

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



Prepared by the British Columbia Invertebrates Recovery Team



Ministry of
Environment

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

Recommended citation

British Columbia Invertebrates Recovery Team. 2008. Recovery strategy for Sand-verbena Moth (*Copablepharon fuscum*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 18 pp.

Cover illustration/photograph

Courtesy of Nick A. Page, Raincoast Applied Ecology

Additional copies

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

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

Publication information

Library and Archives Canada Cataloguing in Publication Data

British Columbia Invertebrates Recovery Team.

Recovery strategy for Sand-verbena moth (*Copablepharon fuscum*) in British Columbia [electronic resource]
(British Columbia recovery strategy series)

Available on the Internet.

“March 008”

Includes bibliographical references: p.
ISBN 978-0-7726-5980-4

1. Noctuidae - British Columbia. 2. Rare moths – British Columbia. 3. Endangered species – British Columbia. 4. Wildlife recovery - British Columbia. I. British Columbia. Ministry of Environment. II. Title.

QL561.N7B74 2008

595.78

C2008-960087-8

Content (excluding illustrations) may be used without permission, with appropriate credit to the source.

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.

RECOVERY TEAM MEMBERS

British Columbia Invertebrates Recovery Team

Jennifer Heron, Chair, B.C. Ministry of Environment, Vancouver, BC

Jessica Hellmann, University of Notre Dame, Notre Dame, Indiana

Suzie Lavallee, University of British Columbia, Vancouver, BC

Arthur Robinson, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC

Geoff Scudder, University of British Columbia, Vancouver, BC

Ross Vennesland, Parks Canada Agency, Vancouver, BC

Nicole Kroeker, Parks Canada Agency, Victoria, BC

William Woodhouse, BC Parks, Nanaimo, BC

AUTHORS

Jennifer Heron, B.C. Ministry of Environment, Vancouver, BC

Nick Page, Raincoast Applied Ecology, Vancouver, BC

Kevin Fort, Environment Canada, Canadian Wildlife Service, Delta, BC

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 by 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 locations¹ 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:

¹ 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%² 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 locations³ (where Sand-verbena Moth is not known to occur) to an area greater than 500 m² 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.

² 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.

³ 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.

TABLE OF CONTENTS

RECOVERY TEAM MEMBERS.....	iii
AUTHORS.....	iii
RESPONSIBLE JURISDICTIONS.....	iii
ACKNOWLEDGEMENTS.....	iii
EXECUTIVE SUMMARY.....	iv
BACKGROUND.....	1
Species Assessment Information from COSEWIC.....	1
Description of the Species.....	1
Populations and Distribution.....	2
Needs of Sand-verbena Moth.....	5
Habitat and biological needs.....	5
Ecological role.....	5
Biologically Limiting factors.....	5
Threats.....	6
Description of the threats.....	6
Actions Already Completed or Underway.....	8
Knowledge Gaps.....	9
RECOVERY.....	9
Recovery Feasibility.....	9
Recovery Goal.....	11
Recovery Objectives.....	11
Approaches Recommended to Meet Recovery Objectives.....	11
Recovery planning table.....	12
Performance Measures.....	14
Critical Habitat.....	14
Identification of the species' critical habitat.....	14
Recommended schedule of studies to identify critical habitat.....	15
Existing and Recommended Approaches to Habitat Protection.....	15
Effects on Other Species.....	16
Socioeconomic Considerations.....	17
Recommended Approach for Recovery Implementation.....	17
Statement on Action Plans.....	17
REFERENCES.....	18

LIST OF TABLES

Table 1. Sand dune habitat at Canadian Sand-verbena Moth locations.....	3
Table 2. Recovery planning table for Sand-verbena Moth.....	12
Table 3. Evaluation of success of Sand-verbena Moth recovery strategy.....	14
Table 4. Schedule of studies.....	15
Table 5. Additional COSEWIC-assessed species occurring within the same locations as Sand-verbena Moth.....	16

LIST OF FIGURES

Figure 1. Sand-verbena Moth locations and sampling (2001–2005) sites in the Strait of Georgia – Puget Sound and west coast of Vancouver Island.....	4
---	---

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:⁴ 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 km², with dimensions less than 220 km long and 45 km wide. The Canadian range of the species is approximately 3700 km² 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

⁴ 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-m² 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.

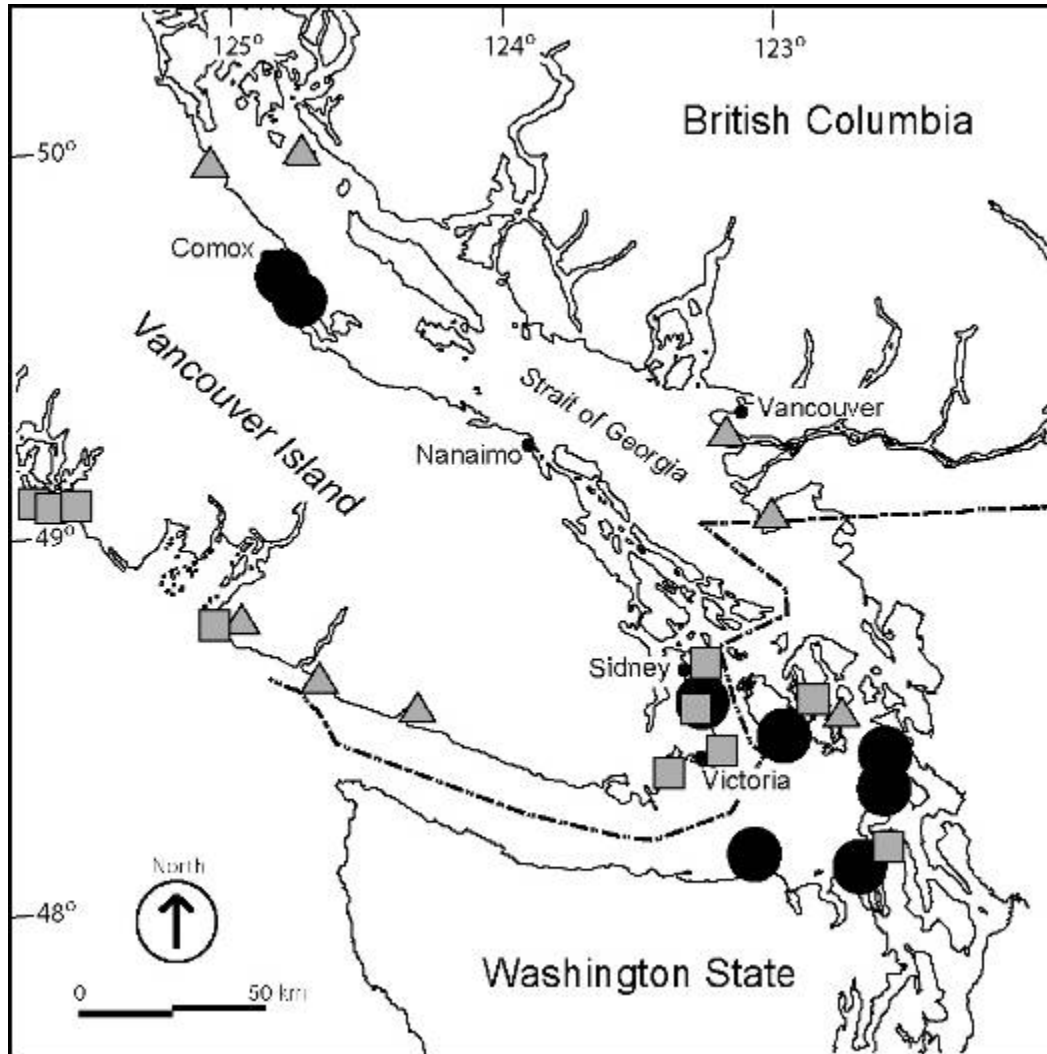


Figure 1. Sand-verbena Moth locations and sampling (2001–2007) sites in the Strait of Georgia – Puget Sound and west coast of Vancouver Island. Sand-verbena Moth locations are shown with black dots. The site south of Sidney encompasses both the Cordova Spit/Island View Beach as one location. James Island 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-m² 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-m² 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 m²) 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 canescens*]) 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 aurally 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 senescence 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%⁵ 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 locations⁶ (where Sand-verbena Moth is not known to occur) to an area greater than 500 m² 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 protection⁷
2. population protection
3. habitat restoration
4. inventory/monitoring
5. public education and stewardship.

⁵ 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.

⁶ 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.

⁷ 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		1. Habitat loss: degradation of habitat through vegetation stabilization; recreation and military training; 2. Btk spray	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

Performance Measures

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

Approach/ strategy	Performance measures
Habitat protection	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Are there population size targets and does annual monitoring show that population size is stable/increasing?
Habitat restoration	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 m². 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.).	○ 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.	○ 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.	○ Determine how far Sand-verbena Moth can disperse ○ 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?).	○ 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.	○ Increase amount of habitat available for natural recolonization events ○ 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	<i>Species at Risk Act</i> status	BC CDC list	Global rank
Contorted-pod evening-primrose (<i>Camissonia contorta</i>)	Endangered (2006)	Schedule 1	Red (S1)	G5
Horned Lark <i>strigata</i> subspecies (<i>Eremophila alpestris strigata</i>)	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.

REFERENCES

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003. COSEWIC assessment and status report on Sand-verbena Moth *Copablepharon fuscum* in Canada. Ottawa, ON. 39 pp. <www.sararegistry.gc.ca/status/status_e.cfm>

Lafontaine, J.D. 2004. Noctuoidea, Noctuidae (Part): Noctuinae, Agrotini. In R.W. Hodges, ed. The moths of North America. Fascicle 27.1.

NatureServe. 2008. NatureServe Explorer: an online encyclopedia of life. <<http://www.natureserve.org/explorer/>> [Accessed February 2008]

Page, N.A. 2005. Habitat recovery research for Sand-verbena Moth: 2005 final report. Unpublished report prepared for Endangered Species Recovery Fund (World Wildlife Fund and Environment Canada). 35 pp.

Tillett, S.S. 1967. The maritime species of *Abronia* (Nyctaginaceae). Brittonia 19:299–327.

Troubridge, J.T. and L.G. Crabo. 1996. A new species of *Copablepharon* (Lepidoptera: Noctuidae) from British Columbia and Washington. J. Entomol. Soc. B.C. 92:87–90.

Personal Communications

Allan, B. 2005–2007. Department of National Defence, Comox, BC.

Hellmann, J. 2007. University of Notre Dame, Indiana.

Page, N.A. 2003–2008. Raincoast Applied Ecology, Vancouver, BC.

Psyllakis, J. 2008. Capital Regional District, Victoria, BC.