COSEWIC
Assessment and Status Report

on the

Aweme Borer
Papaipema aweme

in Canada

ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

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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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Production note:

COSEWIC would like to acknowledge Gary G. Anweiler for writing the status report on the Aweme Borer *Papaipema aweme* in Canada, prepared under contract with Environment Canada, overseen and edited by Theresa B. Fowler, Co-chair (Arthropods), COSEWIC Arthropods Species Specialist Subcommittee.

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Aweme Borer — Provided by the author.

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Aweme Borer

Scientific name
Papaipema aweme

Status
Endangered

Reason for designation
Prior to the collection of one specimen in Ontario in 2005, this moth was last collected 70 years earlier. It is known from only five localities globally, three of which are in Canada. Although the species is poorly known, it is apparently restricted to a rare, fragmented and threatened habitat. Repeated collecting at all of the historic locations has not resulted in relocation of the species, and intensive collecting in the vicinity of the recent record has not yielded any additional specimens.

Occurrence
Ontario

Status history
Designated Endangered in April 2006. Assessment based on a new status report.

COSEWIC
Executive Summary

Aweme Borer
Papaipema aweme

Species information

The Aweme Borer is a noctuid (cutworm or owlet) moth belonging to a subgroup known as the borers. It was described from two specimens collected in 1905 at Aweme, Manitoba, in or near present-day Spruce Woods Provincial Park. The genus *Papaipema*, to which the Aweme Borer belongs, occurs only in North America and is one of the largest noctuid genera, with about fifty described species.

Adult Aweme Borers are medium-size (33-37 mm wingspan), yellowish or pinkish-brown moths with darker brown markings on the forewings. They are difficult to identify by non-experts. There are no described subspecies. The early stages (egg, larva and pupa) are unknown.

Distribution

The Aweme Borer is known from only five localities: Aweme, Manitoba; Grand Bend and Manitoulin Island, Ontario; Beaver Island, Michigan; and Rochester, New York. The Manitoba site is in the Prairie Ecological Area and the Ontario sites are within the Great Lakes Plain Ecozone. The area of occupancy (AO) in Canada is estimated at a maximum of about 625 km^2.

Habitat

The exact locations of the sites where the few specimens were collected in the early 1900s are unknown, and the specific habitat where they occurred is also unknown. Available historical evidence suggests the specimens were associated with sand dune habitats. The only specimen collected in the past 70 years was collected in a remnant oak-prairie fragment. All collection sites are located along former or present shorelines of glacial Lake Agassiz or one of the Great Lakes.

Biology

Almost nothing is known regarding the biology of the Aweme Borer. It is nocturnal and at least weakly attracted to light. There is a single annual generation, with the

adults flying in August. The larvae of all members of the genus *Papaipema* bore into, and live within, the stems, roots or branches of the host plant. The larval host plant of the Aweme Borer is not known.

Population sizes and trends

Aweme Borers are known from only seven specimens collected at five sites in North America. Six of these specimens were collected over a period of 31 years ending in 1936. The most recent specimen was captured almost 70 years later in 2005 in Ontario.

Limiting factors and threats

Loss of habitat and particularly loss of colonies of the unknown host plant are the most likely limiting factors for the species. Fire and predation of pupae by small mammals have been identified as particular threats to *Papaipema* populations in general. A small number of individuals distributed in widely separated and highly fragmented habitat is also known to increase the possibility of extirpation of a species.

Special significance of the species

The Aweme Borer is an extremely rarely encountered insect. More than half of the known collection sites and two-thirds of the known specimens are Canadian.

Existing protection

Both historical Canadian collection sites are probably located within Provincial Parks: Spruce Woods Provincial Park, Manitoba and The Pinery Provincial Park, Ontario. The only recent collection was made on private property.

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 5th 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 entities (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 science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2006)

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 category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' 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. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Aweme Borer

Papaipema aweme

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2006

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SPECIES INFORMATION

Name and classification

Common name: Aweme Borer *Papaipema aweme*
French name: Perce-tige d'Aweme, Jean-François Landry 2004
Order: Lepidoptera (Moths and Butterflies)
Superfamily: Noctuoidea
Family: Noctuidae (Owlet or Cutworm Moths)
Subfamily: Hadeninae
Tribe: Apameini (Borers)
Genus: *Papaipema*
Species: *aweme* (Lyman 1908)

There are no named subspecies (Quinter, in Hodges *et al*. 1983).
Synonyms: Originally described as *Gortyna aweme* Lyman
Moths of North America (MONA) Catalogue No.: 9504
Bibliographic Citation: Lyman, H.H. 1908. Recent work among the borers. Can. Ent., 40(8):249-255.
Type Specimen: Holotype female, CAN., MB, Aweme. Deposited in Lyman Entomological Museum, McGill University, Macdonald campus, Montréal.

The genus *Papaipema* Smith is one of the largest noctuid genera endemic to North America, with at least forty-six described species and five undescribed species known (Goldstein and Quinter 2003). Twenty-six described species occur in Canada (CBIF 2003). Although found throughout most of temperate North America, the genus achieves its greatest diversity in eastern North America (Goldstein and Quinter 2003).

Papaipema aweme appears to have no close relatives (i.e., is not part of a species complex or in a group of sibling species). There is no evidence to suggest it is anything but a “good” species (J.D. Lafontaine, pers. comm.).

Morphological description

The Aweme Borer is a medium-size (33-37 mm wingspan), robust, noctuoid moth (Figure 1). The forewing colour is described in the original description as “gris-incarnate” (greyish flesh-color) (Lyman 1908). The base of the forewings is light brown, with a slightly darker transverse shade near the base and a more pronounced but somewhat diffuse one arcing across the median area. Both the narrow post-median and subterminal lines are darker than the ground colour; the former curves toward the wing base as it nears the costa and the latter is incomplete. The fringes and adjacent terminal areas of the forewings are darker brown. The orbicular spot and claviform spots are similar in size and shape, or the orbicular may be reduced to a small dark ring and the claviform may be almost obsolete. These spots are darker brown than the ground and stand out, as does the larger hourglass-shaped reniform spot. The hind wings are

yellow-white, much paler than, and contrasting with, the forewings and are unmarked or marked with a faint median line and discal mark. The body and in particular the head and thorax, are darker brown (Lyman 1908; Hampson 1910). The adult moth is a rather small, very pale, plain light brown species compared to others in the genus (Schweitzer 1999). Based on published photographs, adults of both sexes are superficially alike. (Rockburne and Lafontaine, 1976; CBIF, 2003).

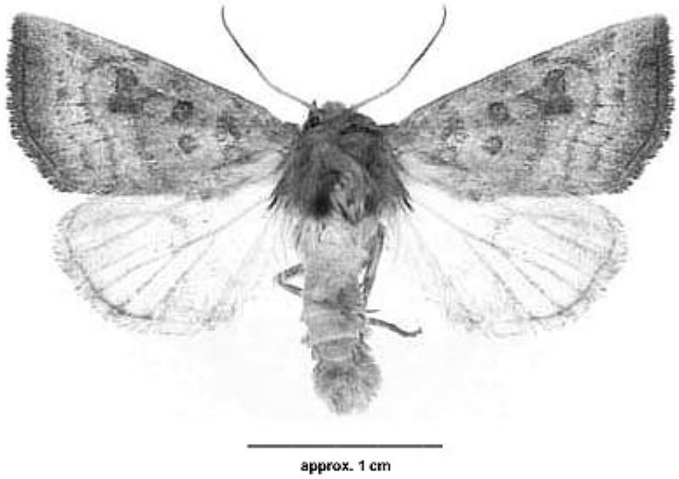

Figure 1. Adult male Aweme Borer.

Colour illustrations of the adult are available in Rockburne and Lafontaine 1976 (Fig. 414) and on the web at the Agriculture and Agri-food Canada Moths of Canada website (http://www.cbif.gc.ca/spp_pages/noctuoidea/jpgs/image_e.php?image%5B%5D=109504.jpg%2CPapaipema+aweme).

The early stages (egg, larva and pupa) are unknown. In general *Papaipema* larvae are dark with dorsal and sub-dorsal white lines; they usually become translucent with the markings becoming very faint or obsolete as they mature (Hessel 1954).

A key to the species of *Papaipema*, including *P. aweme,* is available in Forbes (1954, p. 191). However, many species of *Papaipema* are difficult to identify, even with a key, and there are a number of undescribed species not included in the key. The identity of specimens or suspected specimens of Aweme Borer should be confirmed by recognized experts in noctuid moths and in particular in the genus *Papaipema*. Identification of *Papaipema* species cannot be guaranteed from a photo of a live specimen, and a voucher specimen should be required for positive identification (Schweitzer 1999).

Genetic description

There are no genetic data available for the species. Although some gene flow could conceivably occur or have occurred between populations along the Great Lakes

shoreline, it is unlikely that any gene flow could occur between populations along the Great Lakes and those approximately 1,200 km distant in southwestern Manitoba.

Designatable units

None. There are too few data to evaluate.

DISTRIBUTION

Global range

The range of the Aweme Borer is defined by four collection sites extending along a narrow band from southwestern Manitoba (Aweme area) east to the Great Lakes shoreline in northern Michigan, southern Ontario and northern New York state (Figure 2). All records are historic and the species has not been collected since 1936 (Table 1). The global maximum extent of occurrence (EO) is approximately 160,000 sq. km. The maximum extent of occurrence (EO) in Canada encompasses about 30,000 km^2 in a narrow strip approximately 1,500 km long and 20 km wide.

Table 1. List of specimens of Aweme Borer.

Locality	Date	Collector	Disposition
CAN MB Aweme	1905-08-24	N. Criddle	Lyman Entomological Museum
CAN MB Aweme	1905-08-25	N. Criddle	British Museum of Natural History
CAN MB Aweme	1905-08-26	N. Criddle	Canadian National Collection of Insects
CAN ON Grand Bend	1936-08-15	?	Canadian National Collection of Insects
CAN ON Manitoulin I.	2005-08-19	J. K. Morton	Canadian National Collection (?)
USA MI Beaver Island	1925-08-13	S. Moore	American Museum of Natural History.
USA NY Rochester	1932-08-07	A.G. Richards	U.S. National Museum

Canadian range

The Canadian range is defined by three collection sites; Aweme in southwestern Manitoba and Grand Bend and Manitoulin Island in southeastern Ontario (Fig. 2.). These three Canadian collection sites account for three-fifths of the global sites, and five of the seven known specimens.

The first three specimens were collected at Aweme, Manitoba in August of 1908, while the most recent collection came from Manitoulin Island, Ontario in 2005. The 2005 specimen is the first report of this species in almost 70 years (Table 1).

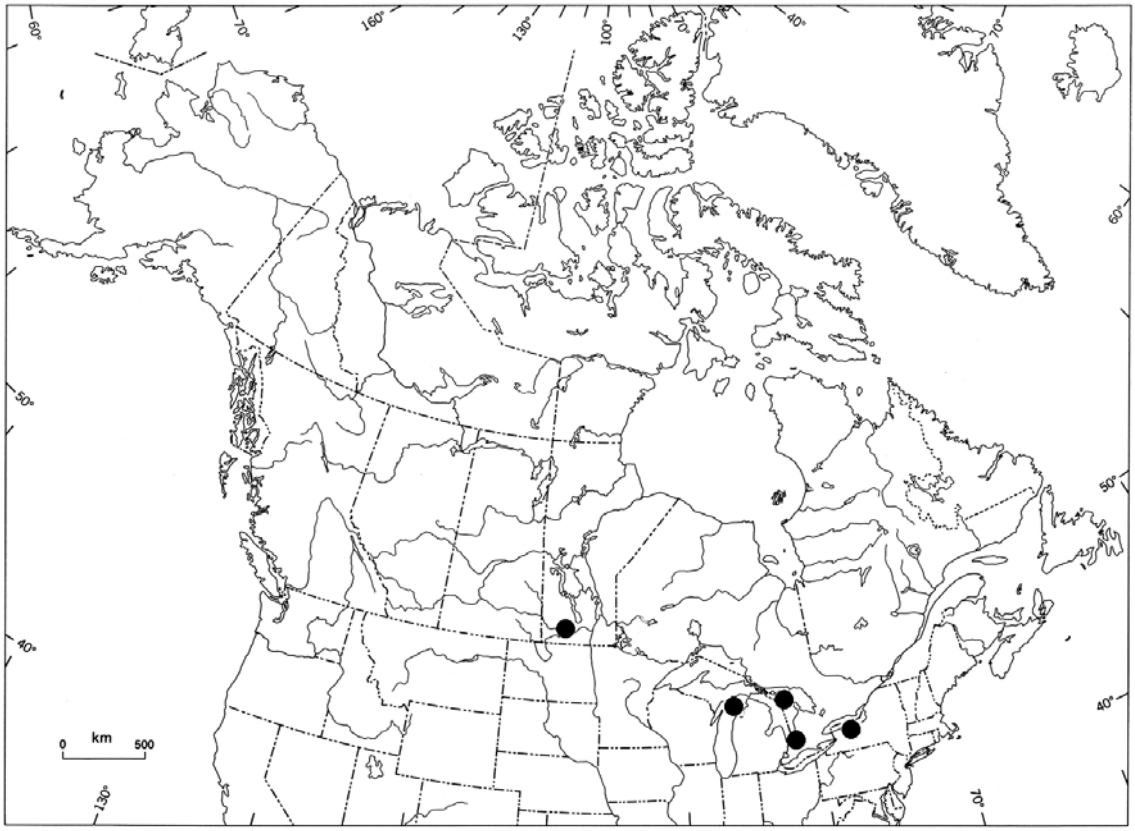

Figure 2. Collection sites for the Aweme Borer.

The Aweme site is located in the Prairie Ecological Area and the Grand Bend and Manitoulin sites in the Great Lakes Plain (COSEWIC 2003). The maximum extent of occurrence (EO) in Canada encompasses about 35,000 km^2 in a narrow strip approximately 1,500 km long and 20 km wide. The maximum area of occupancy (AO) includes a possible 625 km^2: approximately 600 km^2 in Spruce Woods Provincial Park and Canadian Forces Base (CFB) Shilo combined, about 25 km^2 in The Pinery Provincial Park – Grand Bend area, and less than 1 km^2 on Manitoulin Island.

HABITAT

Habitat requirements

Until the 2005 specimen was caught, no one alive today had seen a living Aweme Borer and the precise locations and habitats where the specimens were collected were not known. The locality “Aweme” on the label of specimens collected by Norman Criddle included an area to at least 10 km distance from Aweme, which was the name of the Criddle homestead, and includes much of CFB Shilo and adjacent Spruce Woods Provincial Park (Roughley, 2000). The only historic specimen for which reasonably

precise information is available is the one collected at Beaver Island, Michigan, which was apparently collected at the lights of a boat anchored offshore (K. Stead, personal communication, November 2004).

The most likely habitat of the Aweme Borer was thought to be associated with sand dunes. The Aweme Borer was almost certainly associated with Great Lakes dunes and former inland lakeshores, or possibly in swales formed between these dunes (Schweitzer 1999). Four of the five collection sites are located along the shoreline of the Great Lakes; the fifth (Aweme) is located within the Brandon sandhills, which were formed by glacio-lacustrine sediments of glacial Lake Agassiz (David 1977).

Several bits of evidence support the hypothesis that Aweme Borers are resident in dune habitats. Norman Criddle collected all three of his specimens over a 3-day period (Table 1). This suggests they were not taken close to his residence at Aweme, where he collected for over 30 years, but during one of his less frequent collecting forays in the region. The pale colour of the Aweme Borer also suggests it comes from a dry sandy habitat. Beach or other sand dunes are present in the vicinity of all but the most recent collection sites. The presence of an undescribed species of *Papaipema* on Sable Island, Nova Scotia, not much more than a sandbar in the Atlantic Ocean, indicates that *Papaipema* species can occupy sandy dune habitat (E. Quinter, pers. comm., August, 2004).

Remnant dune habitats, including those at the two localities in Canada where Aweme Borers have been found historically, are known to have a number of otherwise very rarely collected species of moths, including *Acronicta albafufa* Grote, *Pyla areaeola* Balogh and Wilterding, *Loxocrambus awemensis* McD., a number of species of *Schinia* and others (Lafontaine 1996; D. Schweitzer, pers. comm., 2004).

The most recent specimen of the Aweme Borer was collected from a bur-oak prairie on Manitoulin Island, with no sand deposits in the vicinity of the collection site. Oak prairies are also present in the vicinity of most of the historic collection sites (D. Lafontaine, pers. comm.), but were not thought to be associated with the Aweme Borer. Given the recent record, it is possible that the Aweme Borer inhabits open oak habitats instead of sand prairies, or that it is restricted to dry, open sites and can live in both sand and oak prairies. It will be possible to determine the exact habitat requirements of the Aweme Borer only if and when the larvae can be found and the host plant(s) identified.

Aweme lies within the Prairie Ecological Area, and the other collection sites all lay within the Great Lakes Plains Ecological Area (COSEWIC 2003). The Aweme area is within the Aspen Parkland Ecoregion (Gauthier *et al* 2001); the Grand Bend and Manitoulin sites are located within the Mixedwood Plains Ecozone (Lafontaine 1996). Although widely separated by non-prairie habitat today, these two areas were linked in the past, during a post-glacial warming trend that reached its peak about 7,000 years ago and resulted in the expansion of the prairies into north-eastern North America. The disjunct remnants of this ‘prairie peninsula’ persist today across the northeastern

United States and southern Ontario, the areas where Aweme Borers have been collected. Collections of Lepidoptera from relict prairie in southern Ontario (e.g. Windsor Prairie and The Pinery Provincial Park) indicate that prairie species followed this post-glacial expansion eastward, and many persist there to this day in dune habitats (Lafontaine 1996) and other prairie remnants, including oak savannah prairie.

Habitat trends

Manitoba: Native habitat in the Aweme–CFB Shilo–Spruce Woods Provincial Park area has been affected by both natural and anthropogenic changes over the past century. Most native grasslands in the Aweme region have been converted to agricultural use, in particular to irrigated potato production and forage (Fig. 3). Some small areas of native fescue grassland persist in the immediate area of Aweme (Roughley 2000). Native trees, in particular trembling aspen (*Populus tremuloides*) and bur oak (*Quercus macrocarpa*), have replaced much of the original grasslands not converted to agricultural use, in particular in Spruce Woods Provincial Park. However, relatively large areas of native grassland and aspen–oak savannah remain in CFB Shilo and Spruce Woods Provincial Park (Figs. 4-5). Almost all remaining active dunes are now located in the Spirit Dunes within Spruce Woods Provincial Park (Figs. 6-7).

Figure 3. Aweme, Manitoba, type locality for Aweme Borer. Native grasslands habitat converted to forage crop (foreground) and woodland (background). July 29, 2004.

Figure 4. Prairie openings in aspen and oak “barrens” on stabilized sand hills, Spruce Woods Provincial Park. August 26, 2004.

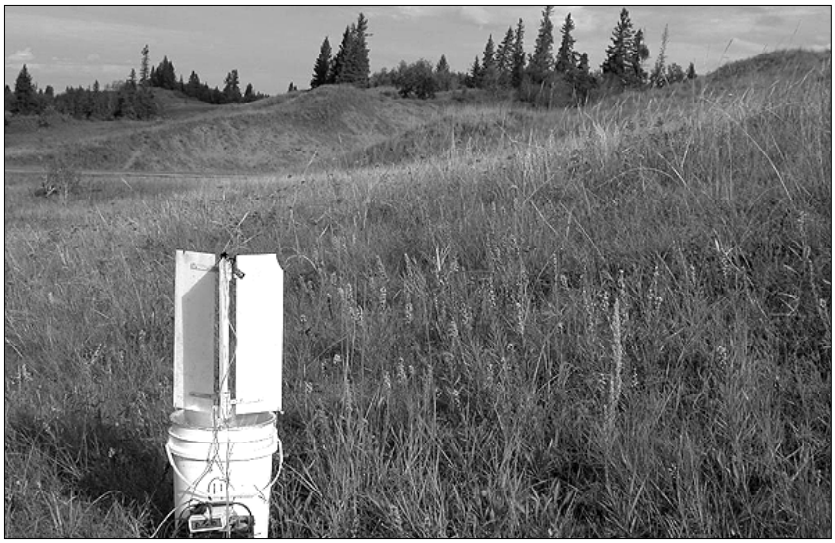

Figure 5. Moth trap in patch of *Liatris* sp., a potential host plant for the Aweme Borer, growing in grassland opening on vegetated sand hills, Spruce Woods Provincial Park. August 26, 2004.

Military activity in CFB Shilo has apparently caused numerous fires on CFB Shilo lands, which have in turn maintained much of that area in grassland. At adjacent Spruce Woods Provincial Park much of the original grassland has been, and continues to be, replaced by aspen-oak woodland (Portman 2004). The active dunes of the Spirit Dunes at Spruce Woods Provincial Park have become progressively more stabilized by vegetation since the 1920s (Fig. 6). Aerial photographs taken in 1928 show active dunes covering an area of approximately 45 ha; this declined steadily to 15-25 ha in the 1960s, but has remained relatively stable since that time (Geological Survey of Canada 2001).

Figure 6. Early stages of dune stabilization by native and introduced vegetation, Spirit Dunes, Spruce Woods Provincial Park. August 26, 2004.

Figure 7. Active dunes, Spirit Dunes, Spruce Woods Provincial Park. August 4, 2004.

Ontario: The Grand Bend area, including The Pinery Provincial Park, is located on sandy soils and historically had a significant oak-savannah component. Soon after The Pinery Provincial Park was established in 1957, over 3,000,000 pines were planted (Invista 2004). Since that time, prescribed burns and pine cutting programs have largely restored the habitat to oak savannah. All habitats in the park had previously been

"seriously degraded to obliterated by grossly out of control deer" (Schweitzer 1999). However, the deer population is now being managed with periodic culls, and savannah vegetation is being managed through prescribed burns. Habitat on adjacent First Nations land is reported to be in more natural condition than habitat within The Pinery Provincial Park, which has been negatively affected by cottage and recreation developments (Ken Stead, pers. comm., November 2004).

The Manitoulin Island site is a large, low-relief limestone island. The site where the collection was made is a small, remnant piece of oak savannah or prairie. Bur-oak prairies were once fairly extensive on Manitoulin Island, but much of this habitat was converted to agriculture or development. Numerous patches of remnant oak prairies still exist on the island, but many are being gradually lost to succession to forest (D. Lafontaine, pers comm.).

Habitat protection/ownership

Aweme is the name of the original Criddle homestead, consisting of two quarter-sections of land. It is now under provincial jurisdiction as Criddle-Vane Provincial Park. Much of the area to the east falls within CFB Shilo and is under federal government jurisdiction. The bulk of the active dunes and a large block of stabilized sand hills, wetlands, oak-aspen woodland and native grassland is under provincial jurisdiction in Spruce Woods Provincial Park. Lands in both areas are largely protected from conversion to most agricultural uses, and large scale alterations of habitat in designated parks are usually subject to more public scrutiny than are lands in private ownership.

In Ontario, the habitat consists of a mix of private, provincial and First Nations (Ipperwash) land. The Pinery Provincial Park is under provincial jurisdiction. Oak savannah on Manitoulin is largely on private property, although the Nature Conservancy also controls a parcel (J. Jones, pers. comm.). The land where the recent specimen was caught is privately owned (J. Morton, via D. Lafontaine, pers. comm.).

BIOLOGY

Essentially nothing is known about the biology of the Aweme Borer, and the following information refers to the genus *Papaipema* in general.

Life cycle and reproduction

Adult Aweme Borers are nocturnal and have been collected at lights at night (M. Nielsen, personal communication 2004; D. Schweitzer, personal communication November 2004). The life cycle is undoubtedly like that of all Lepidoptera, consisting of complete metamorphosis, with egg, larva, pupa, and adult stages.

The life cycle takes one full year to complete. Female *Papaipema* drop eggs loosely in the vicinity of the host plant in the fall and then die. The eggs overwinter and

hatch the following spring. Larvae locate and bore into the host plant, where they complete their growth within the roots or stems, usually within a two-month period. Once mature, they pupate either inside or outside the host plant, depending on species or even individuals (Forbes, 1954; Bird, 1934). They remain in the pupal stage for about a month. Adults live for about two weeks, and females appear to be relatively inactive (Bird, 1934).

Collection records for adult *Papaipema aweme* are from 7-26 August (Table 1), somewhat early for *Papaipema* species (Schweitzer 1999). *Papaipema* moths are active late in the night (actually early morning) hours (Schweitzer 1999).

All *Papaipema* species are endophagous plant borers. They utilize an unusually wide range of plant species as hosts, spread across some 22–25 plant families ranging from ferns to trees to asters and lilies. However, most individual *Papaipema* species are restricted to only one or a few closely related species or genera of plants (Goldstein 1999, Forbes 1954; Rockburne and Lafontaine 1976). Suggested possible hosts of the Aweme Borer include relatively large native species such as Blazing-star (*Liatris* sp.) or an endemic thistle (*Circium* sp.) (J. Troubridge, pers. comm., 2004). The difficulty of identifying the host plant is illustrated by the fact that Dr. Eric Quinter, a borer specialist who has been studying this genus for some time, was unable to identify the host plant of a new species of *Papaipema* recently discovered on Sable Island, despite spending two weeks on the island searching for it among the very limited plant community present there (J.D. Lafontaine, pers. comm., July 2005).

Adult *Papaipema* have functional mouthparts and will come to sugar baits (G. Anweiler, personal observation; M. Nielsen, personal communication, November 2004), and likely obtain nectar from one or more species of native plants.

Predation

Major natural enemies of *Papaipema* include mammals such as rodents and skunks (Hessel 1954, Decker 1930, Schweitzer 1999), woodpeckers (Decker 1930), as well as numerous parasitoids and predatory insects. Larvae of *Papaipema* may be heavily parasitized by both Hymenoptera and Diptera (Fletcher and Gibson 1907; Bird 1934). A tachinid fly, *Masicera senilis* Will., and a braconid wasp, *Apanteles papaipemae* Muesebeck, are probably the most important parasitoids of *Papaipema* larvae (Decker 1930). Small mammals in some cases can completely eradicate small populations of *Papaipema* (Hessel 1954).

Physiology

There are no species-specific data.

Dispersal/migration

Members of the genus *Papaipema* are not known to migrate, and are usually collected in close proximity to the host plants. Dispersal between isolated food patches separated by up to several kilometres does occur (Schweitzer 1999).

Interspecific interactions

There are no data. The Aweme Borer is undoubtedly dependent on one or more unknown species of larval host plant.

Adaptability

Most *Papaipema* species are restricted to, and dependent upon, one or a few related host plants. *Papaipema* species have demonstrated the ability to reoccupy patches of host plant following fire, so long as there are populations in unburned refugia in the vicinity (Schweitzer 1999).

POPULATION SIZES AND TRENDS

Search effort

Extensive collecting of moths has taken place at both historical Canadian sites where Aweme Borers have been found (Table 2). Norman Criddle, who collected the Manitoba specimens, resided and collected in the area for over 30 years (Roughley 2004). Gary Anweiler collected a variety of habitats in the eastern section of Spruce Woods Provincial Park, including the Spirit Dunes and aspen-oak prairie, over a four consecutive night period in late August 2004, using UV traps and mercury vapor light to search specifically for Aweme Borers*.

The Grand Bend–The Pinery Provincial Park area has been collected for moths extensively since about 1990, in particular by Ken Stead, a resident of Port Franks, just south of The Pinery Provincial Park (Table 2). Although over 1,500 species of moths have been collected there, no Aweme Borers have ever been found (K. Stead, pers. comm. November 2004). Less intensive moth collecting has also taken place in The Pinery Provincial Park in past years by “many others”, including Gordon Vogg, Robert Curry, and William Lamond (Steve Marshall, review comment).

J. Morton (M. Oldham, pers. comm. based on correspondence between M. Oldham and J. Morton) has collected moths on Manitoulin and nearby islands since the early 1970s and has been trapping extensively for 20 years. He has collected repeatedly at 419 sites on the island, some of them trapped every three weeks throughout the year from spring to late fall. His work yielded approximately

* This search was not intense enough to cover all habitats and possible variation in hatch times, but an exhaustive search would require a great deal of effort and was beyond the scope of the contract.

1,500 species of Lepidoptera in the Manitoulin area. His database contains over 60,000 records, including information on over 25,000 specimens, making Manitoulin one of the better known areas in Canada with respect to the Lepidoptera that occur there. Despite this extensive collecting effort, including trapping at the right time of year in about six remnant bur-oak prairies, he did not collect *P. aweme* until in August 19, 2005 he caught a single specimen on his property, which has bur-oak prairie.

In the USA, significant trapping efforts to locate Aweme Borers have been carried out since 1987 at and near the Beaver Island Michigan site, including a search specifically for Aweme Borers in late August 1998 (Table 2). Although over 750 species of moths were collected, no Aweme Borers were found (Profant 1991). Aweme Borers are still being searched for periodically in potential habitat in northern Michigan (M. Nielsen, personal communication 2004).

Table 2. Summary of search efforts at Aweme Borer collection sites.

Site	Period	Method(s)	Results	Investigator or Source	Note
Aweme - Spruce Woods, MB	Resident late 1800s-1930s	Variety, including bait and light	3 specimens of *P. aweme*	N. Criddle	
"	26/29-08-2004	Ultra-violet & mercury vapor lights	No *P. aweme*	G. Anweiler	*P. aweme* targeted
Grand Bend – The Pinery P.P. ON	August 1993 (1 week)	Ultra-violet light trap	No *P. aweme*	D. Schweitzer	
"	1996(?) - 1998	Light traps	526 species of noctuids, no *P. aweme*	Hardwick and Stead 1998	
"	Resident 1990(?)-2004	Various, including light traps	1560 species of moths, no *P. aweme*	Ken Stead	
Manitoulin Site	Resident 1985 - present	UV trap(s)	1 aweme	J.K. Morton	
Beaver Island, MI	?	light	1 *P. aweme*	Moore 1930	
"	1987-1988	Light traps	757 species of moths, no *P. aweme*	Profant 1991	
"	17-19/08/1998	Ultra-violet light traps	No *P. aweme*	Penskar *et al* 1999	*P. aweme* targeted

Papaipema species are notoriously difficult to collect except in close proximity to their host plant(s). Not knowing the host plant of the Aweme Borer greatly hinders efforts to locate it or to determine the size of populations (Schweitzer 1999).

Abundance

The Aweme borer is known from a total of seven specimens taken at five widely dispersed sites over a period of one hundred years. Three of the specimens were taken at Aweme, Manitoba during a single three-night period in 1905.

According to the summary report for Aweme Borer on NatureServe (NatureServe 2004) the Aweme Borers can reasonably be assumed to be extirpated at four of the five collection localities, including two of the three Canadian sites. However, much apparently intact native habitat remains in the CFB Shilo – Spruce Woods Provincial Park area, and more extensive and intensive search efforts than have taken place so far are needed before concluding the moth no longer exists (G. Anweiler, personal observations, 2004).

Fluctuations and trends

There are no data on population fluctuations or trends.

Rescue effect

There are no known extant populations of Aweme Borer, other than at the one site on Manitoulin Island. However, should this moth still occur at the Beaver Island, Michigan site or elsewhere along the Great Lakes shoreline, although highly unlikely, it could conceivably re-populate the Grand Bend – The Pinery site if the host plant and suitable habitat are present. The possibility of individuals from Ontario or the United States sites re-colonizing the Manitoba site, or vice versa, are probably nil.

There are no obvious reasons why individuals from any adjacent Great Lakes populations in the United States would not be adapted to survive in southern Ontario.

LIMITING FACTORS AND THREATS

The main limiting factor for Aweme Borers would be the amount and extent of the host plant(s). Nieminen (1996) has pointed out that the pattern of population extinction in moths is affected by host plant characteristics rather than by the characteristics of the moths themselves, and that monophagous moths (feeding on a single species or type of food) are more likely to suffer extirpation than are polyphagous species (feeding on two or more species or types of food), as are species that occur in highly fragmented disjunct populations.

According to Bird (1934), the single most important factor that contributes to the decline of the genus *Papaipema* is fire. The eggs, which are present from early fall through late spring, are exposed and are particularly vulnerable to fires. Controlled and other burns are known to have a negative impact on *Papaipema* species, in particular where fires consume all patches of the host plant in an area in a single season. Food

plant patches may be unoccupied, or nearly so, by immature stages of *Papaipema* for the season following a fall, winter or spring burn because most individuals are killed (Schweitzer 1999). Almost all major workers on the genus have commented on the fire sensitivity of *Papaipema* eggs. Dana (1986) advises always assuming high mortality of *Papaipema* eggs in fall, winter or spring burn units. To preserve the rarer *Papaipema* populations, Schweitzer (1999) recommends protecting an adequate amount of the food plant by dividing occupied habitat into smaller burn units. These smaller units can be burned in rotation with 3-5 years between burns of a single unit, and adjacent units should not be burned in consecutive years. No *Papaipema* site should ever be entirely burned in a single year. The principle of burning blocks and/or rotating burns is applied and addressed in the prescribed burn plans for The Pinery Provincial Park.

As for most species of wildlife, loss of habitat, or some habitat element upon which the species is dependant, is probably the greatest threat. Loss or degradation of native habitats to agricultural, recreational or other uses is perhaps the most widespread and pervasive threat to most species of wildlife, including the Aweme Borer. Cottage and other recreational development has largely replaced native habitat in the Grand Bend – The Pinery Provincial Park region (K. Stead, pers. comm., 2004). Most of the park itself was, or has been, restored to native habitat and is now managed as nature reserve and natural environment zones. Overgrazing by deer and livestock can seriously affect native vegetation and the species dependant upon it. Massive overgrazing by “grossly out of control deer populations” was noted at The Pinery Provincial Park in 1993 (Schweitzer 1999). The deer herd is now being managed and the habitat has recovered measurably and continues to do so. Conversion of grassland habitats to forested habitats, either by natural succession speeded up by suppression of wildfires (i.e. Spruce Woods area) or by planting trees (i.e., historically in The Pinery Provincial Park), are possible threats to species dependant on open habitats. Stabilization of active dunes by vegetation, whether through natural processes or deliberate intervention, can also be a threat to species dependant on active dune habitats. Only patches of remnant bur-oak prairies remain on Manitoulin Island, and only those that have not been burned can be expected to possibly support the Aweme Borer (D. Lafontaine, pers. comm.). Most of the remnants are subject to forest ingrowth as a result of natural succession.

Pesticide applications, especially widespread applications of Lepidoptera-targeting agents, such as Btk spores, could pose a threat in areas where gypsy moths or other pest species are targeted for control.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Aweme Borer is one of the most rarely collected moths in North America; it has been collected only once since 1936. It is known from only three widely separated sites in southern Canada and another two in the northeastern USA. Five of the seven specimens known were collected in Canada.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Aweme Borer is not listed in the US Endangered Species list, the IUCN Red Book or CITES. The Nature Conservancy (NatureServe) has assigned the Aweme Borer a global rank of GH (Globally Historical), a USA national rank of NH (Nationally Historical), a Canadian national rank of NH (Nationally Historical) and Provincial or State ranks of SH (State Historical) in Ontario, Michigan and New York. It is also listed as SNR (Species Not Ranked) in Manitoba. It is not mentioned in the New York State Endangered Species List, but is listed by the state of Michigan as SC (Special Concern).

Any extant populations in Criddle-Vane Homestead Provincial Park and Spruce Woods Provincial Park in Manitoba and The Pinery Provincial Park in Ontario would be protected under legislation protecting wildlife within Provincial Parks. The Manitoulin site is on private property.

TECHNICAL SUMMARY

Papaipema aweme
Aweme Borer — Perce-tige d'Aweme
Range of Occurrence in Canada: Ontario

Extent and Area Information	
• *Extent of occurrence (EO)(km²)*	Area of the site on Manitoulin Island: < 1 km^2 (Max. 35,000 km² – area encompassed by the one extant and two historic collection sites in Canada.)
• *Specify trend in EO*	Not applicable – almost no data
• *Are there extreme fluctuations in EO?*	Not applicable – only one specimen record in the past 70 years
• *Area of occupancy (AO) (km²)*	Known: < 1 km^2 (Max. 625 km^2 including historic sites)
• *Specify trend in AO*	Unknown
• *Are there extreme fluctuations in AO?*	None known
• *Number of known or inferred current locations*	One (2 additional historic locations)
• *Specify trend in #*	Stable at 1
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Fragmented and declining
Population Information	
• *Generation time (average age of parents in the population)*	1 year
• *Number of mature individuals*	Unknown
• *Total population trend:*	Historic declines; recent trend unknown
• *% decline over the last/next 10 years or 3 generations.*	None known
• *Are there extreme fluctuations in number of mature individuals?*	None known
• *Is the total population severely fragmented?*	Probably. Known at a single site; based on known sites, historic population was severely fragmented
• *Specify trend in number of populations*	1 extant plus 2 historic
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: Manitoulin Island – unknown, probably less than 100	
Threats (actual or imminent threats to populations or habitats)	
1. Burning 2. Overgrazing 3. Natural succession 4. Development and other intensive human activity	

Rescue Effect (immigration from an outside source)	
Status of outside population(s)?	**USA**: None – possibly extirpated
• *Is immigration known or possible?*	Not known; unlikely
• *Would immigrants be adapted to survive in Canada?*	Probably
• *Is there sufficient habitat for immigrants in Canada?*	Unknown but likely
• *Is rescue from outside populations likely?*	No, species possibly extirpated in the US
Quantitative Analysis	Not applicable
Current Status Manitoba and Ontario: NRH; MI and NY, NRH; MI SC COSEWIC: Endangered (2006)	

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: D1

Reasons for Designation:
Prior to the collection of one specimen in Ontario in 2005, the moth was last collected 70 years earlier. It is known from only five localities globally, three of which are in Canada. Although the species is poorly known, it is apparently restricted to a rare, fragmented and threatened habitat. Repeated collecting at all of the historic locations has not resulted in relocation of the species, and intensive collecting in the vicinity of the recent record has not yielded any additional specimens.

Applicability of Criteria

Criterion A: (Declining Total Population): Not applicable

Criterion B: (Small Distribution, and Decline or Fluctuation): The known extent of occurrence is much smaller than 5,000 km^2 (smaller than 1 km^2) – B1. The area of occupancy is much smaller than 500 km^2 (smaller than 1 km^2) – B2. The population was likely severely fragmented during historic times but is no longer fragmented as it is known to exist at 1 location – a. There is no evidence of continuing declines and it is unknown whether the species undergoes extreme fluctuations in the number of mature individuals.

Criterion C: (Small Total Population Size and Decline): Not applicable – although the extant population is likely very small, there is no evidence of decline.

Criterion D: (Very Small Population or Restricted Distribution): Very likely meets Endangered under D1 – number of mature individuals is very likely fewer than 250. Also meets Threatened under D2 – the population has a very restricted known area of occupancy (smaller than 1 km^2) and number of locations (1), such that the moth is prone to the effects of human activities and stochastic events.

Criterion E: (Quantitative Analysis): Not applicable.

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AUTHORITIES CONTACTED

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Dr. Gordon Court, Prov. Wild. Status Biol., Alberta Fish & Wildlife, Edmonton AB.
Dr. James Duncan, Manager, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Winnipeg MB.
Alan Dextrase, Aquatic SAR Biologist, Species at Risk Section, Ontario Parks, Ontario Ministry Nat. Resources, Peterborough ON.
Jeanette Pepper, Zoologist, Saskatchewan CDC, Saskatchewan Environment, Regina SK.
Wayne Nordstrom, Alberta Natural Heritage Information Centre, Alberta Environment, Edmonton AB.
Nicolle Firlotte, Manitoba CDC, Winnipeg MB.
Dr. Martin Honey, Curator of Lepidoptera, Natural History Museum, London, England.
Dale Schweitzer, NatureServe and the Nature Conservancy, Post Norris, NJ.
Ken Stead, lepidopterist, Brantford, ON.
Mogens Nielsen, lepidopterist, E. Lansing, MI.
Dr. J. Donald Lafontaine – scientist and noctuid specialist, Canadian National Collection of Insects and Arthropods, Ottawa, Ontario.
Jim Troubridge – lepidopterist and noctuid specialist Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Gary Anweiler is a research associate at the University of Alberta Strickland Entomological Museum, a recognized authority on the noctuoid moths of Alberta and a sitting member of the COSEWIC Arthropods subcommittee.

COLLECTIONS EXAMINED

United States National Museum, Washington, D.C.
Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON
Natural History Museum, London, UK

Note: Because this is such a rare species (7 known specimens), is difficult to identify by non-specialists and has been the subject of searches by researchers currently working on the genus, an extensive search of smaller institutional collections was deemed unnecessary.

Appendix 1. Required contacts for information on species.

Name of report contractor: Gary G. Anweiler
Species: Aweme Borer (*Papaipema aweme* (Lyman) (Lepidoptera, Noctuidae)

Name of jurisdiction	Name of contact(s) and date(s)
Canadian Wildlife Service	Dave Duncan Oct. 28, 2004 Rick Pratt Nov. 24, 2004
Department of Fisheries and Oceans (aquatic species only)	Not applicable
Parks Canada	Not applicable
Provincial / territorial representative(s) corresponding to the range of the species	James Duncan, Nov. 24, 2004 (Manitoba) Alan Dextrase, Nov. 24, 2004 (Ontario)
Conservation Data Centre(s) or Natural Heritage Information Centre(s) corresponding to the range of the species	MB CDC (Nicole Firlotte) June 8, 2004 ON NHIC (Don Sutherland) Nov. 24, 2004
Wildlife Management Board(s) corresponding to the range of the species (species in British Columbia, Yukon, Northwest Territories, Nunavut or northern Quebec)	Not applicable
COSEWIC Secretariat for information on sources of Aboriginal Traditional Knowledge	Gloria Goulet, June 8, 2004
Recovery team (if one exists)	Not applicable