



Fig. 1. Map showing portions of Michigan’s northern Lower Peninsula (MI-LP) and eastern Upper Peninsula (MI-UP). Letter codes refer to Saint Ignace (SI), Hessel (H), Cedarville (C), DeTour Village (D) and Drummond Island (DI). Numbers refer to approximate locations of the Birge Preserve (1) and the Gerstacker Preserve (2).

Importance of Midges to Migrating Birds Along Northern Lake Huron

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The northern Lake Huron shoreline in Michigan’s Upper Peninsula has a largely east-west orientation, extending from St. Ignace eastward to DeTour Village and then to neighboring Drummond Island (Fig. 1). Given this orientation, this shoreline intercepts large numbers of spring migrating birds after they fly across Lake Huron. These birds need to rest and refuel. For many of the insectivorous passerines or perching birds such as warblers (Fig. 2), vireos, and thrushes, they often arrive before the hardwood trees have fully leafed-out and thus there are relatively few terrestrial insects available, such as caterpillars. Nevertheless, many aquatic insects, especially midges (Diptera: Chironomidae; Fig. 3), emerge in large numbers along the shores of Lake Huron and other lakes

and streams in early spring and can serve as prey items for many migrating birds.

In studies conducted in both North America and Europe, gut analyses of various warbler species indicate that midges comprise a large percent (often >50%) of the bird’s diet during migration (Laursen 1978), as well as during the breeding season for both parents and young (Biermann & Sealy 1982, Busby & Sealy 1979). Moreover, MacDade et al. (2011), using stable-carbon-isotope analysis of exhaled CO₂ from migrating birds captured in mist nets along Lake Erie, found that aquatic prey (e.g., midges) were a major component of their diet, especially for the earliest migrants. The above studies generally indicated that midges were taken as prey in proportion to their abundance.

The Nature Conservancy (TNC) recognized the importance of the “Northern Shore of Lake Huron” to migrating birds following a study indicating that midges were an important food resource to migrants, especially during spring migration.

As a result, protection of stopover sites for migrants was incorporated into the conservation program of the Northern Shore of Lake Huron, which was a designated TNC “Last Great Place.” Such a designation is used for larger landscapes that surround core preserves where the TNC and similar organizations work with local



Fig. 2. American Redstart. One of the many warblers that feed on midges (Smith et al. 2004). Photo credit: Dan Pancamo

communities to balance economic growth with environmental protection. One of the first preserves in the area was the Birge Preserve (1992), west of Hessel, which is a Little Traverse Conservancy preserve (Fig. 1). The Birge Preserve and adjoining preserve land protect about 2 miles of Lake Huron shoreline. The Gerstacker Preserve (1993), located east of Cedarville, was TNC's first preserve in the area, and now protects about 5 miles of shoreline (Fig. 1). Many more preserves have been added in recent years.

Midges are a diverse family of flies, mostly 1-10 mm long, and are native to all continents, including Antarctica (Armitage et al. 1995, Ferrington 2008). Midges have been found at elevations over 5600 m in the Himalayas and at depths greater than 1000 m in Lake Baikal in Russia, as well as at latitudes from about 68° South to 82° North. Most midges develop in fresh water, but some develop in salt water, soil, under tree bark, tree holes, decaying vegetation, and even dung. In many aquatic habitats, larval midges are the most numerous insect taxa present, often reaching densities of 1000s per square meter of lake or river bottom. Adult midges are very mosquito-like in appearance, with males having plumose antennae (Fig. 3). Larval midges are elongate, having a well sclerotized head that is distinctly separated from the thorax, a pair of prolegs (sometimes called parapods) on the prothorax and another pair



Fig. 3. *Chironomus plumosus* adult male. This species is Holarctic in distribution and occurs in Michigan. Males form large swarms in spring and summer. Photo credit: © entomart.

near the end of the abdomen. Adult midges often swarm in huge numbers near shorelines (Armitage et al. 1995, Gibson 1945, Ferrington 2008, Wilson 1969).

Bright (2020) lists 24 families of Michigan Diptera where all or some of their members have aquatic larval stages. Of these 24 fly families, which includes over 1000 species, the Chironomidae are the largest, having 305 recognized species in Michigan. In addition, Bright (2020) states that another 247 midge species are present in nearby U.S. states, many of which may also occur in Michigan. BugGuide (<https://bugguide.net/>) reports that there are about 1050 midge species recognized in North America and about 7300 worldwide. However, midge researchers predict that there are over 2000 midge species in North America and 20,000 worldwide (Coffman & Ferrington 1996).

Most midge species complete 1 to 2 generations per year, but some can take multiple years to complete a single generation (up to 7 years has been reported) while others can complete 5 or more generations in a single year (Armitage et al. 1995, Winnell and White 1985). Typically, in aquatic habitats, eggs are laid in batches on the surface of the water or on substrates near the water's edge. After hatching, many larvae settle in the substrate at the bottom

of water bodies at various distances from shore while others are free-living. Midge larvae have four instars and feed on a variety of substrates. Some are detritivores, some feed on algae, some develop inside submerged woody material, and others are predators. After pupation, midge pupae move to the water surface, where adult eclosion takes place. In temperate areas, adult emergence can occur in all seasons of the year, even winter for some species. Adult flight often peaks at dusk or dawn. Males often emerge first and can form large mating swarms. Depending on the midge species, swarming can occur over water, near shoreline, or over certain structures, as well as at different heights. As females enter these swarms, mating and oviposition soon follow.

Many midge species occur along the northern shoreline of Lake Huron. The main species that develop in Lake Huron and are abundant during spring bird migration are listed in Table 1. Some of these midges develop nearshore in rubble substrate (e.g., the *Hydrobaenus*, *Orthocladus*, and *Parakiefferiella* species), while others develop offshore primarily in sand/silt substrates (e.g., the *Heterotrissocladius* and *Monodiamesa* species). For several weeks, the *Heterotrissocladius* species dominate the adult midge populations found along the northern Lake Huron shoreline (PL Hudson, unpublished data).

Ewert et al. (2011) and Hudson & Chriscinske (1998) studied inland distribution of migrating birds and midges in the 1990s at several sites along Michigan's northern Lake Huron shoreline. The plot layout was similar in both studies, with survey stations established along transects in forested areas at distances of 5 (i.e., the forest edge), 400, 800 (half mile), 1600 (1 mile), and 3200 m (2 miles) from shoreline. Estimates of both bird and midge densities were made on multiple dates from late April to early June in 1993 and 1994 and midge densities only in 1997. Findings were similar in both studies with densities of both migrating birds and midges being highest at the shoreline sites, and then falling with distance inland. For

the birds, the pattern of favoring the shoreline was most pronounced for bird species that breed only north of the study area and thus were using the shoreline primarily as a stopover location before they continued to migrate northward (Ewert et al. 2011). In Hudson & Chriscinske's (1998) study, they found that midge densities increased from a low on 30 April (the first sampling date), to a peak on 21 May, and then fell slightly on 4 June. Hudson & Chriscinske (1998) also reported that midges comprised 82-84% of the arthropods collected over all four sampling periods with various types of aerial traps placed at all survey sites. Several other studies have documented the importance of midges to migrating insectivorous birds after they reach the northern Lake Huron shoreline in spring (Smith et al. 1998, 2004, 2007).

Similarly, in Iceland, Dreyer et al. (2015) noted that midge densities drop dramatically with distance from a lake's shoreline. Moreover, in a related study, Dreyer et al. (2012) reported that many other arthropods (e.g., predators such as spiders, harvestmen, and staphylinid beetles; and detritivores such as Collembola) respond positively to midge abundance and demonstrate similar declines in abundance with distance from the shoreline.

In summary, maintaining large tracts of forested land along the northern shore of Lake Huron, and likely elsewhere around the northern Great Lakes, is important for many migrating insectivorous birds, especially in spring, given their importance as stopover sites where birds can refuel on aquatic insects that emerge in vast numbers (Ewert et al. 2011, 2015). In spring, migrating birds may be food-limited, but emerging aquatic insects, especially midges, can serve as an important food resource that provides birds the needed energy to reach their final breeding grounds (Ewert & Hamas 1995).

Table 1. Common midges along the northern Lake Huron shoreline near Cedarville and Hessel based on field observation made in the 1990s, including species, adult length, and location of larval development in Lake Huron (Hudson & Chriscinske 1998, and PL Hudson, unpublished data).

Species	Typical adult length (mm)	Location of larval development
<u>Late April-Early May Emergence Period</u>		
<i>Hydrobaenus johannseni</i> (Sublette)	6.1	nearshore
<i>Heterotrissocladius oliveri</i> Saether	4.9-5.7	offshore
<u>May Emergence Period</u>		
<i>Orthocladius nigrinus</i> Malloch	5.4	nearshore
<i>Heterotrissocladius changi</i> Saether	4.6-5.2	offshore
<i>Hydrosmittia ruttneri</i> (Strenzke & Thienemann)*	2.7-4.0	nearshore
<i>Parakiefferiella bathophila</i> (Kieffer)	2.7-3.4	nearshore
<u>Middle May-Early June Emergence Period</u>		
<i>Stictochironomus</i> n. sp.	6.5-8.1	nearshore
<i>Monodiamesa tuberculata</i> Saether	6.0-8.3	offshore
<i>Micropsectra</i> nr. <i>notescens</i> (Walker)	4.8-5.1	nearshore
<i>Tanytarsus norvegicus</i> (Kieffer)	4.7-5.0	nearshore
<i>Paratanytarsus tenuis</i> (Meigen)	4.5-5.0	nearshore
<i>Stempellina bausei</i> (Kieffer)	3.9-4.0	nearshore

* The species *Hydrosmittia ruttneri* (Strenzke & Thienemann) was recently changed from *Pseudosmittia ruttneri* Strenzke & Thienemann by Ferrington and Saether (2011).



Chironomids in spider web at Lake Erie Metropark in southeast Lower Michigan. Photo by Pat Hudson.

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