

Results of Surveillance for Eurasian ruffe and round goby in Lake Huron, 2005

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*Abstract. – Monitoring for new and expanding populations of aquatic invasive species has been on-going in Lake Huron since 1992 and in the St. Marys River since 2000. Populations of invasive Eurasian ruffe *Gymnocephalus cernuus* and round goby *Neogobius melanostomus* have been documented in the fall using small-mesh bottom trawling gear at ports and rivers in nearshore areas. In 2005, five Lake Huron and five St. Marys River locations were sampled to detect new and document existing populations of these invasives. No new populations of gobies were discovered, and ruffe continue to be absent from our catch. However, gobies continued to persist at all Lake Huron locations where they previously became established. At these locations gobies were the most abundant species captured or were within the top two most abundant species. Catch rates ranged from 0.3 fish/minute at Port Dolomite to 3.9 fish/minute at the Cheboygan River. In general, the catch rate of gobies was up compared to 2004 in the Cheboygan River and Port Dolomite, but down in the Thunder Bay area. Ruffe and gobies remain undetected in the St. Marys River.*

Introduction

The U.S. Fish and Wildlife Service (Service) Alpena Fishery Resources Office has monitored Lake Huron ports and rivers since 1996 to collect information on existing benthic fish communities and to detect and monitor new or existing populations of aquatic invasive species (AIS). In 2000, efforts were expanded to include channels and ports in the St. Marys River. Two invasive fish species, the Eurasian ruffe (ruffe) *Gymnocephalus cernuus* and the round goby (goby) *Neogobius melanostomus*, are of particular concern.

Eurasian ruffe were discovered in the Great Lakes in 1986 at the Duluth-Superior harbor in western Lake Superior (Pratt et al. 1992), and gobies were discovered in the St. Clair River in 1990 (Jude et al. 1992). Both species likely were first introduced into the Great Lakes from the ballast water of ocean-going ships (Mills et al. 1993).

Ruffe and gobies have the potential to disrupt the ecosystem when present in high numbers by disrupting the food web and habitat of native fish and invertebrate species. Both species mature as early as age 2, spawn several times in a season, so they can become abundant quickly (Charlebois et al. 1997, Ogle 1998). They also have complex sensory features that allow them to feed in

darkness and more readily detect predators (Jude et al. 1995, Ogle 1998). Both species have been known to prey on fish eggs and small fish and may impact the reproduction and populations of other species (Adams and Maitland 1998, French and Jude 2001). The larger size and aggressive nature of the round goby has been found to negatively affect spawning and habitat use of other benthic fish species including mottled sculpin and logperch (Balshine et al. 2005, Janssen and Jude 2001). These characteristics provide the ruffe and goby a competitive advantage over native species (Jude 1997, Holker and Thiel 1998).

Within Lake Huron ruffe have maintained a limited distribution. Ruffe were first found in Lake Huron in 1995 from the Thunder Bay River in Alpena, Michigan (Ruffe Control Committee 1996). No expansion or new populations have been detected within the lake since that time. The ruffe population in the Thunder Bay River peaked in 1999 and has declined abruptly in subsequent years. Ruffe had not been captured from the Thunder Bay area since the spring of 2003.

Although gobies were first found in Lake Huron in 1994, they were first detected during our survey efforts in 1997 at the mouth of the Saginaw River in Essexville, Michigan (Schaeffer et al. 2005) (Table 1). We soon detected gobies at other shipping ports including Alpena (1998) and National Gypsum (1999), then over time at rivers and ports in the northern part of the lake including the Cheboygan River (2002) and Port Dolomite (2002) (Schaeffer et al. 2005). This report summarizes efforts conducted in 2005 to monitor the ruffe and goby abundance in nearshore areas of Lake Huron and the St. Marys River.

Methods

A 4.9-m, small-mesh, otter trawl (3.8-cm stretch mesh body, and 6.35-mm square-mesh cod liner) was used to sample for ruffe and goby in Lake Huron and the St. Marys River. Surveillance

was conducted in locations where these species may have been transported in ballast water, mainly shipping ports, shipping channels and river mouths (Ruffe Control Committee 1996). Sampling was also conducted at locations where preferred habitat was found including areas with turbid water, soft substrates, and water depths of 3-8 meters. Sampling took place in September and October (9/26-10/24) of 2005. Effort consisted of a total of 30 minutes of trawling at each sampling location. Tows ranged in duration from 4 to 9 minutes at 1200 RPM. In total, 28 tows were conducted in Lake Huron and 21 tows in the St. Marys River. Water depth was measured with a Furuno depth sounder at the beginning and end of each tow, and bottom water temperatures were measured with a YSI digital thermometer at each location.

The catch was separated by species, and then total lengths were measured on a maximum of 15 specimens of each species. All round goby were retained and euthanized, while non-target species were returned unharmed to the water. Relative abundance was determined for goby and expressed as catch-per-minute-of-effort (CPE) for each location.

Results

Eleven locations in U.S. waters of Lake Huron and the St. Marys River were surveyed in 2005 (Figure 1). Ports in central and southern Lake Huron were not sampled due to restricted staff and budget. A total of 155 minutes of effort were conducted at five locations in northern Lake Huron (Table 2) and 145 minutes of effort were conducted at six locations in the St. Marys River (Table 3).

No ruffe or gobies have been detected in the St. Marys River to date (Table 3). Within Lake Huron, no new populations of ruffe were detected (Table 2), and no ruffe were captured for the fifth consecutive year from the previously established population in the Thunder Bay area (Figure 2).

Gobies were previously discovered at all five Lake Huron locations and continue to persist in those areas (Table 2). A synopsis of the goby catch at each location follows.

Cheboygan River

Gobies were a major portion of the total catch from the Cheboygan River in 2005. The CPE for gobies was 3.9 fish/minute, an approximate five fold increase in abundance over the catch in 2004 (Figure 3). They were the most abundant species captured from the river and composed 98% of the total catch. Gobies collected averaged 65 ± 4.2 mm in total length (95% confidence interval). Only two other species, smallmouth bass *Micropterus dolomieu* and yellow perch *Perca flavescens*, were captured in addition to gobies. Gobies were first discovered from the Cheboygan River in 2002 and since their discovery have composed a large portion of the total catch (Figure 3).

Thunder Bay Area

The Thunder Bay area consists of three sampling locations - two sites in Thunder Bay at the Lafarge shipping channel and the main shipping channel, and one site at the mouth of the Thunder Bay River. Gobies were a major portion of the total catch from the Thunder Bay area in 2005. The average CPE for gobies was 1.5 fish/minute, a decrease in abundance from 2004 (Figure 3). Catches ranged from 0.7 fish/minute in the Thunder Bay River to 2.2 fish/minute in the LaFarge shipping channel (Table 2). Goby abundance has declined within the area since its peak from 2000-2002; however, it remains the most abundant species captured and composed 98% of the total catch (Figure 3). Gobies collected from the Thunder Bay area averaged 55 ± 4.6 mm in total length (95% confidence interval). Only three other fish species, spottail shiner *Notropis spilopterus*, smallmouth bass, and yellow perch, were captured from the Thunder Bay area in addition to gobies. Gobies

were discovered in the Thunder Bay area in 1997 when one was impinged on a water intake screen at the Lafarge Corporation. They were first captured during our surveys there in 1998 (Table 1). Gobies have been the most abundant species captured from the area for a number of years since their discovery (Figure 3).

Port Dolomite

Gobies were a minor component of the total catch from Port Dolomite. Their CPE was 0.3 fish/minute (Table 2), an increase in abundance from 2004 – a year in which gobies were not captured during sampling (Figure 3). Gobies collected at Port Dolomite averaged 66 ± 16.7 mm in total length. They composed 28% of the total catch and were the second most abundant species captured following slimy sculpin *Cottus cognatus*, which composed 52% of the total catch. Three other species were represented in the catch in addition to slimy sculpin and gobies, including channel catfish *Ictalurus punctatus*, Johnny darter *Etheostoma nigrum*, and ninespine stickleback *Pungitius pungitius*. Gobies were first discovered at Port Dolomite in 2002 and were the most abundant species captured that year, then were not caught again until 2005 (Figure 3).

Nine other species were captured from Lake Huron sampling locations and 21 other species were captured from St. Marys River sampling locations in 2005. A list of non-target species is provided in the Appendix for reference.

Discussion

The distribution and abundance of gobies has exceeded that of ruffe in Lake Huron. Gobies generally compose a large portion of the total catch where they become established. Observations of fish communities at surveyed ports revealed that gobies were almost always the most abundant species

where captured, even in their first year of detection, and often remained the most abundant benthic species (Schaeffer et al. 2005). We witnessed this trend within Lake Huron at four of the five locations currently sampled in the Cheboygan River and Thunder Bay area. While the Cheboygan River population continues to increase in abundance, with 2005 the highest abundance yet noted, we documented a decline in the abundance of goby in Thunder Bay. The Thunder Bay population exhibited a rapid increase and has declined from 2000 to 2002 levels. This is a common trend with many aquatic invasive species (Moyle and Light 1996) which may partly explain our observations. Even though the relative abundance of goby has declined, they remain the most abundant benthic species and largest component of the total catch in the fall.

Gobies did not readily become established at Port Dolomite following their initial discovery in 2002 and have not been captured there again until 2005. We don't know why goby have not become abundant at this port, yet are abundant in other nearby harbors located in Cedarville and Hessel.

Without widespread ballast regulations in place, intra-lake shipping has likely spread gobies from infested ports to new areas around Lake Huron (Clapp et al. 2001, Schaeffer et al. 2005). This has been coupled with rapid localized unassisted expansion, possibly due to the behavioral exclusion of juveniles by adult goby (Ray and Corkum 2001). Also, the prior invasion of zebra mussels *Dreissena polymorpha*, a prey item for the goby in its native range, has probably facilitated rapid and successful colonization of gobies around the lake (Jude 1997).

The ruffe, on the other hand, has not been detected at other new areas within Lake Huron in over a decade since its initial discovery. This may be due in part to voluntary ballast water restrictions that were established for ships entering Thunder Bay and the Thunder Bay River by the Great Lakes Carriers Association (GLCA) (Harkins 1996). Soon after ruffe were first discovered in Thunder Bay, the GLCA enacted measures to restrict ships from taking on ballast in nearshore waters of the bay to

help prevent the assisted spread of ruffe to other areas of Lake Huron and the Great Lakes. No other new ruffe sightings have been reported around the lake. Within Lake Superior, ruffe have expanded their range along the southern coast of the lake to new areas through unassisted migration. We can't explain why ruffe have not migrated or moved out of the Thunder Bay area to other parts of Lake Huron in this manner.

Likewise, we do not know the cause of the rapid decline and apparent disappearance of ruffe from Thunder Bay. We believe the decline in ruffe abundance may be due to recruitment failure of the 1999 year class or was the result of a combination of factors which included the invasion and establishment of goby and our efforts to remove ruffe from the area. Gobies became abundant quickly within Thunder Bay. As egg and fry predators (French and Jude 2001), goby have the potential for predation on the eggs and fry of ruffe and may have impacted the success of ruffe reproduction. In addition, our removal of ruffe captured during autumn surveillance using small-mesh bottom trawling may have impacted ruffe recruitment in the area because fall trawling captured mainly young-of-the-year ruffe (unpublished data). We also initiated an adult ruffe removal effort in the Thunder Bay River using small-mesh gillnets to remove ruffe prior to spawning and this removal may have impacted reproduction. Possible predation by goby coupled with removal efforts by our office may have led to the demise of ruffe in Thunder Bay. Continued surveillance is needed in the Thunder Bay area to confirm whether ruffe have been extirpated from there.

The St. Marys River remains free of ruffe and goby despite being the single source and relatively confined vector for shipping traffic into Lake Superior. Both ruffe and goby have been found at ports in Lake Superior and Lake Huron, and could potentially be introduced to the area via shipping ballast water purged to pass through the locks at Sault Ste. Marie. Unassisted range expansion through migration of these species is also a threat to the St. Marys River. Within Lake Huron, gobies have been

documented within 30 km of the St. Marys River to the south at Port Dolomite (unpublished data) and within Lake Superior ruffe have been captured approximately 60 km from the river to the north at the Tahquamenon River (Gary Czypinski, personal communication). As such, goby may be poised to enter the river from existing populations in the south and ruffe may be poised to enter the river from existing populations in the north. Continued surveillance is needed to locate any ruffe or goby in the St. Marys River prior to establishment of populations, when numbers are still low and when control may be an option for eradication.

In order to detect new populations, control existing populations, and prevent establishment of additional populations of ruffe and goby in Lake Huron and the St. Marys River, survey efforts will continue in 2006 and beyond.

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Table 1. Progression of round goby detected at Lake Huron ports over time. The “X” represents years when goby were captured and the “O” represents years when goby were not captured. Blanks represent un-sampled years.

| Location (N to S) | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <u>Lake Huron</u> | | | | | | | | | | | |
| Cedarville - Port Dolomite | O | O | O | O | O | O | O | X | O | O | X |
| Cheboygan - Cheboygan River mouth | O | O | O | O | O | O | O | X | X | X | X |
| Alpena - Thunder Bay area | O | O | O | X | X | X | X | X | X | X | X |
| Tawas – National Gypsum port | | O | O | O | X | X | | X | | X | |
| AuGres – AuGres River mouth | | | O | O | O | | | | | X | |
| Essexville – Saginaw River mouth | | | X | O | X | X | | X | X | X | |
| Carrollton – Saginaw River | | | | | | | | X | | X | |
| Harbor Beach – Detroit Edison port | | | | O | | | | X | | X | |

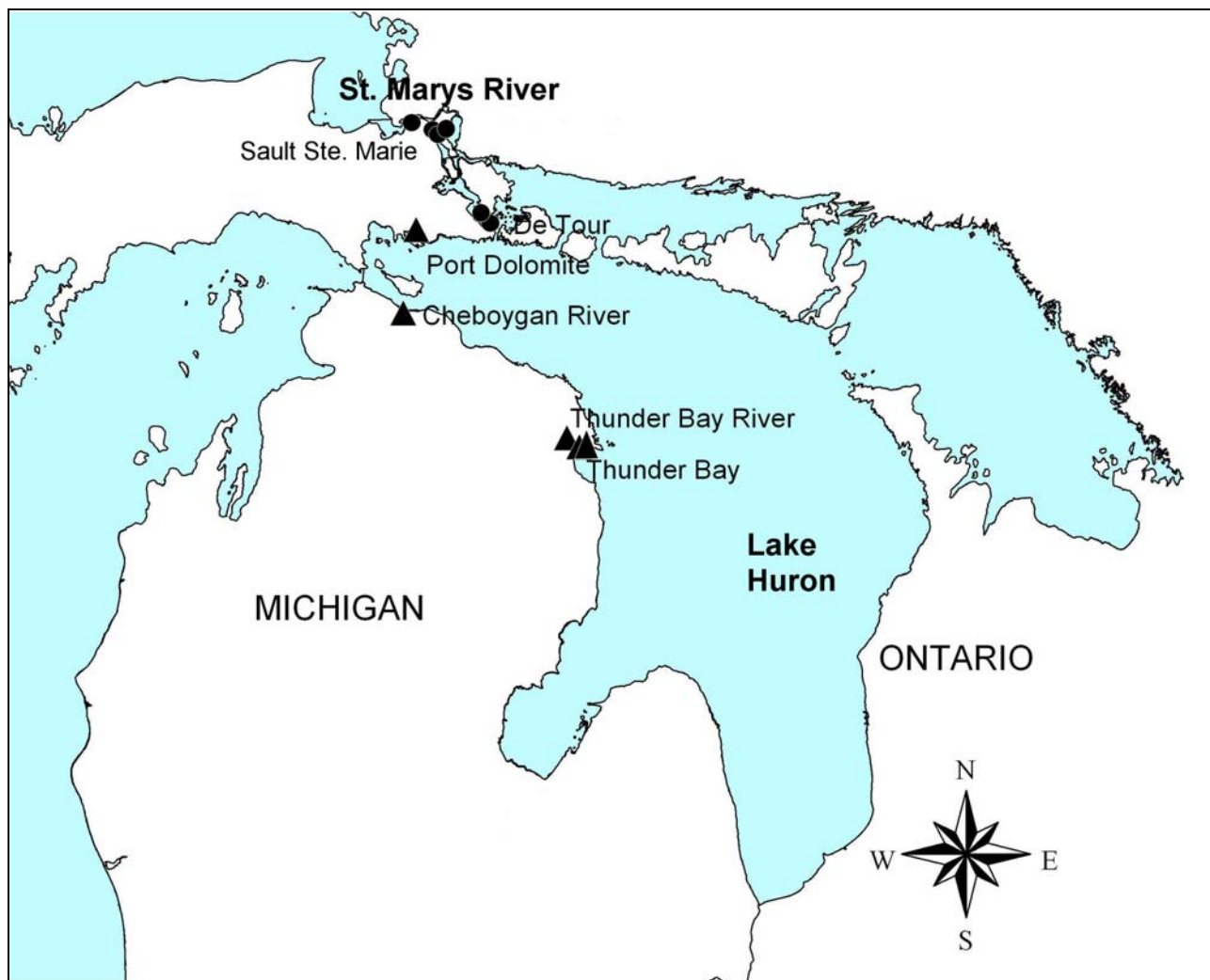


Figure 1. Surveillance sites in Lake Huron (▲) and the St. Marys River (●).

Table 2. Summary of surveillance activities in Lake Huron during 2005.

| Location (N to S) | Effort | Date | Ave. Depth (m) | Ave. Temp. (C) | Ruffe CPE | Goby CPE |
|---------------------------------------|---------------------|------------|----------------|----------------|-----------------------|----------------------|
| Lake Huron | | | | | | |
| Cedarville - Port Dolomite | 30.0 | 9/26/2005 | 6.9 | 13.9 | 0 | 0.3 |
| Cheboygan - Cheboygan River Mouth | 30.0 | 9/28/2005 | 6.9 | 18.2 | 0 | 3.9 |
| Alpena - Thunder Bay Lafarge Channel | 5.0 | 10/24/2005 | 8.4 | 11.1 | 0 | 2.2 |
| Alpena - Thunder Bay Shipping Channel | 60.0 | 10/20/2005 | 6.1 | 12.2 | 0 | 1.5 |
| Alpena - Thunder Bay River | 30.0 | 10/20/2005 | 6.4 | 11.5 | 0 | 0.7 |
| | | | | | Mean Ruffe CPE | Mean Goby CPE |
| | Total Effort | | | | 0 | 1.7 |
| | 155.0 Minutes | | | | | |

Table 3. Summary of surveillance activities in the St. Marys River during 2005.

| Location (N to S) | Effort | Date | Ave. Depth (m) | Ave. Temp. (C) | Ruffe CPE | Goby CPE |
|--|---------------------|-----------|----------------|----------------|-----------------------|----------------------|
| St. Marys River | | | | | | |
| Sault Ste. Marie - Above Locks | 32.0 | 9/27/2005 | 9.3 | 17.8 | 0 | 0 |
| Sault Ste. Marie - Municipal Harbor | 30.0 | 9/27/2005 | 3.8 | 18.0 | 0 | 0 |
| Sault Ste. Marie - Channel South of Sugar Isl. Ferry | 30.0 | 9/27/2005 | 9.1 | 17.8 | 0 | 0 |
| Sault Ste. Marie - Baie de Wasai | 30.0 | 9/27/2005 | 4.8 | 16.4 | 0 | 0 |
| De Tour Village - Coal Dock | 11.0 | 9/26/2005 | 5.6 | 17.5 | 0 | 0 |
| De Tour Village - Maud Bay | 12.0 | 9/28/2005 | 7.5 | 17.2 | 0 | 0 |
| | | | | | Mean Ruffe CPE | Mean Goby CPE |
| | Total Effort | | | | 0 | 0 |
| | 145.0 Minutes | | | | | |

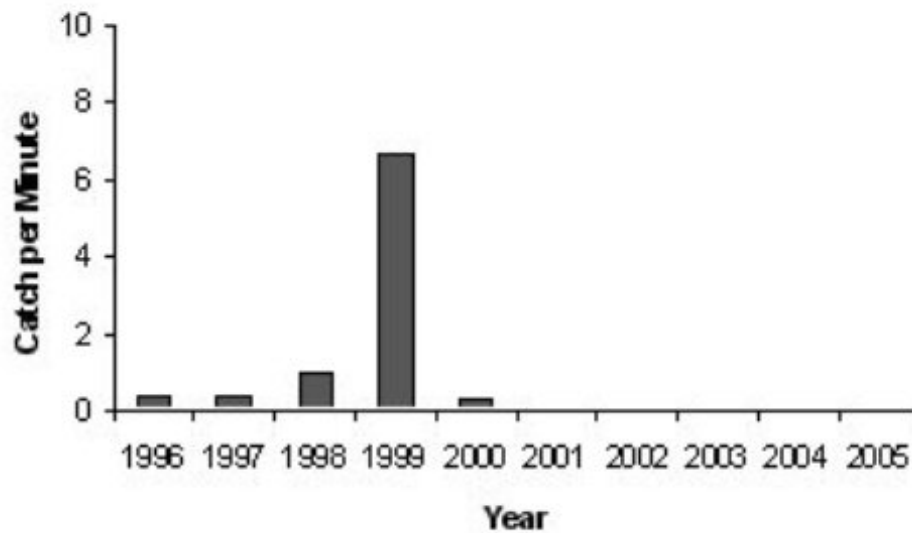


Figure 2. Relative abundance of Eurasian ruffe in the Thunder Bay area, 1996-2005. Sampling was conducted with a 4.9-m bottom trawl, and effort was measured in minutes trawl was fished on the bottom. The sampling location spans from the Second Avenue Bridge downstream to the TB buoy in Thunder Bay.

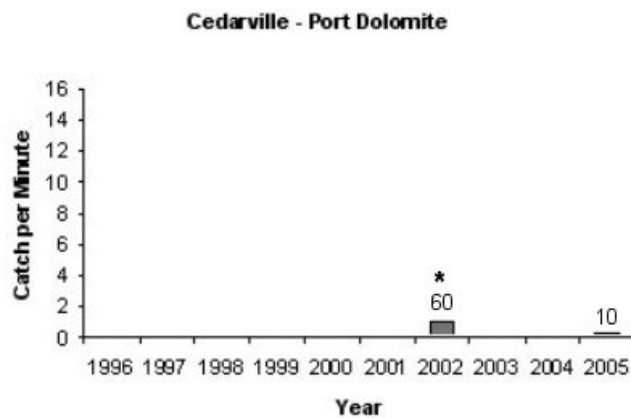
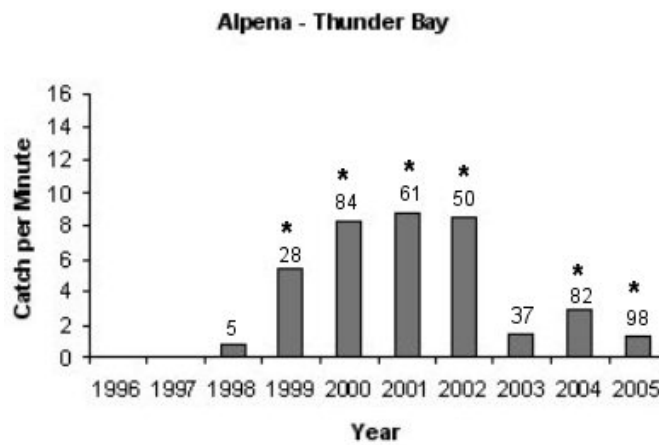
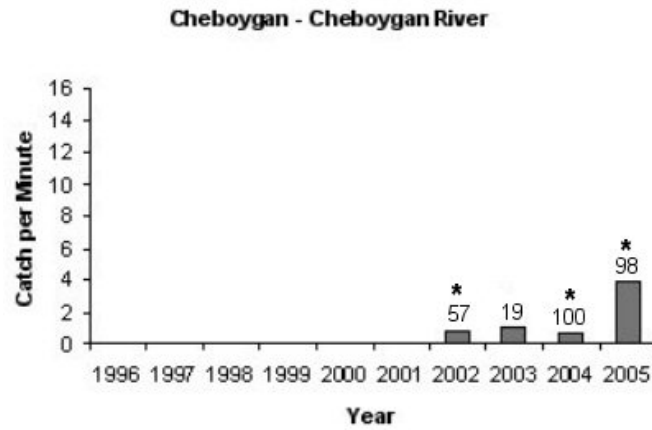


Figure 3. Relative abundance of round gobies at selected ports in Lake Huron, 1996-2005. Sampling was conducted with a 4.9-m bottom trawl, and effort was measured in minutes the trawl was fished on the bottom. Number above each bar indicates percentage of catch made up by goby. The “*” indicates when gobies were most abundant.

Appendix I

Relative abundance (catch per minute) of non-target species captured from Lake Huron in 2005.

| Common name | Scientific name | Cedarville Port Dolomite | Cheboygan Cheboygan River | Alpena Lafarge Channel | Alpena Shipping Channel | Alpena Thunder Bay River |
|-----------------------|-----------------------------|---|--|---------------------------------------|--|---|
| Bluntnose minnow | <i>Pimephales notatus</i> | | | | 0.02 | |
| Channel catfish | <i>Ictalurus punctatus</i> | 0.03 | | | | |
| Johnny darter | <i>Etheostoma nigrum</i> | 0.07 | | | | |
| Ninespine stickleback | <i>Pungitius pungitius</i> | 0.10 | | | | |
| Pumpkinseed sunfish | <i>Lepomis gibbosus</i> | | | | 0.02 | |
| Slimy sculpin | <i>Cottus cognatus</i> | 2.30 | | | | |
| Smallmouth bass | <i>Micropterus dolomieu</i> | | 0.03 | | | |
| Spottail shiner | <i>Notropis hudsonius</i> | | | | | 0.03 |
| Yellow perch | <i>Perca flavescens</i> | | 0.03 | | | |

Appendix II

Relative abundance (catch per minute) of non-target species captured from the St. Marys River in 2005.

| Common name | Scientific name | Sault Ste. Marie Above Locks | Sault Ste. Marie Municipal Harbor | Sault Ste. Marie Sugar Island Channel | Sault Ste. Marie Baie de Wasai | DeTour Coal Dock | DeTour Maud Bay |
|-----------------------|--------------------------------|------------------------------------|---|---|--------------------------------------|------------------------|-----------------------|
| Alewife | <i>Alosa pseudoharengus</i> | | | | | | 30.92 |
| Bluntnose minnow | <i>Pimephales notatus</i> | 0.28 | | | 2.77 | | |
| Bluegill | <i>Lepomis macrochirus</i> | | | | 0.10 | | |
| Gizzard shad | <i>Dorosoma cepedianum</i> | | | | | | 0.08 |
| Golden shiner | <i>Notemigonus crysoleucas</i> | | | | 0.17 | | |
| Johnny darter | <i>Etheostoma nigrum</i> | | | 0.03 | 0.07 | | 0.50 |
| Logperch | <i>Percina caprodes</i> | | | 0.13 | | | 0.67 |
| Mimic shiner | <i>Notropis volucellus</i> | | | | | | 0.08 |
| Ninespine stickleback | <i>Pungitius pungitius</i> | 0.06 | | | | | |
| Northern pike | <i>Esox lucius</i> | | | | 0.07 | | |
| Pumpkinseed sunfish | <i>Lepomis gibbosus</i> | | | | 0.03 | | |
| Rock bass | <i>Ambloplites rupestris</i> | | | | 0.03 | | |
| Rainbow smelt | <i>Osmerus mordax</i> | 0.06 | | | | | 9.58 |
| Slimy sculpin | <i>Cottus cognatus</i> | 0.03 | 0.07 | | 0.07 | | |
| Spottail shiner | <i>Notropis hudsonius</i> | | | | 0.10 | | 8.75 |
| Trout-perch | <i>Percopsis omiscomaycus</i> | | | 0.10 | 0.43 | | 30.08 |
| Walleye | <i>Sander vitreum</i> | | | | | | 0.33 |
| White bass | <i>Morone chrysops</i> | | | | | | 0.33 |
| White perch | <i>Morone americana</i> | | | | | | 10.25 |
| White sucker | <i>Catostomus commersonii</i> | 0.22 | | | 0.10 | 0.06 | 1.25 |
| Yellow perch | <i>Perca flavescens</i> | | | | 0.77 | | 0.17 |

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