

The Butterflies (Lepidoptera) of an Isolated Island: Monhegan, Maine

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Abstract - Repeated surveys of the butterflies of Monhegan Island, ME, from 1998 to 2018 confirmed the presence of at least 40 species. This total represents more than 42% of the state's recorded species—a high proportion given the island's small size and isolation. The rate of discovery indicates that, based on observations accumulated over time, about 50 species could be observed on Monhegan, including large migratory taxa as well as a variety of habitat-limited sedentary residents. The absence of several mainland species can be attributed to limited habitat and lack of some plant species. Records show changes in the butterfly fauna over recent decades; further changes may be expected because of climate warming, habitat modification, and stochastic events.

Introduction

Islands typically support fewer species than same-sized areas on the mainland (MacArthur and Wilson 1967). Island residents must survive with a limited range of habitats, and non-resident visitors are species with high dispersal ability; small islands also experience high extirpation rates along with reduced immigration (MacArthur and Wilson 1967). In accord with island biogeographic theory, fewer butterfly species have been found on islands that are smaller and more distant from the mainland than on those that are larger and closer to mainland sites (see Miller [1984] for a study of the California Channel Islands and Dennis et al. [2008] for studies of European islands).

The small size and isolation of Monhegan, an island 16 km off the coast of Maine, and personal familiarity with the island spurred this study of its butterfly fauna. In this paper, the name Monhegan refers to Monhegan Island rather than the Monhegan Plantation, a civil entity that includes Monhegan Island and the adjacent small island, Manana. Little information has been reported about Monhegan butterflies previously. An early record stated the presence of *Papilio glaucus* L. (Eastern Tiger Swallowtail), *Pieris rapae* (Cabbage White), *Lycaena phlaeas* (American Copper), *Phyciodes tharos* (Drury) (Pearl Crescent), *Nymphalis antiopa* (Mourning Cloak), and *Polites themistocles* (Tawny-edged Skipper) (Maynard 1909), although the correct species would likely have been *Papilio canadensis* (Canadian Tiger Swallowtail) for the swallowtail and *Phyciodes cocyta* (Northern Crescent) for the crescent (as listed in Table 1).

Consequently, I surveyed the butterflies on Monhegan periodically from 1998 through 2018 to answer the following questions. How many of the species known on the mainland (within the state of Maine) can be found on the island? What taxa

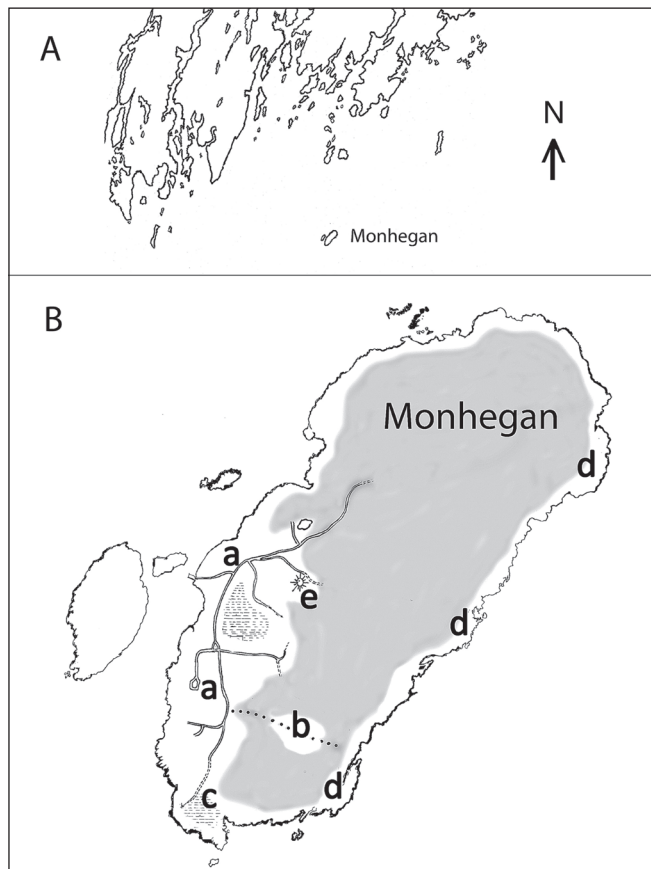
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found on the mainland are absent on Monhegan, and can their absence be attributed to missing host plants or habitats? How might the butterfly community have changed over time?

Field-Site Description

Monhegan is a small island (3 km long and 1 km wide; 270 ha in area) located 16 km off the mid-coast of Maine (43.77°N, 69.32°W) and next to Manana Island (5 ha; Fig. 1A). Monhegan's small size limits the diversity of habitats and potential host plants. About 70% of the island is forested (as shown in Fig. 1B), largely with *Picea glauca* (Moench) Voss (White Spruce) and *P. rubens* Sargent (Red Spruce), in addition to some *Abies balsamea* (L.) Mill. (Balsam Fir), *Acer rubrum* L. (Red Maple), *A. pensylvanicum* L. (Striped Maple), *Populus tremuloides* Michaux (Quaking Aspen), *Betula papyrifera* Marshall (White Birch), *B. alleghaniensis* Britton (Yellow Birch), and *Alnus viridis crispa* (Aiton) (Green Alder) (Harris 2014, Rand et al. 2004, Tolonen 1983). Open habitats are uncommon, although there is an interior wet fen, and, within the village on Monhegan, some gardens and lawns. Other open areas occur along the Underhill Trail, a wetland near the shore at Lobster Cove

Figure 1. Monhegan Island, ME. (A) The relationship of the island to the mid-coast of Maine, 16 km distant. (B) Monhegan Island, 3 km long, showing roads and 2 wetlands, with the shaded area indicating forest cover (the adjacent small island is Manana). Habitats for butterflies are shown as: (a) Monhegan village, (b) Underhill trail through second growth, (c) Lobster Cove wetland, (d) open edges along the eastern cliffs, and (e) open area around the lighthouse.



(southeastern end), along the exposed outer coast, and around the lighthouse (open meadow is common on the small, adjacent island of Manana). These habitats are marked on Figure 1B. Monhegan is not near the mainland coast; the distance over water limits possible immigration, and the island is exposed to oceanic conditions.

In the years since the first human settlements on Monhegan, the vegetation has been altered by lumbering, fire, agriculture, and the introduction of non-native plants (Tolonen 1983). From the 1930s through the 1950s, most of the island was protected from development, which has led to the current extensive forest cover. Indirect changes in the vegetation took place with the introduction of *Odocoileus virginianus* (Zimmerman) (White-tailed Deer) in 1955 and their subsequent elimination by 1999 (Rand et al. 2004). Further vegetative changes may occur in response to the current warming climate. Currently, most of the island (200 ha) is undeveloped and preserved by an island land trust (Monhegan Associates, Inc. 2018).

Methods

I compiled records of butterflies from collected voucher specimens, documentary photographs, and direct sightings during a series of 3–5-d stays (once per year) on Monhegan. The visits took place during 13 of the 21 years from 1998 through 2018 and occurred across the growing season from May to September. The resultant 13 surveys provide records of the butterfly community on the island. The surveys were not standardized observations, e.g., Pollard walks (Pollard and Yates 1993), but resulted from frequent explorations of the island's habitats and extensive trails. I supplemented these data with a small butterfly collection on display in the Monhegan Museum, and solicited additional records from other observers who have spent time on the island (listed in the Acknowledgments). I have noted each species in the complete list (Table 1) as recorded by voucher (V),

Table 1. The 47 species of butterflies recorded on Monhegan Island from surveys and reports through 2018. The record for each species is noted as: V = voucher (31 species), P = photograph (9 species), S = sighting by the author (3 species), and SO = sighting reported by others (4 species). Abundance is noted by: A = abundant, C = common, O = occasional, and R = rare. The status of each species is modified for Monhegan from the Maine Butterfly Survey (2016): BR = breeding resident; TC = frequent temporary colonist; RC = rare temporary colonist; RS = rare stray. The names correspond with those used on the Maine species list (Maine Butterfly Survey 2016). [Table continued on following page.]

Scientific name	Common name	Record	Abund.	Status
Family Hesperidae				
<i>Ancyloxypha numitor</i> (Fabricius)	Least Skipper	V	O	BR
<i>Carterocephalus palaemon</i> (Pallas)	Arctic Skipper	V	O	BR
<i>Epargyreus clarus</i> (Cramer)	Silver-spotted Skipper	S	R	RC
<i>Euphyes vestris</i> (Boisduval)	Dun Skipper	V	R	BR
<i>Hesperia sassacus</i> Harris	Indian Skipper	V	O	BR
<i>Poanes hobomok</i> (Harris)	Hobomok Skipper	V	C	BR
<i>Polites mystic</i> (W.H. Edwards)	Long Dash Skipper	V	C	BR
<i>Polites peckius</i> (W. Kirby)	Peck's Skipper	V	C	BR
<i>Polites themistocles</i> (Latreille)	Tawny-edged Skipper	V	C	BR
<i>Thymelicus lineola</i> (Ochsenheimer)	European Skipper	V	O	BR

Table 1, continued.

Scientific name	Common name	Record	Abund.	Status
Family Lycaenidae				
<i>Celastrina lucia</i> (W. Kirby)	Northern Azure	V	C	BR
<i>Celastrina neglecta</i> (W.H. Edwards)	Summer Azure	V	C	BR
<i>Cupido comyntas</i> (Godart)	Eastern Tailed Blue	V	C	BR
<i>Feniseca tarquinius</i> (Fabricius)	Harvester	P	R	RC
<i>Glaucoopsyche lygdamus</i> (Doubleday)	Silvery Blue	V	C	BR
<i>Lycaena epixanthe</i> (Boisduval & LeConte)	Bog Copper	V	O	BR
<i>Lycaena hyllus</i> (Cramer)	Bronze Copper	V	O	BR
<i>Lycaena phlaeas</i> (L.)	American Copper	V	C	BR
Family Nymphalidae				
Subfamily Libytheinae				
<i>Libytheana carinenta</i> (Cramer)	American Snout	S	R	RS
Subfamily Danainae				
<i>Danaus plexippus</i> (L.)	Monarch	V	C	TC
Subfamily Heliconiinae				
<i>Boloria bellona</i> (Fabricius)	Meadow Fritillary	V	R	BR
<i>Boloria selene</i> (Denis & Schiffermueller)	Silver-bordered Fritillary	V	O	BR
<i>Euptoieta claudia</i> (Cramer)	Variiegated Fritillary	SO	R	TC
<i>Speyeria cybele</i> (Fabricius)	Great Spangled Fritillary	S	O	RC
Subfamily Nymphalinae				
<i>Aglais milberti</i> (Godart)	Milbert's Tortoiseshell	SO	R	RC
<i>Chlosyne harrisii</i> (Scudder)	Harris's Checkerspot	V	O	EXT?
<i>Junonia coenia</i> Huebner	Common Buckeye	P	R	TC
<i>Limenitis archippus</i> (Cramer)	Viceroy	V	R	RC
<i>Limenitis arthemis</i> (Drury)	White Admiral	V	O	TC
<i>Nymphalis antiopa</i> (L.)	Mourning Cloak	P	C	BR
<i>Nymphalis I-album</i> (Boisduval & LeConte)	Compton Tortoiseshell	SO	R	RC
<i>Phyciodes cocyta</i> (Cramer)	Northern Crescent	V	C	BR
<i>Polygonia interrogationis</i> (Fabricius)	Question Mark	P	C	TC
<i>Polygonia comma</i> (Harris)	Eastern Comma	P	R	RC
<i>Vanessa atalanta</i> (L.)	Red Admiral	V	C	TC
<i>Vanessa cardui</i> (L.)	Painted Lady	P	C	TC
<i>Vanessa virginiensis</i> (Drury)	American Lady	V	C	TC
Subfamily Satyrinae				
<i>Coenonympha inornata</i> (W.H. Edwards)	Inornate Ringlet	V	C	BR
<i>Cercyonis pegala</i> (Fabricius)	Common Wood Nymph	V	C	BR
<i>Lethe eurydice</i> (L.)	Eyed Brown	V	O	BR
<i>Megisto cymela</i> (Cramer)	Little Wood Satyr	V	C	BR
Family Papilionidae				
<i>Papilio canadensis</i> Rothschild & Jordan	Canadian Tiger Swallowtail	V	C	BR
<i>Papilio polyxenes</i> Fabricius	Black Swallowtail	SO	R	RC
Family Pieridae				
<i>Colias eurytheme</i> (Boisduval)	Orange Sulphur	P	A	TC
<i>Colias philodice</i> Godart	Clouded Sulphur	P	C	BR
<i>Phoebis sennae</i> (L.)	Cloudless Sulphur	P	R	RS
<i>Pieris rapae</i> (L.)	Cabbage White	V	A	BR

photograph (P), or sighting (S). I based the acceptance of a sighting record on unlikely confusion of the species reported, but all sighting records are noted as such because no confirmation exists for these records. I submitted all records and documentary photographs to the Maine Butterfly Survey (2016), and deposited a few vouchers with the Maine State Museum. The records are available through the Maine Butterfly Survey (2016). I deposited all other vouchers with the McGuire Center for Lepidoptera and Biodiversity, University of Florida, Gainesville, FL. Scientific and common names for species including authors and generic combinations correspond with those used on the Maine species list (Maine Butterfly Survey 2016) and are provided in Table 1 of this paper. The species accumulation analyses were calculated following Soberon and Llorente (1993) and, for the Chao incidence equation, Gotelli and Colwell (2011).

Results

A grand total of 47 species have been reported from the island: 31 by voucher specimens, 9 by photographs, with 7 by sight only (Table 1). I made 3 of the sight records and 4 were reported by others. This total contrasts with 118 species reported for the state of Maine (Maine Butterfly Survey 2016). Given the island's limited area compared to the state as a whole (equal to 0.003% of the state's area), the total for Monhegan was higher than I expected (40 species with confirmed documentation; Table 1). Diversity was highest in the middle of the summer, with more than 17 species observed each visit during surveys from mid-June to mid-August.

I observed 10 species during the initial survey, and the total increased to 40 by the 13th survey in 2018 (Fig. 2). This total includes 37 documented records (vouchered specimens and photographs) plus personal sightings of *Epargyreus clarus* (Silver-spotted Skipper), *Libytheana carinenta* (American Snout), and *Speyeria cybele* (Great Spangled Fritillary). The number of possible species expected to occur on Monhegan can be estimated by analysis of the rate of species accumulation. Using a Chao equation (bias-corrected form) for replicated incidence data (Gotelli and Colwell 2011), richness of the Monhegan butterfly community is projected to be 48 species (standard deviation of the estimate = 7.1; Fig. 2). A logarithmic model of the species discovery rate (Soberon and Llorente 1993) estimated that the total number of species would keep increasing to 46 species. These 2 analytical approaches suggest that records of butterflies on Monhegan could reach a total of ~50 species. If observations by others over the past 3 decades are added to the survey results, the current total stands at 47. This does not mean, however, that 47 species could be found on the island in any 1 year; about 27 species appear to be residents, and an additional 6 species reach the island regularly each year as migrants or temporary colonists.

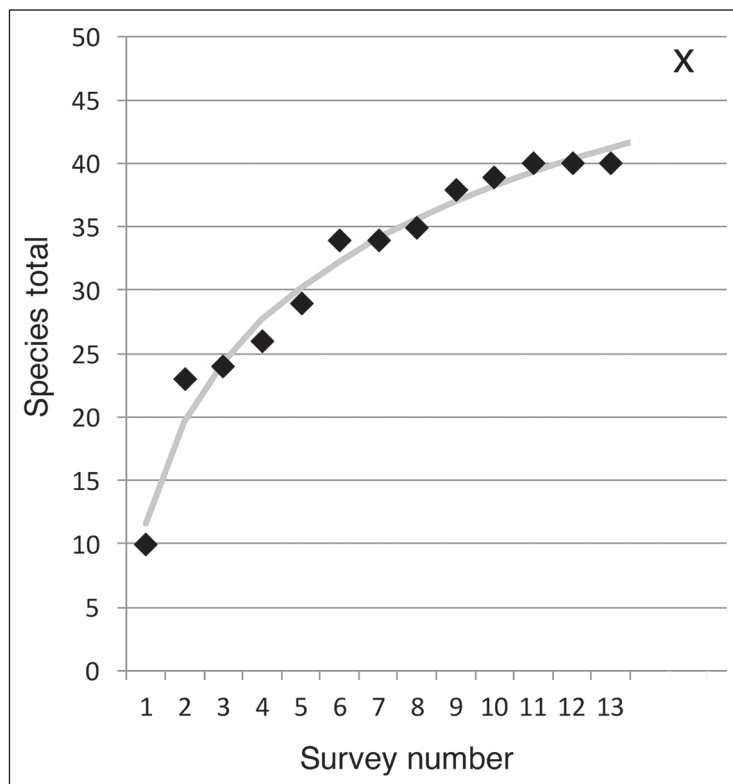
The species on Monhegan include residents, regular migrants from the mainland, and infrequent migrants from southern states. The most commonly encountered butterfly was the Cabbage White, a resident species seen throughout the island, especially in the village, where gardens with Brassicaceae host plants are present. This butterfly was the only species seen on all 13 visits to the island. The sulphurs,

both *Colias philodice* (Clouded Sulphur) and *C. eurytheme* (Orange Sulphur), were also common, especially around the village. I observed 5 strong-flying, large (>5 cm wingspan) species on more than half the visits, both throughout the summer, and in many places on the island: *Danaus plexippus* (Monarch), *Vanessa atalanta* (Red Admiral), *V. cardui* (Painted Lady), *V. virginiensis* (American Lady), and *Polygonia interrogationis* (Fabricius) (Question Mark). All 5 species are migratory and readily reach Monhegan; the first 3 are especially known for widespread mass movements, while the latter 2 migrate more regionally (Cech and Tudor 2005). Although much less common, 3 additional strong-flying species that have been recorded on Monhegan migrate northward to Maine from southern states late in the summer, occasionally in large numbers: *Phoebis sennae* (Cloudless Sulphur), *Junonia coenia* (Common Buckeye), and *Libytheana carinenta* (American Snout). Three small (<3 cm wingspan) resident multivoltine species were among the most frequently observed taxa: *Lycaena phlaeas* (American Copper), *Phyciodes cocyta* (Northern Crescent), and *Coenonympha inornata* (Inornate Ringlet).

Discussion

The most conspicuous taxonomic gap in these records is the absence of species of Theclinae (hairstreaks) and *Callophrys* (elfins). *Quercus* (oaks) and *Pinus* (pines) are missing on the island, explaining the absence of several of these species but not *Satyrium liparops* Leconte (Striped Hairstreak) or *Strymon melinus* (Hübner) (Grey

Figure 2. The species accumulation curve for butterflies on Monhegan determined from 3–5-d surveys conducted once per year during 13 y from 1998 to 2018. The diamonds show the accumulated species totals. The x shows the estimate of total species richness determined from the Chao equation for replicated incidence data (see text).



Hairstreak), both of which use a range of other woody host plants. The absence of elfins is best explained by the absence or limited occurrence of their specific host plants. Other species that seem possible but have not yet been recorded include *Speyeria atlantis* (W.H. Edwards) (Atlantis Fritillary), *Lethe anthedon* (A. Clark) (Northern Pearly-eye), *Erynnis icelus* (Scudder & Burgess) (Dreamy Duskywing), and several *Polygonia* spp. (commas). Continued observation would likely add to the list already accumulated.

Given the northern latitude (43°77'), it is not surprising that for pairs of closely related species, the species on Monhegan is the more northern representative. In particular, all confirmed records of *Phyciodes* species have been of Northern Crescent, rather than Pearl Crescent. In addition, all tiger swallowtails have been Canadian Tiger Swallowtail rather than Eastern Tiger Swallowtail.

Island faunas change over time due to changes in land use as well as periodic immigration and extirpation. The habitats available for sustaining populations of different butterfly species on Monhegan have been altered over time, and other changes have taken place, too. Numerous butterfly species go through population explosions and then seemingly disappear; thus, abundance can be quite variable over time (Cech and Tudor 2005). *Thymelicus lineola* (European Skipper) was introduced to North America in the early 20th century (Cech and Tudor 2005) and is present on Monhegan. *Chlosyne harrisii* (Harris's Checkerspot) was observed through 2008 but has not been observed since, despite an abundance of its host plant, *Doellingeria umbellata* (Mill.) Nees (Flat-topped White Aster). This butterfly is known for being uncommon and very local (Cech and Tudor 2005), and its recent absence may be a local extirpation. With the overall decline of *Danaus plexippus* (Monarch) in eastern North America (Brower et al. 2012), the abundance of this species on the island has also diminished. In sum, a butterfly community of at least 33 species appears to be observable on the island in any 1 year despite the small area, isolation, and changes in land use. The results presented here provide a baseline for continued study of this dynamic island system.

Acknowledgments

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