COSEWIC
Assessment and Status Report

on the

White Flower Moth
Schinia bimatris

in Canada

ENDANGERED
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
White Flower Moth

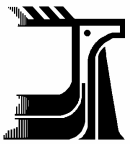
Scientific name
Schinia bimatris

Status
Endangered

Reason for designation
This moth is associated with dune habitats and is known from a small number of scattered sites in North America, with only one extant site in Canada. Most dune habitats in Canada appear to be too dry for this species. Dune habitat has undergone serious. declines and the moth has likely declined as well.

Occurrence
Manitoba

Status history
Designated Endangered in May 2005. Assessment based on a new status report.



COSEWIC
Executive Summary

White Flower Moth
Schinia bimatris

Species information

The White Flower Moth is a relatively small, white owlet moth with a restricted Canadian distribution. The owlet moths, in the family Noctuidae, have a worldwide distribution. They are an incredibly species-rich group, with over 35,000 described species, and many more undescribed: with about 50,000 species, their total diversity likely rivals that of all vertebrates, with about 50,000 species. Despite their diversity, we know relatively little about owlet moths. They are generally stout-bodied, medium-sized moths. Almost all owlets feed on plants and include the economically important cutworm moths.

The White Flower Moth appears to be rare throughout its range and very little is known about its biology. Additional field surveys are needed in southwestern Manitoba to determine if it is restricted to the Spirit Sand Dunes in Spruce Woods Provincial Park, or if populations are more widespread in stabilized dune habitats (dunes overgrown by plants).

Distribution

The only known Canadian records of the White Flower Moth are from the Spruce Woods Provincial Park region of southwestern Manitoba. Elsewhere, this species occurs from Nebraska south and east to Alabama, Mississippi and South Carolina.

Habitat

The only known extant population of the White Flower Moth in Canada inhabits active sand dunes (those not stabilized by vegetation) in the prairie-parkland region of southwestern Manitoba. In the southeastern United States, the species occurs in coastal longleaf pine woodlands.

Biology

Very few data on the biology of this species are available. Adults are nocturnal. The life cycle presumably takes one year to complete. In Manitoba, adults have been

collected from early to late July. The larval and adult food plants are unknown, but the Spruce Woods population is associated with a white primrose which may prove to be a larval host.

Population sizes and trends

The population size of the White Flower Moth has not been determined, but based on the amount of remaining suitable habitat, the plausible current population is thought to be between 100 and 5,000 individuals. There are insufficient data to determine trends in population size.

Limiting factors and threats

Sand dune stabilization through vegetation overgrowth may pose a threat. Hotter and drier conditions in the dunes at the only known extant site in Canada may also be detrimental to the White Flower Moth.

Special significance of the species

The White Flower Moth has a relatively limited global distribution. The only Canadian records of this moth are from the Spirit Dunes near Brandon, Manitoba. This site represents the northern periphery of this species' known range.

Existing protection or other status designations

There are no existing status designations. The only known extant Canadian colony is within a provincial park where habitat is protected from development.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species Because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

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COSEWIC Status Report

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White Flower Moth

Schinia bimatris

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2005

TABLE OF CONTENTS

List of Figures

List of appendices

SPECIES INFORMATION

Name and classification

Schinia bimatris was described by L.F. Harvey in 1875 from specimens collected in Clifton, Bosque County, Texas (Harvey 1875). The common name, White Flower Moth, was apparently first coined by Hooper (1996). *Schinia bimatris* is one of about 150 species of flower moths (Heliothinae) in North America, a subfamily of the owlet moths (Noctuidae) (Hardwick 1996). The genus *Schinia* contains about 120 species worldwide, the majority of which occur in temperate North America (Hardwick 1970, 1996). *Schinia* flower moths are most diverse in the arid grasslands and deserts of the western United States.

Until the host plant(s) is(are) determined and the larvae are described, it is difficult to determine to which *Schinia* species *S. bimatris* is most closely related. There are slight differences in appearance between Canadian *S. bimatris* and those from the southern United States, and the Canadian individuals are on average slightly larger (J. Troubridge, pers. com.). This situation warrants closer scrutiny as it is possible that the southern coastal U.S. and Great Plains populations are not all referable to the same species.

Description

The White Flower Moth has a wingspan of about 32 mm (Hardwick 2996). It is aptly named because the wings are pure glossy white (Figure1). The thorax and abdomen are white, and the head and collar are orange. There is occasionally a light dusting of brown scales along the leading margin of the hindwing (Brou, 2003). The white, unmarked wings and yellow collar are diagnostic—this moth cannot be confused with any other Canadian species.

Illustrations of Canadian specimens of White Flower Moths can be found in Hardwick (1996) and the Agriculture and Agri-food Canada Moths of Canada website (http://www.cbif.gc.ca/moths/noctuoidea/index.htm). Because there are currently no published identification keys to the species of *Schinia*, identification should be confirmed by an experienced lepidopterist through comparison to reference specimens or images.

Figure 1. *Schinia bimatris,* female, Louisiana. Vernon Antoine Brou Jr. photograph.

DISTRIBUTION

Global range

Schinia bimatris has been collected in southwestern Manitoba, as well as from Nebraska south to eastern Texas and east along the Gulf Coast states to Alabama. There are also several records from South Carolina (Figure 2). It has not been recorded in northern Florida (J. Slotten pers. com.) or Georgia (Adams 2002). A specimen labelled "Oslar / Rico, Col." in the Rothschild collection at the British Museum of Natural History (Appendix 1) is the only record for Colorado (M. Honey, pers. com.). The Colorado record is disjunct, separated by a distance of about 800 km from the nearest known populations. A record for Cochise Co., Arizona (Ferguson *et al*., 1999) represents a mapping error (C. Harp, pers. com.).

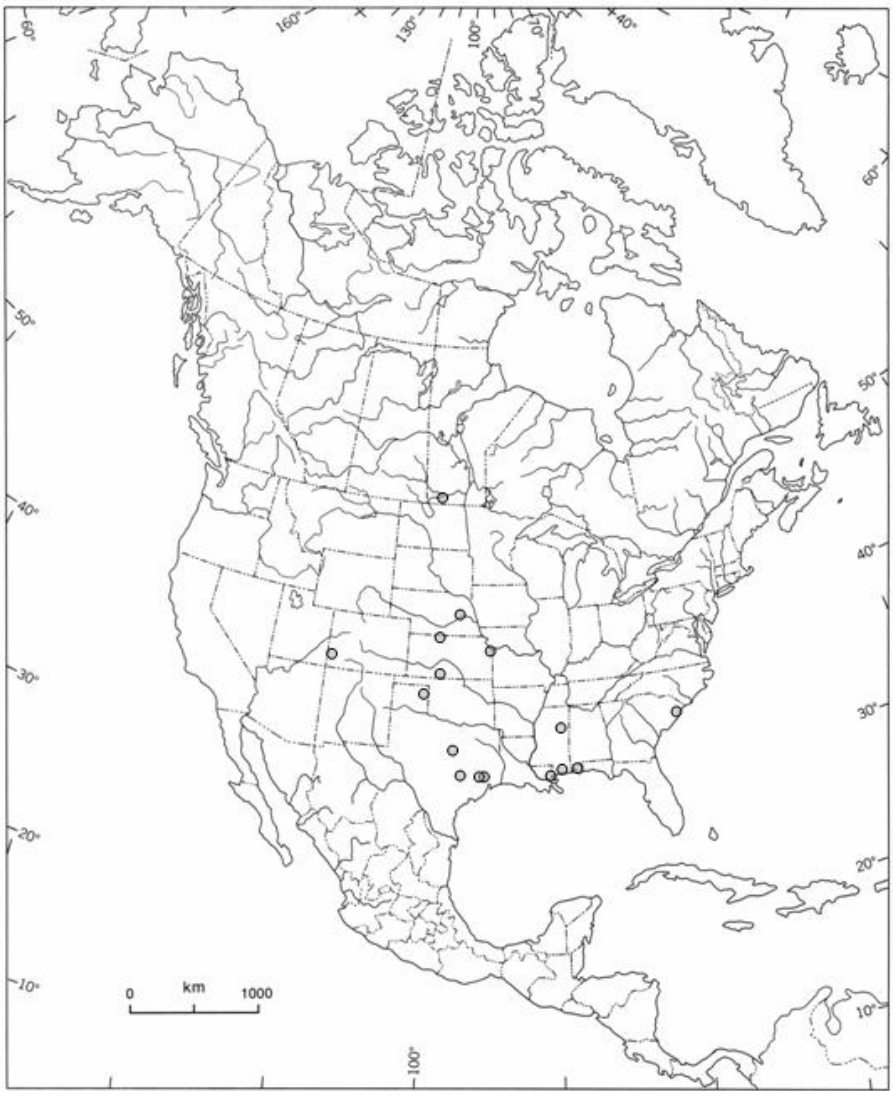

Figure 2. North American distribution of *Schinia bimatris.*

Canadian range

Prior to 2003, the only known Canadian records of *S. bimatris* were a series of about a dozen specimens collected between 1910 and 1927 near Onah and Aweme, near present-day Brandon, Manitoba (Figure 3). In July of 2003, this species was re-discovered when 11 specimens were collected near the historical sites at the Spirit Dunes, Spruce Woods Provincial Park, Manitoba by J. Troubridge and D. Lafontaine (Appendix 1). Based on current information, the range of the species could be very highly disjunct. Based on the historical and extant records of *S. bimatris* in Canada, the extent of occurrence is approximately 250 km^2, and may be smaller if the early records are actually from the Spirit Dunes. It appears that *S. bimatris* is at the northern periphery

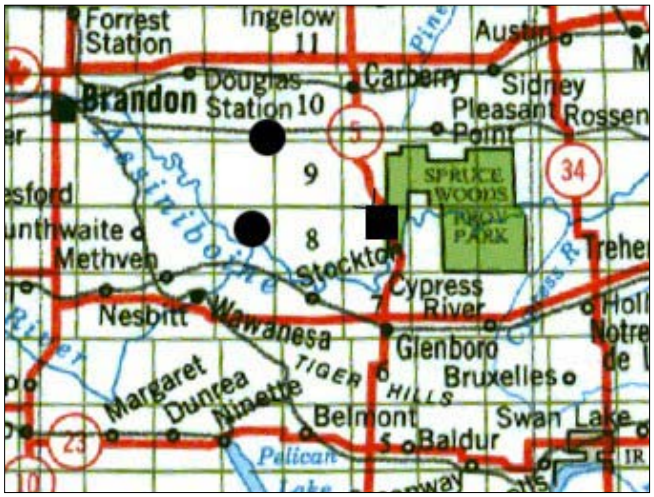

Figure 3. Canadian collection localities of *Schinia bimatris* near Brandon, Manitoba. The circles represent historical records whose exact locations are uncertain and may represent collections from Spruce Woods Provincial Park; the square represents a recent record (SoftMap 2001).

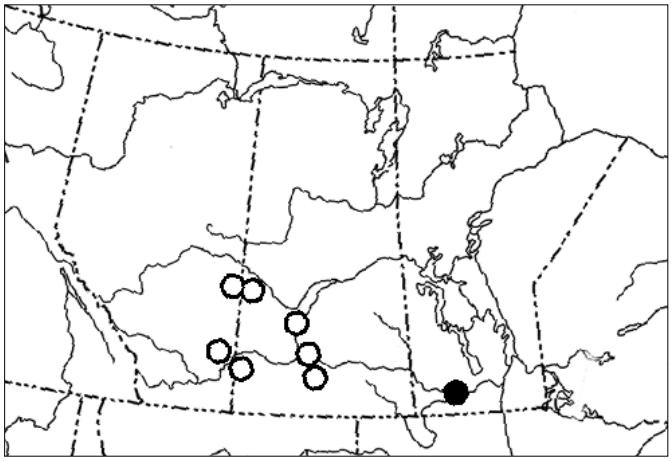

Figure 3b. Sand dune sites of the prairie provinces surveyed for *Schinia bimatris*. The solid circle indicates presence of *S. bimatris*; the empty circles indicate sampled dune habitats where *S. bimatris* has not been found (full data given in Appendix 2).

of its range in southern Manitoba, and there are no records from the intervening area between Manitoba and Omaha, Nebraska (Appendix 1). Attempts to locate *S. bimatris* in Alberta and Saskatchewan in habitat similar to that of the Spirit Dunes site were unsuccessful (Appendix 2). No attempt was made to locate *S. bimatris* at the Aweme and Onah sites because the habitat in the vicinity of these localities is unsuitable. It is in fact likely that the *S. bimatris* specimens were collected some distance from these sites; N. Criddle, who collected the specimens, made frequent collecting trips away from his farm at Aweme (Manitoba Archives), and, given the habitat preferences of *S. bimatris*, he likely collected them in the Spirit Dune complex.

HABITAT

Habitat requirements

The habitat associations and requirements of the Manitoba population of *S. bimatris* appear to be restricted to active sand dunes and blowouts (Figure 4). Stabilized dune habitat should be surveyed in Spruce Woods Provincial Park to determine if this habitat type is also suitable. Stabilized sand dunes, more heavily vegetated than the Spirit Dunes, include Souris, Oak Lake, Lauder, Routledge and St. Lazare sand hills in southwestern Manitoba (Wolfe 2001).

Figure 4. *Schinia bimatris* habitat, Spirit Sand Dunes, Spruce Woods Prov. Park, Manitoba. C. Schmidt photograph.

Spruce Woods Provincial Park is within the Aspen Parkland Ecoregion (Gauthier *et al*. 2001). The local surface geology is characterized by the Brandon Sand Hills, which were formed by glaciolacustrine sediments of glacial Lake Agassiz and were re-worked by aeolian processes following deglaciation (David 1977).

In the southeastern U.S., *S. bimatris* inhabits longleaf pine woodlands (J. Slotten and V.A. Brou Jr., pers. com.) which are characterized by an open, herbaceous understory historically maintained by frequent fires. Longleaf pine woodlands are an endangered ecosystem in the U.S. and are home to a large number of amphibians and reptiles of conservation concern (Noss 1989).

Trends

The Spirit Sand Dunes (Figure 4) cover an area of about 5 km^2, consisting of about 0.2 km^2 of active dunes (Vance & Wolfe 1996). It is thought that the proportion of active dunes has remained fairly stable since the 1960s, prior to which the extent of active dunes was much greater, covering at least 145 ha in the 1920s, with a decline of about 10 to 20% per decade over the past 80 years (Figure 4b; Vance & Wolfe 1996). This decline in active dune habitat likely represents a decline in moth population size. Recent evidence suggests increases in dune activity associated with increased climate warming and aridity (Wolfe 1997), but does not necessarily represent an increase in suitable habitat for the White Flower Moth. In historic times, the Spirit Sand Dunes were kept active by natural disturbances, such as bison grazing and prairie fires. Although the stabilization of these dunes by vegetation overgrowth may have stopped in recent years and may even be reversing, dune re-activation may now be due to higher temperatures and drought conditions resulting from climate change. Although this dune re-activation may produce more active dune habitat, it is possible that the moth needs the more humid conditions that occurred in the past. If so, the current shift toward hot, arid conditions may not provide suitable habitat for the moth (J. Duncan, pers. com.).

Although sand dunes are widespread in the southern prairie provinces, dune blowouts are limited and occur primarily in the Middle Sand Hills, Alberta, Great Sand Hills, Saskatchewan and to a lesser extent in the Brandon Sand Hills, Manitoba (Wolfe 1997).

The absence of historical and recent records of *S. bimatris* from similar habitats in Alberta and Saskatchewan, makes it unlikely that this species is more widespread in Canada. Furthermore, the Brandon Sand Hills occur in a humid to sub-humid region, whereas prairie dunes elsewhere in Canada are characterized by a much more arid climate (Wolfe 1997).

Directed sampling should be carried out in dune habitats, particularly those supporting the suspected host plant. The Minot Dune Field in North Dakota may be the most likely nearest adjacent population, approximately 200 km to the southwest (Forman *et al*. 2001).

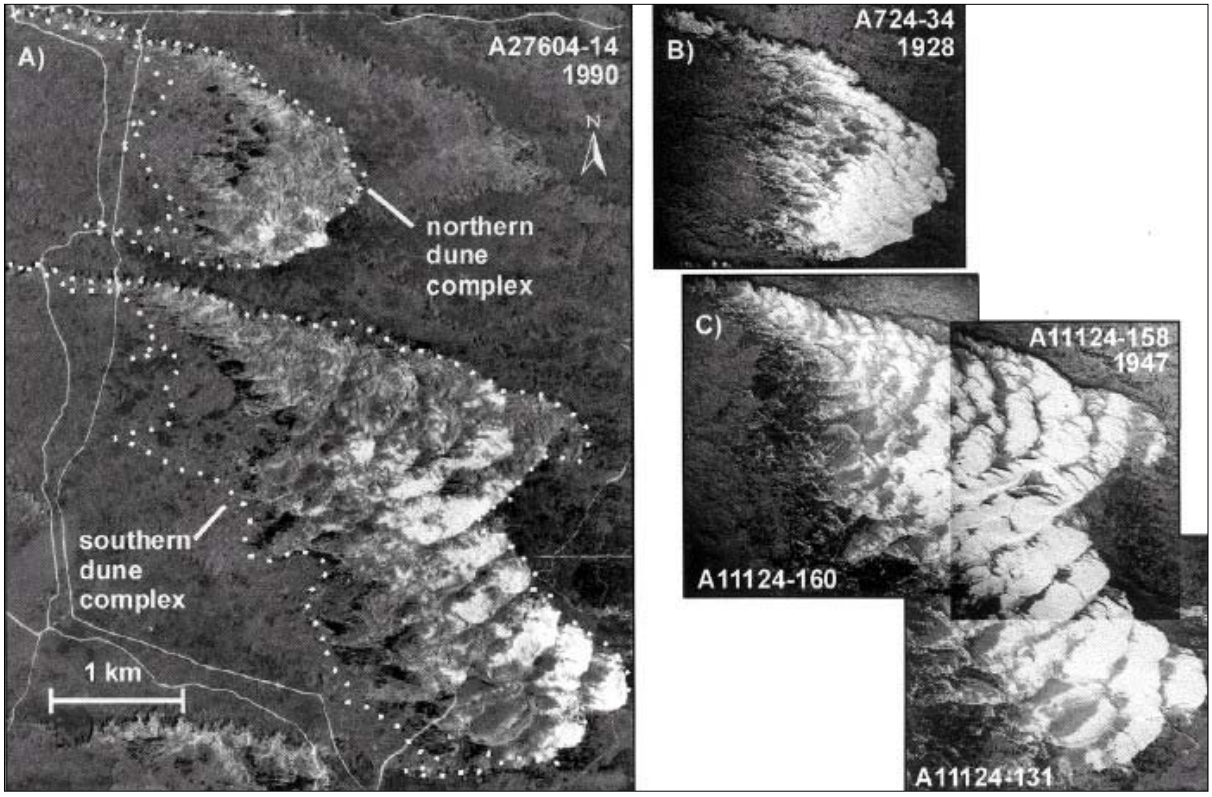

Figure 4b. Aerial photographs of the Spirit Dunes, Manitoba, showing recent dune stabilization. Active blowouts are visible as light areas, in 1990 (A) and 1928 (B) & 1947 (C). [Reproduced from Wolfe *et al*. (2000) with permission of the author.]

Protection/ownership

The habitat of the Manitoba population is encompassed by Spruce Woods Provincial Park and C.F.B. Shilo, under provincial and federal jurisdiction, respectively. The extant population of *S. bimatris* is entirely encompassed by Spruce Woods Provincial Park and is therefore legally protected.

BIOLOGY

General

Very little is known about the biology of the White Flower Moth. Adults are nocturnal and have been collected using ultraviolet light. Diurnal flight activity has also been observed in a Mississippi population where adults were quite common (R.L. Brown, pers. com.). Diurnal activity may by a response to higher population densities; this activity pattern also occurs in *Schinia meadii,* with adults active both in late afternoon and at night (C. Schmidt, unpubl. data).

The life cycle of *S. bimatris* is undoubtedly like that of all other Lepidoptera, consisting of complete metamorphosis. Larvae hatch from eggs, feed on plants, and molt several times before pupating. Adults emerge from the pupae. Although the larval food plants are unknown, most members of the genus. *Schinia* are known to feed on one or a few closely related host plant species (Hardwick 1996). Flower moth larvae generally feed specifically on the flowers and developing seeds of the host plant (Hardwick 1996). Adult flower moths are short-lived, and reared adults usually do not live longer than seven days (Hardwick 1996).

Reproduction

There are no data specific to *S. bimatris*. In general, flower moths mate during the adult flight period. Manitoba collection records indicate the flight period for *S. bimatris* is during the second and third weeks of July (Appendix 1). Female flower moths generally extend their ovipositor into the florets of the larval food plant to place the eggs. Because *Schinia* species lay eggs that are relatively large compared to their body size (Hardwick 1996), the number of eggs produced is likely lower than in other owlet moths. The reported maximum number of eggs laid by female *Schinia* varies from 89 in *S. indiana* to 356 in *S. sueta* (Hardwick 1958). The eggs hatch after several days. The young larvae feed within the flower heads on flower parts and on developing seeds. They grow relatively quickly, completing their development in two to four weeks (Hardwick 1996). Many flower moth species overwinter as pupae, with adult emergence timed to correspond with flowering of the host plant. All flower moths, so far as is known, pupate at or below the surface of the soil (Hardwick 1996).

Survival

There are no data specific to *S. bimatris*. Lepidoptera generally suffer high mortality during the larval stage as a result of predation by birds, predatory invertebrates, parasitic flies and wasps, and infection by fungal, bacterial and viral pathogens. Concealment in flower heads during feeding may be a predator/parasitoid avoidance strategy in flower moths (Hardwick 1996). Flower moths are unusual in that larvae in many species succumb to cannibalism, both from the larvae of conspecifics and of other flower moth species inhabiting the same flower head (Hardwick 1996).

Physiology

No data are available.

Movements/dispersal

There are no data available for *S. bimatris.* Most *Schinia* species are strong fliers and have a rapid, buzzing flight (C. Schmidt, unpubl. data). The ability for strong flight would facilitate colonization of host plant patches separated by unsuitable habitat. Although *Schinia* species may have the ability for dispersal, many species exhibit high site and hostplant fidelity and are rarely observed away from the immediate vicinity of hostplants (Hardwick 1996, Swengel and Swengel 1999).

Nutrition and interspecific interactions

The larval host plant of *S. bimatris* is currently not known. The moth occurs in association with a white evening primrose in the Spirit Dunes (J. Troubridge, pers. com. 2004), likely *Oenothera nuttallii* Sweet. This evening primrose is likely a candidate host plant because it blooms during the flight period of *S. bimatris* and the flowers match the colour of *S. bimatris* adults. Synchrony of flight with flowering as well as cryptic colouration often occur in flower moths because the adults rest on host flowers during the day (Hardwick 1996). Evening primrose species are also known to be hosts for several other flower moths (Hardwick 1996, C. Harp, pers. com. 2003). A search of about 200 *Oenothera* spp. flowers at the Spirit Dunes in 2004 did not reveal any *S. bimatris*, but the summer was unUsually cold and wet so population density may have been below detectable levels.

Should *O. nuttallii* prove to be the larval host plant, its distribution is not likely to limit that of *S. bimatris*. *Oenothera nuttallii* is distributed across the southern Canadian prairies and occurs south to Colorado, Wisconsin and Nebraska (Scoggan 1979). Southern U.S. populations of *S. bimatris* may feed on other *Oenothera* species.

Behaviour/adaptability

No data are available.

POPULATION SIZES AND TRENDS

Until a clearer picture of habitat use, host plant Useand distribution of *S. bimatris* becomes available, it is difficult if not impossible to derive a meaningful estimate of population size(s). Population size will be limited by the amount of suitable flower and seed tissue available to larvae, nectar sources for adults and possibly also by substrate type (in this case loose sand) and such microhabitat characteristics as moisture. *Schinia bimatris* appears to be rare or uncommon even within its habitat, as suggested by the limited numbers recorded in 2003. Attempts to survey *S. bimatris* at the Spirit Dunes site in 2004 were unsuccessful (Appendix 2), but 2004 was an unusually cold and wet year in southern Manitoba, and *S. bimatris* population levels may have been below average. Given the limited extent of suitable habitat and its relative scarcity in 2003, a plausible population estimate would be between 100 and 5,000 individuals (Appendix 3). Because there are no known neighbouring populations of *S. bimatris* in the U.S., the potential for a rescue effect by migrant individuals is unknown, but is likely very low. *Schinia bimatris* has not been recorded from North or South Dakota (G. Fauske, pers. com.), but the Minot Dune field, ND, is 200 km SW of the Spirit Dunes (Forman *et al*. 2001) and may provide suitable habitat. The closest known population is near Omaha, Nebraska, about 1,000 km away.

The southern U.S. populations of *S. bimatris* also occur at low densities; for example, only 43 specimens were taken in a series of light traps operated almost daily

over a 33-year period in Louisiana (V. Brou, pers. com.). Favourable environmental conditions may, however, give rise to temporary population peaks, resulting in highly variable year-to-year population densities. For example, although dozens of *S. bimatris* individuals were observed in a Mississippi population, none were seen in previous years (R. Brown, pers. com.). Stochastic population fluctuations have also been observed in *Schinia indiana* (Swengel and Swengel 1999). Because U.S. populations of *S. bimatris,* as well as populations of some closely related species, occur at low densities and undergo large population fluctuations, it is likely that the Canadian population of *S. bimatris* has similar population dynamics.

LIMITING FACTORS AND THREATS

Schinia bimatris appears to be restricted by the limited availability of suitable active sand dunes. Dune stabilization by vegetation overgrowth may further limit the range of *S. bimatris.* Furthermore, a shift from relatively moist conditions to higher temperatures and more arid conditions, an effect of global climate change, may be re-activating dunes but may also be creating unsuitable microhabitat conditions within these dunes. The food plant and specific habitat requirements of *S. bimatris* need to be established before the exact limiting factors for this species can be determined.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Manitoba population of *S. bimatris* is the only one in Canada, representing the northern edge of the species' known range.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

There are no current status designations for *Schinia bimatris* (NatureServe 2002). There is no current specific protection under Canadian or U.S. jurisdictions. There are no global, national or subnational ranks available for Canada or the U.S. The extant population in Manitoba occurs within provincial land jurisdiction in Spruce Woods Provincial Park where habitat is protected from development.

SUMMARY OF STATUS REPORT

The White Flower Moth is a poorly known species, recorded in Canada only from the Spirit Sand Dunes in Manitoba. This species is more widespread in the Coastal Plain pine woodlands of the southern U.S. Priority should be given to additional surveys of sand hill habitat in southwestern Manitoba and to confirming the larval host plant.

TECHNICAL SUMMARY

Schinia bimatris
White Flower Moth — Héliotin blanc satiné
Southwestern Manitoba

Extent and Area information	
• *extent of occurrence (EO)(km²)*	Max 250 km^2
• *specify trend (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	unknown
• *area of occupancy (AO) (km²)*	5 km^2
• *specify trend (decline, stable, increasing, unknown)*	Has undergone serious declines until recent past, possibly stabilized or even increasing slowly due to sand dune re-activation as a result of drought, but (a) this may only be a fluctuation, and (b) hotter, drier conditions may be unsuitable.
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	unknown
• *number of extant locations*	1 known
• *specify trend in # locations (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	unknown
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Unknown. Dune re-activation may be occurring due to climate change, but the hotter, drier conditions may not be suitable for the moth.
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	one year
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	100 – 5,000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	unknown
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	unknown
• *are there extreme fluctuations in number of mature individuals (>1 order of magnitude)?*	probably
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	probably
• *list each population and the number of mature individuals in each*	Spirit Dunes 100 – 5,000
• *specify trend in number of populations (decline, stable, increasing, unknown)*	stable, as far as is known
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	unlikely

Threats (actual or imminent threats to populations or habitats)	
- The habitat requirements are not known for Canadian populations, but habitat loss through dune stabilization and changing dune microhabitat may be threats.	
Rescue Effect (immigration from an outside source)	extremely low
• *does species exist elsewhere (in Canada or outside)?*	yes
• *status of the outside population(s)?*	unknown
• *is immigration known or possible?*	highly unlikely (nearest known pop in Nebraska ~1000 km away)
• *would immigrants be adapted to survive here?*	unknown
• *is there sufficient habitat for immigrants here?*	unknown
Quantitative Analysis	
Current Status COSEWIC: Endangered (May 2005)	

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: B1ab(iii)c(iv)+2 ab(iii)+(c)(iv)

Reasons for Designation:
This moth is associated with dune habitats and is known from a small number of scattered sites in North America, with only one extant site in Canada. Most dune habitats in Canada appear to be too dry for this species. Dune habitat has undergone serious declines and the moth has likely declined as well.

Applicability of Criteria

Criterion A (Declining Total Population): Insufficient data.

Criterion B (Small Distribution, and Decline or Fluctuation): Meets B1ab(iii)c(iv)+2 ab(iii)+(c)(iv) for endangered. The extent of occurrence is much less than 5,000 km^2, the area of occupancy is much less than 500 km^2, with a population that is very likely severely fragmented and occurring at only one known location (reasonable confidence that it occurs at one, maybe two locations) with serious declines in suitable habitat and probable extreme fluctuations in the number of mature individuals, based on existence of such fluctuations in more southern populations of the species.

Criterion C (Small Total Population Size and Decline): Not applicable.

Criterion D (Very Small Population or Restricted Distribution): Meets D2 for threatened. It occupies and area of less than 20 km^2 and is known to occur at less than 5 locations.

Criterion E (Quantitative Analysis): Insufficient data.

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Chris Schmidt completed a master's degree at the University of Alberta in 2001, focusing on the ecology of the Forest Tent Caterpillar. Prior to this, an undergraduate program culminated in a bachelor's degree in Ecology from the University of Calgary in 1996. He spent several years working as a lab and field technician at the University of Alberta, which involved research on Lepidoptera population dynamics. Recent research interests have resulted in published articles on faunal inventories and aspects of lepidopteran biology. He is currently enrolled in a Ph.D. program at the University of Alberta, focusing on the phylogeny and taxonomy of tiger moths using molecular and morphological techniques.

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COLLECTIONS EXAMINED

Strickland Entomological Museum (University of Alberta, Edmonton, Alberta), Northern Forestry Centre (Edmonton, Alberta), Canadian National Collection of Insects, Arachnids and Nematodes, Buffalo Museum of Science (Buffalo, NY), University of Guelph Entomology Collection (Guelph, ON), British Museum of Natural History (London, UK), Illinois State Natural History Survey (Urbana, IL), Natural History Museum of Los Angeles County (Los Angeles, CA), Michigan State University (East Lansing, MI), Great Lakes Forestry Centre (Sault Ste. Marie, ON), University of Manitoba (Winnipeg, Manitoba), University of Michigan (Ann Arbor, MI), University of Minnesota (St. Paul, MN), New York State Museum (Albany, NY), Jim Troubridge personal collection, Gerald Fauske personal collection, Chuck Harp personal collection.

Appendix 1. Summary of specimen data for *Schinia bimatris*.

Locality	Date	Collector	Source/collection[1]	Number of specimens
CAN MB: Aweme	09-Jul-1925	N. Criddle	AMNH (*fide* C. Harp)	?
CAN MB: Aweme	?	?	LACM	?
CAN MB: Aweme	20-Jul-1910	N. Criddle	UMWM	?
CAN MB: Aweme	18-Jul-1923	N. Criddle	LACM	?
CAN MB: Aweme	31-Jul-1924	N. Criddle	CNCI	1
CAN MB: Aweme	08-Jul-1920	N. Criddle	CNCI	1
CAN MB: Aweme	07-Jul-1920	N. Criddle	CNCI	1
CAN MB: Aweme	09-Jul-1916	N. Criddle	CNCI	1
CAN MB: Aweme	ca. 1900	J. Fletcher	CNCI	1
CAN MB: Onah	16-Jul-1927	N. Criddle	CNCI	2
CAN MB: Onah	18-Jul-1921	N. Criddle	CNCI	1
CAN MB: Spirit Dunes, Spruce Woods P.P.	20-Jul-2003	J.D. Lafontaine & J. Troubridge	J. Troubridge	2
CAN MB: Spirit Dunes, Spruce Woods P.P.	21-Jul-2003	J.D. Lafontaine & J. Troubridge	CNCI & J. Troubridge	7
CAN MB: Spirit Dunes, Spruce Woods P.P.	28-Jul-2003	J.D. Lafontaine & J. Troubridge	J. Troubridge	2
USA AL: Mobile Co., Delchamps	13-Sep-1930	?	AMNH (*fide* C. Harp)	?
USA CO: Dolores Co., Rico	ca. 1900	E.J. Oslar ?	BMNH	?
USA KS: Comanche Co., 0.5 mi. S & 1 mi. W of Coldwater	14-Aug-1990	C.J. Ochs	HSC (*fide* C. Harp)	?
USA KS: Douglas Co., Lawrence	?	?	J. Adams (*fide* C. Harp)	?
USA KS: Kiowa Co.	16-Aug-1993	G.A. Salsbury	G.A. Salsbury (*fide* C. Harp)	3
USA KS: Phillips Co.	?	C.J. Ochs	Unknown (*fide* C. Harp)	1
USA LA: Natchitoches Co., Natchitoches Parish, Red Dirt Unit, Kisatchie National Forest	06-Sep-1997	J. Slotten	J. Slotten	1
USA LA: St. Tammany Parish, Abita Springs	5-15 Sep- years?	V. Brou	V. Brou	?
USA MS: A & M College	31-Aug-1931	R. Hutchins	AMNH (*fide* C. Harp)	1
USA MS: Stone Co., Little Biloxi Wildlife Area	21-Sep-1997	J. Slotten	J. Slotten	1
USA NE: Douglas Co., Omaha	Sep 1903	F.H. Marshall	UMN	?
USA SC: Horry Co., Myrtle Beach	20-Sep-1937	?	LACM	?
USA SC: Georgetown Co., The Wedge Plantation, nr. McClellanville	?	R.B. Dominick	SCMM (*fide* C. Harp)	?
USA TX: Bosque Co., Clifton	4-Oct-1874r?	?	BMNH (*fide* Hardwick 1996)	1
USA TX: Waller Co., Hockley	?	?	AMNH (*fide* C. Harp)	?
USA TX: Harris Co., Houston	23-Sep-1964	A & M.E. Blanchard	BMNH	?

Locality	Date	Collector	Source/collection[1]	Number of specimens
USA TX: Harris Co., Houston	24-Sep-1964	A. Blanchard	CNCI	?
USA TX: Harris Co., Houston	26-Sep-1964	A. Blanchard	CNCI	?
USA TX: Bastrop Co.	?	?	Bordelon & Knudson (*fide* C. Harp)	?
USA TX: Harris Co.	?	?	Bordelon & Knudson (*fide* C. Harp)	?
USA TX: Hemphill Co.	?	?	Bordelon & Knudson (*fide* C. Harp)	?
USA MS: Oktibbeha Co., Osborn	30-Aug – 9-Sep-2003	R.L. Brown	MEM (*fide* R. L. Brown)	25

1 - Museum abbreviations used in Appendix 1. AMNH – American Museum of Nature History, UMWM - University of Manitoba J.B. Wallis Museum, CNCI - Canadian National Collection of Insects, Arachnids and Nematodes, BMNH - British Museum of Natural History, HSC - Hays State College, Hays, KS, LACM - Los Angeles County Museum, SCMM - University of South Carolina McKissick Museum, UMN - University of Minnesota, BMS - Buffalo Museum of Science, NYSM - New York State Museum, MEM – Mississippi Entomological Museum.

Appendix 2. Summary of recent survey sites for *Schinia bimatris*.

Locality	Date	*S. bimatris* present?	Search effort (trap-nights)[1]	Observer
CAN: MB, N of Glenboro, Spirit Dunes, Spruce Woods Prov. Park	20 Jul 2003	Y	8	J. Troubridge & D. Lafontaine
CAN: MB, N of Glenboro, Spirit Dunes, Spruce Woods Prov. Park	21 Jul 2003	Y	8	J. Troubridge & D. Lafontaine
CAN: MB, N of Glenboro, Spirit Dunes, Spruce Woods Prov. Park	28 Jul 2003	Y	8	J. Troubridge & D. Lafontaine
CAN: MB, N of Glenboro, Spirit Dunes, Spruce Woods Prov. Park	24 Jul 2004	N	4	G. Anweiler
CAN: AB, Bindloss, NW, Dune Point	27 Jul 2004	N	4	C. Schmidt
CAN: SK, Burstall Sand Dunes, N Burstall	26 Jul 2004	N	6	C. Schmidt
CAN: AB, sand dunes N of Chauvin	25 Jul 2004	N	8	C. Schmidt
CAN: SK, Suffern Lake Regional Park	31 Jul 2004	N		N. Page
CAN: SK, C.F.B. Dundurn, S Saskatoon	3 Aug 2004	N		N. Page
CAN: SK, Douglas Provincial Park, SE Elbow	4 Jul 2004	N		N. Page
CAN: SK, Seward Sand Dunes, NE Webb	5 Aug 2004	N		N. Page

1 – Number of ultraviolet light traps (12 volt, 20 watt) operated per night.

Appendix 3. Methodology used to calculate population numbers.

Population size is very difficult to estimate with data from light-trap catches, particularly with the very limited data available. The estimate provided is based on the amount of suitable habitat available, and the author's experience with catch efficiency of light traps. The most important variables that come into play are the radius over which a light 'pulls in' moths, the amount and directionality of moth dispersal (which is weather-dependent), and the seasonality of the flight period. To make a rough approximation, the following assumptions were made:

- an attracting radius of light trap of between 3 m and 10 m (Baker, R.R. and Y. Sadovy. 1978. The distance and nature of the light trap response of moths. Nature 276: 818-821.);
- an average of 0.5 moths/trap based on Troubridge and Lafontaine's trapping results from 2003 (11 moths for 24 trap-nights);
- the 2003 sampling occurred during the peak flight time, and about ½ of the total population was available to sampling during the peak (with the remainder having either already completed their flight or not yet emerged); and
- suitable habitat occurs only within the 5 km^2 of open dunes, i.e., the area of occupancy.

Since the attraction radius to light is relatively small, and moths are flying/dispersing, the area sampled by light traps is effectively much larger than just the "area of attraction" based on the 3 to 10 m estimate; this can be thought of as the effective sampling area and has to be estimated. Setting the effective trap radius at 50 m yields a total population estimate of about 600, and a radius of 20 m yields an estimate of about 4000 with the above assumptions. If one accepts the radii as reasonable and assumes 2003 was a year with average population size (we know 2004 was likely a very low year), year to year fluctuations could easily be as low as 100 at the low end and 5,000 or more at the upper end.