

Recovery Strategy for the Macoun's Meadowfoam (*Limnanthes macounii*) in Canada

Macoun's Meadowfoam



2013

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry (<http://www.sararegistry.gc.ca>).

Cover photo: Matt Fairbarns

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RECOMMENDATION AND APPROVAL STATEMENT

The Parks Canada Agency led the development of this federal recovery strategy, working together with the other competent minister(s) for this species under the Species at Risk Act. The Chief Executive Officer, upon recommendation of the relevant Park Superintendent(s) and Field Unit Superintendent(s), hereby approves this document indicating that Species at Risk Act requirements related to recovery strategy development have been fulfilled in accordance with the Act.

Recommended by:



Helen Davies
Field Unit Superintendent, Coastal BC, Parks Canada Agency

Approved by:



Alan Latourelle
Chief Executive Officer, Parks Canada Agency

Part 1: RECOVERY STRATEGY FOR THE MACOUN'S MEADOWFOAM (*Limnanthes macounii*) in CANADA

2013

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has provided the "Recovery Strategy for Macoun's meadow-foam (*Limnanthes macounii*) in British Columbia" to the Government of Canada. The federal Minister of the Environment as the competent minister under the Species at Risk Act (*SARA*) adopts or incorporates, in part, this recovery strategy pursuant to section 44 of the *Act*, with exceptions or modifications as detailed within the body of this document.

The finalized recovery strategy, once included in the Species at Risk Public Registry, will be the *SARA* recovery strategy for this species.

The federal Minister of the Environment's recovery strategy for the Macoun's Meadowfoam consists of two parts:

1. The federal text which completes the existing recovery strategy in terms of meeting the requirements of *SARA* section 41. This text includes additions, exceptions, and modifications to the document being adopted or incorporated, in whole or in part (Part 1).
2. The "Recovery Strategy for the Macoun's meadow-foam (*Limnanthes macounii*) in British Columbia" being adopted, developed by the Garry Oak Ecosystems recovery team Plants at Risk Recovery Implementation Group for the Province of British Columbia (Part 2).

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) 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.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency is the competent minister for the recovery of the Macoun's Meadowfoam and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Province of British Columbia, Environment Canada, Department of National Defence, Scia'new Nation, Songhees Nation, and Stz'uminus First Nation.

SARA section 44 allows the competent ministers 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 strategy for the Macoun's Meadowfoam (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Parks Canada Agency and Environment 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 the Parks Canada Agency and/or Environment Canada, or any other jurisdiction, alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Macoun's Meadowfoam and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada and/or 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 of the Macoun's Meadowfoam will be coordinated with the recovery of other species inhabiting vernal pools and other ephemeral wet areas associated with Garry Oak ecosystems (Parks Canada Agency 2006).

ACKNOWLEDGMENTS

The Garry Oak Ecosystems Recovery Team is the recovery team for the Macoun's Meadowfoam and is thanked for their involvement in the development of this recovery strategy. Additional revision to this document has been made based on comments and edits provided by a number of organizations: the Province of British Columbia, Department of National Defence, Natural Resources Canada, Environment Canada, The Corporation of the District of Oak Bay, the District of Saanich, Scia'new Nation, Songhees Nation, and Stz'uminus First Nation. Thank you to all the landowners who support recovery of this species on their land and provided access for surveys. Further acknowledgements relating to the development of the B.C. recovery strategy are provided in Part 2.

EXECUTIVE SUMMARY

The federal Recovery Strategy for the Macoun's Meadowfoam (*Limnanthes macounii*) in Canada has been produced based upon the Province of British Columbia's recovery strategy for Macoun's Meadowfoam in British Columbia (Part 2). The federal portion of this document (Part 1) includes information to bring the Province of British Columbia's recovery strategy into compliance with policies surrounding the *Species at Risk Act*. These changes are clarification and modifications of the population and distribution objectives and the recovery planning table, and the inclusion of performance indicators, action plan timelines, and critical habitat identification.

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ADDITIONS, MODIFICATIONS AND EXCLUSIONS TO THE ADOPTED OR INCORPORATED DOCUMENT

1. Population and Distribution Objectives

This section replaces information in sections 5.1 “Population and Distribution Goal” and 5.2 “Recovery Objectives” in the Province of British Columbia’s recovery strategy for Macoun’s Meadowfoam in British Columbia (Part 2) with population and distribution objectives as required under the SARA.

In Canada, Macoun’s Meadowfoam is found in seasonally wet microhabitats associated with Garry Oak ecosystems and as such had a naturally, highly restricted range. Within this range, significant habitat loss since European settlement (Lea 2006) has likely resulted in population reductions. Encroachment of vegetation, development, and effects resulting from recreational activities continue to exacerbate the situation (COSEWIC 2004). Given the permanent loss of most of the original habitat, it is not possible to recover the species to its natural area of occupancy or to its original probability of persistence.

In general, it is believed that multiple populations and thousands of individuals are likely required to attain a high probability of long-term persistence for a species (Reed 2005; Brook *et al.* 2006; Traill *et al.* 2009). In an analysis of several published estimates of minimum viable population (MVP) sizes, Traill *et al.* (2007) found that the median population size required for plants to achieve a 99% probability of persistence over 40 generations was approximately 4,800 individuals (but see Flather *et al.* 2011, Garnett and Zander 2011, and Jamieson and Allendorf 2012 for critical evaluations of the analyses and the applicability of the results). Such information provides a useful guide, but developing specific quantitative and feasible objectives must consider more than just generalized population viability estimates, including the historic number of populations and individuals, the carrying capacity of extant (and potential) sites, the needs of other species at risk that share the same habitat, and whether it is possible to establish and augment populations of the species (Parks Canada Agency 2006; Flather *et al.* 2011; Jamieson and Allendorf 2012). Because not enough of this information is available for Macoun’s Meadowfoam, it is currently not possible to determine to what extent recovery is feasible and, therefore, it is not possible to establish quantitative long-term objectives. Recovery planning approaches (see Section 6) are designed to respond to knowledge gaps so that long-term, feasible, and quantitative recovery objectives regarding size and number of populations can be set in the future. At this time it is possible to set short-term objectives that focus on maintaining all extant Canadian populations and preventing a decline in distribution:

Objective 1: Maintain the 31 extant populations at a stable or increasing size.

Objective 2: Prevent a decline in the known distribution¹ of Macoun's Meadowfoam in Canada.

2. Strategic Direction for Recovery

This section modifies information in section 6.2 "Recovery Planning Table" of the Province of British Columbia's recovery strategy for Macoun's Meadowfoam in British Columbia (Part 2). The revised recovery planning table, including adopted portions of the provincial table and federal additions is included below for reference (Table 1, Part 1). The recovery planning table is accepted and modified as follows:

From Table 3, Part 2, the approaches listed under the "Conservation Framework action group" column are accepted as a list of broad strategies to address threats to the species and included in the "Broad Strategy to Recovery" column. In addition, the empty cell in the provincial "Conservation Framework action group" column is assigned a conservation action group of "Ecosystem and Habitat Restoration" and adopted as per the rest of the column as a broad strategy in the Federal table (row 4, Table 1, Part 1).

One additional broad strategy and eight additional approaches are added to the table to further support habitat restoration and stewardship and to explicitly address the limitation of small fragmented populations. The new broad strategy is "Species and Population Management" as per the Province of British Columbia's Conservation Framework. The eight new approaches are found in the first two rows of Table 1, Part 1.

The "Actions to meet objectives" column is accepted as a "General Description of Research and Management Approaches" column and included in Table 1, Part 1. So as not to unduly restrict flexibility in protecting habitat, in the "Actions to meet objectives" column (Table 3, Part 2, section 6.2), "Develop stewardship agreements, conservation covenants with private landowners on all properties" is deleted and replaced with "Identify protection² mechanisms / instruments for the species and its critical habitat" in the corresponding "General Description of Research and Management Approaches" column (Table 1, Part 1).

¹ Distribution is measured by the extent of occurrence (currently about 40km²) and area of occupancy (currently estimated at 0.01-0.02 km²) (COSEWIC 2008). If new populations are discovered, these baseline figures should be updated as required.

² Protection is used in a different sense here in the federal text than in the BC recovery strategy. It is the Government of Canada's responsibility to determine what constitutes effective/legal protection of critical habitat under SARA.

Table 1. Recovery Planning Table

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
			•
1.1; 1.3; 6.1; 6.2; 7.1; 8.1	Urgent	Habitat restoration; Private land Stewardship	<ul style="list-style-type: none"> • Prepare Best (Beneficial) Management Practices to support landowners in habitat stewardship activities such as control of invasive alien plant species, management of recreation activities, and mitigation of fire suppression effects. • Engage landowners and land managers in habitat stewardship.
<p>Limitation: small fragmented populations</p> <p>Knowledge Gap: propagation techniques</p> <p>Knowledge gaps regarding population demography</p>	Urgent	Species and Population Management	<ul style="list-style-type: none"> • Determine long-term species-specific population thresholds and targets. • Implement a population restoration plan for existing populations (including a monitoring component). • Develop population augmentation techniques and priorities to maintain known populations. • Determine total number of populations required to maintain a suitable chance of survival in Canada. • Identify the demographic criteria that would trigger immediate re-evaluation of recovery priorities and activities, and incorporate them into the management plans. • Conduct demographic research in order to identify critical life stages (e.g., recruitment, growth, survival, and seed bank dynamics) necessary for population growth.
<p>1.1; 1.3; 6.1; 6.2</p> <p>1.1; 1.3; 6.1; 6.2</p> <p>1.1; 1.3; 6.1; 6.2</p> <p>1.1; 1.3; 6.1; 6.2; 7.1; 8.1</p> <p>1.1; 1.3; 6.1; 6.2; 7.1; 8.1</p> <p>7.1; 8.1</p>	Urgent	Habitat Protection; Habitat Restoration; Private Land Stewardship	<ul style="list-style-type: none"> • Determine appropriate measures to protect habitat. • Identify protection³ mechanisms / instruments for the species and its critical habitat. • Develop and implement communication strategy among partner organizations. • Develop and implement strategy for communicating with land users/stakeholders with respect to recovery activities as required. • Develop or refine site-specific management plans for protected areas, municipal, and federal lands to reduce or remove threats to populations and habitat. • Conduct experiments to determine appropriate methods for controlling or removing invasive alien species and methods to mimic fire regimes.

³ Protection is used in a different sense here in the federal text than in the BC recovery strategy. It is the Government of Canada's responsibility to determine what constitutes effective/legal protection of critical habitat under SARA.

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
8.1; Knowledge gap 6.1; 6.2; 8.1 All threats All threats	Beneficial Necessary Urgent Urgent	Ecosystem and Habitat Restoration	<ul style="list-style-type: none"> • Assess impacts of invasive alien species at all sites. • Identify impact of disturbance (e.g., soil compaction, trampling, recreational activities, forest and shrub encroachment, and removal of invasive alien species) to the viability of Meadowfoam populations. • Develop and implement monitoring protocol to detect human and natural threats at each known site. • Monitor sites to assess the effects of any management actions.
Knowledge gap	Necessary	Monitor Trends	<ul style="list-style-type: none"> • Develop and implement monitoring protocol for Macoun's Meadowfoam distribution and abundance at each site. • Monitor status of populations to determine population trends.
Knowledge gap	Necessary	Habitat Protection	<ul style="list-style-type: none"> • Identify and map suitable habitat for the species. • Prioritize areas for inventory. • Conduct inventories.
Knowledge gap	Beneficial	Compile/Update Status Report	<ul style="list-style-type: none"> • Describe recruitment of new populations or subpopulations. • Determine mechanisms of dispersal. • Characterize seed bank dynamics.

3. Critical Habitat

This section replaces information in section 7 “Habitat Needs To Meet Recovery Goal” and subsections in the Province of British Columbia’s recovery strategy for Macoun’s Meadowfoam in British Columbia (Part 2). There are currently 31 extant populations of Macoun’s Meadowfoam in Canada, three more since the Provincial Recovery Strategy was prepared (Table 2).

Areas of critical habitat for Macoun’s Meadowfoam are identified in this recovery strategy. Critical habitat is defined in the *Species at Risk Act* as “habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or in an action plan for the species” (Subsection 2(1)). Habitat for a terrestrial wildlife species is defined in the *Species at Risk Act* as “...the area or type of site where an individual or wildlife species naturally occurs or depends on directly or indirectly in order to carry out its life processes or formerly occurred and has the potential to be reintroduced” (Subsection 2(1)).

3.1. Identification of the Species’ Critical Habitat

Critical habitat for Macoun’s Meadowfoam is identified in this recovery strategy. This is not a complete identification because critical habitat has not been identified on Songhees Nation reserve. The Government of Canada continues to work with Songhees Nation towards identification of critical habitat on reserve land and will update this document as appropriate once cooperation and consultation efforts are completed.

Critical habitat in this recovery strategy is identified to the extent possible, based on best available information; more precise boundaries may be mapped and additional critical habitat may be added in the future if ongoing research (e.g., through work by the Province, stewardship and recovery groups, university projects, or related federal Interdepartmental Recovery Fund projects) supports the inclusion of areas beyond those currently identified. The schedule of studies section (found below critical habitat maps) outlines activities required to identify additional critical habitat necessary to support the population and distribution objectives.



Figure 1: Macoun's Meadowfoam is distributed along this seepage track which drains from the crest of the hill in the background and empties on to the beach behind the photographer. The Meadowfoam is located among the short vegetation in the middle foreground.

The habitat of Macoun's Meadowfoam plants is generally characterized as open areas that are vernal moist, and occur on low elevation rocky or grassy slopes within Garry Oak Ecosystems occurring in the Coastal Douglas-fir Biogeoclimatic Zone on southeast Vancouver Island and the Gulf Islands, British Columbia (COSEWIC 2004, Figure 1). Critical habitat attributes were

drawn from section 3.3.1 “Habitat and biological needs” in the Province of British Columbia’s recovery strategy for Macoun’s Meadowfoam in British Columbia (Part 2) and are listed below. The critical habitat attributes below cover the range of attributes for all studied sites and due to their general nature may not exclude some habitat types that are unsuited to the species. Critical habitat attributes are as follows:

- Open areas with full sun and short or sparse vegetation (cover of trees, shrubs, and robust vascular plants is never substantial).
- Elevations less than 195 metres, generally between 5 to 35 metres, above sea level.
- Less than 2 kilometres, usually <200 metres, from the shore of the Pacific Ocean; snow and hard frosts are rare at occupied sites due to the oceanic influence.
- Thin soils, less than approximately 30 cm; soil is generally acidic and rich in organic matter and nutrients.
- Water table during winter is 0 (at the surface) to 5 centimetres above the surface; soil moisture ranges from moderate to moist in spring until the end of April to very dry in summer.
- Intermediate levels of disturbance from human recreation and animal activities: moderate disturbance may contribute to maintenance of Macoun’s Meadowfoam habitat by reducing cover of competing plant species.

The Macoun’s Meadowfoam is intolerant of shading and the area surrounding the plants and seed bank must be clear of shading shrubs and trees; this area is the canopy opening required by the species. Canopy openings must be large enough that the Macoun’s Meadowfoam plants are not sheltered by surrounding vegetation. The minimum size of openings can be determined based on the height of vegetation able to grow in the area and cast shade on the Macoun’s Meadowfoam (Spittlehouse *et al.* 2004). An additional consideration with regards to canopy opening is that when tall vegetation falls, it will cover an area of ground for a distance equal to its height.

In addition to openings, specific hydrological characteristics are critical to the survival of this species. Within its Canadian range, Macoun’s Meadowfoam occurs on sites that have constant seepage in the early spring but are very dry during the summer. This seepage is provided by the catchment(s) associated with each group of plants. The catchment area is directly responsible for receiving rainwater which flows along the prevailing topography to the plants. Surface water flow and subsurface seepage from this catchment area is essential to the survival of the Macoun’s Meadowfoam plants. These catchment areas are generally small and isolated within landscape scale catchments.

Critical habitat for the survival of each patch⁴ of Macoun’s Meadowfoam is composed of the minimum canopy opening and the catchment area. The minimum canopy opening and catchment

⁴ Patch is a term used to refer to a single or group of several plants in close proximity. A specific mapping scale and minimum separation distance have not been used to quantitatively define a patch; the identification of patches is based on survey work performed by a biologist familiar with the species. Lacking any detailed information on seed bank extent, the seed bank is assumed to be included within each patch: the only

area are always connected to the recorded location of a Macoun's Meadowfoam patch and in all cases will overlap to some degree (no special status is applied to areas of overlapping critical habitat). The default minimum canopy opening required for light to reach the plants is the area bounded by a 20 metres distance surrounding the location of each patch in all directions (20 metres is generally the maximum height attained by trees in the soils surrounding Macoun's Meadowfoam). The catchment for each patch of Macoun's Meadowfoam is delineated by following the upslope high point of land which divides water flowing towards the patch location from water flowing away; these catchment areas are generally relatively small and isolated within landscape catchments. Conceptually the catchment can be visualized as a "V" shaped seepage draining into an "O" shaped minimum canopy opening—though in practice the minimum canopy opening and catchment are rarely regularly shaped and it is possible for the catchment to be completely contained within the minimum canopy opening. If the catchment extends beyond the canopy opening, the top of the "V" of seepage influence represents the upper limit of the habitat, otherwise the minimum canopy opening represents the limit of the habitat.

Populations of Macoun's Meadowfoam are likely prone to large annual fluctuations (COSEWIC 2004). While some habitat areas (a minimum canopy opening and catchment) may not be used by growing individuals every year, the presence of plants in one year indicates that the habitat may be critical for storing seeds and boosting seed production in favourable years. All habitat used at any time by each patch of plants in each extant population is required to achieve the population and distribution objectives and is critical habitat; however, due to population fluctuations this habitat cannot be completely identified based on data from any single year: a long term data set is required to ensure the full range of population fluctuation is captured.

Recent data (Fairbarns 2008; Fairbarns 2011; Webb *et al.* 2011; Department of National Defence 2011; B.C. Conservation Data Centre 2011) can be used to identify a minimum baseline of critical habitat to support current Macoun's Meadowfoam populations. It is expected that these datasets do not represent the maximum extent of annual variation in these populations; and therefore, do not represent the total habitat required for the survival of extant Macoun's Meadowfoam populations. The studies referred to above have been used to guide the location of boundaries within which critical habitat is found. It is expected that over time, continued monitoring which documents annual fluctuations in population extent and habitat use will provide data which more confidently characterizes the total habitat needed by this species.

Where the location of populations are known, but ground survey data regarding the location of critical habitat is lacking, a modeling approach has been used to guide the identification of critical habitat and the location of the boundaries within which critical habitat is found. In these cases the minimum canopy opening can be modeled as the default distance of 20 metres around the polygon or UTM coordinate for the location of the plants and is identified as critical habitat. There is no default model to delineate catchment areas and where ground surveys are lacking catchments remain to be mapped, however, while their precise location is not known they are expected to lie within the identified bounding area and are critical habitat. In the case of small

information pertaining to the spatial extent of the Macoun's Meadowfoam seed bank is derived from the physical characteristics of the seeds and dispersal distance is probably very limited (COSEWIC 2004).

islands, all polygons are restricted to the source landmass and modeled polygons do not extend onto adjacent islands.

Within the geographical boundaries identified for each population (Table 2; Figure 2 through Figure 27), critical habitat for Macoun's Meadowfoam is the minimum canopy openings and the catchment area associated with the recorded location of each Macoun's Meadowfoam patch.

Table 2. List of populations and the mapping approach and data sources used to identify critical habitat (CH) for each population. The mapping approach is ground surveys (S), modeling (M), or a combination of both surveys and modeling (M,S).

Population	CH Parcel	Figure (Map Name)	Data Source(s)	Mapping Approach	CDC EO Name [†]
Fort Rodd Hill, Gotha Point	259_01	Figure 2 (Fort Rodd Hill NHS)	Webb <i>et al.</i> 2011	S	Fort Rodd Hill National Historic Site
Fort Rodd Hill, Yew Point	259_02	Figure 2(Fort Rodd Hill NHS)	Webb <i>et al.</i> 2011	S	Yew Point
Albert Head	259_03	Figure 3 (Albert Head)	Department of National Defence 2011	M	Albert Head
Pearson College Rd.	259_04	Figure 4 (Mary Hill)	Department of National Defence 2011	M	Pearson College
Mary Hill, Northeast	259_05	Figure 4 (Mary Hill)	Department of National Defence 2011	M	Mary Hill, Northeast Base
Mary Hill, South	259_06	Figure 4 (Mary Hill)	Department of National Defence 2011	M	Mary Hill, southeast and southwest slopes
Inskip Island	259_07	Figure 5 (Inskip Island)	Department of National Defence 2011	M	Inskip Island
Duntze Head	259_08	Figure 6 (Duntze Head)	Department of National Defence 2011	M	None*
Heritage Point, Chatham Islands	Contact Songhees Nation for information regarding this population.				Chatham Islands, Heritage Point
Rocky Point, Northwest	259_10	Figure 7 (Rocky Point, Northwest)	B.C. CDC 2011	M	Becher Bay IR #2, north of
Rocky Point, West	259_11	Figure 8 (Rocky Point, West)	B.C. CDC 2011; Department of National Defence 2011	M	Beecher Bay Indian Reserve #2
Rocky Point, Southwest	259_12	Figure 8 (Rocky Point Southwest)	Department of National Defence 2011	M	Church Point, west of
Rocky Point, East	259_13	Figure 9 (Rocky Point, East)	Department of National Defence 2011	M	Rocky Point, East
Rocky Point, Central	259_14	Figure 10 (Rocky Point, Central)	Department of National Defence 2011	M	None*
William Head	259_15	Figure 11 (William Head)	Fairbarns 2011	S	Quarantine Cove, Victoria
Trial Islands	259_16	Figure 12 (Trial Islands)	Fairbarns 2011	S	Trial Islands Ecological Reserve
Gonzales Point	259_17	Figure 13 (Gonzales Point)	B.C. CDC 2011; Fairbarns 2011	S	Gonzales Point

Population	CH Parcel	Figure (Map Name)	Data Source(s)	Mapping Approach	CDC EO Name[†]
Gabriola Island, Drumbeg Provincial Park	259_18	Figure 14 (Gabriola Island, Drumbeg Provincial Park / Gabriola Island)	Fairbarns 2011	S	Gabriola Island, Drumbeg Provincial
Beaver Point, Saltspring Island	259_19	Figure 15 (Beaver Point)	B.C. CDC 2011; GOERT 2011	M,S	Beaver Point, Salt Spring Island
Devonian Regional Park Area	259_20	Figure 16 (Devonian Regional Park Area)	Fairbarns 2008; B.C. CDC 2011; Fairbarns 2011	M,S	Devonian Regional Park
Creyke Point	259_21	Figure 17 (Creyke Point)	Fairbarns 2008	S	Creyke Point, East Sooke Regional Park
Cabin Point	259_22	Figure 18 (Cabin Point)	Fairbarns 2008	S	Beechy Head, bay north of
Arbutus Cove	259_23	Figure 19 (Arbutus Cove)	B.C. CDC 2011	M	Arbutus Cove, north of
Gonzales Bay	259_24	Figure 20 (Gonzales Bay)	B.C. CDC 2011; Fairbarns 2011	M	Gonzales Bay, Victoria
Montreul Hill	259_25	Figure 21 (Montreul Hill)	B.C. CDC 2011	M	Montreul Hill
Glencoe Cove/ Kwatsech Park	259_26	Figure 22 (Glencoe Cove/Kwatsech Municipal Park)	B.C. CDC 2011; Fairbarns 2011	M	Gordon Head, Leys Road, Glencoe Cove Park
Cattle Point	259_27	Figure 23 (Cattle Point)	B.C. CDC 2011	M	Uplands Park, Victoria
Downes Point, Hornby Island	259_28	Figure 24 (Downes Point, Hornby Island)	Fairbarns 2011	S	Hornby Island, Downes Point
Saxe Point	259_29	Figure 25 (Saxe Point)	Fairbarns 2011	S	Saxe Point Park, Victoria
Yellow Point	259_30	Figure 26 (Yellow Point)	B.C. CDC 2011; GOERT 2011	M,S	Yellow Point
Harling Point	259_31	Figure 27 (Harling Point And Trafalgar Park)	Fairbarns 2011	S	Harling Point

[†]Element Occurrence (EO) Names from Part 1 in the B.C. Recovery Strategy for Macoun's Meadowfoam (Part 2).

*Indicates a population that is not included in the B.C. CDC Database at the time of writing.

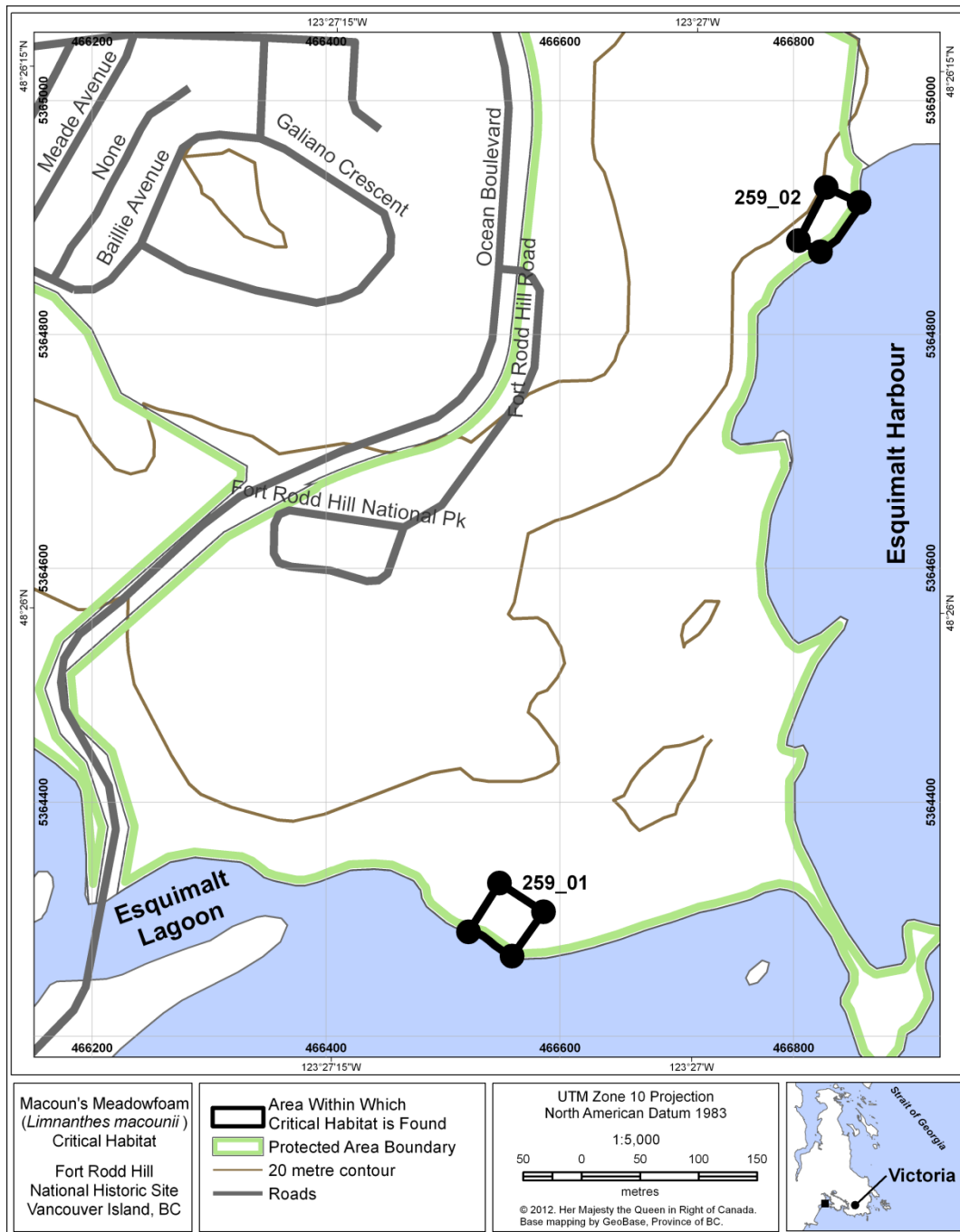


Figure 2. Areas 259_01 and 259_02 (~ 0.20 ha and ~0.15 ha) within which critical habitat for Macoun's Meadowfoam is found near Fort Rodd Hill on federal land. The identified critical habitat within these areas is ~0.15 ha and 0.11 ha.

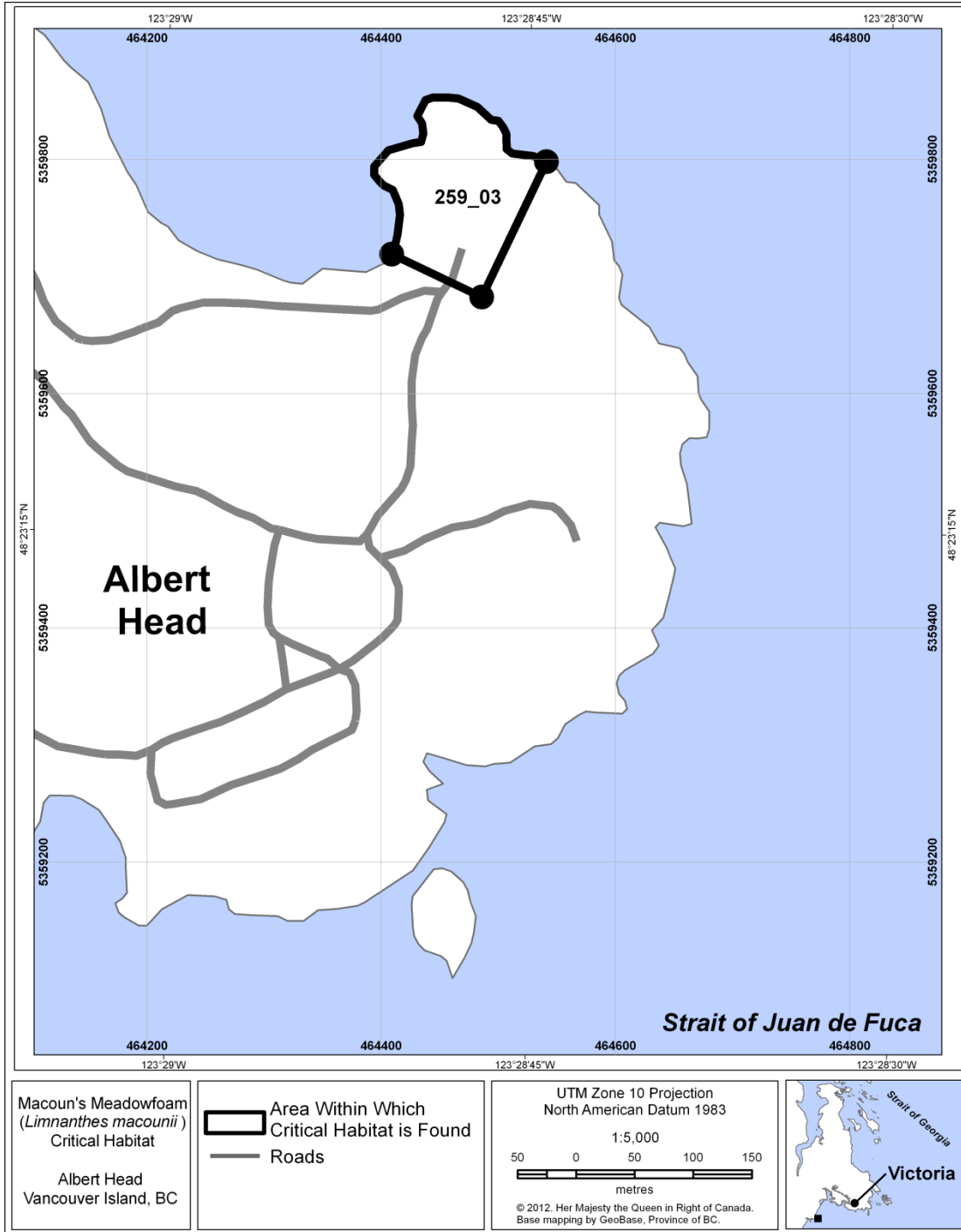


Figure 3. Area 259_03 (~ 1.5 ha) within which critical habitat for Macoun's Meadowfoam is found on Albert Head on federal land. The identified critical habitat within this area is ~ 0.25 ha.

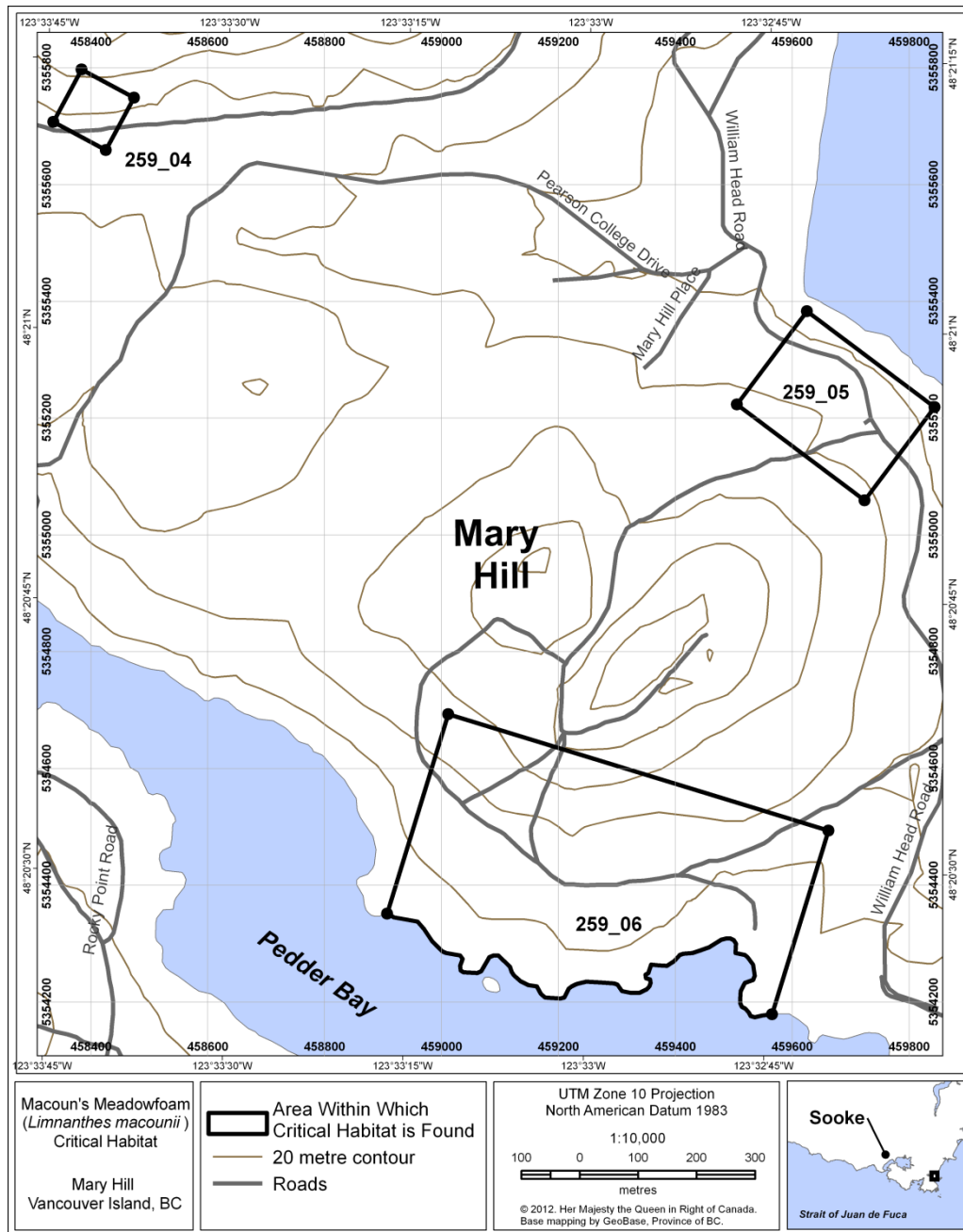


Figure 4. Areas 259_04, 259_05, and 259_06 (~ 1.0, ~ 5.5, and ~ 23.7 ha) within which critical habitat for Macoun's Meadowfoam is found near Mary Hill. The identified critical habitat within this area is ~ 0.13, ~ 0.27, and ~ 0.5 ha.

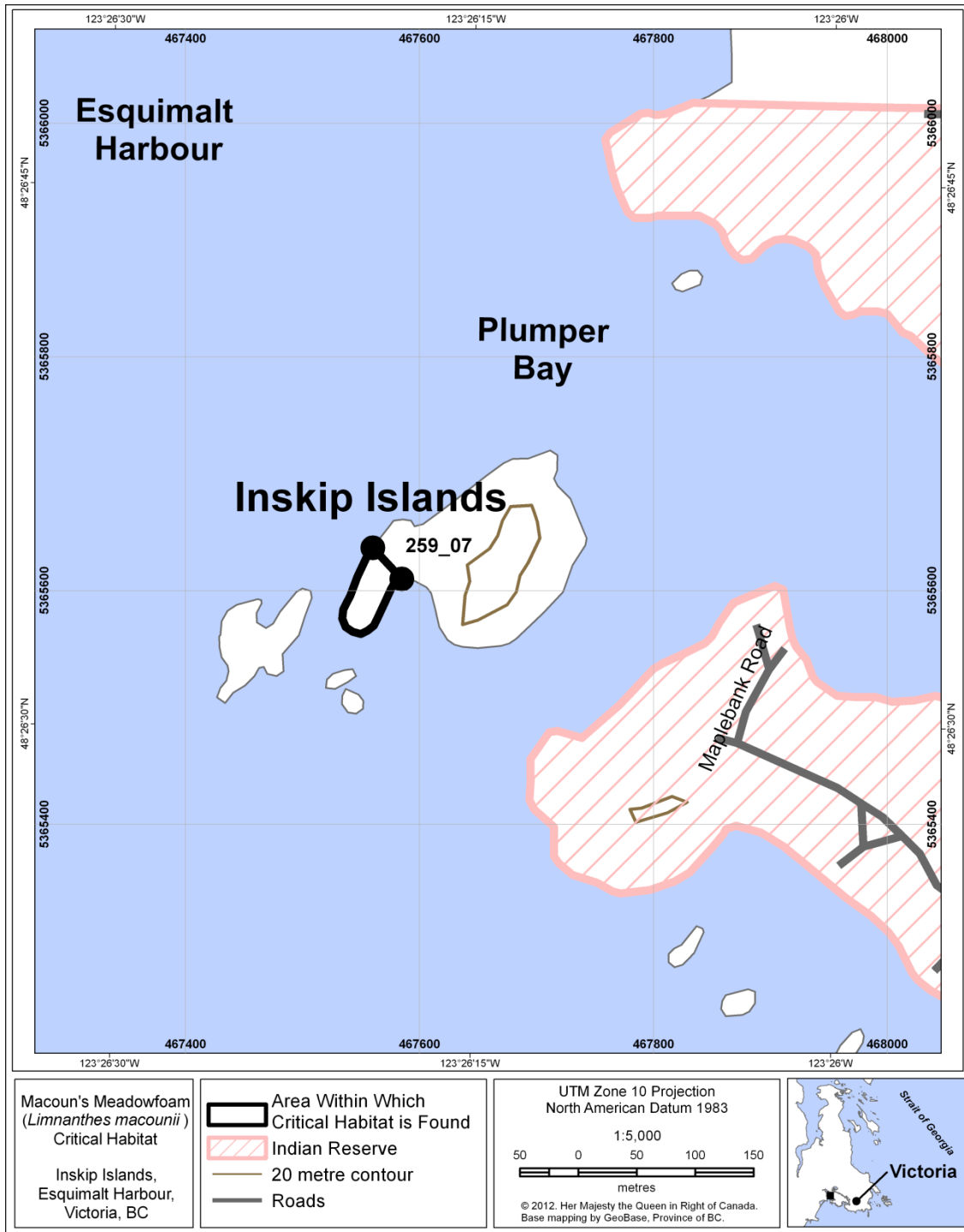


Figure 5. Area 259_07 (~ 0.2 ha) within which critical habitat for Macoun's Meadowfoam is found on northeast Inskip Island on federal land. The identified critical habitat within this area is ~ 0.01 ha.

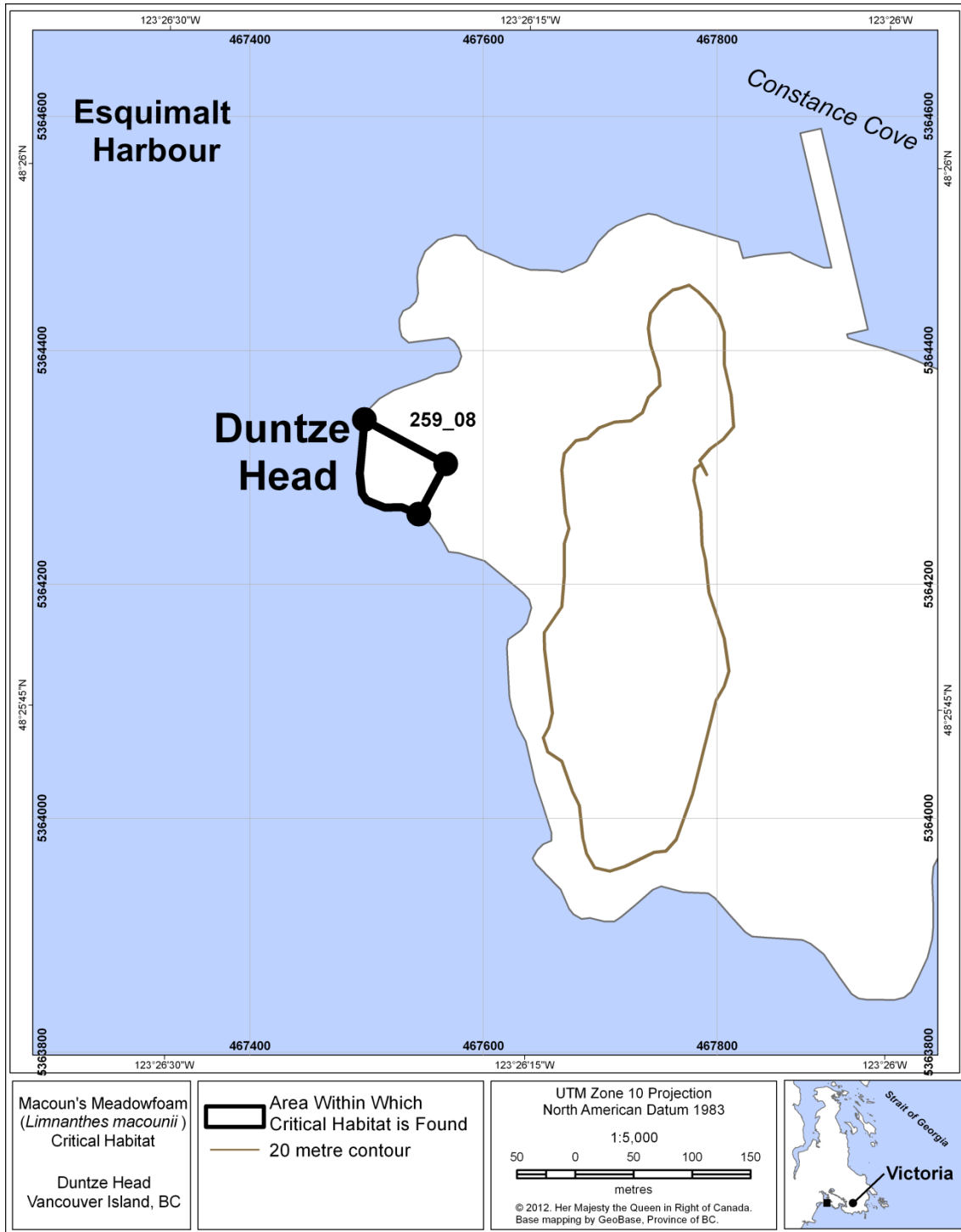


Figure 6. Area 259_08 (~ 0.37 ha) within which critical habitat for Macoun's Meadowfoam is found on Duntze Head on federal land. The identified critical habitat within this area is ~ 0.06 ha.

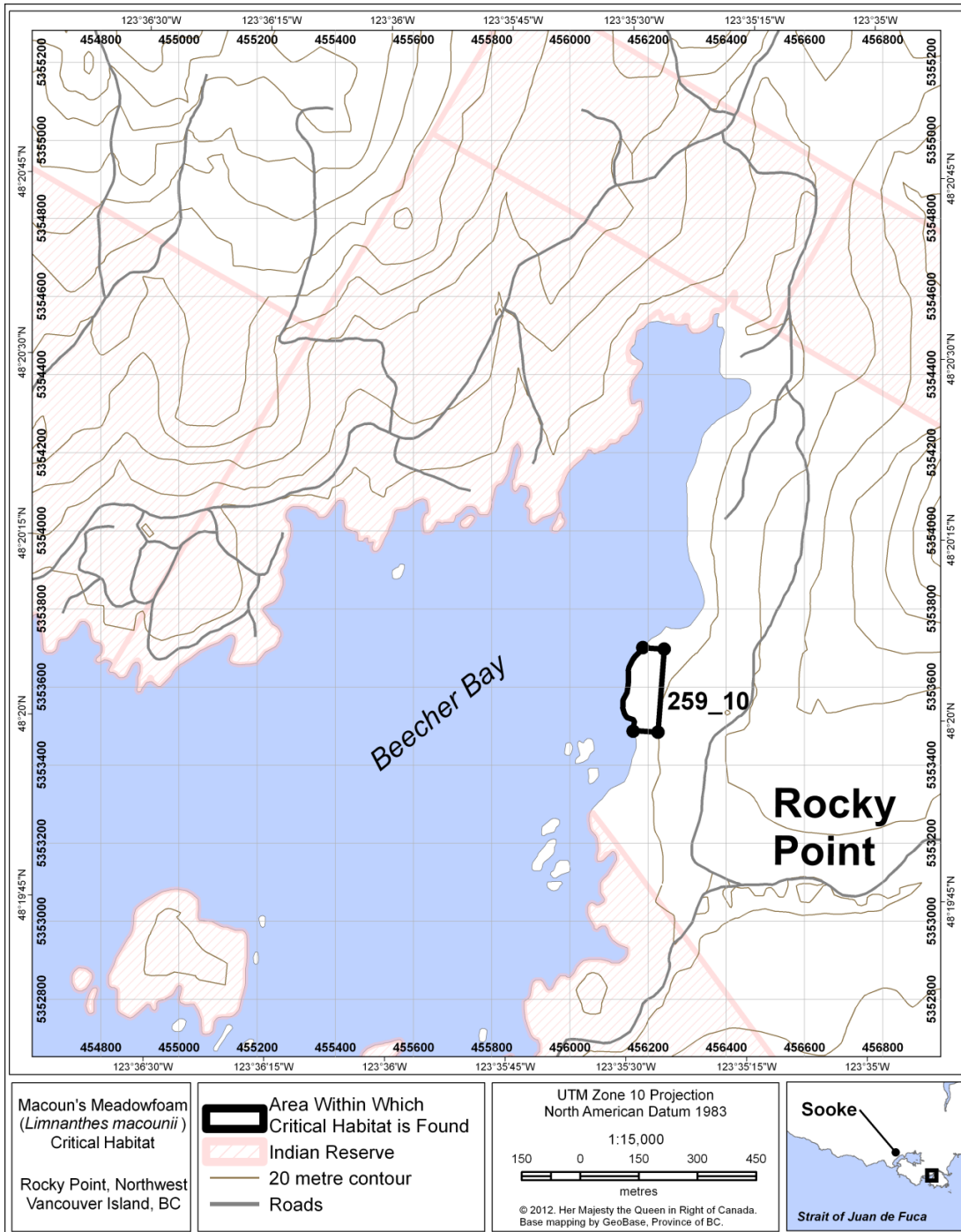


Figure 7. Area 259_10 (~ 1.7 ha) within which critical habitat for Macoun's Meadowfoam is found on northwest Rocky Point on non-federal land. The identified critical habitat within this area is ~ 0.60 ha.

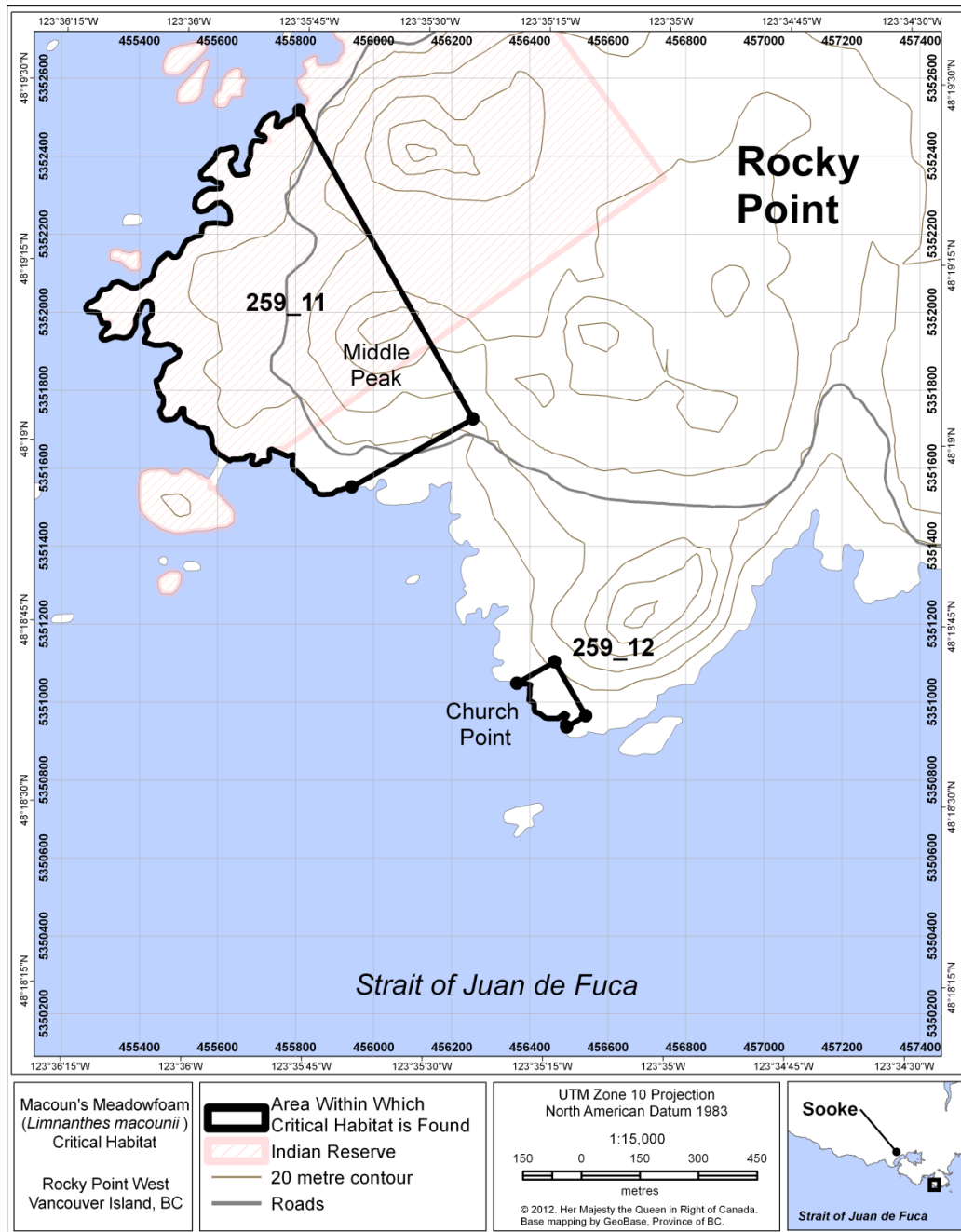


Figure 8. Areas 259_11 (~ 48.9 ha) and 259_12 (~ 1.4 ha) within which critical habitat for Macoun's Meadowfoam is found on west and southwest Rocky Point on federal land. The identified critical habitat within these areas is ~ 10.5 ha and ~ 0.25 ha.

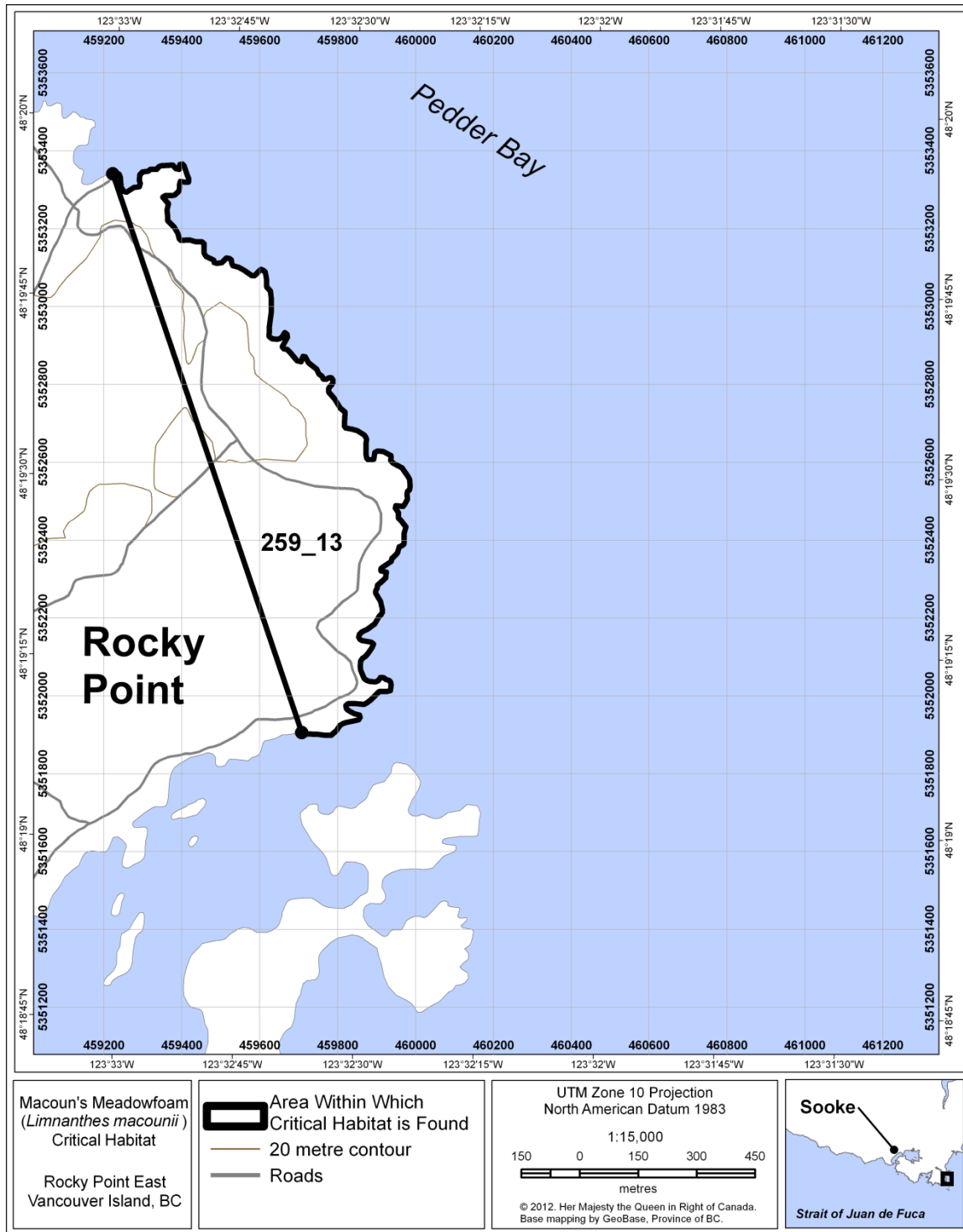


Figure 9. Area 259_13 (~ 43.0 ha) within which critical habitat for Macoun's Meadowfoam is found on east Rocky Point on federal land. The identified critical habitat within this area is ~ 2.3 ha.

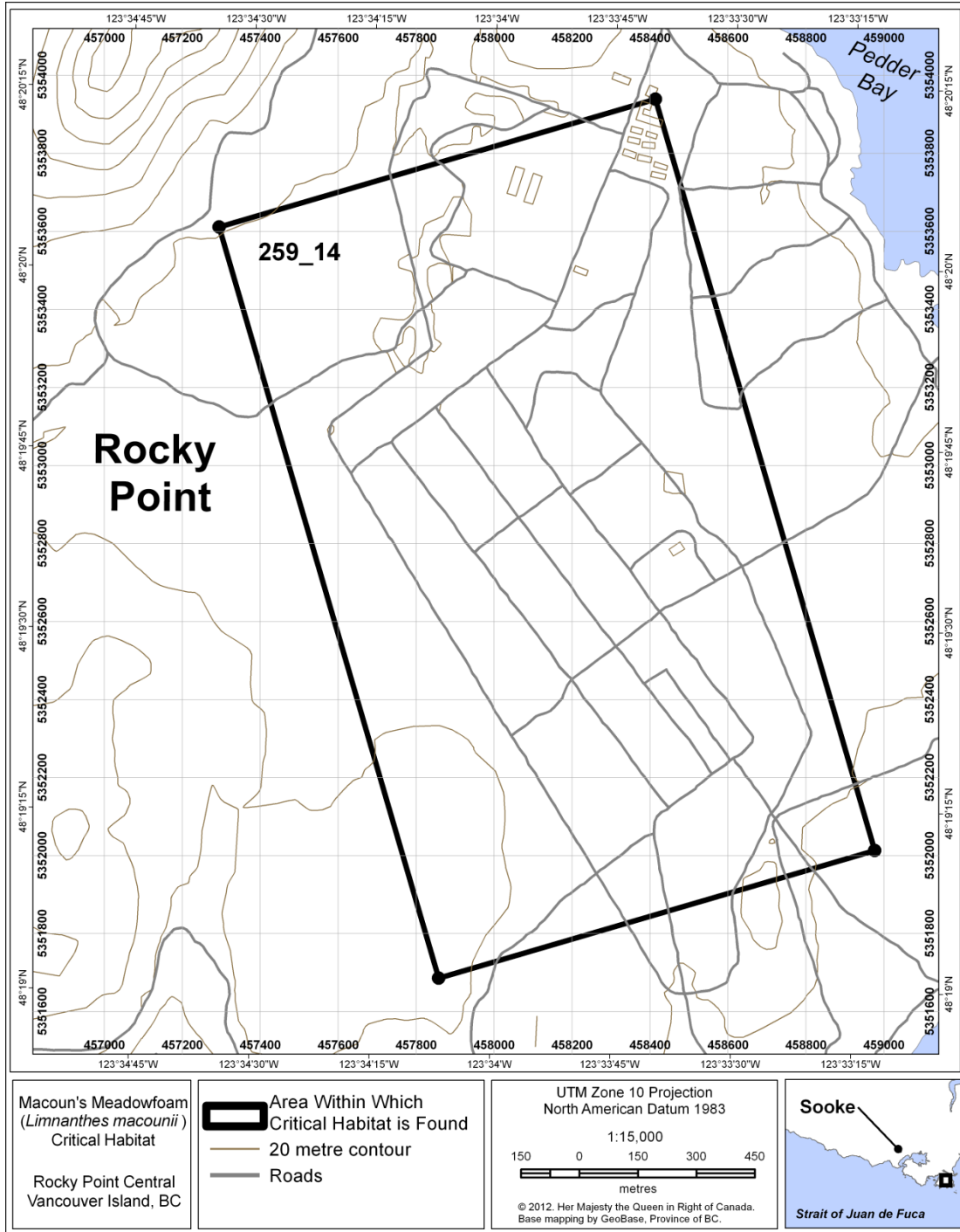


Figure 10. Area 259_14 (~234.0 ha) within which critical habitat for Macoun's Meadowfoam is found on central Rocky Point on federal land. The identified critical habitat within this area is ~ 13.0 ha.

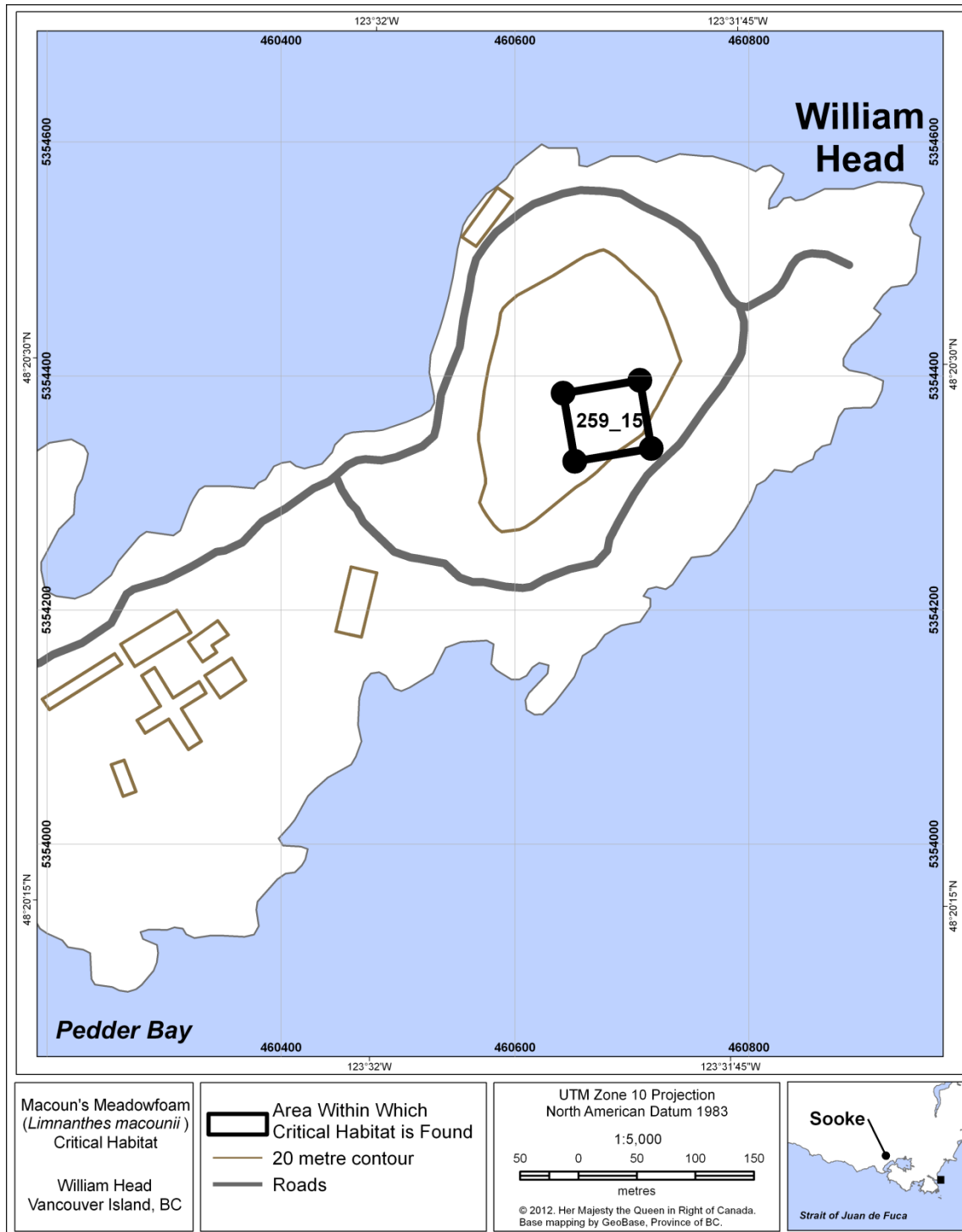


Figure 11. Area 259_15 (~ 0.4 ha) within which critical habitat for Macoun's Meadowfoam is found on William Head on federal land. The identified critical habitat within this area is ~ 0.07 ha.

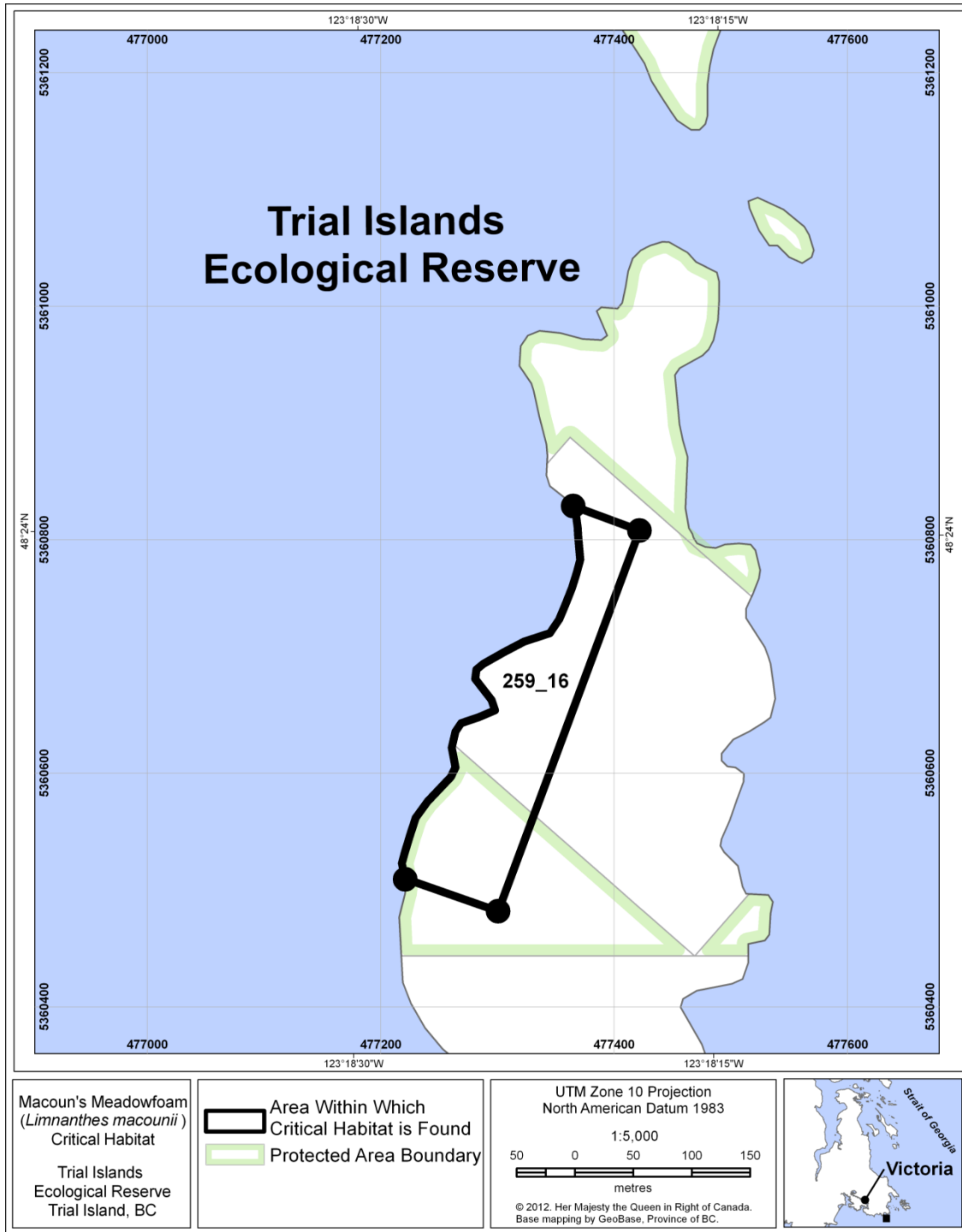


Figure 12. Area 259_16 (~2.4 ha) within which critical habitat for Macoun's Meadowfoam is found on Trial Island on non-federal land. The identified critical habitat within this area is ~ 0.4 ha.



Figure 13. Area 259_17 (~1.6 ha) within which critical habitat for Macoun's Meadowfoam is found on Gonzales Point on non-federal land. The identified critical habitat within this area is ~ 0.2 ha.

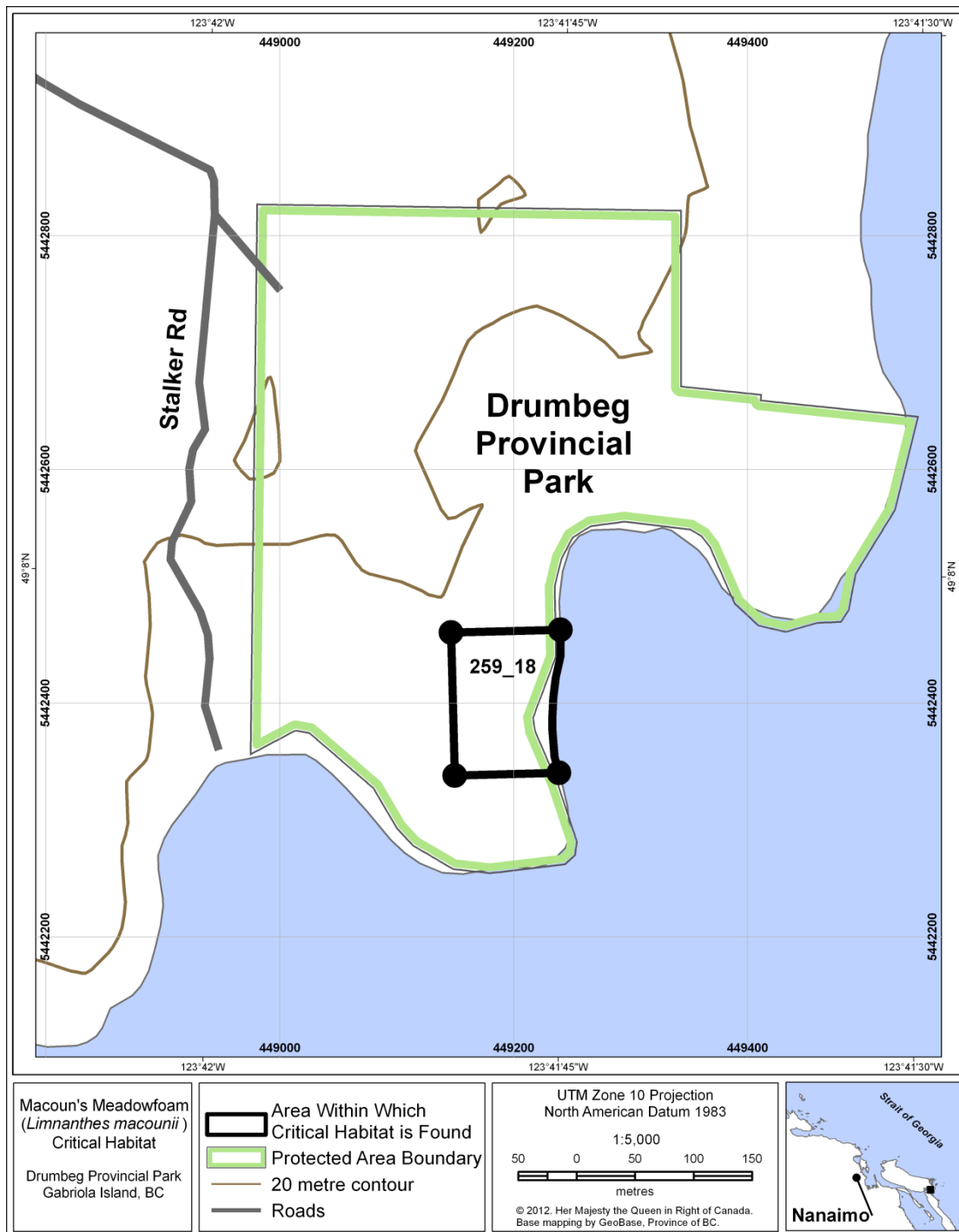


Figure 14. Area 259_18 (~1.1) within which critical habitat for Macoun's Meadowfoam is found in Drumbeq Provincial Park on non-federal land. The identified critical habitat within this area is ~0.25 ha.

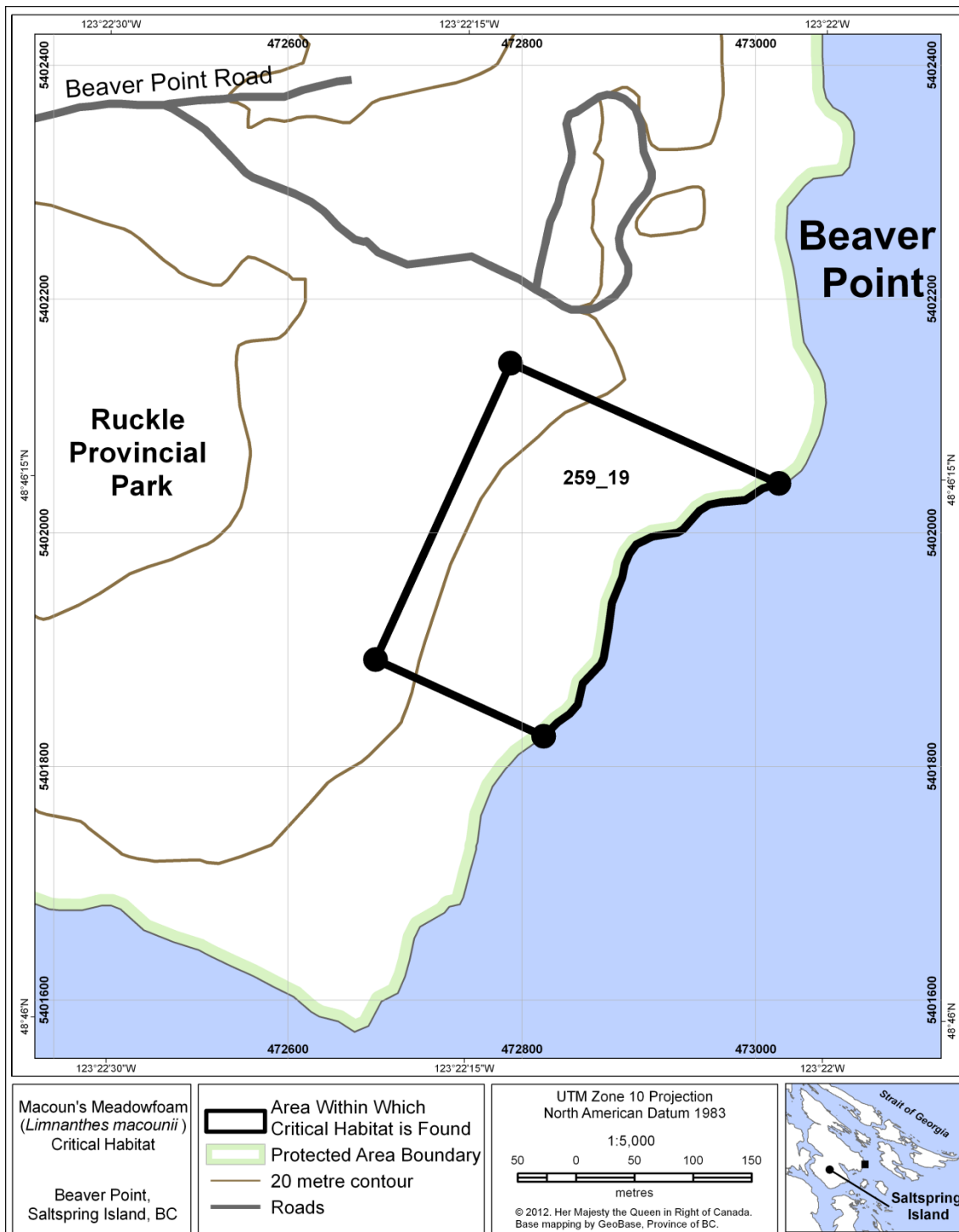


Figure 15. Area 259_19 (~5.0 ha) within which critical habitat for Macoun's Meadowfoam is found on Beaver Point, Saltspring Island on non-federal land. The identified critical habitat within this area is ~ 2.1 ha.

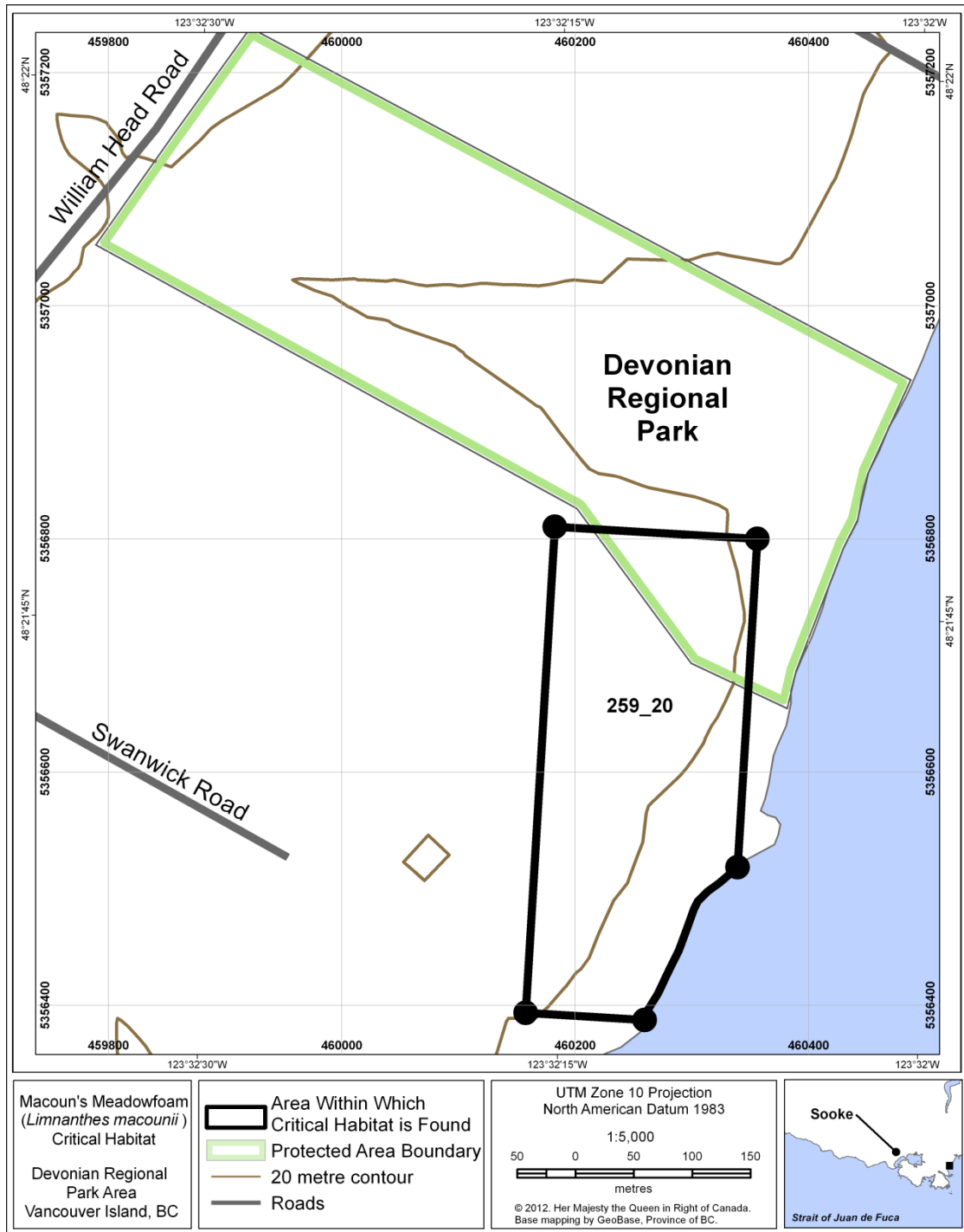


Figure 16. Area 259_20 (~ 6.7 ha) which critical habitat for Macoun's Meadowfoam is found on non-federal land. The identified critical habitat within this areas is ~1.5 ha.

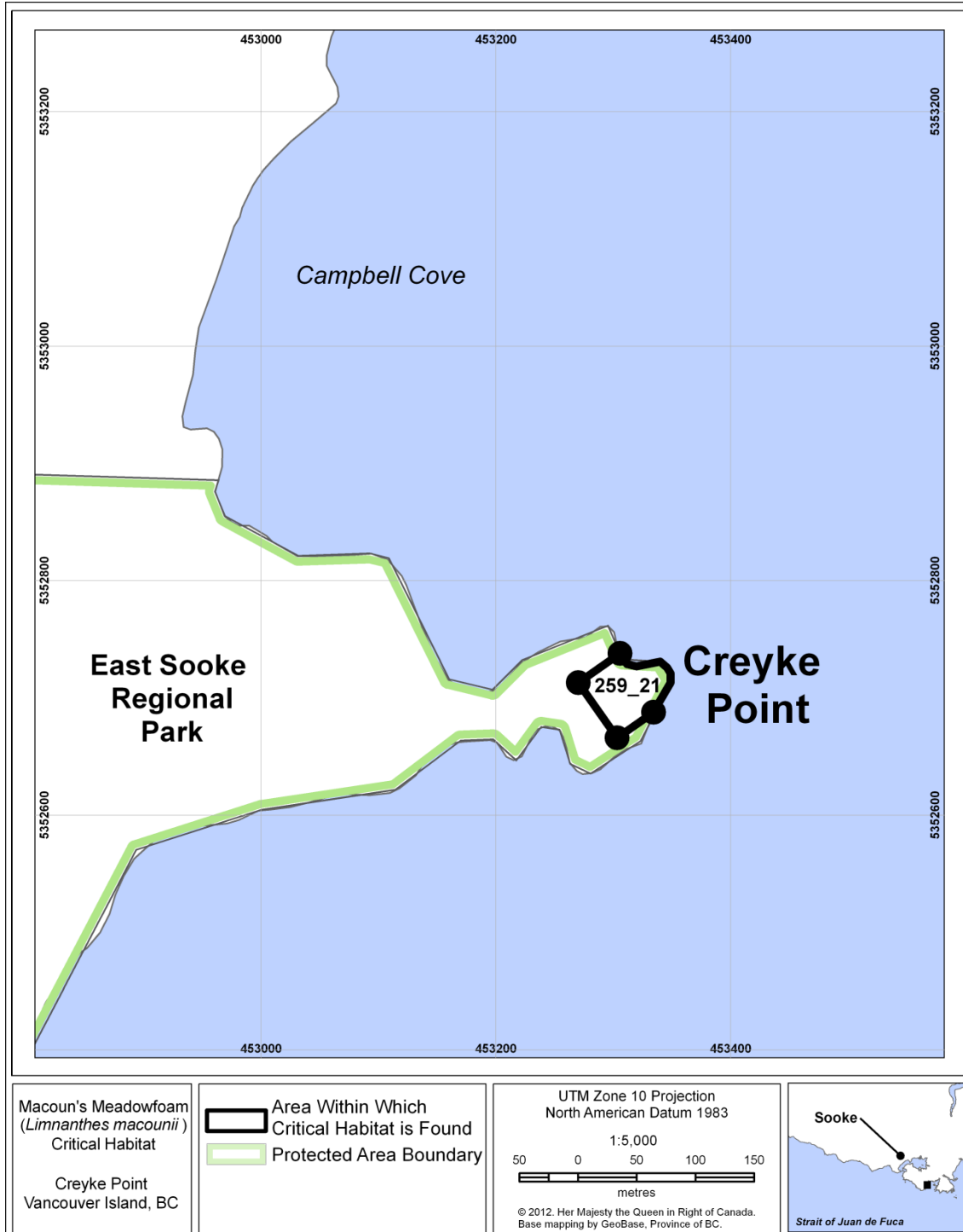


Figure 17. Area 259_21 (~0.3 ha) within which critical habitat for Macoun's Meadowfoam is found on Croyke Point on non-federal land. The identified critical habitat within this area is ~ 0.06 ha.

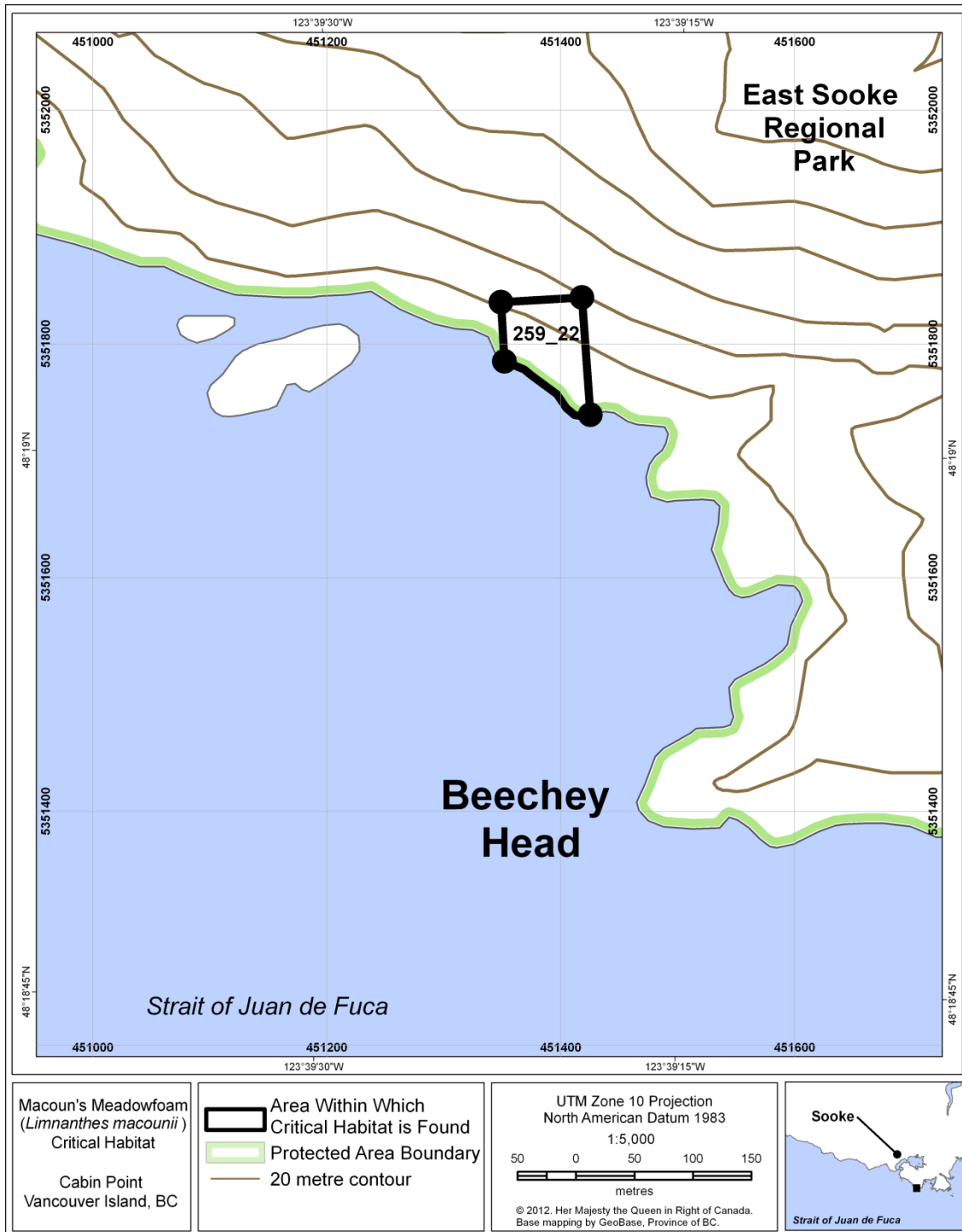


Figure 18. Area 259_22 (~0.5 ha) within which critical habitat for Macoun's Meadowfoam is found on Cabin Point on non-federal land. The identified critical habitat within this area is ~ 0.2 ha.

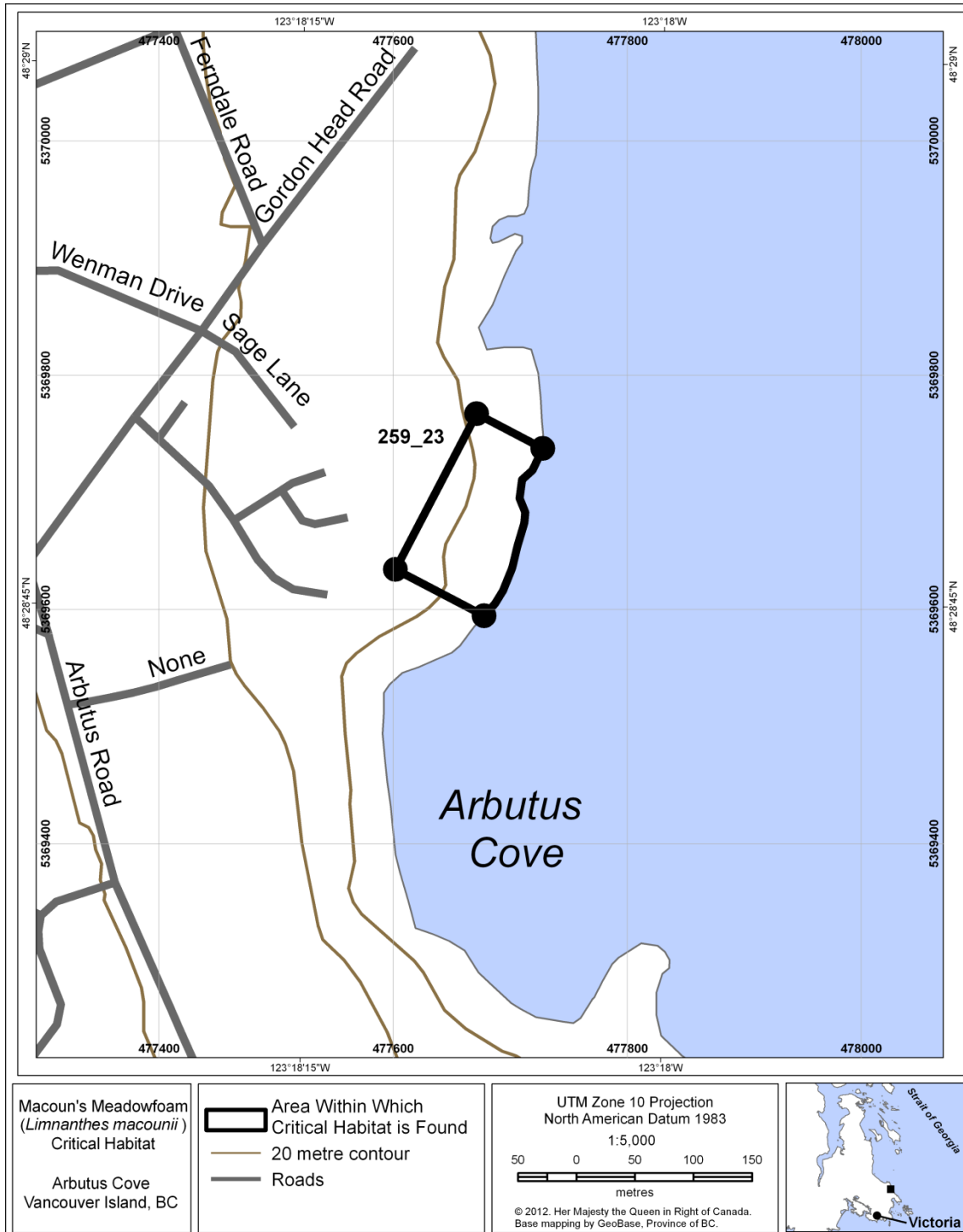


Figure 19. Area 259_23 (~1.2 ha) within which critical habitat for Macoun's Meadowfoam is found north of Arbutus Cove on non-federal land. The identified critical habitat within this area is ~ 0.4 ha.

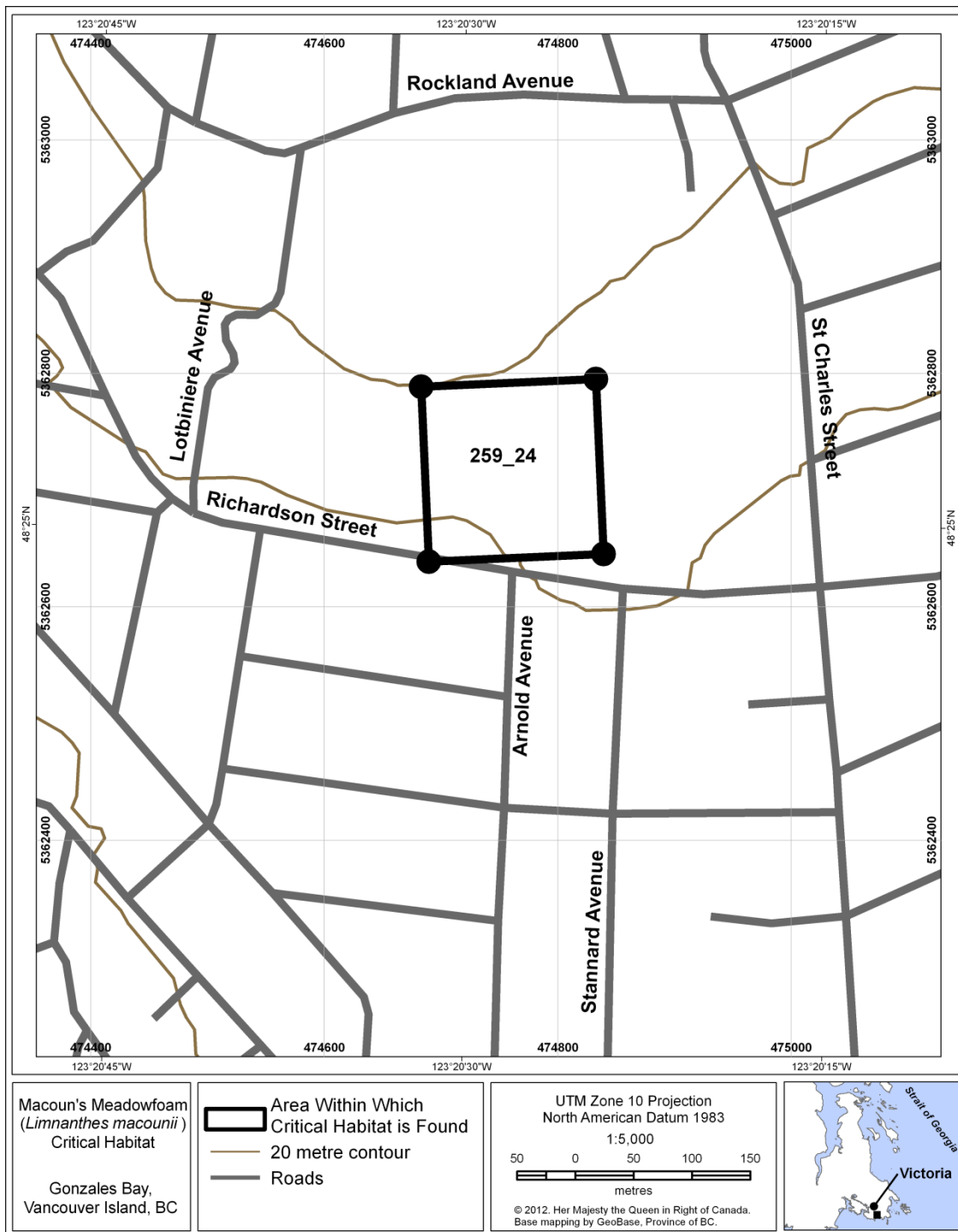


Figure 20. Area 259_24 (~ 2.2 ha) within which critical habitat for Macoun's Meadowfoam is found. The identified critical habitat within this area is ~0.63 ha.

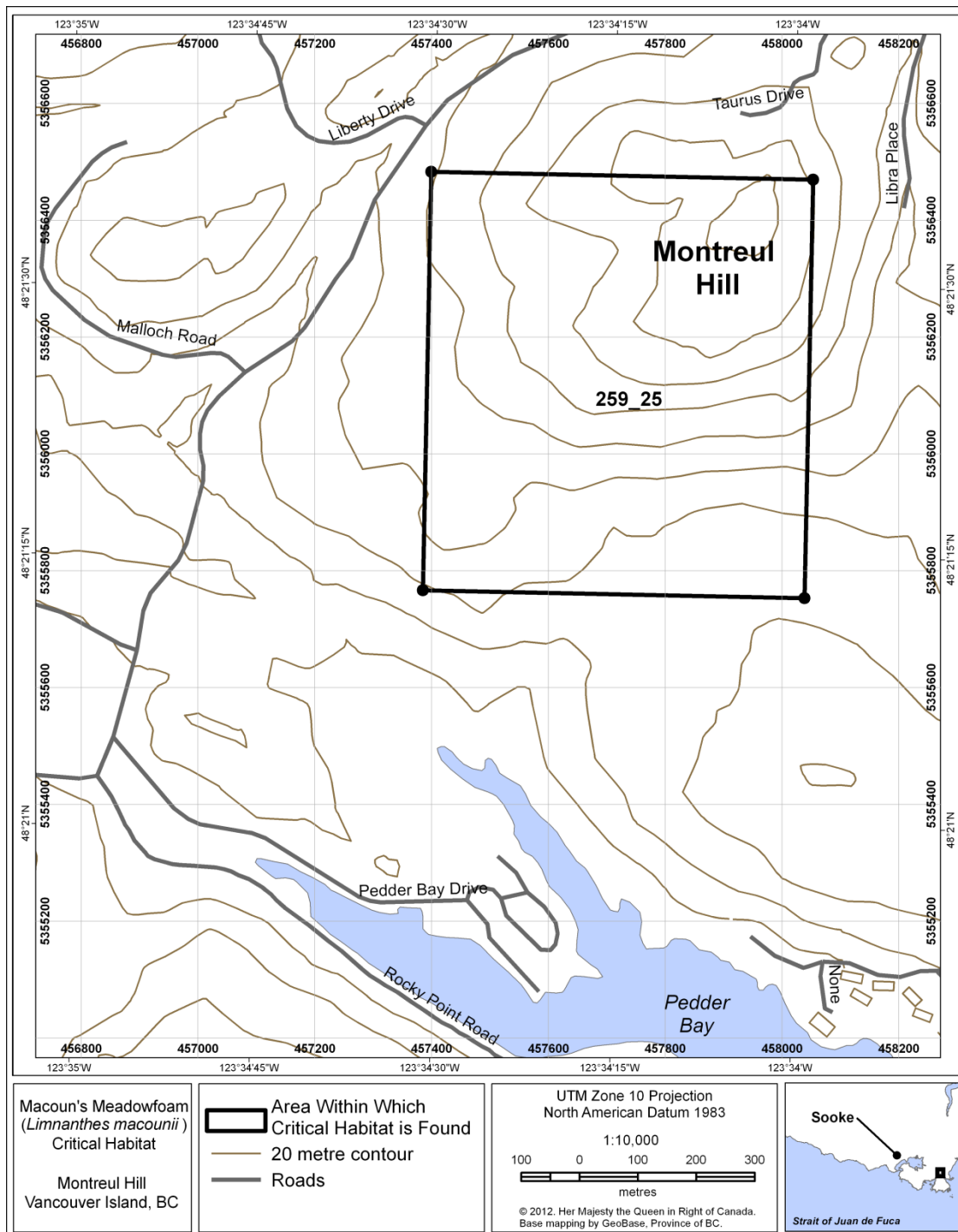


Figure 21. Area 259_25 (~ 46.9 ha) within which critical habitat for Macoun's Meadowfoam is found on Montreuil Hill on non-federal land. The identified critical habitat within this area is ~ 3.3 ha.



Figure 22. Area 259_26 (~ 6.8 ha) which critical habitat for Macoun's Meadowfoam is found on non-federal land. The identified critical habitat within this area is ~ 0.7 ha.



Figure 23. Area 259_27 (~ 33.7) within which critical habitat for Macoun's Meadowfoam is found at Uplands Park on non-federal land. The identified critical habitat within this area is ~1.4 ha. Critical habitat parcel 259_27 is the boundary of Uplands Park.



Figure 24. Area 259_28 (~ 0.6 ha) which critical habitat for Macoun's Meadowfoam is found at Downes Point on non-federal land. The identified critical habitat within this area is ~ 0.06 ha.

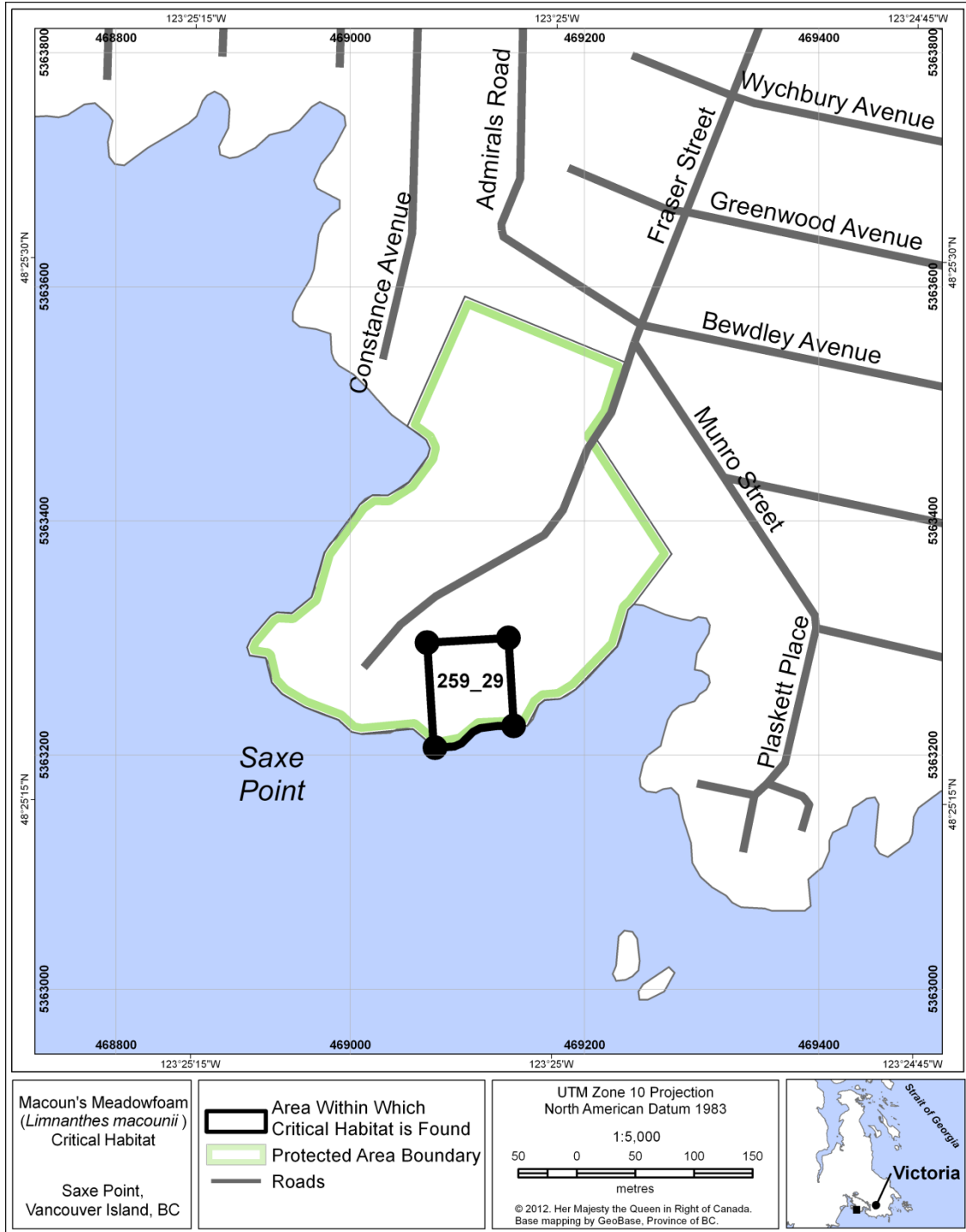


Figure 25. Area 259_29 (~ 0.6 ha) which critical habitat for Macoun's Meadowfoam is found at Saxe Point on non-federal land. The identified critical habitat within this area is ~ 0.1 ha.

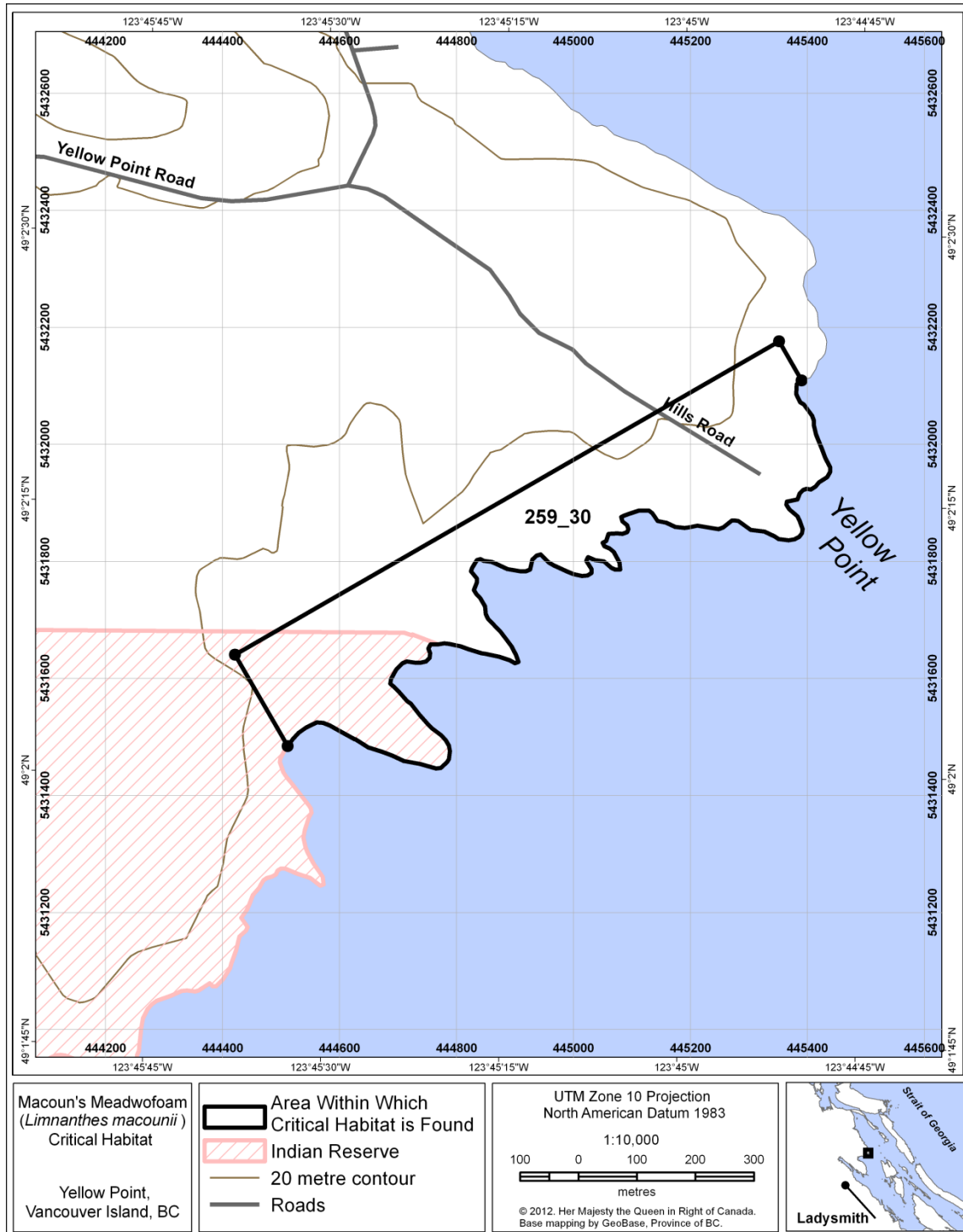


Figure 26. Area 259_30 (~ 20.9 ha) which critical habitat for Macoun's Meadowfoam is found on non-federal and First Nation land. The identified critical habitat within this area is ~ 3.7 ha.

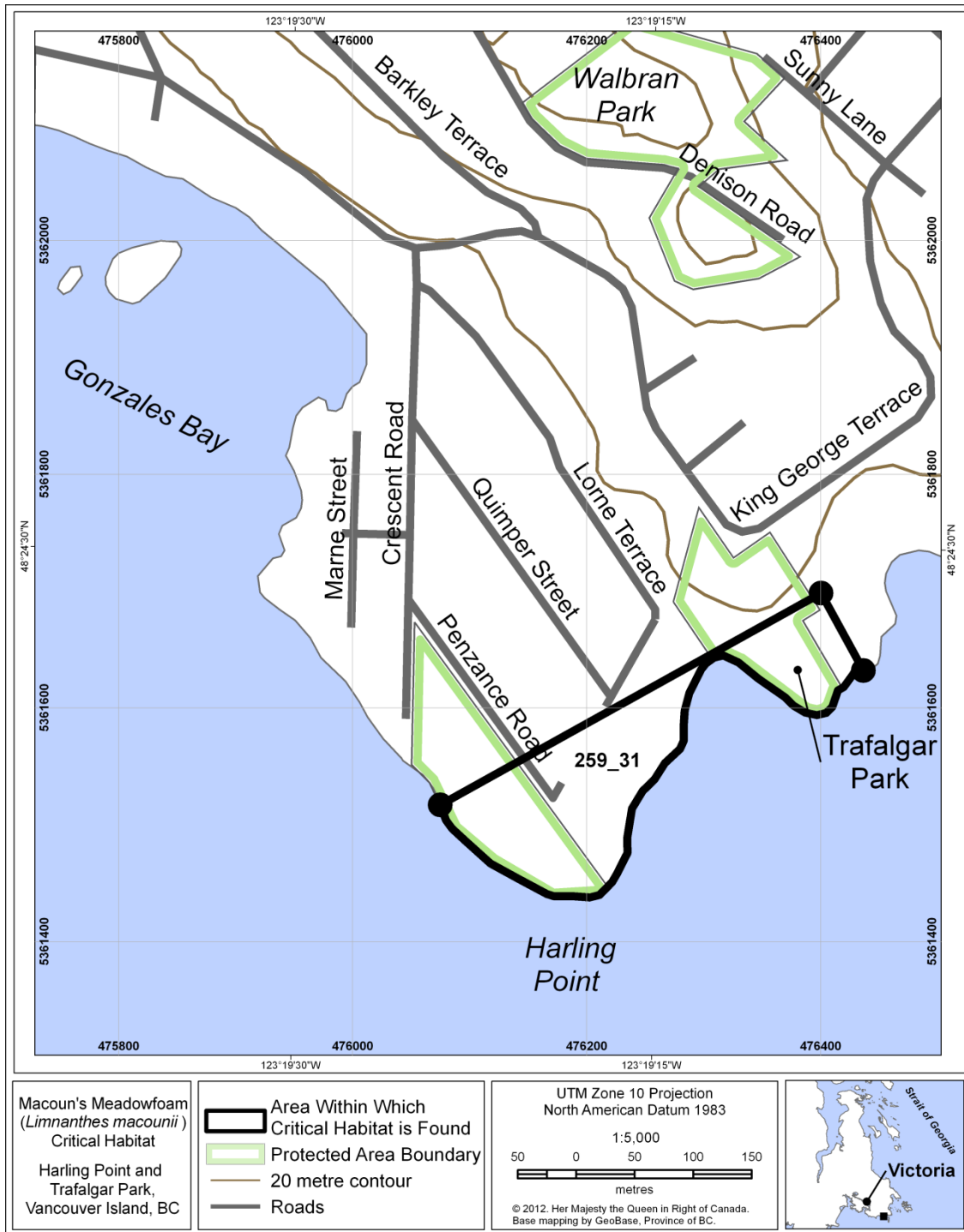


Figure 27. Area 259_31 (~ 2.7 ha) which critical habitat for Macoun's Meadowfoam is found at Harling Point on non-federal land. The identified critical habitat within this area is ~ 0.2 ha.

3.2. Schedule of Studies to Identify Critical Habitat

The schedule of studies section (Table 3) outlines activities required to identify additional critical habitat necessary to support the population and distribution objectives.

Table 3. Schedule of Studies

Description of Activity	Rationale	Timeline
To identify sufficient critical habitat for the survival of existing populations, additional monitoring of existing populations is required to refine the maximum patch extent and habitat used.	Large population fluctuations mean that critical habitat cannot be completely identified based on data from a single year (it may have been a poor year with small populations and some Macoun's Meadowfoam patches may have been undetectable), therefore, a long term data set is required to ensure the full range of population fluctuation and habitat use is captured.	Ongoing, until statistical analysis of population fluctuations provides some measure of confidence that major fluctuations have been accounted for.

3.3. Activities Likely to Result in the Destruction of Critical Habitat

Examples of activities likely to destroy critical habitat are provided below (Table 4). Destruction of critical habitat will result if any part of the critical habitat is degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

Table 4. Examples of activities likely to result in the destruction of critical habitat.

Activity	Effect of activity on critical habitat	Most likely sites
Recreational use (e.g., walking / hiking, bicycling, animal exercising)	Soil compaction and loss of vegetation leading to altered habitat attributes including alteration of hydrological regimes (such as decreased infiltration and increased runoff). Plants may become stressed and die or be unable to germinate due to impaired ability of the habitat to provide suitable soil moisture. Habitat is likely to be lost due to increased erosion.	Uplands Park Saxe Point Park Ruckle Prov. Park Trafalgar Park Harling Point Glencoe Cove Kwatsech Park Creyke Point
Direct land conversion for human development (e.g., residential and commercial development, maintenance or modification of existing structures)	This activity can destroy habitat outright or cause soil compaction and loss of vegetation (see recreational use for effects), shading (e.g., by introduced plants or nearby structures), and altered moisture regime (e.g., impounded drainage, or reduced water flow to the plants through ditching or diversion of subsurface water by built structures). Habitat may be directly lost or light and moisture levels altered such that plants become stressed and die or are unable to germinate due to impaired ability of the habitat to provide suitable habitat attributes.	Arbutus Cove Devonian Park Area Downes Point Montreal Hill Rice Farm Yellow Point Lodge

Activity	Effect of activity on critical habitat	Most likely sites
Landscaping activities (e.g., mowing, trail building, planting)	Landscaping can cause direct land conversion, soil compaction, and loss of vegetation (see recreational use for effect), altered moisture regime (see direct land conversion for effect), and introduction of invasive alien plant species (e.g., intentional plantings or accidental introductions such as facilitated by unclean machinery. Invasive alien plants species compete with Macoun's Meadowfoam and alter the availability of light, water, and nutrients in the habitat, such that the habitat is unlikely to provide the necessary habitat conditions required by Macoun's Meadowfoam. Plants may become stressed and die, or be unable to germinate.	Arbutus Cove Devonian Park area Downes Point Montreal Hill Rice Farm Yellow Point Lodge

4. Measuring Progress

This section replaces section 8 “Performance Measures” in the Province of British Columbia’s recovery strategy for Macoun’s Meadowfoam in British Columbia (Part 2).

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Progress towards recovering Macoun’s Meadowfoam in Canada will be assessed using the following measures:

Objective 1: Maintain the 31 extant populations at a stable or increasing size.

- By 2018 best management practices are developed and implemented at 10 or more sites.
- Ongoing monitoring continues to indicate that the populations remain extant.
- By 2023, the total Canadian population is stable⁵.

Objective 2: Prevent a decline in the known distribution of Macoun’s Meadowfoam in Canada.

- There is no decrease in the known distribution (extent of occurrence and area of occupancy) of Macoun’s Meadowfoam in Canada.

5. Statement on Action Plans

One or more action plans will be completed by November 2018.

⁵ Note that populations are expected to fluctuate and require long term datasets to estimate (Bush and Lancaster 2004).

6. References

- B.C. Conservation Data Centre. 2011. BC Species and Ecosystems Explorer. B.C. Ministry Of Environment Victoria, B.C. Web site: <http://a100.gov.bc.ca/pub/eswp/> [accessed September 2011].
- Brook, B.W., L.W. Traill, and J.A. Bradshaw. 2006. Minimum viable population sizes and global extinction risk are unrelated. *Ecology Letters* 9:375-382.
- Bush, D. and J. Lancaster. 2004. Rare Annual Plants—Problems with Surveys and Assessments. Prairie Conservation and Endangered Species Conference, February 28, 2004.
- COSEWIC. 2004. COSEWIC assessment and status report on the Macoun's Meadowfoam *Limnanthes macounii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 24 pp.
- Department of National Defence. 2011. Unpublished data: GPS coordinates of Macoun's Meadowfoam patches on DND lands. Canadian Forces Base Esquimalt, Victoria, B.C.
- Fairbarns, M. 2008. Report on Potential Critical Habitat for Selected Rare Plant Occurrences in CRD Parks. Capital Regional District, Parks, Victoria, B.C. 37 pp.
- Fairbarns, M. 2011. 2011 Surveys for Critical Habitat for *Limnanthes macounii* (Macoun's Meadowfoam). Garry Oak Ecosystems Recovery Team, Victoria, B.C. 33 pp.
- Flather, C.H., G.D. Hayward, S.R. Beissinger, and P.A. Stephens. 2011. Minimum viable populations: is there a 'magic number' for conservation practitioners? *Trends in Ecology and Evolution* 26:307-316.
- Garnett, S.T., and K.K. Zander. 2011. Minimum viable population limitations ignore evolutionary history. *Trends in Ecology and Evolution* 26(12): 618-619.
- GOERT (Garry Oak Ecosystems Recovery Team). 2011. Unpublished data: Macoun's Meadowfoam habitat surveys. Garry Oak Ecosystems Recovery Team, Victoria, B.C. x + 191 pp.
- Jamieson, I.G., and F. W. Allendorf. 2012. How does the 50/500 rule apply to MVPs? *Trends in Ecology and Evolution* 1566: 1-7.
- Lea, T. 2006. Historical Garry Oak Ecosystems of Vancouver Island, British Columbia, pre-European Contact to the Present. *Davidsonia* 17:34-50.
- Parks Canada Agency. 2006. Recovery Strategy for Multi-Species at Risk in Vernal Pools and other Ephemeral Wet Areas Associated with Garry Oak Ecosystems in Canada. xiv + 73 pp, in Government of Canada. Species at Risk Act Recovery Strategy Series, Ottawa, Ontario.
- Reed, D.H. 2005. Relationship between population size and fitness. *Conservation Biology* 19:563-568.

- Spittlehouse, D. L., R.S. Adams, and R.D. Winkler. 2004. Forest, edge and opening microclimate at Sicamous Creek. B.C. Ministry of Forests, Mines, and Lands, Research. Branch, Victoria, B.C. 43 pp.
- Traill, L.W., C.J.A. Bradshaw, and B.W. Brook. 2007. Minimum viable population size: A meta-analysis of 30 years of published estimates. *Biological Conservation* 139:159-166.
- Traill, L.W., B.W. Brook, R.R. Frankham, and C.J.A. Bradshaw. 2009. Pragmatic population viability targets in a rapidly changing world. *Biological Conservation* 143:28-34.
- Webb, C., H Mahoney, and A. Pelletier. 2011. Unpublished data: critical habitat for *Limnanthes macounii* at Fort Rodd Hill National Historic Site. Parks Canada Agency, Coastal B.C. Field Unit, Victoria, B.C.

APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process, based on national guidelines, directly incorporates consideration of all environmental effects, with a particular focus on possible impacts 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 majority of the proposed recovery activities will lead to better site protection, broader public appreciation of rare species, reduced human impacts, and reduced pressure from invasive alien species. Accordingly, they will have positive effects on most non-target native species, natural communities, and ecological processes. Recovery activities aimed to reduce the impacts associated with encroachment from native trees and shrubs, which have occurred as the result of fire suppression, will have negative impacts on the woody species targeted as well as plant and animal species which rely upon them.

A number of species at risk and provincially rare species occur within or adjacent to populations of Macoun's Meadowfoam (e.g., Table 5). Most recovery activities proposed for Macoun's Meadowfoam can be expected to have a net positive effect on the habitat of these other non-target species and communities. Nevertheless, it is possible that specific management actions carried out during the course of Macoun's Meadowfoam recovery (e.g., weed removal, shrub clearing, and population augmentation) could have unforeseen impacts on co-occurring non-target species. While probably slight, the chances of negative impacts accruing due to recovery activities must be duly considered. One method of mitigating such negative effects is to monitor the results of Macoun's Meadowfoam management. In keeping with the principles of adaptive management, an important component of recovery action planning will be anticipating, monitoring, and mitigating collateral impacts (both positive and negative) on non-target species, communities, and ecological processes.

The potentially negative effects of recovery can also be mitigated or eliminated at the project implementation phase through proper field procedures and/or strong collaboration with key conservation partners such as the Garry Oak Ecosystems Recovery Team and appropriate government agencies. Further, all population augmentation should take a precautionary approach. Some recovery strategy activities may require a project-level environmental assessment as required under the *Canadian Environmental Assessment Act*. Any activities found to require project-level environmental assessments will be assessed at that time pursuant to the provisions of the *Act*.

Table 5. Partial list of species at risk and vulnerable species near Macoun's Meadowfoam populations. These species could be affected by certain recovery activities. Sources: B.C. Conservation Data Centre 2011, NatureServe 2011.

Species and Common Name	British Columbia provincial rank	COSEWIC designation	SARA status
<i>Castilleja ambigua</i> Paintbrush Owl-clover	S2S3 Blue	Not assessed	Not assessed
<i>Crassula connata</i> Erect Pygmyweed	S2 Red	Not assessed	Not assessed
<i>Lotus formosissimus</i> Seaside Birds-foot Lotus	S1 Red	Status pending	Not assessed
<i>Lupinus densiflorus</i> Dense-flowered Lupine	S1 Red	Endangered	Endangered
<i>Microseris bigelovii</i> Coast Microseris	S1 Red	Endangered	Endangered
<i>Orthocarpus bracteosus</i> Rosy Owl-clover	S1 Red	Endangered	Endangered
<i>Sanicula arctopoides</i> Bear's-foot Sanicle	S1 Red	Endangered	Endangered
<i>Ranunculus californicus</i> California Buttercup	S1 Red	Endangered	Endangered
<i>Triphysaria versicolor</i> ssp. <i>Versicolor</i> Bearded Owl-clover	S1 Red	Endangered	Endangered

Actions taken to aid in the recovery of Macoun's Meadowfoam should, if conducted in an open, informative manner, provide benefits for other species at risk and their habitats through increased public awareness of the negative environmental consequences associated with invasive alien species, the need to maintain natural ecological processes, and the need to protect natural habitats from the effects of development. This recovery strategy benefits the environment by promoting the conservation and recovery of the Macoun's Meadowfoam, a natural component of biodiversity. In addition, it is likely that habitat restoration for Macoun's Meadowfoam will benefit other co-occurring native species which occupy the same habitat. The SEA process has concluded that this recovery strategy will likely have several positive effects on the environment and other species. There are no obvious adverse environmental effects anticipated with the implementation of this recovery strategy.

PART 2: RECOVERY STRATEGY FOR MACOUN'S MEADOW-FOAM (*LIMNANTHES MACOUNII*) IN BRITISH COLUMBIA

AS PROVIDED BY THE GOVERNMENT OF BRITISH COLUMBIA

Garry Oak Ecosystems Recovery Team Plants at Risk Recovery Implementation Group. 2011. Recovery strategy for Macoun's meadow-foam (*Limnanthes macounii*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 25pp.

Recovery Strategy for Macoun's meadow-foam (*Limnanthes macounii*) in British Columbia



Prepared by the Garry Oak Ecosystems Recovery Team
Plants at Risk Recovery Implementation Group

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies 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 recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In some cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more information

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

<http://www.env.gov.bc.ca/wld/recoveryplans/revry1.htm>

**Recovery Strategy for Macoun's meadow-foam
(*Limnanthes macounii*) in British Columbia**

**Prepared by the Garry Oak Ecosystems Recovery Team
Plants at Risk Recovery Implementation Group**

April 2011

Recommended citation

Garry Oak Ecosystems Recovery Team Plants at Risk Recovery Implementation Group. 2011. Recovery strategy for Macoun's meadow-foam (*Limnanthes macounii*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 25 pp.

Cover illustration/photograph

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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>>

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DISCLAIMER

This recovery strategy has been prepared by the Garry Oak Ecosystems Recovery Team Plants at Risk Recovery Implementation Group, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia 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 that are deemed necessary, based on the best available scientific and traditional information, to recover Macoun's meadow-foam 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 objectives and 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 strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of Macoun's meadow-foam.

RECOVERY TEAM MEMBERS

Garry Oak Ecosystems Recovery Team (GOERT) Plants at Risk Recovery Implementation Group (RIG) Members

- Brenda Costanzo (co-chair until Dec. 2009), Senior Vegetation Specialist, B.C. Ministry of Environment, Victoria, BC
- Tracy Cornforth, Department of National Defence, Canadian Forces Base Esquimalt, Esquimalt, BC
- Matt Fairbarns (co-chair), Botanist, Victoria, BC
- Chris Junck, Outreach Specialist, Garry Oak Ecosystems Recovery Team, Victoria, BC
- Todd Kohler, Consultant, Vancouver, BC
- Terry McIntosh, Botanist, Vancouver, BC
- Mike Miller, Consultant, Vernon, BC
- James Miskelly, Consultant, Victoria, BC
- Brian Reader, Parks Canada Agency, Victoria, BC
- Simone Runyan, Consultant, Vernon, BC
- Shyanne Smith, Program Chair, Garry Oak Ecosystems Recovery Team, Victoria, BC
- Andrea Schiller, Department of National Defence, Victoria, BC

Former recovery team member

- Ted Lea (retired), Vegetation Ecologist, Victoria, BC

RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for Macoun's meadow-foam under the *Accord for the Protection of Species at Risk in Canada*. Parks Canada Agency and Environment Canada's Canadian Wildlife Service, Pacific and Yukon Region, participated in the preparation of this recovery strategy.

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EXECUTIVE SUMMARY

This recovery strategy has been developed to provide guidance for the recovery of Canadian populations of Macoun's meadow-foam (*Limnanthes macounii*), a vascular plant at risk. Macoun's meadow-foam is an annual species with small, whitish flowers.

Globally, Macoun's meadow-foam occurs only in North America. In Canada, it is only found along a narrow coastal area in British Columbia and is, therefore, a British Columbia endemic. This species is only found in British Columbia on southern Vancouver Island and a few adjacent Gulf Islands. Twenty-eight extant populations are known. Habitats for this species are wet depressions, vernal pools, and seepage sites in lowland areas. It was designated as Threatened by COSEWIC in 2004 and listed as such under Schedule 1 of the Species at Risk Act in Canada. In British Columbia, the Macoun's meadow-foam is ranked S2 (imperilled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks the Macoun's meadow-foam as a priority 1 under goal 1 (contribute to global efforts for species and ecosystem conservation).

Threats to Macoun's meadow-foam include: residential and commercial development; recreation activities; fire suppression; invasive alien plants; and climate change.

The population and distribution goal for Macoun's meadow-foam is to maintain the extant populations in British Columbia.

Recovery objectives are:

1. Ensure long-term protection¹ for the known populations and habitat of Macoun's meadow-foam.
2. Assess and mitigate the extent of the main threats to Macoun's meadow-foam populations (e.g., construction of buildings and facilities; invasive alien plants; fire suppression; recreational activities).
3. Determine sizes and population trends of all known populations.
4. Confirm the distribution of all populations (existing and new locations) of Macoun's meadow-foam in British Columbia.
5. Address knowledge gaps relating to recruitment of new populations or subpopulations, mechanisms of dispersal and seed bank dynamics.

¹ Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

RECOVERY FEASIBILITY SUMMARY

The recovery of Macoun's meadow-foam in British Columbia is considered feasible based on the criteria outlined by the Government of Canada (2009):

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, over 100,000 individuals are capable of reproduction and, therefore, available to improve the population growth rate or population abundance.

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

Yes, sufficient suitable habitat is available to support the species at its known locations. There may be additional suitable habitat along the 200 kilometres of coastline where the species occurs.

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

Yes, significant threats (residential and commercial development; recreation activities; fire suppression; invasive alien plants) to the species or its habitat can be avoided or mitigated through recovery actions. However, the impact that climate change may have in the future cannot be mitigated.

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

Yes, the standard recovery techniques exist, and will be attempted in efforts to achieve the population and distribution objectives for this species.

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1 COSEWIC SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2004

Common Name (population):* Macoun's Meadowfoam

Scientific Name* *Limnanthes macounii*

COSEWIC Status: Threatened

Reason for designation: A Canadian endemic highly restricted within a narrow coastal fringe of seasonally wet microhabitats where it is at risk from continued competition with a wide range of exotic plants. Its presence in a highly urbanized area results in habitat disruption and population losses.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1988. Status re-examined and designated Threatened in November 2004. Last assessment based on an updated status report.

* Common and scientific names reported in this recovery strategy follow the naming conventions of the British Columbia Conservation Data Centre, which differs slightly from COSEWIC's naming conventions.

2 SPECIES STATUS INFORMATION

Macoun's meadow-foam^a	
Legal Designation	
Identified Wildlife^b : No	B.C. Wildlife Act : No SARA Schedule : 1 (2006)
Conservation Status^c	
B.C. List: Red	B.C. Rank: S2 (2007) National Rank : N2 Global Rank ^d : G2 (2006)
Subnational Ranks^e : N/A – only found in BC	
B.C. Conservation Framework^f	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority ^g : 1 (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: 2 (2009)
Action Groups:	Compile Status Report; Monitor Trends; Planning; List under Wildlife Act; Send to COSEWIC; Habitat Protection; Habitat Restoration; Private Land Stewardship; Species and Population Management

^a Data source: B.C. Conservation Data Centre (2010) unless otherwise noted.

^b Identified Wildlife under the Forest and Range Practices Act.

^d The global conservation status rank assigned to Macoun's meadow-foam is based on the assumption that the Californian population is not Macoun's meadow-foam (NatureServe 2008)

^e S = Subnational; N = National; G = Global; 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: Ministry of Environment (2010).

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

3 SPECIES INFORMATION

3.1 Species Description

Macoun's meadow-foam is a small, annual plant that usually grows from 2-5 cm, sometimes to 15 cm tall (see Front Cover photo). Plants have hairless stems that may be unbranched or have one or more branches. Small plants grow upright, while larger plants lie on the ground with branch tips pointing up. Leaves range from 1-7 cm long and are divided into 3-13 segments arranged in two rows. The edges of the leaf segments may have pointed or rounded divisions. Its flowers usually have four to five petals and are 7-10 mm in diameter. The white petals are obovate, or broadest towards the slightly notched tips, and have two rows of hairs at the base. The green sepals that surround the petals are narrowed towards the sharp-pointed tips. Following fertilization, the flowers usually produce 3-4 (sometimes one), 3 mm long nutlets. The relatively conspicuous nutlets are yellow-green to brown, conical in shape, and attached to the plant at the small part of the cone. The tips of the nutlets are covered in warty lumps.

3.2 Populations and Distribution

Globally, Macoun's meadow-foam only occurs in North America and likely is endemic to British Columbia¹ (Figure 1). In British Columbia (B.C.), Macoun's meadow-foam is restricted to southern Vancouver Island and a few adjacent Gulf Islands (Figure 2; COSEWIC 2004). The species extends from East Sooke northeast to Victoria (including the adjacent Inskip, Chatham, and Trial islands), with outlying populations at Yellow Point on Vancouver Island, and on Salt Spring, Gabriola, and Hornby islands (Figure 2). The estimated extent of occurrence of Macoun's meadow-foam is 40 km² and the estimated area of occupancy is <0.02 km² and was considered to be declining (COSEWIC 2004).

¹ There is an unconfirmed population in California, however, according to the Flora of North America, is potentially another species (Tucker, 2010).



Figure 1. Global distribution of Macoun's meadow-foam. Closed circle indicates confirmed localities in British Columbia; open circle indicates unconfirmed locality in California.

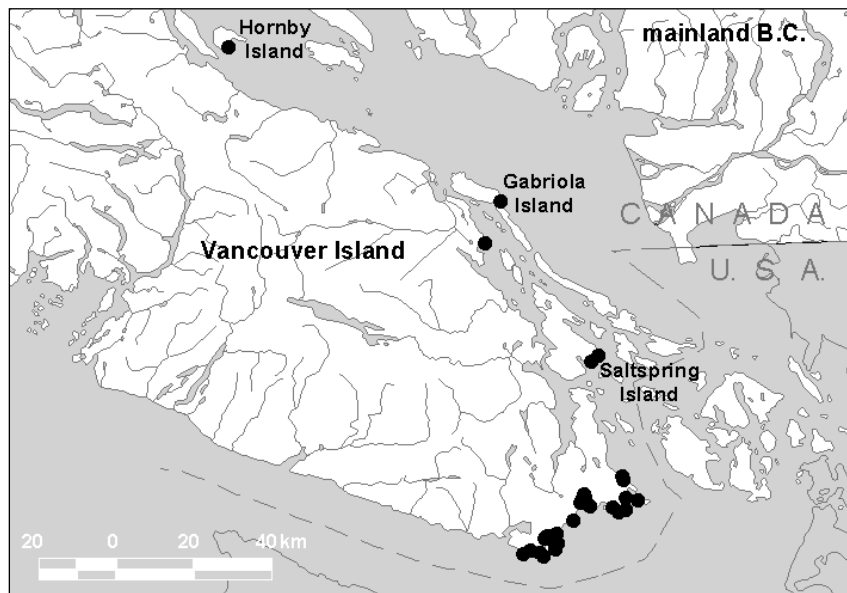


Figure 2. British Columbian distribution of Macoun's meadow-foam as of 2003 (B.C. CDC 2008a).

Macoun's meadow-foam grows in relatively small, discrete areas of suitable habitat that often occur in clusters. A total of 32 populations² of Macoun's meadow-foam have been documented in B.C., of which 28 are extant (COSEWIC 2004; B.C. CDC 2008a). In 2004, the estimated number of Macoun's meadow-foam individuals in B.C. was 20,000 (COSEWIC 2004). The B.C. population of Macoun's meadow-foam declined in size by 8–12% from 1994 to 2003, with an estimated net loss of 800–1,200 individuals (COSEWIC 2004). However, surveys in 2010 found two new populations at Rocky Point estimated at a minimum of 110,000 plants (Cornforth, pers. comm. 2010). These new Macoun's meadow-foam populations result in a substantial increase to the total estimated B.C. population.

Within the 30 years during which population sizes have been documented, 104 subpopulations³ have been observed, of which 84% are extant and 16% apparently have been extirpated (COSEWIC 2004; B.C. CDC 2008a). Of the 87 extant subpopulations, 26 are large (>200 individuals), 22 are of medium size (51–200 individuals), 36 are small (<50 individuals), and three have unknown sizes.

Most subpopulations have been tracked for only one or two years, but about 63% of those that were measured appear to be stable or increasing based on this limited data.

Population and subpopulation information is detailed in Appendix 1.

3.3 Needs of Macoun's meadow-foam

3.3.1 Habitat and biological needs

Table 1 summarizes the habitat and biological needs of Macoun's meadow-foam.

Table 1. Summary of habitat characteristics for Macoun's meadow-foam (COSEWIC 2004).

General characteristics	Habitat Summary	<ul style="list-style-type: none"> • open places or sparsely treed woodlands, usually <200 m from shore of Pacific Ocean (up to 2 km from shore) • rocky sites with shallow soil • wet or submerged in winter and completely dry in summer
	Elevation	<ul style="list-style-type: none"> • usually grows 5–35 m above sea level, but occasionally as high as 195 m above sea level
	Light requirements	<ul style="list-style-type: none"> • optimal growth occurs in full-sun habitats • when plants grow in shade (among tall grasses or overshadowed by woody plants), the plants are thin and elongated and usually produce fewer nutlets

² The B.C. Conservation Data Centre (B.C. CDC) has mapped and defined the populations, and their corresponding element occurrences based on a separation distance of 500 m rather than the default distance of 1 km specified by the "Habitat-based Strategy for Delimiting Plant Element Occurrences" (NatureServe 2004).

³ Populations consist of either the plants that grow within a single area of suitable habitat or the plants that grow within a cluster of suitable habitat areas. In the latter case, the plants growing in a continuous area of suitable habitat is considered a subpopulation.

Climate	General	<ul style="list-style-type: none"> • the climate of the species' range is characterized by mild winters and dry, cool summers • snow and hard frosts are rare
	Microclimate	<ul style="list-style-type: none"> • plants tend to occur at coastal sites that have higher ground temperatures and moister soil in the winter compared to corresponding inland sites
	Annual	<ul style="list-style-type: none"> • most of the precipitation is in the winter months, precipitation declines sharply in the spring, and sites experience strong moisture deficits in the summer • growth period spans from late September or October to May; relatively mild temperatures and high rates of precipitation in this period are essential for the plant's survival • dry summers are important for seed maturation
	Climate fluctuations	<ul style="list-style-type: none"> • adverse conditions for plant growth and development are associated with lower than average temperatures in winter and drier than average conditions in early spring • low temperatures in the fall can impede germination; winter frosts can kill the plants
Physiographic and topographic characteristics	Bedrock	<ul style="list-style-type: none"> • sites occur in bedrock depressions (lined with shallow soil) where water pools, or along bedrock fractures (with soil deposits) with intermittent seepage • sites generally have volcanic underlying bedrock, with sandstone bedrock at a few sites
	Soils	<ul style="list-style-type: none"> • soils are shallow, ranging from a few cm to about 30 cm thick • the most viable populations tend to occur in soils <4 cm deep • soils are humus-rich and black: Orthic Humic Regosol soil classification • soils are nutrient-rich and acidic
Soil conditions		<ul style="list-style-type: none"> • the plant has the following edaphic requirements: water table at the ground surface or up to 5 cm above ground surface during winter; fresh and moist soil in spring until the end of April; and very dry soil in summer
Ecology	Biogeoclimatic unit	<ul style="list-style-type: none"> • CDFmm – the Moist Maritime subzone of the Coastal Douglas-fir zone
	Ecosystems	<ul style="list-style-type: none"> • the species occurs in the following ecosystems: • vernal pools: open depressions with a large number of annual plants • ephemeral seepage streams on open slopes • seagull-roosting places: wet depressions and the end of seepage streams in places where seabirds gather and feed (nutrient-rich) • open woodlands: depressions and seepy places in open mixed woodlands of Douglas-fir (<i>Pseudotsuga menziesii</i>), Garry oak (<i>Quercus garryana</i>), arbutus (<i>Arbutus menziesii</i>), Rocky Mountain juniper (<i>Juniperus scopulorum</i>), or shore pine (<i>Pinus contorta</i> var. <i>contorta</i>)
	Sensitive ecosystems	<ul style="list-style-type: none"> • sites usually occur in the following mapped Sensitive Ecosystems: coastal bluffs, herbaceous, and woodland
	Disturbance regime (see below)	<ul style="list-style-type: none"> • sites are commonly subject to intermediate levels of disturbance from human recreation and seabird activities • moderate disturbance from humans and seabirds may contribute to maintaining Macoun's meadow-foam habitat by reducing cover of competing plant species

Disturbance regime

Although some types of disturbance can be detrimental to this species, twice a year tilling in late spring and early fall in a complex of old fields, meadows and wetlands at Rocky Point on DND lands has apparently created the ideal habitat for Macoun's meadow-foam. At this location, a thin layer of soil overlays an impermeable clay base, allowing the furrows to collect water in fall after the area is disced with a plow. This disturbance, therefore, creates safe sites where the species is able to germinate in the late fall, and also potentially brings nutlets to the surface for germination. The plants are then able to flower and set seed prior to the second plowing of this area in the late spring.

3.3.2 Limiting factors

Several biological factors limit the recovery potential of Macoun's meadow-foam in Canada are described below.

Habitat specificity

Macoun's meadow-foam has specific habitat requirements in terms of climate, physiography, moisture regime, ecosystem type, and disturbance regime (Table 1). Suitable habitats are limited in extent and are restricted to a small geographic range (southern Vancouver Island and some adjacent islands). The limited extent of habitat may be linked to widespread fire suppression, which encourages secondary succession and loss of suitable habitats.

Small and fragmented populations

Small, fragmented populations reduce the likelihood of persistence following stochastic events that cause mortality, or reduce reproductive success. Demographic stochasticity and genetic factors will also affect the probability of small populations persisting (Hanski 1999; Pollard 1966; Keiding 1975; Newman and Pilson 1997).

Limited dispersal ability

The nutlets of Macoun's meadow-foam have no dispersal structures; they simply fall off the plant (COSEWIC 2004). Waterfowl may occasionally disperse the nutlets; this has been observed with the seeds and fruits of other vernal pool and aquatic plant species (Sauer 1991). The limited dispersal ability of Macoun's meadow-foam may be associated with a low frequency of recruitment of new populations and subpopulations.

Low genetic variability

In an allozyme study of eight Macoun's meadow-foam localities, no evidence of genetic differentiation was found among populations, and low genetic variability was found within populations (Kesseli and Jain 1984).

4 THREATS

Threats are defined as the proximate (human) activities or processes that have caused, are causing or may cause the destruction, degradation and/or impairment of biodiversity and natural processes. Threats can be historical, ongoing, and/or likely to occur in the future. Threats do not include intrinsic biological features of the species or population such as inbreeding depression, small population size and genetic isolation which are considered limiting factors.

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 British Columbia Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system see the CMP website (CMP 2010). For information on how the values are assigned or overall impact is calculated see Master *et al.* (2009) and table footnotes for details. Threats for Macoun's meadow-foam were assessed for the entire province based on populations known as of 2008 (Table 2).

Table 2. Threat classification table for Macoun's meadow-foam.

Threat		Impact ^a (calculated)	Scope ^b	Severity ^c	Timing ^d	Population(s)	Stress ^e
1	Residential & commercial development	Medium	Restricted	Serious	High		
1.1	•Housing & urban areas	Medium	Restricted	Serious	High	8 on private land	Reduced population size; local extirpations
1.3	•Tourism & recreation areas	Medium - Low	Restricted	Serious - Moderate	High	10 in parks	Reduced population size or reduced population viability; local extirpations; increased mortality; poor reproductive success
6	Human intrusions & disturbance	Medium	Large	Moderate	High		
6.1	•Recreational activities	Medium	Large	Moderate	High	All except DND lands	Reduced population size; reduced population viability; increased mortality
6.2	•War, civil unrest & military exercises	Low	Small	Moderate	Low	6 at DND	Reduced population size; reduced population viability; increased mortality
7	Natural system modifications	Medium	Large	Moderate	High		
7.1	•Fire & fire suppression	Medium	Large	Moderate	High	Most	Reduced population size; reduced population viability; increased mortality
8	Invasive & other problematic species & genes	High	Pervasive	Serious	High		
8.1	•Invasive non-native/alien species	High	Pervasive	Serious	High	All	Reduced population size or reduced population viability; local extirpations; increased mortality; poor reproductive success
11	Climate change & severe weather	High	Pervasive	Serious	Unknown		
11.2	•Droughts	High	Pervasive	Serious	Unknown	All	Reduced population size; local extirpations

^a **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 stress is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: very high (75% declines), high (40%), medium (15%), and low (3%).

^b **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%)

^c **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 three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%)

^d **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.

^e **Stress** – the condition or aspect (key ecological, demographic, or individual attribute) of the conservation target that is impaired or reduced by a threat (e.g., directly or indirectly results from human activities).

4.2 Description of the Threats

The overall province-wide Threat Impact for this species is Very High⁴. The threats to Macoun's meadow-foam habitats are similar to those described for vernal pools, ephemeral wetlands, and maritime meadows on southeastern Vancouver Island (Parks Canada Agency 2006a; 2006b). Major threats include: residential and commercial development (construction of buildings and facilities for housing and recreation); invasive alien plants; human intrusions and disturbance (from recreational activities and military exercises); natural system modification (fire suppression) and potentially climate change (Table 2). Details are discussed below under the Threat Level 1 headings.

IUCN-CMP Threat 1. Residential & commercial development

1.1 Housing and Urban Areas: Some of the remaining areas of Macoun's meadow-foam habitat are at risk because they occur predominantly on coastal properties which may be desirable for residential development. Privately owned properties may be most threatened by habitat conversion, e.g., for landscaping purposes. A total of 27% of Macoun's meadow-foam subpopulations occur on private land.

Examples of Macoun's meadow-foam populations and subpopulations that have been extirpated due to the construction of buildings and facilities include:

- a population was extirpated when a sundeck was built over a depression with Macoun's meadow-foam on Salt Spring Island (B.C. CDC 2008a);
- a site was subdivided and the construction of a sewer line diverted seepage flow away from the plants, with the resultant loss of a population (B.C. CDC 2008a);
- two subpopulations on private land west of Devonian Park were lost when the area was developed: one site was drilled for seawater intake for a heat pump, and at another site, building debris associated with residential construction was burned (B.C. CDC 2008a);
- a subpopulation was lost due to drilling associated with hydrothermal energy exploration in Metchosin (B.C. CDC 2008a).

⁴ The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species: 2 High, and 3 Medium (Table 2).

1.3 Tourism and Recreation Areas: A variety of agencies are responsible for managing natural habitats where Macoun's meadow-foam occurs (e.g., federal, municipal, provincial governments, and private operations). The inconspicuous appearance of Macoun's meadow-foam makes it easy to overlook and habitat may be damaged unless the locations are known to site operators.

Most agencies that have Macoun's meadow-foam populations on their properties are aware of it, but in some cases the site management plans do not make specific reference to the occurrences. As well, site operators may not have easy access to maps of populations or may lack training in identifying the occurrences. In the past, operational activities have led to the damaging or direct destruction of portions of Macoun's meadow-foam populations, or degradation of the habitats. These activities have included: mowing of vegetation; installation and maintenance of site infrastructure; driving of motorized service vehicles in wet season; redirection of trails; road construction; digging of ditches or trenches; deposition of gravel and other materials; changes in hydrological regimes of adjacent sites. Specific examples are as follows:

- the installation of a new water line destroyed half of a subpopulation in 2006 in Ruckle Provincial Park by excavating through the habitat of Macoun's meadow-foam (Annschild, pers. comm. 2008); and
- during the installation of tent pads in Ruckle Provincial Park in February 2008, motorized vehicles created ruts in the saturated soil adjacent to a Macoun's meadow-foam site altering the hydrology of the occupied site (Annschild, pers. comm. 2008).

However, some site operation activities can be beneficial to Macoun's meadow-foam populations, such as appropriately timed mowing, which reduces the proliferation of competing species.

IUCN-CMP Threat 6. Human intrusions & disturbance

6.1 Recreational Activities: Recreational activities may threaten populations of Macoun's meadow-foam. While the species' habitats are somewhat resilient to moderate disturbance during its dormant season (summer), the species and its habitats are vulnerable to disturbance during its growth period in the wet season.

Recreational activities of particular concern include:

- Heavy trampling during the wet season, which "may result in the creation of near-permanent ruts, compact soil, change the microtopography of pool bottoms, crush pool vegetation and reduce seed production, leading to a gradual decline in populations" (Fairbarns 2004). This soil compaction and disturbance is associated with trampling by humans or dogs as well as bicycling.
- Use of recreational equipment and vehicles infested with carpet burweed propagules. This non-native invasive plant, relatively new to Canada, has been spreading among RV parks and campgrounds in southwestern B.C. (Ceska and Ceska 2007). Carpet burweed competes directly with Macoun's meadow-foam and poses a serious risk to populations.
- Construction of unauthorized bicycle motocross jumps in Uplands Park. These structures are built by excavating topsoil from intact vernal pools and meadows and park trails. The excavated material is stacked to create ramps and jumps. Park staff demolish these jumps as they are found, returning the soil material to the excavations

as best they can. It is not possible to completely restore the excavated vernal pool sites.

- Soil disturbance by dogs digging in wet depressions during the wet season (Fairbarns 2004).

While many recreational activities can be damaging, localized disturbance may be important to maintaining microsite conditions. Some human trampling, for example, may be beneficial to the species, especially if it occurs during the summer, following plant senescence. Trampling can serve to curb the proliferation of non-native perennial grasses and other competitors. Soil compaction due to trampling may also contribute to maintaining the optimal soil depth for the species, ensuring that seeds do not become buried too deeply for optimal germination. As site managers assume greater stewardship responsibilities for Macoun's meadow-foam, well-intentioned attempts to reduce disturbance can threaten populations. Dramatic increases in levels of disturbance may also threaten Macoun's meadow-foam populations. All of these factors need to be investigated further.

6.2 War, Civil Unrest and Military Exercises: Similar concerns as noted above in section 6.1 Recreational Activities may apply here with respect to military exercises at six sites (Appendix 1). However, these sites are not currently threatened as the Department of National Defence (DND) Canadian Forces Base (CFB) Esquimalt is engaged in several stewardship activities aimed at managing and protecting plant species at risk.

IUCN-CMP Threat 7. Natural System Modifications

7.1. Fire and Fire Suppression: The maintenance of an appropriate disturbance regime, in this instance a fire regime, is important for the survival of Macoun's meadow-foam as disturbance creates and/or maintains the open habitats required for this species. While traditional First Nations ecosystem management using fire may have maintained open habitats in historic times, current fire suppression regimes have contributed to the increase in distribution of forest trees and shrubs in Garry oak ecosystems where Macoun's meadow-foam is found. This lack of fire regime has potentially led to the loss and alteration of many Macoun's meadow-foam habitats due to secondary succession.

IUCN-CMP Threat 8. Invasive & other problematic species & genes

8.1 Invasive Non-Native/Alien Species: Invasive, in particular alien plants represent threats to Macoun's meadow-foam populations and some subpopulation extirpations and declines may be attributed to the proliferation of non-native species. Invasive non-native species act as competitors for germination sites, as well as for available soil moisture. They also produce shading, add leaf litter, as well as build up a thatch layer. All of these factors can inhibit seedling development of Macoun's meadow-foam.

Several categories of non-native plants are of concern:

- Non-native perennial grasses represent the most serious threat to populations because they compete directly with Macoun's meadow-foam (COSEWIC 2004); they cover bare soil areas where the species grows, and they deposit litter that accumulates and alters the local moisture regime.

- The non-native shrubs Scotch broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*) may overshadow Macoun's meadow-foam populations.
- English ivy (*Hedera helix*) contributed to the decline and disappearance of two subpopulations in Glencoe Cove.
- Two relatively recent non-native invasive winter annual species are of serious concern to Macoun's meadow-foam populations: subterranean clover (*Trifolium subterraneum*) (DND lands) and carpet burweed (*Soliva sessilis*) at Uplands Park; (COSEWIC 2004), and carpet burweed at Ruckle Provincial Park.

IUCN-CMP Threat 11. Climate change & severe weather – Potential Threat

Graham (2003) discusses the threat that climate change represents to species of ephemeral pools.

Ephemeral pool species and ecosystems are tied directly to temperature and precipitation patterns, and thus have the potential to be greatly affected by climate change. Vernal pool systems appear to be quite sensitive to climatic shifts. Individual species could be seriously affected, and perhaps even driven to extinction in some cases, under some predicted scenarios.

5 RECOVERY GOAL AND OBJECTIVES

5.1 Population and Distribution Goal

The goal for Macoun's meadow-foam is to maintain the extant populations in British Columbia.

5.2 Recovery Objectives

Recovery will be considered significantly advanced if the following short-term (five to ten years) objectives have been met:

1. Ensure long-term protection⁵ for the known populations and habitat of Macoun's meadow-foam.
2. Assess and mitigate the extent of the main threats to Macoun's meadow-foam populations (e.g., construction of buildings and facilities; invasive alien plants; fire suppression; recreational activities).
3. Determine sizes and population trends of all known populations
4. Confirm the distribution of all populations (existing and new locations) of Macoun's meadow-foam in British Columbia.
5. Address knowledge gaps relating to recruitment of new populations or subpopulations, mechanisms of dispersal and seed bank dynamics.

5.3 Rationale for the Goal and Objectives

The population and distribution goal is to maintain the extant populations in British Columbia (see Appendix 1). This is particularly important as this species is endemic to Canada and is only found in British Columbia with no possible rescue effect from populations outside of Canada (COSEWIC 2004). Maintaining the existing populations is a realistic goal and will prevent the status of this species from worsening (e.g., becoming Endangered). It is likely that the status for Macoun's meadow-foam will remain as Threatened, due to its small, fragmented distribution range and very restricted area of occupancy. This is true even if more populations are found and protected and/or the total estimated population numbers increase (as was recently the case with the discovery of new populations at Rocky Point in 2010).

⁵ Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

6 APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Underway

Actions listed below have been categorized by the action groups of the B.C. Conservation Framework. Status of the action group for this species is given in brackets.

Compile Status Report (complete)

- COSEWIC report completed (COSEWIC 2004).

Send to COSEWIC (complete)

- Macoun's meadow-foam designated Threatened (COSEWIC 2004).

Planning (complete)

- BC Recovery Strategy completed (this document, 2010).

Habitat Protection, Habitat Restoration and Private Land Stewardship (in progress)

Macoun's meadow-foam populations occur on properties with a wide variety of land tenures. Many of the owners or land managers are involved in stewardship activities aimed at protecting natural habitats.

One of the most important initiatives related to recovery of Macoun's meadow-foam is a project entitled "Report on Potential Critical Habitat in Garry Oak Ecosystems" (Parks Canada Agency 2009). This project involves delineating and mapping habitat required for the survival and recovery of a number of plant species at risk found in Garry oak and associated ecosystems on selected federal lands and provincial protected areas, one of which is Macoun's meadow-foam.

Most provincial, regional and municipal parks where Macoun's meadow-foam occurs have management plans that have been prepared by the responsible jurisdictions. These plans address the protection of natural habitats generally, and most do not make specific reference to the occurrence of Macoun's meadow-foam. Some examples of specific efforts to monitor and manage populations of plant species at risk in parks include (but are not limited to):

- Uplands Municipal Park: identification of management issues related to species at risk (Fairbarns 2004), species at risk monitoring, regular stewardship activities, and invasive species control.
- Saxe Point Municipal Park: training workshop and informal management plan for species at risk (Katschor, pers. comm. 2008).
- Trial Islands Ecological Reserve: monitoring of species at risk, invasive species control designed to minimize impacts to species at risk (Fairbarns, pers. comm. 2008).
- Ruckle Provincial Park: population monitoring, carpet burweed control activities (Annschild, pers. comm. 2008).

The Department of National Defence (DND) Canadian Forces Base (CFB) Esquimalt is engaged in several stewardship activities aimed at managing and protecting plant species at risk. The

DND has sponsored several surveys for species at risk on DND lands on Vancouver Island (e.g., Fairbarns 2006). CFB Esquimalt lands at Rocky Point, Albert Head, and Mary Hill are closed to members of the public. Rocky Point and Albert Head Macoun's meadow-foam sites have been demarcated with Seibert Stakes (with the exception of the firebreak), which communicate to property users that the areas are "off limits." The DND is also involved in surveys for, and mapping of, Macoun's meadow-foam occurrences; maps identifying "sensitive areas" with instructions to not enter or disturb these areas are provided to property users. DND biologists are currently developing a species at risk work plan for Macoun's meadow-foam that will identify actions required to further protect these sites. In the fall of 2010, baseline data was collected at known locations, and monitoring will likely occur on a three-year cycle (Cornforth, pers. comm. 2010).

The Garry Oak Ecosystems Recovery Team (GOERT) is involved in an outreach and landowner contact program for species at risk, including Macoun's meadow-foam.

One population of Macoun's meadow-foam is under a restrictive covenant on the District of Saanich lands (see Appendix 1, CDC EO#33). This natural state restrictive covenant is specific for Macoun's meadow-foam and monitoring occurs regularly. There are compliance and enforcement mechanisms in place (Pollard, pers. comm. 2010).

6.2 Recovery Planning Table

Recovery planning for Macoun's meadow-foam is summarized in Table 3.

Table 3. Recovery planning table for Macoun's meadow-foam.

Obj. No.	Conservation Framework action group	Actions to meet objectives	Threats or concern addressed	Priority
1,2	Habitat Protection;	•Determine appropriate measures to protect habitat	1.1; 1.3; 6.1; 6.2	Urgent
1,2	Habitat Restoration;	•Develop stewardship agreements, conservation covenants with private landowners on all properties	1.1; 1.3; 6.1; 6.2	Urgent
1,2	Private Land Stewardship	•Develop and implement communication strategy among partner organizations	1.1; 1.3; 6.1; 6.2	Urgent
1,2		•Develop and implement strategy for communicating with land users/stakeholders with respect to recovery activities as required	1.1; 1.3; 6.1; 6.2; 7.1, 8.1	Urgent
1,2		•Develop or refine site-specific management plans for protected areas, municipal, and federal lands to reduce or remove threats to populations and habitat	1.1; 1.3; 6.1; 6.2; 7.1, 8.1	Urgent
2		•Conduct experiments to determine appropriate methods for controlling or removing alien invasive species and methods to mimic fire regimes	7.1, 8.1	
2		•Assess impacts of invasive alien species at all sites	8.1; Knowledge gap	Beneficial
2		•Identify impact of disturbance (e.g., soil compaction, trampling, recreational activities, forest and shrubland encroachment, removal of invasive alien species) to the viability of meadow-foam populations	6.1; 6.2; 8.1	Necessary
2		•Develop and implement monitoring protocol to detect human and natural threats at each known site	All threats	Urgent
2		•Monitor sites to assess the effects of any management actions	All threats	Urgent
3	Monitor Trends	•Develop and implement monitoring protocol for Macoun's meadow-foam distribution and abundance at each site	Knowledge gap	Necessary
3		•Monitor status of populations to determine population trends	Knowledge gap	Necessary
4	Habitat Protection	•Identify and map suitable habitat for the species	Knowledge gap	Beneficial
4		•Prioritize areas for inventory	Knowledge gap	Beneficial
4		•Conduct inventories	Knowledge gap	Beneficial
5	Compile/Update Status Report	•Describe recruitment of new populations or subpopulations	Knowledge gap	Beneficial
5		•Determine mechanisms of dispersal Characterize seed bank dynamics	Knowledge gap	Beneficial

^a Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

7 HABITAT NEEDS TO MEET RECOVERY GOAL

To meet the population and distribution goal for this species, it is recommended that specific habitat attributes are identified for Macoun's meadow-foam, and locations of habitat are geospatially described on the landscape, to facilitate management to mitigate habitat threats.

7.1 Identification of Habitat for Management / Protection

Specific habitat attributes for the survival/ recovery of Macoun's meadow-foam are presented in Table 1. Habitat needed for the survival/ recovery of the species is not being spatially identified for Macoun's meadow-foam in B.C. at this time as outstanding work needs to be completed to quantify area requirements for the species.

A schedule of studies outlining the work necessary to spatially identify habitat needed to meet the recovery goal is provided in Table 4.

7.2 Schedule of Studies to Identify Habitat Needed to Meet Recovery Goal

Table 4. Studies needed to describe survival/recovery habitat to meet the population and distribution goal for Macoun's meadow-foam.

Description of research activity	Start date	Completion date
1. Conduct surveys: <ul style="list-style-type: none"> • Map occupied habitat using established mapping techniques. 	2011	2013
2. Describe and record condition of occupied habitat: <ul style="list-style-type: none"> • Delineate the habitat features and site conditions supporting the species. • Compile site-specific information on community composition, site characteristics, ecological condition (vegetation competition, land use activities, presence/density of invasive alien species, other intrinsic limitations) and landscape context (adjacent land use, succession, habitat connectivity). 	2011	2014

8 PERFORMANCE MEASURES

The success of the recovery program will be determined primarily through monitoring of populations and habitat trends through time. Macoun's meadow-foam is an annual species and therefore the distribution of occurrences can be expected to be dynamic (on a scale of decades) within areas of suitable habitat. Population sizes can also vary dramatically from year to year, and these variations don't necessarily reflect the probability of persistence of the species. However, even though there can be a wide variation in the number of plants within each population year-to-year, the individual numbers within each of three size categories (small: 1-50 plants; medium: >50 – 200 plants; large: >200 plants) are consistent between years (COSEWIC 2004). If population monitoring indicates that the number of extant populations is stable or

increasing, then the population and distribution goal for Macoun's meadow-foam will have been met.

The recovery strategy will be reviewed in five years to assess progress and to identify additional approaches or changes that may be required to achieve recovery.

The following performance measures will be used to evaluate progress by 2016:

- At least four sites have stewardship agreements established for the protection of the species (Objective 1).
- All parks have site-specific management plans in place (Objectives 1 and 2).
- Research projects have been initiated by 2015 to identify threats and assess risk to populations (Objective 2).
- Determination of the sizes and population trends of all known populations have been initiated (Objective 3).
- Inventory of potential habitats has been conducted (Objective 4).
- Knowledge gaps relating to recruitment of new populations or subpopulations, mechanisms of dispersal and seed bank dynamics have been initiated (Objective 5).

9 EFFECTS ON OTHER SPECIES

Many at-risk species and ecosystems occur in or adjacent to Macoun's meadow-foam habitats. COSEWIC assessed and provincial plant species at risk include: snake-root sanicle (*Sanicula arctopoides*), rosy owl-clover (*Orthocarpus bracteosus*) (SARA listed), paintbrush owl-clover (*Castilleja ambigua* ssp. *ambigua*), bearded owl-clover (*Triphysaria versicolor* ssp. *versicolor*) (SARA listed), erect pygmyweed (*Crassula connata* var. *connata*), and seaside birds-foot trefoil (*Lotus formosissimus*). Since this species occurs within Garry oak and associated ecosystems, there are additional flora and fauna that would be protected by conserving Macoun's meadow-foam (GOERT 2002a).

Coordinated, ecosystem-based approaches are needed to ensure that Macoun's meadow-foam recovery activities are compatible with recovery activities for other species and ecosystems such as the Garry Oak Ecosystems Recovery Team Recovery Strategy and the Parks Canada multi-species strategy for vernal pools. The Garry Oak Ecosystems Recovery Team could possibly carry out landowner contact programs to engage landowners and land managers in future surveys, monitoring, and conservation of the species. As well, a component of the GOERT outreach program includes a field manual for species at risk, which includes Macoun's meadow-foam (GOERT 2002b).

10 REFERENCES

- B.C. Conservation Data Centre. 2010. BC Species and Ecosystems Explorer. B.C. Min. Environ., Victoria, BC. <<http://a100.gov.bc.ca/pub/eswp/>> [Accessed June 24, 2010]
- British Columbia Conservation Data Centre (B.C. CDC). 2008a. Element occurrence record: *Limnanthes macounii*. B.C. Min. Environ., Victoria, BC.
- British Columbia Conservation Data Centre (B.C. CDC). 2008b. Glossary. <<http://www.env.gov.bc.ca/atrisk/glossary.html>> [Accessed Feb. 1, 2008]
- Buxton, E. and R. Ornduff. 1999. Noteworthy collections - California: *Limnanthes macounii* Trel. (Limnanthaceae). Madroño 45:184.
- Ceska, A. and O. Ceska. 2007. Carpet burweed (*Soliva sessilis*, Asteraceae): rare and introduced species that occur with it in British Columbia, Canada. Botanical Electronic News: 373. <<http://www.ou.edu/cas/botany-micro/ben/ben373.html>> [Accessed Feb. 1, 2008]
- Ceska, A. and O. Ceska. 1999. *Limnanthes macounii*: end of an endemic species. Menziesia 4(4):8–9.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2004. COSEWIC assessment and update status report on the Macoun's meadow-foam *Limnanthes macounii* in Canada. Ottawa, ON. <http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_macouns_meadowfoam_e.pdf> [Accessed Feb. 1, 2008]
- Conservation Measures Partnership. 2010. Threats taxonomy. <<http://www.conservationmeasures.org/initiatives/threats-actions-taxonomies/threats-taxonomy>> [Accessed June 24, 2010]
- Douglas, G., D. Meidinger, and J. Pojar, eds. 1999. Illustrated flora of British Columbia, Volume 3: Dicotyledons (Diapensiaceae through Onagraceae). B.C. Min. Environ., Lands and Parks and B.C. Min. For., Victoria, BC.
- Erter, B. 2000. Floristic surprises in North America north of Mexico. Ann. Missouri Bot. Garden 87:81–109. <http://ucjeps.berkeley.edu/floristic_surprises.html> [Accessed Feb. 1, 2008]
- Fairbarns, M. 2004. Uplands Park and Cattle Point: managing rare plants. Prepared for Oak Bay Municipality, Victoria, BC. Unpubl. rep.
- Fairbarns, M. 2006. Survey for species at risk on Department of National Defence Lands on Vancouver Island: Work Point (Golf Hill), Mary Hill, Albert Head, CFMETR, South Ballenas Island. Prepared for Can. For. Serv. and Dep. of National Defence, Victoria, BC.
- Garry Oak Ecosystems Recovery Team (GOERT). 2002a. Recovery strategy for Garry Oak and associated ecosystems and their associated species at risk in Canada 2001–2006. <http://www.goert.ca/documents/RSDr_Feb02.pdf>

- Garry Oak Ecosystems Recovery Team (GOERT). 2002b. Field manual: species at risk in Garry Oak and associated ecosystems in British Columbia.
<http://www.goert.ca/publications_resources/species_at_risk.php>
- Government of Canada. 2009. *Species at Risk Act* Policies, Overarching Policy Framework – Draft. Ministry of Environment, Ottawa. 38pp.<http://dsp-psd.pwgsc.gc.ca/collection_2009/ec/En4-113-2009-eng.pdf> [Accessed May 3, 2010]
- Graham, T.B. 2003. Climate change and ephemeral pool ecosystems: potholes and vernal pools as potential indicator systems. <<http://geochange.er.usgs.gov/sw/impacts/biology/vernal/>> [Accessed Feb. 1, 2008]
- Hammerson, G.A., D. Schweitzer, L. Master, and J. Cordeiro. 2008. Ranking species occurrences: a generic approach. NatureServe, Arlington, VA.
<<http://www.natureserve.org/explorer/eorankguide.htm>> [Accessed Feb. 1, 2009]
- Hanski, I. 1999. Metapopulation ecology. Oxford Univ. Press, Oxford, U.K.
- Keiding, N. 1975. Extinction and exponential growth in random environments. *Theor. Pop. Biol.* 8:49–63.
- Kesseli, R. and S.K. Jain. 1984. An ecological genetic study of gynodioecy in *Limnanthes douglasii* (Limnantheceae). *Amer. J. Bot.* 71(6):775-786.
- Master, L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, J. Nichols, L. Ramsay, and A. Tomaino. 2009. NatureServe Conservation Status Assessments: Factors for Assessing Extinction Risk. NatureServe, Arlington, VA.
<http://www.natureserve.org/publications/ConsStatusAssess_StatusFactors.pdf> [Accessed June 24, 2010]
- Ministry of Environment. 2010. Conservation framework. B.C. Min. Environ., Victoria, BC.
<<http://www.env.gov.bc.ca/conservationframework/index.html>> [Accessed June 24, 2010]
- NatureServe. 2004. A habitat-based strategy for delimiting plant element occurrences: guidance from the 2004 Working Group.
<http://www.natureserve.org/library/delimiting_plant_eos_Oct_2004.pdf> [Accessed Feb. 1, 2008]
- NatureServe. 2009. NatureServe explorer: an online encyclopedia of life (web application). Version 6.1. Arlington, VA. <<http://www.natureserve.org/explorer>> [Accessed June 24, 2010]
- Newman, D. and D. Pilson. 1997. Increased probability of extinction due to decreased genetic effective population size: experimental populations of *Clarkia pulchella*. *Evol.* 51: 354–362.
- Parks Canada Agency. 2009. Report on Potential Critical Habitat in Garry Oak Ecosystems. Unpublished, Victoria, BC.

- Parks Canada Agency. 2006a. Recovery strategy for multi-species at risk in maritime meadows associated with Garry oak ecosystems in Canada. Species at Risk Act Recovery Strategy Series. Parks Canada Agency, Ottawa, ON.
- Parks Canada Agency. 2006b. Recovery strategy for multi-species at risk in vernal pools and other ephemeral wet areas in Garry oak and associated ecosystems in Canada. Species at Risk Act Recovery Strategy Series. Parks Canada Agency, Ottawa, ON.
- Pollard, J.H. 1966. On the use of the direct matrix product in analyzing certain stochastic population models. *Biometrika* 53:397–415.
- Sauer, J.D. 1991. Plant migration: the dynamics of geographic patterning in seed plant species. Univ. California Press, Berkeley, CA.
- Tucker, G.C. 2010. *Limnanthes*. In: Flora of North America Editorial Committee, eds., 1993+. Flora of North America North of Mexico. 16+ vols. New York and Oxford. Vol. 7, p. 176. <http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250095081> [Accessed November 3, 2010]

Personal Communications

- Annschild, Robin. Biologist, Salt Spring Island Conservancy. Salt Spring Island, BC.
- Buxton, Eva. Senior Botanist/Ecologist, LSA Associates, Inc., Point Richmond, CA.
- Ceska, Adolf. Botanist, Ceska Geobotanical Consulting. Victoria, BC.
- Cornforth, Tracy. Environment Officer, Department of National Defence, Canadian Forces Base Esquimalt. Esquimalt, BC.
- Donovan, Marta. Biologist, B.C. Conservation Data Centre. Victoria, BC.
- Fairbarns, Matt. Biologist, Aruncus Consulting. Victoria, BC.
- Katschor, Andy. Manager, Esquimalt Parks and Recreation. Esquimalt, BC.
- Penny, Jenifer. Botanist, B.C. Conservation Data Centre. Victoria, BC.
- Pollard, Adriane. Manager of Environmental Services, Planning Department, District of Saanich, Victoria, BC.
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APPENDIX 1. B.C. POPULATIONS OF MACOUN'S MEADOW-FOAM

Table A1. B.C. populations and subpopulations of Macoun's meadow-foam. Data from COSEWIC 2004; B.C. CDC 2008a; Fairbarns, pers. comm. 2008.

CDC EO # ^a	Viability	Population name	Site	Municipality or District	Ownership	Subpopulations		
						Number	Recent size ^b	Last observation
1	fair	BEECHY HEAD, BAY NORTH OF	East Sooke Regional Park (Cabin Point)	Sooke	CRD Parks	1.1	medium	2002-2003
2	fair-good	CREYKE POINT, EAST SOOKE REGIONAL PARK	East Sooke Regional Park	Sooke	CRD Parks	2.1	large	2002-2003
3	fair?	BECHER BAY 1R #2, WEST OF ROCKY POINT	Becher Bay First Nation Reserve #2	Sooke	Beecher Bay First Nation	3.1	extirpated	1984
						3.2	small	2002-2003
						3.3	small	2002-2003
						3.5	small	2002-2003
						3.6	medium	2002-2003
						3.7	small	2002-2003
						3.8	small	2002-2003
						3.9	extirpated	1977
						Old Orchard	extirpated	1977
5	fair	CHURCH POINT, WEST OF	Canadian Forces Base Rocky Point	Metchosin	DND	4.1	medium	2002-2003
6	good	ROCKY POINT, EAST ^c	Canadian Forces Base Rocky Point	Metchosin	DND	5.1	large	2002-2003
						5.2	small	2002-2003
						5.3	large	2002-2003
						5.4	large	2002-2003
						5.5/5.8	large	2002-2003
						5.6	medium	2002-2003
						5.7	small	2002-2003
						5.9	small	2002-2003
						5.10	large	2002-2003
						5.11	small	2002-2003
						5.12	large	2002-2003
						5.13	small	2002-2003
						5.14	medium	2002-2003
						5.15	medium	2002-2003

CDC EO # ^a	Viability	Population name	Site	Municipality or District	Ownership	Subpopulations		
						Number	Recent size ^b	Last observation
						5.16	medium	2002-2003
10	fair-good	QUARANTINE COVE, VICTORIA	William Head Prison	Metchosin	federal	6.1	medium	2002-2003
11	fair-good	MARY HILL, SOUTHEAST AND SOUTHWEST SLOPES		Metchosin	DND	1977 pop.	extirpated	1977
						7.1	large	2002-2003
						7.2	extirpated	1977
						7.4	medium	2002-2003
12	fair	MARY HILL, NORTHEAST BASE		Metchosin	DND	1977 pop.	?	1977
						7.5	small	2002-2003
						7.6	small	2002-2003
						7.7	small	2002-2003
13	extirpated	ASH POINT		Metchosin	private	8.1	extirpated	1977
14	fair?	PEARSON COLLEGE		Metchosin	private	9.1	small	2002-2003
15	poor	DEVONIAN REGIONAL PARK	Devonian Regional Park	Metchosin	CRD Parks	11.1	small	2002-2003
			outside of Park		private	11.2	extirpated	1987
						11.3	extirpated	1988
						11.4	small	2006
						11.5	small	2006
						11.6	extirpated	1987
16	good	SAXE POINT PARK, VICTORIA	Saxe Point Park	Esquimalt	Esquimalt Parks	18.1	large	2002-2003
17	good	MONTREAL HILL		Metchosin	private	10.1	small	2002-2003
						10.2	small	2002-2003
						10.3	small	2002-2003
						10.4	medium	2002-2003
						10.5	medium	2002-2003
						10.6	medium	2002-2003
20	good	ALBERT HEAD		Metchosin	DND	12.1	small	2002-2003
						12.2	small	2002-2003
						12.3	large	2002-2003
21	fair-poor	ARBUTUS COVE, NORTH OF		Saanich	private	25.1	small	2002-2003
22	fair	HORNBY		Hornby Island	private	32.1	medium	2002-2003

CDC EO # ^a	Viability	Population name	Site	Municipality or District	Ownership	Subpopulations		
						Number	Recent size ^b	Last observation
		ISLAND, DOWNES POINT				32.2	small	2002-2003
23	fair	FORT RODD HILL NATIONAL HISTORIC SITE	Fort Rodd Hill National Historic Site	Colwood	Parks Canada	13.1	medium	2002-2003
24	fair-good	YEW POINT	Fort Rodd Hill National Historic Site	Colwood	Parks Canada	14.1	large	2002-2003
25 ^d	fair-good	INSKIP ISLAND	Inskip Island	marine	DND	16.1	large	2002-2003
25 ^d	extirpated	ASHE HEAD	Songhees Nation Reserve	Capital Regional District	Songhees Nation	17.1	extirpated	1987
27	good	HARLING POINT	Chinese Cemetery at Harling Point National Historic Site	Oak Bay	private	20.1	large	2002-2003
			Trafalgar Park		District of Oak Bay Parks	new	large	2007
28	good	TRIAL ISLANDS ECOLOGICAL RESERVE	Trial Islands Ecological Reserve	marine	BC Parks	21.1/"north pop."	large	2002-2003
						21.2	medium	2002-2003
						21.3	small	2002-2003
						new*	small	2002-2003
29	good	GONZALES POINT	Victoria Golf Club	Oak Bay	private	22.1	large	2002-2003
						22.2	large	2002-2003
						22.3	small	2002-2003
						22.4	large	2002-2003
30	good-excellent	CHATHAM ISLANDS, HERITAGE POINT	Chatham Islands	marine	Songhees Nation	23.1	large	2002-2003
						23.2	small	2002-2003
31	good?	UPLANDS PARK, VICTORIA	Uplands Park	Oak Bay	District of Oak Bay Parks	24.1	large	2002-2003
						24.2	medium	2002-2003
						24.3	large	2002-2003
						24.4	small	2002-2003
						north boat ramp	?	2002-2003
33	fair-poor	GORDON HEAD, LEYNS	Glencoe Cove-Kwatsech Park	Saanich	Saanich Parks	1	small	2006
						3	extirpated	1987

CDC EO # ^a	Viability	Population name	Site	Municipality or District	Ownership	Subpopulations					
						Number	Recent size ^b	Last observation			
		ROAD, GLENCOE COVE PARK	outside of Park		District of Saanich	4	extirpated	1987			
						2	small	2006			
34	good	YELLOW POINT	Yellow Point Lodge	Ladysmith	private	1 (30.5)	large	2002-2003			
						2	extirpated	1977			
						3	extirpated	1977			
						4 (30.4)	medium	2002-2003			
						5 (30.3)	medium	2002-2003			
						6 (30.2)	medium	2002-2003			
						7 (30.1)	large	2002-2003			
							Rice farm	private	8 (29.6)	medium	2002-2003
									9 (29.5)	extirpated	1987
							Chemainus First Nation Reserve	Chemainus First Nation	10 (29.4)	small	2002-2003
									11 (29.3)	large	2002-2003
									12 (29.2)	small	2002-2003
									13 (29.1)	small	2002-2003
36	extirpated	ELEANOR POINT, SALT SPRING ISLAND	Salt Spring Island	Salt Spring Island	private	27.1	extirpated	1978			
37	good	BEAVER POINT, SALT SPRING ISLAND	Ruckle Provincial Park	Salt Spring Island	BC Parks	28.2	medium	2002-2003			
						28.3	large	2002-2003			
						28.4	large	2002-2003			
						28.5	small	2002-2003			
						28.6	?	2002-2003			
43	good-excellent	GABRIOLA ISLAND, DRUMBEG PROVINCIAL PARK	Drumbeg Provincial Park	Gabriola Island	BC Parks	31.1	medium	2002-2003			
44	poor	GONZALES BAY, VICTORIA	Government House	Victoria	federal	19.1	small	2004			
45	extirpated	VIEW ROYAL		View Royal	private	15.1	extirpated	1987			

^a These numbers are the labels of the mapped occurrences in the CDC. "Missing" numbers have no significance.

^b small = <50 plants; medium = 51–200 plants; large = >200 plants

^c Note that this table does not include the data from surveys in 2010 that estimated over 100,000 individual plants found at this location.

^d EO #25 was formerly mapped as a single population by the B.C. CDC (B.C. CDC 2008a), but has since been separated into two EOs/populations because they are separated by a body of seawater (Ceska, pers. comm. 2008; Penny, pers. comm. 2008).