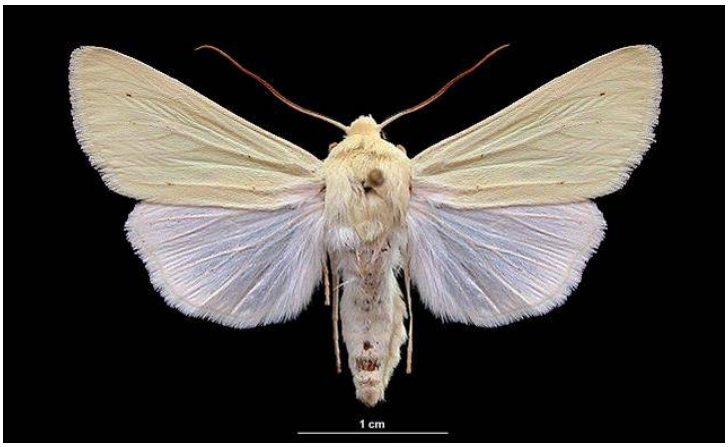
COSEWIC
Assessment and Status Report

on the

Pale Yellow Dune Moth
Copablepharon grandis

in Canada



SPECIAL CONCERN
2007

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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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215
Fax: 819-994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

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COSEWIC
Assessment Summary

Assessment Summary – November 2007

Common name
Pale Yellow Dune Moth

Scientific name
Copablepharon grandis

Status
Special Concern

Reason for designation
Although the area of occupancy is small, there is some evidence of decline in its extent of occurrence and area of occupancy. The species persists in widely separated dune systems, the declines are not well documented, and the status of threats is unclear. It requires semi-stable sand dunes which are declining.

Occurrence
Alberta, Saskatchewan, Manitoba

Status history
Designated Special Concern in November 2007. Assessment based on a new status report.

COSEWIC
Executive Summary

Pale Yellow Dune Moth
Copablepharon grandis

Species information

Copablepharon grandis (Strecker 1878) Pale Yellow Dune Moth is a medium-sized moth with evenly coloured pale yellow forewings and white hindwings.

Distribution

Copablepharon grandis is widely distributed in western North America. It has been found from southern California in the southwest to central Texas in the southeast, and as far north as Lloydminster, Alberta. It has been found at approximately 84 localities in North America since it was described in 1878. Its range is 4,345,223 km^2 globally and 184,590 km^2 in Canada. Since 1902, *C. grandis* has been captured 36 times representing ten localities in Canada: four in Alberta, five in Saskatchewan, and one in Manitoba. Three of the ten localities were found during the 2004–2005 sampling program.

Habitat

Copablepharon grandis occurs in sparsely vegetated sandy habitats. Sampling records from 2004–2005, supplemented with inferences about habitat conditions in previous sampling locations, suggest it most often occurs in semi-stable dunes with sparse grass and forb cover. Several factors affect habitats in which *C. grandis* has been found: 1) cattle grazing; 2) land development; 3) recreational disturbance; 4) sand dune stabilization; 5) reduced fire frequency.

Biology

Little is known about the biology of *C. grandis*. It is a nocturnal moth with a short summer flight season and is difficult to observe in the field. Indeed, other than light-trap captures, it was not observed in the field in 2004–2005.

The moth has one flight season per year; in Canada it is from early July to late August. Eggs are fully formed in newly emerged adults, but mating and egg laying have not been observed. Eggs are believed to be deposited in shallow sand. Larvae emerge

from the eggs approximately three weeks later. Larvae likely feed nocturnally on the above-ground parts of plants and bury themselves in the sand during the day; they may also feed below ground. Larvae likely undergo a below-ground diapause between the fall and early spring, although the location and depth of burial are unknown. Spring or early summer feeding may also occur prior to pupation. Pupation occurs in an earthen cell in the soil. *Copablepharon grandis* does not appear to be limited to a single host-plant for adult feeding, reproduction, or larval feeding.

Dispersal abilities of *C. grandis* have not been measured. Given that dune habitats are often patchily distributed, it is likely that short-distance dispersal occurs. However, dispersal between regionally isolated dunes systems (>10 km) is considered unlikely or is very infrequent.

Population sizes and trends

A total of 18 *C. grandis* specimens were captured in 2004–2005 ranging from 1 per trap to 12 per trap (mean of 3 per trap where present). Because of the low number of moths captured and the inherent uncertainties in measuring capture success, suitable habitat, and other factors, a reliable population estimate cannot be calculated for *C. grandis*. There is no quantitative information on population fluctuations and trends for *C. grandis*. The population of *C. grandis* near Turtle Mountain, North Dakota, USA, is approximately 250 km south of the closest Canadian population at Spruce Woods Provincial Park in Manitoba. Recolonization is unlikely over this distance.

Limiting factors and threats

Copablepharon grandis is most threatened by the progressive stabilization of sand dunes caused by natural vegetation colonization.

Grazing is a possible threat to *C. grandis.* Grazing may maintain sparsely vegetated sandy habitats; however, it may cause soil compaction and browsing of vegetation that is used for larval feeding, and may destroy eggs, larvae, or pupae.

The spatial isolation of *C. grandis* habitats may make the species susceptible to demographic collapse, particularly with development of the landscape between suitable habitats. Demographic collapse is considered a possible threat.

Development activities, such as road building and petroleum infrastructure construction that result in direct loss or disturbance to natural habitats or mortality of moths are considered a possible threat to *C. grandis*.

Recreation may be intensive in some sandy habitats and result in loss of vegetation, disturbance to sand substrates, and destruction of eggs, larvae, and pupae. Recreation may also maintain or create open sand habitats. It is considered a possible threat.

Special significance of the species

Copablepharon grandis is associated with sand dunes, a regionally rare habitat in the southern Canadian prairies. *Copablepharon* moths are of interest to entomologists and taxonomists because of their association with spatially isolated dune habitats. There is no information to suggest that *C. grandis* has an important cultural or economic role for First Nations.

Existing protection or other status designations

Copablepharon grandis is not protected in any jurisdiction in North America. Portions of the populations at Wainwright (Wainwright Dunes Ecological Reserve), Suffern Lake Regional Park, and Spirit Dunes (Spruce Woods Provincial Park) are found in protected areas.

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 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 (2007)

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 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.

Environment Canada
Canadian Wildlife Service

Environnement Canada
Service canadien de la faune

Canada

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

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SPECIES INFORMATION

Name and classification

Scientific name: *Copablepharon grandis*

Classification: Order: Lepidoptera
Superfamily: Noctuoidea
Family: Noctuidae
Subfamily: Noctuinae
Tribe: Agrotini
Genus: Copablepharon
Species: grandis

Synonyms: *Aedophron grandis* Strecker, 1878; *Ablepharon grandis* Strecker (1878); *Copablepharon grande* Franclemont and Todd, 1983.

Moths of North America (MONA) Number: RWH 10681

Bibliographic citation: Strecker, F.H.H. 1878. Lepidoptera, Rhopaloceres and Heteroceras, Indigenous and Exotic; with Descriptions and Colored Illustrations. Reading, PA. 143 pp. 14 pls.

Type specimens: Type locality: Arizona, USA; lectotype stored at Field Museum of Natural History, Chicago, Illinois.

English names: *Grand Copablepharon* was suggested by Hooper (1994); proposed name: *Pale Yellow Dune Moth*.

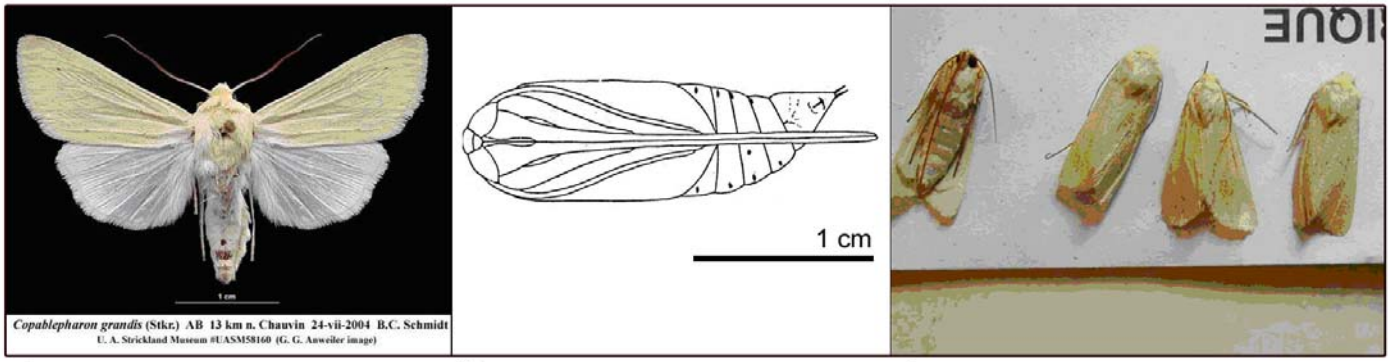
French name: Noctuelle jaune pâle des dunes

Taxonomic background and similarities: *Copablepharon grandis* is one of two species included in the *grandis* group by Lafontaine (2004). The other member of the group is *Copablepharon sanctaemonicae* Dyar which is found in sand dunes of the southern Californian coast. The group is characterized by a narrow, S-shaped clasper of the male genitalia, and elongate, pointed anal papillae in females.

Morphological description

Adults

Copablepharon grandis is a medium-sized moth with evenly coloured pale yellow forewings and white hindwings in both sexes (Figure 1). Forewing length varies from 16–20 mm. The forewing is often uniform in colour but may have one or more small dark dots on the subterminal band and dark shading on the margin of the hindwings. There is some geographical variation. Specimens from the Great Basin tend to be smaller than those from the Great Plains, including Canada (Lafontaine, 2004).



a) b) c)

Figure 1. Adult and pupal stages of *C. grandis*: a) adult moth from Strickland Museum collection (captured at Chauvin, AB by B.C. Schmidt); b) drawing of pupa from Strickland (1920); note the length of the external proboscis sheath; c) group of adult moths captured in Dundurn, SK in 2004 by N.A. Page. Photo a by G.G. Anweiler; photo c by N.A. Page. Image b reproduced with permission.

Eggs

Strickland (1920) described the eggs of *C. grandis* as sub-globular and greenish-white with a shallowly wrinkled upper surface and a smooth underside.

Larvae

The larva is light brown with white median and lateral lines. It was described by Strickland (1920) as similar to the red-backed cutworm (*Euxoa ochrogaster* Guenée) but more lightly pigmented. He noted that a mature larva was 38 mm long. Another noteworthy feature is that the D-1 and D-2 setae are similar in size, unlike those in *Euxoa* species (Fauske, 1992).

Pupae

The pupa is about 19 mm long with an external sheath (haustellum) enclosing the proboscis which extends 2 mm beyond the apex of the abdomen (Figure 1b). The cremaster is short and smooth, and the terminal setae are straight (Lafontaine, 2004). Pupation occurs in an earthen cell that is similar to that of *Euxoa* species (Strickland, 1920).

Genetic description

Genetic analysis of *C. grandis* has not been undertaken as part of the All Leps Barcode of Life project (Biodiversity Institute of Ontario, 2007). Geographical isolation of sandy habitats in the southern Canadian prairies suggests that population-level genetic variation may occur but has not been investigated.

Designatable units

There is no reason to consider this species as existing in more than one designatable unit in Canada or throughout its range.

DISTRIBUTION

Global range

Copablepharon grandis is widely distributed in western North America but sampling records suggest it is most prevalent in the arid steppe of the Great Basin and the southern Rocky Mountains (Figure 2). It has been found from southern California in the southwest to central Texas in the southeast and as far north as Lloydminster, AB. Its global extent of occurence is 4,345,223 km^2. The species appears to have a range disjunction with one group of occurrences in the southwestern US, and a second group west of the Great Lakes and extending in to the southern Canadian prairies. More sampling is needed in the intervening portion of the Great Plains to ascertain *C. grandis*' distribution more completely. The moth has been found at approximately 84 localities in North America since it was described in 1878.

Canadian range

Since 1902, *C. grandis* has been captured 36 times in ten localities in Canada (Figure 3): four in Alberta, five in Saskatchewan, and one in Manitoba. Three of the ten localities were found during the 2004–2005 sampling program (Appendix 1). Its Canadian extent of occurence is 184,590 km^2 based on a minimum convex polygon encompassing all known localities in Canada. Some additional populations are likely to occur in the Canadian prairies. *Copablepharon grandis* has not been captured in the active sand dunes of the Palliser Triangle, such as the Great Sand Hills or Middle Sand Hills. An additional record is noted in Strickland (1920, p. 82): "on May 9 [1913] a single larva of *C. grandis* was taken in a stubble field at Monarch, Alberta". However, this specimen is not available for taxonomic review and cannot be verified. It is included in Figure 3 with a unique symbol. Monarch, AB is northwest of Lethbridge on the Oldman River and is an area of arid, sandy habitats. The Canadian range of *C. grandis* is in the aspen parkland ecoregion and moist mixed grassland of the prairie ecozone (Marshall and Schut, 1999).

The estimated maximum area of occupancy is 203 km^2 in Canada. This is based on area of occupancy encompassed by known or suspected presence in habitats within the Canadian range measured with a 1 km grid overlaid on Landsat satellite images obtained in 2000; grid squares with suitable habitat were considered occupied. The area of occupancy is less than 50 km^2 based on a 2X2 km^2 grid overlaid on actual occurrences.

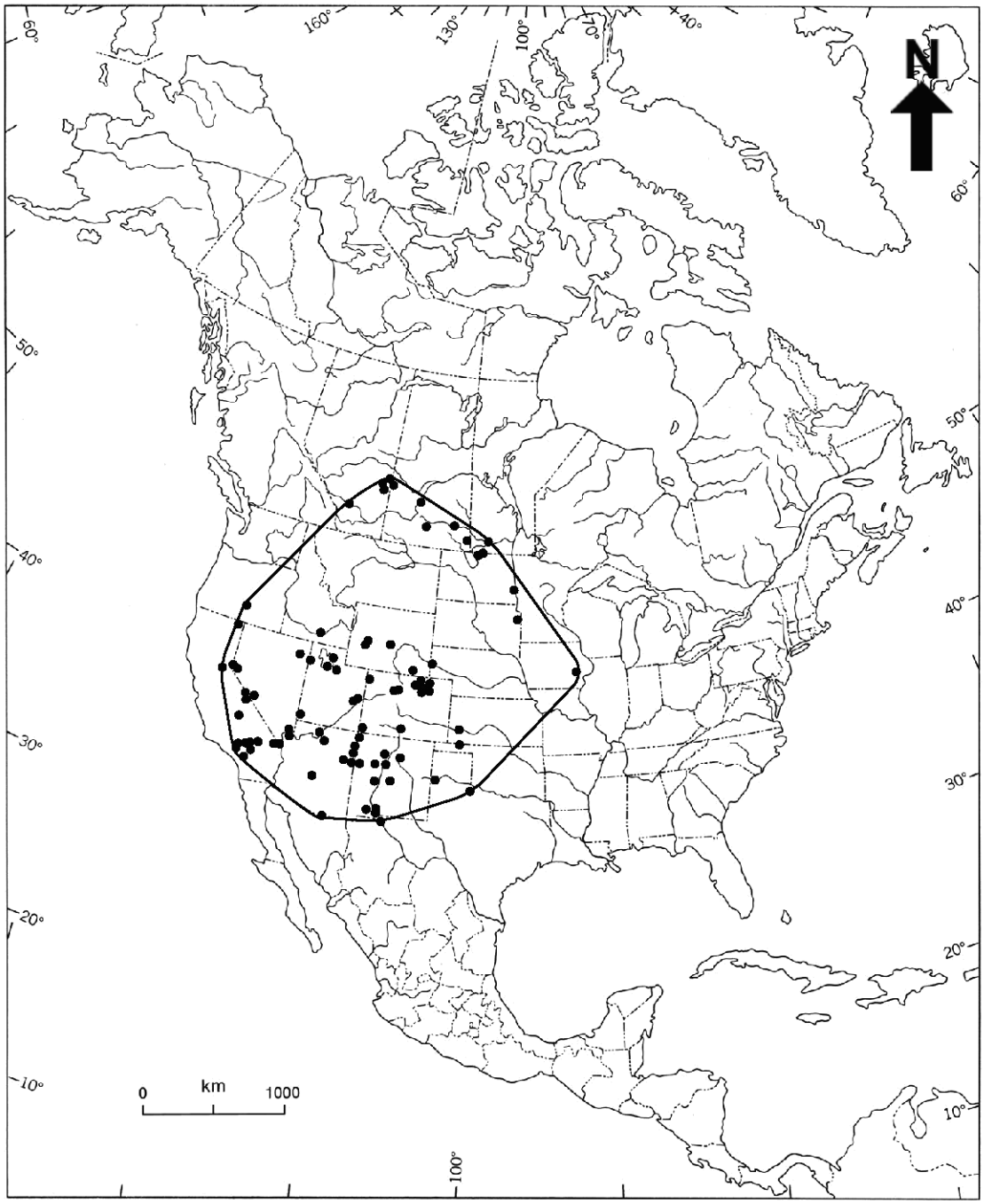


Figure 2. Distribution of *Copablepharon grandis* in North America. The extent of occurrence is shown with the dark line.

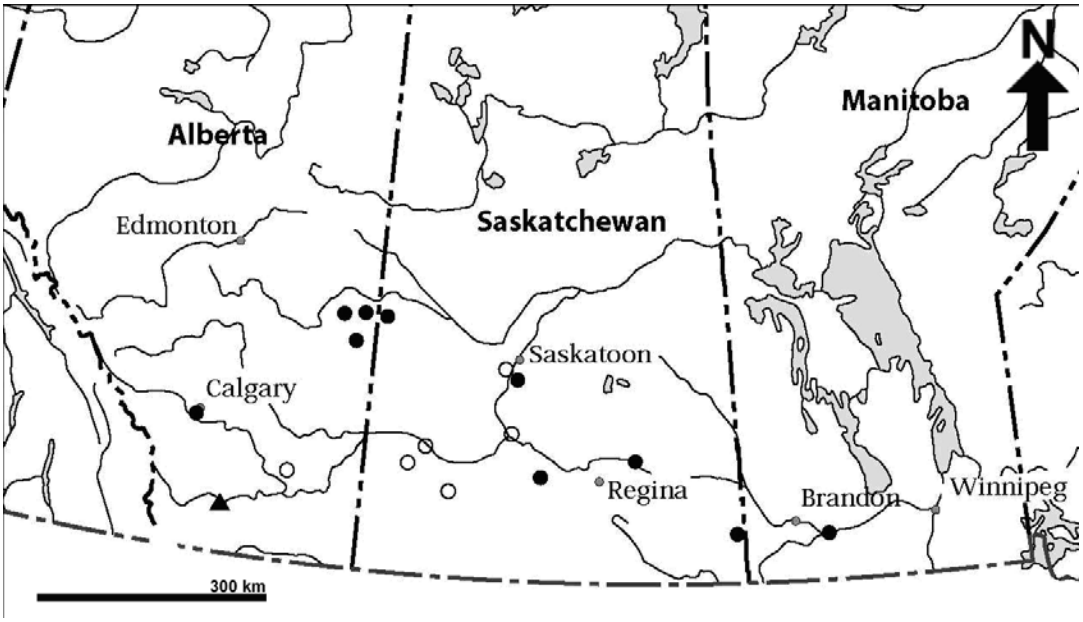


Figure 3. Distribution of *Copablepharon grandis* in Canada. Black dots represent known localities. Open circles indicate sites with sparsely vegetated sandy habitats sampled in 2004–2005 in which *C. grandis* was not captured. An unverified record from Monarch, AB (Strickland, 1920) is shown with a black triangle.

Population structure

The population structure of *C. grandis*, including the boundaries of populations and the occurrence of subpopulations, is poorly understood. Sampling records indicate that *C. grandis* is found in sparsely vegetated, sandy habitats that are patchily distributed within a matrix of more densely vegetated grasslands, shrublands, and forests. This distribution suggests that populations may be composed of subpopulations that are connected through dispersal at a local scale (0.5–2 km), but are isolated at a regional-scale (Figure 3).

HABITAT

Habitat requirements

Copablepharon grandis occurs in sparsely vegetated sandy habitats. Sampling records from 2004–2005 supplemented with inferences about habitat conditions in previous sampling locations, suggest that the moth most often occurs in semi-stable dunes with sparse grass and forb cover. These include depressional blowouts, dune faces, and road cuts (see examples in Figure 4). It has also been recorded twice in sandy, eroded areas (at Maryfield, SK and Fort Qu'appelle, SK) that are not characterized as sand dunes. This association with loose sandy soils suggests that open sand is needed for egg laying or for larval development. Strickland (1920) also found that captive raised moths layed eggs in the soil. A larva purported to be of this species was also found in a "stubble field" at Monarch, AB (Strickland, 1920).

Figure 4. Habitat characteristics of sites where *C. grandis* was captured in 2004–2005: a) open blow-out near Artland, SK (1 *C. grandis* captured); b) semi-stable blowout near Dundurn, SK (12 *C. grandis* captured); c) human-made fireguard near Dundurn, SK (2 *C. grandis* captured); d) large south-facing semi-stable dune at Wainwright DND Base, AB (1 *C. grandis* captured); e) sand exposure along disturbed roadside in Sounding Lake, AB area (1 *C. grandis* captured); and f) suspected *C. grandis* habitat in the Bush Lake Sandhills near Table Mountain, SK (no sampling undertaken). All photos by N.A. Page.

Open sand may not be the only critical environmental factor influencing the distribution of *C. grandis*. The moth was not captured in several sites in 2004–2005 in which habitat conditions appeared to be suitable. In particular, it has not been recorded in the Great Sand Hills, Burstall Sand Hills, or Seward Sand Hills—all sites with an assemblage of active, semi-stable, and stable sand dunes—nor was it captured in semi-stable dunes in Douglas Lake Provincial Park, SK. This information contributes to the difficulty in defining *C. grandis'* specific habitat requirements and suggests that climatic factors may also be important.

Lafontaine (2004) noted that *C. grandis* is likely the most frequently collected species of *Copablepharon* because of its large geographic range and broader range of habitats. Fauske (1992) stated that it was associated with midgrass and bunchgrass prairies, and areas of aeolian drift soils.

Copablepharon grandis does not appear to be limited to a single host-plant for adult nectaring, reproduction (e.g., ovipositing), or larval feeding. This conclusion is based on the variability of plant species recorded within the immediate vicinity of sampling sites in 2004–2005 as well as the moth's suspected use of open sand, rather than leaves or flowers, for ovipositing. Strickland (1920) reared a *C. grandis* larva on two unrelated plants—alfalfa (*Medicago sativa* L.) and barley (*Hordeum* sp.), which also suggests that the larvae do not rely on a single host-plant. The use of a common grass and a common legume is noteworthy in that it indicates that many plants are likely suitable host plants for larval feeding.

Plants recorded at sampling sites in Saskatchewan and Alberta in which *C. grandis* was captured include: prairie sandreed (*Calamovilfa longifolia* (Hook.) Scribn.), creeping juniper (*Juniperus horizontalis* Moench), sand dropseed (*Sporobolus cryptandrus* Pursh), needle and thread grass (*Stipa comata* Trin. & Rupr.), silverberry (*Elaeagnus commutata* Bernh. ex Rydb), Indian rice grass (*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barworth), blue grama grass (*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths), wheat grass (*Agropyron* spp.), lance-leaved psoralea (*Psoralea lanceolata* Pursh), sun-loving sedge (*Carex pensylvanica* ((Mackenzie) W.A. Weber)), hay sedge (*Carex siccata* Dewey), pasture sagewort (*Artemisia frigida* Wild), prairie Junegrass (*Koeleria macrantha* (Ledeb.) J.A. Schultes), choke cherry (*Prunus virginiana* L.), lichens (*Cladina* spp. and *Cladonia* spp.), prairie rose (*Rosa arkansana* Porter), common annual sunflower (*Helianthus annuus* L.), and Canada wildrye (*Elymus canadensis* L.).

Plant communities found in semi-stable, sparsely vegetated dunes in Saskatchewan, Alberta, and Manitoba vary regionally but are often similar in composition and structure. Coenen (2003) described and classified sand dune plant communities in the Wainwright Dunes Ecological Reserve in east central Alberta which are characteristic of *C. grandis* habitat in terms of species composition and physiognomy. Two sparsely vegetated plant communities on sandy soils were identified: 1) sand grass–sand dropseed–hay sedge herbaceous vegetation; and 2) creeping juniper/sand grass–sun-loving sedge dwarf shrubland. *Copablepharon grandis* was

captured in similar plant communities in the Wainwright, Sounding Lake, Chauvin, and Sufferin Lake localities in 2004–2005. As well, the site in which 12 were captured at a semi-stable dune blowout at Dundurn, SK in August 2004 is very similar in terms of plant composition and open sand cover to the creeping juniper/sand grass–sun-loving sedge dwarf shrubland (see Figure 4b). These communities develop on sloped, well-drained sandy soils with some sand movement; the former has approximately 60% open sand while the latter has around 30% (Coenen, 2003). The creeping juniper/sand grass–sun-loving sedge dwarf shrubland community is common on depressional blowouts (see Figure 4b).

Other plant communities described from semi-stable sand dunes include a sun-loving sedge–sand dropseed–Schweinitz's flatsedge (*Cyperus schweinitzii* Torr.)–sand grass plant community from the Manito Sandhills near the Sufferin Lake locality in west central Saskatchewan (Thorpe and Godwin, 1993) and a sand dropseed–prairie sandreed–Indian rice grass plant community from the Pakowki Lake area in southern Alberta (Coenen and Bentz, 2003). Hulett *et al*. (1966) described vegetation in the Dundurn area south of Saskatoon, SK, but did not formally characterize plant communities.

Sand hills in the Canadian prairies are characterized by fine or moderately fine sand, moderately high pH (8.1–8.3), less than 0.5% organic matter, and small amounts of silt and clay (<8% in total weight) (Hulett *et al*., 1966). Water-holding capacity is very low. The soils are classified as regosols by the Canadian Soil Classification System.

Habitat trends

Sandy soils are widespread in the southern Canadian prairies and are composed of glaciofluvial, glaciolacustrine, and deltaic sediments from the last glaciation that have been reworked by wind action (David, 1977). However, most sandy habitats are stable, vegetated and lack open sand except in isolated blowouts, drier dune ridges, road cuts, and other disturbed sites (Figures 4 and 5). The suspected association of *C. grandis* with sparsely vegetated sandy habitats suggests that the incremental process of dune stabilization that has affected most dune systems in the Canadian prairies in the last 200 years has maintained habitat for this species at some sites. However, the process of vegetation development on dunes often leads to the development of a sandy grassland which may exclude *C. grandis*. For example, exposed sand in the blowout shown in Figure 4b will likely be lost as vegetation, such as creeping juniper and bryophytes, colonizes. *Copablepharon grandis* may be associated with a transitional habitat that occurs between active dunes and stable, sandy grasslands.

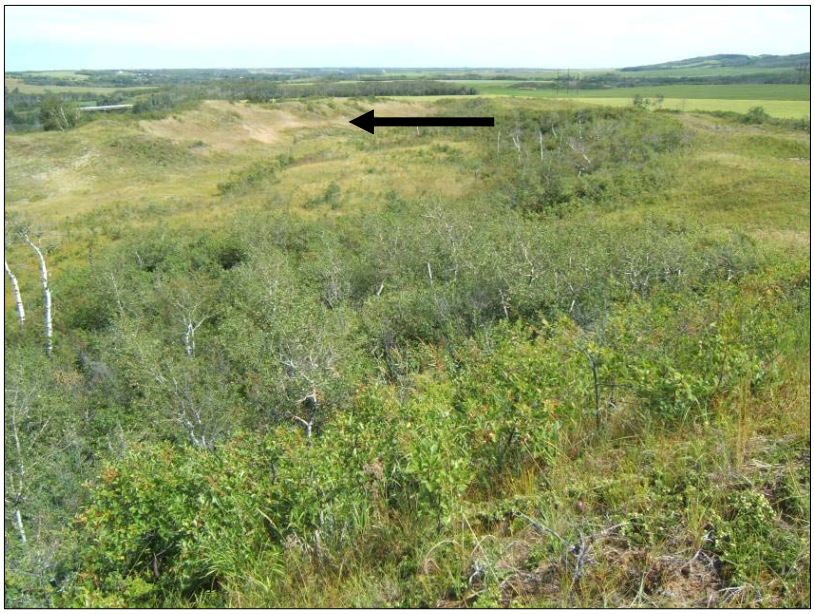


Figure 5. Example of an isolated and largely stabilized dune (see arrow) in Bushy Lake Sand Hills, SK (Table Mountain area). The surrounding landscape is developed for agriculture or vegetated with shrub thickets, forest, or dry grasslands. Sampling was not undertaken at this site. Photo by N.A. Page.

Several factors affect habitats in which *C. grandis* has been found: 1) sand dune stabilization; 2) reduced fire frequency; 3) cattle grazing; 4) land development and 5) recreational disturbance.

Stabilization of active sand dunes in the southern prairies in the past 100 years has been documented by considerable research (Wolfe *et al*., 2001; Wolfe and Thorpe, 2005; Hugenholtz and Wolfe, 2005). However, research has focused on active dune systems such as the Great Sand Hills, Burstall Dunes and Spirit Dunes, and there is very little specific information on changes in the extent or condition of semi-stable dunes in which *C. grandis* has been found. Vegetation colonizes dune surfaces during periods of increased precipitation, while prolonged drought results in reduced vegetation cover and an increase in dune activity (Wolfe *et al*., 2001).

Reduced fire frequency may affect sparsely vegetated sandy habitats in the southern Canadian prairies by increasing vegetation cover. Fires of both natural and anthropogenic origins were likely more common in the Canadian prairies in the past (Boyd, 2002), but the effects of these fires on dunes and dry grasslands is poorly understood.

Cattle grazing occurred in most of the sparsely vegetated sandy habitats visited in Saskatchewan and Alberta as part of the 2004–2005 sampling program. Minor grazing may maintain sparsely-vegetated conditions, but intensive grazing is likely detrimental to *C. grandis* because trampling disturbs vegetation, compacts soil (Figure 6), and may crush eggs, larvae, or pupae. *Copablepharon grandis* was not captured in any habitats with intensive cattle activity, but there was minor grazing activity in three of the sites in which it was captured.

Figure 6. Example of a small dune blowout (Duchess, AB) that has been disturbed by cattle grazing. Note the hummocked surface and trail formation from cattle use. Cattle often use dune blowouts for loafing. It is not known if *C. grandis* occurs at this site. Photo by N.A. Page.

Land development including roads, buildings, water reservoirs, gas wells, and transmission lines may affect *C. grandis* habitat by destroying vegetation and disturbing soil.

Recreation may cause small-scale disturbance to *C. grandis* habitat. Minor recreational disturbance may help maintain exposed substrates, but more intensive disturbance, such as motorized vehicle use, may destroy vegetation, compact soils, or crush eggs, larvae, or pupae. Military training at CFB Wainwright and other DND sites, while not recreational, likely has similar effects as off-road vehicle use, including soil and vegetation disturbance. More active training, including the use of explosives, removes vegetation cover, exposes sandy soils, and may destroy moths and may also initiate fires.

Protection and ownership

Most Canadian sites with known or suspected *C. grandis* populations occur in publicly owned lands, primarily provincial lands that are leased for cattle grazing. Ownership and protection status of these sites is summarized in Table 1. Only one known population of *C. grandis* occurs primarily in a protected area: Spruce Woods Provincial Park (MB). A small portion of the population in the Suffern Lake area is within Suffern Lake Regional Park; however, park activities focus on recreation rather than conservation. In addition, the species likely occurs in the Wainwright Dunes Ecological Reserve but it has not been captured there. The ownership of US sites is not known.

Table 1. Land ownership and protection status for known Canadian populations of *C. grandis*.

Population/Locality	Province	Land Ownership and Protection Status
Wainwright	AB	Department of National Defence (CFB Wainwright); Wainwright Dunes Ecological Reserve likely also supports the species
Sounding Lake Sand Hills	AB	Unknown; provincial grazing land and roadsides
Calgary (unknown site)	AB	Unknown capture site
Chauvin / Siegner Lake Sand Hills	AB	Unknown; provincial grazing land?
Suffern Lake Regional Park	SK	Portion of population in regional park; other areas in provincial grazing lands
Dundurn	SK	DND base (active training); portion may also be in the White Cap Indian Reserve 94 and provincial grazing land
Caron	SK	Unknown capture site
Maryfield (Pipestone Valley)	SK	Private land
Fort Qu'appelle, Qu'appelle Valley	SK	Private land
Spirit Dunes / Aweme	MB	Spruce Woods Provincial Park; Department of National Defence (CFB Shilo)

BIOLOGY

The biology of *Copablepharon grandis* is poorly known. This nocturnal moth with a short summer flight season is only rarely observed in the field. Indeed, other than occurring in light-trap captures, it was not observed in the field during the 2004–2005 sampling program. Current knowledge of its biology is based on published information in Lafontaine (2004), Fauske (1992), Seamans (1925), and Strickland (1920).

Lifecycle and reproduction

Based on all records, the flight season of *C. grandis* is from early May to early October (22 weeks) and peaks around the end of July (Figure 7). In Canada, the flight season is shorter—from early July to late August (8 weeks). Sex ratios in collections are generally evenly split.

Eggs are fully formed in newly emerged adult females, but mating and egg laying have not been observed. Eggs are believed to be deposited in loose, sandy soil (Strickland, 1920). Based on observations in the related *Copablepharon longipenne* Grote, eggs hatch approximately three weeks later.

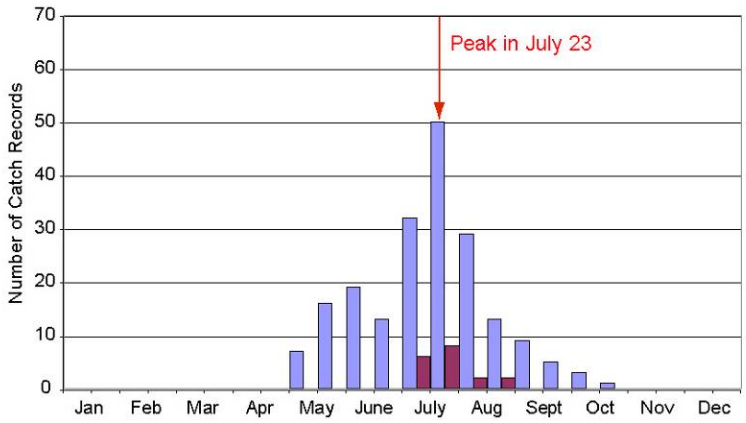


Figure 7. Flight season of *C. grandis* based on sampling records. The light bars indicate all North American records while the dark bars indicate Canadian records.

Larval and pupal life stages have not been described except for Strickland's (1920) observations of one fourth-instar larva purported to be of this species found in early May in a stubble field at Monarch, Alberta. Larvae are believed to feed nocturnally and spend the day buried in the sand; they may also feed on below-ground roots and shoots. Larval growth likely occurs between hatching in August and the onset of cool weather in October. Larvae may undergo a below-ground diapause between the fall and early spring, although the location and depth of burial are unknown. Spring or early summer feeding may also occur prior to pupation (observed in *Copablepharon fuscum* Troubr & Crabo). The pupal stage is very poorly known except that it likely begins in late June or early July in Canada (July 5 for Strickland's captured specimen). Pupation occurs in an "earthen cell" below ground (Strickland, 1920).

Copablepharon grandis adults have been observed resting inside Nuttall's evening-primrose (*Oenothera nuttallii* Sweet) blossoms during the day (C. Schmidt, pers. comm.).

Predation and parasitism

There is no information on predation, parasitism, disease or other factors that may reduce survival of *C. grandis*. Songbirds were observed feeding on adult *C. longipenne* moths in the Great Sand Hills and Burstall Dunes in July 2004 (COSEWIC, 2007b) and may also consume *C. grandis*.

Physiology

Copablepharon grandis flies during the onset of warmer weather in early summer and maximizes its larval growth during July and September. The larvae overwinter in the sand, although conditions of dormancy (e.g., depth of burial) or other overwintering strategies are unknown. It is unknown how seasonal temperature changes affect adult flight periods, mating, or survival of larvae.

The influence of climate on *C. grandis* distribution is not known. Because the species is at the northern periphery of its range in Canada, climate factors may limit its distribution. Soil freezing or soil moisture levels may be important factors influencing physiology. The lack of captures from the dune systems in the southern Canadian prairies may also be related to climatic factors.

Climate data from the Canadian range in which *C. grandis* is found are summarized as follows. In Saskatoon, SK, the mean winter (Dec–Feb) temperature is -14.8^{o}C, the mean summer (June–Aug) temperature is 15.7^{o}C, the mean monthly winter precipitation is 13.8 mm (95% as snow), and the mean monthly summer precipitation is 47.7 mm. In Wainwright, AB, the mean winter temperature is -14.3^{o}C, the mean summer temperature is 16.2^{o}C, the mean monthly winter precipitation is 21.5 mm (97% as snow) and the mean monthly summer precipitation is 61.7 mm.

Dispersal and migration

The dispersal abilities of *C. grandis* have not been measured. *Copablepharon* species that have been observed in the field (*C. fuscum* and *C. longipenne*) are strong fliers (COSEWIC, 2003; COSEWIC, 2007a). Given that dune habitats are often patchily distributed across the landscape (100 m to 2 km apart), it is likely that dispersal occurs at this scale at least infrequently. However, dispersal between regionally isolated dunes systems (>10 km) is considered unlikely or very infrequent. The potential for long-distance dispersal has likely declined as agricultural activity has developed the landscape between sandy habitats. There is no information that suggests *C. grandis* migrates.

Interspecific interactions

There is no information on nutrition or interspecific interactions. Strickland (1920) successfully raised an older larva on alfalfa and barley. *Copablepharon grandis* was often captured (3 of 4 captures) with *C. viridisparsa* Dod in the 2004–2005 sampling program, but it is unknown whether there is any competition between the species.

Adaptability

There is no information on the adaptability of *C. grandis*, other than the lifecycle observations and habitat requirements described previously.

A larva reportedly of *Copablepharon grandis* was raised successfully from the fourth-instar to a pupa by Strickland (1920) using alfalfa and barley as food sources in the laboratory.

POPULATION SIZES AND TRENDS

Search effort

Multiple light-traps (bucket traps with 12 V UV lights) were set in ten sites in sparsely vegetated sandy habitats in southern Saskatchewan and Alberta between July 31–August 6, 2004 and July 23–27, 2005. A total of 28 traps were installed in potential *C. grandis* habitat.

Copablepharon grandis was captured in six traps from four sites: Dundurn DND Base south of Saskatoon, SK; Sounding Lake area, SK; CFB Wainwright, AB; and Suffern Lake Regional Park, SK. Three of these localities are new records for *C. grandis*, and the record from Dundurn confirms the moth's continuing presence near Saskatoon that was originally described in 1939. Additional sampling was undertaken by G.G. Anweiler and B.C. Schmidt and a new locality was found near Chauvin, SK. A summary of the 2004–2005 trapping results and site information is presented in Appendix 2. Figure 3 shows the location of known populations and unsuccessful trap sites.

Sampling in 2004 and 2005 provided new information on population distribution, and, more importantly, it increased our understanding of habitat requirements. Trapping was generally undertaken with multiple traps which allowed sampling over a range of habitat conditions (e.g., active and semi-stable dunes).

The species has not been seen in the Calgary area or to the south in Alberta since at least 1913 despite more active moth trapping in recent decades.

Abundance

A total of 18 *C. grandis* specimens were captured in 2004–2005 ranging from 1 per trap to 12 per trap (mean of three per trap). Schmidt (pers. comm., 2005) captured 15 *C. grandis* in five ultraviolet light-traps while sampling for *Schinia* species in a sandy grassland near Chauvin, SK. These captures represent less than 1% of the total number of moths captured in these sites, an indication of the low local abundance of the species. A summary of the 2004–2005 trapping results in presented in Appendix 2.

Because of the low number of *C. grandis* captured and the inherent uncertainties in measuring capture success, available habitat, and other factors, a population estimate cannot be calculated for the species. Light-trap captures provide a biased estimate of population size and should be used cautiously for characterizing population density.

Fluctuations and trends

There is no quantitative information on population fluctuations and trends for *C. grandis*. The inherent difficulty in assessing population sizes, variability, and trends in rare, nocturnal insects has greatly reduced the potential for detailed population information.

Rescue effect

The population at Turtle Mountain, North Dakota, USA is approximately 250 km south of the closest Canadian locality at Spruce Woods Provincial Park in Manitoba. Recolonization over this distance is unlikely.

LIMITING FACTORS AND THREATS

The limiting factors and threats to *C. grandis* in Canada are the following:

Habitat Loss: Decline of semi-open dune habitat (Hugenholtz and Wolfe 2005, Wolfe and Thorpe 2005), although it may be proceeding somewhat more slowly than decline of active dunes, is likely to reduce habitat further over the next few decades.

Cattle Grazing: Grazing is considered a possible threat to *C. grandis*. It may maintain sparsely vegetated sandy habitats (Figures 6 and 8). However, grazing may result in soil compaction and browsing of vegetation that is used for larval feeding, and may also crush eggs, larvae, or pupae.

Figure 8. Example of the effects of cattle grazing on sand dune habitat. The portion of the dune on the right side of the fence is affected by cattle use and shows trail formation, reduced vegetation cover, and substantially greater open sand. The habitat on the left side of the fence is more stable with higher vegetation cover. Photo from the Straw Road area of the Great Sand Hills, SK. Photo by N. A. Page (2005).

Population Isolation and Demographic Collapse: Populations of *C. grandis* in Canada may be at risk from demographic collapse because of their isolation. Ecological theory predicts that the risk of a subpopulation going extinct in a single patch is reduced with increasing numbers of surrounding subpopulations (Hanski, 1982). This risk reduction is caused by the "rescue effect" that allows immigration between patches to prevent the complete collapse of a group of subpopulations. Development of the land between suitable habitats may increase the risk of extirpation. The lack of information on the population structure of *C. grandis* makes it difficult to assess the risk of demographic collapse; it is considered a possible threat.

Land and Infrastructure Development: Activities such as road building, petroleum infrastructure construction, and excavation of water holes for cattle that result in direct loss or disturbance to dry grasslands, sandy habitats, and badlands are considered a possible threat to *C. grandis*. *Copablepharon grandis* may benefit from some forms of human disturbance.

Recreation: Recreational activities, including horse riding, ATV riding, off-road vehicle use, walking and hiking, may be intensive in some *C. grandis* habitats and result in vegetation loss and soil disturbance. Recreation may affect the population in the Spirit Dunes, Spruce Woods Provincial Park. Recreation is considered a possible threat to *C. grandis* in Canada

Collecting specimens for research purposes is considered to have an insignificant effect on *C. grandis*.

Conservation concerns in similar species

All known Canadian *Copablepharon* species are associated with dune habitats, which are rare in Canada. *Copablepharon viridisparsa* shares similar habitats in the Canadian prairies with *C. grandis* and is being assessed by COSEWIC (COSEWIC, 2007a). It is noteworthy that one *Copablepharon taxon*, *Copablepharon viridisparsa* ssp. *hopfinger*i Franclemont is the only moth taxon known to have been extirpated from western Canada (Lafontaine and Troubridge, 1998). Historically, it occurred in a small site with sandy soils near Castlegar, BC. *Copablepharon fuscum* (Sand-verbena Moth) is the only *Copablepharon* species west of the Cascade Mountains. It is very rare in southwestern BC (three to five populations) and was designated as Endangered by COSEWIC in 2004. It may be more sensitive to change than *C. grandis* because it relies on a single host plant.

SPECIAL SIGNIFICANCE OF THE SPECIES

Copablepharon grandis is associated with sparsely vegetated sandy habitats, a regionally rare habitat in the southern Canadian prairies. *Copablepharon* moths are of interest to entomologists and taxonomists because of their rarity and association with spatially isolated dune habitats. There is no information that suggests that *C. grandis* has, or had, an important cultural or economic role for First Nations.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Copablepharon grandis is not protected in any jurisdiction in North America and is currently listed as “not assessed” (GNR) by NatureServe (2006). Populations at Wainwright (Wainwright Dunes Ecological Reserve), Suffern Lake Regional Park, and Spirit Dunes (Spruce Woods Provincial Park) occur in protected areas. Two sparsely vegetated plant communities in which *C. grandis* occurs are ranked by Alberta Natural Heritage Information Centre: 1) sand grass–sand dropseed–hay sedge herbaceous vegetation and 2) creeping juniper / sand grass–sun-loving sedge dwarf shrubland. Both are ranked as imperiled/vulnerable (S2S3).

TECHNICAL SUMMARY

Copablepharon grandis
Pale Yellow Dune Moth — Noctuelle jaune pâle des dunes
Range of Occurrence in Canada: southern Alberta, Saskatchewan, Manitoba

Extent and Area Information

• Extent of occurrence (EO)(km²) (based on distribution records)	maximum of 184,590 km^2 in Canada
• Specify trend in EO	apparently declined over past 100 years
• Are there extreme fluctuations in EO?	No
• Area of occupancy (AO) (km²)	maximum possible 203 km^2 <50 km^2 based on 2X2 grid
• Specify trend in AO	Likely declining
• Are there extreme fluctuations in AO?	No
• Number of known or inferred current locations	10 known in Canada; 84 globally
• Specify trend in #	decline, not seen in southern Alberta since 1913
• Are there extreme fluctuations in number of locations?	No
• Specify trend in area, extent or quality of habitat	declining

Population Information

• Generation time (average age of parents in the population)	1 year
• Number of mature individuals	Not estimated
• Total population trend:	Not known; possible decline
• % decline over the last/next 10 years or 3 generations.	Not known
• Are there extreme fluctuations in number of mature individuals?	Unknown; likely
• Is the total population severely fragmented?	Patchily distributed because of habitat
• Specify trend in number of populations	Not known; possible decline
• Are there extreme fluctuations in number of populations?	No

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Threats (actual or imminent threats to populations or habitats)

Sand dune stabilization is an ongoing threat.
Heavy cattle grazing is likely detrimental to the species.
Land development will in most cases make the habitat unsuitable.
Recreational use will have a negative effect unless it is of minimal intensity.
Demographic collapse remains a possibility in isolated populations.

Rescue Effect (immigration from an outside source)

• Status of outside population(s)? • USA: >60 locations known; likely with similar trends to those in Canada	
• Is immigration known or possible?	Unlikely without intervention but some US areas poorly inventoried
• Would immigrants be adapted to survive in Canada?	Yes, likely
• Is there sufficient habitat for immigrants in Canada?	Yes, but declining
• Is rescue from outside populations likely?	Unlikely

Quantitative Analysis

Not undertaken (limited data)

Current Status

COSEWIC: Special Concern (November 2007)

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code**: Not applicable
Reasons for Designation: Although the area of occupancy is small and there is some evidence of decline in its extent of occurrence and area of occupancy, the species persists in widely separated dune systems, the declines are not well documented, and the status of threats is unclear. It requires semi-stable sand dunes which are declining.	

Applicability of Criteria

Criterion A: (Declining Total Population): No data
Criterion B: (Small Distribution, and Decline or Fluctuation): 2- Area of occupancy is small; a) severely fragmented but is likely to be found at some additional locations; b) continued decline is insufficiently documented.
Criterion C: (Small Total Population Size and Decline): Total population unknown but not likely to be below 10,000.
Criterion D: (Very small Population or Restricted Distribution): Total population more than 1000 and area of occupancy not as restricted as required under the definition.
Criterion E: (Quantitative Analysis): No quantitative analysis undertaken.

ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED

The following people are acknowledged for providing information that was used in the preparation of this report or assistance in undertaking field sampling: Jim Troubridge (Agriculture and Agri-Food Canada), Steven Wolfe (Natural Resources Canada), Don Lafontaine (Agriculture and Agri-Food Canada), Gary Anweiler (E.H. Strickland Entomological Museum, University of Alberta), Gerald Fauske (North Dakota State University), Chris Schmidt (University of Alberta), David Gummer (Royal Alberta Museum), Keith Roney (Royal Saskatchewan Museum), Ron Hooper (Fort Qu'appelle, Saskatchewan), Dan Johnson (University of Lethbridge), Valerie Coenon (Geowest Environmental Consultants Ltd.), Donna Hurlburt (Bowater Mersey Paper Company), Shane Mascarin (Department of National Defence, CFB Wainwright), Cheryl-Anne Beckles (Department of National Defence, CFB Dundurn), Ryan Cossitt (Saskatchewan Agriculture, Food and Rural Revitalization), and Lars Crabo (Bellingham, Washington State).

Steven Wolfe should be thanked again for providing maps and other critical information about the location of dunes and sand deposits in the Canadian prairies. Jim Troubridge's assistance was essential in helping plan the field component of this study and identifying all noctuid moths captured. Desiree Mou was a very capable field assistant and now knows more about *Copablepharon* moths than she would have ever believed.

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Authorities consulted

Acorn, John. Sessional Lecturer, Department of Renewable Resources, University of Alberta, Edmonton, Alberta.

Anweiler, Gary. Lepidopterist, E.H. Strickland Entomological Museum, University of Alberta, Edmonton, Alberta.

Court, Gordon. Provincial Wildlife Status Biologist, Fish and Wildlife Division, Government of Alberta Edmonton, Alberta.

Crabo, Lars. Entomologist, Bellingham, Washington.

Duncan, David. Head, Wildlife Management, Environment Canada, Edmonton, Alberta.

Duncan, James. Manager, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Winnipeg, Manitoba.

Fauske, Gerald. Research Specialist, North Dakota University, Fargo, North Dakota.

Goulet, Gloria, Aboriginal Traditional Knowledge Subcommittee of COSEWIC, Environment Canada, Ottawa, Ontario.

Gummer, David. Curator of Mammalogy, Royal Alberta Museum, Edmonton, Alberta.

Hooper, Ron. Entomologist, Fort Qu'appelle, Saskatchewan.

Lafontaine, Don. Research Scientist, Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Nordstrom, Wayne. Senior Zoologist, Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Government of Alberta, Edmonton, Alberta.
Pepper, Jeanette. Zoologist, Saskatchewan Conservation Data Centre, Resource Stewardship Branch, Saskatchewan Environment, Regina, Saskatchewan.
Poulin, Ray. Canadian Wildlife Service Edmonton, Alberta.
Roney, Keith. Chief Curator, Royal Saskatchewan Museum, Regina, Saskatchewan.
Schmidt, Chris. Entomologist, University of Alberta, Edmonton, Alberta.
Troubridge, Jim. Manager, Insect Collection, Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario.
Wellicome, Troy. Species at Risk Biologist, Canadian Wildlife Service, Environment Canada, Edmonton, Alberta.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Nick Page is a biologist who works on the assessment and management of species and ecosystems. His project work includes watershed planning, plant community ecology, and studies of rare invertebrates. He completed a Master of Science degree in the Institute for Resources, Environment, and Sustainability at the University of British Columbia in 2003. His thesis focused on regional and local effects of exotic plant invasion in beach vegetation of Vancouver Island, BC. He wrote the COSEWIC status report for the Sand-verbena Moth, an endangered *Copablepharon* moth found in sand dunes of the Strait of Georgia, BC. He is also studying three other *Copablepharon* species (*C. longipenne*, *C. viridisparsa*, and *C. absidum*).

COLLECTIONS EXAMINED

The following collections were contacted:

E.H. Strickland Entomological Museum, University of Alberta (contact: Gary Anweiler)

Royal Saskatchewan Museum (contact: Keith Roney)

Manitoba Museum (contact: Randall Mooi)

Canadian National Collection (CNC) of Insects, Acari and Nematodes (contact: Jim Troubridge)

Jim Troubridge, Private Collection

APPENDIX 1

Canadian records of *Copablepharon grandis*[1]

Locality	Province	Date	No.	Sex	Collector	Deposited[2]
Wainwright DND Base	AB	July 27, 2005	1	male	N. Page and D. Mou	CNC
Sounding Lake Sand Hills	AB	July 26, 2005	2	male	N. Page and D. Mou	CNC
Calgary (unknown site)	AB	August 9, 1902	1	female	I.N. Willing	CNC
Chauvin / Siegner Lake Sandhills	AB	July 25, 2004	15	mixed	B.C. Schmidt	UASM
Suffern Lake Regional Park (Artland)	SK	July 31, 2004	1	mixed	N. Page and D. Mou	CNC
Saskatoon (unknown site)	SK	July 19, 1939	1	male	K.M. King	CNC
Saskatoon (unknown site)	SK	July 24, 1939	1	male	K.M. King	CNC
Dundurn Base	SK	August 3, 2004	14	mixed	N. Page and D. Mou	CNC
Caron (2 mi SW)	SK	August 21, 1968	1	male	D.F. Hardwick	CNC
Maryfield	SK	August 15, 1980	1	unk.	R. Hooper	RSM
Fort Qu'Appelle	SK	July 22, 1985	1	unk.	R. Hooper	RSM
Aweme	MB	July 3, 1904	1	male	J. Fletcher	CNC
Aweme	MB	July 30, 1907	1	Unk.	N. Criddle	NFRC
Aweme	MB	July 4, 1910	1	male	N. Criddle	CNC
Aweme	MB	July 10, 1910	1	female	N. Criddle	CNC
Aweme	MB	July 8, 1911	2	male	N. Criddle	CNC
Aweme	MB	July 8, 1911	1	Unk.	N. Criddle	NFRC
Aweme	MB	July 12, 1911	1	unk.	N. Criddle	RSM
Aweme	MB	July 14, 1911	1	unk.	N. Criddle	RSM
Aweme	MB	July 28, 1912	1	female	N. Criddle	CNC
Aweme	MB	August 4, 1915	1	female	N. Criddle	CNC
Aweme	MB	July 10, 1920	1	unk.	J.B. Wallis	RSM
Aweme	MB	July 18, 1920	1	female	N. Criddle	LACM
Aweme	MB	July 23, 1920	1	female	N. Criddle	CNC
Aweme	MB	August 28, 1920	1	female	N. Criddle	CNC
Aweme	MB	July 12, 1921	1	male	N. Criddle	CNC
Aweme	MB	July 15, 1921	1	male	N. Criddle	CNC
Aweme	MB	July 15, 1921	1	female	N. Criddle	CNC
Aweme	MB	July 21, 1921	1	unk.	J.B. Wallis	RSM
Aweme	MB	July 14, 1923	2	unk.	J.B. Wallis	RSM
Aweme	MB	July 11, 1925	2	unk.	J.B. Wallis	MMMN
Aweme	MB	July 12, 1925	2	unk.	J.B. Wallis	RSM
Aweme	MB	July 26, 1925	1	female	N. Criddle	CNC
Aweme	MB	July 15, 1927	1	unk.	J.B. Wallis	RSM
Spirit Dunes	MB	July 21, 2003	8	mixed	J. Troubridge	CNC
Spruce Woods Provincial Park	MB	July 29, 2004	1	unk.	G.G. Anweiler	UASM
Aweme	MB	July 11 - no year	1	female	unknown	CNC
Aweme	MB	July 20 - no year	1	unk.	J.B. Wallis	RSM
Aweme	MB	no date	1	female	N. Criddle	USNM

[1] This excludes 1 larva captured in a stubble field at Monarch, AB on May 9, 1913 (noted in Strickland, 1920 but now unavailable for review).

[2] CNC = Canadian National Collection of Insects, Acari and Nematodes; UASM = E.H. Strickland Entomological Museum; MMMN = Manitoba Museum of Man and Nature; RSM = Royal Saskatchewan Museum; LACM = Los Angeles County Museum of Natural History; USNM = United States National Museum, Smithsonian Institute; NFRC = Northern Forestry Centre Research Collection

APPENDIX 2

Summary of 2004 and 2005 *Copablepharon grandis* trapping in Saskatchewan and Alberta

Site	Date	Trap Site	Comments	*C. grandis*?
2004				
Suffern Lake Regional Park, Saskatchewan	July 31, 2004	Site A (road blowout)	western Saskatchewan	not captured
	July 31, 2004	Site B (stabilized hill)		
	July 31, 2004	Site C (larger blowout)		1
Dundurn Base, Saskatchewan	August 3, 2004	Site 1 (Fireguard South)	south of Saskatoon	not captured
	August 3, 2004	Site 2 (Fireguard North)		2
	August 3, 2004	Site 3 (stabilized blowout near Vimy Hill)		not captured
	August 3, 2004	Site 4 (semi-stable blowout)		12
Douglas Lake Provincial Park, Saskatchewan	August 4, 2004	Site 1 (semi-active blowout / ridge)	near Elbow, SK	not captured
Seward Sand Hills, Saskatchewan	August 5, 2004	Site A (edge of large open dune)	near Webb, SK	not captured
	August 5, 2004	Site B (stabilized dune to south)		not captured
	August 5, 2004	Site C (open dune to southwest)		not captured
Cranberry Flats, Saskatchewan	August 6, 2004	Site 1 (stabilized blowout)	very near Saskatoon	not captured
2005				
Cramersburg Sandhills, Saskatchewan	July 23, 2005	Site A (near tent)	southwest SK	not captured
	July 23, 2005	Site B (southwest edge of active dune)	near Lancer	not captured
	July 23, 2005	Site C (northeast edge of active dune)		not captured
	July 23, 2005	Site D (stabilized blowout depression)		not captured
Great Sand Hills, Saskatchewan	July 24, 2005	Site A (west edge of Boot dune)	southwest SK	not captured
		Site B (dune ridge south of Boot dune)	(near Sceptre)	not captured
		Site C (grass dune ridge north of road)		not captured
Rolling Hills, Alberta	July 25, 2005	Site A (shortgrass prairie near tent)	South central Alberta	not captured
		Site B (shortgrass prairie near compressor station)		not captured
		Site C (shortgrass prairie on Encana Line)		not captured
Sounding Lake Sandhills, Alberta	July 26, 2005	Site A (blowout on south side of road)	south central Alberta	not captured
		Site B (old road bed with sunflowers)	(near Provost)	1
		Site C (dune ridge on north side of road)		1
Wainwright DND Base, Alberta	July 27, 2005	Site A (semi-stable blowout, Pipeline Rd)	south central Alberta	not captured
		Site B (semi-stable dune ridge)	(near Wainwright)	not captured
		Site C (semi-stable dune ridge)		1
		Total *C. grandis* Captured		18
		Number of Successful Traps		6
			Moths per Trap	3.0

Note: each site (e.g., Site B) refers to a single trap site with a bucket trap (modified Robinson trap) with a 12 V UV bulb operated from dusk to dawn.