# Distribution of midges (Order: *Chironomidae*) in forest habitats along St. Martin's Bay: Does abundance vary with distance from shore?

Samuel K. Riffell, Department of Zoology, Michigan State University, East Lansing, Michigan 48824

## Introduction

Recent concern over the declines of many migratory songbirds (see Martin and Finch 1995 and references therein) has led to an increased emphasis on study of songbird biology on both breeding and wintering grounds. The biology of songbirds during migration, however, is not well known. For many birds, migration through more southerly inland stopover sites is often timed according to leaf emergence and peaks in large invertebrate abundances (Graber and Graber 1983). In the northern Great Lakes Region, phenology is delayed. Migrating and breeding birds arrive well before leaves emerge and when forest invertebrate abundances are still low (Ewert and Hamas, *unpublished data*), and thus midges may be the only abundant insect food source available during spring migration. Recent studies have documented a marked concentration of migrating songbirds within 800 meters of the coastline (Ewert and Hamas, *unpublished data*) relative to densities present during the breeding season and fall migration. Spring migrants have been observed feeding on swarms of midges (Ewert and Hamas, *personal observation*), leading to the theory that increased densities of migrating songbirds is a response to higher densities of midges nearer the coast. The distribution of midges in forested habitats adjacent to the shoreline of St. Martin's Bay was documented at three distances from the shore. Such information is important for continued study and conservation of the Lake Huron coastal marsh ecosystm.

## Material and Methods

*Insect Traps and Placement*

Insect traps were constructed from polyetylene cups with a surface area of 520 $cm^2$ coated with Tanglefoot® spray adhesive. A total of twenty-seven traps were placed at stations along three transects running perpendicular to the shore on the west coast of St. Martin's Bay. Stations were located at 50 m, 400 m, and 1000 m from the shoreline; three traps were placed at each location. Each trap was hung 2m above the ground in a tree at the edge of a small (<10 m diameter) opening in the canopy which was near the transect station. All traps were hung in fir (*Abies balsamea*) to avoid possible confounding effects of substrate on midge abundances.

To assess the possibility that midges may congregate more in and around some species of tree than others, another 27 traps were placed in three different tree species: fir, larch (*Larix laricina*) and cedar (*Thuja occidentalis*). Three traps were placed 2 m above ground in each of three randomly selected trees of each species. All trees selected for trapping were approximately 50 m from shore.

Traps were set on 19 May 1996 and retrieved on 4 June 1996, which coincided with the peak songbird migration through the area (S. K. Riffell, *personal observation*).

*Statistical Analyses*

Log-transformed number of midges captured were entered as the dependent variable in an factorial analysis of variance model (Ott 1993). Distance from shore (DISTANCE) and transect number (TRANSECT) were included as main effects. An interaction term (DISTANCE X TRANSECT) was also included in the model. I used an a priori $\alpha = 0.10$ to test the null hypothesis that there were no differences in midge abundance relating to distance from shoreline, to transect number, and that there was no significant interaction between distance and transect number. I also used analysis of variance to test the hypothesis that tree species (SPECIES) did not affect the number of midges captured on sticky traps. Assumptions of ANOVA were satisfied for all analyses: data points within groups were normally distributed and had similar variances (Ott 1993).

## Results

Although an inverse relationship between distance from shoreline and midge abundance was observed (Table 1), the effect of DISTANCE was not significant (Table 2). The DISTANCE X TRANSECT interaction term was significant (Table 2), but the interaction was disorderly (see Figure 1) and there use of F-test for main effects is not appropriate (Ott 1993:695). No significant effects of tree SPECIES on trap captures were detected (Table 3).

## Discussion

A prevailing hypothesis explaining the observed concentration of migratory songbirds within approximately 1/2 mile of the shoreline during the spring is that the birds are exploiting higher densities of midges present nearer the shore. Data presented here, however, indicates that midge abundance declines little, if at all, with distances up to 1000 m from the shoreline. Thus, differences in midge abundance may not be enough to completely explain observed patterns in migratory bird distributions.

Sticky traps were placed in the understory at approximately 2.0 m above the ground. In contrast, most migratory birds are observed feeding in upper strata of the forest canopy (D. Ewert, M. Hamas, S. Riffell, *personal observation*), and swarms of midges have been observed in the vicinity of these songbirds in the upper canopy. Thus, the sticky traps likely did not sample the shoreline habitats in the same manner that they were used and sampled by the migratory birds. Midge abundance in the upper canopy may indeed drop dramatically with distance from shoreline. Data presented here cannot address this possibility. Experiments should be designed to estimate insect (midge) abundance in the upper canopy at different distances from shore during the spring migration period.

Although data here do not support the hypothesis that midge abundance is greatest near the shoreline and decreased dramatically with distance from shore, neither do the data address the possibility that midge abundances do show an inverse relationship with distance in the upper canopy. Additionally, disorderly interactions make interpreting the effects on distance from shoreline tenuous at best. Based on these results, further experiments to test the midge/distance

hypothesis should be conducted, and alternate hypotheses to explain the observed pattern of migratory bird distributions should be considered as well.

## Acknowledgments

Great Lake Integrated Pest Management helped in designing sticky traps. Financial assistance was provided by the Zoology Department at Michigan State University.

## Literature Cited

Graber, J. W. and R. R. Graber. 1983. Feeding rates of warblers in spring. Condor 85:139-150.

Martin, T. E. and D. M. Finch, eds. 1995. Ecology and management of Neotropical migratory birds: a synthesis and review of critical issues. Oxford University Press, New York, New York, USA.

Ott, L. An introduction to statistical analysis. PWS-Kent Publishing Company, Boston, Massachusetts, USA

Table 1. Number of midges captured per sticky trap as a function of distance from shoreline.

| Distance (m) | n | Mean | Standard Error | Range |
|---|---|---|---|---|
| 50 | 9 | 43.2 | 4.92 | 28-70 |
| 400 | 8 | 37.0 | 6.07 | 24-74 |
| 1000 | 9 | 33.3 | 3.19 | 19-50 |

Table 2. Results of ANOVA on log -transformed number of midges captured.

| *Source* | *DF* | *Sum of Squares* | *F Value* | *Pr > F* |
|---|---|---|---|---|
| Model | 8 | 1.439 | 1.99 | 0.1106 |
| Error | 17 | 1.535 | | |
| Corrected Total | 25 | 2.974 | | |

| *Source* | *DF* | *Type I SS* | *F Value* | *Pr > F* |
|---|---|---|---|---|
| DISTANCE | 2 | 0.298 | 1.65 | 0.2212 |
| TRANSECT | 2 | 0.223 | 1.23 | 0.3161 |
| DISTANCE*TRANSECT | 4 | 0.918 | 2.54 | 0.0777 |

| *Source* | *DF* | *Type III SS* | *F Value* | *Pr > F* |
|---|---|---|---|---|
| DISTANCE | 2 | 0.282 | 1.56 | 0.2389 |
| TRANSECT | 2 | 0.238 | 1.32 | 0.2934 |
| DISTANCE*TRANSECT | 4 | 0.918 | 2.54 | 0.0777 |

Table 3. Number of midges captured per sticky trap as a function of tree species.

| Species | n | Mean | Standard Error | Range |
|---|---|---|---|---|
| a | 9 | 42.3 | 2.77 | 30-54 |
| b | 9 | 42.4 | 3.91 | 24-59 |
| c | 9 | 38.6 | 2.81 | 24-53 |

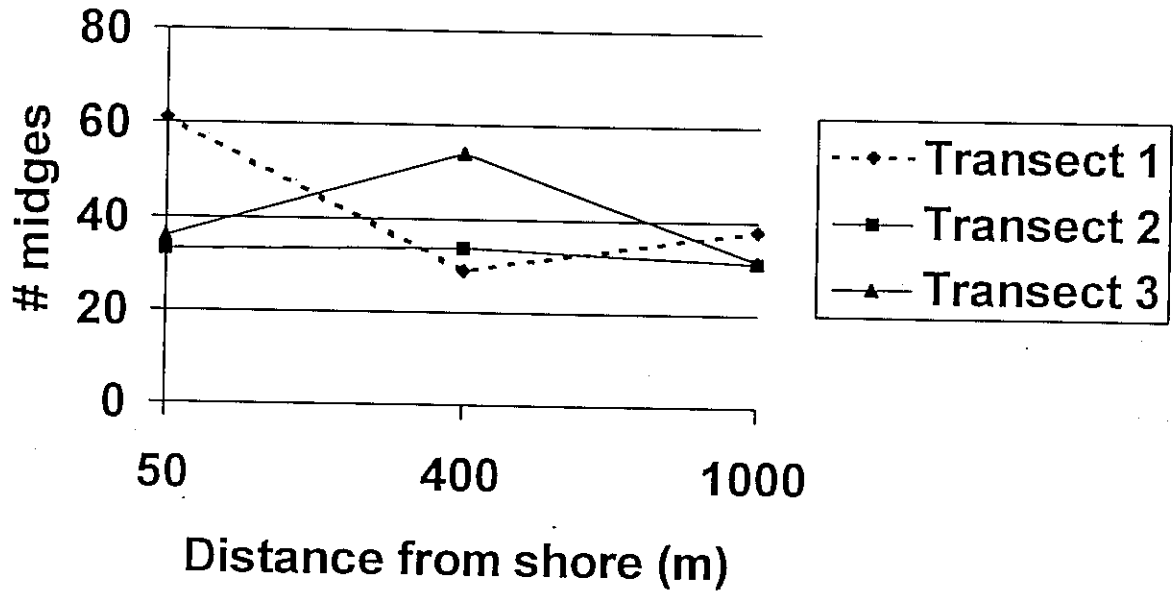


Figure 1. Mean number of midges caught per trap as a function of distance from shore. Each point on the graph for a particular distance x transect combination is a mean of three traps.

Les Cheneaux Islands Area - Preliminary Fish Species List 11/1/96

(Note: In many cases, if fewer than 10 individuals of a species were caught, they are not included in this list; they will be added after examination of frozen specimens. Also, some identifications are preliminary, especially for the shiners.)

**Mackinac Bay**

6/18/96
1 unid. centrarchid
1 unid. clupeid
23 brown bullhead (21 YOY)
25 spottail shiner
1 pumpkinseed sunfish
11 stickleback
10941 bowfin (all YOY)
2 johnny darter (in river)
1 sculpin (in river)
3 pearl dace (in river)
2 northern pike (YOY, in river)

7/23/96
346 yellow perch (3 YOY)
59 brown bullhead (all YOY)

8/20/96
11 yellow perch

**Duck Bay**

6/19/96
2 unid. centrarchid
1 unid. shiner
101 yellow perch
118 bowfin (all YOY)
1 brown bullhead

7/24/96
643 yellow perch (all YOY)
626 brown bullhead (all YOY)
56 largemouth bass (all YOY)

8/21/96
34 brown bullhead (29 YOY)

**Cedarville Bay**

6/21/96
12 brown bullhead
1 yellow perch
3148 bowfin (all YOY)

7/25/96
25 yellow perch

8/22/96
1 unid. centrarchid
3 yellow perch
4 rock bass
2 bluegill
1 brown bullhead

**Mismer Bay**

6/20/96
62 unid. shiner
1 unid. centrarchid

7/26/96
44 pearl dace
20 emerald shiner
3 brown bullhead (2 YOY)
2 bowfin

8/24/96
2 brown bullhead

**St. Martin's Bay**

6/22/96
29 northern pike (YOY)
357 spottail shiner
434 pearl dace
30 banded killifish
28 brook stickleback
13 darter
1 sea lamprey

7/22/96
18 golden shiner
192 emerald shiner
312 pearl dace
1030 brassy minnow
3 banded killifish
19 darter
90 spottail shiner
1085 unid. shiner

8/19/96
7 spottail shiner
13 banded killifish
130 emerald shiner
3 yellow perch
1834 pearl dace (1290 YOY)
64 brassy minnow
1 sculpin
119 brown bullhead (YOY)
1 stickleback
2 unid. minnow

**Prentiss Bay**

6/23/96
1 common carp
23 spottail shiner
2220 bowfin (YOY)
24 unid. minnow

7/27/96
12 white sucker
54 smallmouth bass (YOY)
11 stickleback

8/23/96
1 bowfin

Status Report to the Michigan Chapter, TNC
Great Lakes Science Center - Great Lakes Marsh Study
November 30, 1996
by
Patrick L. Hudson

1. Study results to date

Offshore Macrobenthos - bioindicators of water quality

Samples were successfully taken in the spring and fall at 4 sites in the Les Cheneaux Island area as described in the study plan. Additional samples were collected in Duck Bay, West Entrance area, and Search Bay to more fully describe the offshore benthic fauna. Sample processing is going slowly since in addition to mayflies and oligocheate worms, the samples contained a very diverse invertebrate fauna in excess of 30 taxa. Picking and processing all the material in the sample takes more time but the additional information seems well worth the effort, and would complete the description of the invertebrate fauna in the island area. Density estimates of Hexagenia limbata and Ephemera simulans from McKay Bay have both averaged around 400 $m^{-2}$. These densities are similar to that found in other bodies of water with large populations of burrowing mayflies (western Lake Erie, Lake St. Clair, St. Marys River). Mayflies appear to be absent from samples taken in the harbor at Cedarville, based on field observations, however they were present further out in the Sheppard Bay area. Casual observations suggest that any impact in the Cedarville Harbor is probably very localized.

Nearshore Meio Benthos

All samples were collected according to procedures described in the study plan. Sampling sites were chosen based on a combination of sediments and vegetation characteristics. In the intense study at Prentiss Bay, six habitats were sampled in May, July, and September. South of M134, a sand silt (bulrush) habitat was sampled, a silt habitat (devoid of vegetation), and a fine sediment-root mass habitat (cat-tail). North of the highway sediments were all fine and associated with root masses of the dominant vegetation. We sampled in Carex, Calamagrostis, and in Calamagrostis with shrub development. The amount of standing water became progressively less has one moved from Carex to the shrub habitat. In the broad study we selected a silt and Calamagrotis habitat at each of the other five sites since they were the only communities common to all sites.

Sample processing has gone slow but the technique we developed appears to work rather well. As far as we know, no one has looked at meio fauna communities in wetlands. Our finding of two species of cyclopoid copepods (Diacyclops languidoides and D. nearcticus) rarely collected in North America in the Calamagrotis habitat would support this conclusion. Previous collections of these species were mainly from groundwater habitats associated with streams and rivers. Apparently the groundwater and root masses associated with wet meadows and shrub swamps in Prentiss Bay mimic that found in the interstial habitat of streams and rivers. We hope to find several keystone species in each habitat which we can use to describe each invertebrate

community. Nematodes, water mites, rotifers, ostracods, copepod nauplii, and harpacticoids were common taxa. Total length of these taxa ranged from 60um to 2.8 mm and densities from 1 to 4 x $10^6 m^{-2}$.

Processing Fish Stomachs

No work has been done on this project. We have been told by the MSU and UM scientist that fish have been collected for this study but we have not yet made an attempt to secure the material. We did receive some fish from the Inter-Tribal Fisheries and Assessment Program seining study in St. Martins Bay. We also have access to all the fish collected from cormorant stomachs by Susan Maruca in the island area. We will try to get at this material after the first of the year.

Species List

The invertebrate taxa list for the Northern Lake Huron Shoreline now contains about 165 taxa (Table 1). This list should double or triple if species level identification are made for each group (e.g. Rotifera, Tipulidae).

Chironomids associated with spring warbler migration

At least twelve species of adult chironomids were found to emerge along the northern Lake Huron shoreline from ice out till early June (Table 2). Species identifications are still provisional and somewhat difficult. Continued work in this area should produce the necessary familiarity to make this process easier. To quantify the density of adults available to migrating warblers we tried spraying cedar and white spruce fronds with a sticky substance, counting the adults attached after a set time, and then measuring the surface area of the plants with a computer scanner. Estimates as high as 1.7 chironomid adults per square inch were found on shoreline vegetation. The habitat of the larval stages of these spring emerging species in Lake Huron was estimated based on known life history information. Most of the species probably live in nearshore areas (9 out of 12) with about half on rocky sediments and half on sand-silt sediments.

Somatochlora hineana

In August, we attempted to locate populations of the endangered Hine's emerald dragonfly (Somatochlora hineana) along the shoreline of Lake Huron and Michigan. No specimens of Somatochora were collected, however a very extensive list of dragonfly species associated with the Great Lakes shoreline was developed (Table 3). We will continue to survey calcareous wetlands in the upper and lower peninsula of Michigan.

2. Surprising findings

The wet interphase between upland forest and standing water appears to be a rather unique habitat in the Les Cheneaux Island area, where the relatively cold groundwater seepage meets the relatively stable temperature regime of the Great Lakes. This interphase in the Les Cheneaux Island area is especially dynamic, protected or created by dunes, islands, or roads. In addition, the influence of seiches, unique to large bodies of water, adds another variable to the hydrology equation. The community of invertebrates sampled so far in this habitat appear to be as novel as many of the plants associated with the Great Lakes shoreline.

Sampling in the deeper waters of the Les Cheneaux Island area has presented a very diverse fauna found nowhere in the Great Lakes but with members who are common in certain areas of the Great Lakes. Because of the pristine nature of the Les Cheneaux Island area this faunal composition may represent what originally inhabitated the protected, shallow, nearshore areas of the Great Lakes prior to human kinds degradation of these areas. This community could be a remediation goal of government agencies involved in cleanup activities.

3. Enrichment

Maybe to early to measure but the possibility of learning and conceiving of ideas from such a broad group of scientist is compelling. So far I am impressed that know one individual has dominated the thrust of research being done. It will be interesting to see how the results can be melded together into a big picture.

4. Relationships

I probably never would have exited on to M134 if it had not been for the TNC. The Les Cheneaux Area is beautiful and has presented me with several areas of exciting work that I never would have got involved in. I have added many unique taxa found in the area to my checklist of invertebrates found in the Great Lakes. In addition, the funding has come in at a time when our own resources were at a very low level.

Table 1

Invertebrate Taxa List
Northern Lake Huron Shoreline
Nov. 21, 1996 version

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Taxa | St. Martin | Search | Mismer | Hessel | Mackinac | Cedarville | Duck | McKay | Prentiss | Dudley | Stevenson |
| 2 | | | | | | | | | | | | |
| 3 | Porifera | | | | | | | | | | | |
| 4 | Coelenterata | | | | | | | | | | | |
| 5 | Turbellaria | | | | | | | | | | | |
| 6 | Rotifera | | | | | | | | | | | |
| 7 | Nematoda | | | | | | | | | | | |
| 8 | Tardigrada | | | | | | | | | | | |
| 9 | Bryozoa | | | | | | | | | | | |
| 10 | Plumatella nitens | | | | | | | | | | | |
| 11 | Annelida | | | | | | | | | | | |
| 12 | Oligochaeta | | | | | | | | | | | |
| 13 | Aeolosomatidae | | | | | | | | | x | | |
| 14 | Enchytraeidae | | x | | | | | | | x | | |
| 15 | Naididae | | | | | | | | | | | |
| 16 | Amphichaeta leydigi | | | | | | | | | x | | |
| 17 | Chaetogaster diaphanus | | | | | | | | | x | | |
| 18 | Chaetogaster diastrophus | | x | | | | | | | x | | |
| 19 | Nais communis | | x | | | | | | | x | | |
| 20 | Nais simplex | | x | | | | | | | | | |
| 21 | Nais variablis | | x | | | | | | | x | | |
| 22 | Pristina aequiseta | | x | | | | | | | x | | |
| 23 | Slavinia appendiculata | | x | | | | | | | x | | |
| 24 | Stylaria lacustris | | x | | | | | | | x | | |
| 25 | Veidovskyella comata | | x | | | | | | | x | | |
| 26 | Lumbriculidae | | | | | | | | | | | |
| 27 | Eclipidrilus lacustris | | x | | | | | | | | | |
| 28 | Stylodrilus heringianus | | x | | | | | | | x | | |
| 29 | Tubificidae | | | | | | | | | | | |
| 30 | Limnodrilus udekemianus | | | | | | | | | x | | |
| 31 | Hirudinea | | | | | | | | | | | |
| 32 | Crustacea | | | | | | | | | | | |
| 33 | Copepoda | | | | | | | | | | | |
| 34 | Harpacticoid | | | | | | | | | | | |
| 35 | Attheyella americana | | | | | | | | | x | | |
| 36 | Bryocamptus hutchinsoni | | | | | | | | | x | | |
| 37 | Bryocamptus zschokkei | | | | | | | | | x | | |
| 38 | Elaphoidella subgracilis | | | | | | | | | x | | |
| 39 | Moraria laurentica | | x | | | | | | | | | |
| 40 | Moraria sp. | | | | | | | | | x | | |
| 41 | Parastenocaris delamarei | | | | | | | | | | | |
| 42 | Parastenocaris lacustris | | | | | | | | | | | |
| 43 | Cyclopoida | | | | | | | | | | | |
| 44 | Acanthocyclops brevispinosus | | | | | | | | | x | | |
| 45 | Acanthocyclops venustoides | | | | | | | | | | | |
| 46 | Acanthocyclops robustus | | | | | | | | | x | | |
| 47 | Diacyclops albus | | | | | | | | | | | |
| 48 | Diacyclops languidoides | | | | | | | | | | | |
| 49 | Diacyclops nearcticus | | | | | | | | | | | |
| 50 | Ectocyclops phaleratus | | | | | | | | | x | | |
| 51 | Eucyclops agilis | | | | | | | | | x | | |
| 52 | Macrocyclops albidus | | | | | | | | | x | | |
| 53 | Microcyclops rubellus | | | | | | | | | x | | |
| 54 | Microcyclops varicans | | | | | | | | | x | | |
| 55 | Paracyclops poppei | | | | | | | | | x | | |
| 56 | Tropocyclops prasinus mexicanus | | | | | | | | | x | | |
| 57 | Calanoida | | | | | | | | | | | |
| 58 | Eurytemora affinis | | | | | | | | | x | | |
| 59 | Leptodiaptomus sicilis | | | | | | | | | x | | |
| 60 | Cladocera | | | | | | | | | | | |
| 61 | Alona | | | | | | | | | x | | |
| 62 | Chydorus | | | | | | | | | x | | |
| 63 | Diaphanosoma brachyurum | | | | | | | | | x | | |
| 64 | Ilyocryptus | | | | | | | | | x | | |
| 65 | Latona setifera | | | | | | | | | x | | |
| 66 | Scapholeberis kingi? | | | | | | | | | x | | |
| 67 | Sida crystallina | | | | | | | | | x | | |
| 68 | Simocephalus | | | | | | | | | x | | |
| 69 | Ostracoda | | | | | | | | | | | |
| 70 | Isopoda | | | | | | | | | | | |
| 71 | Asellus | | | | | | | | | x | | |
| 72 | Amphipoda | | | | | | | | | | | |
| 73 | Hyalella azteca | | | | | | | | | x | | |
| 74 | Gammarus | | | | | | | | | x | | |
| 75 | Decapoda | | | | | | | | | | | |
| 76 | Hydracarina | | | | | | | | | | | |
| 77 | Insecta | | | | | | | | | | | |

Invertebrate Taxa List
Northern Lake Huron Shoreline
Nov. 21, 1996 version

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Taxa | St. Martin | Search | Mismer | Hessel | Mackinac | Cedarville | Duck | McKay | Prentiss | Dudley | Stevenson |
| 78 | Collembola | | | | | | | | | | | |
| 79 | Entomobrya nivalis | | | | | | | | | | | |
| 80 | Isotomurus ?tricolor | | | | | | | | | | | |
| 81 | Lepidocyrtus paradoxus | | | | | | | | | | | |
| 82 | Proisotoma woodi | | | | | | | | | | | |
| 83 | Ephemeroptera | | | | | | | | | N | A | |
| 84 | Caenis amica | | | | | | | | | | A | |
| 85 | Caenis hilaris | | | | | | | | | | A | |
| 86 | Caenis latipennis | | | | | | | | | | | |
| 87 | Caenis macafferti? | | | | | | | | | | | |
| 88 | Caenis youngi | | | | | | | | | | | |
| 89 | Ephemera simulans | | | | | | | | | | | |
| 90 | Eurylophella ?lutulenta | | | | | | | | | | | |
| 91 | Hexagenia limbata | | | | | | | | | | | |
| 92 | Leptophlebia sp. | | | | | | | | | | | |
| 93 | Nixe? sp. | | | | | | | | | | A | |
| 94 | Stenacron interpunctatum | | | | | | | | | | A | |
| 95 | Stenonema femoratum | | | | | | | | | | | |
| 96 | Odonata | | | | | | | | | | | |
| 97 | Zygoptera | | | | | | | | | | | |
| 98 | Coenagrionidae | | | | | | | | | | | |
| 99 | Enallagma hageni | A | A | | | | | | | A | | |
| 100 | Nehalennia irene | | | | | | | | | A | | |
| 101 | Ischnura verticalis | A | A | | | | | | | | | |
| 102 | Lestidae | | | | | | | | | A | | |
| 103 | Lestes disjunctus disjunctus | | A | | | | | | | | | |
| 104 | Lestes sp. | | N | | | | | | | | | |
| 105 | Anisoptera | | | | | | | | | | | |
| 106 | Aeschnidae | | | | | | | | | A | | |
| 107 | Aeshna canadensis | A | A | | | | | | | | | |
| 108 | Aeshna constricta | A | | | | | | | | | | |
| 109 | Aeshna eremita | A, N? | | | | | | | A | | | |
| 110 | Aeshna umbrosa | | A | | | | | | | N | | |
| 111 | Aeshna sp. | | | | | | | | | N | | |
| 112 | Basiaeschna janata | | A | | | | | | | | | |
| 113 | Libellulidae | | | | | | | | | N | | |
| 114 | Dorocordulia libera | A | | | | | | | | | | |
| 115 | Ladona julia | | A | | | | | | | N | | |
| 116 | Leucorrhinia intacta | | A | | | | | | | | | |
| 117 | Leucorrhinia proxima | | A | | | | | | | N | | |
| 118 | Leucorrhinia sp. | | | | | | | | | | | |
| 119 | Libellula pulchella | A | | | | | | | | | | |
| 120 | Libellula quadrimaculata | N | A | | | | | | | | | |
| 121 | Somatochlora walshii | A | | | | | | | | | | |
| 122 | Somatochlora williamsoni | A | A | | | | | | A | A | | |
| 123 | Somatochlora sp. | | | | | | | | | N | | |
| 124 | Sympetrum danae | | | | | | | | A | A | | |
| 125 | Sympetrum obtrusum | A | | | | | | | | N | | |
| 126 | Sympetrum semicinctum | | | | | | | | | N | | |
| 127 | Sympetrum vicinum | A | | | | | | | | | | |
| 128 | Plecoptera | | | | | | | | | | | |
| 129 | Paracapnia angulata | | | | | | | | | | | |
| 130 | Hemiptera | | | | | | | | | | | |
| 131 | Megaloptera | | | | | | | | | | | |
| 132 | Sialis itasca | | A | | | | | | | | | |
| 133 | Trichoptera | | | | | | | | | | | |
| 134 | Hydroptilidae | | | | | | | | | | A | |
| 135 | Agraylea multipunctata | | | | | | | | | L | A | |
| 136 | Oxyethira | | | | | | | | | | A | |
| 137 | Polycentropus cinereus | | | | | | | | | L | | |
| 138 | Polycentropus sp. | | | | | | | | | | | |
| 139 | Lepidostomatidae | | | | | | | | | | | |
| 140 | Lepidostoma sp. | | | | | | | | | | | |
| 141 | Phryganeidae | | | | | | | | | | A | |
| 142 | Agrypnia straminea | | | | | | | | | | | |
| 143 | Limnephilidae | | | | | | | | | A | | |
| 144 | Limnephilus parvulus | | | | | | | | | | A | |
| 145 | Limnephilus sackeni | | | | | | | | | | A | |
| 146 | Pycnopsyche guttifer | | | | | | | | | | | |
| 147 | Molannidae | | | | | | | | | | A | |
| 148 | Molanna ulmerina | | | | | | | | | | | |
| 149 | Lepidoptera | | | | | | | | | L | | |
| 150 | Parargyractis confusalis | | | | | | | | | | | |
| 151 | Coleoptera | | | | | | | | | | | |
| 152 | Gyrinidae | | | | | | | | | | | |
| 153 | Gyrinus analis | | A | | | | | | | | | |

Invertebrate Taxa List
Northern Lake Huron Shoreline
Nov. 21, 1996 version

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Taxa | St. Martin | Search | Mismer | Hessel | Mackinac | Cedarville | Duck | McKay | Prentiss | Dudley | Stevenson |
| 154 | Gyrinus aquiris | | | | | | | | | | A | |
| 155 | Gyrinus pectoralis | | A | | | | | | | | | |
| 156 | Dytiscidae | | | | | | | | | | | |
| 157 | Hydroporus sp. | A | | | | | | | | | | |
| 158 | Hygrotus sayi | | | | | | | | | | A | |
| 159 | Hygrotus sellatus | | A | | | | | | | | | |
| 160 | Ilybius biguttulus | | | | | | | | | | A | |
| 161 | Rhantus sp. | | | | | | | | | L | | |
| 162 | Hydrophilidae | | | | | | | | | | | |
| 163 | Enochrus ochraceus | | A | | | | | | | A | | |
| 164 | Laccobius agilis | | | | | | | | | A | | |
| 165 | Laccobius truncatipenis | | A | | | | | | | | | |
| 166 | Paracymus subcupreus | A | | | | | | | | | | |
| 167 | Tropistemus blatchleyi | | A | | | | | | | | | |
| 168 | Tropistemus sp. | | L | | | | | | | | | |
| 169 | Diptera | | | | | | | | | | | |
| 170 | Chironomidae | | | | | | | | | | | |
| 171 | Diamesinae | | | | | | | | | | | |
| 172 | Diamesa | | | | | | | | | | L | |
| 173 | Pagastia orthogonia | | | | | | | | | A | | P |
| 174 | Prodiamesinae | | | | | | | | | | | |
| 175 | Monodiamesa turberculata | | | | | | | | | A | | A,P |
| 176 | Tanypodinae | | | | | | | | | | | |
| 177 | Larsia sp. | | | | | | | | | | | |
| 178 | Natarsia sp. | | | | | | | | | | | |
| 179 | Orthocladiinae | | | | | | | | | | | |
| 180 | Acricotopus lucens | A | | | | | | | | | | |
| 181 | Hydrobaenus johannseni | | | | | | | | | A | | A,P |
| 182 | Chaetocladius | | | | | | | | | P | | |
| 183 | Chaetocladius stamfordi | | | | | | | | | A | | |
| 184 | Corynoneura | | | | | | | | | | | |
| 185 | Cricotopus annulator | | | | | | | | | A | | |
| 186 | Cricotopus coronatus | | | | | | | | | | A | A,P |
| 187 | Eukiefferiella claripennis | | | | | | | | | | | A,P |
| 188 | Heterotrissocladius changi | | | | | | | | | A | | P |
| 189 | Heterotrissocladius oliveri | | | | | | | | | A | A | |
| 190 | Limnophyes brachytomus | | | | | | | | | | A | |
| 191 | Orthocladius dentifer | | | | | | | | | | | A |
| 192 | Orthocladius nigritus | | | | | | | | | A,P | | P |
| 193 | Orthocladius oliveri | | | | A | | | | | | | P |
| 194 | Orthocladius robacki? | | | | | | | | | A,P | | |
| 195 | Parakiefferiella bathophila | | | | A | | | | | | | A |
| 196 | Parakiefferiella fennica | | | | | | | | | | | A,P |
| 197 | Psectrocladius sp. | | | | | | | | | | | |
| 198 | Pseudosmittia ruttneri | | | | | | | | | A | A | |
| 199 | Chironominae | | | | | | | | | L | | |
| 200 | Cladotanytarsus sp. | | | | | | | | | | | |
| 201 | Lipiniella prob. arenicola | | | | | | | | | | A | |
| 202 | Micropsectra nigripila | | | | | | | | | A | | |
| 203 | Microtendipes chloris | | | | | | | | | A | | |
| 204 | Paracladopelma galaptera | | | | | | | | | | A | |
| 205 | Paratanytarsus tenuis | | | | | | | | | L | | |
| 206 | Polypedilum sp. | | | | | | | | | | A | |
| 207 | Stictochironomus nr. unguiculatus | | | | | | | | | L | | |
| 208 | Tanytarsus sp. | | | | | | | | | | | |
| 209 | Ceratopogonidae | | | | | | | | | | | |
| 210 | Atrichopogon | | | | | | | | | | | |
| 211 | Bezzia/Palpomyia | | | | | | | | | | | |
| 212 | Culicoides | | | | | | | | | | | |
| 213 | Dasyhelea | | | | | | | | | | | |
| 214 | Dixidae | | | | | | | | | | | |
| 215 | Tipulidae | | | | | | | | | | | |
| 216 | Empididae | | | | | | | | | | | |
| 217 | Hemerodromia | | | | | | | | | | | |
| 218 | Gastropoda | | | | | | | | | | | |
| 219 | Pelecypoda | | | | | | | | | | | |

Table 2

ADULT CHIRONOMID EMERGENCE PHENOLOGY OF COMMON SPRING SPECIES FOUND ALONG THE SHORELINE IN THE LES CHENEAUX ISLAND AREA OF NORTHERN LAKE HURON. ALSO INCLUDED ARE ADULT SIZE RANGES Of MALES AND ESTIMATED HABITAT OF THE LARVAL STAGE.

| | Total Body Length of Male Including Antenna (mm) | Habitat |
|---|---|---|
| Late April-Early May Emergence Period | | |
| *Hydrobaenus johannseni* (Sublette) | 6.1 | nearshore - rubble |
| *Heterotrissocladius oliveri* Saether | 4.9-5.7 | offshore - sand/silt |
| May Emergence Period | | |
| *Orthocladius nigritus* Malloch | 5.4 | nearshore - rubble |
| *Heterotrissocladius changi* Saether | 4.6-5.2 | offshore - sand/silt |
| *Pseudosmittia rutteri* Strenzke et Thien. | 2.7-4.0 | nearshore - ? |
| *Parakeifferiella bathophila* (Kieffer) | 2.7-3.4 | nearshore - rubble |
| Middle May-Early June Emergence Period | | |
| *Stictochironomus* n. sp. | 6.5-8.1 | nearshore - sand/silt |
| *Monodiamesa tuberculata* Saether | 6.0-8.3 | offshore - sand/silt |
| *Micropsectra* nr. *notescens* (Walker) | 4.8-5.1 | nearshore - ? |
| *Tanytarsus norvegicus* gr. Kieffer | 4.7-5.0 | nearshore - ? |
| *Paratanytarsus tenuis* Meigen | 4.5-5.0 | nearshore - ? |
| *Stempellina bausei* Kieffer | 3.9-4.0 | nearshore - ? |

Table 3

## Great Lakes Odonata Survey, Aug. 1996

**17 Aug. 1996 (Pat Hudson, Ken Tennessen, Tex Wells)**

1) MI, Arenac Co., Lake Huron, Wigwam Bay Wildlife Area
   *Enallagma carunculatum* 3m 2f (common)
   *Enallagma signatum* 1m (only one seen)
   *Ischnura verticalis* 3m 1f (common)
   *Leucorrhinia frigida* (only one seen)
   *Sympetrum vicinum* 1m (teneral, numerous)
   *Anax junius* (1 nymph close to emergence)
   Saw *Aeshna* sp. (probably *canadensis* and/or *eremita*).

2) MI, Alpena Co., L. Huron, Squaw Bay, east shore near Hwy. 23 and north shore off Partridge Pt. Rd.
   *Aeshna canadensis* 2m (numerous)
   *Aeshna constricta* 1m
   *Libellula pulchella* 3m
   *Libellula quadrimaculata* 1m
   *Sympetrum costiferum* 11m 3f (common)
   *Sympetrum obtrusum* 4m (common)
   *Sympetrum vicinum* 2m
   *Lestes disjunctus disjunctus* 5m 2f (common)
   *Enallagma ebrium* 1m (only one seen)
   *Enallagma hageni* 1m
   *Ischnura verticalis* 1m 1f
   *Nehalennia irene* 1m 1f
   Saw *Libellula lydia*.

3) MI, Alpena Co., L. Huron, Whitefish Bay, just east of Alpena
   *Aeshna canadensis* 1m (numerous)
   *Aeshna eremita* 1m
   *Aeshna umbrosa* 1m
   *Leucorrhinia proxima* 1m
   *Sympetrum costiferum* 1m 1f
   *Lestes disjunctus disjunctus* 2m 1f
   *Lestes vigilax* 1m
   *Enallagma hageni* 2m
   Saw *Ischnura verticalis*.
   Nymphs of: *Aeshna* sp., *Ladona julia, Sympetrum vicinum*.

**18 Aug. 1996 (Pat Hudson, Ken Tennessen, Tex Wells)**

1) MI, Mackinac Co., marsh along Hwy. M134, Prentiss Bay, Lake Huron
   *Somatochlora williamsoni* 3m (a few others seen)
   *Sympetrum danae* 1m (several tenerals)
   *Lestes disjunctus disjunctus* 1m (common)
   *Nehalennia irene* 1f (numerous)
   Nymphs of: *Aeshna* sp., *Sympetrum vicinum*, *Leucorrhinia* spp., *Somatochlora* sp.

2) MI, Mackinac Co., McKay Creek, Hwy. M-134
   *Aeshna umbrosa* 1m
   *Somatochlora williamsoni* 2m 1f
   *Sympetrum obtrusum* 1m 1f (common)

3) MI, Mackinac Co., pond, jct. Hwy. 123 & I-75
   *Aeshna canadensis* 1m (numerous)
   *Sympetrum costiferum* 3m (common)
   *Sympetrum danae* 4m 1f
   *Sympetrum obtrusum* 1 pr.
   Nymphs of: *Aeshna* sp. (*canadensis*?), *Libellula quadrimaculata*, *Leucorrhinia* sp.

4) MI, Mackinac Co., Summberby Swamp, Hwy. 123
   *Cordulegaster diastatops* 1f (only one seen)
   *Sympetrum danae* 3m
   *Lestes congener* 1m
   *Lestes dryas* 2m 1f
   *Lestes unguiculatus* 1m 1f
   Nymph of: *Boyeria vinosa*, *Cordulegaster bilineata*, *C. maculata.*

5) MI, Mackinac Co., Lake Huron, St. Martin Bay, about 1 mi. S of Hwy. M-134
   *Aeshna canadensis* 1 pr. (common)
   *Aeshna constricta* 1m
   *Aeshna eremita* 2m (common)
   *Somatochlora walshii* 2m (over gravel road)
   *Somatochlora williamsoni* 3m (common)
   *Enallagma hageni* 2m 2f (common)
   Saw *Ischnura verticalis.*
   Nymphs of: *Aeshna* sp. (*eremita*?), *Libellula quadrimaculata.*

6) MI, Mackinac Co., Search Bay, 1 mi. S of Hwy. M-134, Lake Huron
*Aeshna canadensis* 1m
*Aeshna umbrosa* 1m
*Somatochlora williamsoni* 1m
Saw *Leucorrhinia proxima*, *Libellula quadrimaculata*, *Lestes disjunctus disjunctus*, *Enallagma hageni*, *Ischnura verticalis*.

**19 Aug. 1996 (Pat Hudson, Ken Tennessen, Tex Wells)**

1) MI, Mackinac Co., Lake Michigan, W of St. Ignace, Boulevard Dr.
*Sympetrum costiferum* 2m 1f
*Lestes disjunctus disjunctus* 3m 2f
Saw *Sympetrum obtrusum*.

2) MI, Mackinac Co., Pte. aux Chenes River, Hwy. 2
*Somatochlora williamsoni* 4m 1f (numerous)
*Sympetrum costiferum* 1m
*Leucorrhinia frigida* 1m
Saw *Aeshna canadensis*, *Sympetrum obtrusum*, *Sympetrum vicinum*.

3) MI, Mackinac Co., Brevort River, Hwy. H-57 [not Great Lakes water, but dragonflies from here probably feed on insects from L. Michigan]
*Aeshna constricta* 1f
*Boyeria vinosa* 1m
*Sympetrum internum* 3f
Saw *Calopteryx maculata*.

4) MI, Mackinac Co., St. Martin Island (north bay), Lake Huron
*Aeshna canadensis* 1m (numerous)
*Sympetrum costiferum* 2m 1f 4 prs. (common)
*Sympetrum danae* 4m (numerous)
*Sympetrum obtrusum* 1m (numerous)
*Lestes disjunctus disjunctus* (numerous)
*Enallagma hageni* 2 prs. (numerous)
Saw *Libellula quadrimaculata*.
Nymphs of: *Aeshna* sp., *Leucorrhinia proxima* (?).

5) MI, Mackinac Co., Big St. Martin Island (east bay), L. Huron
*Somatochlora walshii* 1f (only one seen)
*Sympetrum costiferum* 1f (numerous)
*Sympetrum danae* 1m
Saw *Aeshna* sp., *Somatochlora williamsoni*, *Libellula quadrimaculata*, *Sympetrum obtrusum*, *Lestes disjunctus disjunctus*.
Nymphs of: *Aeshna* sp. (probably *canadensis*), *Anax junius* (?), *Leucorrhinia proxima* (?), *Sympetrum vicinum*.

**20 Aug. 1996 (Pat Hudson, Ken Tennessen)**

1) MI, Mackinac Co., South Service Rd., S of Hwy. M-134
*Aeshna canadensis* 1f
*Aeshna constricta* 1f
*Aeshna eremita* 1m
*Somatochlora walshii* 1f
Saw *Libellula pulchella*, *Sympetrum obtrusum*, *Sympetrum vicinum*.

2) MI, Mackinac Co., Brevort River, Hwy. H-57
*Ophiogomphus colubrinus* 1m
*Stylurus scudderi* 2m
Saw *Aeshna* sp., *Boyeria vinosa*, *Sympetrum obtrusum*, *Calopteryx aequabilis*, *Calopteryx maculata*.
Nymphs of: *Aeshna* sp., *Boyeria vinosa*, *Cordulegaster maculata*, *Ophiogomphus colubrinus*, *Gomphus* (*Gomphus*) sp. (probably *lividus* or *descriptus*), *Calopteryx aequabilis*, *Calopteryx maculata*.