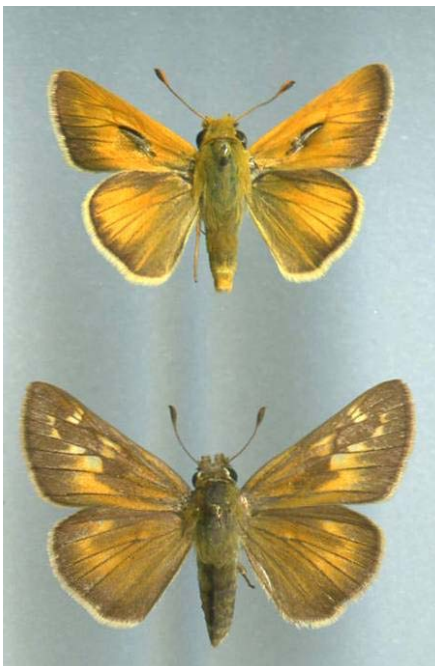
COSEWIC
Assessment and Status Report

on the

Ottoe Skipper
Hesperia ottoe

in Canada



ENDANGERED
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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

COSEWIC 2005. COSEWIC assessment and status report on the Ottoe Skipper *Hesperia ottoe* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 26 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:
COSEWIC would like to acknowledge Dr. Reginald P. Webster for writing the status report on the Ottoe Skipper *Hesperia ottoe* prepared under contract with Environment Canada, overseen and edited by Theresa Fowler, the COSEWIC Arthropods Species Specialist Subcommittee Co-chair.

For additional copies contact:

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

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur de l'hespérie ottoé (*Hesperia ottoe*) au Canada.

Cover illustration:
Ottoe skipper — Male (top) and female (bottom) of *Hesperia ottoe*. Photos provided by the author.

Catalogue No. CW69-14/448-2005E-PDF
ISBN 0-662-40660-5
HTML: CW69-14/448-2005E-HTML
0-662-40661-3


Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
Ottoe Skipper

Scientific name
Hesperia ottoe

Status
Endangered

Reason for designation
This species has been found at very few locations in the Canadian prairies where it is associated with fragmented and declining mixed-grass prairie vegetation. It has recently been found at only one location.

Occurrence
Manitoba

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

COSEWIC
Executive Summary

Ottoe Skipper
Hesperia ottoe

Species information

The Ottoe Skipper is a member of the family Hesperiidae, the Skippers. Skippers differ from other butterflies by having a hook on the end of their clubbed antennae. They are members of the order Lepidoptera (Butterflies and Moths).

The adult Ottoe Skipper has a 29- to 35-mm wingspan. Males and females differ in coloration. Males are yellowish orange with a diffuse brownish border on the upper side of the wings and an elongated dark mark (called the brand) on the front wing. The underside is uniform, pale yellowish-orange. Females lack the brand and are dull brown with pale buff markings on the upper side of the front wings. The underside of the wings is pale orange and usually without spots.

The whitish eggs are hemispherical in shape and about 1.3 mm in diameter. The larvae are greenish brown with a dark brown head and a black prothorax (the first segment behind the head). Caterpillars attain a length of 20-25 mm when fully grown.

Distribution

The Ottoe Skipper occurs in isolated populations from southern Manitoba southward to Michigan and Texas and westward to Colorado. In Canada, the Ottoe Skipper was recorded from three localities in southern Manitoba.

Habitat

The Ottoe Skipper is an obligate resident of upland, dry, mixed-grass (bluestem) prairies and sand prairies. It does not occur in true tall-grass prairies.

Biology

Each life history stage of the Ottoe Skipper has its specific resource requirements. There is only one adult generation per year. Adults are active for only a six- to seven-week period, usually from mid- to late June to mid-August. Individual adults may live as long as three weeks.

Adult females usually mate within one or two days after emerging from the chrysalis. They begin laying eggs on the second or third day after emergence. Eggs

are usually laid singly on the undersides of leaves of the caterpillar host plants or on the flowerheads of purple coneflowers. Ottoe Skipper caterpillars eat a variety of grass species, all of which are characteristic of their native prairie habitats.

Caterpillars go through six or seven stages, or instars, before forming a chrysalis. During the fourth instar, the larvae stop feeding (usually in late September) and enter an obligatory diapause (a form of hibernation). They pass the winter in this stage, resume feeding in spring, complete development during June or July, and form a chrysalis. Adults emerge two and a half weeks later.

Population sizes and trends

Since the 1950s, over 99% of the mixed-grass and sand-prairie habitat of the Ottoe Skipper in North America has been degraded or converted to agricultural uses.

In Canada, only a small proportion of prairie habitats remain. The distribution of the Ottoe Skipper in North America is fragmented. In Canada, this skipper has only been found in three places in southern Manitoba. The species has not been found at two of these locations since the 1920s. At the third site, the Ottoe Skipper was present in the 1980s but was not found in surveys conducted in 2002 and 2003. It is possible that the Ottoe Skipper no longer occurs in Canada.

Limiting factors and threats

The Ottoe Skipper lives only in mixed-grass and sand-prairie habitats. It is extremely susceptible to any disturbances, such as over-grazing, wild fires, inappropriate prescribed burning, row crop agriculture and mining, which alter the floral and structural components of its preferred habitat. Key adult and caterpillar food resources must be present in the habitat for the long-term survival of this insect. Both the flower species preferred by adults for nectaring and the grass species preferred by the caterpillars for food are characteristic of native prairie habitats and rarely occur in agricultural habitats, making these habitats completely unsuitable for the Ottoe Skipper.

Special significance of the species

The Ottoe Skipper is one of a very small group of specialist butterflies that occur only in mixed-grass and sand-prairies in Canada. This species was last recorded at one site in Canada in the late 1980s.

Existing protection or other status designations

The Ottoe Skipper currently has no legal protection in Canada at the national level. However, it is listed as endangered under Manitoba's Endangered Species Act. In the United States, the Ottoe Skipper receives no federal protection under the US Endangered Species Act. It is considered critically imperiled in two states, imperiled in eight states, vulnerable in one state, and is unranked in four states.

COSEWIC HISTORY

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

COSEWIC MANDATE

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

COSEWIC MEMBERSHIP

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

DEFINITIONS (NOVEMBER 2004)

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

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

Environment Canada | Environnement Canada
Canadian Wildlife Service | Service canadien de la faune
Canada

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

COSEWIC Status Report

on the

Ottoe Skipper

Hesperia ottoe

in Canada

2005

TABLE OF CONTENTS

List of figures

SPECIES INFORMATION

Name and classification

Hesperia ottoe W.H. Edwards, or the Ottoe Skipper, is a member of the family Hesperiidae, the Skippers, subfamily Hesperiinae, the Branded Skippers, and the order Lepidoptera, the Butterflies and Moths. No subspecies are recognized (Layberry *et al*. 1998).

Description

Hesperia ottoe has a wingspan between 29 and 35 mm (Layberry et al. 1998). The upper side of the wings of adult males is yellowish orange with a diffuse brownish border on the forewing (Figure 1). There is a dark, elongated mark, called the stigma, on the forewing of the male. The stigma has a black interior felt patch and contains androconial scales (these contain a male sex pheromone). The underside of the wings is pale yellowish orange without the medial spots (macular band) on the hind wing that are often present on *Hesperia* species.

The upper side of the wings of adult females is dull brown with pale buff markings (Figure 1). There are usually one or two round, translucent, whitish (hyaline) spotS on the front wing among the pale buff band of markings. The size of this translucent spot varies from one individual to the next. Females do not have a stigma on the front wing. The underside of the wings is pale orange (like in males) and there are usually no medial spots on the hind wing, although a few females may have a trace of these spots. Excellent illustrations of adults are given in Layberry *et al.* (1998) (Plate 2, figures 14-15) and in Howe (1975) (Plate 89, figures 7-8). The genitalia are illustrated in McCabe and Post (1977) (figure 57).

Males of *H. ottoe* may be confused with the Dakota Skipper (*Hesperia dacotae* Skinner), the Leonard's Skipper (*H. leonardus pawnee* Dodge), and the Plains Skipper (*Hesperia assiniboia* Lyman). *Hesperia dacotae* is smaller than *H. ottoe*. Both sexes of *H. l. pawnee* and *H. dacotae* usually have a faint band of spots on the underside, although in some males of *H. dacotae* this band is nearly absent. Males of *H. l. pawnee* have yellow interior felt in the stigma, and females have a squarish translucent forewing spot on the upper side. *Hesperia assiniboia* is darker above and has a slightly greenish ground colour on the under side. *Hesperia l. pawnee* and *H. assiniboia* fly a few weeks later than *H. ottoe*, usually in August and early September (Layberry *et al.* 1998).

The eggs (basal diameter 1.31 mm, height 1.0 mm) are hemispherical in shape and have a smooth surface. They are gleaming white when first laid and turn duller white to creamy yellow after two days (Dana 1991). The larva is greenish brown with a dark brown head and black prothorax. Larvae probably attain a length of 20-25 mm when fully grown. No technical descriptions of the immature stages have been published (Layberry *et al*. 1998).

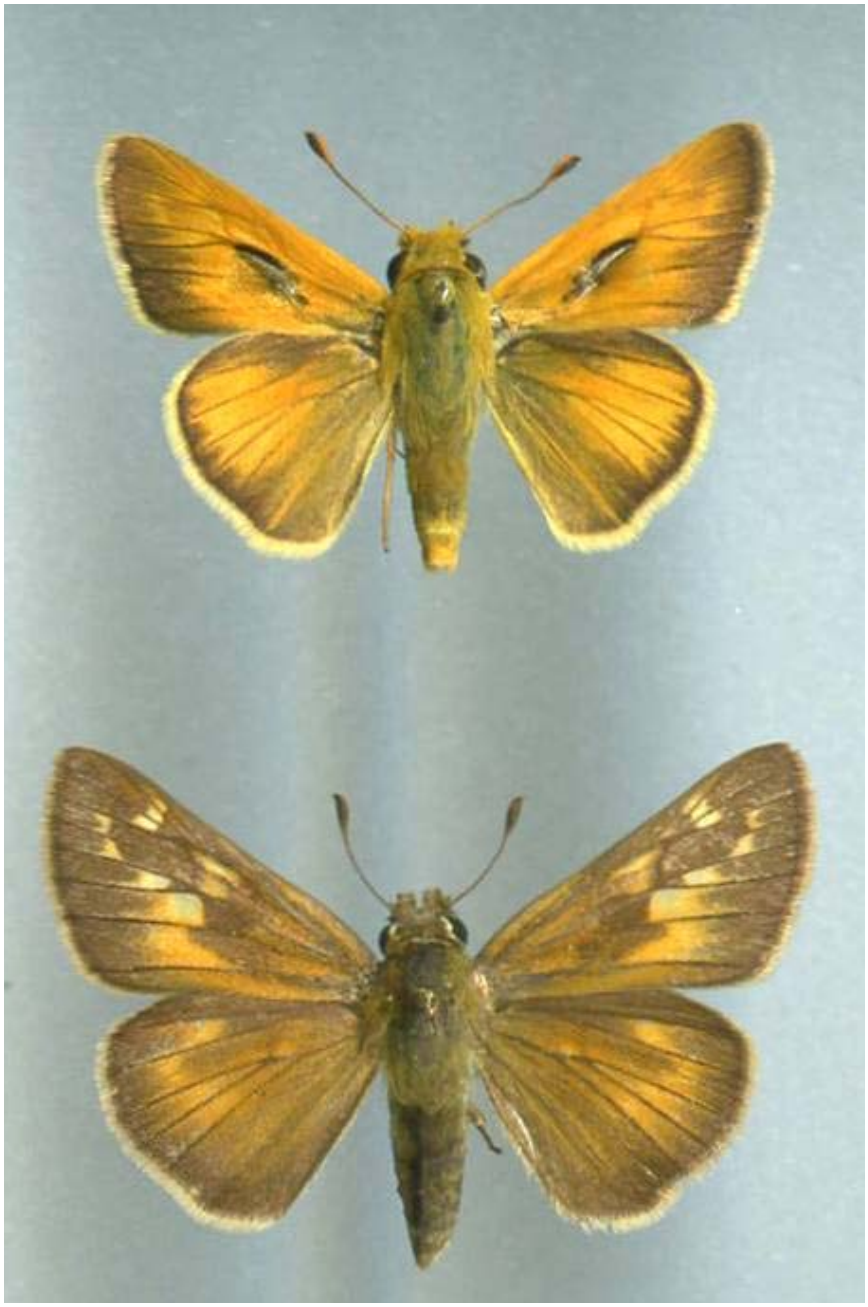


Figure 1. Male collected in Iowa (top) and female collected in Michigan (bottom) of *Hesperia ottoe*.

DISTRIBUTION

Global range

Hesperia ottoe ranges from southern Manitoba southward to Michigan and Texas and westward to Colorado in mixed-grass prairies and sand prairies (Dana 1991, Opler and Malikul 1992) (Figure 2).

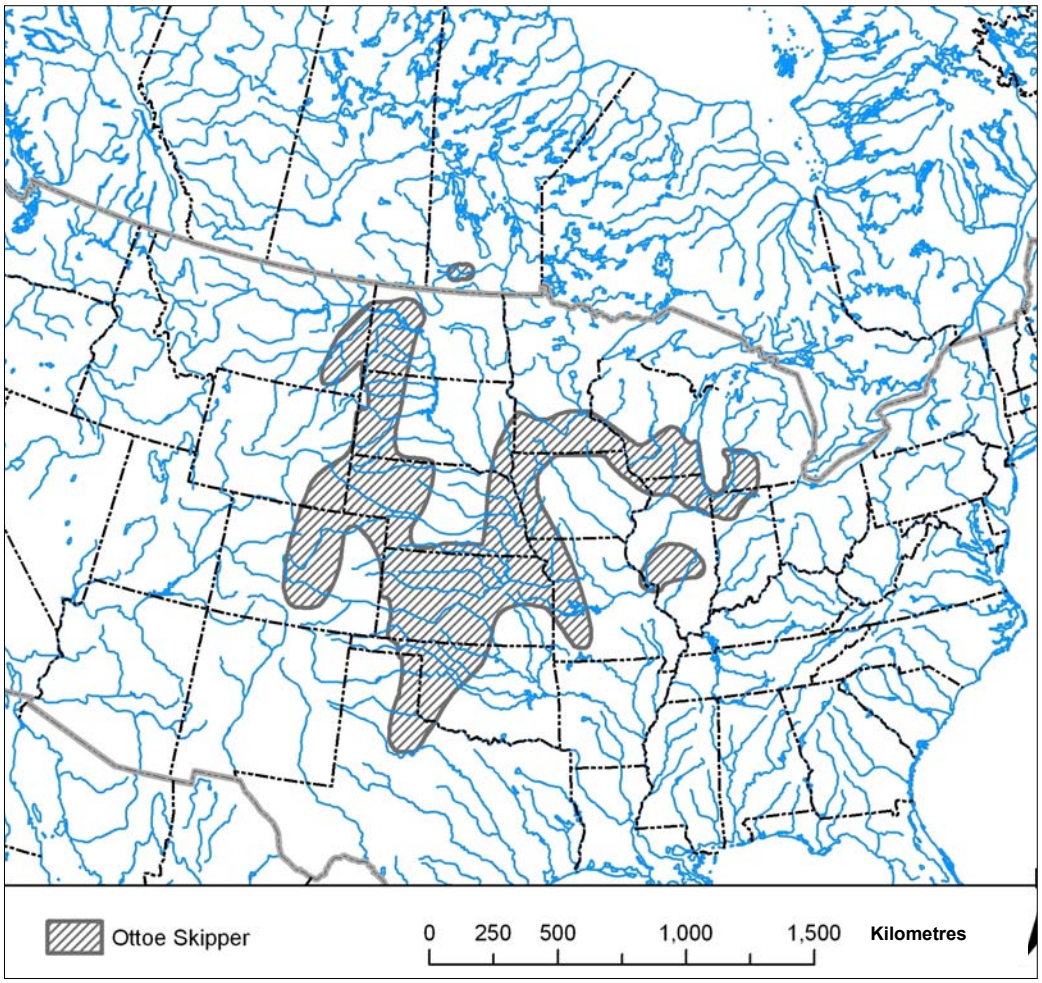


Figure 2. Global range of *Hesperia ottoe*.

Canadian range

In Canada, *H. ottoe* is known from only three localities in southern Manitoba. *Hesperia ottoe* was first recorded in 1921 from the “Aweme” area (about 10 km north of Wawanesa) (CNC collection database: Manitoba Conservation, Biological and Conservation Data System data). There is also a record with no collection data from Rounthwaithe (CNC collection database) and another record from Spruce Woods Provincial Park from the late 1980s (Klassen et al. 1989, Westwood, pers. com. 2003) (Figure 3).

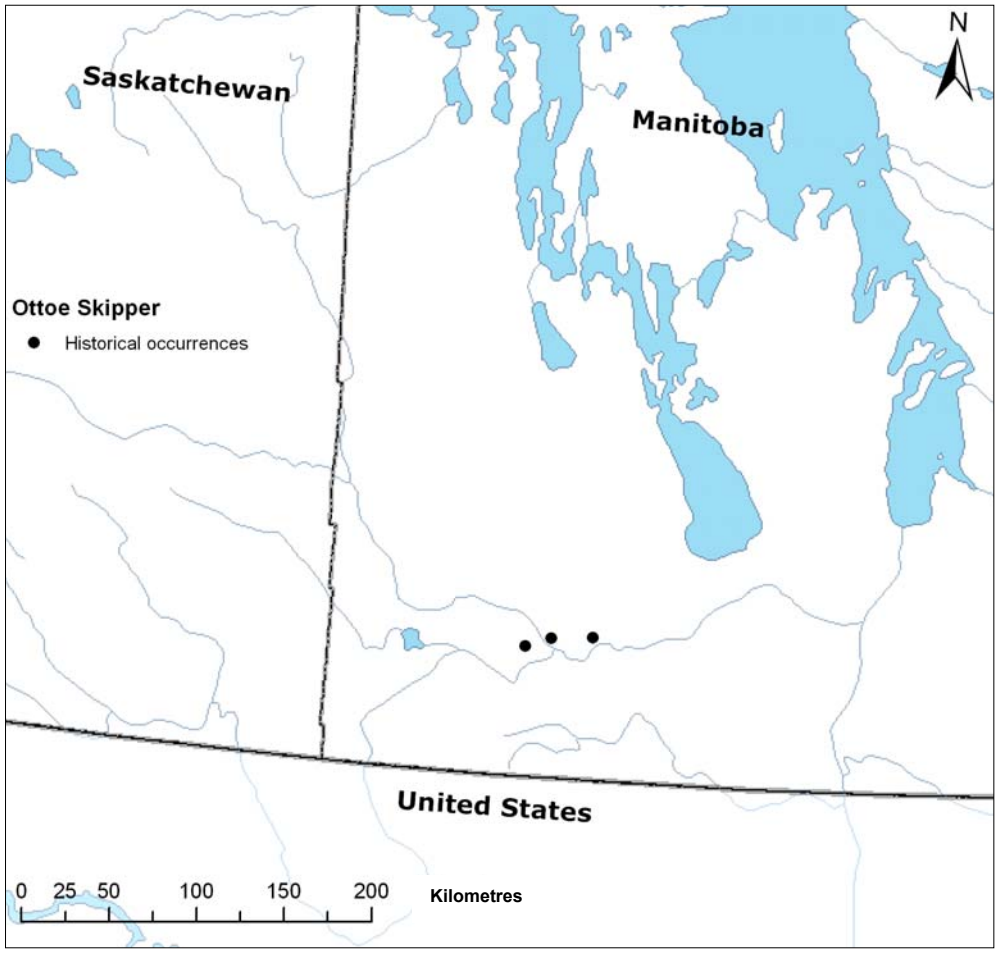


Figure 3. Canadian range of *Hesperia ottoe*.

HABITAT

Habitat requirements

In Canada, *H. ottoe* is (or was) an obligate resident of upland, dry, mixed-grass (bluestem) prairies and sand prairies. In the United States, this skipper occurs in similar

types of prairies, often those with topographic relief (Dana 1991, Swengel and Swengel 1999, NatureServe 2003). *Hesperia ottoe* does not occur in true tall-grass prairie, and females were never observed ovipositing in mesic parts of mixed-grass prairies (Dana 1991).

In Spruce Woods Provincial Park, the sand and mixed-grass prairies occur as 1- to 20-ha openings among spruce (*Picea* sp.) and Bur Oak (*Quercus macrocarpa*) groves. The terrain in these areas is generally hilly and the prairies often occur on the hills (formerly sand dunes). Bunch grasses, such as Little Bluestem (*Andropogon scoparius*), are common on the higher ground, while Big Bluestem (*A. gerardii*) is more common in lower areas or at the bases of the prairie hills. Cactus (*Opuntia* sp.) and Wild Onion (*Allium* sp.) occur on some of the drier sites. Wild Bergamot (*Monarda fistulosa*) and Snowberry (*Symphoricarpos albus*) are common along the margins of the prairie openings. Similar vegetation is present at the other mixed-grass/sand prairie sites near Aweme. Purple coneflower (*Echinacea angustifolia*) is rare at Aweme, but frequent in the small, remnant, mixed-grass prairies west of Shilo. This flower was not observed at Spruce Woods Provincial Park during 2003.

Trends

The historical distribution of *H. ottoe* in North America will never be precisely known as much of the mixed-grass prairie and sand prairie habitats had been severely degraded by overgrazing or converted to row crop agriculture before any surveys for this and other prairie insects were initiated.

In Manitoba, most mixed-grass prairie and sand prairie sites outside of Spruce Woods Provincial Park, including those at Aweme, have been degraded by overgrazing and invasion of exotic plants. Most prairie sites west of Shilo have been converted to row crops, such as potatoes, or are being mined for gravel. The remaining areas of relatively intact mixed-grass prairie are very small; it is doubtful they could support populations of *H. ottoe*. Relatively undisturbed sand prairie habitats that could potentially support a population of *H. ottoe* still exist in Spruce Woods Provincial Park. However, this skipper, which was first reported from the park in the 1980s, was not found during a five-day survey of the park in 2003. It is possible that the skipper was missed because this survey may not have been conducted at the optimal time of year (Duncan, pers.com. 2005).

Protection/ownership

The single site where *H. ottoe* was last recorded is in Spruce Woods Provincial Park. The Aweme site is now protected in the Criddle/Vane Homestead Provincial Park managed by Manitoba Wildlife.

BIOLOGY

General

Like other butterflies, *H. ottoe* undergoes complete metamorphosis with adult, egg, caterpillar, and pupal stages. Each stage often has different resource and microhabitat requirements.

Adult activity period

Hesperia ottoe has only one generation per year. Adults are present for six to seven weeks, usually from mid-June to mid August, depending on the season (McCabe and Post 1977, Layberry *et al.* 1998, Nielsen 1999, Swengel and Swengel 1999). In Canada, adults have been collected in late July and mid-August (CNC collection database, Manitoba Conservation, Biological and Conservation Data System data; Klassen *et al*. 1989).

In a study by Dana (1991), *H. ottoe* males began to emerge in field plots five to six days earlier than females. The delay was expected as the duration of post-diapause development is longer in female larvae than in males (Dana 1991). Although protandry (males emerge before females) occurs in this species, emergence was protracted (21 days) in both sexes, resulting in considerable overlap in the emergence period of the two sexes (Dana 1991). In field plots, adults emerged over a 28-day period starting in early July. Dana (1991) estimated the potential adult life span of *H. ottoe* in nature to be around three weeks.

Adult food resources

Access to nectar is important to *H. ottoe* and other species of butterflies. Nectar provides adults with an energy source as well as water and allows females to attain maximal fecundity (Murphy *et al.* 1983).

No observations of nectaring are available for Canadian populations of *H. ottoe*. In a dry-mesic bluestem prairie in Minnesota (Hole-in-the-Mountain Prairie), Dana (1991) observed *H. ottoe* nectaring on ten species of flowers. The most frequently used species have relatively concealed nectar. In order of usage, these were Purple coneflower (*E. angustifolia*), Hoary Vervain (*Verbena stricta*), a thistle (*Cirsium flodmanii*), and a milkweed (*Asclepias viridiflora*) (Dana 1991). However, over 90% of all flower visitations were to *E. angustifolia*. In North Dakota, Fleabane (*Erigeron strigosus*) and Long-headed Coneflower (*Ratibida columnifera*) were the most common nectar sources of *H. ottoe* (McCabe 1981). Swengel (1994) observed *H. ottoe* on 16 species of flowers in Wisconsin. Most visits were to Wild Bergamot (*M. fistulosa*) and Blazingstar (*Liatris* sp.). *Hesperia ottoe* is probably opportunistic, foraging on the species of flowers that are most profitable at a given site.

Few of the above plant species were present at any of the historical sites for *H. ottoe*, although *M. fistulosa* was common in Spruce Woods Provincial Park.

Echinacea was not present in the park, was rare at Aweme, and was frequent in the small, remnant, mixed-grass prairies west of Shilo. Other potential nectar sources, such as Snowberry (*S. albus*) were common on the edges of mixed-grass prairie openings, especially in Spruce Woods Provincial Park. *Symphoicarpos albus* was frequented by many butterfly and skipper species.

In Minnesota, freshly emerged males of *H. ottoe* were frequently observed puddling on muddy margins of stock ponds and on gravel roads after rain (Dana 1991). The adults were likely obtaining nutrients (mineral salts, amino acids) and water from these sites (Arms *et al.* 1974, Adler and Pearson 1982).

Courtship behaviour

No information is available on mating behaviour of populations *of H. ottoe* in Canada. However, detailed descriptions of the courtship behaviour of this species are provided by Dana (1991) from populations in Minnesota. Mate-seeking behaviour dominates the daily flight period of male *H. ottoe* and the mating system appears to be a form of scramble competition polygyny (Dana 1991).

Most commonly, courtship is of the waiting-perching-pursuit type. Males often perch on high vantage points above the grass canopy, such as the flower heads (capitula) of composites (*E. angustifolia*), and pursue any insects that fly nearby (Dana 1991). In hilly terrain, males often perch on hill and ridge tops. When a male encounters another male during the initial pursuit, the pursuit often develops into an aerial engagement with the two individuals whirling about each other, often to considerable heights, before the engagement is broken off (Dana 1991). *Hesperia ottoe* males often did not return to the same perch sites, as would be typical of territorial behaviour (Dana 1991).

If a male encounters a female *H. ottoe*, a different set of behaviours ensues. Perching males attempt to mate with any females that move within their visual range. Typically, the female flies a short distance and lands. The male pursues her, lands and quickly walks alongside her while curving his abdomen with claspers spread toward the abdomen of the female and attempts to copulate with her (Dana 1991). If receptive, the female extends her abdomen and they mate. If the male is rejected, the female holds her abdomen between closed wings and periodically jerks her wings forward. Unsuccessful males may attempt to mate a few additional times before flying to a nectar source (Dana 1991). Pheromones contained in androconial particles in the stigmata of males probably play a role in courtship and as a species isolating mechanism (Dana 1991).

A form of mate seeking or searching type behaviour is also often observed in *H. ottoe*. In this behaviour, males fly rapidly from one *E. angustifolia* capitulum to another, exhibiting a brief “bobbing” flight pattern near each capitulum without landing. Only one encounter of a male exhibiting this behaviour with a female was observed and a standard courtship sequence ensued.

Most mating attempts take place from late morning (10:00 h) to as late as 17:00 h. The peak number of pursuits, however, was observed between 14:00 and 16:00 h (Dana 1991). No data are available on the duration of copulation. If a mating pair is disturbed, it may take flight and travel several metres in a direct flight path. The female is the carrier in *H. ottoe* (Dana 1991).

All observed copulations were with freshly emerged females (unworn), suggesting females mate within a day or two of adult emergence (Dana 1991). It is not known if males and females mate more than once during their life span.

Oviposition behaviour and fecundity

Females do not start laying eggs until at least 36 hours after emerging (mature oocytes were not present in the ovaries until 36 hours after adult emergence) (Dana 1991). Once females commence laying eggs, oviposition continues throughout much of the female's 3-4 week lifespan (Dana 1991). However, few data are available on daily egg production in this species. Based on the number of distinguishable oocytes in a young female, the potential lifetime fecundity was estimated to be around 225 eggs per female (Dana 1991).

In the USA, female *H. ottoe* lay eggs on a wide variety of grasses and forbs (Dana 1991). In a study at the Hole-in-the-Mountain Prairie in Minnesota, females oviposited on five species of grasses and several species of forbs (Dana 1991). The most common species of grasses used for oviposition, in decreasing order of usage, were *A. scoparius*, *A. gerardii*, *Bouteloua curtipendula*, and *Dichanthelium wilcoxianum*. Most of these grasses are also larval host plants. However, 50% of all observed ovipositions were on the capitula of purple coneflower (*E. angustifolia*).

Females ovipositing on grasses place eggs singly to the underside of leaves or the upper surface of erect grass blades, usually within the grass canopy (Dana 1991). Females fly slowly above the grass canopy and land on bare spots before crawling into the grasses. After laying an egg, the female flies to a new site.

Females laying eggs on the capitula of *E. angustifolia* fly rapidly and directly to a capitulum (the catpitula are usually much higher than the grass canopy), feed on the flower, then curl their abdomen down and affix a single egg on the outward-facing convex underside of a receptacular bract, and then fly to a new capitulum (Dana 1991). This behaviour is often repeated several times in succession, and oviposition occurs throughout the day (Dana 1991).

Larval resources

H. ottoe larvae use a variety of grass species. In Minnesota, larvae were found feeding on *A. scoparius, B. curtipendula, A. gerardii and D. wilcoxianum* (Dana 1991). Other common grasses, like *Koeleria cristata* and *Stipa spartea,* were not eaten, although they were consumed in no-choice experimental conditions (Dana 1991).

Larvae generally feed on all grass species close to their shelters, excluding the avoided species (Dana 1991). Nielsen (1958) reported the grass *Leptoloma cognatum* as a host in Michigan, and McGuire (1982) reported ovipositions on *A. scoparius* from several locations within the skipper's range.

The preferred host of *H. ottoe* in Minnesota was Little Bluestem (*A. scoparius*) (Dana 1991*).* Bunch grasses, like *A. scoparius*, have a dense cluster of erect blades and a mass of persistent basal material that remains edible throughout the summer and into the fall. MacNeill (1964) suggests that the architecture of these grasses makes them ideal for shelter construction by the larvae and provides a readily available food source close to the shelter. Although other species of grasses can be eaten by the larvae, some may not be suitable because of different architecture (too tall) or summer senescence (Dana 1991). The non-native *Poa pratensis* and Smooth Brome Grass (*Bromus inermis*), although eaten under laboratory conditions, have a mid-summer senescence, or dormancy, making them unsuitable for the larvae of *H. ottoe* later in the summer and early fall.

Larval development

The eggs of *H. ottoe* hatch within 12-13 days depending on temperature (Dana 1991). *Hesperia ottoe* has six to seven instars or larval stages. Each of the first three instars lasts between 7 and 26 days under field conditions. The duration of the fourth instar is between 14 and 36 days and growth often becomes slowed (Dana 1991). Larvae enter an obligatory diapause during the fourth instar, which occurs in late September or October in Minnesota (Dana 1991). During the subsequent spring, the fifth-instar larvae moult shortly after feeding resumes. The duration of the next two instars is 8-13 days and 17-25 days, respectively. Once feeding is completed, the last-instar larvae moult into the pupal stage, which lasts 12-19 days under natural conditions (Dana 1991).

Larval behaviour

Typically, newly eclosed larvae of *H. ottoe* first eat the chorion before constructing a leaf shelter (Dana 1991). Those on the capitula of *E. augustifolia* drop to the grass canopy. Newly hatched larvae construct shelters by fastening two or three grass blades together from the points of divergence from the stem of a vegetative shoot of the host, forming a narrow tube with the distal portion of the blades remaining free. The shelters are usually several centimetres above the soil surface. The larvae feed on the free distal portions of the blades forming the shelter and deposit their frass in the lower end (Dana 1991). Feeding takes place both diurnally and nocturnally. The larvae abandon the shelter (which is about 6 cm long) when its lower end fills with frass, and construct a new one. Two to three leaf blade shelters are constructed before constructing a buried shelter in late August or early September in which the larvae diapause (Dana 1991). The buried shelter is at, or entirely below, the soil surface and consists of a steeply angled tubular chamber lined with silk within a clump of one or more of the host grasses (Dana 1991). After diapause, the larvae produce two or three elongated horizontal shelters on the soil surface. These shelters are often concealed by the basal material of

the grass clump (Dana 1991). Prior to pupation, the larvae construct a new chamber, which is not waterproof, unlike the waterproof chambers of *H. dacotae* (Dana 1991).

Larvae in the buried shelters typically leave their chambers, cut off and remove grass blade segments, carry them back to their chambers, and feed on them within the chambers (Dana 1991). They forage on those grass species that are in close proximity to their shelters (Dana 1991).

Natural mortality factors

Few data are available on natural mortality factors for *H. ottoe*. A small proportion of ova on the capitula of *E. augustifolia* are parasitized by *Trichogramma* sp. (Hymenoptera: Trichogrammatidae) and a scelionid wasp (Hymenoptera: Scelionidae) (Dana 1991). Damsel bugs (Hemiptera: Nabidae) may also consume this skipper's eggs (Dana 1991). An *Apanteles* wasp (Hymenoptera; Braconidae) was reared from cocoons found in leaf shelters, and a soft-winged flower beetle larva (Coleoptera; Melyridae) was found feeding on a second-instar larva in a leaf blade shelter (Dana 1991).

Dana (1991) hypothesized that *H. ottoe's* preference for laying eggs on *E. angustifolia* capitula might be related to reducing the risk of the ova and early instar larvae being consumed by grazing ungulates, such as bison. He observed that cattle tend to avoid these stems when they have sufficient forage. *Echinacea angustifolia* may also be an indicator of the presence of good larval host plants (Dana 1991).

Population dynamics

Little information is available on the long-term population trends for *H. ottoe* in Canada or the United States. It is possible that the species is extirpated from Canada.

Movements/dispersal

Little information is available on the dispersal of *H. ottoe* in Canada or the United States. In a mark-release-recapture experiment at the Hole-in-the-Mountain preserve in Minnesota, marked adults moved across 200 m of unsuitable habitat between two sections of prairie (Dana 1991). This skipper is a powerful flier and should be capable of covering large distances for a skipper. Anecdotal evidence from Dana (pers. com. 2004) suggests that this species may move at least 3 km over unsuitable habitat. A female was collected in a small (2 hectares) prairie fragment in Minnesota (without a previously known population) which was 3 km from the closest potential source population (the site had appropriate habitat, but had not been surveyed). The closest known population is about 95 km away. It is likely that this observation represents a dispersal event (or the offspring of one).

Because of the long periods between Canadian records and the species' apparent ability to cross relatively large areas of unsuitable habitat, there is some uncertainty as to whether *H. ottoe* is a Canadian resident species. Some researchers think that the

few scattered occurrences in Canada may represent cases of vagrancy (Lafontaine, pers. com. 2004, Webster, pers. com. 2005). However, there is considerable evidence suggesting that the specimens recorded in Canada were residents: because extant *H. ottoe* populations in the US are highly local and generally uncommon, they are an unlikely source for vagrants, which tend to come from large populations; the closest known population of *H. ottoe* is about 200 km to the southwest, too great a distance for a small skipper, even a strong flier, to be likely to cover; all Canadian records occur in the same general area of Manitoba, an unlikely scenario for vagrants, which would be likely to show up in widely separated sites; and vagrants would likely occur as single specimens, but all Canadian records involve at least two individuals. In addition, *The Butterflies of Canada* (Layberry *et al.* 1998) and *The Butterflies of Manitoba* (Klassen *et al*. 1989) both treat *H. ottoe* as a Canadian species. In the absence of convincing evidence to the contrary, *H. ottoe* is considered a Canadian resident, an approach consistent with the Species at Risk Act.

Interspecific interactions

No data are available on interspecific interactions of *H. ottoe* for Canadian populations. In Minnesota, Dana (1991) observed that interactions with males of other species outnumbered those with conspecifics. However, the interspecific interactions were shorter than those with other males of *H. ottoe*.

Adaptability

Hesperia ottoe is extremely susceptible to habitat changes and is rarely found in prairie habitats that have been degraded (McCabe and Post 1977, Dana 1991). Although the immature stages and adults can use a variety of plant species for growth and reproduction, they appear to use only species associated with undisturbed prairie habitats. Alteration of this plant community results in the loss of critical resources for the skipper and the loss of the skipper from altered sites. The continued fragmentation of suitable prairie habitats into progressively more widely dispersed remnants make *H. ottoe* especially susceptible to habitat degradation.

POPULATION SIZES AND TRENDS

Few data are available on population sizes and trends at any sites where *H. ottoe* was previously known in Canada. In the Canadian National Collection, there are two male *H. ottoe* collected on July 27, 1921 and two females collected on August 12, 1926 from the “Aweme” area (CNC collection database: Manitoba Conservation, Biological and Conservation Data System data). There is also a record from Rounthwaithe, with no collection data (CNC collection database). *Hesperia ottoe* was not reported again in Canada until the late 1980s, when a few individuals were collected by Richard Westwood in Spruce Woods Provincial Park (Klassen et al. 1989, Westwood, pers. com. 2003). Unfortunately, these specimens could not be located. The paucity of records since its original discovery suggests that this species has always been very rare in Canada.

Hesperia ottoe was not found at any of the previously known localities during a 7-day survey in 2003 (Figure 4). In the United States, *H. ottoe* and *H. dacotae* often co-occur on mixed-grass prairie areas (Dana 1991). However, H. ottoe was not observed at any of the Canadian sites surveyed for *H. dacotae* during 2002 (Figure 4). It is possible that *H. ottoe* no longer exists in Canada. However, since the habitat in Spruce Woods Provincial Park where this skipper was last reported appears to be relatively undisturbed, it is possible that the species still exists there or in the surrounding areas. Population numbers of most skipper species appeared to be very low in Manitoba in 2003 (compared to 2002), possibly due to drought conditions that had prevailed in the region since the winter. *Hesperia ottoe* may not have been detected because the population numbers may have been low. More surveys are needed before it can be concluded that the species is extirpated at this site and in Canada.

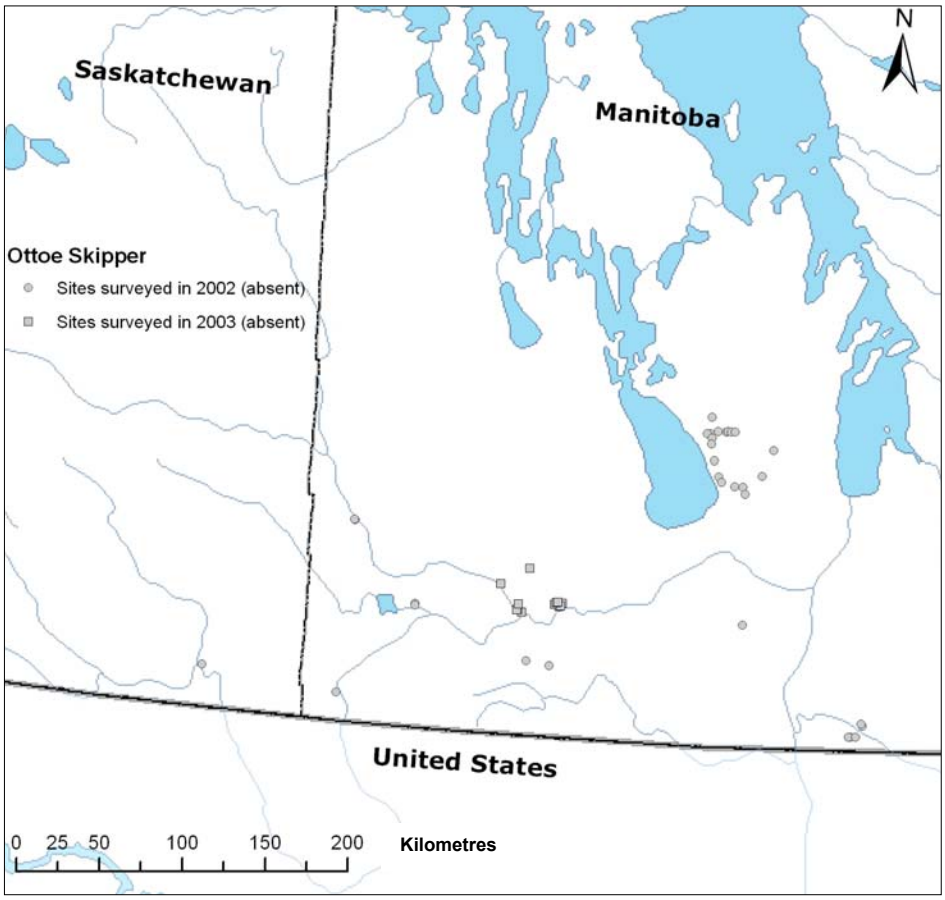


Figure 4. Survey sites for *Hesperia ottoe* in 2002 and 2003.

Little information is available on population sizes and trends for *H. ottoe* in the United States. Although *H. ottoe* is widely distributed in the United States, it is generally highly local and generally uncommon to rare at most sites (Dana 1991, Dana, pers.

com. 2004, NatureServe 2003). In North Dakota, all records for this species obtained by McCabe and Post were single individuals, and no two captures were made within 48 km of each other (McCabe and Post 1977).

LIMITING FACTORS

Hesperia ottoe lives only in dry-mesic mixed-grass (bluestem) and sand prairie habitats. It is extremely susceptible to any habitat changes that alter the floral and structural components of its preferred habitat. Key adult and larval food resources must be present in the habitat for the long-term survival of this species.

Nectar flowers

Regular access by adults to nectar is probably critical to the survival of adult *H. ottoe*. Nectar provides carbohydrates needed to meet the energetic needs for flight and allows females to attain maximal fecundity (Murphy et al. 1983). Without a readily available source of nectar, lifetime fecundity would likely be reduced, thereby reducing the number of potential offspring in the next generation. Nectar also provides water, which may be the most critical resource for adult *H. ottoe* in the prairie habitat where free water is often absent (Dana 1991). *Hesperia leonardus pawnee* Dodge inadvertently deprived of water while confined in field cages died within a few hours on a hot, windy day (Dana 1991).

Although *H. ottoe* is a relative generalist, it has preferred species of flowers for nectaring (Dana 1991). Flower preference varies regionally, in part related to the relative abundance of the flower species in the habitats where the skipper lives. Among the preferred nectar flowers in the United States are *E. angustifolia* and *V. stricta*, characteristic components of undisturbed, native, mixed-grass prairie habitats in Canada and the United States. No data are available on nectar flowers used by Canadian populations of *H. ottoe*.

Male *H. ottoe* also puddle (Dana 1991) and may be obtaining mineral salts and water (Arms et al. 1974, Adler & Pearson 1982).

Larval host plants

The larvae of *H. ottoe* feed on a variety of grass species in nature (Nielsen 1958, McGuire 1982, Dana 1991). The preferred host grasses of *H. ottoe* are bunch grasses, such as little Bluestem (*A. scoparius*) and *B. curtipendula* (Dana 1991). All host grasses are late-maturing species that have a dense cluster of erect blades and a mass of persistent basal material that remains edible throughout the summer and into the fall (Dana 1991). These grass species are characteristic of undisturbed native prairie habitats in North America.

THREATS

Conversion of habitat to non-grassland

Since the 1850s, over 99% of native prairie habitat has been ploughed, converted to agricultural row crops or hay fields, or degraded by overgrazing (Samson and Knopf 1994). Agricultural habitats are completely unsuitable for the survival of *H. ottoe*. Many mixed-grass and sand prairie remnants have probably survived because poor soils (sandy) or steep terrain make them unsuitable for row-crop agriculture. However, most mixed-grass prairie sites west of Shilo have been recently converted to potatoe fields or are currently being mined for gravel.

Grazing

Mixed-grass- and sand-prairie specialist butterflies, such as *H. ottoe* and *H. dacotae*, appear to be very susceptible to the effects of overgrazing (McCabe and Post 1977, Royer and Marrone 1992, Royer and Royer 1998, Swengel 1998a, Swengel and Swengel 1999), which reduces or eliminates critical adult nectar resources and removes forage for larvae. Trampling by cattle may kill larvae and cause soil compaction. These factors make overgrazed habitats unsuitable for the skipper (McCabe and Post 1977). Dana (1997) further observed that exotic grasses, such as *P. pratensis* and *B. inermis*, become the major or dominate species, and native species richness and diversity declines.

Although overgrazing can potentially eliminate populations of *H. ottoe*, grazing is not always detrimental (Dana 1991, Swengel 1998b). Light rotational grazing can be beneficial by creating or maintaining areas of mixed-grass vegetation structure which is preferred by this skipper (Dana 1991). Swengel (1998b) observed that a lightly grazed prairie in Wisconsin had relatively high richness of prairie specialist butterflies, especially compared to burned or idle sites.

Haying

Haying may either be detrimental or beneficial to *H. ottoe* populations depending on when in the season it is done. If mowing is done before or during the adult flight period, the critical adult nectar sources are eliminated and exotic grasses such as *P. pratensis* are favoured (McCabe 1981, Dana 1997). This situation can cause the elimination of *H. ottoe* from the prairie. Haying later in the summer when *H. ottoe* larvae are feeding within the aerial leaf shelters may also be detrimental to the skipper. In contrast, late-season (late September into October) mowing when the larvae have entered their buried shelters at the soil surface (Dana 1991) reduces the adverse effects created by mowing early and may even be beneficial to *H. ottoe* and other prairie specialists (McCabe 1981, Skadsen 1997, Swengel and Swengel 1999). Mowing prairies and removing the cuttings helps to maintain the vegetation structure by preventing or delaying succession to woody plants and reducing the accumulation of litter on the soil.

Controlled burning and wildfires

Wildfires were an important element for sustaining the flora and fauna of native prairies prior to their destruction (Bragg 1995). Now, prescribed or controlled burns are often used by managers to maintain the native grassland structure and floral complexes. These burns differ from wildfires in that remnant prairies are often burned far more frequently (sometimes once every three years), more thoroughly (sometimes border to border), and at times during the season when wildfires would not normally occur (Orwig and Schlicht 1999). Although prescribed burns may be beneficial for maintaining the prairie flora and certain insect species, they may be devastating to other species of insects (Swengel 2001). Prescribed burning of isolated prairies can cause local extirpations of some insect species, especially habitat specialists such as *H. ottoe*, *H. dacotae* and *Oarisma poweshiek* (Parker) (McCabe 1981, Schlicht and Saunders 1994, Swengel 1996, 1998b, 2001, Orwig and Schlicht 1999). Prior to the destruction of the prairies, burns were patchy, which allowed re-colonization of burned sites by skippers from adjacent unburned areas (Swengel 1998b). Now, there are often no source populations available for re-colonization once a population has been locally extirpated. In Minnesota prairies, significantly lower abundances of *H. ottoe* and other habitat specialists were observed at sites that had been burned than at sites that had been hayed (Swengel and Swengel 1999, Swengel 1996, 1998b). Dana (1991) suggested that rotational, controlled, early spring burning might benefit H. ottoe by increasing nectar plant density and reducing high levels of litter that might negatively impact the development of immature stages. It was suggested that early spring burning would have less impact on the larvae than late spring, summer or fall burning, because the larvae would still be within shelters at or below the soil surface. However, two to four years after early spring burning, the abundances of *H. ottoe*, *H. dacotae*, and several other habitat specialist butterflies were still lower than pre-burn abundances on several Minnesota reserves (Swengel 1996), showing that early spring burning is a major threat to these species.

Currently, controlled burns are not being done in Spruce Woods Provincial Park. However, wildfires started in the Shilo Military Base to the west of the park periodically burn into the park and could negatively impact the *H. ottoe* and other insect species should large areas of the park burn.

Succession

Prairies that are protected from all activities, such as grazing, mowing or prescribed burns, can become unsuitable for *H. ottoe* because of the growth of woody shrubs and taller grasses, accumulation of litter, reduction in nectar sources, and invasion of exotic plants, such as *B. inermis* (McCabe 1981, Dana 1991, Dana 1997).

It appears that some form of disturbance is required for the persistence of prairie habitat that is appropriate for this skipper. In view of the detrimental effects of prescribed burning, probably the best solution for preventing succession is mowing in the late summer or in the fall. McCabe (1981) suggests that the optimal time for

mowing is in October. Mowing at this time has no apparent negative impact on the tall-grass prairie flora or fauna. The Hook and Bullet Refuge in Minnesota has been maintained in this way for over 50 years (McCabe 1981). However, because of high topographic relief, haying may not be feasible on many of the mixed and sand-prairies where *H. ottoe* occurs. Small controlled rotational burns early in the spring may be the only solution for maintaining the flora and fauna at these sites. Prior to the colonization of the prairies by Europeans, most prairie habitats were maintained by periodic grazing by bison and occasional prairie fires. Since much of the habitat was suitable for *H. ottoe*, adults were able to re-colonize adjacent suitable habitats when forced to leave areas made temporarily unsuitable by grazing or fires. The suitable habitats that now remain are too widely separated to allow for re-colonization, and must be maintained by artificial means (McCabe 1981).

Exotic species

Exotic plants, such as Leafy Spurge (*Euphorbia esula* L.), Kentucky Blue Grass (*P. pratensis*), and Smooth Brome *(B. inermis*), are significant threats to native prairie habitats in North America. Once these exotic species invade a site, they can out-compete and replace the native plants required for the survival of *H. ottoe* and other prairie specialists. *Hesperia dacotae* was probably eliminated from at least one site in North Dakota as a direct result of the invasion of *E. esula* (Royer and Royer 1997). Because of early senescence, *P. pratensis* and *B. inermis* are unsuitable for the larvae of *H. ottoe* (Dana 1991). Grasslands that become dominated by these species cannot support this skipper. Chemical control of *E. esula* often eliminates the nectar sources required by this skipper and may have caused the extirpation of *H. dacotae* from several sites in North Dakota (Royer and Marrone 1992). *Euphorbia esula* was abundant on mixed-grass prairies near Aweme and is invading Spruce Woods Provincial Park. Nectar sources were eliminated in 2004 near the Criddle Estate (Aweme) in Manitoba as a direct result of chemical control of *E. esula.*

Habitat fragmentation

Originally, *H. ottoe* probably existed as essentially a single population throughout much of the almost continuous mixed-grass prairies in the north- and south-central plains of North America. Now it occurs as a series of isolated populations throughout much of its former range (NatureServe 2003). In Canada, only one population may still exist, and none of the known Canadian sites is closer than 150 km to population centres in the United States. The closest population in North Dakota is considered imperiled (S1) (NatureServe 2003). There is only a very remote probability that any one of the Canadian population centres where the species formerly occurred could be re-founded by natural dispersal after being eliminated. Small isolated populations of this species are also at a greater risk of becoming extirpated by unusual weather events or other accidental events (Hanski et al. 1996).

Collection of natural history specimens

Collection of natural history specimens may pose a threat to this species because population numbers are very low (assuming the species is still present in Canada). However, skippers are generally not as popular with most collectors as are other, more showy species of butterflies. In Manitoba, it is currently illegal to collect specimens of *H. ottoe* without a scientific permit.

SPECIAL SIGNIFICANCE OF THE SPECIES

Hesperia ottoe is one of a very small group of specialist butterflies that occurs only in native mixed-grass and sand prairie habitats in Canada. This species now occurs in a series of isolated populations in the United States and may occur at one site in Canada. The loss of this species from Canada will be the loss of an element of the endangered prairie ecosystem.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Hesperia ottoe currently has no legal protection in Canada at the national level. However, *H. ottoe* is listed as endangered by the Province of Manitoba under its Endangered Species Act. Under this provincial law, it is unlawful to kill, injure, possess, disturb or interfere with the species. It is also unlawful to disturb or destroy its habitat or any natural resources it depends on for its life or propagation without a permit.

Although *H. ottoe* receives no federal protection under the US Endangered Species Act, a status report is being prepared for the US Fish and Wildlife Service. NatureServe (2004) ranks the species G3; N1 in Canada; S1? in Manitoba; S1 in Indiana; S1S2 in Michigan; S2 in Colorado, Illinois, Iowa, Minnesota, South Dakota and Wisconsin; S2S3 in Kansas, Missouri and Montana; S3 in Nebraska; and SNR (unranked) in North Dakota, Oklahoma, Texas and Wyoming.

SUMMARY OF STATUS REPORT

Hesperia ottoe is found only in upland mixed-grass and sand prairie habitats. It is extremely susceptible to disturbances that alter the floral and structural components of its preferred habitat. This skipper was probably more widespread in southern Manitoba in the past. Over 99% of its habitat has been converted to row crops or severely degraded by over-grazing, and only about 300 km^2 of mixed-grass and sand prairie now remains. *Hesperia ottoe* was last recorded in Canada during 1986 from Spruce Woods Provincial Park. This skipper was not found during a recent survey of prairie habitats in Manitoba and Saskatchewan. It is possible that *H. ottoe* no longer exists in Canada.

TECHNICAL SUMMARY

Hesperia ottoe
Ottoe Skipper *Hespéri Ottoé*
Manitoba

Extent and Area information	
• *extent of occurrence (EO)(km²)*	Small, may be 0
• *specify trend (decline, stable, increasing, unknown)*	N/A or likely declining
• *are there extreme fluctuations in EO (>1 order of magnitude)?*	Unlikely
• *area of occupancy (AO) (km²)*	Small, may be 0
• *specify trend (decline, stable, increasing, unknown)*	N/A or likely declining
• *are there extreme fluctuations in AO (>1 order magnitude)?*	Unknown
• *number of extant locations*	Maximum one site, possibly extirpated
• *specify trend in # locations (decline, stable, increasing, unknown)*	N/A
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Continuing to decline
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	One year
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	Unknown, may be 0, but very small if species is extant
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Unknown, species possibly extirpated from Canada
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	Unknown, may be N/A
• *are there extreme fluctuations in number of mature individuals (>1 order of magnitude)?*	Unknown for Canadian populations
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤1 successful migrant / year)?*	Yes, if still extant
• *list each population and the number of mature individuals in each*	Aweme - extirpated Rounthwaithe - extirpated Spruce Woods Provincial Park - may be extirpated
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Past declines, currently unknown, may be N/A
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	Unlikely

Threats (to populations or habitats)	
Actual threats: habitat loss and degradation from invasion by exotic plant species and their control (*Euphorbia esula* is invading Spruce Woods Provincial Park, the last site in Canada where *H. ottoe* may be extant.) Potential threats: habitat loss and degradation due to: conversion to row crops mining for gravel overgrazing controlled burning haying at inappropriate time of year succession habitat fragmentation	
Rescue Effect (immigration from an outside source)	Low
• *does species exist elsewhere (in Canada or outside)?*	Yes
• *status of the outside population(s)?*	Threatened or in decline
• *is immigration known or possible?*	Highly unlikely
• *would immigrants be adapted to survive here?*	Likely
• *is there sufficient habitat for immigrants here?*	No
Quantitative Analysis	**Not peformed**
Current Status COSEWIC: Endangered (May 2005)	

Status and Reasons for Designation

Status: **Endangered**	**Status Criteria**: B1ab(iii)+2ab(iii)
Reasons for Designation: This species has been found at very few locations in the Canadian prairies where it is associated with fragmented and declining mixed-grass prairie vegetation. It has recently been found at only one location.	
Applicability of Criteria **Criterion A**: Not applicable as there is insufficient information on population size and declines. **Criterion B**: Meets criterion B1ab(iii)+2ab(iii) for endangered. In Canada, its extent of occurrence and area of occupancy are both very small (EO<<5,000 km², AO<<500 km²), and it possibly exists at one location with continuing habitat decline. **Criterion C**: Likely meets criterion C2a(i,ii) for endangered. If extant, the total population is much less than 2,500 mature individuals, with a continuing decline inferred based on habitat decline, combined with population fragmentation where no population is likely larger than 250 mature individuals and all individuals are in one population. **Criterion D**: Likely meets criterion D1 for endangered. There are likely fewer than 250 mature individuals. **Criterion E**: Insufficient data to perform analysis.	

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Acknowledgements

Jason Greenall (Manitoba Wildlife) and Annabelle Jessop (Canadian National Collection) provided collection records for the Ottoe Skipper. Access to collections was provided by Donald Lafontaine (Canadian National Collection), Robert Roughly (University of Manitoba) and Robert Robbins (Smithsonian Institution). Invaluable information on, and related to, the Ottoe Skipper was graciously supplied by Robert Dana, Philip Delphey, Timothy McCabe, Ronald Royer, Stephen Spomer, Scott and Ann Swengel, Peggy Westorpe and Richard Westwood. James Duncan, Gordon Jones, Jack Dubois and William Watkins (Manitoba Conservation) provided assistance in securing the necessary collection permits, maps of Manitoba, and other invaluable assistance with this project. Alain Filion (Canadian Wildlife Service) provided the maps used in this report. Theresa Fowler provided many helpful comments and served as coordinator and editor of this report. I thank Marie Andrée Giguère for assistance in preparing the figure of *H. ottoe*.

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

Authorities contacted

Dana, Robert. November 2002, February 2004. Natural Heritage and Nongame Research Program, Minnesota Department of Natural Resources, 500 Lafayette Rd., Box 25, St. Paul, MN 55155-4025.

Delphey, Phillip. October 2002. U.S. Fish and Wildlife Service, Twin Cities Field Office, 4101 E. 80th Street, Bloomington, MN 55425.

Duncan, James. February 2002 and May 2005. Acting Chief, Program Manager for the Insect Species Group, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg MB R3J 3W3.

Greenall, Jason. March 2002. Botanist/Ecologist, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg MB R3J 3W3.

Jessop, Annabelle. February 2002. Biodiversity Section, Eastern Cereal and Oilseed Research Centre, K.W. Neatby Building, 960 Carling Ave., Ottawa, Ontario.

Lafontaine, J. Donald. October 2001 and September 2004. Research Scientist and Curator of Lepidoptera, Biodiversity Section, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, K.W. Neatby Building, 960 Carling Ave., Ottawa, Ontario.

McCabe, Timothy. March 2002. Curator, New York State Museum, Cultural Education Center, Room 3132, Albany, N.Y. 12230-0001.

Roughley, R. March, July 2002. Entomologist, Department of Entomology, University of Manitoba, Winnipeg, MB, Canada R3T 2N2.

Royer, Ronald. October 2002. Division of Science, Minot State University, 500 University Avenue West, Minot, ND 58707, Tel: (701) 858-3209.
Spomer, Stephen M. March 2002. Entomologist, University of Nebraska, Lincoln, Institute of Agriculture & Natural Resources, Department of Entomology, 202 Plant Industry, Lincoln, NE 68583-0816.
Swengel, Scott. November 2002. 909 Birch St. Baraboo, WI 53913.
Watkins, William. April, July 2003. Program Manager for the Insect Species Group, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg MB R3J 3W3.
Westhorpe, Peggy L. July 2003. Habitat Stewardship Manager, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg MB R3J 3W3.
Westwood, Richard. October 2002, May 2003. Co-author of "The Butterflies of Manitoba", Centre for Forest Interdisciplinary Research & Departments of Biology and Environmental Studies, University of Winnipeg, Winnipeg, MB R3B 2E9.

INFORMATION SOURCES

Adler, P.H. and D.L. Pearson. 1982. Why do male butterflies visit mud puddles? Canadian Journal of Zoology 60: 322-325.
Arms, K., P. Feeny and R. Lederhouse. 1974. Sodium: stimulus for puddling by tiger swallowtail butterflies, *Papilio glaucus*. Science 185: 372-374.
Bragg, T.B. 1995. The physical environment of Great Plains grasslands. Pp. 49-81 in Joerm, A. and K.H. Keeler. The Changing Prairie: North American Grasslands. Oxford University Press, Oxford, UK. 244 pp.
Dana, R.P. 1991. Conservation management of the prairie skippers *Hesperia dacotae* and *Hesperia ottoe*: basic biology and threat of mortality during prescribed burning in spring. Minnesota Agricultural Experiment Station Bulletin 594-1991 (AD-SB-5511-S). University of Minnesota, St. Paul. 63 pp.
Dana, R.P. 1997. Characterization of three Dakota skipper sites in Minnesota. Unpublished report, Minnesota Department of Natural Resources, Natural Heritage and Nongame Research Program, St. Paul, MN. December, 22, 1997. 17 + pp.
Hanski, I.A., A. Moilanen and M. Gyllenberg. 1996. Minimum viable metapopulation size. American Naturalists 147:527-541.
Howe, W.H. 1975. The Butterflies of North America. Doubleday & Company, Inc. Garden City, New York. xiii + 633 pp.
Klassen, P., A.R. Westwood, W.B. Preston and W.B. McKillop. 1989. The Butterflies of Manitoba. Winnipeg: Manitoba Museum of Man and Nature. 300 pp.
Layberry, R.A., P.W. Hall and J.D. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press, Toronto, Ontario. 280 pp.
MacNeill, C.D. 1964. The skippers of the genus *Hesperia* in western North America, with special reference to California (Lepidoptera: Hesperiidae). Univ. Calif. Publ. Entomol. 35:1-230.

McCabe, T.L. 1981. The Dakota skipper, *Hesperia dacotae* (Skinner): range and biology, with special reference to North Dakota. Journal of the Lepidopterists' Society 35:179-193.
McCabe, T.L. and R.L. Post. 1977. Skippers (Hesperoidea) of North Dakota. North Dakota Insects Pub. No. 11, North Dakota State University, Agricultural Experimental Station, Fargo, North Dakota.
McGuire, W.W. 1982. New oviposition and larval hostplant records for North American *Hesperia* (Rhopalocera; Hesperiidae). Bulletin of the Allyn Museum 72: 1-6.
Murphy, D.D., A.E. Launer and P.R. Ehrlich. 1983. The role of adult feeding in egg production and population dynamics of the checkerspot butterfly *Euphydryas editha*. Oecologia 56:257-263.
NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.8. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
Nielsen, M.C. 1958. Observations of *Hesperia pawnee* in Michigan. Lepidopterists' News. 12:37-40.
Nielsen, M.C. 1999. Michigan butterflies and skippers: A field guide and reference. Michigan State Univ. Ext., East Lansing. 248 pp.
Opler, P.A. and V. Malikul. 1992. A Field Guide to Eastern Butterflies. Houghton Mifflin Co., Boston. 396 pp.
Orwig, T. and D. Schlicht. 1999. The last of the Iowa skippers. American Butterflies. 7(1):4-12.
Royer, R.A. and G.M. Marrone. 1992. Conservation status of the Dakota skipper (*Hesperia dacotae*) in North and South Dakota. Unpublished report, U.S. Fish and Wildlfie Service, Denver, CO. 15 March 1992. 44 + pp.
Royer, R.A. and M.R. Royer. 1998. Report on an inventory of habitat and occurrence of Dakota skipper [*Hesperia dacotae* (Skinner 1911)] in the Towner-Karlsruhe Habitat Complex (McHenry County, North Dakota) during 1998. Unpublished report, Division of Science, Minot State University, and U.S. Fish and Wildlfie Service, St. Paul, MN, December 1, 1998. 25 + pp.
Samson, F. and F. Knopf. 1994. Prairie conservation in North America. Bioscience (6):418-421.
Schlicht, D. and M. Saunders. 1994. Completion of status surveys for the Dakota skipper (*Hesperia dacotae*) and the Poweshiek skipper (*Oarisma poweshiek*) in Minnesota (with additional data on the regal fritillary (*Speyeria idalia*). Unpublished report, Minnesota Department of Natural Resources, Natural Heritage and Nonegame Research Program, St. Paul, MN. July 29, 1994. 22 + pp.
Skadsen, D.R. 1997. A Report on the results of a survey for Dakota skipper [*Hesperia dacotae* (Skinner 1911)] in northeast South Dakota during 1997 and 1997 flight periods, Unpublished report, South Dakota Department of Game, Fish, and Parks. Pierre, SD, December 31, 1997. 34 + pp.
Swengel, A.B. 1994. Skipping over the prairie: Dakota and Ottoe skippers fly free. American Butterflies 2(2):4-9.
Swengel, A.B. 1996. Effects of fire and hay management on abundance of prairie butterflies. Biological Conservation. 76-73-85.

Swengel, A.B. 1998a. Effects of management on butterfly abundance in tallgrass prairie and pine barrens. Biological Conservation. 83:77-89.
Swengel, A.B. 1998b. Comparisons of butterfly richness and abundance measures in prairie and barrens. Biodiversity and Conservation 7: 1639-1659.
Swengel, A.B. 2001. A literature review of insect responses to fire, compared to other conservation managements of open habitat. Biodiversity and Conservation 10:1141-1169.
Swengel, A.B. and A.R. Swengel. 1999. Observations of prairie skippers (*Oarisma poweshiek. Hesperia dacotae, H. ottoe, H. leonardus pawnee,* and *Atrytone arogos iowa*) (Lepidoptera: Hesperiidae) in Iowa, Minnesota, and North Dakota during 1988-1997. The Great Lakes Entomologist. 32(4):267-292.
Webster, R.P. 2004. COSEWIC status report on Dakota Skipper *Hesperia dacotae* (Skinner). Committee on the Status of Endangered Wildlife. 35 pp.

BIOGRAPHICAL SUMMARY OF REPORT WRITER

Reginald P. Webster is currently working as a private consultant. He holds a PhD degree in Entomology from the Department of Entomology, Michigan State University. He has authored or co-authored over 20 scientific publications, including recent papers on the life history of the endangered Maritime Ringlet butterfly and a description of a new species of moth. He has also authored numerous reports on the biology, ecology and population structure of the Maritime Ringlet. He taught courses in Population Biology and Ethology at the University of New Brunswick. Since 1999, Dr. Webster has been doing surveys of rare and endangered butterflies for the Maine Department of Inland Fisheries & Wildlife. During the past 10 years, he has been conducting inventories of butterflies, moths and selected families of beetles (mostly Carabidae) at several sites in New Brunswick. He is currently a member of the Arthropods Specialist Subcommittee of COSEWIC.

COLLECTIONS EXAMINED

Canadian National Collection, Ottawa, Ontario (visited during February 2002), the University of Manitoba Collection, Winnipeg, MB (visited during July 2002), and the Smithsonian Institute (National Museum of Natural History), Washington DC (visited during April 2002).