

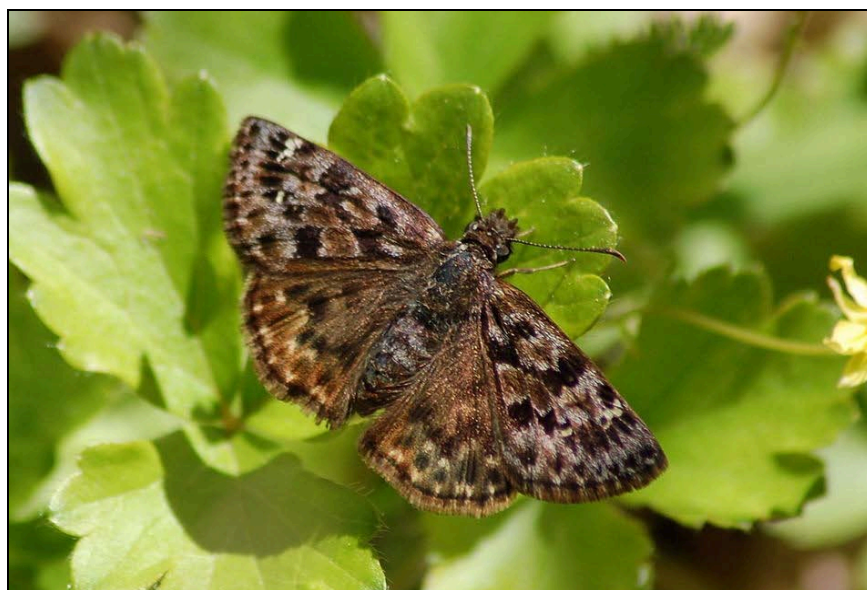
COSEWIC
Assessment and Status Report

on the

Mottled Duskywing
Erynnis martialis

Great Lakes Plains population
Boreal population

in Canada



ENDANGERED
2012

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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Production note:

COSEWIC acknowledges Jessica Linton (née Grealey) for writing the provisional status report on the Mottled Duskywing (*Erynnis martialis*) prepared under contract with Environment Canada. The contractor's involvement with the writing of the status report ended with the acceptance of the provisional report. Considerable modifications to the status report were completed during the subsequent review process and were overseen by Laurence Packer and Jennifer Heron, Co-chairs of the COSEWIC Arthropods Specialist Subcommittee. Personal communications to the original writer are listed simply as such herein; those that were made to Laurence Packer are stated as such.

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COSEWIC Assessment Summary

Assessment Summary – November 2012

Common name

Mottled Duskywing - Great Lakes Plains population

Scientific name

Erynnis martialis

Status

Endangered

Reason for designation

The population has disappeared from Quebec and now occupies a few, isolated locations in southern Ontario that continue to decline in number. Population numbers are also declining. The species is primarily threatened by habitat fragmentation, but also by habitat loss and degradation through, for example, development, natural succession, fire suppression, and extensive deer browsing.

Occurrence

Ontario, Québec

Status history

Designated Endangered in November 2012.

Assessment Summary – November 2012

Common name

Mottled Duskywing - Boreal population

Scientific name

Erynnis martialis

Status

Endangered

Reason for designation

This butterfly is declining throughout its North American range. In Canada, this particular population is restricted to a small area of pine woodland in southeastern Manitoba. All locations are under threat. One location is predicted to become flooded within ten years and the other four are expected to experience substantial population declines due to natural forest succession. The species' habitat at all locations is at risk of Btk spraying to control Gypsy Moth. Any currently undocumented sites are likely to be experiencing a similar range of threats.

Occurrence

Manitoba

Status history

Designated Endangered in November 2012.



COSEWIC Executive Summary

Mottled Duskywing *Erynnis martialis*

Great Lakes Plains population
Boreal population

Wildlife Species Description and Significance

Mottled Duskywing (*Erynnis martialis*) is a butterfly in the skipper family (Hesperiidae). It is a medium-sized (wingspan 23-29mm) dark grey skipper with a very mottled appearance and a characteristic purplish hue. Yellow-brown spots create the mottled hindwing pattern, which distinguishes the Mottled Duskywing from other duskywing butterflies.

Mottled Duskywing is taxonomically distinct with no known subspecies. It is also genetically distinct from its closest relatives. The Mottled Duskywing is a butterfly representative of some of the rarest ecosystems in Canada, such as oak woodlands, pine woodlands, tall grass prairies and alvars with dry or sandy soils and early successional habitat. The Mottled Duskywing is experiencing declines similar to other butterfly species that occupy similar habitats such as the Karner Blue, Frosted Elfin, and Eastern Persius Duskywing, all assessed as extirpated in Canada.

Distribution

The present day range of Mottled Duskywing is from the eastern United States from Pennsylvania to Minnesota, south to Georgia and eastern and central Texas. The species extends into Canada in southeastern Manitoba and southern Ontario with populations in each region being separate designatable units (DU): the Boreal population (southern Manitoba) and Great Lakes Plains population (southern Ontario and historically Québec).

Habitat

The Mottled Duskywing requires its host plants, New Jersey Tea (Great Lakes Plains DU) and Prairie Redroot (Boreal DU), during its life cycle. In Canada, these plants grow in dry, well-drained soils or alvar habitat within oak woodland, pine woodland, roadsides, riverbanks, shady hillsides and tall grass prairies. The butterfly is frequently absent from apparently suitable host plant patches, suggesting additional limiting factors play a role in the species' site occupancy. The host plants also appear to be declining throughout most of the butterfly's range and the habitats may also be imperiled.

Biology

Females oviposit single eggs on flower pedicels or other parts of the host plant. Larvae emerge and construct silk leaf-nests. The species overwinters as mature larvae, which pupate in April and emerge as adults from mid-May to late June throughout most of their Canadian range. In southwestern Ontario, a second brood pupates in early July and a second flight period occurs from mid-July to late August.

Population sizes and trends

The Mottled Duskywing has always been reported as small colonies. It has experienced widespread declines across most of its known global range. Within Ontario, the species appears to have become extirpated from many historic sites in the past 20 years. At some sites where the butterfly has been recently recorded, surveys within the past five years have failed to record it. In Manitoba, the Mottled Duskywing also appears to be declining in both abundance and habitat quality. The species is considered extirpated from Québec.

Threats and limiting factors

Almost all current sites are under some threat. Urban development, natural succession, inappropriate fire management (for the butterfly and its host plant), Btk spray to control the non-native defoliator Gypsy Moth, natural flooding and the planting of Jack Pines are the primary threats to one or more sites.

There appear to also be unknown biological limiting factors contributing to the decline of Mottled Duskywing. Compounding the threats is the species' metapopulation structure, which likely makes it sensitive to habitat fragmentation. When sites are simultaneously impacted by one or more threats, and populations become extirpated from one of an interconnected series of sites, it is unlikely the site will be recolonized through natural dispersal, especially in southern Ontario.

Protection, Status and Ranks

The Mottled Duskywing is not protected by federal legislation. In Ontario, the butterfly is protected under two provincial statutes: the *Fish and Wildlife Conservation Act* and the *Provincial Parks and Conservation Reserves Act*. In Manitoba, the species is not listed under the provincial Endangered Species Act. The species' habitat is protected within Manitoba provincial forests and parks; however timber production and Mottled Duskywing habitat management objectives potentially conflict.

The provincial conservation status ranks are imperiled (S2) in Ontario, imperiled in Manitoba (S2) and presumed extirpated in Québec (SH). The Canada national status rank is imperiled/vulnerable (N2N3). Host plants are apparently secure (S4) in Ontario, vulnerable (S3) in Manitoba and imperiled (S2) in Québec.

In Ontario five historic sites are within protected areas: Bronte Creek Provincial Park, Glenorchy Conservation Area, Karner Blue Sanctuary (private conservation area), Pinery Provincial Park and St. Williams Forestry Conservation Reserve. In Manitoba, all sites where the butterfly has been recorded in recent years are in Provincial Parks or Forests.

TECHNICAL SUMMARY – DU1

Erynnis martialis
Mottled Duskywing

Hespérie tachetée
Population des plaines des Grands Lacs

Great Lakes Plains population
Range of occurrence in Canada (province/territory/ocean): Ontario and Québec

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2008) is being used)	One generation per year except 2 generations per year in extreme southwestern Ontario
Is there an inferred continuing decline in number of mature individuals?	Yes. Inferred decline based on habitat loss.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown. Substantial losses are expected based upon observed multiple threats at each site.
Observed percent reduction in total number of mature individuals over the last [10 years, or 3 generations].	Unknown. Recent sites (1990-2007) no longer have populations and in some cases the host plant has disappeared.
Expected percent reduction in total number of mature individuals over the next [10 years, or 3 generations].	Unknown. Substantial reductions inferred based on multiple simultaneous threats within each site.
Observed percent reduction in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Decline to zero has been observed at many sites in the past, including recently; declines are expected to continue, exact % unknown but clearly substantial.
Are the causes of the decline clearly reversible and understood and ceased?	The causes of observed and predicted declines are highly variable. Threats are somewhat understood most are not considered reversible and have not ceased.
Are there extreme fluctuations in number of mature individuals?	Fluctuations are not extreme. The butterfly has never been recorded in large numbers.

Extent and Occupancy Information

Estimated extent of occurrence Historic EO 145,881km ² Recent EO (since late 1990's) 35,291km ² Recent EO with very recently extirpated sites removed but all recently unsearched sites included 24,437km ²	24,437km ²
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<p>Index of area of occupancy (IAO) (Always report 2x2 grid value; other values may also be listed if they are clearly indicated (e.g., 1x1 grid, biological AO)).</p> <p>Historic IAO 192km² Recent IAO (since late 1990's) 76km² Recent IAO with very recently extirpated sites removed but all recently unsearched sites included 44km², the latter figure is considered a likely maximum number</p>	44km ²
<p>Is the total population severely fragmented?</p> <p>Definitely, most sites are separated by considerably greater distances than the species can possibly disperse under natural conditions and even populations within extant metapopulations are likely often isolated. Loss of any of the remaining populations or metapopulations would have a significant impact upon the species. Most remaining populations are at immediate risk of extirpation and only a few sites that have not been searched recently might possibly have sufficient habitat for populations to persist for much longer.</p>	yes
<p>Number of "locations*"</p> <p>Each metapopulation consists of numerous habitat patches, some occupied sites and others unoccupied. Each metapopulation represents a single location each.</p>	9
<p>Is there an inferred and projected continuing decline in extent of occurrence?</p>	Yes. Based upon known threats.
<p>Is there an inferred and projected continuing decline in index of area of occupancy?</p>	Yes. Based upon known threats and recent observations.
<p>Is there an inferred and projected continuing decline in number of populations?</p>	Yes. Based upon known threats and recent observations.
<p>Is there an inferred and projected continuing decline in number of locations?</p>	Yes. Based upon known threats and ongoing observations.
<p>Is there an observed and projected continuing decline in area, extent and quality of habitat?</p>	Yes. Based upon known threats and recent observations.
<p>Are there extreme fluctuations in number of populations?</p>	No.
<p>Are there extreme fluctuations in number of locations*?</p>	No.
<p>Are there extreme fluctuations in extent of occurrence?</p>	No.
<p>Are there extreme fluctuations in index of area of occupancy?</p>	No.

* See definition of location.

Number of Mature Individuals (in each population)

Population	N Mature Individuals
List populations with number of mature individuals in each: 1. Alderville – small if extant 2. Burlington metapopulation – small 3. Camp Borden – small if extant 4. Marmora – small 5. Niagara – perhaps not extant 6. Oakville – small 7. Ottawa – not seen since 2008 8. Pinery – at most small 9. Stirling – small at best	Unknown. Populations are considered small, never known as abundant, usually seen as a single or few individuals on any one survey.
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown. Not performed, but probability of extinction considered extremely high by species experts.
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Threats (actual or imminent, to populations or habitats)

Habitat fragmentation Habitat loss or degradation due to: <ul style="list-style-type: none"> • Development • Natural succession • Fire suppression and fire treatment • Extensive deer browsing • Herbicide spraying Direct impacts on population due to: <ul style="list-style-type: none"> • Insecticide use • Fire treatment • Construction 	
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Rescue Effect (immigration from outside Canada)

Status of outside population(s)? USA: The species is at best critically imperiled in all US states adjacent to Ontario, it is declining in the USA with 9 states raising its ranking between 2008 and 2012. The Ontario populations are considered completely isolated from those in the USA.	
Is immigration known or possible?	Considered impossible
Would immigrants be adapted to survive in Canada?	Temporarily perhaps
Is there sufficient habitat for immigrants in Canada?	Unlikely given that the habitat quality of current populations is declining due to numerous threats. However, translocation to unoccupied host plant patches may provide temporary population persistence if the habitat is actively managed.
Is rescue from outside populations likely?	Not possible under natural conditions, possible with active management and reintroductions

Current Status

COSEWIC: Designated Endangered in November 2012.
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Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: B2ab(i,ii,iii,iv,v)
Reasons for Designation: The population has disappeared from Quebec and now occupies a few, isolated locations in southern Ontario that continue to decline in number. Population numbers are also declining. The species is primarily threatened by habitat fragmentation, but also by habitat loss and degradation through, for example, development, natural succession, fire suppression, and extensive deer browsing.	

Applicability of Criteria

Criterion A: Not applicable. Substantial decline in total population is expected based upon known and expected threats, but the values for total population decline are not known with sufficient precision to warrant use of A3 even though the authorities in the field believe that the species meets predictions for this criterion and consider the species to be on the verge of extirpation in Ontario.
Criterion B: Small distribution and general decline in populations. Meets endangered B2ab(i,ii,iii,iv,v) because the IAO, at 44km ² , is much less than 500km ² (and the possibility it would reach this number is low), the species persists in scattered metapopulations and some isolated populations that are much further apart than the species can disperse and habitat patches are often smaller than would be required to support a viable population and are decreasing in quality. The Ontario locations are completely isolated from those in the adjacent United States. The species has been found at 9 locations in the past ten years but it has certainly disappeared from one of them and has not been seen at others where search effort has been less intensive. A decline is predicted in EO, IAO, quality of habitat, number of locations and number of mature individuals. Threats and fragmentation effects are likely to be similar for any undocumented population, if any such populations exist, which is improbable.
Criterion C: Not applicable. Total population size small and number of sites it occupies declining. Accurate population estimates are not available.
Criterion D: Not applicable. Restricted distribution. Population size unknown, though small.
Criterion E: Not applicable. Quantitative analyses not available.

TECHNICAL SUMMARY – DU2

Erynnis martialis
Mottled Duskywing
Boreal Population

Hespérie tachetée
Population boréale

Range of occurrence in Canada (province/territory/ocean): Manitoba

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used)	One generation per year.
Is there an inferred continuing decline in number of mature individuals?	Unknown. Abundance declines predicted for the Boreal DU.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Predicted decline of 40% among known populations
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Likely a decline, but little recent data for this DU.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Most known populations are expected to have decreased substantially over the relevant time period. Attempts at providing a number have not been deemed accurate, but certainly exceed 50%.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown. Extent of recent declines is not known, but future declines are certain for known sites.
Are the causes of the decline clearly reversible and understood and ceased?	The causes of observed and predicted declines are highly variable. Threats are somewhat understood; most are not considered reversible and have not ceased.
Are there extreme fluctuations in number of mature individuals?	No.

Extent and Occupancy Information

Estimated extent of occurrence Historically and recently 4,914km ² but if recent absences are removed this decreases to 2,250km ² .	4,914km ²
Index of area of occupancy (IAO) (Always report 2x2 grid value; other values may also be listed if they are clearly indicated (e.g., 1x1 grid, biological AO)). Historically 92km ² Recently at most 88km ² and perhaps as low as 20km ² .	88km ²
Is the total population severely fragmented?	Probably because sites between observations seem not to have the species

Number of "locations*"	At most 5 known, more are possible
Is there an inferred and projected continuing decline in extent of occurrence?	Yes. Based upon known threats and loss of some sites.
Is there an inferred and projected continuing decline in index of area of occupancy?	Yes. Based upon known threats and loss of some sites.
Is there an inferred and projected continuing decline in number of populations?	Yes. Based upon known threats and loss of some sites.
Is there an inferred and projected continuing decline in number of locations?	Yes. Based upon known threats and loss of some sites.
Is there an observed and projected continuing decline in area, extent and quality of habitat?	Yes. Based upon known threats.
Are there extreme fluctuations in number of populations?	No.
Are there extreme fluctuations in number of locations*?	No.
Are there extreme fluctuations in extent of occurrence?	No.
Are there extreme fluctuations in index of area of occupancy?	No.

Number of Mature Individuals (in each population)

Population	N Mature Individuals
List populations with number of mature individuals in each: <ol style="list-style-type: none"> 1. Northwest Angle Provincial Forest 2. Whiteshell Provincial Park 3. Wampum Provincial Forest 4. Agassiz Provincial forest 5. Sandilands Provincial Forest 	Unknown. Populations are considered small and usually seen as a single or few individuals on any one survey.
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown.
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Threats (actual or imminent, to populations or habitats)

Habitat loss or degradation due to: <ul style="list-style-type: none"> • Natural vegetative succession • Tree planting of Jack Pine • Possibly extensive deer browsing of host plants Direct impacts on population due to: <ul style="list-style-type: none"> • Insecticide application. • Flooding
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* See definition of location.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? USA: N3. Its status is unknown in adjacent Minnesota, but is probably declining there as it is everywhere where there are sufficient data to assess trends.	
Is immigration known or possible?	Unknown, not likely.
Would immigrants be adapted to survive in Canada?	Possibly
Is there sufficient habitat for immigrants in Canada?	Possibly, though all known sites face threats.
Is rescue from outside populations likely?	No.

Current Status

COSEWIC: Designated Endangered in November 2012.
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Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: B2ab(i,ii,iii,iv,v)
Reasons for Designation: This butterfly is declining throughout its North American range. In Canada, this particular population is restricted to a small area of pine woodland in southeastern Manitoba. All locations are under threat. One location is predicted to become flooded within ten years and the other four are expected to experience substantial population declines due to natural forest succession. The species' habitat at all locations is at risk of Btk spraying to control Gypsy Moth. Any currently undocumented sites are likely to be experiencing a similar range of threats.	

Applicability of Criteria

Criterion A: Does not meet A criteria despite known populations are expected to decline substantially over the next ten years, substantial decline in total population is expected based upon known and expected threats but the values for total population decline are not known with sufficient precision to warrant use of A3.
Criterion B: Small distribution and general decline in populations. Meets endangered B2ab(i,ii,iii,iv,v) because the IAO is 88km ² (this decreases to 20km ² if recently failed searches are removed from the data). This is much less than 500km ² (and the chances of it occurring in another 103 squares would seem to be vanishingly small) and habitat patches are (1) smaller than would be required to support a viable population, and (2) often separated from other habitat patches by fairly large distances in comparison to the species' expected dispersal distance. The species has been found at 5 locations in the past ten years and a decline is predicted in EO, IAO, quality of habitat, number of locations and number of mature individuals. Any undocumented locations for the species are expected to be subject to the same most serious threats predicted for the known locations. Even though large areas remain to be searched for this species, the chance that there are 25X as many occupied sites than have been seen recently would seem to be unlikely.
Criterion C: Not applicable. Total population size small and number of sites it occupies declining. Accurate population estimates are not available.
Criterion D: Not applicable. Restricted distribution. Population size unknown, though small, and undocumented locations may exist.
Criterion E: Not applicable. Quantitative analyses not available.



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 (2012)

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.



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

COSEWIC Status Report

on the

Mottled Duskywing *Erynnis martialis*

Great Lakes Plains population
Boreal population

in Canada

2012

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Erynnis martialis* (Scudder, 1869)
Synonyms: *Nisoniades martialis*, *Nisoniades ausonius*, *Thanaos quercus*
Bibliographic Citation: Scudder, S.H. 1869. A Preliminary List of the Butterflies of Iowa. Trans. Chicago Acad. Sci. 1: 326-337.
English name: Mottled Duskywing
French Name: Hespérie tachetée

Classification

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Lepidoptera
Family	Hesperiidae
Genus	<i>Erynnis</i>
Species	<i>Erynnis martialis</i>

Mottled Duskywing (*Erynnis martialis*) was described by Scudder (1869) from specimens collected in Iowa (Burns 1964). Confusion between *E. ausonius* and *E. martialis* was later resolved when Cook (1906) concluded they were the same species. There are no subspecies of Mottled Duskywing.

Morphological Description

The Mottled Duskywing is a medium-sized (wingspan: 25-29 mm) dark grey skipper with a very mottled appearance and a purplish hue (Figure 1). Yellow-brown spots create the mottled hindwing pattern and are present on both the dorsal and ventral surfaces in both sexes. This degree of mottling distinguishes the species from other duskywings. Female Mottled Duskywings lack abdominal hair-like scent scales (hair pencils) found on other duskywing species (Scott 1986).



Figure 1. Adult Mottled Duskywing. Photograph by J. Linton, Marmora, Ontario.

Eggs are laid singly on the host plant and are yellowish in colour. Larvae are light green in colour with a dark head (Layberry *et al.* 1998; Scott 1986). They feed in leaf-nests on two species of host plants (*Ceanothus spp.* see Habitat). The pupae of Mottled Duskywings are green. In Canada the species hibernates as mature larvae, likely in leaf litter.

Genetic Description

Historical observation and collection data from over the past 100 years indicate that the Mottled Duskywing has been restricted in Canada to small, isolated colonies where its host plant occurs. The species has little genetic variation among individuals sampled from southern Ontario (at most 0.2% differentiation) but is genetically distinct from other *Erynnis* with at least 5% sequence divergence from the closest related species, *E. funeralis*, *E. zarucco* and *E. tages*, based upon DNA barcode data (E. Zakharov per. comm. 2007).

Population Spatial Structure and Variability

There is no data on population spatial structure and variability for the Mottled Duskywing. The species persists in small populations but there have been no studies of gene flow or variation within populations. Nonetheless, the distance between the Great Lakes Planes DU in Ontario (ON) (and historically Quebec) and Boreal DU in Manitoba (MB) is enormous and the populations in the two provinces have undoubtedly been isolated since the retreat of the ice sheets. Gene flow between populations in Canada is unlikely and is also not considered possible through the United States due to the species' limited dispersal ability and geographic separation between populations. The remaining Ontario populations are considered isolated (NatureServe 2012).

Designatable Units

The range of Mottled Duskywing is disjunct in Canada with two designatable units: the Great Lakes Plains population in southern Ontario and Quebec, and the Boreal population in southeastern Manitoba. The distances between populations in ON are sufficiently large and dispersal between them is unlikely. This suggests that gene flow between the two provinces is also not possible. Given the enormous distances involved combined with the species' similarly patchy distribution in much of its declining range in the northern USA, step-wise gene flow through the United States is similarly impossible. NatureServe (2012) states that the species in "Ontario is no longer part of any contiguous range". The existence of the species in woodland clearings in Manitoba and dry savannah areas in Ontario suggests that the populations in the two areas have distinctly different adaptations. The distance separating them, both in time and space, suggests that genetic differentiation at a meaningful level is highly probable. Each of the two DUs is considered significant based upon COSEWIC's definitions.

Special Significance

The Mottled Duskywing is endemic to habitats in Canada and the United States that contain sandy or other well drained soils, early successional habitat, and *Ceanothus* colonies. Its habitat in Ontario consists of globally important and rare habitats such as oak savanna, alvars and sand and granite barrens. The Mottled Duskywing is taxonomically distinct. No Aboriginal Traditional Knowledge is available for the Mottled Duskywing (Goulet pers. comm. 2009).

DISTRIBUTION

Global Range

Historically, Mottled Duskywing ranged throughout eastern and central United States and parts of south-central Canada (Figure 2). In the United States the species ranged from New England west to Wyoming, south to Georgia and eastern and central Texas (Burns 1964; Howe 1975). Severe population declines have been observed in many U.S. states, especially east of Ohio. The butterfly is considered extirpated from Connecticut, Massachusetts, New Hampshire and New Jersey and possibly extirpated in Delaware, Maryland, Ohio, Pennsylvania and Rhode Island (NatureServe 2012).

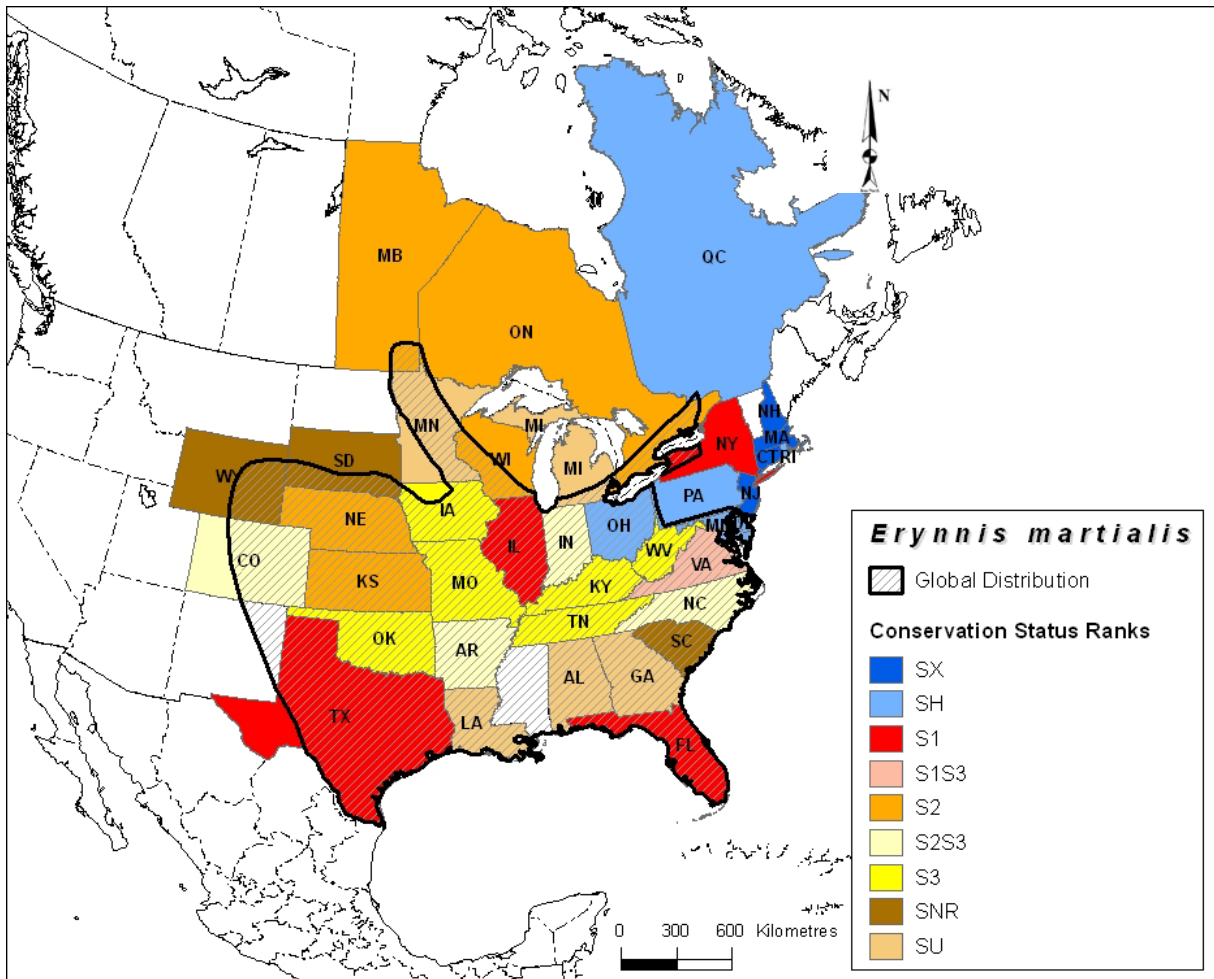


Figure 2. Estimated North American Range of Mottled Duskywing.

Canadian Range

In Canada Mottled Duskywing ranges within southeastern Manitoba and southern Ontario. Historically, the range of the Mottled Duskywing extended to southwestern Québec; however, the species is considered extirpated from this province (P. Hall pers. comm. 2007; R. Layberry pers. comm. 2008; Domaine *et al.*, 2010). The Mottled Duskywing has declined in distribution and abundance in Canada since the early 1990s. Small local colonies are still found in southeastern Manitoba and sporadically in southern Ontario. All historically known sites of the Mottled Duskywing in Canada are shown in Figure 3.

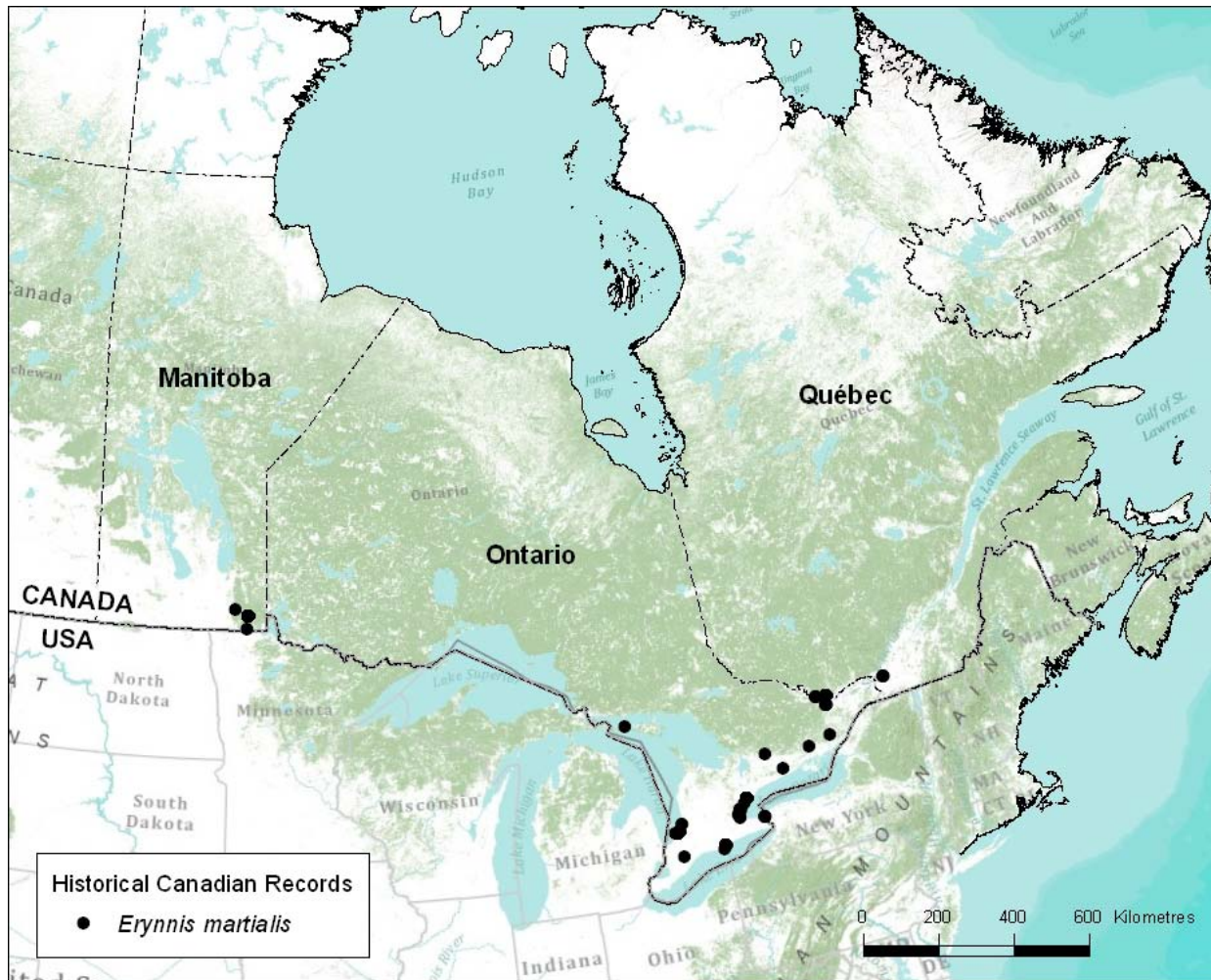


Figure 3. Historical Canadian records of Mottled Duskywing.

Ontario

The Mottled Duskywing is extant in Ontario. The estimated range is based on 1998 to 2012 records (Figure 4) and a smaller range that removes sites where recent searches have failed to record the species (Figure 5). The most recent observations (within the past ten years) are of a single or small number of individuals in small sites from the southern portion of the province. In total, there are nine metapopulations composed of one to numerous sites in southwestern Ontario:

1. Alderville (2008) – small if extant
2. Burlington – small
3. Camp Borden (2007) – small if extant
4. Marmora (2012) – small
5. Niagara (1991) – unknown if extant

6. Oakville (2003) – small
7. Ottawa (2008) – not seen since 2008
8. Pinery (1990) – unknown, but may persist at the Karner Blue Sanctuary where “several individuals have been seen in the last couple of years” (B. Kulon pers. comm. 2012);
9. Stirling (2006) – small at best

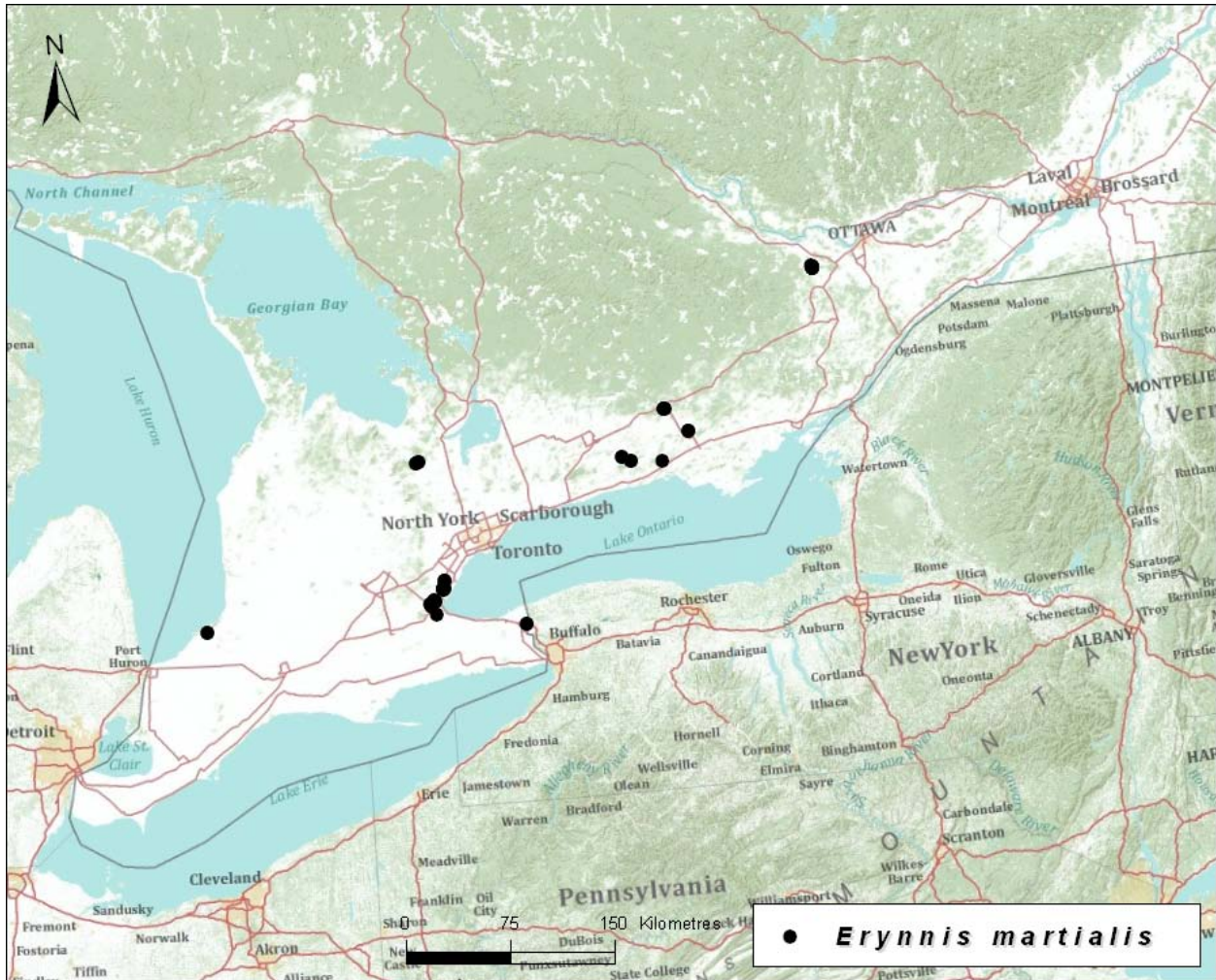


Figure 4. Recent Great Lakes Plains DU (Ontario) records of Mottled Duskywing (1998-2008).

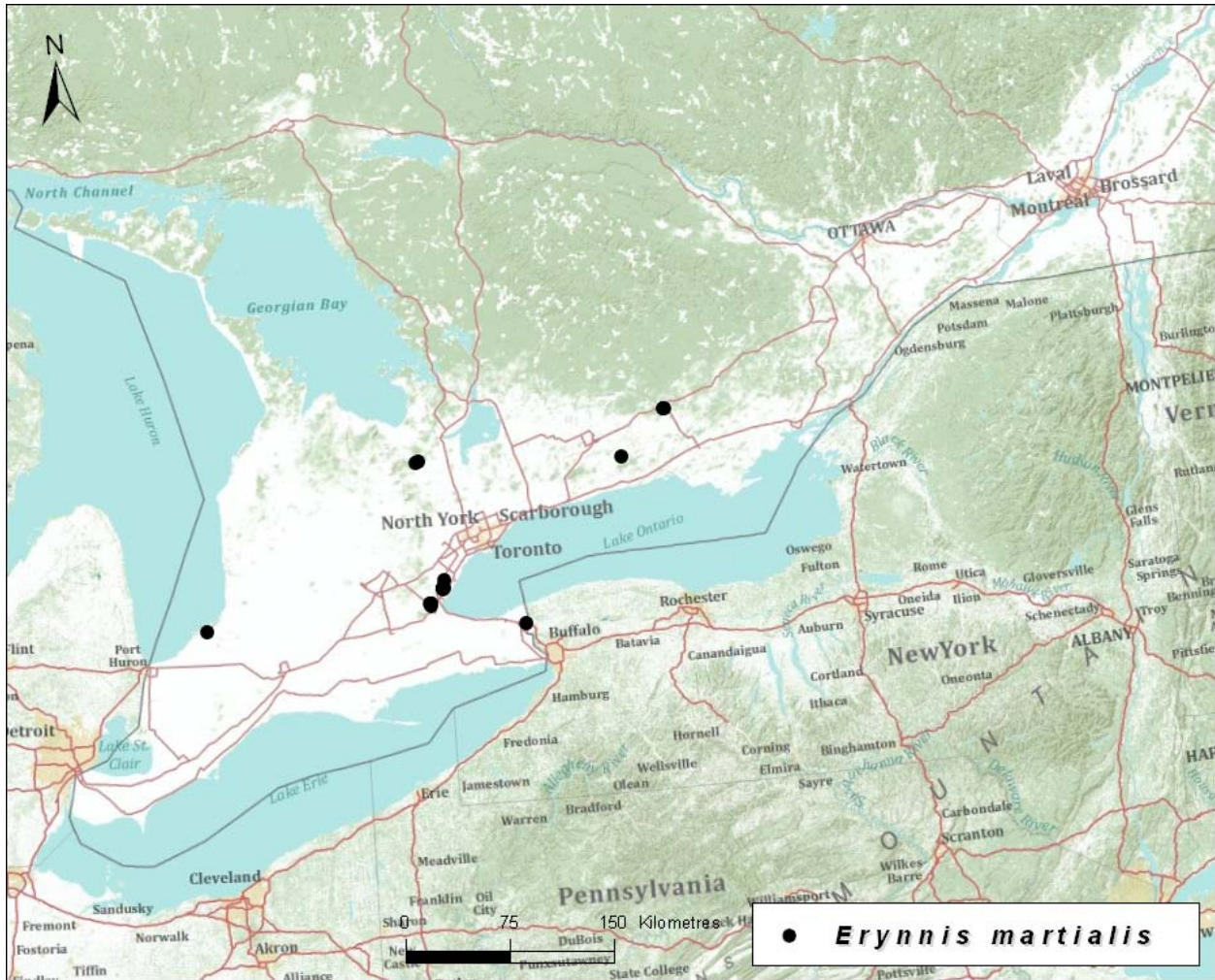


Figure 5. Great Lakes Plains DU (Ontario) Mottled Duskywing sites with sites removed that have been searched since 2008 and where no Mottled Duskywing were recorded.

Older records include Niagara (1991), Constance Bay (1997), Pinery Provincial Park (1990), St. Williams area (1994) and Manitoulin Island (1987) (Table 1). Historical data suggests that its strongest localities were at Pinery Provincial Park and St. Williams (A. Wormington, personal communication to C. Jones).

Table 1. Search effort for sites where Mottled Duskywing was not recorded.

Site	Most recent record	Search effort (person hours) since last known record
Bronte Creek, Ontario	2000	18
Burnt Lands, Ontario	2008	18
Constance Bay, Ontario	1997	29
Stirling, Ontario	2006	3
Pinery Provincial Park, Ontario	1990	12
St. Williams area, Ontario	1994	18
Manitoulin Island, Ontario	1987	Unknown, but most years
Wampum Provincial Park, Ontario	2003	1
Northwest Angle, Ontario	2003	20

Notes on Potential Habitat in Ontario

It might be assumed that Mottled Duskywing has a potentially widespread distribution in Ontario based on the distribution of the larval host plants, *Ceanothus* (= *C. ovatus*) and *C. americanus*, as portrayed in Soper and Heimburger (1982). There are three reasons why this assumption is inappropriate (P. M. Catling pers. comm. to L. Packer, 2012):

1. These maps are not of current distribution but rather show distribution over a period of more than 100 years up to 1980. The plants are gone from many of the sites shown on the maps with some recent extirpations and declines noted elsewhere in this report.
2. The quality of the sites is generally poor. At many sites where host plants are present, there are only a few individuals and often in poor condition as a result of overgrowth by native and or invasive alien plants or other threats (see Threats and Limiting Factors). Over the longer term, this decline in host plant abundance is largely the result of historical fire suppression. More recent declines have diverse causes.
3. It is clear that a healthy population of the host plant is not the only requirement for Mottled Duskywing. For example, nectaring plants, and other habitat features for behavioural, physiological and life history needs are also necessary. Clearly not all of the host plant sites are able to satisfy these needs (see Search Effort).

Soper and Heimbürger's (1982) maps were certainly thorough at the time, the plants are conspicuous, easy to identify and their work indicated all historical occurrences. However, they are now considerable overestimates of current abundance of the two *Ceanothus* species which are mostly restricted to habitats – savannas, alvars, granite barrens, and sand barrens – that have been well documented as being special, rare and declining (e.g. Bakowsky and Riley 1994, Brownell and Riley 2000, Carbyn and Catling 1995, Catling and Brunton 2010, Catling and Brownell 1995, Catling and Brownell 1999a-c, Catling and Catling 1993, Catling 2008, Catling *et al.* 2010). Many of the historical habitats are known to have disappeared and/or to have diminished to tiny patches (P.M. Catling pers. comm. to L. Packer 2012).

The combined distribution of the two host plant species in Ontario over the duration of Soper and Heimbürger's (1982) mapping is 149 (the number of dots on their maps – which approximates sites that are ~1km from one another). The present day distribution of these host plants is not known, but is certainly substantially less. It is worth noting that 87% of these sites for which records were made between 1880 and 1980 have to persist now for the IAO of the Eastern DU to approach 500km² and this assumes all the dots on the maps to be 2km apart from adjacent ones. Furthermore, extensive areas of host plant that were previous sites (e.g., Pinery and St. Williams) are now extirpated. Smaller areas that once had both butterfly and host plant which now have small populations of host plant are known from the Burlington area where observations were detailed (R. Curry pers. comm. to C. Jones 2012). Areas where the host plants have disappeared include the historic Québec Mottled Duskywing sites.

Given the extent of butterfly research in Ontario in recent years, the special habitat of the host plant, the fact that the Mottled Duskywing is often missing from even extensive patches of *Ceanothus*, that it has not recolonized re-established patches of host plant (at Constance Bay) and that suitable patches of host plant quite close to known butterfly populations are devoid of the species (e.g., Marmora), it seems unlikely that small populations of this species have gone unnoticed. Threats faced by hypothetical sites are likely similar to those where the butterfly was recently recorded (see Threats). It is also improbable that sites with recent observations provide sufficient habitat for the species to persist for much longer.

Based upon museum collections, it may also have had a stronghold in the Toronto area in the 19th century.

Manitoba

The Mottled Duskywing is extant in Manitoba. Records are from the southeastern portion of the province from Northwest Angle Provincial Forest, Whiteshell Provincial Park, Wampum Provincial Forest, Agassiz Provincial forest, and Sandilands Provincial Forest (R. Westwood pers. comm. 2007; P. Klassen records from the Manitoba Provincial Museum; H. Flynn pers. comm. to L. Packer 2012). Small colonies have been observed in recent years and the population as a whole may currently be generally stable in southeastern Manitoba although severe threats remain (R. Westwood pers.

foot) that require extensive surveying if accurate population estimates of the Mottled Duskywing are to be estimated. However, it is exceedingly unlikely that these could yield an increase in IAO to 500km².

Québec

The Mottled Duskywing is likely extirpated in Québec. Historically, the butterfly was recorded from two areas in southwestern Québec: Norway Bay (now Bristol, Outaouais region) and La Trappe (near Oka, Laurentides region) (B. Skinner pers. comm. 2007). It has not been recorded from La Trappe since the 1950's. The colony at Norway Bay has not been recorded since 1958 and was likely extirpated by cottage development (P. Hall pers. comm. 2007). The host plants are also considered lost from the sites where the butterfly occurred (L. Handfield and R. Layberry, pers. comm. to C. Schmidt 2012).

Extent of Occurrence (EO) and Index of Area of Occupancy (IAO)

In Manitoba best estimates of the current EO are 4,914km² and IAO 20 - 88km². Historically the EO is the same and the IAO slightly larger than the upper estimate at 92km².

In Ontario, the current EO is 24,437km² and IAO 44km². These values exclude sites where the species has not been found in the recent searches and no searches have taken place in recent years. For all sightings since 1998 the EO increases to 145,881km² and IAO 192km².

Search Effort

During the preparation of this status report, experts completed Mottled Duskywing inventory at previously known sites. During 2007 and 2008, government resource offices and local botanists were contacted for *Ceanothus* distribution data. Historical records for the Mottled Duskywing reviewed and contact to observers/collectors for specific site information. At each site, searchers spread out looking for colonies of *Ceanothus* and Mottled Duskywings adults. Host plants that appeared to have insect damage were checked for larvae and eggs but none were observed. At most sites where the Mottled Duskywing was found, photographs were taken and the number of individuals counted. Based on expertise of the observers, it is absolutely certain that all observations of the Mottled Duskywing in 2007 and 2008 were correctly identified. No specimens were taken due to the small number of individuals observed. Counts of the Mottled Duskywing at each site are thought to be fairly accurate because so few individuals were observed.

Several localities where the Mottled Duskywing was once known were not surveyed in 2007 or 2008 (or since). This decision was based on: 1) limited or very old records (>20 years); 2) communication with local experts, which determined it was very unlikely that these colonies still existed (P. Hall pers. comm. 2007; C. Jones pers. comm. 2008; R. Layberry pers. comm. 2008; R. Westwood pers. comm. 2007; B. Kulon pers. comm. 2008) – indeed, in some of these cases the food plant cannot be found at the sites and/or 3) localities are regularly searched for Mottled Duskywing by other qualified observers, this was particularly true of the St. Williams and Pinery areas, which receive numerous visits from entomologists annually, and continues to be the case at these sites as well as in the Oakville and Burlington population.

Substantial earlier searches for butterflies were performed by Dr. J.T. Kerr and associates in four areas, including two that were known historical Mottled Duskywing sites in 1995 and 1996. Transects were searched and butterflies within a 1m radius from the walked path were identified. For the spring and summer broods (both of which are expected to occur in the region under consideration here), search effort included over 20 and 40 hours respectively of search along the Delhi-Simcoe railroad and six and twelve hours respectively in the vicinity of Trenton (neither known sites for the butterfly). Known sites surveyed included three and six hours at the Manestar Tract (St. Williams metapopulation) and four and eight hours at the Karner Blue Sanctuary (Pinery metapopulation). No Mottled Duskywings were observed (J.T. Kerr, personal communication to L. Packer, 2012).

Data on habitat and search effort is considerably greater for Ontario than for Manitoba largely because of the greater naturalist population close to known Mottled Duskywing sites in the former and the remote and largely difficult-of-access nature of the species' known sites in Manitoba.

The Mottled Duskywing is extant in Ontario. The most recent observations are of a single or small number of individuals and are from the southern portion of the province.

The Oakville population was last recorded in 2003, despite considerable search effort (see Search Effort).

The Pinery population may now only persist at the Karner Blue Sanctuary where "several individuals have been seen in the last couple of years" (B. Kulon pers. comm. 2012).

The Ottawa population may have become extirpated recently (last seen in 2008 and not seen since despite extensive search).

Additional isolated records are from Camp Borden (last seen in 2007 but no search effort since), Niagara (last seen in 1991, not seen in one search of unknown duration since), Marmorata (extant in 2012), Alderville (last seen in 2008, likely extant) and Stirling (last seen in 2006, not seen in 3 hours of search since).

The species seems to have disappeared from Constance Bay (last seen in 1997), Pinery Provincial Park (1990), the St. Williams area (1994) and Manitoulin Island (1987) (Table 1).

In Ontario, historical records are known from various localities but the Mottled Duskywing has not been recorded in many of these in several decades and from even fewer in the last five years (Figure 5). Most historical records are based on existing collections referenced in the Collections Examined section of this report.

The species exhibits a metapopulation structure as indicated by historical records and recent observations. The following metapopulations are named in this report: Burlington, Oakville, Ottawa, Pinery and St. Williams. Other sites, both historical and recent, appear more isolated. The current Manitoba sites may represent one metapopulation, but information for this DU are more scanty.

It should be stated at the outset that there is a considerable amount of undocumented search effort for butterflies, especially in Ontario. This is because of the considerable natural history interest people have in them, the possibility of identification through image taking and the activities of collectors. Much of this activity targets rare species which are, for obvious reasons, of greatest interest. In Ontario, there are over 78,000 records of butterflies with accurate identification information for the past ten years, with the rarer species over-represented in relation to their abundance. It is difficult to establish search effort in terms of person-hours during the flight period for Mottled Duskywing that resulted from these activities except in rare instances. Consequently, data on search effort described below are almost certainly a considerable underestimate.

Manitoba

In 2007 and 2008 19 sites in Sandilands Provincial Forest were surveyed for Mottled Duskywing. Three adult Mottled Duskywing were observed. Recent records are within extensive trails walked by those who recorded the butterfly (R. Westwood personal communication to L. Packer, 2012).

Surveys in 2001 and 2003 recorded Mottled Duskywing in Northwest Angle Provincial Forest (20 hours search effort) and Wampum Provincial Forest (one hour search effort) (R. Westwood pers. data University of Winnipeg) (Table 1). The species is recorded from 5 sites within the aforementioned forest complex and probably occurs in additional sites.

Ontario

Burlington Metapopulation

Mottled Duskywing was recorded in 2012 (10 hours search effort) (B. van Ryswyk and R. Curry personal communication to C. Jones 2012; N. Finney personal communication to J. Linton 2012). Surveys over the past 12 years have recorded no record of Mottled Duskywing at three of these sites since 2008 (R. Curry personal communication to L. Packer 2012).

Oakville Metapopulation

One Mottled Duskywing was recorded in 2012. The species has been recorded at only three sites in the past ten years. Search effort at additional historic sites did not record the species. Total recent search effort is unknown but exceeds 18 hours.

Ottawa Metapopulation

Mottled Duskywing was last recorded in 1997 from the Constance Bay area. From 1997 to present (38 hours of search effort) the species has not been recorded and is now considered extirpated despite host plant presence. The Burnt Lands are a large area with numerous sites. The species was recorded in 2003 (one hour search effort, in one of three searches in 2007 (19 hours search effort) and in two of five visits in 2008 (43 hours search effort). Since 2008 (27 hours search effort) the species has not been recorded and habitat quality has substantially declined (C. Schmidt pers. comm. to L. Packer 2012; R. Cavasin pers. communication to C. Schmidt 2012; P. Hall pers. comm. 2009). Additional searches in three suitable habitat sites did not record the host plants. The Ottawa metapopulation may be extirpated.

Pinery Metapopulation

Mottled Duskywing has not been recorded in the Provincial Park since 1990 despite considerable search effort. However, the species was recorded at the nearby Karner Blue Sanctuary in 2003 and “several” individuals have been seen there in the last “couple of years” (B. Kulon pers. comm. to L. Packer 2012). Total search effort is unknown but since 2006 a minimum of 4 hours search effort has occurred (J. Linton pers. data). This site was considered one of two Mottled Duskywing strongholds in Ontario (P. Hall pers. comm. to C. Jones 2012).

St. Williams Metapopulation

Mottled Duskywing was last recorded from this area in 1994. Since this time, there have been 27 hours of search effort and no records. At one time, this area was considered one of two most secure sites in Ontario (P. Hall pers. comm. to C. Jones 2012). Additional yearly search effort (undocumented search time) by local naturalists and University of Guelph entomology students has not recorded the butterfly.

Isolated Sites

Mottled Duskywing may occur at (most recent observation in brackets, with no documented search effort since the initial record): Camp Borden (2007, observed in three person-hours of search), Marmora (2012, observed on three separate visits averaging less than two hours per visit), Alderville (2008, observed in one hour of search).

Mottled Duskywing has not been recorded from the following sites despite recent search effort (most recent record, search effort): Backus Woods (1985, two hours, habitat unsuitable), Bobcaygeon (1931, eight hours), Manitoulin Island (1987, unknown search effort but repeated visits over many years since), Marlbank (1975, one hour), Niagara (2003, unknown), Northumberland Forest (1986, two hours), Stirling (2006, three hours). The species is may be extant in the Stirling and Niagara areas but not likely at the other areas because of a decline in habitat quality.

The habitat at the following sites is no longer considered suitable for Mottled Duskywing: Chaffeys Locks (1964) (this record is considered dubious, C. Schmidt, pers. comm. to L. Packer 2012), Hamilton (date unknown, the vague site collection data could actually refer to one of the potentially extant sites in the Burlington metapopulation), Port Credit (1950), Skunks Misery (1988), St. Joseph (1936) and Toronto (1901).

The following suitable host plant sites for which no historical records are known were searched with no Mottled Duskywing recorded: Rice Lake (three separate populations of the host plant), Foy Provincial Park, a second site at Marmora.

Lastly, 90% of Ontario's alvars have been surveyed during the flight period of Mottled Duskywing with no records (P. Catling pers. comm. to L. Packer 2012). These have each been visited more than once totalling over 1000 hours during which the butterfly would have been recorded if it had been observed. Similarly, P. Catling has searched 50 additional prairie-like habitats over at least 500 hours search effort without recording the butterfly. He had observed the species at two of its historic sites in earlier decades.

Québec

Despite recent search effort, Mottled Duskywing has not been recorded in Québec since 1958 and the butterfly likely no longer occurs in the province (Domaine *et al.*, 2010; C. Schmidt pers. comm. 2012). No searches were made in Québec during preparation of this status report. The host plant can no longer be located at historic sites (R. Layberry and R. Handfield pers. comm. to C. Schmidt 2012).

HABITAT

Habitat Requirements

In Canada, the host plant for Mottled Duskywing is Prairie Redroot (also named Narrow-leaved New Jersey Tea) (*Ceanothus herbaceus*) and New Jersey Tea (*Ceanothus americanus*). Mottled Duskywing is more narrowly and patchily distributed than its host plant range.

In Canada, *Ceanothus* species require dry, sandy or well-drained soils or alvar habitat (Soper and Heimbürger 1982; Layberry *et al.* 1998). *Ceanothus* colonies occur within oak woodland, pine woodland, roadsides, river banks, oak savannahs, shady hillsides, tall grass prairies and alvars, and are always associated with dry, sandy soils.

In Canada, New Jersey Tea is restricted to southern Ontario and southern Québec. The plant is quite common in the deciduous forest region and the Ottawa and St. Lawrence valleys. Prairie Redroot is also found, although less commonly, in southern Ontario near the shores of the Great Lakes, in the Ottawa Valley, the northern end of the Bruce Peninsula, Manitoulin Island, and in the region between Lake-of-the-Woods and Thunder Bay (Soper and Heimbürger 1982). In Québec, Prairie Redroot is restricted to the southern portion of the province that borders Ontario. In Manitoba, Prairie Redroot occurs in small colonies over a wide geographical area within the southeastern portion of the province.

In southeastern Manitoba, suitable Mottled Duskywing habitat may exist over an extensive portion of Sandilands Provincial Forest, Wampum Provincial Forest, and Northwest Angle Provincial Forest where the host plant was observed to occur in scattered, but fairly dense patches. In southern Ontario, *Ceanothus* species can be fairly abundant within a site but limited to isolated and widely dispersed colonies. During the 2007 and 2008 surveys it was observed that fairly small colonies of *Ceanothus* (approximately 20 plants) could support Mottled Duskywing. These observations are likely to be remnants of dwindling populations of butterfly and host plant both of which had been more common in the past: they should not be considered as evidence that 20 plants is sufficient for a sustainable butterfly population. Additionally, the lack of the butterfly at sites where hostplants are common suggests either limited dispersal combined with a lack of repopulation of sites where a population becomes extirpated or that some other limiting factors are in operation.

The Mottled Duskywing is sometimes associated with other imperiled butterflies and their habitats (Swengle and Swengle 1997, Haglund 2006), including Frosted Elfin (*Callophrys irus*) and Karner Blue (*Lycaeides melissa samuelis*), both of which are extirpated in Canada (COSEWIC 2012) and last occurred in one and both, respectively, of the two former habitats with Mottled Duskywing.

Habitat Trends

Mottled Duskywing is closely dependent on habitat that is often prime for development, such as the sandy headlands along the Great Lakes shores (Campbell *et al.* 1990). Habitats for historically known colonies have disappeared, due to development, in several sites in both Ontario and Québec (R. Layberry pers. comm. 2008; P. Hall pers. comm. 2007). The last known record of the Mottled Duskywing from a previously well-known colony in Constance Bay, Ontario was 1997, despite annual searches for it since. The abundance of New Jersey Tea plants around Constance Bay declined over the decade since its last occurrence there (P. Hall pers. comm. 2007). This decline resulted from a combination of succession, extensive deer browsing and development pressures. An attempt at reintroducing a large stand of New Jersey Tea in a clearing at Constance Bay was successful, but the Mottled Duskywing has not returned (P. Hall, pers. comm. 2007).

In some instances, the disappearance of the Mottled Duskywing could be connected to extensive spraying of the area to eradicate Gypsy Moths (*Lymantria dispar*) in the early 1990s (D. Lafontaine pers. comm. 2007) and since then one population has become extirpated in the Burlington metapopulation as a result of this cause (W. Lamond personal communication to C. Jones, 2012). Spraying of herbicides has been observed to kill New Jersey Tea at another known Mottled Duskywing site in the Burlington area (W. Lamond, personal communication to C. Jones, 2012). One small population has been destroyed by building (R. Curry, personal communication to C. Jones, 2012) and at other sites the host plant is being crowded out by succession (H. van Ryswyk and W. McIveen, personal communications to C. Jones, 2012). Each of these factors has caused the extirpation of local populations within the Burlington metapopulation.

Habitat trends at some closely observed extant localities for the species are all negative. In some areas succession is crowding out the remaining host plant (Marmora, Oakville metapopulation, Burlington metapopulation), invasive dog-strangling vine is crowding out the host plant at one site (within the Burlington metapopulation) and too-intense use of fire as a restoration strategy is severely impacting the host plant at Alderville (C. Jones, personal communication to L. Packer, 2011 and 2012).

An additional threat is consumption of host plants by White-tailed Deer. This has been considered to be the major threat to the Mottled Duskywing in the United States (Schweitzer *et al.*, 2011). Deer have had a major impact on at least one Ontario Mottled Duskywing site (R. Curry, personal communication to Colin Jones, 2012). One naturalist reported for a different site that “all the NJ Tea I saw at [the site] had evidence of heavy deer browse, way more than any of the surrounding shrubs” (H. van Ryswyk, personal communication to C. Jones, 2012).

At the Manitoulin Island site the larval hostplant has largely disappeared from the area although this seems not to have been caused by succession or by any obvious anthropogenic disturbance (J. Morton, pers. comm. to A. Dextrase, 2009).

The Marmora site for the species is threatened either by succession or development (C. Jones, pers. comm. 2012): roads are already in place for a subdivision, as is clearly visible in Google Earth.

Throughout southern Ontario, *Ceanothus* populations are considered secure (NHIC 2000a, 2000b) but both New Jersey Tea and Prairie Redroot are declining throughout much of the eastern portion of their ranges and populations of these larval host plants and adult nectaring plants are becoming smaller and smaller. Many populations now contain only a few overgrown plants. The Mottled Duskywing no longer occupies many of its previously known sites. This is a trend that is also being experienced throughout the rest of this species' North American range (NatureServe 2012; Table 2).

Table 2. Conservation status ranks for the Mottled Duskywing (as of 2011) and changes since last assessment in 2008 (NatureServe 2012).

Jurisdiction	2008	2011	Conservation status rank change from 2008 to 2011
Global		G3	
Canada	N2N3	N2	Uplisted to Imperiled
Ontario		S2	
Manitoba	S4S5	S2	Uplisted to Imperiled
Québec		SH	
USA		N3	
Alabama		SU	
Arkansas		S2S3	
Colorado		S2S3	
Connecticut		SX	
Delaware		SH	
District of Columbia		SNR	
Florida		S1	
Georgia		SU	
Illinois		S1	
Indiana		S2S3	
Iowa		S3	
Kansas		S2	
Kentucky		S3	
Louisiana		SU	
Maryland	S1	SH	Uplisted to Possibly Extirpated
Massachusetts		SX	
Michigan		SU	
Minnesota		SU	
Missouri	S4?	S3	Uplisted to Vulnerable
Nebraska		S2	
New Hampshire		SX	
New Jersey	SH	SX	Uplisted to Presumed Extirpated

Jurisdiction	2008	2011	Conservation status rank change from 2008 to 2011
New York	S1S2	S1	Uplisted to Critically Imperiled
North Carolina	S3	S2S3	Uplisted to Imperiled/Vulnerable
Ohio	S1?	SH	Uplisted to Possibly Extirpated
Oklahoma	SNR	S3	Now ranked Vulnerable (status not formerly ranked in state)
Pennsylvania		SH	
Rhode Island		SH	
South Carolina		SNR	
South Dakota		SNR	
Tennessee	(S3S4)	S3	
Texas	(SNR)	S1	Now ranked Vulnerable (status not formerly ranked in state)
Virginia		S1S3	
West Virginia		S3	
Wisconsin		S2	
Wyoming		SNR	

Currently, the Karner Blue Recovery Team, the Canadian Wildlife Service and the Ontario Ministry of Natural Resources are involved in a recovery strategy for the Karner Blue and Frosted Elfin butterflies in Canada. The recovery goals and objectives aim to create enough suitable habitat for these species in three geographically distinct areas (Pinery, St. Williams, and Alderville) so that they can be reintroduced (Government of Canada 2007). These recovery actions, especially involving the restoration of oak savannah and tallgrass prairie habitat which includes planting *Ceanothus* species, should improve the quality and possibly increase the area of habitat for the Mottled Duskywing, which has been recorded at all three sites, but may not persist at the first two. However, the intensity and frequency of burning at Alderville appears to be detrimental to New Jersey Tea (*C. Jones, pers. comm. 2012*).

In Manitoba, extensive areas of habitat have been preserved due to their situation within Provincial Forests that eliminate development pressures and also allow succession processes to occur over a fairly large area. These areas are actively logged which may benefit the Mottled Duskywing by allowing the colonization of Prairie Redroot. However, the dense planting of young Jack Pine in cleared areas counteracts these beneficial effects and is expected to decrease population sizes of the butterfly at all but one currently extant sites in the near future (*H. Flynn, personal communication to L. Packer, 2012*).

BIOLOGY

Life Cycle and Reproduction

Females oviposit single eggs on flower pedicels or other parts of the host plant (Scott 1986). Larvae feed on *Ceanothus* plants inside leaf-nests that they construct by joining leaves together using silk. They overwinter as mature larvae which pupate in April for 2-4 weeks before emerging as adults. The flight period is mid-May to late June throughout the Canadian range (Layberry *et al.* 1998). In extreme southwestern Ontario, a second brood pupates in early July and a second flight period is mid-July to late August (Layberry *et al.* 1998).

Physiology and Adaptability

There is no information on the physiology and adaptability of Mottled Duskywing. The lack of occupancy at suitable host plant suggests that additional limiting factors may govern the species' presence.

Dispersal and Migration

There is no information on the dispersal of Mottled Duskywing. The species is not migratory. Extirpated sites do not appear to become recolonized, suggesting that even moderate and incremental dispersal over ten or more years is unlikely. The large distances between colonies limit the butterflies' ability to re-colonize areas following population loss, which may account for its absence in areas where habitat appears ideal. Along with many other rare butterflies, Mottled Duskywing probably survived in the past through metapopulation structure with individual populations sufficiently near to each other to permit recolonization after extirpation. Such close proximity no longer occurs except perhaps in the Burlington and Oakville metapopulations, and Ontario populations are completely isolated from those the United States (NatureServe, 2012) as they are from those in Manitoba. It is seldom abundant (Layberry *et al.* 1998).

Behaviour

Male Mottled Duskywing "hilltop" or patrol near host plants awaiting females (Scott 1986; Opler and Krizek 1984). Individuals are often seen nectaring on a variety of flowers including *Ceanothus* species or on wet sand in the company of other *Erynnis* species (Layberry *et al.* 1998; Linton 2007 & 2008 unpublished observations). The butterflies are generally observed within close proximity of their host plant and are readily flushed. They fly low to the ground in a fast, erratic pattern making them difficult to identify while in flight.

POPULATIONS SIZE AND TRENDS

Sampling Effort and Methods

Surveys for Mottled Duskywing have primarily been to record or confirm the species' presence within a habitat patch. Surveys have been by wandering transects which follow no set route, and likely target host plant patches.

Abundance

Mottled Duskywing has never been reported as common in Canada (up to 20 individuals being seen by a single person on any one day in recent decades), and within its historical range, has been restricted to small, local colonies where its host plants occur.

Fluctuations and Trends

There are no data on fluctuations, although earlier opinion suggests Mottled Duskywing fluctuated in numbers substantially in Manitoba (R. Westwood pers. comm. 2007); however, the population is generally thought to be more stable now (R. Westwood pers. comm. 2008). Nonetheless, trends throughout the species' range are downward (NatureServe 2012), and in some places strong populations have disappeared (see Habitat Trends). The species has never been reported as common.

Rescue Effect

The potential for rescue effect is considered negligible for the Ontario population but unknown for Manitoba. The Ontario population is no longer considered connected with those in the United States (NatureServe 2012). Adjacent states list the species as extirpated in New Hampshire, possibly extirpated in Pennsylvania and critically imperiled (New York) (NatureServe 2012). For Manitoba the species is unranked in adjacent Minnesota (NatureServe 2012).

THREATS AND LIMITING FACTORS

The metapopulation structure that this butterfly exhibits relies upon intermediate successional stage habitat suitable for growth of its host plant. Consequently, both lack of disturbance and disturbances themselves are detrimental over different time scales. Anthropogenic fragmentation of potentially suitable habitat exacerbates the consequences of both effects. The increased habitat fragmentation brought about by various anthropogenic factors has reduced the species' ability to move among suitable sites, and intrinsic genetic factors brought about by small effective population sizes are undoubtedly in operation as has been shown for other butterflies with similar metapopulation structure (Saccheri *et al.* 1998). Habitat fragmentation is probably the overall most important long-term threat for the species, both within persisting metapopulations and among them. Small isolated populations are at risk of extinction for genetic reasons (Saccheri *et al.* 1998; Frankham *et al.* 2010).

Reported reasons for its decline in the United States include habitat loss due to development, insecticide spraying and deer browsing, with the latter being considered the most serious (NatureServe 2012; Schweitzer *et al.* 2011).

Manitoba

Jack Pine (*Pinus banksiana*) plantations threaten four of the five known metapopulation sites in Manitoba. Logging operations may not significantly impact larval host plants. However, after logging, Jack Pine are planted and quickly shade and out-compete host plants. The Mottled Duskywing population projections suggest a reduction of approximately 70% at these sites (H. Flynn pers. comm. to L. Packer 2012).

The fifth site in Manitoba is subject to flooding at least once per ten years (based on historic weather events) and which extirpates the butterfly (H. Flynn pers. comm. to L. Packer 2012).

Threats at potential Manitoba sites for the Mottled Duskywing are likely similar to those at known sites. Even if the species is found in new sites, habitat decline is likely ongoing simultaneously.

Ontario

Burlington Metapopulation

One site has been lost due to pesticide application, another is threatened by herbicide application that reduced host plant abundance, a third destroyed by urban construction, a fourth is under threat from plant succession and a fifth is under threat from a combination of natural succession, competition by introduced Dog-strangling Vine (*Cynanchum rossicum*) and browsing of the host plant by White-tailed Deer (*Odocoileus virginianus*).

Oakville Metapopulation

Succession is the major threat and in much of this area few host plants persist. Additional threats include the development of a campsite and presence of a bike trail, both contributing to increased site disturbance.

Ottawa Metapopulation

Considered extirpated. Recent threats include the spray of BtK (*Bacillus thuringiensis* variety *kurstaki*) to control introduced defoliator Gypsy Moth (*Lymantria dispar*), host plant browsing by White-tailed Deer and plant succession.

Pinery Metapopulation

The butterfly has disappeared from most of this area but likely persists at the Karner Blue Sanctuary in small numbers.

St. Williams Metapopulation

Likely extirpated from this site, although the threats to the site are not clear.

Isolated Sites

Threats to these sites are not clear. At all sites, the possibility of Btk spray to control Gypsy Moth is possible and browsing of host plants by White-tailed Deer is ongoing. Site-specific threats are:

- Marmora – this site is currently being developed as a subdivision (access roads have already been built). However, even if the development does not occur, this population is unlikely to persist because the host plant is declining due to natural succession (C. Jones pers. comm. to L. Packer 2012). This site is not expected to remain occupied by Mottled Duskywing in the long term, although it was occupied in 2012.
- Alderville – an aggressive burn regime is being applied at this site (to restore habitat) although this is detrimental to the host plant abundance (C. Jones pers. comm. to L. Packer 2012).
- Stirling – vegetation control along this hydro-line may be detrimental to the host plants depending upon the method used. If mowing were to be implemented damage would be minimal, however if herbicide application introduced, herbicide would kill off the host plant.
- Camp Borden – military activities and the potential of Btk spray to control Gypsy Moth are considered the most probable threats at this site.

Number of Locations

Given the diverse nature of the threats and the large number of small sites at some metapopulations, deciding upon an accurate number of locations for Mottled Duskywing using COSEWIC definitions is challenging. The safest approach is likely to consider each metapopulation and isolated population as representing a single location each. Thus, there are at most 9 known recent locations for the species in Ontario (Great Lakes Plains DU) and five locations in Manitoba (Boreal DU). Additional locations may occur within both DUs, but new locations would also be experiencing similar threats and declines.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

In Ontario, the Mottled Duskywing is protected under two provincial statutes: it is listed in Schedule 11 (Specially Protected Invertebrates) under the *Fish and Wildlife Conservation Act, 1997* (S.O. 1997, Chapter 41) and populations in parks are protected under the Provincial Parks and Conservation Reserves Act, 2006 (S.O. 2006, Chapter 12).

In Manitoba, the species is not listed under the provincial *Endangered Species Act*. The species' habitat is protected within provincial forests and parks; however, timber production and habitat management objectives for Mottled Duskywing potentially conflict.

Non-Legal Status and Ranks

The provincial conservation status ranks are imperiled (S2) in Manitoba, imperiled in Ontario (S2) and presumed extirpated in Québec (SH). The Canada national status rank is imperiled/vulnerable (N2N3). Host plants are apparently secure (S4) in Ontario, vulnerable in Manitoba (S3), and imperiled (S2) in Québec (NatureServe 2012).

The United States national status rank is vulnerable (N3) (NatureServe 2012). Individual state conservation status ranks throughout the butterfly's US range are listed in Table 2 (NatureServe 2012).

The global conservation status rank is vulnerable (G3) (NatureServe 2012).

Mottled Duskywing is not listed under the U.S. *Endangered Species Act*.

Habitat Protection and Ownership

In Manitoba (Boreal DU) all recently occupied sites are in Provincial Parks or Forests. These provincial Crown lands are used primarily as a source of sustainable timber (Manitoba Conservation 2009). However, forest management objectives (e.g., forest regeneration) often conflict with the habitat needs (e.g., open habitat that enables host plant growth) and long-term persistence of the butterfly.

In Ontario (Great Lakes Plains DU) five historic sites are within provincial Crown protected areas: Bronte Creek Provincial Park, Burnt Lands Provincial Park, Glenorchy Conservation Area, Pinery Provincial Park and St. Williams Forestry Conservation Reserve. Karner Blue Sanctuary is a private conservation area. Additional nature reserves include Niagara Glen. The species is considered extirpated from Québec.

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Jessica Linton is a Terrestrial and Wetland Biologist employed by Natural Resource Solutions Inc. (NRSI), an environmental consulting firm in Waterloo, Ontario. She graduated from the Environment and Resource Studies Honors Co-op undergraduate program at the University of Waterloo with a specialization in biology. Jessica has studied different aspects of butterfly physiology and ecology for approximately 10 years. She spent 9 months in Costa Rica managing a butterfly and insect education centre before being contracted by the Environment Canada's Ecological Monitoring and Assessment Network to design and pilot a butterfly monitoring program for Canada. In her free time Jessica organizes different butterfly identification and monitoring workshops and seminars for various organizations such as universities, naturalist groups, and nature reserves. She is also a passionate wildlife photographer.

Currently Jessica is working on her Master's degree at the University of Waterloo. Her thesis research is focused on studying how different urban land-uses affect biodiversity, using butterflies as an indicator species.

COLLECTIONS EXAMINED

Specimen and observation records from the following institutions/sources were consulted:

- Canadian National Collection of Insects, Arachnids, and Nematodes at Agriculture, and Agri-Food Canada
- Collection d'insectes du Québec ;
- University of Guelph Insect Collection;
- Museum of Manitoba
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