

Recovery Plan for Manroot (*Marah oreganus*) in British Columbia



Prepared by B.C. Ministry of Environment



October 2012

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies or recovery plans that are prepared as advice to the Province of British Columbia on the general strategic approach required to recover species at risk. Recovery strategies or recovery plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares recovery strategies to ensure coordinated conservation actions and 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 summarizes the best available science-based knowledge of a species or ecosystem to identify goals, objectives, and strategic approaches that provide a coordinated direction for recovery. These documents outline what is and what is not known about a species or ecosystem, identify threats to the species or ecosystem, and explain what should be done to mitigate those threats, as well as provide information on habitat needed for survival and recovery of the species (if available). The Province of British Columbia accepts the information in these documents as advice to inform implementation of recovery measures, including decisions regarding measures to protect habitat for the species. When sufficient information to guide implementation for the species can be included, the document is referred to as a recovery plan, and a separate action plan is not required.

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/rcvry1.htm>>

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Disclaimer

This recovery plan has been prepared by the B.C. Ministry of Environment 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 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 plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the recovery of manroot.

ACKNOWLEDGEMENTS

This plan was written by Brenda Costanzo and Marta Donovan of the B.C. Ministry of Environment, Ecosystems and Sustainability Branch. This document follows the B.C. guide for recovery planning (Ministry of Environment 2010a).

EXECUTIVE SUMMARY

Manroot (*Marah oreganus*) is a perennial vine which grows from a large woody root, producing annual stems bearing tendrils and glossy green leaves with 5–7 lobes. Flowers arise from the leaf axils as separate male and female reproductive structures. Fruits are spherical, tapering to a beak and with dark green stripes and prickles.

Manroot was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as there are fewer than 20 mature plants remaining with no evidence of seedling production. The main threats to the few remaining populations include habitat destruction or degradation (e.g., development, road maintenance/widening, recreational activities), competition from invasive alien plant species, and loss/alteration of habitats due to secondary succession under current fire suppression regimes. In British Columbia, manroot is ranked S1 (critically imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks manroot as a priority #1 under goal #3 (maintain the diversity of native species and ecosystems). Recovery is considered to be biologically and technically feasible.

The population and distribution goal for manroot is to maintain the extant populations within British Columbia, and to re-introduce the species at the extirpated site, if deemed feasible.

The recovery objectives are to

1. Ensure long-term protection¹ for the four known populations and habitat of manroot.
2. Assess and mitigate the extent of the main threats to existing manroot populations (e.g., residential development, recreational activities, road maintenance/widening, invasive alien plants and fire suppression).
3. Confirm the distribution of all populations (existing and new locations) in British Columbia.
4. Determine sizes and population trends (reproductive success, seed dispersal, germination rates, etc.) of all known populations.
5. Determine if a population can be re-established at the historic site, and if deemed feasible, re-introduce the species.

RECOVERY FEASIBILITY SUMMARY

The recovery of manroot in B.C. is considered technically and biologically 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, extant plants are reproducing. The Saanich Peninsula population is known to produce fruit and seeds.

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.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.
Yes, there are occupied locations and areas of unoccupied habitat that appear capable of sustaining the species.
3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.
Yes, threats (e.g., residential and commercial development, recreational activities, road maintenance, invasive alien species) to the species or its habitat can be avoided or mitigated through recovery actions. The impact of climate change in the future likely cannot be mitigated. See Table 2.
4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.
Yes. Threat mitigation and reintroduction require existing standard recovery techniques.

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1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2009

Common Name:** Coast Manroot

Scientific Name:** *Marah oreganus*

COSEWIC Status: Endangered

Reason for Designation: A long-lived perennial vine occurring at only three widely separated locations on southeastern Vancouver Island and adjacent Gulf Islands. Fewer than 20 mature plants remain with no evidence of seedling production. Losses of few known sites, alien species, and chance events affecting the handful of remaining individuals.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Endangered in November 2009.

* Committee on the Status of Endangered Wildlife in Canada.

** Common and scientific names reported in this recovery strategy/plan follow the naming conventions of the B.C. Conservation Data Centre, which may be different from names reported in the section by COSEWIC.

2 SPECIES STATUS INFORMATION

manroot^a	
Legal Designation:	
Identified Wildlife: ^b No	<i>B.C. Wildlife Act:</i> ^c No
SARA Schedule: Decision Not to List	
Conservation Status^d	
B.C. List: Red B.C. Rank: S1 (2007) National Rank: N1 Global Rank: G5 (1990)	
Other Subnational Ranks: ^e CA: SNR, ID: SNR, MT: SNR, NE: SU, OR: SNR, WA: SNR, WY: SNR	
B.C. Conservation Framework (CF)^f	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority: 4 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.	Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.	Priority: 1 (2009)
CF Action Groups:	Compile Status Report; Planning; List under <i>Wildlife Act</i> ; Send to COSEWIC; Habitat Protection; Private Land Stewardship; Species and Population Management

^a Data source: B.C. Conservation Data Centre (2012) unless otherwise noted.

^b Identified Wildlife under the *Forest and Range Practices Act*, which includes the categories of species at risk, ungulates, and regionally important wildlife (Province of British Columbia 2002).

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

^d S = subnational; N = national; G = global; 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. U.S. data from NatureServe (2012).

^e Data source: NatureServe (2012).

^f Data source: Ministry of Environment (2010b).

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

3 SPECIES INFORMATION

3.1 Species Description

Coast manroot is a perennial vine from a large, woody root with herbaceous annual stems that are climbing or trailing bearing branched tendrils. Leaves are alternate, up to 20 cm long, glossy green, and palmately lobed (5–7 lobes). Leaf bases are shallowly lobed and cordate (heart-shaped). Leaves are stalked and bristly above and sparsely hairy below. Its white flowers are monoecious, with separate male and female flowers on the same plant. Male flowers are arranged in racemes (elongate unbranched inflorescences) or panicles (branched inflorescences) arising from the leaf axils. Female flowers are on short pedicels, individually arising from the leaf axils at the base of the male inflorescence. Male flowers are 3–15 mm wide, cup-shaped, white to cream or yellow-green, with 5–8 lobes. Fruits are green with dark green stripes, weakly spiny, elliptic to egg-shaped, up to 4–5 cm in diameter, and tapering to a slight beak. Seeds are 1–2 in each locule, 16–22 mm long, disk-shaped, and flattened (Douglas *et al.*, eds. 1998; Miller and Schlising 2012).



Figure 1. Illustration of manroot (Hitchcock *et al.* 1959). Published with permission of University of Washington Press.

3.2 Populations and Distribution

Manroot occurs from southern British Columbia south into central California (Figure 2), generally west of the Cascade Mountains. Hitchcock *et al.* (1959) report that this species extends east to the Oregon-Idaho boundary (along the Snake River). NatureServe (2012) states that the

species occurs in Wyoming, Nebraska, and Montana. However, these records may be based on misidentifications of wild cucumber (*Echinocystis lobata*). The USDA NRCS database does not show this species as occurring in these three states (USDA NRCS 2009).

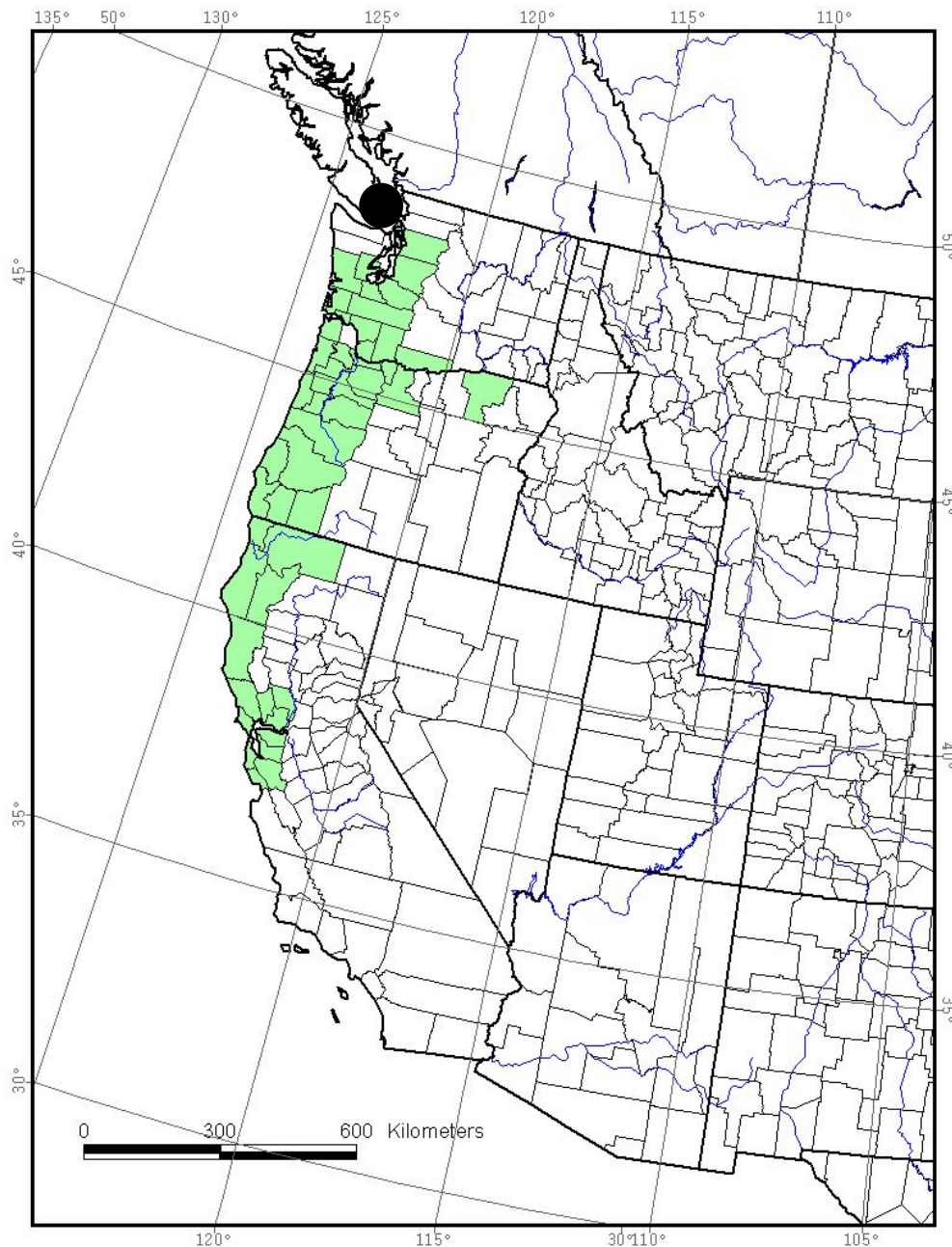


Figure 2. Manroot distribution in North America and Canada. Large circle represents generalized occurrences in B.C.; shaded counties in the United States are based on county records in the USDA NRCS 2009 (from COSEWIC 2009).

B.C. has four extant populations of manroot (Figure 3; Table 1), of which two are known to flower and produce fruit. Manroot has probably never been common in B.C. given that it is at the northern extreme of its geographic range. The alteration of habitat due to urban development, fire

suppression, and alien plant species invasions have likely resulted in the loss of some populations as manroot occurs in Garry oak (*Quercus garryana*) ecosystems, which are among the most threatened ecosystems in Canada (Garry Oak Ecosystem Recovery Team 2011).

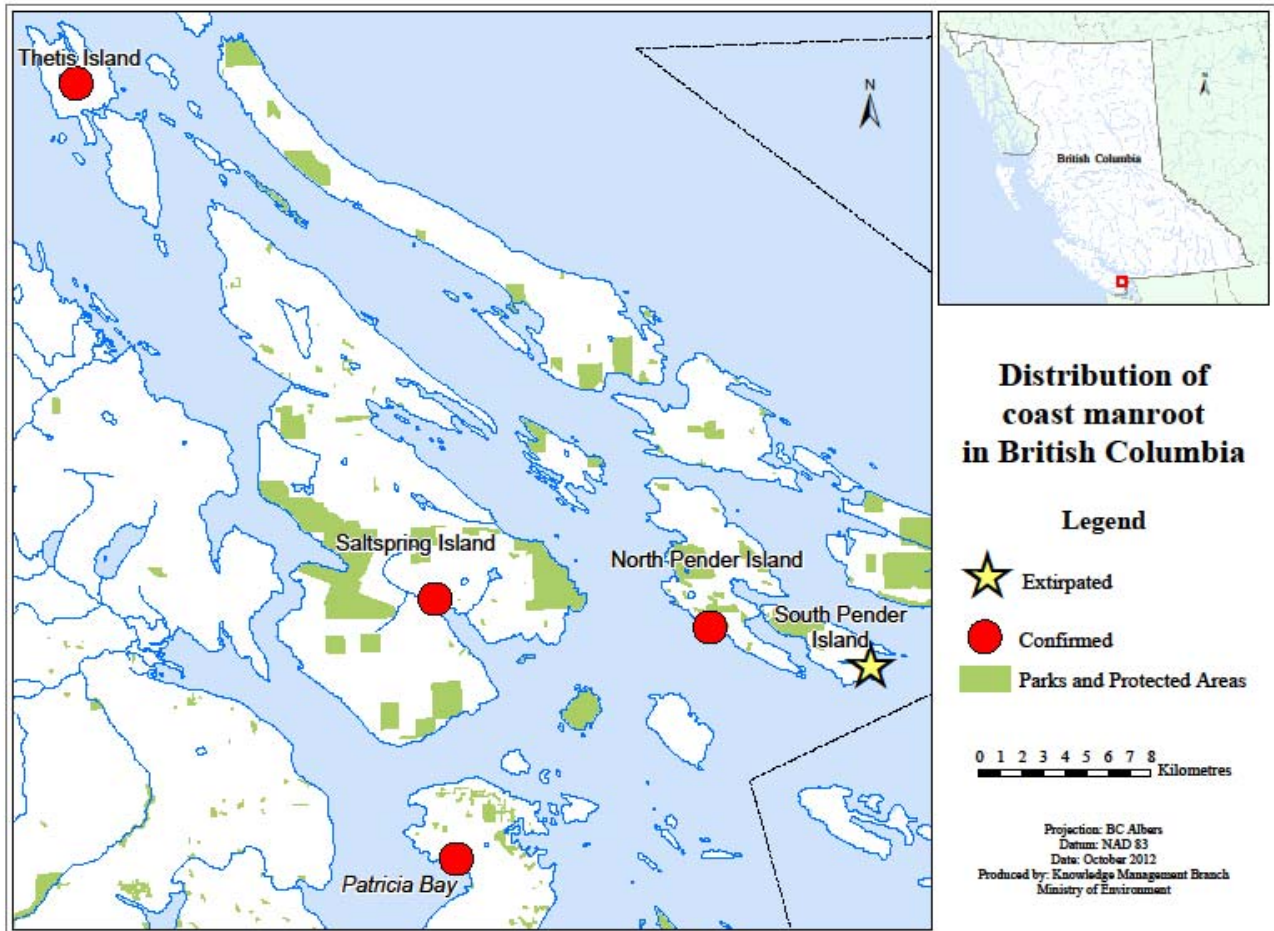


Figure 3. Manroot distribution in B.C.

Table 1. Status and description of manroot populations in B.C.

Population ^a	Status and description	Land tenure
Saanich Peninsula (EO #3)	150 m ² ; one individual; 2012; fruiting and flowering	First Nations
Saltspring Island (EO #1)	2800 m ² ; 15 individuals; 2006	Private
North Pender Island (EO #6)	100 m ² ; two individuals; 2004; fruiting	Private
South Pender Island (EO #2)	Extirpated; last observed in 1964	Private
Thetis Island	25 m ² ; 12 plants; 2012	Private

^aThe Element Occurrence (EO) number is provided in parentheses. This is used by the B.C. Conservation Data Centre when mapping occurrences.

3.3 Needs of the Manroot

3.3.1 Habitat and Biological Needs

Throughout its range, manroot occurs in shrubby to open areas at the edges of forests, in grassy fields, thickets, open woodlands, and hillsides (COSEWIC 2009). In British Columbia it is found in Garry oak ecosystems. Habitats include south-facing, rocky hillsides and rock outcrops and openings at the edges of mixed woodlands usually at lower elevations and within 30 metres of the shoreline.

Manroot requires cool and moist conditions for seed germination, which occurs from late fall until early winter.

3.3.2 Limiting Factors

Dispersal of propagules in manroot may be hindered by fragmentation of suitable habitat for this species, as well as by the lack of seed and/or fruit dispersers. In the United States, seeds are also known to be dispersed by small rodents and it was assumed that they were then buried in the soil (Schlising 1966, 1969). However, no studies have been done in B.C. on animal dispersal agents. Successful seedling recruitment may be linked to the burial of the seeds. Schlising (1969) demonstrated that manroot seeds placed on the soil surface had significantly lower seedling establishment (2%), than those buried at various depths in the soil (69–100%).

Field observations in the Berkeley Hills, where the reproductive ecology of manroot has been extensively studied, suggested that plants of manroot may be self-incompatible. In experiments where flowers were hand-pollinated, none of the flowers that were hand-pollinated with pollen from the same plants (self-pollinated) set fruit or seeds. However, 42% of cross-pollinations, either from pollen applied from other individuals or through natural pollinations, did lead to fruit or seed formation (Schlising 1966). If manroot is an obligate outcrosser that requires pollination by a genetically dissimilar plant to produce viable seed, the limited seed set observed in B.C. populations may be the result of reduced genetic variation between individual plants in the small populations that have been observed.

4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.² Threats presented here do not include biological features of the species or population such as inbreeding depression, small population size, and genetic isolation; or

² Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2009).

likelihood of regeneration or recolonization for ecosystems, which are considered limiting factors.³

For the most part, threats are related to human activities, but they can be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, flooding) may be especially important when the species or ecosystem is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2009). As such, natural phenomena are included in the definition of a threat, though should be applied cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky *et al.* 2008) so that this type of event would have a disproportionately large effect on the population/ecosystem compared to the effect they would have had historically.

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the [CMP website](#) (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat “impact” is calculated from scope and severity. For information on how the values are assigned, see [Master *et al.* \(2009\)](#) and table footnotes for details. Threats for manroot were assessed for the entire province (Table 2).

³ It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts.

Table 2. Threat classification table for manroot in B.C.

Threat #	Threat description	Impact ^a	Scope ^b	Severity ^c	Timing ^d	Population(s)
1	Residential & commercial development	Medium	Large (31–70%)	Moderate (11–30%)	High (Continuing)	
1.1	Housing & urban areas	Medium	Large (31–70%)	Moderate (11–30%)	High (Continuing)	North Pender Island Saltspring Island
2	Agriculture & aquaculture	Not Calculated	Not Scored (Past)	Not Scored (Past)	Insignificant/ Negligible (Past)	
2.3	Livestock farming & ranching	Not Calculated	Not Scored (Past)	Not Scored (Past)	Insignificant/ Negligible (Past)	South Pender Island
4	Transportation and service corridors	Low	Small (1–10%)	Extreme (71–100%)	Moderate (Possibly in short term)	
4.1	Roads and railroads	Low	Small (1–10%)	Extreme (71–100%)	Moderate (Possibly in short term)	Saanich Peninsula
6	Human intrusions & disturbance	Low	Pervasive (71–100%)	Slight (1–10%)	High (Continuing)	
6.1	Recreational activities	Low	Pervasive (71–100%)	Slight (1–10%)	High (Continuing)	All locations
7	Natural system modifications	Low	Small (1–10%)	Slight (1–10%)	High (Continuing)	
7.1	Fire & fire suppression	Low	Small (1–10%)	Slight (1–10%)	High (Continuing)	All locations
7.3	Other ecosystem modifications	Low	Small (1–10%)	Moderate (11–30%)	High (Continuing)	Saanich Peninsula
8	Invasive & other problematic species & genes	Low	Pervasive (71–100%)	Slight (1–10%)	High (Continuing)	
8.1	Invasive non-native/alien species	Low	Pervasive (71–100%)	Slight (1–10%)	High (Continuing)	All locations
11	Climate change & severe weather	Not Calculated	Pervasive (71–100%)	Extreme (71–100%)	Low (Possibly in the long term)	
11.1	Habitat shifting & alteration	Not Calculated	Pervasive (71–100%)	Extreme (71–100%)	Low (Possibly in the long term)	All locations
11.2	Droughts	Not Calculated	Pervasive (71–100%)	Unknown	Low (Possibly in the long term)	All locations

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

^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%; Negligible < 1%).

^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%; Negligible < 1%; Neutral or Potential Benefit \geq 0%).

^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, $>$ 10 years or 3 generations) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

The overall province-wide Threat Impact for this species is High.⁴ The greatest threat is residential and commercial development (Table 2). Details are discussed below under the Threat Level 1 headings.

The greatest historic threat to populations of manroot has been from habitat loss and degradation. The alteration of habitat within its distribution has likely resulted in the loss of some populations as the Garry oak ecosystems where manroot occurs are among the most threatened ecosystems in Canada, with less than 5% in a natural or near-natural condition. Most (95%) of the pre-contact Garry oak ecosystems have been lost through human activities such as urbanization and suburban growth and agriculture (Garry Oak Ecosystem Recovery Team 2011).

IUCN-CMP Threat 1. Residential and commercial development

1.1 Housing and urban areas

Three of the extant populations of manroot are on private land, and the fourth is on First Nations land. Specific development plans for the four sites are unknown at this time, but none of the populations currently have protection from future land use changes, which could alter or destroy manroot habitat. With a moderate climate and attractive surroundings, the Gulf Islands and the Victoria area are some of the most desirable places to live in Canada, and pressures from residential development continue to threaten the environmental quality of natural areas in the region. Habitat fragmentation caused by human activities, such as the clearing of native vegetation, also threatens extant populations by restricting the ability of the population to expand and disperse to new areas. Development, even on adjacent sites, can alter the hydrology of locations and potentially increase or decrease the available water. An increase or decrease in the flow of water at critical phases of the life cycle (e.g., germination) could result in failure of seeds to germinate and develop. Such impacts, if prolonged over multiple growing seasons and of sufficient severity, could result in extirpation of individual populations.

IUCN-CMP Threat 2. Agriculture and aquaculture

2.3 Livestock farming and ranching

The South Pender Island plant was likely destroyed by livestock trampling when a fence around a grazing pasture failed (COSEWIC 2009). As this population is extirpated, this is considered to be a past threat. However, this threat will need to be re-assessed if re-introductions at this location are considered in the future.

⁴ The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate. This includes 1 Medium and 4 Low (Table 2). The overall threat considers the cumulative impacts of multiple threats.

IUCN-CMP Threat 4. Transportation and service corridors**4.1. Roads and railroads**

Road building may also constitute a threat to populations by fragmenting potential and suitable habitat for manroot and decreasing the potential for natural seed dispersal to new sites. Road widening could threaten the Saanich Peninsula population in the future, although there are no known plans for this currently. In addition to direct impacts to plants through removal or other physical disturbance resulting from road widening, soil disturbance associated with road construction increases the potential for invasive species by facilitating the transport of seeds and vegetative propagules from other areas (see Threat #8.1).

In addition, road construction (e.g., ditching, infilling) can change the hydrology of the site, which could affect manroot (i.e., redistributing either too much or too little water) at a crucial life stage. An increase or decrease in the flow of water at critical phases of the life cycle (e.g., germination) could result in failure of seeds to germinate and develop.

IUCN-CMP Threat 6. Human intrusion and disturbance**6.1 Recreational activities**

Trampling by people or dogs at all locations may damage plants and also have an impact on the ability of these small populations to reproduce. This includes both unintentional damage as well as intentional damage by individuals who would prefer to have the species removed from the area for personal reasons (e.g., development opportunities).

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 manroot 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 encroachment of forest trees and shrubs into Garry oak ecosystems where manroot is found. This lack of fire regime has potentially led to the loss and alteration of manroot habitats due to secondary succession.

7.3 Other ecosystem modifications

The population on the Saanich Peninsula is directly adjacent to a two-lane roadway, which periodically receives roadside maintenance in the form of mowing. Although mowing can reduce the growth of competing plants, there is also the potential that the stems, branches, and reproductive structures of manroot might be cut or shredded. Flowering and seed production could also be affected if mowing occurs during that phase of the plant's life cycle. Other activities associated with road maintenance and repair such as grading, ditch and culvert clearing, and sediment disposal also have the potential to negatively affect plants at this location.

IUCN-CMP Threat 8. Invasive and other problematic species and genes**8.1 Invasive non-native/alien species**

Non-native plants have invaded both existing and potential habitat of manroot at all populations. Although these introduced species likely compete with manroot for space and resources, manroot appears to tolerate some degree of competition, possibly due to the large underground root that contributes to its longevity. However, seedling establishment may be limited by invasive plants, which outcompete manroot for germination sites and resources for seedling development. The overall severity of this threat is thought to be slight and more research is required.

IUCN-CMP Threat 11. Climate change and severe weather**11.1 Habitat shifting and alteration**

With climate change there is the potential for an increase in sea level, and as all populations of manroot are close to the shoreline, there is a possibility of inundation and subsequent extirpation. In addition, a warming climate may favour the growth of invasive plants that are more adapted to specific temperatures and moisture conditions. The timing of such events is unknown. Conversely, a warmed climate may present conditions that are more similar to those within the heart of the species' range (i.e., California) and may be better suited to this species' survival. The true effects of climate change on this (and other) species, however, will not be known for some time and a precautionary principle is considered warranted in the meantime.

11.2 Drought

Changes in precipitation or localized hydrology as a result of climate change may negatively impact manroot, especially if the effects occurred for several successive years in the same population. An increase or decrease in the flow of water at critical times for germination or growing season could lead to lack of germination and thus seedling development. The possible severity of this threat is unknown.

The B.C. populations of manroot are at the northern extreme of the geographic range of the species, and such isolated peripheral populations may be genetically and morphologically divergent from central populations (Lesica and Allendorf 1995). These peripheral plant populations are small and, therefore, may not have high levels of genetic diversity, but the diversity they do hold may be unique and they may hold different variants or alleles of genes that are not present in other parts of its range. The long-term survival of a species and its ability to adapt to changing ecological conditions may rest on the conservation of these genetically distinct peripheral populations (Lesica and Allendorf 1995).

5 RECOVERY GOAL AND OBJECTIVES**5.1 Population and Distribution Goal**

The goal for manroot is to maintain the extant populations within British Columbia, and to re-introduce the species at the extirpated site, if deemed necessary.

5.2 Rationale for the Population and Distribution Goal

The population and distribution goal is to maintain the extant populations in British Columbia (see Table 1). This is particularly important as this species is native to Canada and only found in B.C. There is a low rescue effect from populations outside of Canada (COSEWIC 2009). Maintaining the existing populations is a realistic goal and will prevent the status of this species from declining (e.g., becoming Extirpated). It is likely that the status for manroot will remain Endangered, due to its small, fragmented distribution range and highly restricted area of occupancy.

5.3 Recovery Objectives

Recovery will be considered significantly advanced if the following short-term (5–10 years) objectives have been met:

1. Ensure long-term protection⁵ for the known populations and habitat of manroot.
2. Assess and mitigate the extent of the main threats to manroot populations (e.g., development, recreational activities, road maintenance/widening, invasive alien plants, and fire suppression).
3. Confirm the distribution of all populations (existing and new locations) of manroot in British Columbia.
4. Determine sizes and population trends (reproductive success, seed dispersal, germination rates, etc.) of all known populations.
5. Determine if a population can be re-established at the historic site, and if feasible, re-introduce the species by 2016.

6 APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Underway

The following actions have been categorized by the action groups of the B.C. Conservation Framework (Ministry of Environment 2010b). Status of the action group for this species is given in parentheses.

Compile Status Report (complete)

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

Send to COSEWIC (complete)

- Manroot assessed as Endangered (COSEWIC 2009). Re-assessment due 2019.

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.

Planning (complete)

- B.C. Recovery Plan completed (this document, 2013).

Habitat Protection and Private Land Stewardship (in progress)

- Landholder contact should be carried out in conjunction with Garry Oak Ecosystem Recovery Team (GOERT) and its partner organizations.

6.2 Recovery Planning Table**Table 3.** Recovery planning table for manroot.

Objective	Conservation Framework action group	Actions to meet objectives	Threat^a or concern addressed	Priority^b
1, 2	Habitat protection; Private Land Stewardship	• Determine appropriate measures to protect habitat	1.1, 6.1, 7.1, 7.3, 8.1	Essential
		• Develop stewardship agreements, conservation covenants with private landowners on all properties	1.1, 6.1, 7.1, 7.3, 8.1	Essential
		• Advise landowners on best management practices to mitigate threats	1.1, 6.1, 7.1, 7.3, 8.1	
2	Habitat protection; Private Land Stewardship	• Assess impacts of invasive alien species at all locations	8.1	Beneficial
		• Monitor locations to assess the effects of any management actions taken to mitigate invasive alien species	8.1	Beneficial
3	Habitat protection; Private Land Stewardship	• Identify and map occupied and suitable habitat for the species	Knowledge gaps	Beneficial
		• Prioritize areas for inventory		Beneficial
		• Conduct inventories		Beneficial
4	Habitat protection; Private Land Stewardship	• Develop and implement monitoring protocols for manroot distribution and abundance at each location	Knowledge gap	Necessary
		• Monitor status of populations to determine population trends	Knowledge gap	Necessary
5	Species and Population Management	• Determine requirements for seed germination.	Knowledge gap	Beneficial
		• Determine the suitability of the South Pender Island historic location for re-introduction	Knowledge gap	Beneficial
		• Develop a re-introduction plan with the landowner if feasible		1.1, 6.1, 7.1, 7.3, 8.1
		• Re-introduce the species if feasible	Small populations	

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

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

7 INFORMATION ON HABITAT NEEDED TO MEET RECOVERY GOAL

Threats to manroot habitat have been identified. To meet the population and distribution goal for this species, it is recommended that specific habitat attributes be identified for manroot. In addition, it is recommended that locations of habitat are geospatially described on the landscape to mitigate habitat threats and to facilitate the actions for meeting the population and distribution goal.

7.1 Description of Survival/Recovery Habitat

Currently, only general habitat requirements are known for manroot. Specific habitat requirements for the species still need to be determined. When this outstanding work has been completed, it would be beneficial if the habitat needed for survival/recovery of the species was spatially identified for manroot in B.C. (see Section 7.2). At minimum, survival/recovery habitat is described as the suitable habitat (see Section 3.3.1) within the area of occupancy⁶ for this species based on International Union for the Conservation of Nature standards (IUCN Standards and Petitions Subcommittee 2010).

7.2 Studies Needed to Describe Survival/Recovery Habitat

A schedule of studies outlining the work necessary to identify survival/recovery habitat is provided in Table 4.

Table 4. Studies needed to describe survival/recovery habitat to meet the population and distribution goal for manroot.

Description of activity	Outcome/rationale	Timeline
1. Conduct surveys: <ul style="list-style-type: none"> • Map occupied (survival) habitat using established mapping techniques 	Known sites are accurately mapped	2013–14
2. Describe and record condition of occupied (survival) 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) 	Information on the occupied habitat characteristics and features available for monitoring of management activities	2014–15

⁶ Area of occupancy (AOO) is defined as the area within its extent of occurrence, which is occupied by a taxon, excluding cases of vagrancy. Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. AOO is measured using a grid size of 2 km (a cell area of 4 km²) (IUCN Standards and Petitions Subcommittee 2010).

8 MEASURING PROGRESS

The following performance indicators provide a way to define and measure progress toward achieving the population and distribution goal and recovery objectives. Performance measures are listed below for each objective.

Objective 1

- At least two locations have stewardship agreements established for the protection of the species by 2016.

Objective 2

- Research projects have been initiated by 2015 to identify threats and assess risk to populations.

Objective 3

- Inventory of suitable habitats has been conducted by 2016.

Objective 4

- Monitoring of the sizes and population trends of all known populations has been initiated by 2014.

Objective 5

- The feasibility for re-introduction has been assessed by 2014. Potential habitat has been investigated by 2015, and if feasible, the plant re-introduced by 2016.

9 EFFECTS ON OTHER SPECIES

This species occurs within Garry oak and associated ecosystems; as such, the associated flora and fauna would also be protected by conserving manroot (GOERT 2002). There are no species at risk directly associated with this species or found at its known locations. Negative impacts to other species are not anticipated.

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