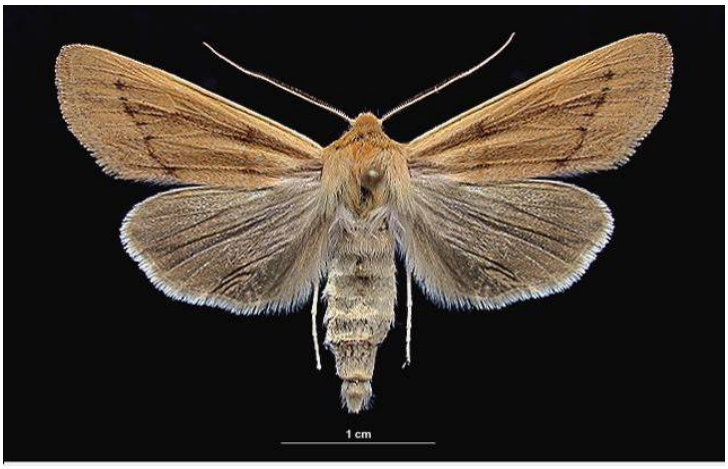
COSEWIC
Assessment and Status Report

on the

Dusky Dune Moth
Copablepharon longipenne

in Canada



ENDANGERED
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:

COSEWIC 2007. COSEWIC assessment and status report on the Dusky Dune Moth *Copablepharon longipenne* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 33 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:
COSEWIC would like to acknowledge Nick A. Page for writing the status report on the Dusky Dune Moth (*Copablepharon longipenne*) in Canada, prepared under contract with Environment Canada. The report was overseen by Laurence Packer, Co-chair, COSEWIC Arthropods Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la Noctuelle sombre des dunes (*Copablepharon longipenne*) au Canada.

Cover illustration:
Dusky Dune Moth — Photo by G.G. Anweiler.

Catalogue No. CW69-14/535-2008E-PDF
ISBN 978-0-662-48450-9

COSEWIC
Assessment Summary

Assessment Summary – November 2007

Common name
Dusky Dune Moth

Scientific name
Copablepharon longipenne

Status
Endangered

Reason for designation
The species is restricted to open, active sand areas that are both fragmented and declining. Although it may be common where found, it occurs in a small proportion of the total seemingly suitable sites and has been lost from historical localities. Dispersal between dune systems is considered to be extremely unlikely. Since the 1940's, the area of suitable habitat has declined by an estimated 10-20% per decade.

Occurrence
Alberta, Saskatchewan, Manitoba

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

COSEWIC
Executive Summary

Dusky Dune Moth
Copablepharon longipenne

Species information

The Dusky Dune Moth (*Copablepharon longipenne* Grote 1882) is a medium-sized, light brown moth that has a line of black dots on the forewing. It occurs as two subspecies, of which only the nominate form occurs in Canada.

Distribution

Copablepharon longipenne is found from southern Manitoba, Saskatchewan, and Alberta to western Texas and southern New Mexico. It is associated with the Great Plains. Its range is 1,258,285 km^2 globally and 164,480 km^2 in Canada. Since 1922, *C. longipenne* has been recorded at 12 localities in Canada: four in Alberta, seven in Saskatchewan, and one in Manitoba.

Habitat

Copablepharon longipenne is associated with sparsely vegetated active sand dunes. It is considered a habitat specialist. Field observations suggest that the presence of open sand is important for reproduction; *C. longipenne* was observed laying eggs on the edge of active dunes. Active dunes in the Canadian prairies have declined in the past 100 years as increased precipitation has led to vegetation development.

Most Canadian sites with known or suspected *C. longipenne* populations occur in publicly owned lands, primarily provincial lands that are leased for cattle grazing. Three populations or suspected populations occur in protected areas.

Biology

Little is known about the biology of *C. longipenne*. Reproduction occurs once per year during a single flight season. In Canada, the flight season is approximately ten weeks long and extends from the middle of June to the middle of August. Adults have been observed nectaring on the flowers of dune plants during the evening. Mating has been observed to occur on plants or on the sand surface near vegetation. Eggs are deposited in a group approximately 1 cm below the sand surface.

Larval feeding has not been observed except for one case where larvae were feeding on the below-ground parts of roses. Based on the variability of plant species recorded within the immediate vicinity of sampling sites, *C. longipenne* is not likely to be restricted to a single host-plant for adult nectaring, reproduction, or larval feeding.

The dispersal abilities of *C. longipenne* have not been measured. There is no information that indicates it migrates.

Population sizes and trends

There is no quantitative information on population sizes and trends for *C. longipenne*. Based on the stabilization trends of sand dunes in the Canadian prairies, it is inferred that *C. longipenne* populations are declining at a rate of 10–20% per decade.

The US population near Fort Peck, Montana, is approximately 270 km south of the closest Canadian population. The possibility of rescue over this distance is unlikely.

Limiting factors and threats

The progressive stabilization of sand dunes caused by vegetation colonization is considered a threat to *C. longipenne*. This threat affects all populations in Canada.

Development activities that result in destruction of sand dunes are considered a possible threat to *C. longipenne*. However, some disturbance associated with development may create habitat for *C. longipenne* by increasing open sand.

Populations of *C. longipenne* in Canada may be at risk from demographic collapse. Populations of *C. longipenne* are spatially isolated and may have increased risk of extinction. Demographic collapse is considered a possible threat.

Grazing is a possible threat to *C. longipenne.* It may initiate active sand movement in dunes and limit colonizing vegetation. However, it may cause soil compaction and browsing of vegetation that is used for larval feeding, and may also destroy eggs, larvae, or pupae.

Recreation may be intensive in some sand dunes 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. Recreational activities are considered a possible threat.

Special significance of the species

Copablepharon longipenne is closely associated with active sand dunes, a regionally rare habitat in the southern Canadian prairies. It can be considered one of several focal species representing the sensitivity and uniqueness of this habitat type in Canada.

There is no information to suggest that *C. longipenne* has, or had, an important cultural or economic role for First Nations.

Existing protection or other status designations

Copablepharon longipenne is not protected in any jurisdiction in Canada or the United States and its conservation status has not been ranked by any provincial or federal organizations.

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

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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 longipenne*

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

Synonyms: *Copablepharon longipennis* (Hampson, 1903); *C. serraticornis* A. Blanchard 1976; *C. serratacorne* Franclemont and Todd, 1983. Moths of North America (MONA) Number: RWH 10685, 10689

Bibliographic citation: Grote, A.R. 1882. New moths. Canadian Entomologist 14(9): 169–176.

Type specimens: Type locality: Montana; holotype in US National Museum.

English names: *Brown Copablepharon* was proposed by Hooper (1994); suggested names are *Palliser Dune Moth* reflecting the moth's association with the Palliser Triangle in Canada or *Great Plains Dune Moth*, which reflects its global distribution. Jean-François Landry suggests: Dusky Dune Moth

French name: Noctuelle Sombre des Dunes.

Taxonomic background and similarities

Copablepharon longipenne belongs to the largest of eight *Copablepharon* species groups recognized by Lafontaine (2004). The *longipenne* group contains eleven allopatric species from dune ecosystems in western North America. *Copablepharon longipenne* is the only species from this group found in Canada.

Two subspecies of *C. longipenne* are recognized, although only one occurs in Canada. *Copablepharon longipenne* ssp. *longipenne* occurs from southern Manitoba to southern Alberta in Canada and south to Wyoming in the US. It is distinguished from the other subspecies by its darker yellow forewing with a prominent postmedial line with a black dot on each wing vein (Lafontaine, 2004). *Copablepharon longipenne* ssp. *serraticornis* occurs in dry sandy prairie from eastern Colorado and western Nebraska southward to the bottom of the Texas Panhandle and westward to southern New Mexico (Lafontaine, 2004).

Morphological description

Adults: *Copablepharon longipenne* is a medium-sized, light brown moth with a distinctive line of black dots on the forewing (Figure 1a, b, and d). Adults are sexually dimorphic in size: forewing length averages 16.5 mm (range 11–19 mm) in males and 18.5 mm (range 17–20 mm) in females (Lafontaine, 2004). A pale streak is often present along the edge of the forewing or between the cubital and anal veins (Lafontaine, 2004). A series of uniformly sized black dots mark each wing vein at the postmedial line. The hindwing is brown-grey darkening towards the fringe. The fringe is dark brown basally and white outwardly.

Figure 1. Adult and egg stages of *Copablepharon longipenne*: a) mounted specimen from the CNC collection (collection site unknown); b) adult female ovipositing in open sand (Seward Sand Hills, SK); c) egg mass excavated from open sand in the Seward Sand Hills; and d) adult moth hiding beneath shrub vegetation in Great Sand Hills, SK. Photo a by J.T. Troubridge. Photos b, c, and d by N.A. Page.

Eggs

The eggs of *C. longipenne* are translucent white spheres, approximately 0.3 mm in diameter. They are deposited in groups of 15 to 35 in open sand (Figure 1c).

Larvae

The larvae of *C. longipenne* have a grey base colour overlain with brownish-red stripes (Seamans, 1925). The ventral surface is distinctly bluish. The head and thoracic shield are light brown with grey mottling.

Pupae

The pupae of *C. longipenne* are similar to those of other species of *Copablepharon* with a distinctive separate compartment (haustellum) enclosing the proboscis. The haustellum extends to the posterior margin of the 6th abdominal segment. The apex of the last abdominal segment is short and smooth with a pair of straight hairs. The pupa is enclosed in an earthen cell below ground (Strickland, 1920).

Genetic description

Genetic variation in a mitochondrial gene has recently been measured in ten *Copablepharon* species, including *C. longipenne*, as part of the All Leps Barcode of Life project (Biodiversity Institute of Ontario, 2007); however, results are not available. Geographic isolation of sand dune areas in the southern Canadian prairies suggests that population-level genetic variation may occur.

Lafontaine (2004) noted that *C. longipenne* and five closely related species (*Copablepharon solumbia* Crabo and Lafontaine*, C. michiganensis* Crabo and Lafontaine*, C. mutans* Crabo and Lafontaine*, C. nevada* Crabo and Lafontaine*,* and *C. pictum* Fauske and Lafontaine) may be geographic isolates of the same species. More work using molecular techniques or laboratory rearing was recommended to improve the understanding of the taxonomic relationships of these taxa. Because *C. longipenne* is the only species from this group present in Canada, any taxonomic changes resulting from such work are not anticipated to affect the conservation significance of this species.

DISTRIBUTION

Global range

The distribution of *Copablepharon longipenne* is associated with the Great Plains, a geologically defined region running through the centre of North America (Trimble, 1990). *Copablepharon longipenne* is found from southern Manitoba, Saskatchewan, and Alberta, to western Texas and southern New Mexico (Figure 2). The most northern locality is near Saskatoon, Saskatchewan, and the most southern is near Paducah in north central Texas. The estimated extent of occurrence is 1,258,285 km^2 globally.

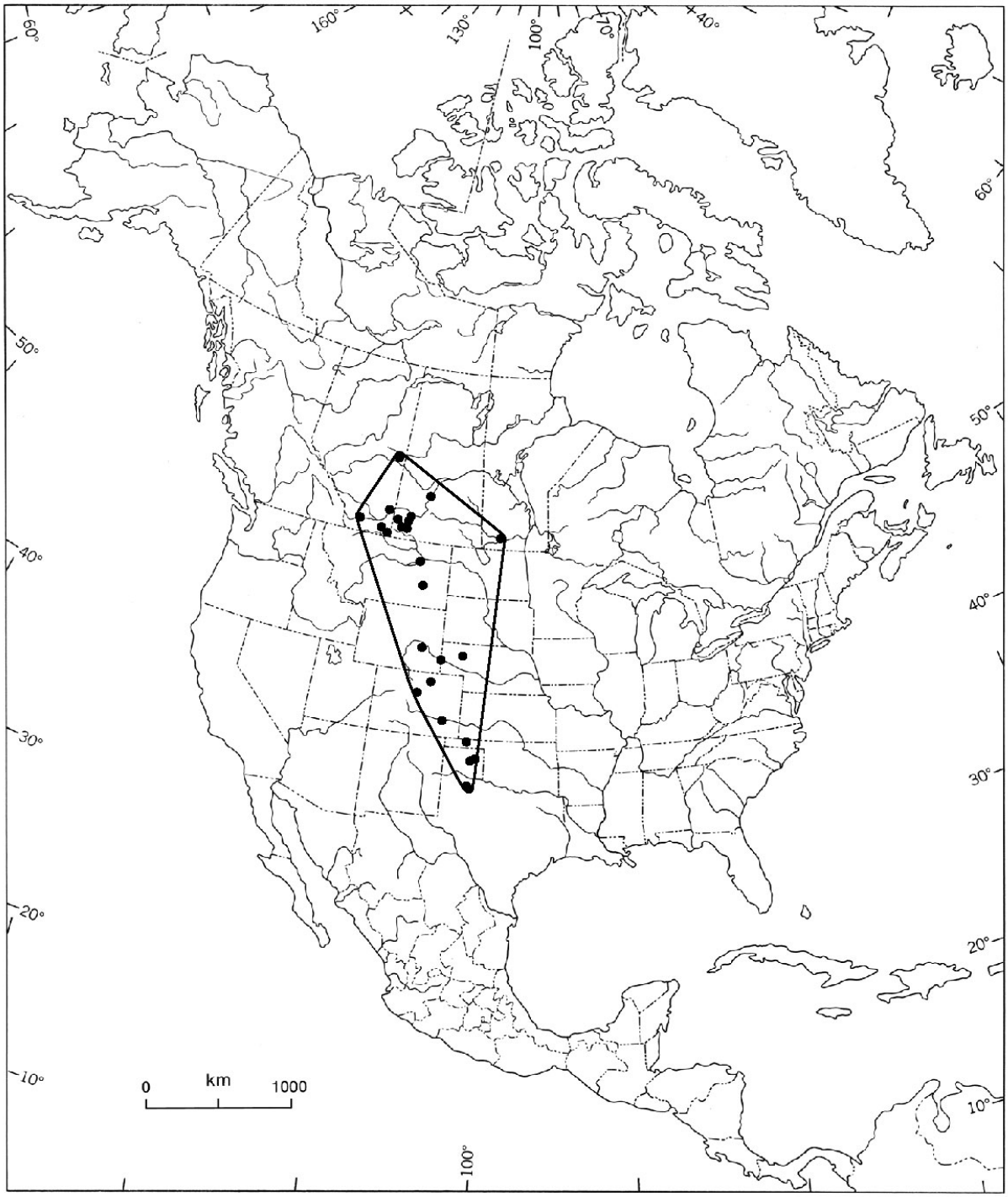

Figure 2. Distribution of *Copablepharon longipenne* in North America. Occurrences are shown as black dots and the extent of occurrence is depicted with the black line.

Canadian range

The estimated extent of occurrence in Canada is 164,480 km^2 based on a minimum convex polygon encompassing all known localities in Canada. Except for the population near Brandon, MB, all known populations are found in the Palliser Triangle, a region of dry, shortgrass prairie that extends from the southwestern corner of Manitoba to south central Alberta and as far north as Lloydminster, SK (Barendregt *et al.,* 1988). The Palliser Triangle is the driest region in the Canadian prairies. *Copablepharon longipenne* was not captured in more northern dune areas near North Battleford, SK and Wainwright, AB despite repeated light-trapping surveys. It has, however, been recorded historically from nearby Rivercourse, AB. More formally, most of the Canadian range of *C. longipenne* is in the mixed grassland ecoregion of the prairie ecozone (Marshall and Schut, 1999). The population in Manitoba occurs in the aspen parkland ecoregion of the prairie ecozone. The estimated maximum area of occupancy is 126 km^2 in Canada. Area of occupancy encompassed known or suspected presence in open dune habitats within *C. longipenne's* Canadian range measured using a 1 km grid overlaid on Landsat satellite imagery from 2000; grid squares with open sand dunes were considered occupied habitat. However, the species is definitely absent from some apparently suitable areas. For known populations, the AO is estimated to be less than 50 km^2.

Copablepharon longipenne has been recorded at 12 localities in Canada since 1922, representing 12 populations (Figure 3; Appendix 1): five in Alberta, six in Saskatchewan, and one in Manitoba. Three of the 12 localities were discovered in southern Saskatchewan (Dundurn, Cramersburg, and Seward sand hills) by N.A. Page in 2004–2005 and one new population was recorded at Dune Point in southern Alberta by B.C. Schmidt (Appendix 1). Additional sites in the southern Canadian prairies may support *C. longipenne*. Figure 3 shows the location of four suspected localities based on the presence of active sand dunes. It is not known if *C. longipenne* has been extirpated from any sites in Canada. Active sand dunes no longer occur in the Lethbridge area, and it is unlikely that the population recorded there in 1922 is still present. Vegetation stabilization of sand dunes in the Middle Sand Hills and elsewhere may have caused extirpation of some populations or subpopulations.

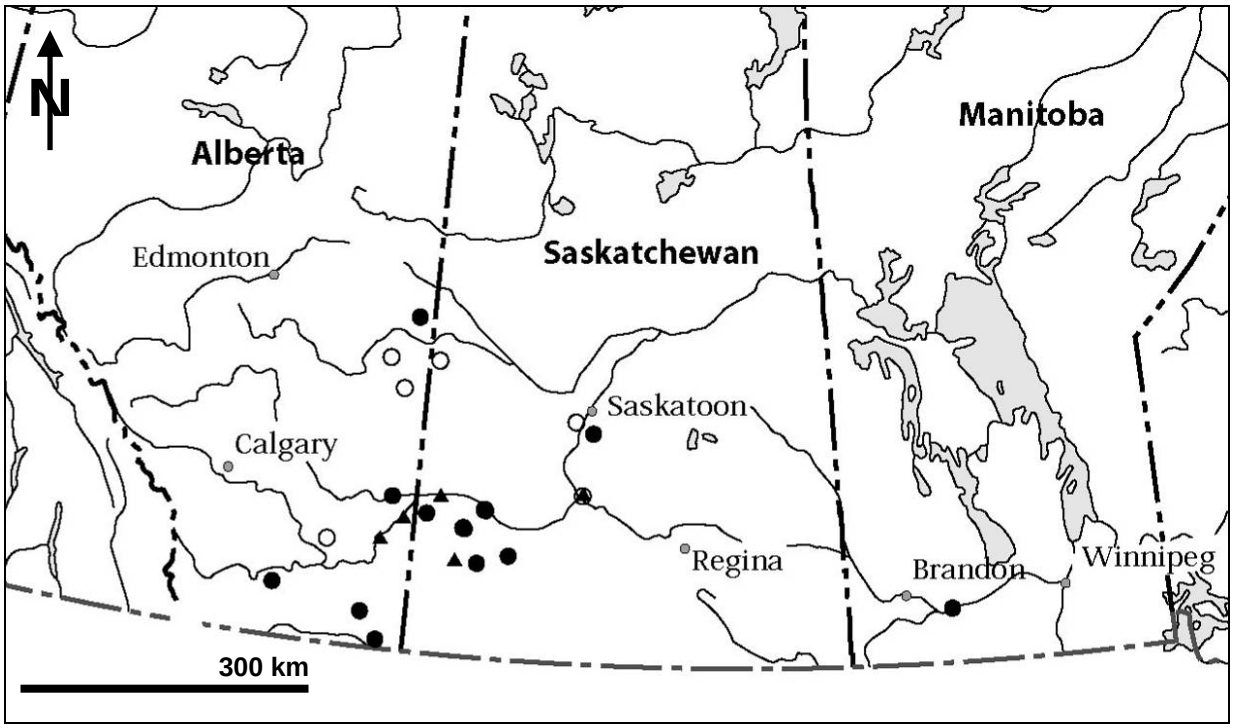

Figure 3. Distribution of *Copablepharon longipenne* in Canada. Black dots represent known localities and open dots indicate dune or dry grasslands sites sampled in 2004–2005 in which *C. longipenne* was not captured. Triangles represent suspected localities identified during field work or through air photo interpretation; other sites may exist.

Population structure

Copablepharon longipenne is associated with sparsely vegetated active sand dunes or blowouts that generally occur as spatially isolated patches within larger areas of dry, sandy grassland. Active dunes are often clustered because of shared substrate conditions and physical processes. The largest area of active sand dunes in Canada is the Great Sand Hills in southwestern Saskatchewan where four clusters of active dunes occur.

The population structure of *C. longipenne* reflects the spatial patterns of sand dune features at both the regional and local scale. Populations likely occur across multiple active sand dunes within a landscape of stable, semi-stable, and active dunes. Dispersal between nearby sand dunes (e.g., 250–1,000 m apart) is likely but unsubstantiated, but dispersal between regionally isolated dune fields is likely very rare. However, that *C. longipenne* recolonized the southern Canadian prairies after the last glacial period may suggest long-distance dispersal to be possible. Figure 4 shows the distribution of dune fields and sandy habitats in southwestern Saskatchewan and the distribution of active sand dunes in a representative area of the Great Sand Hills. Areas between the sand dune areas are likely inhospitable to *C. longipenne* because of different soils and agricultural activity.

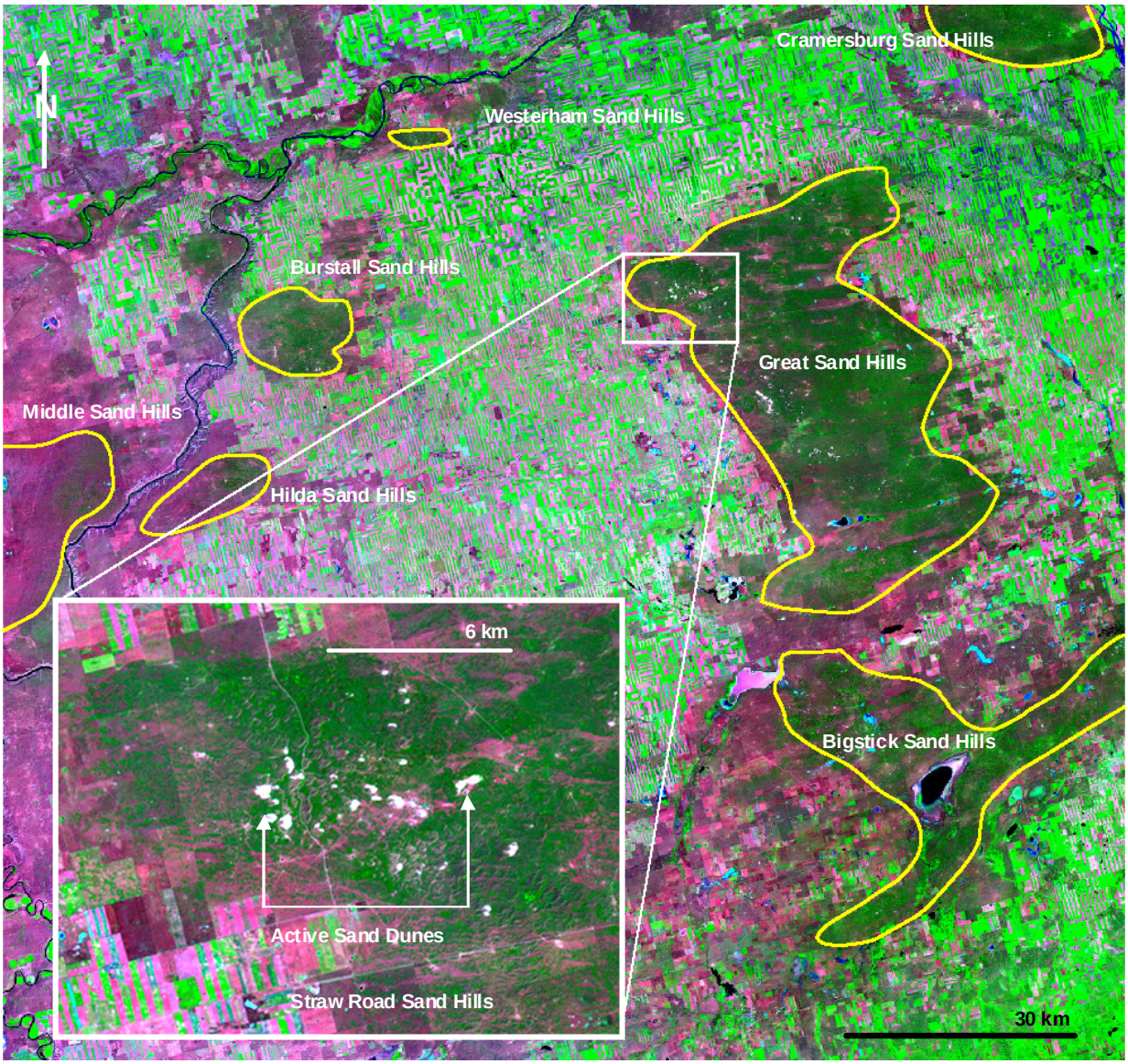

Figure 4. Regional and local scale distribution of sand dunes in southwestern Saskatchewan (Landsat image from 2000). The inset box shows active sand dunes (white patches) in a portion of the Great Sand Hills near Liebenthal, SK (Straw Road dune cluster). The juxtaposition of the sandy habitats (dark patches) amongst the heavily developed agricultural landscape is clear.

HABITAT

Habitat requirements

Copablepharon longipenne is associated with sparsely vegetated active sand dunes and blowouts. It is considered a habitat specialist because it occurs only in a specific habitat type. During sampling in 2004–2005, the highest abundance of *C. longipenne* adults (up to 142 moths per trap) occurred in open dunes with >75% of the surface made up of open sand. The species was never captured in stable or semi-stable dunes unless they were immediately adjacent to an active dune. Field observations of ovipositing behaviour in 2004–2005 suggest that the presence of open sand is important for reproduction; *C. longipenne* was observed ovipositing on the leeward edge (slip face) of active dunes or other depositional areas. Sand deposition may prevent exposure or predation of eggs. Movement of sand by wind is considered an essential process for maintaining habitat for *C. longipenne.*

Substrates in active sand dunes in the southern 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% of total mass) (Hullett *et al*., 1966). The water-holding capacity of these substrates is very low, and only specialized plants are able to establish and grow on them. These soils are classified as regosols by the Canadian Soil Classification System.

Sand dunes are spatially discrete habitat patches. If sand supply is low, wind movement of sand is weak, or colonization by vegetation is rapid, active dunes are small and scattered. The smallest size of a sand dune or group of dunes in which a population of *C. longipenne* will persist is unknown. However, the moth was captured in isolated dunes around 0.5 ha in size at Cramersburg Sand Hills, SK and Dune Point, AB. Most sites in which *C. longipenne* was captured have multiple active dunes or blowouts within a landscape of dry grasslands (Figure 5).

Figure 5. Sand dune habitat characteristics: a) human-made fireguard with open sand in which *C. longipenne* was abundant (Dundurn Sand Hills, SK); b) semi-stabilized dune blowout in which *C. longipenne* was not captured (Dundurn Sand Hills, SK); c) dune margin with high abundance of *C. longipenne* (Seward Sand Hills, SK); d) dry grassland near open dune in which *C. longipenne* was not captured (Great Sand Hills, SK); e) active dune complex with lance-leaved psoralea and Canada wildrye on the slip face (Cramersburg Sand Hills, SK; *C. longipenne* was captured); and f) sparsely vegetated margin of active dune in Burstall Sand Hills, SK with lance-leaved psoralea and sand dock colonization (not sampled in 2004–2005 but *C. longipenne* found several times previously). All photos by N.A. Page (a, b: August 2004; c–f: July 2005).

Plants and plant communities in active dunes and sparsely vegetated dune margins in the southern Canadian prairies have been described by Hullett *et al.* (1966), Epp and Townley-Smith (1980), Radenbaugh (1988), Coenen and Bentz (2003), and Gerry and Anderson (2003). Plants with adaptations to dry, nutrient-poor conditions in sand dunes include lance-leaved psoralea (*Psoralea lanceolata* Pursh), wheat grass (*Agropyron* spp.), Indian rice grass (*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barkworth), Canada wildrye (*Leymus canadensis* L.), prairie sandreed (*Calamovilfa longifolia* (Hook.) Scribn.), prairie Junegrass (*Koeleria macrantha* (Ledeb.) J.A. Schultes), sand dropseed grass (*Sporobolus cryptandrus* (Torr.) Gray), skeleton-weed (*Lygodesmia juncea* (Pursh) D. Don ex Hook.), sand-dock (*Rumex venosus* Pursh), petiolate sunflower (*Helianthus petiolaris* Nutt.), prickly rose (*Rosa acicularis* Lindl.), and silverberry (*Elaeagnus commutata* Bernh. ex Rydb.). Plant communities described from active and semi-stable dunes include a sand dock herbaceous association from Pakowki Lake (Coenen and Bentz, 2003), an Indian rice grass–Canada wildrye Sparsely Vegetated Association (Wallis, 1980 in Allen, 2004), and two mixed herb alliances described from the Great Sand Hills: sand dropseed Sand Hill Herbaceous Vegetation and sand grass Sand Hill Herbaceous Vegetation (Gerry and Anderson, 2003). More sampling and analysis is needed to develop a comprehensive classification of sand dune vegetation in the Canadian prairies.

Fauske (1992) stated that *C. longipenne* was often associated with grama-needlegrass-wheatgrass steppe, and recorded from aeolian drift areas.

Habitat trends

Sand deposits are widespread in the southern Canadian prairies. Wolfe (2001) mapped 5,900 km^2 of aeolian deposits (sand or silt moved by wind) in the portion of the Canadian prairies in which *C. longipenne* occurs. However, active dunes are rare. Based on data in Hugenholtz and Wolfe (2005), active dunes in the Tunstall Sand Hills account for 0.5% of the total area, while active dunes in the Seward and Great Sand Hills encompass 0.4% and 0.2% of the total area of the dune field respectively. Similarly, an assessment of land cover in the Great Sand Hills, the largest and most well-known of sand dune areas in the Canadian prairies, found that active dunes comprise less than 0.5% of the total area of 1,136 km^2 (Saskatchewan Environment and Public Safety, 1991). Most areas of sand hills are vegetated and lack open sand habitat except in isolated blowouts, road cuts, and other disturbed sites. Sand deposits in the southern Canadian prairies are glaciofluvial, glaciolacustrine, and deltaic sediments from the last glaciation that have been reworked by wind action (David, 1977).

Based on the sampling records and field observations that suggest *C. longipenne* is associated with active sand dunes, natural dune stabilization has reduced the amount of its habitat in Canada. Stabilization of sand dunes in the southern prairies in the past 100 years has been well documented (Figure 6) (Vance and Wolfe. 1996; Wolfe, 1997; Wolfe *et al.*, 2001; Wolfe and Thorpe, 2005; Hugenholtz and Wolfe, 2005). Dune stabilization is driven by changes in regional precipitation. 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). Unlike other dune ecosystems, such as those on the Pacific Coast, stabilization of sand dunes in the Canadian prairies appears to be a largely natural phenomenon (Wolfe, 2001). Vance and Wolfe (1996) found that most dune fields in southern Alberta, Saskatchewan and Manitoba have become vegetated at a rate of 10% to 20% per decade. For example, the total area of active sand dunes in the northwest portion of Great Sand Hills has declined from 207 ha in 1946 to 161 ha in 1991 (Hugenholtz and Wolfe, 2005). During this time, the number of active sand patches declined from 340 to 130. Bender and Gummer (2005), using air and satellite photo data, recently found that open sandy areas in the Middle Sand Hills (an area along the South Saskatchewan River north of Medicine Hat) have declined by up to 57% per decade. Wolfe (2001) also noted that droughts in the 1930s, 1960s, and 1980s did not slow vegetation stabilization of dunes in the Canadian prairies, but that the present trend to a warmer and drier climate in the region may result in increased dune activity.

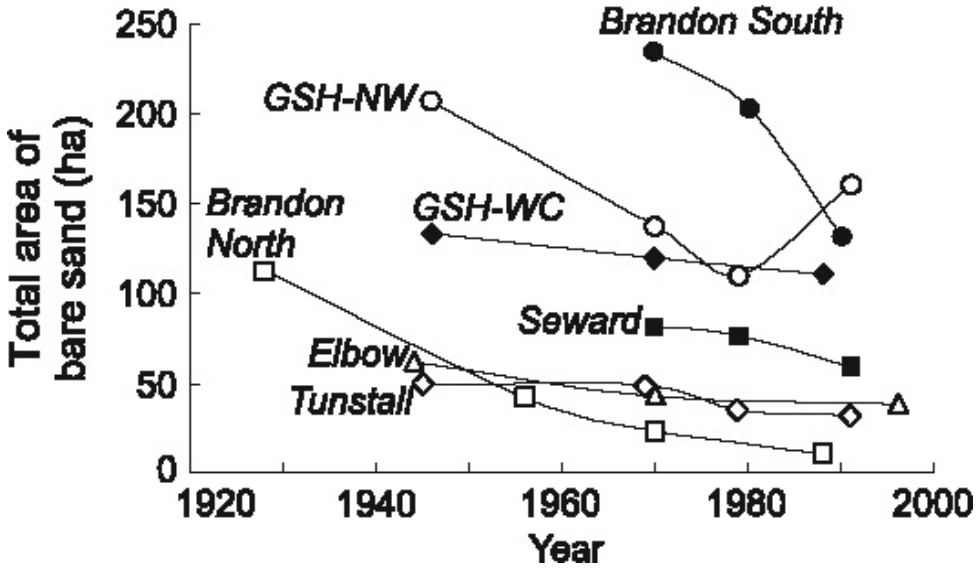

Figure 6. Historical change in active dunes at seven dune sites in Canada (from Hugenholtz and Wolfe, 2005). Note, Brandon North and South are referred to as the “Spirit Dunes” in this report; GSH-NW refers to dunes in the northwest portion of the Great Sand Hills and GSH-WC to dunes in the south-central portion. Figure used with permission.

Invasive plant species do not appear to be a major contributor to sand dune stabilization in the Canadian prairies. Gerry and Anderson (2003) documented 18 non-native plants in the Great Sand Hills area and found at least one exotic species in 91% of assessed sites. However, few are abundant. Non-native plants were more common in areas affected by agriculture and grazing.

Longer-term changes (>100 years) to sand dune activity in the southern prairies have also been documented through geological research (Wolfe *et al.,* 2001). Optical dating of sand grains and climate records from tree rings suggests that widespread sand dune activity was initiated by below-average precipitation during the 1700s and a drought in the 1790s. Dunes have been stabilizing in the Canadian prairies since the 1820s when regional precipitation increased (Figure 7).

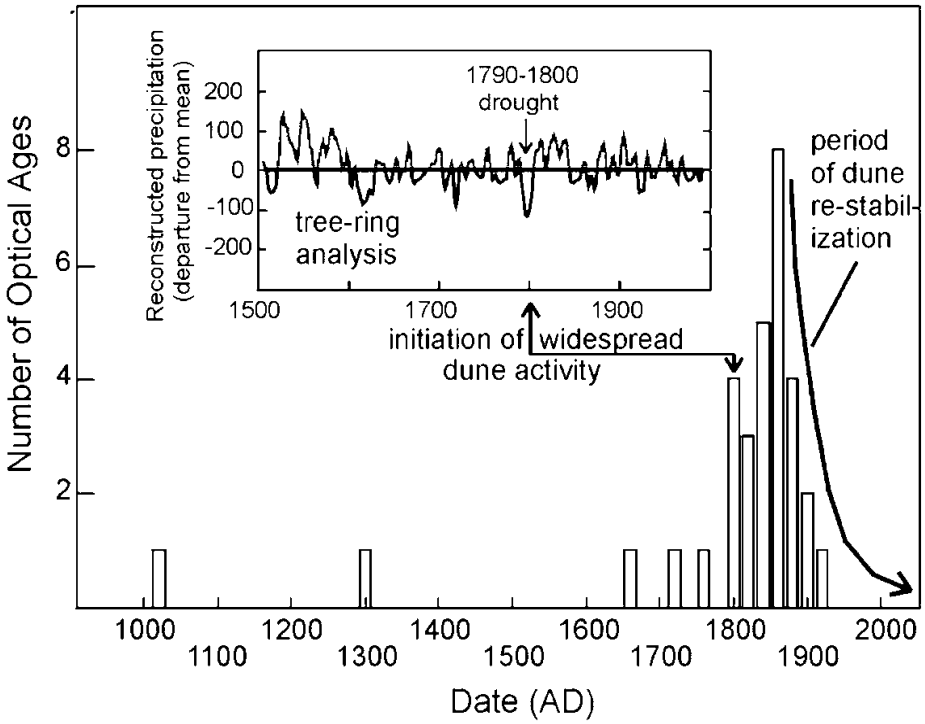

Figure 7. Long-term trends in dune activity in the southern Canadian prairies (from Wolfe *et al.,* 2001). The number of optical ages is a measure of sand grain exposure to sunlight. Figure used with permission.

Land development activities such as roads, buildings, gas wells, and transmission lines have also degraded *C. longipenne* habitat where disturbance is intense. However, some disturbance may initiate dune activity or increase open sand in stabilized sand hills. For example, *C. longipenne* was captured in an unvegetated fire break in the Dundurn Sand Hills south of Saskatoon.

Cattle grazing occurs within, or adjacent to, most dune sites visited in Saskatchewan and Alberta. Minor grazing may initiate dune activity (Hugenholtz and Wolfe, 2005), but intensive grazing is likely detrimental to *C. longipenne* because trampling disturbs vegetation, compacts soil, and may crush eggs, larvae, or pupae. Recent increases in dune activity in some dune fields, such as the northwest portion of the Great Sand Hills, may reflect localized effects of increased grazing (Hugenholtz and Wolfe, 2005). Other agricultural activities are not a threat to *C. longipenne* because, as shown in the satellite image in Figure 4, grain or oil seed cultivators avoid sandy soils.

Increases in fire frequency may also increase dune activity by decreasing vegetation cover. Fire of both natural and anthropogenic origin was likely more common in the Canadian prairies in the past (Boyd, 2002); however, the effects of fire on sand dune ecosystems are poorly understood.

Recreation, including the development of trails, may degrade *C. longipenne* habitat. Localized disturbance may help sustain open dunes, but intensive, widespread disturbance may destroy vegetation, compact soil, and destroy eggs, larvae, or pupae. Off-road vehicle use was observed in the Burstall Sand Hills and in the protected portion of the Great Sand Hills in July 2005. It was likely more common and widespread in the past.

Protection and ownership

Most Canadian sites with known or suspected *C. longipenne* 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. Three known or suspected populations of *C. longipenne* occur in protected areas: the Great Sand Hills Representative Area Ecological Reserve that was protected in 2005 and encompasses the largest of the active dune fields; Elbow dunes in Douglas Lake Provincial Park (SK) (suspected *C. longipenne* population); and Spruce Wood Provincial Park (MB). A portion of the Pakowki Lake area is a wildlife viewing site but it is not formally protected. The ownership of US sites is not known.

Table 1. Land ownership and protection status for known or suspected Canadian populations of *C. longipenne*.

Population/Locality	Province	Land Ownership and Protection Status
Known Populations (based on current or historic sampling records)		
Lethbridge	AB	Recent presence unconfirmed; exact location unknown
Pakowki Lake (Manyberries)	AB	Province of Alberta; grazing leases
Onefour, Dominion Range Station	AB	Recent presence unconfirmed; exact location unknown; Onefour Agricultural Research Substation (federal)
Sunnydale (Oyen?)	AB	Exact location unknown (may be Dune Point)
Dune Point (Bindloss)	AB	Unknown; provincial grazing land?
Spirit Dunes	MB	Spruce Woods Provincial Park; Department of National Defence (CFB Shilo)
Burstall Dunes	SK	Unknown; provincial grazing land?
Bigstick Sand Hills (Tompkins)	SK	Big Stick Community Pasture, PFRA
Great Sand Hills	SK	Ecological reserve; Provincial grazing land (leased)
Dundurn Sand Hills	SK	Department of National Defence (CFB Dundurn); Dundurn PFRA
Seward (Webb) Sand Hills	SK	Swift Current-Webb Community Pasture, PFRA
Cramersburg Sand Hills	SK	Unknown; likely provincial grazing land

Population/Locality	Province	Land Ownership and Protection Status
Suspected Populations (based on presence of suitable habitat)		
Tunstall Lake Sand Hills	SK	Bitter Lake Community Pasture, PFRA
Bigstick Sand Hills	SK	Unknown; provincial grazing land?
Elbow / Douglas Lake	SK	Douglas Lake Provincial Park
Westerham Sand Hills	SK	Unknown; provincial grazing land?
Middle Sand Hills	AB	Suffield NWA; CFB Suffield

BIOLOGY

The biology of *C. longipenne* is poorly known. This nocturnal moth with a short summer flight season is difficult to observe in the field. Current knowledge of the biology of *C. longipenne* is based on limited field observations in August 2004 and July 2005, supplemented with published information in Lafontaine (2004), Fauske (1992), Seamans (1925), and Strickland (1920).

Life cycle and reproduction

Copablepharon longipenne has one flight season per year during which it reproduces. In Canada, the flight season of *C. longipenne* is approximately ten weeks long and extends from the middle of June to late August (Figure 8). It peaks in July. The flight season in the US appears to be similar but may extend into September. These differences could be related to climatic differences along a north-south gradient, or could be influenced by incomplete sampling records. Reproduction coincides with the flight season and adult moths die shortly after reproducing.

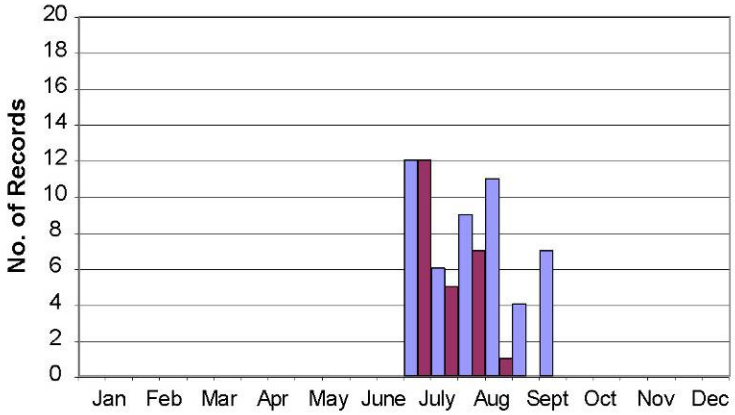

Figure 8. Estimated flight season of *C. longipenne* based on sampling records. The light bars indicate all North American records while the dark bars indicate Canadian records.

Adult *C. longipenne* have been observed nectaring during the evening on the flowers of dune plants, particularly lance-leaved psoralea. Mating was observed twice in 2005 and occurred on the lower stems of silverberry or on the sand surface near vegetation (Figure 9). Field observations indicate that eggs are deposited in groups of 15 to 35 approximately 10 mm below the sand surface. Based on observations of eggs collected in August 2004, larvae hatch after approximately three weeks.

Figure 9. Reproduction and predation: (a) mating occurring in July 2005 (Great Sand Hills, SK); (b) predation by birds was observed frequently in the margin of active dunes (note, discarded wings shown with arrow).

Seamans' (1925) observed that larvae fed on the below-ground parts of roses. Feeding likely occurs between hatching in August and the onset of cool weather in September–October. Larvae likely undergo a below-ground diapause between the fall and early spring, although the location and depth of burial are unknown. Based on observations of *Copablepharon fuscum* Troubr. & Crabo in coastal BC (COSEWIC, 2004), feeding may also occur in spring or early summer prior to pupation. The pupal stage is very poorly known, except that it likely occurs between early June and late July and lasts 17–19 days (Seamans, 1925). The adult lifespan is not known.

Observations of *C. longipenne* at the Seward Sand Hills in August 2004 suggests that oviposition occurs on the leeward side of active sand dunes. The placement of eggs in accretional sites may reduce exposure and desiccation from sand movement, and may also reduce predation of eggs.

Sex ratios of adult specimens in collections are generally evenly split (J. Troubridge, pers. comm.).

Predation and parasitism

Seamans (1925) observed that none of the *C. longipenne* larvae he raised in captivity were parasitized; he believed that the subterranean feeding habits prevented parasitization. Predation of adults by birds was observed frequently in sampling sites in July 2005. The discarded wings of *C. longipenne* were found at dawn in association with bird tracks (Figure 9). Small birds, such as sparrows, appeared to actively search for moths hiding in the shrub and forb vegetation along the margins of active dunes. Common nighthawks (*Chordeiles minor* Forster) were also observed feeding on aerial insects above sand dunes in Saskatchewan. It is not known if small mammals (including bats or rodents), or other invertebrates such as beetles, prey on adult moths, larvae, or eggs.

Physiology

Copablepharon longipenne flies during the onset of warmer weather in early summer and maximizes its larval growth during July and August, the warmest months in the Canadian prairies. The larvae likely overwinter in the sand, although conditions of dormancy (e.g., depth of burial) or other overwintering strategies are unknown.

The influence of climate on *C. longipenne* distribution is unknown. Distribution is associated with the warmest and driest region in the Canadian prairies. Climate data from the Canadian range of *C. longipenne* are summarized as follows: in Swift Current, SK the mean monthly winter temperature (Dec–Feb) is -10.8^{o}C, the mean monthly summer (June–Sept) temperature is 16.9^{o}C, the mean monthly winter precipitation is 17.3 mm (most as snow), and the mean monthly summer precipitation is 55.5 mm. It is not known how seasonal temperature changes affect adult flight periods, mating, and larval survival.

Dispersal and migration

The dispersal abilities of *C. longipenne* have not been measured. Field observations suggest it is a strong flier and it easily evaded capture with hand-nets during strong winds. Given that open dune habitats are often patchily distributed across a landscape (0.1–2.5 km apart), it is likely that dispersal at this scale is frequent. However, regional dispersal between sand dunes areas (e.g., landscape-level dispersal > 10 km) is considered unlikely or very infrequent. There is no information that suggests *C. longipenne* is migratory.

Interspecific interactions

There is no information on inter-specific interactions that may reduce survival of *C. longipenne*. Observations indicate it uses open sand, rather than leaves or flowers, for ovipositing. Seamans (1925) noted that “this species was found feeding entirely on rose bushes”, however, several sites in which *C. longipenne* were captured in 2004–2005 did not support rose species. The larvae of *C. longipenne* could feed on grasses (Canada wildrye, wheat grasses, etc.), shrubs (roses, silverberry, etc.), and dune forbs such as lance-leaved psoralea and sand-dock.

Adaptability

There is no information on the adaptability of *C. longipenne* other than the lifecycle observations described previously. The moth is a disturbance-tolerant species associated with active sand dunes with frequent sand movement. However, based on its specific habitat requirements, it may not be adaptable to habitat change.

Copablepharon longipenne was raised successfully from young larvae to adults by Seamans (1925).

POPULATION SIZES AND TRENDS

Search effort

Multiple light traps (bucket traps with 12 V UV lights) were set in ten sites in active or semi-stable dunes, sandy habitats, or dry grasslands in southern Saskatchewan and Alberta between July 31–August 6, 2004 and July 23–27, 2005. *Copablepharon longipenne* was captured in ten of 28 traps from a total of four sites: Dundurn DND Base south of Saskatoon, SK; Seward (Webb) Sand Hills near Swift Current, SK; Cramersburg Sand Hills, SK; and Great Sand Hills, SK. Three of the four sites represent new localities for *C. longipenne*. A summary of the 2004–2005 trapping results and site information is presented in Appendices 2. Figure 3 also shows the location of known populations, unsuccessful trap sites, and suspected populations. *Copablepharon longipenne* was not captured at six other sites with dry, sandy grassland or semi-stable or stable sand dunes.

Additional observations of *C. longipenne* were also made through visual observations and hand-net captures in the Seward Sand Hills on August 5, 2004 and in the Great Sand Hills on July 24 and 25, 2005.

Two points increase confidence in our understanding of the distribution, abundance and habitat requirements of *C. longipenne* in Canada. First, *C. longipenne*, where it occurs, is often abundant and easily trapped or observed. Light-trapping is considered very effective in capturing this species and it can also be observed in dune areas at dusk. Second, sampling in 2004 and 2005 provided new information on habitat

requirements. Trapping was generally undertaken with multiple traps which allowed sampling over a range of habitat conditions (e.g., active and stabilized dunes). *Copablepharon longipenne* was only captured in, or adjacent to (<100 m), active sand dunes, and it was abundant only along the sparsely vegetated margins of active dunes.

Copablepharon longipenne has been collected in Alberta only once in the last 50 years, in spite of recent collecting in dune habitats in the province. Chris Schmidt took specimens in a small area of active dune blowouts north of Bindloss in 2007 (Appendix 1). It has not been found in its historical localities in the province.

Abundance

A total of 409 *C. longipenne* moths were captured ranging from 1–142 per trap (mean of 41 per trap). These captures ranged from approximately 5–65% of the total number of moths captured in these sites, and indicate that *C. longipenne* can be locally abundant. However, because of uncertainties in measuring capture success, available habitat, and other factors, a population estimate cannot be calculated for *C. longipenne*. Light-trap captures provide a biased estimate of population size and should be used cautiously for characterizing population density within or between sample sites.

Estimates of larval density, which could have provided an estimate of overall density, were not obtained. Larvae were absent in July and August when light-trapping was undertaken.

Fluctuations and trends

There is no quantitative information on population fluctuations and trends for *C. longipenne*. It is difficult to assess with any degree of certainty the population size, variability, and trends in rare nocturnal insects.

Based on the stabilization trends of active sand dunes in the southern Canadian prairies (Wolfe, 2001; Hugenholtz and Wolfe, 2005), it is inferred that *C. longipenne* populations are declining at a rate of 10–20% per decade. This rate of decline is expected to continue over the next 20 years. These numbers assume that no other impacts are influencing the populations of this species and so these estimates are likely underestimates.

In addition to the recent collecting done in Saskatchewan and Alberta by Page (Appendix 2), Alberta dune areas that have been collected using MV lights and ultraviolet light traps in recent years without encountering *longipenne* include the Edgerton – Chavin area dunes (collected extensively and repeatedly), the Wainwright Ecological Dunes (once), and the Pakowki Lake dunes, where the species was recorded in 1925 (several times). It is noteworthy that in the Burstall and Great Sand Hills dunes in adjacent Saskatchewan, *longipenne* was collected in large numbers when found (J. Troubridge, pers. comm. to G. Anweiler).

Rescue effect

The US population near Fort Peck, Montana is approximately 270 km south of the closest Canadian population. The possibility of rescue over this distance is unlikely. To determine if other nearby populations exist, additional sampling is needed in northern Montana.

LIMITING FACTORS AND THREATS

The following are limiting factors and threats to *Copablepharon longipenne* in Canada.

Sand Dune Stabilization

The progressive stabilization of active sand dunes caused by vegetation colonization is considered a serious threat to *C. longipenne*. This threat affects all *C. longipenne* populations in Canada.

Land and Infrastructure Development

Development activities, such as road building, petroleum infrastructure construction, and excavation of water holes for cattle, which result in direct loss of sand dunes, are considered a threat to *C. longipenne*. Some types of disturbance associated with development may create habitat for *C. longipenne* by increasing open sand or initiating dune activity.

Population Isolation and Demographic Collapse

Populations of *C. longipenne* in Canada may be at risk from demographic collapse. Like other species confined to patchy habitats, populations of *C. longipenne* are spatially isolated. Ecological theory predicts that the risk of a subpopulation going extinct in a single patch (e.g., sand dune) 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. Hugenholtz and Wolfe (2005) documented declines in the number and size of active sand patches in several dune fields including Seward, Great, and Tunstall sand hills. However, the presence of *C. longipenne* in small and isolated active dunes in Cramersburg and Dundurn sand hills indicates relatively few active dunes are needed to support a population of *C. longipenne*, although the long-term viability of these isolated populations is uncertain. The conversion of the landscape surrounding sandy habitats and dunes to agriculture may have increased the risk of demographic collapse by reducing opportunities for dispersal

Cattle Grazing

Grazing has contradictory effects on *C. longipenne* habitat. It may initiate active sand movement in dunes and limit colonizing vegetation (Figure 10). Hugenholtz and Wolfe (2005) suggested that recent dune activity in the northwest portion of the Great Sand Hills may be the result of recent drought and grazing stress from livestock. 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. It is considered a possible threat to *C. longipenne.*

Figure 10. 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 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).

Recreation

Recreation, including horse riding, ATV riding or off-road vehicle use, and walking or hiking, may be intensive in some sand dunes and result in loss of vegetation and disturbance to sand substrates (Figure 11). It is considered a potential threat to *C. longipenne*. Recreation is limited to relatively small areas but was pronounced in the Burstall Sand Hills, SK, in accessible dunes in the Straw Road area of the Great Sand Hills, SK, and in the Spirit Dunes near Brandon, MB. It is considered a possible threat to *C. longipenne* in Canada. Recreation may also maintain or create open sand habitats.

Figure 11. ATV use in the Burstall Sand Hills has resulted in disturbance to vegetation and soils.

Research Collecting

Collecting specimens is not considered to be a threat to *C. longipenne*.

Conservation concerns in similar species

All known Canadian *Copablepharon* species are associated with dune habitats, which are rare in Canada. *Copablepharon grandis* Strecker and *C. viridisparsa* Dod share similar habitats with *C. longipenne* in the Canadian prairies and are being assessed by COSEWIC (COSEWIC, 2007a; COSEWIC, 2007b). It is noteworthy that one *Copablepharon*, *Copablepharon viridisparsa* spp. *hopfingeri* 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 at Brilliant, BC (near Castlegar). *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 2003 (COSEWIC, 2003). It may be more sensitive to change than *C. longipenne* because it relies on a single host-plant.

SPECIAL SIGNIFICANCE OF THE SPECIES

Copablepharon longipenne is closely associated with active sand dunes, a regionally rare habitat in the southern Canadian prairies. It can be considered a focal species representing the sensitivity and uniqueness of this habitat type in Canada. However, it does not appear to provide an essential ecosystem role (e.g., pollination, habitat creation, food web, predation, etc.) that would not be provided by other species.

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. longipenne* has, or had, an important cultural or economic role for First Nations.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Copablepharon longipenne is not protected in any jurisdiction in Canada. The State of Wisconsin lists it as globally secure but possibly critically imperiled at the state level (G4 S1?) and describes its status as “Special Concern”, but has no laws regulating its use, possession, or harvesting (NatureServe, 2006). However, *C. longipenne* is not known from Wisconsin (Lafontaine, 2004) and this record may be confused with *Copablepharon michiganensis* Crabo and Lafontaine. Portions of *C. longipenne* populations occur in the following protected areas: Great Sand Hills Representative Area Ecological Reserve (SK) and Spruce Woods Provincial Park (MB).

Two sand dune plant communities with which *C. longipenne* is associated are ranked by the Alberta Natural Heritage Information Centre: *Rumex venosus* herbaceous association is designated as imperiled/vulnerable (S2S3) and *Oryzopsis hymenoides–Leymus canadensis* sparsely vegetated association as possibly imperiled (S2?).

TECHNICAL SUMMARY

Copablepharon longipenne
Dusky Dune Moth Noctuelle sombre des dunes
Range of Occurrence in Canada: southern Alberta, Saskatchewan, Manitoba

Extent and Area Information

• *Extent of occurrence (EO)(km²)* (based on distribution records)	164,480 km^2 in Canada
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No.
• *Area of occupancy (AO) (km²)* based upon a 2X2km grid	48 km²
• *Specify trend in AO*	Probably declining
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	12 known in Canada; 22 globally
• *Specify trend in #*	Likely declining due to dune stabilization
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Probably declining at a possible rate of 10-20% per decade

Population Information

• *Generation time (average age of parents in the population)*	1 year
• *Number of mature individuals*	Not known
• *Total population trend:*	Probably declining
• *% decline over the last/next 10 years or 3 generations.*	Possibly 10-20% decline over 10 yrs based on decline of active sand dunes
• *Are there extreme fluctuations in number of mature individuals?*	Unknown; likely
• *Is the total population severely fragmented?*	Yes; patchy
• *Specify trend in number of populations*	Stable or possible minor decline
• *Are there extreme fluctuations in number of populations?*	No

Threats (actual or imminent threats to populations or habitats)

Sand dune stabilization
Demographic collapse (possible threat)
Land and infrastructure development (possible threat)
Cattle grazing (possible threat)
Recreation (possible threat)

Rescue Effect (immigration from an outside source)

• *Status of outside population(s)?* USA: 10 populations known; likely with similar trends to Canadian populations	
• *Is immigration known or possible?*	Unlikely without intervention
• *Would immigrants be adapted to survive in Canada?*	Yes, likely
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	No

Quantitative Analysis

Not undertaken (insufficient data)

Current Status

COSEWIC: ENDANGERED (November 2007) Designated as “Special Concern” in State of Wisconsin (note, but not likely present there)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	B2ab (ii, iii)
Reasons for Designation: [Note especially if it is a Canadian endemic with 100% of its distribution in Canada] The species is restricted to open, active sand areas that are both fragmented and declining. Although it may be common where found, it occurs in a small proportion of the total seemingly suitable sites and has been lost from historical localities. Dispersal between dune systems is considered to be extremely unlikely. Since the 1940’s, the area of suitable habitat has declined by an estimated 10-20% per decade.	

Applicability of Criteria

Criterion A: (Declining Total Population): The total population is likely declining, but we do not have accurate data on numbers.
Criterion B: (Small Distribution, and Decline or Fluctuation): Area of occupancy likely less than 50 km^2 and certainly less than 500 km^2. Severely fragmented. Decline in area of occupancy and quality of habitat as a result of dune stabilization. The species has only been found in, or immediately adjacent to active dunes and these are extremely restricted areas which are declining in extent. It has not been found in its historic sites in Alberta despite searches for it in recent years.
Criterion C: (Small Total Population Size and Decline): Although the species is severely restricted in its Area of Occupancy, numbers in some sites are moderate.
Criterion D: (Very Small Population or Restricted Distribution): More than 1000 mature individuals are expected to occur.
Criterion E: (Quantitative Analysis): not applicable.

ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED

Acknowledgements

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), Stephen 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).

Stephen 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.

The report benefited from the comments of anonymous reviewers.

Funding for the preparation of this status report was provided by the Canadian Wildlife Service, Environment Canada

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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. grandis, C. viridisparsa, 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 longipenne.*

Locality	Prov	Date	No.	Sex	Collector	Deposited[1]
Lethbridge (specific site unknown)	AB	August 13, 1922	1	female	H.E. Gray	CNC
Lethbridge (specific site unknown)	AB	August 14, 1922	1	male	H.E. Gray	CNC
Lethbridge (specific site unknown)	AB	August 23, 1922	1	female	H.E. Gray	CNC
Lethbridge (specific site unknown)	AB	August 3, 1922	1	male	H.E. Gray	CNC
Lethbridge (specific site unknown)	AB	July 31, 1922	1	female	H.E. Gray	LACM
Manyberries (Pakowki Lake)	AB	July 22, 1925	6	male	H.L. Seamans	CNC
Manyberries (Pakowki Lake)	AB	July 22, 1925	1	female	H.L. Seamans	CNC
Manyberries (Pakowki Lake)	AB	unknown	1	male	unknown	AMNH
Manyberries (Pakowki Lake)	AB	July 22, 1925	1	male	H.L. Seamans	LACM
Onefour, Dominion Range Station	AB	July 10, 1951	2	female	D.F. Hardwick	CNC
Sunnydale, Lloydminster	AB	July 3, 1942	1	male	P.F. Bruggemann	CNC
Dune Point, Bindloss	AB	July 27, 2007	unk.	unk.	B.C. Schmidt	USAM
Aweme	MB	August 8, 1911	1	male	E. Criddle	CNC
Aweme	MB	unknown	1	male	unknown	USNM
Aweme	MB	July 20, 1910	1	unk.	N. Criddle	RSM
Aweme	MB	August 17, 1931	unk.	unk.	R.H. Handford	NFRC
Bald Head Hills 13 mi N Glenboro	MB	August 8, 1958	20	male	N.B. Chillcott	CNC
Bald Head Hills 13 mi N Glenboro	MB	August 8, 1958	6	female	N.B. Chillcott	CNC
Bald Head Hills 13 mi N Glenboro	MB	August 9, 1958	1	male	N.B. Chillcott	CNC
Onah	MB	July 30, 1919	1	female	N. Criddle	CNC
Spirit Dunes	MB	July 29, 2004	7	mixed	G.G. Anweiler	UASM
Spirit Dunes	MB	July 21, 2003	>50	mixed	J. Troubridge	CNC
Burstall Dunes	SK	July 1, 1998	>50	mixed	J. Troubridge	CNC
Burstall Dunes	SK	August 10, 1977	2	unk.	R. Hooper	RSM
Burstall Dunes (6 km N)	SK	July 10, 1996	1	male	unknown	LACM
Burstall Dunes (3 km N)	SK	July 13, 1999	>50	mixed	J. Troubridge	CNC
Burstall Dunes (6 km N)	SK	July 2, 1985	1	female	Landry	CNC
Burstall Dunes	SK	July 26, 2004	many	mixed	B.C. Schmidt	USAM
Great Sand Hills (Liebenthal area)	SK	July 13, 1999	1	male	L.G. Crabo + J. Troubridge	CNC
Great Sand Hills (Liebenthal area)	SK	July 24, 2005	18	male	N. Page + D. Mou	CNC
Bigstick Sand Hills (Tompkins area)	SK	July 22, 1969	1	unk.	R. Hooper	RSM
Dundurn Base	SK	August 3, 2004	78	mixed	N. Page + D. Mou	CNC
Seward (Webb) Sand Hills	SK	August 5, 2004	286	mixed	N. Page + D. Mou	CNC
Cramersburg Sand Hills	SK	July 23, 2005	18	mixed	N. Page + D. Mou	CNC

[1] CNC = Canadian National Collection of Insects, Acari and Nematodes; UASM = E.H. Strickland Entomological Museum; MM= Manitoba Museum; RSM = Royal Saskatchewan Museum; LACM = Los Angeles County Museum of Natural History; USNM = United States National Museum, Smithsonian Institute; NFRC = Northern Forestry Research Collection. AMNH = American Museum of Natural History, New York

APPENDIX 2

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

Site	Date	Trap Site	Comments	*C. longipenne*
2004				
Suffern Lake Regional Park, Saskatchewan	July 31, 2004	Site A (road blowout)	western SK	not captured
	July 31, 2004	Site B (stabilized hill)		not captured
	July 31, 2004	Site C (larger blowout)		not captured
Dundurn Base, Saskatchewan	August 3, 2004	Site 1 (Fireguard South)	south of Saskatoon	34
	August 3, 2004	Site 2 (Fireguard North)		44
	August 3, 2004	Site 3 (stabilized blowout near Vimy Hill)		not captured
	August 3, 2004	Site 4 (semi-stable blowout)		not captured
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	142
	August 5, 2004	Site B (stabilized dune to south)		10
	August 5, 2004	Site C (open dune to southwest)		134
Cranberry Flats, Saskatchewan	August 6, 2004	Site 1 (stabilized blowout)	very near Saskatoon	not captured
2005				
Cramersburg Sand Hills, Saskatchewan	July 23, 2005	Site A (near tent)	southwest SK	not captured
	July 23, 2005	Site B (southwest edge of active dune)	near Lancer	3
	July 23, 2005	Site C (northeast edge of active dune)		24
	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	12
	July 24, 2005	Site B (dune ridge south of Boot dune)	(near Sceptre)	5
	July 24, 2005	Site C (grass dune ridge north of road)		1
Rolling Hills, Alberta	July 25, 2005	Site A (shortgrass prairie near tent)	South central Alberta	not captured
	July 25, 2005	Site B (prairie near compressor station)		not captured
	July 25, 2005	Site C (shortgrass prairie on Encana Line)		not captured
Sounding Lake Sand Hills, Alberta	July 26, 2005	Site A (blowout on south side of road)	south central Alberta	not captured
	July 25, 2005	Site B (old road bed with sunflowers)	(near Provost)	not captured
	July 25, 2005	Site C (dune ridge on north side of road)		not captured
Wainwright DND Base, Alberta	July 27, 2005	Site A (semi-stable blowout, Pipeline Rd)	south central Alberta	not captured
	July 27, 2005	Site B (semi-stable dune ridge)	(near Wainwright)	not captured
			Total *C. longipenne* Captured	409
			Number of successful traps	10 of 28
			Moths per trap	40.9

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.