PROPOSED

Species at Risk Act
Recovery Strategy Series
Adopted under section 44 of SARA

Recovery Strategy for the Sand-verbena Moth (*Copablepharon fuscum*) in Canada

Sand-verbena Moth



2012

Canada

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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 (SAR) Public Registry (www.sararegistry.gc.ca).

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RECOVERY STRATEGY FOR THE SAND-VERBENA MOTH (*Copablepharon fuscum*) IN CANADA

2012

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia (Part 2) under Section 44 of the *Species at Risk Act.* Environment Canada has included an addition which completes the SARA requirements for this recovery strategy, and excludes the section on Socio-Economic Considerations. Socio-economic factors are not part of the consideration process for federal recovery strategies developed under SARA. These factors are kept isolated from this strategic phase of recovery planning.

2012

This Recovery Strategy for the Sand-verbena Moth in Canada consists of:

Part 1: Federal Addition to the "Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia", prepared by Environment Canada.

Part 2: "Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia", prepared by the British Columbia Invertebrates Recovery Team for the British Columbia Ministry of Environment.

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PART 1: Federal Addition to the "Recovery Strategy for the Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia", prepared by Environment Canada

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.

SARA section 37 requires the competent Minister, which is the federal Minister of the Environment in this case, to prepare a recovery strategy for all listed extirpated, endangered or threatened species. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)).

The attached provincial recovery strategy (Part 2 of this document) was provided as science advice to the jurisdictions responsible for managing the species in British Columbia. Environment Canada has prepared this federal addition to meet the requirements of SARA.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Sand-verbena Moth 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 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.

SPECIES STATUS INFORMATION

Legal Designation: SARA Schedule 1 (Endangered)

Table 1: Conservation Status (from NatureServe 2010 and B.C. Conservation Framework 2010):

Global (G) Rank	National (N) Rank(s)	Sub-national (S) Rank(s)	COSEWIC Status	B.C. List	B.C. Conservation Framework
G1*	N1	S1	Endangered	Red	Priority 2, Goals 1 & 3

* Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; SNR – status not ranked

** The three goals of the B.C. Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems

It is estimated that the percent of the global range/ distribution of this species in Canada is 76% (3700 km^2).

SPECIES AT RISK ACT REQUIREMENTS

The following sections address specific requirements of SARA that are either not addressed in the "Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia" (Part 2 of this document, referred to hereafter as "the provincial recovery strategy") or need to be highlighted.

1. Socio-economic Considerations

The provincial document contains a short statement on socio-economic considerations. As socio-economic factors are not a consideration in any aspect of the preparation of SARA recovery strategies (see section 41(1) of SARA), the Socio-economic Considerations section of the provincial document is not considered part of the federal Minister of the Environment's recovery strategy for this species.

2. Recovery Feasibility

This section replaces the "Recovery Feasibility" section in the provincial recovery strategy.

Recovery of the Sand-verbena Moth (*Copablepharon fuscum*) is considered technically and biologically feasible based on the four criteria for assessing feasibility (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. Self-sustaining populations of Sand-verbena Moth are present in four locations in British Columbia. Little information exists on population structure, dispersal, and reproductive capability of Sand-verbena Moth at each known location. The ability of these populations to persist in such a fragmented landscape with increasing habitat loss or change indicates that there are individuals capable of reproduction.

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

   Yes. Although, Sand-verbena Moth populations occur in remnant habitat patches of Yellow Sand-verbena in British Columbia. Restoration of dune habitats affected by vegetation stabilization, recreation use, or other threats is possible at all locations. Potential recovery measures include removing invasive plants to restore open dune habitat or managing recreational activities (e.g., extensive foot traffic) to minimize soil compaction. Restoration and maintenance of sand dune habitats will be necessary to ensure populations remain. It is believed that the species can perpetuate itself given sufficient habitat and food-plant availability.

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

Yes. Although the Canadian range of Sand-verbena Moth coincides with a densely populated part of British Columbia, and threats to its habitat will continue, it will be possible to mitigate threats to its habitat from recreational developments and habitat degradation. Taking steps to maintain natural sand dune environments and Yellow Sand-verbena habitat connectivity is important to maintain the long-term viability of sub-populations at each location.

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

Yes. Effective recovery techniques exist to increase habitat for Sand-verbena Moth. They focus on removal of stabilizing vegetation and supplementing host-plant resources through establishment of Yellow Sand-verbena. Captive breeding to supplement the wild populations and locations may be required for the creation of a new sub-population, or may take place to gain knowledge regarding this species life history and reproductive capabilities. Techniques used to recover this species are similar to the recovery techniques applied to species with similar threats, issues and requirements, both from ecological and social perspectives. There are no proposed recovery techniques likely to be applied that are thought highly experimental, as evaluated by science and recovery team members.

3. Population and Distribution Objectives

This section replaces the "Recovery Goal" section in the provincial recovery strategy.

The Population and Distribution Objective for the Sand-verbena Moth is:

To increase the size of the four known extant Sand-verbena Moth sub-populations[1] and establish one additional sub-population in Canada.

Rationale:

Surveys from 2001 to 2007 confirmed four locations of Sand-verbena Moth in British Columbia. These are outlined in the provincial recovery strategy. Since the posting of the provincial recovery strategy, the BC Invertebrates Recovery Team has decided that creation of an additional sub-population would be important in reducing the impact of stochastic events on the Canadian Population. That decision is reflected in this federal addition.

[1] Sub-population replaces the word meta-populations referenced within the COSEWIC Status Report and the Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia. It is assumed that each of the four locations mentioned in the Recovery Strategy supports a sub-population.

There are no population estimates for any of the sub-populations making it impossible to set quantifiable objectives referencing number of individual moths. Mark-recapture studies are expensive and time-consuming and have some potential impacts on the target populations, which limits their effectiveness.

For butterfly species, increasing population density can be proportional to increasing habitat availability (Turlure et al., 2010). Due to lack of detailed sub-population numbers it is assumed that a measureable benchmark for increasing the size of extant sub-populations (population objective) is a corresponding increase in available habitat. Consistent with the provincial recovery strategy, a 20% increase in Yellow Sand-verbena (measured as foliar cover) at each location will be considered enough to meet the population objective regarding sub-population size.

4. Broad Strategies and General Approaches Recommended to Meet Population and Distribution Objectives

The majority of the approaches recommended to meet the population and distribution objectives are contained in the recovery planning table (Table 2: Recovery planning table for the Sand-verbena Moth (SVM)) in the provincial recovery strategy. Additional recommended approaches are included here (see Table 2) to guide implementation of the changes reflected in the federal population and distribution objectives. Once implemented, these approaches, combined with the approaches in the provincial document and the critical habitat schedule of studies, will be sufficient to meet the population and distribution objectives.

Table 2: Additional Recommended Approaches

Priority	Approach / Strategy	Threat / Limitation Addressed	Description of Management and Research Approaches	Outcome/Deliverables
High	Inventory, monitoring, and habitat protection	Knowledge gap and habitat protection	Determine the specific habitat attributes needed to support Sand-verbena Moth. o Determine soil conditions needed to support Yellow Sand-verbena. o Determine Yellow Sand-verbena density required to support Sand-verbena Moth. o Quantify in-situ growth rates of Yellow Sand-verbena.	Knowledge required for refining components of critical habitat and informing habitat expansion activities.
High	Habitat restoration and habitat protection	Habitat loss and host plant patch size	Increase the Yellow Sand-verbena by 20% foliar cover at each extant location.	Include restored sites as critical habitat once they demonstrate the requisite biophysical attributes.

Priority	Approach / Strategy	Threat / Limitation Addressed	Description of Management and Research Approaches	Outcome/Deliverables
High	Habitat restoration and species introduction	Habitat loss and host plant patch size.	Prioritize and identify a location for an additional sub-population, and undertake Yellow Sand-verbena restoration and Sand-verbena Moth introduction at that location.	A functioning sub-population at one additional site is required to meet the population and distribution objectives.

5. Critical Habitat

5.1 Identification of the Species' Critical Habitat

This section replaces the "Critical Habitat" section in the provincial recovery strategy.

Section 41(1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Critical habitat is defined in SARA as: "the 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."

The 2008 provincial recovery strategy for this species noted that critical habitat could not be identified at that time (nor is it required in the provincial process), but that it might be identified in a subsequent action plan. This federal recovery strategy does identify critical habitat to the extent possible for this species. More precise boundaries may be mapped, and additional critical habitat may be added in the future if additional research supports the inclusion of areas beyond those currently identified. A primary consideration in the identification of critical habitat is the amount, quality, and locations of habitat needed to achieve the population and distribution objectives.

Critical habitat is identified to the extent possible using the best information available for each of the four locations mentioned in the "Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia". This identification constitutes a partial identification of critical habitat. A complete identification of critical habitat for Sand-verbena Moth will require an increase in available habitat and thus the number of individuals in the sub-population at each location, and the creation of a new sub-population at a new location.

Biophysical Attributes

Critical habitat contains the following biophysical attributes:

- Yellow Sand-verbena plants that produce flowers at least once every two years.
- The soil both under and within 5 meters of any Yellow Sand-verbena plant which produces flowers at least once every two years.

Rationale:

It is clear that Yellow Sand-verbena is an important habitat requirement for Sand-verbena Moth, but the specifics of patch size, plant density, and plant growth rates required to support the Sand-verbena Moth remain undefined (COSEWIC, 2003; BC Invertebrates Recovery Team, 2008; N. Page, pers. comm., 2010). Until these specific attributes can be studied (see Table 2) it is prudent that all plants, and associated soil, capable of supporting the entire lifecycle of Sand-verbena Moth be considered necessary for the survival or recovery of the species.

While Sand-verbena Moth relies on Yellow Sand-verbena for all life stages except pupation, it requires flowering Yellow Sand-verbena for egg laying and adult feeding (BC Invertebrates Recovery Team, 2008). It stands to reason that Yellow Sand-verbena plants not capable of flowering can not support the full life cycle of the moth. There are sites within each location that contain Yellow Sand-verbena that no longer flowers due to competitive vegetation and altered soil chemistry associated with sand dune stabilization (Jones et al., 2004; N. Page, pers. comm., 2010). It is also important to note that first year plants will not be used for egg-laying as those that do flower tend to do so after the breeding season (N. Page pers. comm., 2010). The two year time period for flowering is to ensure that new plants established from either natural processes or active introduction are given a chance to develop into habitat capable of supporting Sand-verbena Moth.

Larval refuge and hibernation, and Sand-verbena Moth pupation, are dependent on the sand beneath and around Yellow Sand-verbena (COSEWIC, 2003; N. Page, unpublished). It is not thought that larvae or pupae would use the sand more than 5 meters from the Yellow Sand-verbena for these activities, nor would larvae cross more than 5 meters of open sand to feed on nearby Yellow Sand-verbena plants (N. Page, pers. comm., 2010).

Locations Containing Critical Habitat

Critical habitat is defined as any place containing the biophysical attributes stated above, at each of the four locations mentioned in the provincial recovery strategy. Those locations are Goose Spit (Appendix 1, Figure 1), Sandy Island (Appendix 1, Figure 2), Cordova Spit / Island View Beach (Appendix 1, Figure 3), and James Island (Appendix 1, Figure 4). The extent of those locations is identified by bounding rectangles that encompass the areas which contain critical habitat now, and associated habitat that may be identified as critical habitat for Sand-verbena Moth in the future.

5.2 Schedule of Studies to Identify Critical Habitat

This section replaces the "Recommended schedule of studies to identify critical habitat" section in the provincial recovery strategy.

Table 3: Schedule of Studies to Identify Critical Habitat

Description of Activity	Outcome/Rationale	Timeline for Completion
Locate and characterize daytime adult refuge sites.	Not enough is known about adult daytime refuge sites to include them in the critical habitat identification. They are, however, considered to be important components of critical habitat to be included at a latter date.	2012
Determine movement activities and capabilities of Sand-verbena Moth.	Not enough is known about movement corridors between patches of Yellow Sand-verbena to include them in the critical habitat identification. They may be important components of critical habitat to be included at a latter date.	2012

5.3 Examples of Activities Likely to Result in Destruction of Critical Habitat

Destruction of critical habitat will be determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

Sand-verbena Moth is dependent on Yellow Sand-verbena and associated sand for all stages of its lifecycle. Yellow Sand-verbena is a perennial coastal dune specialist which typically grows in open sandy soils lacking plant cover. Activities that are likely to result in destruction of critical habitat, the main component of which is Yellow Sand-verbena, include but are not limited to, the activities below.

Table 4: Activities likely to result in destruction of critical habitat for Sand-verbena Moth

Activity	How the activity is likely to destroy critical habitat	Biological function lost
Planting or introduction of plants (both invasive and native) that may cause dune stabilization or interspecies competition.	Results in loss or degradation of Yellow Sand-verbena and surrounding substrate.	Egg laying, larval feeding, larval refuge, larval hibernation, pupation, adult feeding and refuge.
Introduction of herbivores that may feed on Yellow Sand-verbena.	Results in loss or degradation of the Yellow Sand-verbena.	Egg laying, larval feeding, adult feeding and refuge.

Activity	How the activity is likely to destroy critical habitat	Biological function lost
Repeated trampling (e.g.: foot traffic or vehicle traffic) of Yellow Sand-verbena.	Results in physical damage to, or destruction of Yellow Sand-verbena.	Egg laying, larval feeding, adult feeding and refuge.
Harvesting or removal of Yellow Sand-verbena plants	Results in loss of Yellow Sand-verbena.	Egg laying, larval feeding, adult feeding and refuge.
Anthropogenic activities that cause the compaction or disruption of sand near Yellow Sand-verbena. Examples include repeated tent use or digging.	Results in compaction, removal, or overturning of the soil near Yellow Sand-verbena. This may affect both the surrounding substrate or Yellow Sand-verbena, or both.	Egg laying, larval feeding, larval refuge, larval hibernation, pupation, adult feeding and refuge.
Application of herbicides which may impact Yellow Sand-verbena.	Results in loss or degradation of Yellow Sand-verbena.	Egg laying, larval feeding, adult feeding and refuge.
Deposition of waste materials or fertilizers.	Alteration of soil conditions supporting Yellow Sand-verbena.	Egg laying, larval feeding, larval refuge, larval hibernation, pupation, adult feeding and refuge.

Activities that introduce excess water or reduce water input, to a level that may affect hydrology of the site. Examples include increasing runoff from man made structures or diverting water via ditching.	Alteration of the moisture regime may reduce the ability of the substrate to support Yellow Sand-verbena.	Egg laying, larval feeding, adult feeding and refuge.
Establishment of major light sources that attract moths and predators.	Light may draw individuals away from important, unlit, patches of habitat.	Egg laying and adult feeding.
Anthropogenic introduction of barriers to sand movement. Examples include fences and dune stabilization structures.	Results in loss or degradation of Yellow Sand-verbena and surrounding substrate.	Egg laying, larval feeding, larval refuge, larval hibernation, pupation, adult feeding and refuge.
Unnecessary anthropogenic introduction of materials that may bury Yellow Sand-verbena or alter the natural disturbance regime. An example includes augmentation of recreational beaches with imported sand.	Results in burying of Yellow Sand-verbena or alteration of processes such as high tides and wave action required to maintain the surrounding substrate.	Egg laying, larval feeding, larval refuge, larval hibernation, pupation, adult feeding and refuge.

Activity	**How the activity is likely to destroy critical habitat**	**Biological function lost**

6. Statement on Action Plans

An action plan will be posted on the Species at Risk Public Registry by 2014.

7. 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 in this statement.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Sand-verbena Moth. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the provincial recovery strategy in particular: description of the species' habitat and biological needs, ecological role, and limiting factors; effects on other species; and the recommended approaches for recovery.

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APPENDIX 1: Maps and Coordinates of Critical Habitat

Note: In the maps that follow the metes and bounds descriptions, critical habitat includes all areas containing the appropriate biophysical attributes that fall within the bounding rectangles.

Bounding Rectangles: Environment Canada, unpublished data, 2011.
Ortho-photograph: Vancouver Island East Ortho-photographs. 50 cm. 2002.

1) Critical habitat for Sand-verbena Moth at Goose Spit:

The critical habitat for the Goose Spit location (Figure 1) is within the bounding rectangle described by the following coordinates (Datum: North American Datum 83, Coordinate System: Universal Transverse Mercator, Zone 10):

- Starting at the Point of Commencement (POC) at 362956.886, 5503437.663 meters.
- Thence, approximately 163.5 degrees in a straight line to Point 1 (P1) at 363101.463, 5502948.180 meters.
- Thence, approximately 253.5 degrees in a straight line to Point 2 (P2) at 361073.110, 5502347.994 meters.
- Thence, approximately 343.5 degrees in a straight line to Point 3 (P3) at 360928.521, 5502837.480 meters.
- Thence, approximately 73.5 degrees in a straight line to the Point of Commencement (POC).

2) Critical habitat for Sand-verbena Moth at Sandy Island:

The critical habitat for the Sandy Island location (Figure 2) is within the bounding rectangle described by the following coordinates (Datum: North American Datum 83, Coordinate System: Universal Transverse Mercator, Zone 10):

- Starting at the Point of Commencement (POC) at 366272.443, 5499616.943 meters.
- Thence, approximately 159.4 degrees in a straight line to Point 1 (P1) at 367071.397, 5497485.850 meters.
- Thence, approximately 249.4 degrees in a straight line to Point 2 (P2) at 366091.160, 5497117.631 meters.

- Thence, approximately 339.4 degrees in a straight line to Point 3 (P3) at 365292.181, 5499248.731 meters.

- Thence, approximately 69.4 degrees in a straight line to the Point of Commencement (POC).

3) Critical habitat for Sand-verbena Moth at Cordova Spit and Island View Beach:

The critical habitat for the Cordova Spit and Island View Beach location (Figure 3) is within the bounding rectangle described by the following coordinates (Datum: North American Datum 83, Coordinate System: Universal Transverse Mercator, Zone 10):

- Starting at the Point of Commencement (POC) at 472730.614, 5382904.935 meters.

- Thence, approximately 175.9 degrees in a straight line to Point 1 (P1) at 472913.186, 5380367.828 meters.

- Thence, approximately 265.9 degrees in a straight line to Point 2 (P2) at 472406.351, 5380331.356 meters.

- Thence, approximately 355.9 degrees in a straight line to Point 3 (P3) at 472223.779, 5382868.463 meters.

- Thence, approximately 85.9 degrees in a straight line to the Point of Commencement (POC).

4) Critical habitat for Sand-verbena Moth at James Island:

The critical habitat for the James Island location (Figure 4) is within the bounding rectangle described by the following coordinates (Datum: North American Datum 83, Coordinate System: Universal Transverse Mercator, Zone 10):

- Starting at the Point of Commencement (POC) at 473675.699, 5386016.139 meters.

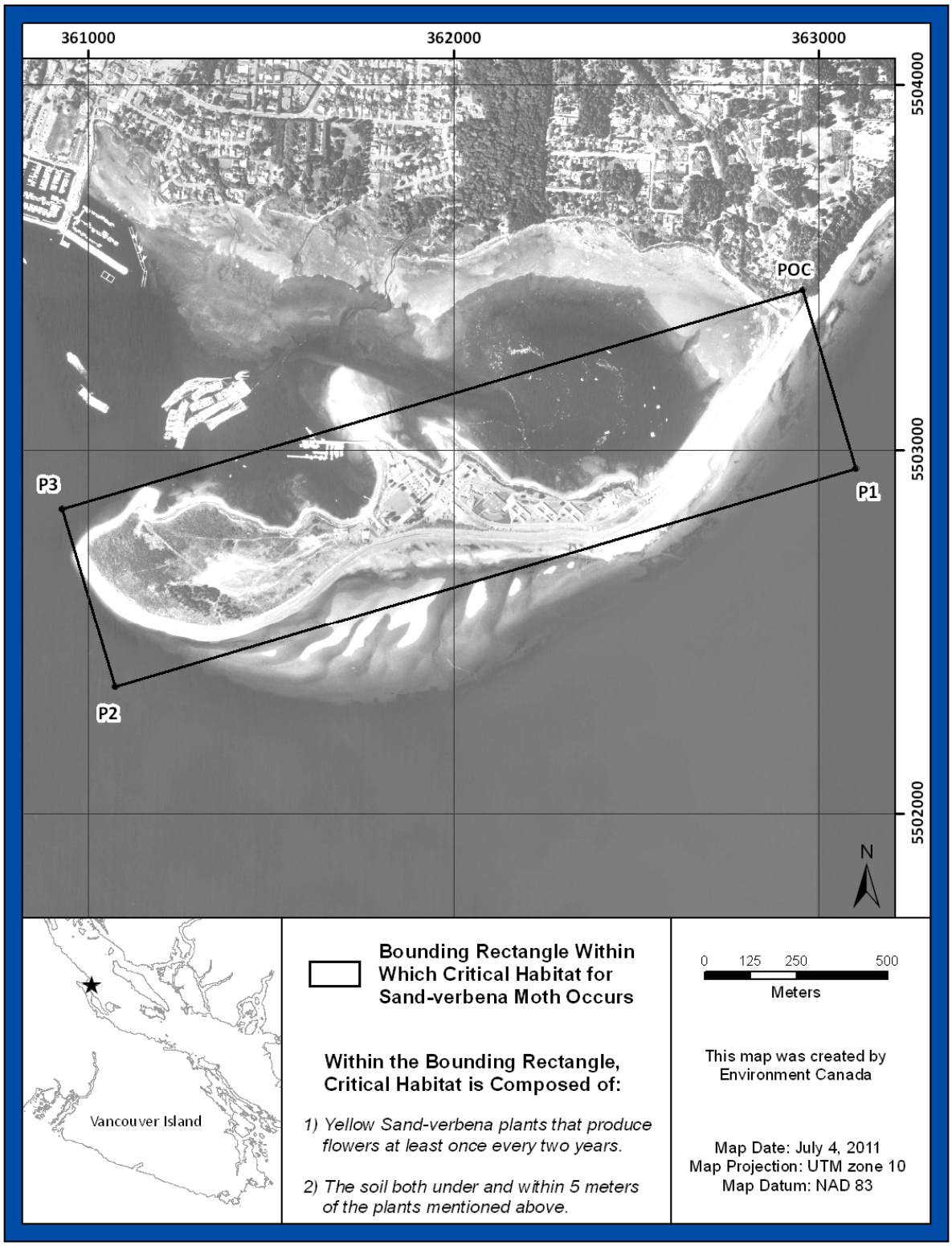
- Thence, approximately 147.7 degrees in a straight line to Point 1 (P1) at 475759.503, 5382712.050 meters.

- Thence, approximately 237.7 degrees in a straight line to Point 2 (P2) at 474153.997, 5381691.925 meters.

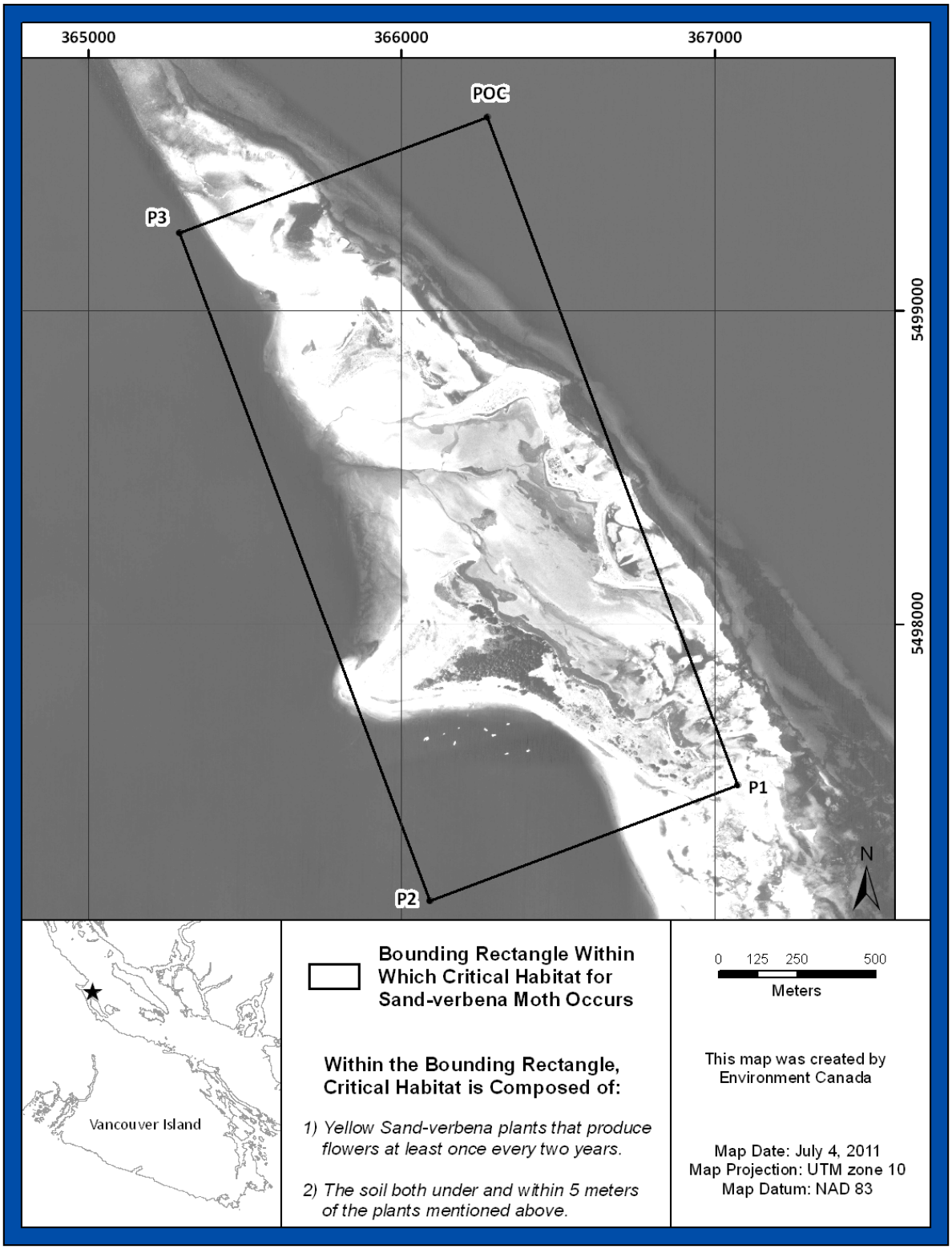
- Thence, approximately 327.7degrees in a straight line to Point 3 (P3) at 472070.147, 5384996.012 meters.

- Thence, approximately 57.7 degrees in a straight line to the Point of Commencement (POC).

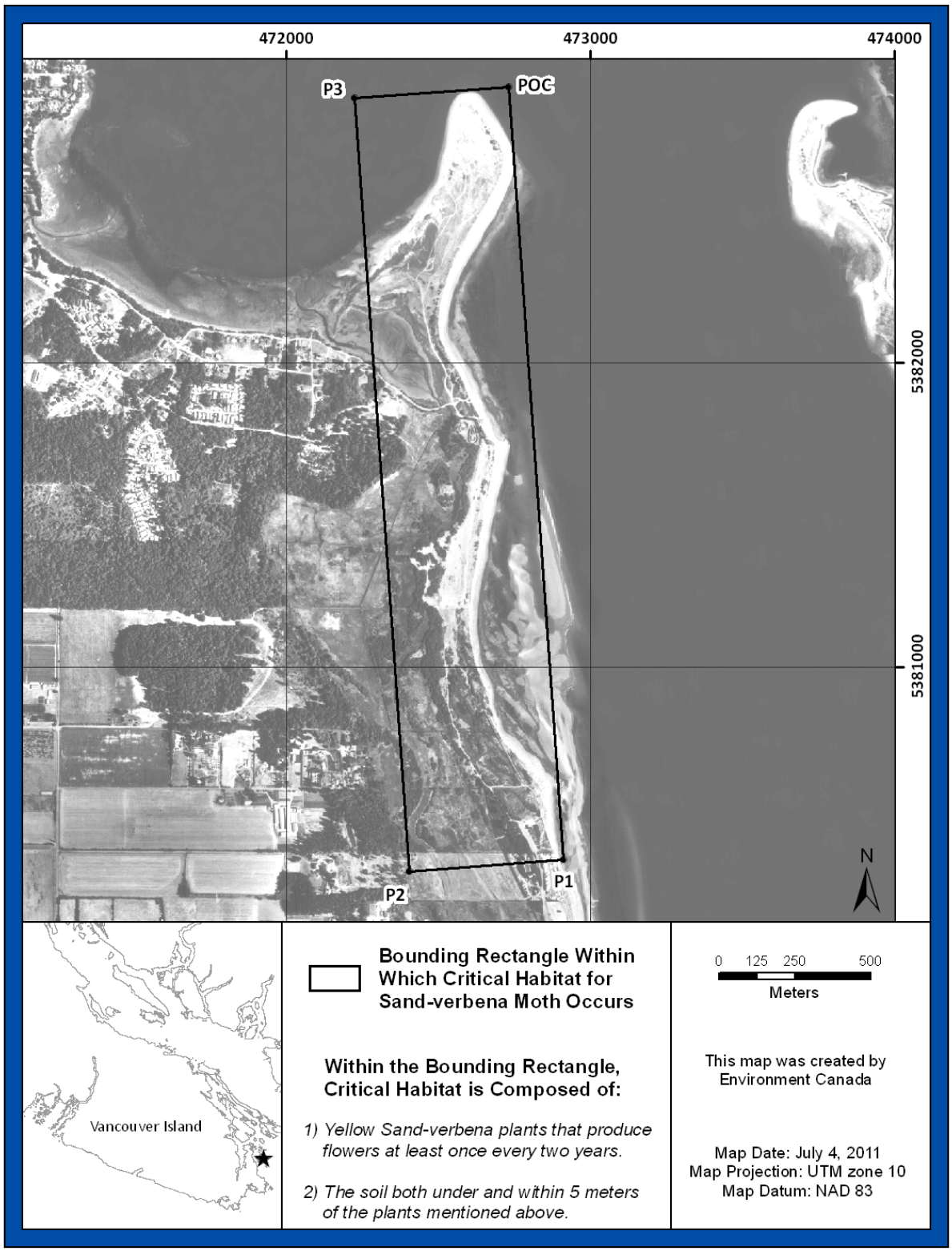
Appendix 1 - Figure 1: Critical Habitat for Sand-verbena Moth at Goose Spit.



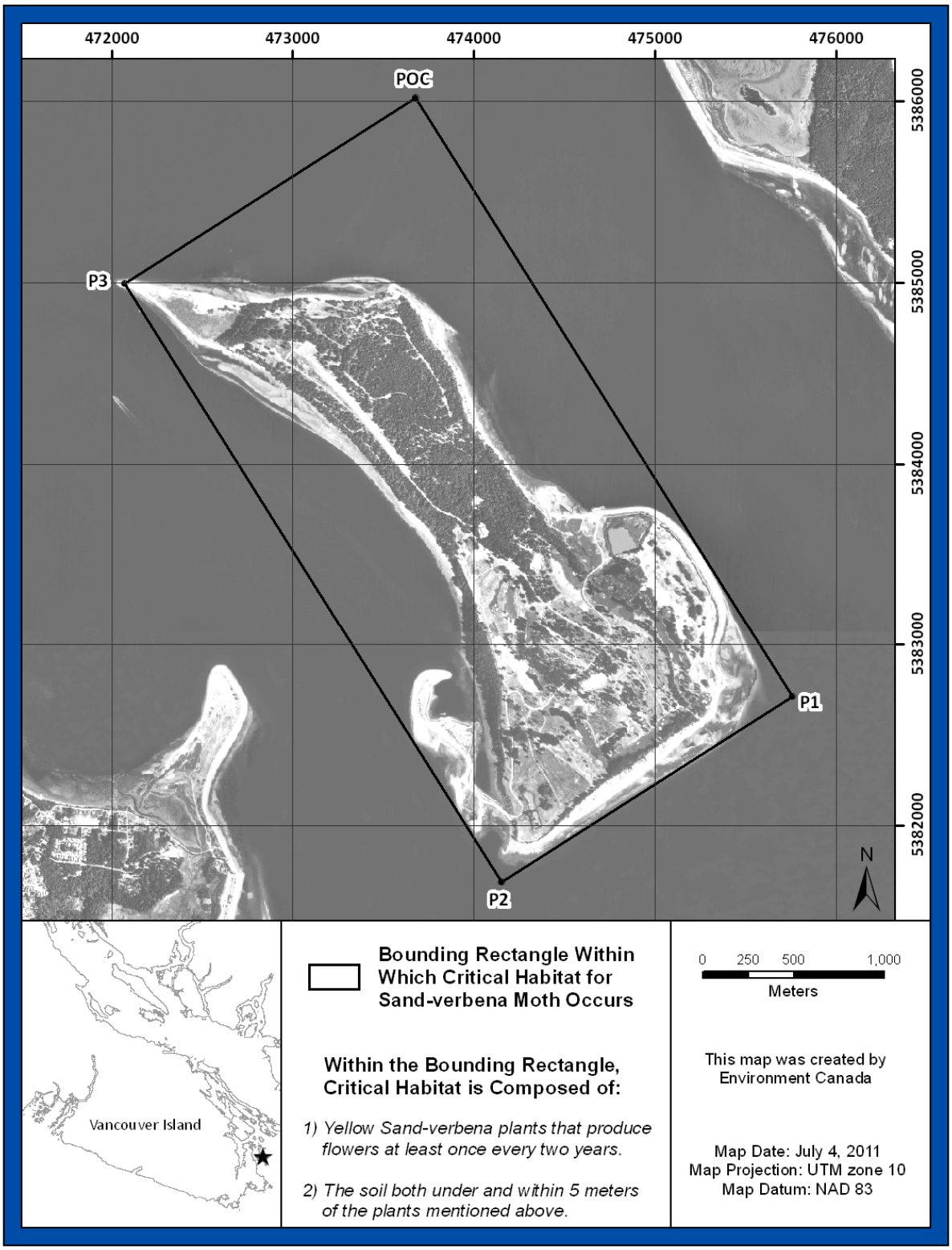
Appendix 1 - Figure 2: Critical Habitat for Sand-verbena Moth at Sandy Island.



Appendix 1 - Figure 3: Critical Habitat for Sand-verbena Moth at Cordova Spit and Island View Beach



Appendix 1 - Figure 4: Critical Habitat for Sand-verbena Moth at James Island.



PART 2: Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia, prepared by the British Columbia Invertebrates Recovery Team

Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia



Prepared by the British Columbia Invertebrates Recovery Team

March 2008

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 most 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/rcvry1.htm>

Recovery Strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia

Prepared by the British Columbia Invertebrates Recovery Team

March 2008

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Disclaimer

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

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover Sand-verbena Moth populations in B.C. 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 implementing the directions set out in this strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of Sand-verbena Moth.

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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for Sand-verbena Moth under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service (CWS) and Parks Canada Agency participated in the preparation of this recovery strategy.

ACKNOWLEDGEMENTS

Nick Page has contributed data and scientific expertise to this recovery strategy, and his independent research on this and other *Copablepharon* moths is vital to these species' recovery in Canada. Additional review was completed Lucy Reiss and Trish Hayes (Canadian Wildlife Service, Pacific and Yukon Region, Environment Canada); Carolyn Seburn (Canadian Wildlife Service, Northern and Central Region, Environment Canada); and Brenda Costanzo and Jeff Brown (B.C. Ministry of Environment).

EXECUTIVE SUMMARY

Description and life history
Sand-verbena Moth has dark brown wings, distinct black and pale yellow lines running parallel to the wing margins, and a wingspan from 35 to 40 mm. The flight season is from mid-May to early July, when adults deposit eggs singly or in small groups in the trumpet-shaped flowers of its only host plant, yellow sand-verbena (*Abronia latifolia*). Larvae feed on yellow sand-verbena leaves and flowers throughout the summer, and overwinter from early fall through early spring. The adult moths live between 7 and 21 days.

Populations and distribution
Sand-verbena Moth occurs in the Strait of Georgia – Puget Sound region of British Columbia (B.C.) and Washington State, respectively. Globally, there are nine known locations. Surveys from 2001 to 2007 show four locations[2] in B.C. Sand-verbena Moth locations are regionally isolated and there is probably no movement of individuals between locations. Preliminary studies imply that each location is composed of a series of subpopulations, which likely have a direct correlation with the patchy distribution of yellow sand-verbena in coastal spits and dunes. Actual numbers of individuals within any given population in B.C. is unknown.

Habitat and biological needs
Sand-verbena Moth depends on yellow sand-verbena plants during all life stages except pupation. Egg laying occurs in the flowers, larvae feed on the leaves, and adult moths feed on the flower nectar. Yellow sand-verbena only grows in beaches, spits, dunes, and other sand-dominated coastal ecosystems. Only large coastal sand features support patches of yellow sand-verbena large enough to sustain a Sand-verbena Moth population.

Threats
Activities that alter the sand dune vegetation or abiotic conditions at Sand-verbena Moth population sites are considered habitat threats. Categorized threats include (1) habitat loss or degradation (degradation of habitat through vegetation stabilization, habitat conversion, recreation and military training, coastal erosion and stochastic events); (2) *Bacillus thuringiensis kurstaki* spray, potentially used to control invasive gypsy moth in areas near Sand-verbena Moth locations; (3) natural biological enemies (parasitic flies, herbivory of host plants); and (4) climate change.

Recovery feasibility
Recovery of Sand-verbena Moth is technically and biologically feasible.

Recovery goal and objectives
The recovery goal is *to maintain Sand-verbena Moth within healthy sand dune ecosystems at each location in Canada*. The recovery objectives are:

[2] A Sand-verbena Moth *location* is an isolated metapopulation of the species. A location can be defined by many subpopulations, and the combination of these subpopulations defines that location. In Canada, there are four locations for Sand-verbena Moth: Goose Spit, Sandy Island, Cordova Spit/Island View Beach, and James Island.

1. to increase yellow sand-verbena patches (measured as foliar cover) at each location by 20%[3] by 2017. Existing patches of yellow sand-verbena should not be permitted to decrease below existing patch size;
2. by 2017, to restore three additional yellow sand-verbena plant locations[4] (where Sand-verbena Moth is not known to occur) to an area greater than 500 m^2 of foliar cover at each location; and
3. by 2012, to demonstrate an increased number of stewardship activities initiated and completed for land managers and public users of properties occupied by Sand-verbena Moth.

Recommended approaches for recovery

The recommended approach to recovery is to focus on habitat management of known population sites with emphasis on broader processes that sustain sand dune ecosystems and yellow sand-verbena populations. Sand-verbena Moth recovery should be coordinated with recovery of other sand dune species. Cooperative efforts to address research gaps and undertake population studies or restoration projects should be coordinated through a Sand-verbena Moth Recovery Action Group. Collaboration with management agencies in the United States could also occur.

Critical habitat

Critical habitat for Sand-verbena Moth is not currently defined or identified in this recovery strategy.

A draft action plan will be ready for submission to the Province of B.C. by March 2012. This action plan may be a multi-species sand dune ecosystem action plan, as there are similar threats with other species at risk within these ecosystems.

[3] This rate of increase will result in a doubling of host-plant resources by 2045 and partially address the estimated historic loss of yellow sand-verbena at known population sites. Sand dune habitat was significantly impacted by storms during 2005–06, resulting in 2–10 m of shoreline being lost over a 200-m stretch of beach. Habitat loss included yellow sand-verbena patches. Increasing yellow sand-verbena patch populations by 20% will offset future loss.

[4] These sand dune habitats can be adjacent to known locations or within potential dispersal distances to known locations. These locations could be within possible dispersal distance to an already existing Sand-verbena Moth location, or be within dune habitats beyond what may be considered dispersal distance.

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BACKGROUND

Sand-verbena Moth (*Copablepharon fuscum*) was scientifically described in Troubridge and Crabo (1996) from specimens collected in coastal sand dunes near Sidney, BC, and on Whidbey Island, Washington State (WA). Most *Copablepharon* moths occur in arid, sandy environments in western North America (Lafontaine 2004) and Sand-verbena Moth is the only species in this genus found west of the Cascade Mountains. Three additional *Copablepharon* species live in B.C.: *Copablepharon absidum, Copablepharon hopfingeri,* and *Copablepharon spiritum,* although none are within coastal sand dune ecosystems.

Species Assessment Information from COSEWIC

Date of assessment: November 2003
Common name: Sand-verbena Moth
Scientific name: *Copablepharon fuscum* Troubridge and Crabo
Status: Endangered
Reason for designation: The global population of this moth is very small and occurs in a very restricted range. The Canadian population, occurring at only three small sites, is even smaller and more restricted. The moth and its host plant are habitat specialists dependent on coastal dunes, a rare habitat along the West Coast. This habitat has undergone extensive losses due to stabilization of open dunes (including the introduction of invasive plant species), development, and recreational use. The host plant and therefore the moth are facing the threat of continuing declines due to the loss and degradation of coastal dunes.
Occurrence: British Columbia
Status history: Designated Endangered in November 2003. Assessment based on a new status report.

Description of the Species

Sand-verbena Moth is in the Noctuidae moth family. The species has dark to golden brown wings with distinct black and pale yellow lines running parallel to the wing margins. The wingspan is 35–40 mm and sexes are similar in size and colouration. Sand-verbena Moth does not resemble other moth species in B.C. and field determination based on forewing colour patterns is reliable.

Sand-verbena Moth flight period is from mid-May to early July, with a peak in mid-June (COSEWIC 2003). The flight period is correlated with the onset of the flowering period of the species' only host plant, yellow sand-verbena (*Abronia latifolia Eschsch.*). The adult moths live between 7 and 21 days during which time the females deposit eggs singly or in small groups in the trumpet-shaped flowers of its host plant. Young larvae are green. As the larvae age, they turn brown and show pale longitudinal stripes with a lighter brown head capsule. Larvae feed on yellow sand-verbena leaves and flowers for the remainder of the summer, entering diapause (winter dormancy in insects) sometime in the fall. Diapause ends sometime in the early spring and larvae continue to feed until pupation, which occurs below ground in early spring. Pupae are 20 mm in length, dark brown, and surrounded by a thin layer of sand particles. *Copablepharon*

moths have a distinctive long tongue that is not encased within the pupal structure. This tongue is considered a distinguishing characteristic of the *Copablepharon* genus.

Populations and Distribution

Sand-verbena Moth occurs in the Strait of Georgia – Puget Sound region of B.C. and Washington State. Globally, there are nine known locations:[5] four in B.C. and five in Washington State (Figure 1). Each location is comprised of a metapopulation of Sand-verbena Moth, defined by the patchily growing host plant yellow sand-verbena (*Abronia latifolia*) (see additional information below). The four B.C. locations are considered disjunct (COSEWIC 2003; N. Page, pers. comm., 2007). The global range of the species is approximately 4850 km^2, with dimensions less than 220 km long and 45 km wide. The Canadian range of the species is approximately 3700 km^2 and the maximum distance between global populations is 220 km (COSEWIC 2003).

Sand-verbena Moth depends entirely on yellow sand-verbena plants during all life stages except pupation. Yellow sand-verbena is a sand dune obligate that is endemic to the Pacific Coast with a range that extends from Santa Barbara, California to the Queen Charlotte Islands/Haida Gwaii, B.C. There are 28 known yellow sand-verbena locations in B.C. (COSEWIC 2003).

Surveys from 2001 to 2007 confirmed four locations of Sand-verbena Moth in B.C.: (1) Goose Spit near Comox; (2) Sandy Island north of Denman Island; (3) Cordova Spit/Island View Beach near Sidney; and (4) James Island west of Sidney (Table 1). The Goose Spit, Sandy Island, and Island View Beach locations were identified when the species was first described in 1996 (COSEWIC 2003). The James Island site was confirmed with a Sand-verbena Moth location in 2007.

Sand-verbena Moth locations are regionally isolated and there is likely little or no movement of individuals between locations, as the two closest locations are Cordova Spit and James Island, which are separated by approximately 2.1 km (N. Page, pers. comm., 2008). Populations within a location probably form metapopulations composed of numerous subpopulations that are a direct result of the patchy distribution of yellow sand-verbena at each site, and overall in coastal spits and dunes. Yellow sand-verbena grows in patches with separation distances of 100 to 500 m within locations and frequent movement between patches is likely. There are no population estimates for any of the B.C. locations.

Populations of Sand-verbena Moth at the four known locations appear stable although it is premature to suggest the populations will remain stable given that insect populations fluctuate widely from year to year based on weather patterns and other stressors (see “Biologically limiting factors” section) in the previous year. In addition, threats to the species’ habitat are evident (COSEWIC 2003) and increasing (see “Threats” section). At these known locations there

[5] A Sand-verbena Moth *location* is defined as an isolated metapopulation of the species as defined by COSEWIC. A location can be defined by many subpopulations, and the combination of these subpopulations defines that location. In Canada, there are four locations for Sand-verbena Moth (1. Goose Spit; 2. Sandy Island; 3. Cordova Spit/Island View Beach; 4. James Island).

is little information on the general biology and population structure of Sand-verbena Moth, thus it is difficult to assess trends for the species. There is little information on the use of specific yellow sand-verbena plants; it is unknown what structure and configuration within each location are necessary to maintain a population. Sand-verbena Moth does not reside in habitat where yellow sand-verbena patches have less than 500-m^2 foliar cover (COSEWIC 2003; Page 2007). However, this statement is only quantitative and neither indicates this area as a minimum patch size nor suggests that patches should be managed to this size.

Sand-verbena Moth has a global rank of "G1G2" (critically imperiled to imperiled) (Natureserve 2008) and the B.C. Conservation Data Centre lists the species provincially as "S1" (imperiled). Yellow sand-verbena is listed as "G5S3" (globally secure; provincially vulnerable) by the B.C. Conservation Data Centre.

Dune plant communities are part of the provincial Rare Natural Plant Community Red and Blue list and listed as "S1S2" plant association "*Carex macrocephala* Herbaceous Vegetation," which encompasses portions of Sand-verbena Moth habitat.

Table 1. Sand dune habitat at Canadian Sand-verbena Moth locations (COSEWIC 2003; Page 2005, 2007).

Population and location name	Park land	First Nations land (ha)	Other federal land (DND) (ha)	Private land (ha)	Total dune area (ha)*
1. Goose Spit	0.4 (Capital Regional Park)	2.4	7.0	0.0	9.8
2. Sandy Island Marine Provincial Park	17.8 (provincial park)	0.0	0.0	0.0	17.8
3. Island View Beach and Cordova Spit, Capital Regional Park	3.6 (Capital Regional Park) 4.8 (municipal park)	11.8	0.0	0.0	20.2
4. James Island	0.0	0.0	0.0	13.3 (James Island)	13.3

*Total dune area includes the area of sparsely vegetated or vegetated sand dunes rather than just the portion in which Sand-verbena Moth has been captured or yellow sand-verbena has been observed. It excludes developed areas and portions of the site with extensive tree or shrub cover.

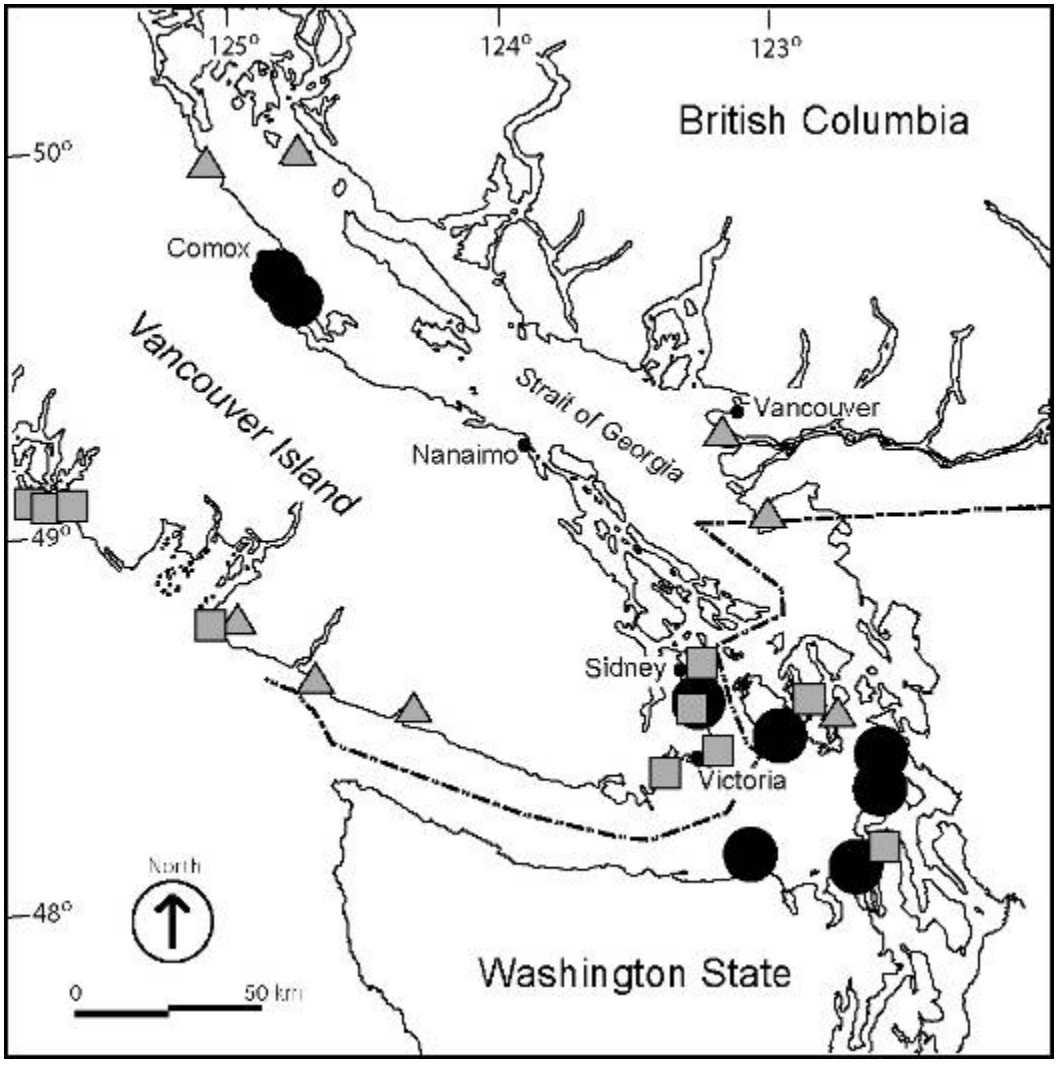


Figure 1. Sand-verbena Moth locations and sampling (2001–2007) sites in the Strait of Georgia – Puget Sound and west coast of Vancouver Island. Sand-verbena Moth locations are shown with black dots. The site south of Sidney encompasses both the Cordova Spit/Island View Beach as one location. James Island is one location although the dot is obscured due to the scale of the map. Sites with yellow sand-verbena that were sampled without successful capture are shown with squares. Dune sites without yellow sand-verbena that were sampled without capturing Sand-verbena Moth are shown with triangles.

Needs of Sand-verbena Moth

Habitat and biological needs

Sand-verbena Moth depends on yellow sand-verbena plants during all life stages except pupation. Egg laying occurs in the flowers, larvae feed on the leaves, and adult moths feed on the flower nectar. Yellow sand-verbena is a long-lived and slow-growing perennial plant with a distinctive prostrate growth form; bright yellow umbellate flowers; and succulent leaves, stems, and roots (Tillett 1967). Yellow sand-verbena flowers from early May to early October, with a peak throughout June.

Yellow sand-verbena is always found near sea level and only grows in beaches, spits, dunes, and other sand-dominated coastal ecosystems. The plant grows in sandy soils (dominant particle size is 0.25–0.15 mm) that are weakly acidic (pH 5.5–6.3) and nutrient poor (total nitrogen < 0.01%) (COSEWIC 2003). Yellow sand-verbena locations typically lack dense herbaceous or bryophyte plant cover, likely a result of periodic disturbance by natural environmental processes (e.g., storms, wave-washed logs, and wind). Such weather processes prevent dune stabilization which would otherwise occur through natural succession and plant encroachment.

The matrix and dimensions of yellow sand-verbena habitat patch sizes necessary to sustain populations of Sand-verbena Moth are poorly understood. Based on sampling records, it is estimated that greater than 500-m^2 yellow sand-verbena cover (sum of all plants) is required to maintain a viable Sand-verbena Moth population and larger patches likely support greater Sand-verbena Moth populations (COSEWIC 2003; N. Page, pers. comm., 2007). Smaller patches do not appear to have sufficient yellow sand-verbena resources to maintain a long term population of Sand-verbena Moth (COSEWIC 2003; Page 2005). Sand-verbena Moth does not reside in habitat where yellow sand-verbena patches are less than 500-m^2 foliar cover. However, this statement is only quantitative and neither indicates this area as a minimum patch size nor suggests that patches should be managed to this size.

Ecological role

Sand-verbena Moth is an important component of the conservation value of B.C.'s native ecosystems. It is considered a focal species for the conservation of coastal sand dunes in B.C. and its reliance on a single host plant that grows only in dunes and spits highlights the complexity of these ecosystems. While it is not considered an essential pollinator of yellow sand-verbena nor to have other crucial ecological roles such as food-web dynamics, the moth is often locally abundant and is likely used by bats, small mammals, and birds for food. Larval feeding damages but does not kill yellow sand-verbena plants.

Biologically limiting factors

Host-plant specificity

Sand-verbena Moth is parasitic and entirely dependent upon yellow sand-verbena during all stages of its life cycle except pupation. No similar plants in coastal sites are, or could be, used as an alternate host for egg laying, larval feeding, or nectar for the Sand-verbena Moth.

Host-plant patch size
Large populations (> 500 m^2) of yellow sand-verbena are required to sustain a Sand-verbena Moth population and are only found in large coastal sand features such as dunes and spits. Yellow sand-verbena populations are limited by the size and quality of sand beaches and dune environments in which it grows.

Small and isolated populations
Sand-verbena Moth locations appear to be isolated with little or no gene flow between them. Dispersal capabilities of Sand-verbena Moth are poorly understood and moths have not been documented greater than 100 m from dense yellow sand-verbena patches. The closest locations in B.C. (Cordova Spit and James Island) are approximately 2 km apart.

Threats

Description of the threats

1. Habitat loss

Degradation of habitat through vegetation stabilization: Stabilization of sand dunes as a result of vegetation encroachment from both native (e.g., roadside rock moss [*Racomitrium canescen*s]) and introduced (e.g., Scotch broom [*Cytisus scoparius*] and cheatgrass [*Bromus tectorum*]) plants has degraded or destroyed habitat for both Sand-verbena Moth and its host plant. It is considered a severe threat at all locations. Dune stabilization from vegetation encroachment results in loss of dense yellow sand-verbena patches and a decline in flowering.

Habitat conversion: Direct and complete irreversible physical destruction of sand dune environments for park use (e.g., campgrounds, parking areas) has occurred at Cordova Spit, Sandy Island, and Goose Spit. The development of military training facilities (e.g., buildings, training apparatus, and parking areas) has resulted in past destruction or degradation of Sand-verbena Moth habitat. Expansion of beach areas (e.g., proposed at Island View Beach Capital Regional Park), destruction of dune ecosystems for marine developments (e.g., Goose Spit), and the natural succession of dune areas will continue to alter all dune sites. Construction and maintenance activities at known sites can destroy habitat or the eggs, larvae, pupae, and adults of Sand-verbena Moth.

Recreation and military training: Use of sand dunes for recreation or military training has caused localized disturbance to Sand-verbena Moth habitat at all locations. Yellow sand-verbena plants may be trampled or destroyed and sand substrates may be compacted. Sand-verbena Moth eggs, larvae, pupae, and adults may also be damaged or killed through trampling. Less intensive disturbance may prevent vegetation stabilization and benefit yellow sand-verbena populations. National security considerations clearly supersede those governing species at risk where the two are in conflict.

Coastal erosion and stochastic events: Sand-verbena Moth habitat occurs within 100 m of the shoreline (often within 25 m), which makes it susceptible to coastal erosion and natural or human-induced changes to sand transport. Coastal erosion may destroy yellow sand-verbena

plants and their associated Sand-verbena Moth larvae by removing sand and breaking or crushing plants. Because of their small spatial extent, populations of Sand-verbena Moth are vulnerable to natural stochastic events such as large winter storms, climatic extremes, wildfire, and heavy winds during the flight season. These natural events typically occur during winter storms when larvae are overwintering in the sand. For example, storms in the winter of 2005–2006 caused 2–10 m of coastal erosion of dune front at Goose Spit for a length of 200 m along the beach (B. Allan, pers. comm., 2007), and resulted in loss of yellow sand-verbena plants that are used by Sand-verbena Moth.

The construction of erosion barriers to prevent/minimize further erosion of Comox bluffs has decreased sand transport to Goose Spit. This human-induced change has likely impacted the natural dynamics of sand movement within the dune ecosystem and may lead to vegetation stabilization.

2. Btk spraying

Btk (*Bacillus thuringiensis* var. *kurstaki*) spraying is considered a potential threat to all Sand-verbena Moth populations. Btk is a component of commercial products to control defoliating caterpillars including European Gypsy Moth (*Lymantria dispar)*. It uses spores of a naturally occurring pathogenic bacteria applied aerially to kill target and non-target butterfly and moth larvae. Although not imminent, Btk spray has the potential to result in high mortality of larvae. To date, Btk has not been sprayed near Sand-verbena Moth populations, although all locations of Sand-verbena Moth occur along prominent points of entry (e.g., there is a popular recreational vehicle camp site adjacent to Island View Beach Capital Regional Park, and visitors could potentially introduce gypsy moth to this location). Btk for gypsy moth is typically applied in early April to early May, which coincides with the feeding period of Sand-verbena Moth larvae.

3. Natural biological enemies

Parasitic flies: Tachinid flies (Family Tachinidae) are introduced (alien) parasitic flies used as a biological control agent for the European Gypsy Moth. These flies are known to have a detrimental effect on all moths. Currently these flies are only introduced in eastern United States and Canada, although they are considered a potential threat to Sand-verbena Moth populations if they establish in coastal B.C. There is a possibility the species could be introduced to western North America through natural dispersal mechanisms or intentionally for biological control.

Herbivory: Columbian black-tailed deer (*Odocoileus hemionus columbianus*) feeds on yellow sand-verbena plants during the summer when most dune plants have senesced. This may damage larvae or reduce food availability. Introduced rabbits (Eastern Cottontail [*Sylvilagus floridanus]* and European Rabbit [*Oryctolagus cuniculus*]) may also browse yellow sand-verbena plants. This has been observed in San Juan Island, WA, and at Goose Spit (Eastern Cottontail only). Herbivory is considered a minor threat at all locations.

4. Climate change

Climate change is considered a potential, but poorly understood threat to Sand-verbena Moth habitat. It may threaten Sand-verbena Moth habitat through sea-level rise, as all Canadian locations occur less than 5 m above sea level. Climate change is considered a threat to other Lepidoptera species (J. Hellmann, pers. comm., 2007).

Climate change may also increase summer drought in coastal B.C. and thus result in premature senescence of yellow sand-verbena plants. Sand-verbena Moth larvae feed on the leaves and shoots of the plant through the summer, molting and gaining energy reserves that will sustain diapause throughout the winter. Throughout the dry periods of the summer, when freshwater to the host plant decreases, the plant will lose leaves and begin to senesce early (enter winter dormancy). This premature senesence will impact the larval host-plant resources.

Actions Already Completed or Underway

All actions below are from work completed by Page from 2001 to 2007.

1. Surveys were completed between 2001 and 2007 of all potential Sand-verbena Moth population sites on public land.
2. Land managers for the Department of National Defence and British Columbia Parks and Protected Areas were made aware of the presence and significance of Sand-verbena Moth populations within properties they manage.
3. Preliminary management guidelines for activities near Sand-verbena Moth habitat at Goose Spit (Canadian Forces Base Comox) have been developed by the federal Department of National Defence. Within these guidelines is a map of yellow sand-verbena and posted information signs at the entrance to the dune area at this location.
4. Research was completed on methods for reducing stabilizing vegetation and increasing host-plant resources through propagation of yellow sand-verbena.
5. Distribution and abundance of yellow sand-verbena populations were mapped at the three Canadian Sand-verbena Moth locations.

The actions below were completed by various agencies:

6. Yellow sand-verbena patches and sand dunes were surveyed on James Island. Sand-verbena Moth was found on two of three sites surveyed (survey initiated by B.C. Ministry of Environment and completed by Page 2007).
7. Yellow sand-verbena plant populations were augmented through transplanting activities at Goose Spit; Endangered Species Recovery Fund project (N. Page, pers. comm., 2005–2007).
8. Public education pamphlet was printed and distributed to agencies responsible for managing lands with known Sand-verbena Moth populations; interest groups; and those interested in dune conservation (June 2007) (Page and B.C. Ministry of Environment).
9. Broom was removed at Goose Spit, Comox (November 2006) and dune areas were monitored for re-growth of broom (Department of National Defence).

10. Dunes were stabilized (construction of abutment) and yellow sand-verbena plants were transplanted at Goose Spit, Comox (January 2007); these plants were then monitored (Department of National Defence).
11. A first draft of Sand-verbena Moth recovery action plan was prepared (March 2007).
12. Yellow sand-verbena patches at Goose Spit were temporarily fenced in 2007, to prevent trampling during cadet training activities.
13. Capital Regional District management actions at Island View Regional Park were targeted to address identified threats that include uncontrolled access to sand dune habitats (e.g., dogs walked off leash damaging to yellow sand-verbena). Management actions include construction of a split rail fence to limit access and the development of an education program to encourage dog walkers to follow established walkways.
14. Sand-verbena Moth habitat was reviewed at Sandy Island, 2007 (BC Parks).

Knowledge Gaps

1. Population estimates for the four known locations for Sand-verbena Moth in Canada and quantification of the density of moths in relation to yellow sand-verbena (sparse vs. dense; flowering vs. non-flowering).
2. Determination of Sand-verbena Moth occurrence in potential habitat on private land in the southern portion of the Strait of Georgia.
3. Refined mapping and population estimates of yellow sand-verbena at known and potential locations.
4. Determination of dispersal ability of Sand-verbena Moth adults from mark-recapture studies.
5. Determine spatial boundaries of Sand-verbena Moth locations with reference to the James Island, and Cordova Spit/Island View Beach locations.
6. Determination of population structure within each location as well as the connectivity between isolated yellow sand-verbena patches or populations.
7. Assessment of the use of sparse, non-flowering patches of yellow sand-verbena for reproduction and larval growth.
8. Yellow sand-verbena establishment and growth in relation to environmental factors in coastal dunes; and
9. Expansion of research on habitat restoration of yellow sand-verbena populations, including methods to reduce stabilizing vegetation and increase host-plant resources.

RECOVERY

Recovery Feasibility

Recovery of Sand-verbena Moth is technically and biologically feasible. Currently, there are four known locations in B.C. Populations at these locations appear to be self-sustaining, although threats are immediate. Suitable habitat is present in B.C., and existing populations may be increased through habitat restoration focusing on increasing host-plant resources.

Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?
Self-sustaining populations of Sand-verbena Moth are present in four locations in B.C. Little information exists on population structure, dispersal, and reproductive capability of Sand-verbena Moth at each known location. The ability of these populations to persist in such a fragmented landscape with increasing habitat loss or change indicates that there are individuals capable of reproduction.

Is sufficient habitat available to support the species or could it be made available through habitat management or restoration?
Sand-verbena Moth populations occur in remnant habitat patches of yellow sand-verbena in B.C. Restoration of dune habitats affected by vegetation stabilization, recreation use, or other threats is possible at all locations. Potential recovery measures include removing invasive plants to restore open dune habitat or managing recreational activities (e.g., extensive foot traffic) to minimize soil compaction. Restoration and maintenance of sand dune habitats are necessary to ensure populations remain. It is assumed the species can perpetuate itself given sufficient habitat and food-plant availability.

Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?
The Canadian range of Sand-verbena Moth coincides with a densely populated part of B.C., and threats to its habitat will continue. However, it may be possible to mitigate threats to its habitat from recreational developments and habitat degradation. Taking steps to maintain natural sand dune environments and yellow sand-verbena habitat connectivity is important to maintain the long-term viability of metapopulations at each location.

Do the necessary recovery techniques exist and are they known to be effective?
Effective recovery techniques exist to increase habitat for Sand-verbena Moth. They focus on removal of stabilizing vegetation and supplementing host-plant resources through establishment of yellow sand-verbena (see Page 2005).

Captive breeding to supplement the wild populations and locations is not thought necessary for the recovery of Sand-verbena Moth. Captive breeding may take place to gain knowledge regarding this species life history and reproductive capabilities.

Techniques used to recover this species are similar to the recovery planning applied to species with similar threats, issues and requirements, both from ecological and social perspectives. There are no proposed recovery techniques likely to be applied that are thought highly experimental, as evaluated by science and recovery team members.

Recovery Goal

The recovery goal is *to maintain Sand-verbena Moth within healthy sand dune ecosystems at each location in Canada*.

Recovery Objectives

1. To increase yellow sand-verbena patches (measured as foliar cover) at each location by 20%[6] by 2017. Existing patches of yellow sand-verbena should not be permitted to decrease below existing patch size.
2. By 2017, to restore three additional yellow sand-verbena plant locations[7] (where Sand-verbena Moth is not known to occur) to an area greater than 500 m^2 of foliar cover at each location
3. By 2012, to demonstrate an increased number of stewardship activities initiated and completed for land managers and public users of properties occupied by Sand-verbena Moth.

Approaches Recommended to Meet Recovery Objectives

Broad strategies to effect recovery are outlined in Table 2. These broad strategies include:

1. habitat protection[8]
2. population protection
3. habitat restoration
4. inventory/monitoring
5. public education and stewardship.

[6] This rate of increase will double host-plant resources by 2045 and partially address the estimated historic loss of yellow sand-verbena at known population sites. Sand dune habitat was significantly impacted by storms during 2005–2006, resulting in 2–10 m of shoreline being lost over a 200-m stretch of beach. Habitat loss included yellow sand-verbena patches. Increasing yellow sand-verbena patch populations by 20% will offset future loss.
[7] These sand dune habitats can be adjacent to known locations or within potential dispersal distances to known locations. These locations could be within possible dispersal distance to an already existing Sand-verbena Moth location, or be within dune habitats beyond what may be considered dispersal distance.
[8] 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 planning table

Table 2. Recovery planning table for Sand-verbena Moth (SVM).

Priority	Obj. no.	Approach/ strategy	Threat or concern addressed	Specific steps	Outcomes or deliverables
High	All	Habitat protection	1. Habitat loss: degradation of habitat through vegetation stabilization; habitat conversion; recreation and military training 2. Btk spray	Develop a detailed habitat action plan that includes stewardship, and management and restoration actions specific to each location	Essential habitat is protected and restored
High	All		1. Habitat loss: degradation of habitat through vegetation stabilization; habitat conversion; recreation and military training; 2. Btk spray	Establish a Sand-verbena Moth Recovery Action Group comprised of land managers and interest groups at known population sites	Reduced risk of development of SVM habitat; increased protection of SVM populations
Mod	All			Collaborate with U.S. agencies with SVM populations	Increased knowledge and expertise; improved management of all SVM populations
High	All			Develop and distribute best management practices for SVM habitats, including provisions for increasing yellow sand-verbena patches within known sites	Best management practices are used by land managers to maintain SVM populations and habitat
Mod	All		1. Habitat loss: degradation of habitat through vegetation stabilization	Incorporate SVM recovery into broader planning through revision of existing management plans such as park plans	Increased likelihood of land managers to incorporate SVM conservation into land use decisions
Mod	All			Provide training or information materials to staff working in or near SVM habitat	Incremental habitat loss or population impacts from operations and maintenance activities are reduced
Mod	1, 2		3. Natural biological enemies; herbivory	Protect translocated or new young yellow sand-verbena plants by placing barriers around them	Increased area of yellow sand-verbena patches
Mod	1		1. Habitat loss: degradation of habitat through vegetation stabilization	Develop an invasive species management strategy specific to the four known SVM locations	Yellow sand-verbena is more abundant and more broadly distributed at each site

Priority	Obj. no.	Approach/ strategy	Threat or concern addressed	Specific steps	Outcomes or deliverables
Mod	1	Population protection	2. Btk spraying	Develop methods of reducing or avoiding risks from Btk spraying programs with responsible agencies (Gypsy Moth Management Committee)	SVM populations are not at risk from Btk spraying programs
High	All	Habitat restoration	1. Habitat loss: degradation of habitat through vegetation stabilization	Remove stabilizing vegetation and replant yellow sand-verbena	Increase in host-plant resources
Low	1, 2		1. Habitat loss: degradation of habitat through direct loss from winter storms	Model coastal sediment transport and erosion risk	Improved understanding of coastal processes and risk of habitat loss from erosion
High	All		1. Habitat loss: degradation of habitat through vegetation stabilization	Remove Scotch broom and other invasive plants	Reduction in incremental loss of open sand dunes and yellow sand-verbena
Mod	2	Inventory and monitoring	Knowledge gap	Develop population estimates for SVM in known populations; estimate density	Increased ability to assess population status, and effects of recovery actions
High	2		Knowledge gap	Repeat sampling on James Island	Confirm presence of SVM at southwest spit
Mod	All		Knowledge gap	Improve estimates of SVM dispersal ability through mark-recapture studies; as partially demonstrated by occupancy in adjacent (previously unoccupied) restored yellow sand-verbena sites	Populations are defined and understanding of subpopulations is increased
Mod	N/A		Knowledge gap	Undertake genetic studies to obtain information on isolation of subpopulations	Population isolation and gene flow may be defined
Mod	1, 2		Knowledge gap	Update mapping of yellow sand-verbena and quantify estimates of total cover	Population size is known, increased understanding of host-plant resource requirements, and population structure
High	3	Public education and stewardship	1. Habitat loss (all); 2. Btk spray 3. Natural biological enemies (all); 4. Climate change	Increase public knowledge of SVM and coastal dune ecosystems through interpretive signs and other education materials	Decreased risk of threat to habitat or populations from recreation activities

Performance Measures

Table 3. Evaluation of success of Sand-verbena Moth recovery strategy.

Approach/ strategy	Performance measures
Habitat protection	• Has a detailed habitat protection plan been developed for selected sites to be managed for these species? • Are known populations protected? • Have all relevant national, provincial, regional, municipal, and aboriginal governments been informed and consulted?
Population protection	• Are there population size targets and does annual monitoring show that population size is stable/increasing?
Habitat restoration	• Have potential restoration sites been identified and prioritized? • Has restoration been attempted at any of the identified sites? • Have restoration techniques been successful in creating new habitat?
Inventory and monitoring	• Has inventory of known or potential populations been conducted each year? • Have unchecked dune habitats been surveyed for yellow sand-verbena and Sand-verbena Moth?
Public education and stewardship	• Have most landowners who have occupied or potential habitat been contacted, provided with information, and consulted? • Have conservation agreements been developed with most landowners who have habitat necessary for the survival or recovery of the species?

Critical Habitat

Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* [S. 2], is proposed for identification at this time.

More information about the habitat requirements for Sand-verbena Moth needs be completed before any specific sites can be formally proposed as critical habitat. Critical habitat for Sand-verbena Moth will include abundant and healthy yellow sand-verbena plants with a foliar cover greater than 500 m^2. Additional information needed includes the spatial configuration of yellow sand-verbena plants that is necessary to maintain a population of Sand-verbena Moth; the distance between smaller plant patches, whether moths use these plant patches and the importance of these patches; whether yellow sand-verbena needs to be of a certain age to produce certain chemicals for ingestion/importance for larval development. It is expected that critical habitat for the Sand-verbena Moth will be identified in the action plan. A schedule of studies outlining the work necessary to identify critical habitat is found below.

Recommended schedule of studies to identify critical habitat

Table 4. Schedule of studies.

Description of activity	Outcome/rationale	Timeline
1. Conduct population estimates and better define moth abundance (density) in relation to yellow sand-verbena plants (sparse vs. dense, etc.).	o Better define the parameters of yellow sand-verbena needed to sustain a viable population of the moth	2008–2012
2. Define habitat use by life history stage.	o Identify which components of habitat are used at different life stages	2008–2012
3. Describe the spatial boundary of Sand-verbena Moth populations based on light-trapping surveys.	o Determine how far Sand-verbena Moth can disperse o Determine the importance of outlying patches of yellow sand-verbena, and the size of patches that can sustain populations of SVM given a patchily distributed matrix of plants	2008–2012
4. Identify the use of areas outside of yellow sand-verbena patches by Sand-verbena Moth (e.g., how far are larvae found from yellow sand-verbena plants?).	o On a micro-scale, establish what components of the surrounding microhabitat around the plant are vital to the species	2008–2012
5. Identify, map, and prioritize sites with habitat restoration potential for Sand-verbena Moth.	o Increase amount of habitat available for natural recolonization events o Should a storm or other catastrophic event destroy one of the populations, there is available habitat to potentially do recolonization trials	2008–2009

Existing and Recommended Approaches to Habitat Protection

Portions of three Canadian locations occur in provincial, regional, or municipal parks (Table 1). Habitat measures for Sand-verbena Moth within Island View Beach Regional Park are incorporated into an ongoing ecosystem management process (J. Psyllakis, pers. comm., 2008). The Department of National Defence has developed preliminary guidelines for activities in a portion of the Goose Spit location.

While much Sand-verbena Moth habitat is within protected areas, ongoing threats to this habitat (see "Threats" section) continue within some protected areas. Threats within the Island View Beach Regional Park location include uncontrolled access to sand dune habitats (e.g., dogs walked off leash causing damage to yellow sand-verbena). Management actions targeted to address these threats at Island View Regional Park include construction of a split rail fence to limit access and the development of an education program to encourage dog walkers to follow established walkways (J. Psyllakis, pers. comm., 2008).

For successful protection of species at risk there will be a strong need to engage in stewardship on various land tenures. Stewardship involves the voluntary cooperation of landowners and managers to protect species at risk and the ecosystems they rely on. The *Canada – British*

Columbia Agreement on Species at Risk recognizes that "stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk" and that "cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk."

This stewardship approach will cover many different kinds of activities, including: following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat; conservation covenants on property titles; eco-gifting of property (in whole or in part) to protect certain ecosystems or species at risk; or sale of property for conservation. For example, both government and non-governmental organizations have had good success in conserving lands in the province. This could be aided by the B.C. Trust for Public Lands.

Stewardship approaches

- *Increase emphasis on conservation management of known locations*: In all known locations, conservation concerns are often secondary to recreation or military use. The conservation of sand dune ecosystems generally, and Sand-verbena Moth habitat specifically, should be a higher priority for managing agencies in all locations.
- *Control stabilizing vegetation*: Habitat restoration activities to remove stabilizing mosses, grasses, and shrubs should be undertaken to prevent long-term loss of yellow sand-verbena.
- *Reduce human disturbance*: Sand-verbena Moth habitats are attractive for recreation and other activities. Human disturbance such as trail or road development should be minimized to prevent destruction of habitat. Public education will be an important component of this approach.

Effects on Other Species

Efforts to restore and protect sand dune and sand beach ecosystems will be beneficial to many species that rely on this scarce and declining ecosystem (Table 5).

Table 5. Additional COSEWIC-assessed species occurring within the same locations as Sand-verbena Moth.

Name	COSEWIC status	*Species at Risk Act* status	BC CDC list	Global rank
Contorted-pod evening-primrose (*Camissonia contorta*)	Endangered (2006)	Schedule 1	Red (S1)	G5
Horned Lark *strigata* subspecies (*Eremophila alpestris strigata*)	Endangered (2003)	Schedule 1	Red (SX)	G5T2

A species ranked by the B.C. Conservation Data Centre but not assessed by COSEWIC that may occur within the same locations as Sand-verbena Moth includes:

- black knotweed (*Polygonum paronychia*) "G5-S3" (Blue-listed)

Another species occurs within sand dune environments where yellow sand-verbena grows (but does not include Sand-verbena Moth):

- pink sand-verbena (*Abronia umbellata*) (endangered, *Species at Risk Act* Schedule 1)

There are no expected detrimental effects on these additional species at risk by actions taken to recover Sand-verbena Moth. Recovery efforts for the moth are likely to benefit these additional species at risk.

Socioeconomic Considerations

Recovery of Sand-verbena Moth is not expected to have extensive socioeconomic impacts. A detailed review of the socioeconomic considerations will be completed in the action plan for this species. The main considerations involve recreation use, historic land use activities (e.g., military training), and potential development activities such as campgrounds or other tourism facilities within sand dune habitats. Southern Vancouver Island sandy beach habitats are widely used for recreation, particularly low-elevation areas that are easily accessible by foot and automobile and adjacent to shallow marine environments. Sand dune environments are natural areas for sunbathing and swimming, and fencing or protection of these areas may conflict with recreation use. There is a potential cost should land managers decide to create alternate sand environments as well as post signs for public education. The protection of the habitat for Sand-verbena Moth will allow some recreational benefits and natural sand dune ecosystem viewing opportunities and promote this and other butterflies at risk.

Recommended Approach for Recovery Implementation

Currently, a single-species approach is the recommended scale for the recovery of Sand-verbena Moth. Incorporating management provisions into other jurisdictional plans such as the Capital Regional District, municipalities, and regional protected areas will also increase the conservation success of this species. Eventually, a sand dune ecosystem approach to recovery will likely proceed as there are many provincially Red- and Blue-listed species at risk that may be assessed by COSEWIC as “at risk” in the future.

Statement on Action Plans

A draft action plan will be ready for submission to the Province of B.C. by March 2012. This action plan will likely be a multi-species document, as recovery actions are similar among sand dune species.

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