity of this threat is predicted to be “slight” (1–10% population decline in the affected areas over the next three generations).

IUCN-CMP Threat 6. Human intrusions & disturbance (threat impact “low”)

The scope is assessed as large, meaning that 31–70% of the snake population is exposed to this threat. The largest contributors to the rating are recreational activities and gardening and landscaping that occur throughout much of the Sharp-tailed Snake’s range. Additionally, Sharp-tailed Snakes are exposed to military training activities within a small portion of their range.

The Sharp-tailed Snake occurs in several recreational areas, including Capital Regional District parks and trails and the Gulf Islands National Park Reserve. Many provincial, regional, and local parks are small and receive intense recreational use, which may threaten the species if not managed. Off-road recreational activities, such as mountain biking and use of motorized vehicles, can destroy sensitive habitats, as observed at some occupied sites in the Highlands District. Off-trail foot traffic, especially if it occurs frequently or by groups of people, can also disturb talus slopes and other sensitive habitat features important for thermoregulation, overwintering, summer inactivity, refuges and oviposition. Hiking and activities confined to trails are expected to have no impact on the snakes or their habitats.

Off-road military training exercises occur on DND properties where the snakes occur. These activities can potentially do damage to talus patches and other important habitat features as indicated above, unless conducted with care.

Where the species occurs within residential areas, landscaping and gardening practices can result in habitat degradation, especially when it involves removal of cover or conversion of natural areas to cultivated garden beds. Damage to egg-laying and hibernation habitats is of particular concern (COSEWIC 2009). Activities that include removal of rocks and other cover decrease habitat quality for the snakes. Inadvertent mortality of snakes has occurred during lawn-mowing and weed-whacking, and a snake sheltering under a rock was accidentally crushed. It is unclear whether such mortalities occur at a rate that would have population effects or whether they are

rare, incidental occurrences. Research targeting this and other species in sensitive Garry oak habitats or fragile talus patches may also result in habitat degradation, unless conducted with special care. These activities usually include foot traffic and soil disturbance associated with invasive plant removal.

The severity of the combined effect of all the above activities on the snakes is assessed as “slight,” meaning that a population decline of 1–10% is expected over the next three generations in the affected areas.

IUCN-CMP Threat 8. Invasive & other problematic species & genes (threat impact “low”)

Threats posed to the Sharp-tailed Snake by both invasive, non-native plants and animals are included in this category. Encroachment by conifers (problematic native species), and the threat that it poses to long-term maintenance of snake habitats, is discussed under “natural system modifications” (Threat 7).

The scope of the threat from invasive, non-native species is assessed as “pervasive,” meaning that 71–100% of the snakes are exposed to this threat. Monocultures of introduced invasive plants, such as Himalayan blackberry (*Rubus armeniacus*), Scotch broom (*Cytisus scoparius*), and spurge-laurel (*Daphne laureola*), are prevalent at many of the areas occupied by the Sharp-tailed Snake and deemed to pose the greatest threat. Although habitat structure is probably more important for snakes than specific composition of plant species, dense monocultures of invasive, introduced plants in open areas shades basking sites and decrease habitat complexity, and may also reduce prey (gastropod) availability.

The non-native Common Wall Lizard (*Podarcis muralis*) is expanding its range on southern Vancouver Island and has been found at Sharp-tailed Snake sites in the Highlands District (Engelstoft and Ovaska 2010). Competition for resources, such as refuges or egg-laying sites, is a possibility but has not been studied.

Many known Sharp-tailed Snake sites are close to human habitations with associated domestic and feral animals (e.g., cats and introduced pheasants). One snake was found dead on a driveway, probably killed by a cat (Spalding 1995). The impact of free-ranging cats on birds and mammals can be considerable, and reptiles are also taken (Loss *et al.* 2013). Several snakes found at a North Pender Island site had scarring consistent with attempted predation by birds, possibly pheasants (Engelstoft and Ovaska 1999). The magnitude of threat posed by native and introduced predators to the Sharp-tailed Snake is unknown.

Overall, the severity of the combined threat to the Sharp-tailed Snake from invasive plants and animals is predicted to be “slight,” and result in 1–10% population decline in the affected areas over the next three generations. Many uncertainties are associated with this estimate.

4.2.2 Threats Deemed to Have “Negligible” Impact

Several threats presently considered negligible are included in Table 2 for the sake of completeness and to flag these threats for future assessments. They are described below.

IUCN-CMP Threat 2. Agriculture & aquaculture

The rocky woodland areas where the Sharp-tailed Snake occurs have minimal agricultural potential. However, some new vineyard development or expansion is possible, especially on the Gulf Islands. A few sites have hay cutting close to forest edges, which could threaten the snakes.

IUCN-CMP Threat 3. Energy production & mining

Gravel extraction for road construction and establishment of flagstone quarries are possible in Sharp-tailed Snake habitat but would be restricted to small areas. However, if talus patches where snakes congregate for hibernation or egg-laying are destroyed, the consequences for the snake population are serious. At one site in Metchosin, quarrying for road construction destroyed Sharp-tailed Snake habitat in the past. Also, past quarrying activities may have created habitat near the Pemberton population, but there is concern that the population there would be adversely affected if the quarries were reactivated.

4.2.3 Threats Deemed Potentially Important but Impacts of Which Are Unknown at Present**IUCN-CMP Threat 7. Natural system modifications**

Over the short term, intense fires and retardants used to extinguish them are likely harmful for snakes, whereas over the long term, they are beneficial in maintaining the open nature of the habitat and retarding conifer encroachment. In the past, periodic burning maintained these ecosystems, and fire suppression over the past 150 years has changed the natural disturbance regimes. In addition to wildfires, aboriginal peoples used controlled burning to maintain meadow and woodland habitats on southern Vancouver Island for harvesting of plants and wildlife (Cook 2004). Fires are likely to increase in frequency with droughts and climate change. However, most Sharp-tailed Snake sites are in or near populated areas where wildfires are extinguished rapidly.

IUCN-CMP Threat 9. Pollution

Snakes are exposed to pesticides, fertilizers, and other household chemicals that might be used in residential or agricultural areas at or near occupied sites. They may also experience secondary poisoning from consuming poisoned slugs, although no evidence of such poisonings is available. These potential effects have not been studied, and there is much uncertainty about whether they occur and to what extent.

IUCN-CMP Threat 11. Climate change & severe weather

The Sharp-tailed Snake exists at the northern extremity of its range in B.C. and may benefit from higher temperatures and the expansion of open woodland predicted with climate change. However, barriers posed by roads and urban developments may restrict dispersal of snakes to new areas that become available. Increased frequency and severity of summer droughts might

reduce the length or timing of the activity periods of the snakes with unknown but potentially harmful effects.

5 RECOVERY GOAL AND OBJECTIVES

5.1 Population and Distribution Goal

The recovery (population and distribution) goal is to ensure that Sharp-tailed Snake populations are stable or increasing in abundance and are well distributed across the species' natural range in British Columbia.

5.2 Rationale for the Recovery (Population and Distribution) Goal

The Sharp-tailed Snake was listed as Endangered by COSEWIC (2009) due to its small Canadian range and small area of occupancy, as well as a severely fragmented population⁵ and continued decline in habitat quality. It is unlikely that the Extent of Occurrence will ever increase above 5000 km², the threshold for down-listing from Endangered, unless future surveys on the mainland B.C., which has not been adequately surveyed for the species, result in new records over wide areas. Similarly, it is unlikely that the Index of Area Occupancy, based on the number of 2 x 2 km grid cells superimposed on occupied populations within the Canadian range, will increase from the current value of 132 km² (33 occupied grid cells) to above the threshold value of 500 km² (125 occupied grid cells). However, down-listing to Threatened may be possible, if threats to the habitat can be removed, habitat connectivity increased, and/or a significant number of undocumented populations discovered, so that the population is no longer severely fragmented. In practice, fragmentation could be decreased through habitat protection and threat reduction, which would increase long-term viability of populations, and by an increase in connectivity among and within populations.

5.3 Recovery Objectives

The following are the recovery objectives for the next 5 years:

1. maintain or enhance habitats important for the Sharp-tailed Snake's survival and recovery at each occupied site;
2. increase habitat connectivity within populations and where possible, between those populations that are close to each other;
3. investigate the existence of additional populations throughout the species' B.C. range, including suitable habitats outside the known range;
4. reduce gaps in our knowledge of the species' seasonal movements, dispersal, habitat requirements, demographic trends, and population ecology and clarify threats to improve protection, habitat management, and threat mitigation measures; and

⁵ Severe fragmentation means that one half or more of the snakes are in habitat patches that are not sufficiently large to support viable populations over the long term.

5. engage landholders and land managers in stewardship and increase public awareness of the Sharp-tailed Snake and its habitats.

6 APPROACHES TO MEET RECOVERY OBJECTIVES

6.1 Actions Already Completed or Underway

Compile Status Report (complete):

- COSEWIC report completed (COSEWIC 2009). Update due 2019.
-

Planning (ongoing):

- B.C. Recovery Strategy completed (Sharp-tailed Snake Recovery Team 2008); updated B.C. Recovery Plan (this document, 2015).
-

Habitat protection and private land stewardship (in progress):

- The Gulf Islands National Park Reserve protects about 36 km² of land (including a 25-m intertidal zone) in the southern Gulf Islands (Parks Canada 2014). The park reserve includes properties on 15 islands, including North and South Pender, Saturna, Mayne, and a number of smaller islands. The Sharp-tailed Snake occurs at Greenburn Lake on South Pender. Several other park reserve lands contain potential habitat for the species (Engelstoft *et al.* 2002).
- The Capital Regional District Parks and Trails system includes 33 regional parks and two trails that protect 13,000 ha of land (Capital Regional District 2014). The parks range from under 2 to 4100 ha, but most are small. The Sharp-tailed Snake has been found in larger parks, such as Mount Work (697 ha), Thetis Lake (834 ha), Sea to Sea Regional Park Reserve (3874 ha), and Sooke Hills Wilderness Regional Park Reserve (4010 ha), and also in smaller parks, such as Brooks Point Regional Park (4.8 ha) and a very small park (< 0.1 ha) on Saltspring Island. With a few exceptions, there are only 1 or 2 observations from most of these sites.
- Several B.C. provincial parks have suitable habitat (e.g., Sooke Potholes, Gowlland Tod, John Dean, and Mount Maxwell Provincial Parks). The species has been found only in Gowlland Tod Provincial Park (955 ha upland habitat; found in 2013).
- Sharp-tailed Snake habitat is also available in other parks, and there are observations of the species from Cal Reville Nature Sanctuary and Highlands Municipal Parks (69 ha).
- Three conservation covenants (legally binding) protect Sharp-tailed Snake Habitat: (1) residential property on North Pender Island to protect a small but locally important rocky knoll used by the Sharp-tailed Snake (held by Islands Trust and Pender Island Conservation Association); (2) on a 17-acre private land in Metchosin (held by Habitat Acquisition Trust and the Land Trust); (3) on two publicly owned areas (Brooks Point Regional Park and Sea to Sea Green Belt). The Salt Spring Island Conservancy holds a conservation covenant on a property adjacent to a known Sharp-tailed Snake population on Mount Tuam. In Pemberton, the Stewardship Pemberton Society holds a conservation covenant on one of the known sites in the area.

- Stewardship agreements (not legally-binding) have been signed by private landowners at approximately 20 properties with Sharp-tailed Snake observations, representing approximately 60% of known sites on private lands, and several other sites with suitable habitat (but not confirmed occurrences) for the species on Saltspring, North and South Pender, and Vancouver islands (by Habitat Acquisition Trust and Salt Spring Island Conservancy; 2005–2014).
- Habitat Acquisition Trust provided information on habitat protection measures for the species to Islands Trust planners and North Pender Island Local Trust Committee Members during the development of the Development Permit Areas. The information was incorporated into the North Pender Island Official Community Plan (2007).
- General and specific guidelines for protecting this species were incorporated into the document *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Development in British Columbia* (MFLNRO 2014).
- Detailed Best Management Guidelines specific for the Sharp-tailed Snake are being prepared as of May 2015 by the B.C. Ministry of Environment (Lower Mainland Regional Office).
- Extension materials produced include the following:
 - Sharp-tailed Snake information web page for habitat management guidelines on private lands (Habitat Acquisition Trust 2014a).
 - Sharp-tailed Snake identification guide (B.C. Ministry of Environment 2006).
 - Training video prepared by Department of National Defence in 2006, posted on Habitat Acquisition Trust website (Habitat Acquisition Trust 2014b).
 - Sharp-tailed Snake species account in *Wildlife in British Columbia at Risk Series* (MWLAP 2004).
 - Brochure *Attracting Snakes into Your Backyard — Tips for Reptile-friendly Landscaping and Gardening* (Ovaska and Engelstoft 2003).
 - Sharp-tailed Snake fact sheet (MWLAP 2002).
- Habitat assessment, surveys, and population studies on federal lands through the Government of Canada Interdepartmental Recovery Fund (IRF) (annual reports may be requested from the applicable organizations):
 - Gulf Islands National Park Reserve (2002–2010) (by Parks Canada).
 - Department of National Defence properties on southern Vancouver Island (2003–2010).
 - National Research Council property on southern Vancouver Island (2007–2014, ongoing).
 - Coast Guard lands on Discovery Island (2004–2005).
 - Transport Canada lands on Saltspring Island (2007–2012).
- Habitat assessment, surveys and population studies in the Cowichan Valley funded by the Province of BC (2013).
- Habitat assessment and surveys within Capital Regional District Parks and Trails System: all major Capital Regional District parks (2006–2011).
- Landowner contacts and surveys of private and other lands:
 - Pemberton area of B.C. mainland (2011–2014, ongoing; by Stewardship Pemberton).
 - Vancouver Island (2004–2014, ongoing; by Habitat Acquisition Trust).
 - Pender Islands (PICA 2003–2004; 2005–2014, ongoing; by Habitat Acquisition Trust).
 - Saltspring Island (2004–2014, ongoing; Salt Spring Island Conservancy).

- Mayne Island (sporadically since 2004; Mayne Island Conservancy).
 - Galiano Island (sporadically since 2004; Galiano Conservancy Association).
- Research into various aspects of the species' ecology, 1996–2014: distribution, ecology, and movements (Engelstoft and Ovaska 1999, 2010; Engelstoft *et al.* 2013, 2014); thermal ecology (Isaac and Gregory 2003); habitat associations (Wilkinson and Gregory 2005).
- Monitoring protocols were prepared (Isaac *et al.* 2006).
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Habitat restoration (in progress):

- Habitat restoration at eight private properties on Saltspring Island, 2002–2008 (Meier 2001; Ovaska and Engelstoft 2008).
- Invasive plant control at several sites.

6.2 Recovery Action Table

Recommended actions to meet the recovery objectives for the Sharp-tailed Snake are presented in Table 3, below.

Table 3. Recovery action table for Sharp-tailed Snake.

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b	Performance measures: indicator for process (above), indicators for achievements (below)
1, 2	Habitat Protection	Collaborate with regulators to include habitat protection measures into land use plans (e.g., development permit areas in Official Community Plans)	1.1 Housing & urban areas 1.3 Tourism & recreation areas	Essential	Process: # of regulatory bodies or organizations that are approached and provided with information across the Sharp-tailed Snake's range. Achievement: Sharp-tailed Snake habitats are incorporated into official land use plans.
1, 2, 3	Habitat Protection	Encourage park planners and managers with municipal, regional, provincial, and federal governments to survey for and manage this species on their lands	6.1 Recreational activities 6.2 War, civil unrest, & military exercises 6.3 Work & other activities	Necessary	Process: # of planners and managers with municipal, regional, provincial, and federal governments that are approached and provided with information across the Sharp-tailed Snake's range. Achievement: Sharp-tailed Snake habitats are incorporated into management plans for parks and federal properties (% of coverage by above across the Sharp-tailed Snake's range).
1, 2, 3	Habitat Protection	Encourage First Nations groups to survey for and manage this species on their lands	1.1 Housing & urban areas 1.3 Tourism & recreation areas 5.3 Logging & wood harvesting 6.1 Recreational activities 6.2 War, civil unrest, & military exercise 6.3 Work & other activities	Necessary	Process: # of First Nation groups that are approached and provided with information on the species within range of populations that occur near First Nations Reserve lands (e.g., Sc'ianew or Beecher Bay FN lands in Metchosin). Achievement: Sharp-tailed Snake habitats are incorporated into land use or management plans (% of coverage by above across the Sharp-tailed Snake's range).

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b	Performance measures: indicator for process (above), indicators for achievements (below)
1, 2, 3, 5	Habitat Protection and Private Land Stewardship	Encourage landowners to survey for and voluntarily protect and manage this species on their lands (e.g., through stewardship agreements with local conservation organizations)	1.1 Housing & urban areas 6.1 Recreational activities 6.3 Work & other activities	Essential	Process: 1. # of sites where landowners engage in voluntary stewardship activities (e.g., by signing informal land care agreements). 2. # of new landowners or community members recruited to search for or monitor snakes, or undertake stewardship activities. Achievement: % of unprotected sites for which protection through voluntary stewardship is achieved.
1, 2	Habitat Protection	Formally protect key habitats on private lands (e.g., through conservation covenants)	1.1 Housing & urban areas 1.3 Tourism & recreation areas 5.3 Logging & wood harvesting	Essential	Process: # of occupied sites where landowners have been approached about formally protecting land for the species. Achievement: % of unprotected sites for which formal protection is achieved; this depends solely on landowner interest, and quantitative targets cannot be set.
1, 2	Habitat Protection	Collaborate with developers in the vicinity of known sites to ensure protection of important habitats and maintenance of habitat connectivity	1.1 Housing & urban areas	Essential	Process: # of developers approached about formally protecting land for the species. Achievement: % of unprotected sites for which formal protection is achieved; this depends solely on developer's interest, and quantitative targets cannot be set.
1, 2	Habitat Protection	Prioritize sites and prepare a plan to increase connectivity of habitats within and among populations (e.g., through land acquisitions, greenways, or stewardship of strategic properties)	1.1 Housing & urban areas 1.3 Tourism & recreation areas 4.1 Roads & railroads	Essential	Process: Priority sites are identified in a connectivity plan; # of public and private landowners and conservation groups approached to implement the plan. Achievement: % of unprotected sites for which protection is achieved.

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b	Performance measures: indicator for process (above), indicators for achievements (below)
5	Private Land Stewardship	Develop and make printed and online stewardship and interpretive materials, including best management practices (BMP) documents, available to the land managers, developers, and targeted audiences in focal areas	1.1 Housing & urban areas 1.3 Tourism & recreation areas 6.1 Recreational activities 6.3 Work & other activities	Necessary	Process: 1. # of people reached through outreach efforts (e.g., website traffic counts, participants in workshops/presentations, outreach materials produced or distributed). 2. Posting of BMP document and number of people using it. Achievement: 1. # of sites/areas impacted by stewardship efforts. 2. Number of new sites discovered as a result of public input.
4	Habitat Protection	Conduct research on seasonal movements, dispersal and habitat requirements (for hibernation, foraging, egg-laying, and other activities)	Concern: Inadequate knowledge of habitat requirements hinders effective habitat protection	Essential	Process: Research is initiated addressing habitat use; # of sites where this research is conducted. Achievement: Clarification of seasonal habitat requirements, including key features and their attributes, is obtained; this information is incorporated into Critical Habitat description and other protection and management measures for the species.
4	Habitat Protection	Conduct research into the demographic trends and population ecology	Concern: Inadequate knowledge of demographic trends and population ecology hinders effective threat mitigation	Beneficial	Process: Research is initiated to address gaps in knowledge of life history of the Sharp-tailed Snake. Achievement: Improved understanding of the species' demography and population ecology is used to clarify and mitigate threats to populations.
3	Habitat Protection	Conduct habitat suitability assessment across the species' potential range, including selected areas of mainland B.C.	Concern: Habitat protection and fragmentation cannot be addressed through land use planning without knowledge of habitat suitability at broad-scales	Necessary	Process: Percentage of potential range where broad-scale habitat suitability assessment has been completed. Achievement: Percentage of potential habitat assessed for habitat suitability at broad or fine scales.

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b	Performance measures: indicator for process (above), indicators for achievements (below)
3	Habitat Protection	Conduct surveys of high-suitability habitats, as identified through habitat assessments, including mainland B.C.	Concern: Undocumented populations need to be located so that they can be protected; populations as currently understood may be connected, if undocumented sites are found in the intervening areas, creating increasing opportunities for dispersal and helping maintain viable populations	Essential	Process: Percentage of high-suitability habitats surveyed for the species or where new survey efforts have started. Achievement: Number of new sites found for the species through survey efforts or reports from the public.
1, 2	Habitat Protection	Determine the extent of the species' distribution at known sites	Concern: Inadequate knowledge of spatial requirements hinders effective management	Essential	Process: # sites where distributional studies are in progress. Achievement: Extent of occurrence has been delineated at known sites and incorporated into management plans and Critical Habitat descriptions.
1	Habitat Protection	Monitor population trends at selected sites	Concern: Needed to evaluate whether habitat protection and management measures are effective	Beneficial	Process: Number of sites included in monitoring trends in occupancy or where intensive monitoring has been started. Achievement: Evidence of long-term persistence of snake populations at sites where management actions (stewardship and protection) have been implemented.
4	Habitat Protection	Conduct genetic studies to investigate relationships between island and mainland populations to elucidate their degree of isolation and uniqueness	Concern: Facilitates setting priorities for habitat protection and allocation of efforts	Beneficial	Process: 1. Protocols for collecting genetic samples are developed. 2. # of sites where samples have been collected Achievement: Genetic relatedness of populations is clarified with respect to regional differences, such as island versus mainland populations. Appropriate management units are delineated.

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b	Performance measures: indicator for process (above), indicators for achievements (below)
4	Habitat Protection	Conduct genetic studies to investigate population structure and size, and relatedness of individuals	Concern: Facilitates monitoring population trends and allocation of efforts	Beneficial	Process: 1. Protocols for collecting genetic samples are developed. 2. # of sites where samples have been collected. Achievement: Genetic population structure and size, and relatedness of individuals of the population are elucidated to help assess viability of populations.
4	Species Management	Assess threats from habitat fragmentation and road mortality at each known site, and collect information on road mortalities through surveys and community outreach	4.1 Roads & railroads	Beneficial	Process: 1. # of occupied sites assessed to have a potential problem with roadkill. 2. Proportion of above sites where monitoring for roadkill has started. Achievement: Threats from road mortality are clarified and incorporated into formal assessment (e.g., IUCN threats calculator).
1, 2	Habitat Restoration	Engage in habitat restoration/ enhancement and assess the effectiveness of the actions	8.1 Invasive non-native/alien species	Beneficial	Process: 1. Assessment of sites where restoration is needed is completed. 2. # of sites where restoration has been initiated. Achievement: % of sites where restoration has been carried out and where monitoring Sharp-tailed Snake responses has started.

^a Threat numbers according to the IUCN-CMP classification (see Table 1 for details).

^b Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

6.3 Narrative to Support Recovery Planning Table

Recommended actions have been categorized by the action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2014), in the order of categories in Table 3.

6.3.1 Habitat Protection and Private Land Stewardship

The main thrust of this recovery plan is to ensure that further loss and fragmentation of habitats of the Sharp-tailed Snake are prevented and that habitat connectivity is maintained or enhanced. This is achieved through habitat securement that includes both voluntary stewardship and more formal protection measures. Those measures that protect habitat either over wide areas, such as zoning or land use plans, or over the long term, such as conservation covenants on private or public lands, are included in the Habitat Protection category in Table 3. These measures provide more permanent and effective protection than voluntary stewardship activities, but both are needed to effectively secure habitat for the Sharp-tailed Snake, much of the range of which occurs on private lands.

A number of Sharp-tailed Snake populations occur within areas that are already protected, such as parks, or that receive protection from development at present, such as Department of National Defence and National Research Council properties. However, within all these areas, the identification and protection of important habitat areas and key features, such as talus patches and small south-facing openings, is required to conserve Sharp-tailed Snake populations. The needs of the Sharp-tailed Snake are to be taken into account when developing or expanding infrastructure, including access roads, and when managing human activities, such as recreational activities within parks or military exercises within DND lands. These relatively large and undeveloped areas provide opportunities to maintain and, in some cases, to restore habitat connectivity across the landscape.

Habitat securement measures are to focus on habitats at known sites and surrounding areas within areas occupied by those populations where existing protection is relatively low, including Metchosin (Sooke Road), Saltspring Island (northwest and northeast), North Pender (Washington Road), and Pemberton populations (Appendix 1). In addition to securing sites where the species is known to occur, opportunities to improve habitat connectivity both within populations and among adjacent populations need to be assessed, so that priority areas can be identified and secured. Areas with new Sharp-tailed snake records are to be incorporated into the process as they are discovered.

On private lands, permanent habitat protection can be achieved through conservation covenants, eco-gifting, or other such means, and requires collaborative efforts by motivated landowners and local non-government organizations. Land acquisitions (e.g., by conservation organizations or through additions to parks systems) can be used strategically to secure habitat in key areas but are a feasible option only in special cases due to the high cost of land within much of the range of the Sharp-tailed Snake in B.C.

The strategy to protect habitat on undeveloped private lands includes proactively approaching land managers and planners, and encouraging the incorporation of habitat needs of this species into management and land use plans, such as Official Community Plans, which are updated periodically. This approach, together with habitat suitability assessment at broad scales (see below), will help prevent fragmentation and isolation of suitable habitats and identify opportunities to maintain connectivity through strategic land use planning or acquisitions.

Stewardship initiatives address habitat protection on private lands. Because several known sites are on private lands, working closely with landowners is a priority. Initiating and maintaining personal contacts with landowners of all properties where the Sharp-tailed Snake occurs provide a proactive approach to protect key habitat features and to anticipate changes in either ownership or land use. Landowners are to be encouraged to minimize disturbance to natural areas on their properties; protect rock outcrops, talus patches, and other habitat features important for the snakes from disturbance; and collaborate with researchers in monitoring populations. A best management practices document for the Sharp-tailed Snake, outlining these and other measures, is under development by the Province. Landowners are also to be encouraged to enter into voluntary, non-binding stewardship agreements with local conservation organizations. Habitat restoration/enhancement projects can be conducted as needs for these activities are identified and as opportunities arise. Restoration projects on private lands foster stewardship by bringing together volunteers, landowners, and researchers. Monitoring the use of the restored habitat by snakes is essential to assess the effectiveness of the measures and whether similar measures are expected to be useful at other sites.

Outreach activities include strategic distribution and display of stewardship and interpretive materials; delivery of workshops; and other initiatives that increase public awareness, appreciation, and understanding of the snakes and their habitats.

Habitat suitability assessments and surveys

Assessing habitat suitability throughout the species' Canadian range, followed by surveys, is a first step towards protecting habitats of possible undocumented populations of the Sharp-tailed Snake. Cryptic and burrowing habits make these snakes difficult to find, and survey coverage remains incomplete. New records continue to be found with increasing survey efforts, both within areas where the species is known to occur and outside the known B.C. range of the species. Surveys should focus both on habitats that are already protected, as they may form core areas for recovery efforts, and on areas that require additional management or protection measures. On Vancouver Island and the Gulf Islands, surveys should target intervening areas between populations to investigate existing connectivity and opportunities for enhancement.

At a finer scale, surveys at known sites will help determine habitat use and the area of occupancy. These, in turn, help in assessing threats to local populations, evaluating detailed habitat restoration and protection requirements, and obtaining estimates of population size.

Preliminary habitat suitability assessments have been prepared for portions of the species' range (Saltspring Island, parts of Vancouver Island), but wide-scale coverage and an approach using GIS modeling is desirable. On the B.C. mainland, broad-scale habitat suitability assessment should be targeted to likely areas and could focus on working outwards from known sites. A

broad-scale assessment may be followed by detailed, finer-scale assessments of priority areas selected for surveys. Habitat features to be incorporated in the assessment include forest and vegetation cover, substrate, aspect, slope, and other terrain features.

Survey efforts are to target three types of areas: (1) high-quality habitats identified through habitat assessment to locate possible new populations; (2) known sites to provide information on the extent of local distribution; and (3) areas with historical records of the species that either have not been surveyed or have received little survey effort in recent years.

Monitoring trends

Monitoring population trends of the Sharp-tailed Snake allows evaluating priority populations or sites for conservation actions. Such monitoring also provides information on whether management or habitat protection measures implemented are adequate. Monitoring may consist of determining continued presence to obtaining more detailed trend information on the population size. The level chosen will depend on particular objectives and available resources. Intensive population monitoring with mark-recapture methods offer the most detailed information but also require most effort and can be costly. However, intensive population monitoring carried out at selected sites in different parts of the species' range are valuable, and they also provide information on habitat use and movements (see below). Monitoring protocols have been prepared for the Sharp-tailed Snake (Isaac *et al.* 2006).

Research to support habitat protection measures

Research is needed into several aspects of the species' biology. The most pressing need is to obtain information on habitat use patterns, including seasonal habitat use, movements, and important micro- and macrohabitat features. This information will help better identify habitat features that need protection or management and the size of the area required to encompass year-round needs of the species. Information on demographic and life history parameters is also needed to help assess the recovery potential and population viability. Developing partnerships with universities and other agencies to promote research on the species' biology is beneficial and may increase the involvement of students. However, completing student projects on this cryptic species requires perseverance and dedication and may not be feasible within the short timeframes of some projects.

With the confirmation of the existence of Sharp-tailed Snake on mainland B.C. in 2011, it has become increasingly important to obtain information on the uniqueness of geographically isolated populations through genetic studies. This information will help in assessing priorities and most urgent protection needs. Information on the genetic structure of populations will also help in evaluating the significance of habitat fragmentation.

6.3.2 Species Management

Road mortality poses a potential but unknown threat to Sharp-tailed Snake populations. As a proactive measure, close contact with landowners and managers is encouraged to ensure that new roads are placed away from known Sharp-tailed Snake habitats. The strategy consists of

examining the degree of habitat fragmentation by roads at all known sites and assessing potential threats. Where needed, field surveys are to be conducted to examine movements of snakes across roads and/or incidence of roadkill. Landowners and residents near known Sharp-tailed Snake sites are to be encouraged to collect and report road-killed snakes.

6.3.3 Habitat Restoration

Habitat restoration may consist of removal of invasive plants, such as scotch broom, gorse, or laurel-leaved daphne, which are prevalent in Sharp-tailed Snake habitats and often form dense monocultures. If invasive plant control is undertaken, preferred timing is when the snakes are not present at or near the surface in winter and mid-summer. Care should be taken to minimize disturbance to the substrate. Where a large area is to be cleared, it is desirable to work the area in stages, so as not to leave snakes with no cover-objects.

Creating small openings on warm rocky slopes by selectively removing conifers may enhance habitat for Sharp-tailed Snakes in Garry oak and other ecosystems where conifer encroachment is a problem. Various rock structures, such as mortar-free stack walls and rock piles, have been used to enhance habitat on residential properties, but their effectiveness remains to be determined (Ovaska and Engelstoft 2003, 2008). It is important to incorporate follow-up monitoring for any restoration or enhancement activities undertaken.

7 SPECIES SURVIVAL AND RECOVERY HABITAT

Survival/recovery habitat is defined as the habitat that is necessary for the survival or recovery of the species. This is the area that the species naturally occurs or depends on directly or indirectly to carry out its life-cycle processes or formerly occurred on and has the potential to be reintroduced.

7.1 Biophysical Description of the Species' Survival/Recovery Habitat

A description of the known biophysical features and their attributes of the species' habitat that are required to support these life-cycle processes (functions) are provided in Section 3.3 and reflect our knowledge of habitat requirements of the Sharp-tailed Snake, as of October 2014. Additional work required to fulfill habitat knowledge gaps are included in the Recovery Action Table (Table 3). The appropriate research to fill knowledge gaps such as seasonal habitat use and detailed habitat attributes is likely to be long term, due to the secretive and burrowing habits of the snakes, which makes them difficult to study.

7.2 Geospatial Description of the Species' Survival/Recovery Habitat

The quantity of survival/recovery habitat required for a species is guided by the amount of habitat needed to meet the recovery goal. Habitat should be focused around areas of known populations. Addressing knowledge gaps for this species (see Table 3) will help inform the quantity of habitat required.

8 MEASURING PROGRESS

The performance measures in Table 3 provide a way to define and measure progress toward achieving the recovery (population and distribution) goal and recovery objectives. Performance indicators are included both for the process (i.e., to evaluate how well the actions were carried out) and for measuring achievement (i.e., to evaluate how effective the actions were in meeting the objectives). Performance indicators for the process provide valuable interim measures and are usually easier to measure than those for ultimate achievement, which may reflect long-term effects on the target population. For the Sharp-tailed Snake, changes in populations and distribution are particularly challenging to measure and evaluate due to the cryptic habits of the snakes.

Performance indicators consist of a target and a measure. It is deemed that all known sites occupied by the Sharp-tailed Snake need to be secured either through formal protection or stewardship actions; therefore, for habitat protection strategies, 100% securement from threats is the ultimate target. Securement can be achieved in various ways, including voluntary stewardship, as outlined in the recovery measures in Table 3. However, setting timelines and more detailed targets is problematic because much of the species' distribution is on private lands and formal protection, in particular, depends solely on landowner interest. In addition, other actions are constrained by data gaps in the distribution and habitat requirements of the species, which need to be addressed for adequate management. As well, quantitative targets (such as percentage of the species' range to be surveyed) and timelines are subject to funding availability.

9 EFFECTS ON OTHER SPECIES

In addition to the Sharp-tailed Snake, the habitat protection, stewardship, and outreach strategies outlined in Table 3 are expected to benefit other components of the ecosystem. The benefits will extend to Garry oak–arbutus ecosystems, which are at risk in B.C.

Surveys for the snakes could disturb the habitat if carried out carelessly. However, adverse effects can be eliminated or minimized by taking proper precautions, which include replacing all natural cover searched, avoiding disturbance to unstable talus slopes, and consulting a botanist before placing artificial cover-objects in sensitive habitats, such as within Garry oak ecosystems.

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Appendix 1. Summary of the area of occupancy and existing protection for Sharp-tailed Snake populations.

Population	# of properties or parks with observations	# of secure properties	# of observations from all properties	Area of polygon for delineated population (ha) ^a	Area of delineated occupied habitat polygons (ha) ^b	% of protected habitat in occupied habitat polygons by population	% of total protected area in occupied habitat polygons ^c	Index of area of occupancy (km ²) ^d
1. Metchosin, Mary Hill - Galloping Goose	3	1	28	419	104	59	0.5	4
2. Metchosin, Sooke Rd	1	1	28	314	40	14	0.2	4
3. Langford, Mount McDonald	1	1	3	314	40	100	1.6	4
4. Langford, Mill Hill	1	1	4	421	81	60	1.8	4
5. Sooke, Mount Peden	1	1	1	314	40	100	1.6	4
6. Highlands-Saanich	9	6	291	3364	357	80	11.4	28
7. Saanich, Observatory Hill	1	1	175	314	160	60	1.8	4
8. Saltspring Island, Mount Tuam	2	2	> 3	421	70	73	2.0	4
9. Saltspring Island, Northwest	29	0	> 30	1904	757	3	0.8	28
10. Saltspring Island, Northeast	4	0	> 20	157	58	1	0.0	4
11. South Pender Island	14	4	17	717	323	25	3.2	16
12. North Pender Island, Magic Lake	13	1	> 50	568	187	0	0.0	8
13. North Pender Island, Port Washington	2	0	2	306	64	4	0.1	4
14. Galiano Island (site unknown)	1	?						
15. Pemberton	4	1	> 14	1275	231	8	0.7	16
16. Chase (site unknown)	1	?						
Total	73	18		10808	2510	NA	25.8	132

^a Areas of the 16 populations were derived by following these steps: plotted all sightings; created a 40 ha buffer around each sighting (40 ha is assumed to represent sufficient area to support a viable population based on information from two properties with more than 60 known individual snakes); created a minimum convex polygon of these buffered sites; trimmed non-habitat (such as ocean and lakes) off; calculated area.

^b Areas of occupied habitat were derived by following these steps: plotted all sightings; created a buffer of 40 ha (see rationale in ^a); merged overlapping polygons; trimmed non-habitat (such as ocean and lakes) off; calculated area; delineated protected areas in each polygon; calculated area and percentage.

^c Includes federal land, parks/ecological reserves, and private lands under conservation covenants; other private or Crown lands are considered unprotected.

^d Based on the number of 2 x 2 km grids that contain occurrences.

Appendix 2. Association between threats and survival and recovery habitat of Sharp-tailed Snake in British Columbia.^a

Threat description	Effect of threat on habitat (pathway)	Functions affected	Features affected	Attributes affected
1.1. Housing & urban areas	Habitat is lost or degraded; loss of essential habitat features, such as overwintering or oviposition sites, would have serious consequences, even if the area affected is small; connectivity is lost if the site is large or intensively developed.	Foraging, thermoregulation, overwintering/hibernation, summer inactivity, refuges, oviposition, seasonal movements, and dispersal	All features (see Table 1)	All attributes (see Table 1)
4.1. Roads & railroads	(a) Habitat connectivity is impeded or lost; roads within 100 m from known sites could impede seasonal movements; long-term viability would be impeded if connections among populations that are farther apart (e.g., 1–5 km) (NatureServe 2014) are impeded; (b) Habitat is lost, which is especially significant if there is loss or degradation of key features, such as overwintering or oviposition sites.	(a) Seasonal movements and dispersal; (b) overwintering, summer inactivity, oviposition, refuges	(a) Refuges and cover that facilitate movements; (b) talus	(a) Substrate structure, understory vegetation, substrate type, coarse woody debris; talus; (b) thermal conditions and moisture in sheltered sites
5.3. Logging & wood harvesting	Canopy removal can alter the mosaic pattern of small openings and forest required by the species; leaving a transition zone of forest along rocky openings would alleviate the effects; substrate disturbance can destroy important microhabitat features.	Summer inactivity, refuges, thermoregulation, foraging	Cover-objects, including coarse woody debris and rocks	Surface cover-objects of various sizes for shelter during daily activities; suitable moisture and thermal conditions
6.1. Recreational activities	Substrate and vegetation can be disturbed by off-road use by people on foot, mountain bikes, ATVs, or other vehicles, especially in sensitive habitats such as talus and in transition zones between open and closed forest that are important for the snakes.	Thermoregulation, overwintering, summer inactivity, refuges, oviposition	Talus; cover-objects, including coarse woody debris and rocks	Shelter and suitable moisture and thermal conditions
6.2. War, civil unrest, & military exercises	Substrate and vegetation can be disturbed by off-road use by people on foot, ATVs, or other vehicles, especially in sensitive habitats such as talus and in transition zones between open and closed forest that are important for the snakes.	Thermoregulation, refuges, oviposition	Talus; cover-objects, including coarse woody debris and rocks	Shelter and suitable moisture and thermal conditions

Threat description	Effect of threat on habitat (pathway)	Functions affected	Features affected	Attributes affected
6.3. Work & other activities	Substrate and vegetation can be disturbed by landscaping and gardening activities; cleaning up, turning over soil for cultivation, removal of rocks, and woody debris can all destroy or degrade habitat features	Foraging, thermoregulation, overwintering, summer inactivity, refuges, oviposition	All features (see Table 1)	All attributes (see Table 1)
7.1. Fire & fire suppression	Conifer encroachment on woodland habitat shades out important habitat features and reduces availability of warm sites, making them less suitable for snakes.	Thermoregulation, refuges, oviposition	Forest gaps and mosaic pattern	Thermal conditions
8.1. Invasive non-native/alien species	Dense monocultures of invasive shrubs shade out habitat and reduce habitat complexity, which may lead to reduced prey availability.	Foraging, thermoregulation, overwintering, summer inactivity, refuges, oviposition	All features (see Table 1)	All attributes (see Table 1)

^a Threats assessed as either Negligible (all instances) or Unknown (unless Timing was “high”) are not included.