



**SURVEILLANCE
FOR RUFFE IN
THE GREAT LAKES, 2006**



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[Return to Aquatic Invasive Species](#)

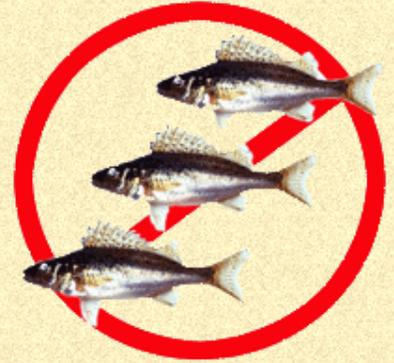
[Introduction](#) | [Objectives](#) | [Methods](#) | [Results](#) | [Discussion](#) | [Acknowledgments](#) | [Bibliography](#)

INTRODUCTION



The **ruffe** (*Gymnocephalus cernuus*), an Eurasian percid, was likely introduced to the St. Louis River Estuary (SLRE), Minnesota/Wisconsin, during the mid 1980s in the ballast water of an ocean-going ship (Pratt et al. 1992). Ruffe increased rapidly and became the most abundant fish in the SLRE by 1990, based on bottom trawl assessment. The population peaked at about eight million in trawls by 1995 and subsequently declined to about two million in trawls by 2004; however, ruffe remained the most abundant species in trawls through 2004; the U.S. Geological Survey (USGS) terminated bottom trawl assessments in the SLRE after 2004 (unpublished,

USGS, Great Lakes Science Center, Lake Superior Biological Station, Ashland, Wisconsin). In 1991, ruffe were detected in Thunder Bay Harbour, Ontario, (Busiahn 1997). Due to potential competition for food and space, ruffe pose a threat to native fish populations (Ruffe Task Force 1992).



In the right habitat, ruffe can become very abundant. These trays contain over 2,000 ruffe captured during surveillance of Thunder Bay Harbour, Ontario, 10/06. Note the "glossy" eyes like a walleye.

Experimental research conducted by the University of Minnesota-Duluth revealed that ruffe consume a significant amount of benthic macroinvertebrate energy (Schuldt et al. 1999). In a presentation of this experiment, co-author Carl Richards, University of Minnesota Natural Resources Research Institute, stated in conclusion: "With the significant amount of benthic macroinvertebrate energy that ruffe are consuming in the St. Louis River Estuary, something has got to be happening in that ecosystem. We are just not seeing it yet." In the same experiment, research also demonstrated significant declines in the growth of yellow perch (*Perca flavescens*), at ruffe densities less than, equal to, and greater than the densities of yellow perch (Henson 1999). However, a statistical analysis of bottom trawl data conducted by USGS showed no significant relationship between an increasing ruffe population and declining native fish populations in the St. Louis River, Minnesota/Wisconsin (Bronte et al. 1998).

In three Wisconsin tributaries just east of the St. Louis River, 1995-2002 trawl data suggested that yellow perch abundance declined in years when ruffe abundance increased (Evrard et al. 1998; Czypinski et al. 2002). However, this trend was statistically analyzed and found to be weakly significant ($p < 0.10$) for all three tributaries combined (unpublished, D. H. Ogle, Department of Mathematics, Northland College, Ashland, Wisconsin).

As a result of increasing abundance and expansion outside the SLRE and speculation about potential impacts on native fish populations, the Aquatic Nuisance Species Task Force declared the ruffe to be a "nuisance species" in the spring of 1992. By authority of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, this designation authorized the formation of a control committee charged with the responsibility of designing and implementing a control plan. The **Ruffe Control Plan** was drafted in 1995 with a revision in 1996 after ruffe were discovered in Lake Huron in 1995 (Kindt et al. 1996).

The goal of the Ruffe Control Plan was and still is "to prevent or delay the spread of ruffe in the Great Lakes and inland waters" (Ruffe Control Committee 1996). Surveillance was one of eight objectives designed into the plan to achieve this goal.

Formal ruffe surveillance efforts began in 1992 to detect pioneering populations of ruffe in the Great Lakes (Slade and Kindt 1992). These efforts were initiated by the U.S. Fish and Wildlife Service (USFWS) - Ashland Fishery Resources Office (Ashland FRO) and the Ontario Ministry of Natural Resources (OMNR) - Lake Superior Management Unit.

The term ruffe surveillance, as used herein, is defined as efforts designed and implemented specifically to find and collect ruffe.

The term other fish sampling, as used herein, is defined as efforts implemented to assess a fishery (including sea lamprey (*Petromyzon marinus*) assessments), in which ruffe were not specifically the target species, but the gear used was capable of capturing ruffe. Fishery assessment methods and results were provided to us per our request to fishery management and/or research agencies working in the Great Lakes. This is not a complete list of fishery sampling using gear that is capable of capturing ruffe, only that which was reported or known to us.

Following is a chronology of ruffe detection and subsequent surveillance for the Great Lakes Basin:

1986: Ruffe were discovered in the SLRE (Duluth-Superior Harbor), Minnesota/Wisconsin, by the Wisconsin Department of Natural Resources (WDNR). This was the initial sighting of ruffe in North America.

1991: Major ruffe range expansion was detected. A crew from Ashland FRO discovered ruffe in Thunder Bay Harbour, Ontario, 293 km northeast of the SLRE along the north shore of Lake Superior. This introduction was likely a ballast water transfer from shipping operating between the Duluth/Superior Harbor, Minnesota/Wisconsin and Thunder Bay Harbour.

1992: Major ruffe range expansion was detected. Ashland FRO initiated formal ruffe surveillance, and located several new populations along the south shore of Lake Superior, thus extending the known range of ruffe to the Sand River, Wisconsin, 60 km east of the SLRE.

1993: Major ruffe range expansion was detected. Ashland FRO discovered eight new locations colonized by ruffe in Lake Superior. Ruffe were not detected in Chequamegon Bay, Wisconsin, as expected, but were collected further east in the Bad River, Wisconsin, 156 km east of the SLRE (Busiahn 1997). At the Bad River, ruffe were poised to enter Michigan waters of Lake Superior. USFWS-Lower Great Lakes Fishery Resources Office (LGLFRO) initiated ruffe surveillance in U.S. waters of Lakes Erie and Ontario (Slade et al. 1994). No ruffe were detected in the Lower Great Lakes.

1994: Major ruffe range expansion was detected. Ashland FRO discovered ruffe at five new locations in Lake Superior, the farthest of which was the Ontonagon River, Michigan, 276 km east of the SLRE. OMNR-Lake Superior Management Unit also captured ruffe in Thunder Bay Harbour, Ontario, Lake Superior, where they had not been caught since 1991 (Slade et al. 1995). No ruffe were detected in the Lower Great Lakes.

1995: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Huron near the mouth of the Thunder Bay River, Michigan; this discovery was 480 km east of the Ontonagon River, Michigan (Busiahn 1997). The Thunder Bay River was the only confirmed location where ruffe had been captured outside of Lake Superior, and it became the periphery of the ruffe range in the Great Lakes. This introduction into Lake Huron was likely an assisted range expansion from ballast water release. No ruffe were detected in the Lower Great Lakes.

1996: No ruffe range expansion was detected. USFWS-Alpena Fishery Resources Office (Alpena FRO) assumed ruffe surveillance for U.S. waters of Lake Huron and one site in northern Lake Michigan. OMNR-Lake Superior Management Unit captured eight ruffe, the largest single-year catch since trawling began in Thunder Bay Harbour, Ontario in 1991 (Czypinski et al. 1997). Five of these specimens were young-of-the-year (YOY) indicating that successful reproduction was occurring in tributaries flowing into Thunder Bay, Ontario. No ruffe were detected in the Lower Great Lakes.

1997: Some interior ruffe range expansion was detected. Ruffe were discovered in three new locations within their known range in Lake Superior. OMNR conducted ruffe surveillance in Canadian waters of Lake Huron. Ruffe catch rates at peripheral locations were approximately less than or equal to previous years. No ruffe were detected in the Lower Great Lakes. Many agencies, as well as the public, contributed to the ruffe surveillance effort by providing voluntary reports of incidental captures.

1998: No ruffe range expansion was detected, but ruffe became the most abundant species captured during fall bottom trawling ruffe surveillance in the Thunder Bay River, Michigan, Lake Huron, a peripheral range location. OMNR expanded ruffe surveillance into Canadian waters of Lake Erie, and LGLFRO added fall surveys to their ruffe surveillance locations. However, no ruffe were detected in the Lower Great Lakes.

1999: Only minor ruffe range expansion was detected. Ashland FRO detected ruffe in one new location in Lake Superior, the Firesteel River, Michigan, representing a range expansion of 12 km eastward along the south shore of Lake Superior. The catch per unit effort (CPE) of ruffe in the Thunder Bay River, Michigan, Lake Huron, increased from 60 per hour bottom trawling in 1998 to 660 per hour bottom trawling. The majority of the Thunder Bay River ruffe catch was YOY, and ruffe remained the most abundant species captured in trawls from this location. Round goby (*Neogobius melanostomus*) were first captured from the Thunder Bay River. No ruffe were detected in the Lower Great Lakes.

2000: No ruffe range expansion was detected. Ruffe catch rates at peripheral locations (Thunder Bay Harbour, Ontario, Lake Superior, and Thunder Bay River, Michigan, Lake Huron) were less than or equal to previous years. The exception was the Ontonagon River, Michigan Lake Superior, where the mean ruffe CPE (No./Hr. bottom trawling) more than doubled from 5 in 1999 to 11. The CPE of ruffe in the Thunder Bay River, Michigan, Lake Huron declined from 660 to 18 per hour bottom trawling. Round goby were the most abundant species captured from the Thunder Bay River during ruffe surveillance. No ruffe were detected in the Lower Great Lakes.

2001: Minor ruffe range expansion was detected. OMNR detected ruffe near the mouth of the Current River, Lake Superior, which is located within Thunder Bay Harbour, Ontario. This discovery represents a range expansion of 8 km eastward along the north shore of Lake Superior. A large catch of YOY ruffe from one bottom trawl tow in the Ontonagon River, Michigan, increased the mean CPE (No./Hr. bottom trawling) of that colony more than 7 fold to 78. However, no ruffe were captured east of the Ontonagon River along the south shore of Lake Superior. Using a 38 mm stretch mesh gill net (15 m panel), the Red Cliff Tribal Fisheries Department in cooperation with Ashland FRO attempted to capture ruffe during a lake whitefish (*Coregonus clupeaformis*) spawning assessment near the Apostle Islands, Lake Superior. The objective of this effort was to investigate potential ruffe predation on lake whitefish eggs; no ruffe were captured in this one-night effort. No ruffe were captured from the Thunder Bay River colony or any other ruffe surveillance location in Lake Huron. No ruffe were detected in the Lower Great Lakes.

2002: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Michigan near Escanaba, Michigan, and in the Sturgeon River Sloughs, Keweenaw Waterway, Lake Superior, 101 km east of the Ontonagon, River, Michigan, the previous eastern boundary of the ruffe

range along the south shore of Lake Superior. In the Ontonagon River, although trawling indicated a decline in ruffe abundance from 2001, the overall trend in ruffe abundance continues to increase. No ruffe expansion was detected in Lake Huron, and no ruffe were captured in trawls within the ruffe range in Lake Huron.

Alpena FRO initiated reduction of the spawning ruffe population in the Thunder Bay River, Michigan, Lake Huron, with a 38 mm stretch mesh gill net (30.5 m panel); a total of 96 ruffe were captured in 52 nights of effort. The Red Cliff Tribal Fisheries Department in cooperation with Ashland FRO continued a ruffe capture effort during lake whitefish spawning near the Apostle Islands, Lake Superior; no ruffe were captured in this one-night gill net effort.

Due to unseasonably cold weather, no ruffe surveillance was conducted in Thunder Bay Harbour, Ontario, the eastern boundary of the ruffe range along the north shore of Lake Superior. No ruffe were detected in the Lower Great Lakes.

2003: Minor ruffe range expansion was detected in Thunder Bay Harbour, Ontario, Lake Superior, and in Little Bay de Noc, Michigan, Lake Michigan. However, ruffe CPE in trawls increased significantly in Thunder Bay Harbour from 78/hour in 2000 to 569/hour in 2003. In addition, round goby and white perch (*Morone americana*) were discovered in Thunder Bay Harbour, the second confirmed location for round goby in Lake Superior. Ruffe surveillance was expanded in Lake Michigan by Ashland and Green Bay FROs to include a total of nine major ports, but no ruffe were captured outside of Little Bay de Noc. Ruffe were not captured from new locations in Lake Huron.

In Lake Huron, the Alpena FRO continued reduction of spawning ruffe in the Thunder Bay River, removing a total of ten ruffe in 74 nights of gill net effort. In Lake Superior, a combination of bottom trawling, gill netting, and trapping conducted by the Ashland FRO failed to effectively (achieve a minimum reduction of 90% of the ruffe population) reduce the ruffe spawning population in the Ontonagon River Estuary, Michigan. Totals of 65, 16, and 4 ruffe were removed in 5.2 hours of trawling effort, 23 nights of trapping effort, and 2.9 hours of gill netting (30.5 m panel) effort, respectively. A bycatch of 62 stocked juvenile lake sturgeon (*Acipenser fulvescens*) were also captured, standard data were recorded, and all sturgeon were released alive. No ruffe were detected in the Lower Great Lakes.

2004: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Marquette Harbor, Michigan, Lake Superior, 110 km east of the Sturgeon River Sloughs, Keweenaw Waterway, the previous detected eastern boundary of the ruffe range along the south shore of Lake Superior. The Michigan Department of Natural Resources (MIDNR) discovered ruffe in Big Bay de Noc, Lake Michigan, 15 km east of Little Bay de Noc. Little Bay de Noc was the location of initial discovery of ruffe in Lake Michigan in 2002. Ruffe were not captured from new locations in Lake Huron, nor were they captured from the Thunder Bay River, Michigan. Ruffe remained undetected in the Lower Great Lakes, and in all inland lakes and streams within the Great Lakes Basin.

2005: In Lake Superior, minor range expansion was detected. The USGS-Lake Superior Biological Station incidentally captured one sub-adult ruffe from Thunder Bay, Ontario, 5 km northeast of Thunder Bay Harbour, Ontario, the previous eastern boundary of the ruffe range along the north shore of Lake Superior. The MIDNR incidentally captured one mature ruffe from Torch Lake, a new location within the Keweenaw Waterway; ruffe were first detected in the Keweenaw Waterway in 2002. The Ashland FRO captured one mature ruffe from lower Marquette Harbor, Michigan, where ruffe were first detected in 2004. Marquette Harbor continues to be the eastern boundary of the ruffe range along the south shore of Lake Superior.

In Lake Huron, no ruffe were captured from new or previously detected locations, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995. In Lake Michigan, MIDNR captured no ruffe in other fish sampling from Big Bay de Noc, where they were first detected in 2004. However, MIDNR captured a total of 22 ruffe in other fish sampling from Little Bay de Noc, where ruffe were first detected in 2002. The Big and Little bays de Noc of northern Green Bay continue to comprise the ruffe range in Lake Michigan. No ruffe were captured from the Lower Great Lakes, where they remain undetected as well as in all inland lakes and streams within the Great Lakes Basin.



Ruffe are very easily captured in a bottom trawl. Once a ruffe population is established in a preferred habitat, trawl catches approaching 90% ruffe are not uncommon.

2006: Along the south shore of Lake Superior, surveillance activity confirmed a major ruffe expansion 226 km east of Marquette Harbor, Michigan, the previous eastern boundary of the ruffe range. An Ashland FRO crew captured one adult ruffe near Grand Marais, Michigan, 120 km east of Marquette Harbor. The MIDNR confirmed one adult ruffe captured by an angler in Little Lake Harbor, Michigan, 167 km east of Marquette Harbor. The Ashland FRO confirmed two adult ruffe captured by an angler in the Tahquamenon River estuary, a tributary on the west shore of Whitefish Bay, 226 km east of Marquette Harbor and 55 km west of the Soo Locks. The OMNR confirmed that ruffe span the entire length (13 km) of Thunder Bay Harbour of Thunder Bay, Ontario, the eastern boundary of the ruffe range along the north shore. OMNR also reported that a commercial fisherman captured three adult ruffe in a 120 mm (4.75 inches) stretch mesh gill net near the Welcome Islands in Thunder Bay, 3.5 km east of the Mission River estuary. OMNR also captured one adult ruffe 42 km upriver from the mouth of the Kaministiquia River, a tributary of Thunder Bay Harbour.

In Lake Huron, no ruffe have been captured since 2003 and their status is uncertain.

In Lake Michigan, no ruffe were reported from new locations or Big Bay de Noc, where they were first detected in 2004. However, MIDNR captured a total of 40 ruffe from Little Bay de Noc, 18 more than were captured there in 2005. Little Bay de Noc and Big Bay de Noc of Green Bay continue to comprise the ruffe range in Lake Michigan.

Ruffe remain undetected in the Lower Great Lakes, and in all inland lakes and streams within the Great Lakes Basin. The following report summarizes ruffe surveillance and other reported fish sampling capable of incidentally capturing ruffe on the periphery and outside of the detected range of ruffe in the Great Lakes Basin during 2006.

[Return to top](#)

OBJECTIVES

The primary objective of ruffe detection activities is early detection and description of age and/or size composition. The secondary objectives are to describe the fish community at each location surveyed, and to monitor peripheral range locations where ruffe had been previously detected. In Lake Superior, the peripheral locations include Thunder Bay Harbour, the Keweenaw Waterway, Marquette Harbor, West Bay near Grand Marais, Michigan, and the Taquamenon River Estuary. In lakes Huron and Michigan, the peripheral locations include the Thunder Bay River and shipping lanes, and Big and Little bays de Noc, respectively.

These objectives address the needs of the Ruffe Control Program (Ruffe Control Committee 1996) by defining the range of ruffe and detecting reproducing populations on the periphery of the range. Early detection of range expansion minimizes rate of spread by public awareness, and voluntary ballast water management by the Great Lakes maritime industry.

METHODS

U.S. Waters of the Great Lakes



Adjusting the lead lines on a bottom trawl.

Ruffe surveillance was concentrated in habitat defined as cloudy, turbid, or stained water with little light penetration and soft substrate. These areas included estuaries, embayments, tributary mouths, canals, and in or near shipping ports. We focused on areas that ruffe could potentially colonize through ballast water from inter- and intra-lake shipping. Ruffe surveillance usually concentrated in the deepest habitat at the site as determined by electronic depth sounders, but depths from 3-8 m were targeted when available, which compares to the depth range ruffe were found in the SLRE. This habitat included natural channels, dredged shipping channels, and pools. However, ruffe surveillance was not limited to these areas; shallow areas in rivers and areas with heavy vegetation (sloughs) were also surveyed.

The primary gear used in each of the Great Lakes was a nylon bottom trawl (4.9 m headrope), commercially manufactured with a 3.8 cm stretch-mesh body, a 31.8 mm stretch-mesh cod end, and a 12.7 mm stretch-mesh inner liner to hold small specimens. During the fall survey in Lake Superior, the Ashland FRO tested a sapphire skate trawl (3.65 m headrope) similar in mesh size to the standard nylon trawl manufactured by Innovative Nets, Louisiana. Sapphire is a technologically advanced plastic-like material that does not absorb water and is very strong.

Bottom trawls were pulled with a variety of vessels and were deployed and retrieved either by hand or with a winch powered hydraulically, electrically, or by gasoline engine. The target time for trawl tows was 5 to 10 minutes per tow, but varied in duration depending on the size of the area trawled, the presence of submerged obstacles, and numbers of fish captured. Tow speed was maintained at approximately 3 km/hour, and was monitored by commercially manufactured trolling speed indicators or engine tachometer readings.

In addition to bottom trawls, other gear employed included mini fyke nets, gill nets, and experimental perch traps (called modified Windermere traps) (Edwards et al. 1998). The mini fyke nets consisted of 0.7 m x 1.0 m rectangular hoops interconnected with 6.35 bar-length x 12.7 mm stretch-mesh netting and a 15 m lead net. The gill nets consisted of a 0.6 m x 11.0 m panel of 38 mm multifilament stretch mesh. The modified Windermere traps measured 0.6 m x 1.2 m with netting consisting of a 6.35 mm bar-length x 12.7 mm stretch-mesh. The diameter of the trap entrance holes measured 5.08 to 6.35 cm.

The term established location, as used herein, refers to a geographic body of water that was selected for ruffe surveillance based on the risk of

invasion by ruffe. The risk was determined by qualitative assessment of existing habitat known to be attractive to ruffe (i.e. deep channels and pools, low water clarity, soft substrate). Water bodies with significant areas of such habitat were deemed to be a greater risk to invasion.

The term established transect, as used herein, is defined as a fixed bottom trawl tow or trap site selected for ruffe surveillance within an established location based on its probability of containing ruffe. The probability of containing ruffe was assessed by the combination of habitat characteristics known to be attractive to ruffe.

Bottom water temperature was recorded prior to each established trawl tow (transect), except when consecutive tows were conducted in close proximity to each other. Depth was recorded at the start and finish of individual tows and then averaged to determine the mean depth for each tow. The mean depths of all tows at an established location were averaged to calculate the mean depth at that established location. Tows were directed along and across contours, but the majority were along contour. For established trap sites (transects), depth was recorded, and bottom water temperature was recorded during set and lift events.

LGLFRO recorded depths at several additional intervals (e.g. 2, 5, and 7 minutes) to determine the mean depth for each tow. Surface temperature, surface and bottom dissolved oxygen levels, and water transparency were also recorded at each location sampled in Lakes Erie and Ontario, (Table 4).

Catches of fish were sorted by species and counted, and the total length of up to 50 specimens of each species was measured to the nearest millimeter. All captured species were released, except aquatic invasive species (AIS) [i.e. ruffe, round goby, white perch, sea lamprey, tubenose goby (*Proterorhinus marmoratus*), threespine stickleback (*Gasterosteus aculeatus*), fourspine stickleback (*Apeltes quadracus*), common carp (*Cyprinus carpio*), rudd (*Scardinius erythrophthalmus*), rusty crayfish (*Orconectes rusticus*), zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis*), and Eurasian watermilfoil (*Myriophyllum spicatum*)]. Captured AIS were either destroyed or preserved in 95% ethyl alcohol (EtOH). Specimens of unidentified species were retained frozen for later identification.

Public awareness of ruffe continued to be emphasized. Ruffe Watch cards and other information were distributed to harbor-masters, marinas, bait vendors, and motel managers, as well as cooperators and individual private citizens near sampling locations in the Great Lakes. Accomplishment reports, information for newsletter articles, and presentations were also conducted or provided.

Cooperation from agency partners and the public continued to expand the coverage and frequency of ruffe observations. Private anglers continued to report ruffe catches within the detected ruffe range, and some agencies and organizations reported fish sampling that was capable of incidental ruffe capture. Contributors included the USFWS Sea Lamprey Control Offices-Marquette Biological Station (MBS) and Ludington Biological Station (LBS); the USGS-Great Lakes Science Center; MIDNR; the Great Lakes Indian Fish and Wildlife Commission (GLIFWC); Chippewa Ottawa Resource Authority (CORA); National Park Service (NPS); Lake Superior State University (LSSU); Dow Chemical-USA; Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI); and the Little Traverse Bay Band of Ottawa Indians (LTBBOI).



Canadian Waters of the Great Lakes

Non-typical morphology of ruffe captured in Thunder Bay Harbour, Ontario, 10/06.

Ruffe surveillance in Canadian waters was conducted only in Lake Superior and the St. Marys River. The method of ruffe surveillance was bottom trawling (4.9 m headrope), and is described within the prior section (U.S. waters of the Great Lakes).

Other fish sampling gear that was capable of capturing ruffe consisted of gill nets (stretch mesh less than or equal to 120 mm), bottom trawls, trap nets, minnow traps, seines, and boom and backpack electrofishing.

OMNR has maintained an awareness program for ruffe and other exotic species in partnership with the Ontario Federation of Anglers

and Hunters (OFAH) since 1992. Posters, fact sheets and Ruffe Watch ID packages were distributed at many events and meetings during 2006. A waterproof bait-bucket sticker featuring ruffe and three other invaders was also distributed throughout the province. The partnership also maintains a toll-free Invading Species Hotline (1-800-563-7711) to facilitate reporting of new sightings and range expansions of ruffe and other AIS, and an Invading Species Website (www.invadingspecies.com) to disseminate ruffe and other AIS information to the public.

[Return to top](#)

RESULTS

GREAT LAKES BASIN (Canadian Waters)

The OMNR/OFAH partnership program received 302 species reports from the public, but no ruffe were reported.

LAKE SUPERIOR

	<p>Ruffe Surveillance in Canadian Waters</p>
<p>Indication of a large ruffe catch; ruffe gilled at the head of the trawl. Thunder Bay Harbour, Ontario, 10/06.</p>	
	
<p>Ruffe catch at the tail of the trawl. Thunder Bay Harbour, Ontario, 10/06.</p>	

Thunder Bay Harbour, Ontario The OMNR-Upper Great Lakes Management Unit-Lake Superior and the Ashland FRO conducts a fall survey annually to monitor ruffe range expansion within the harbour and to assess abundance of ruffe and native species. A total of 25 bottom trawl transects is established, that includes the McKellar and Mission rivers, and the lower reach of the Kaministiquia River, as well as the harbour proper (Figures 1, 2 and Table 1). Trawling was completed on 17 transects as far north as Transect 8 (Figure 2) for a total effort of 1.3 hours. Tows were not completed at Transects 1 through 7 (north and central harbour) (Figure 2) due to encounters with bottom obstructions. A total of 3,560 fish was captured, including 940 adult ruffe and 1,405 sub-adult ruffe. Other captured AIS consisted of a total of 16 fourspine stickleback. The total catch consisted of 20 fish taxa and one crayfish taxa, with ruffe dominating (66%) the catch followed by trout-perch (*Percopsis omiscomaycus*) (12%), and rainbow smelt (*Osmerus mordax*) (9%). Ruffe were first detected here in 1991.

Ruffe Surveillance in U.S. Waters

On the periphery and outside of the detected ruffe range, the Ashland FRO conducted ruffe surveillance once during spring and once during fall at six established locations. The St. Marys River above the Soo Locks was planned as a seventh location during the fall survey, but had to be cancelled due to weather. The surveys captured a total of five ruffe from a previously detected location (Keweenaw Waterway, Michigan), and one ruffe was captured from a new location (West Bay near Grand Marais, Michigan) (Figure 1). This new discovery expanded the ruffe range 120 km eastward from Marquette Harbor, the previous eastern boundary of the ruffe range along the south shore. Due to slow expansion of ruffe and difficulty in conducting effective monitoring, no ruffe surveillance was conducted in Minnesota waters. A summary of fish species captured at these locations is available upon request from the Ashland FRO.

Keweenaw Waterway, Michigan A total of 16 bottom trawls was completed over eight established transects in the southern half of the waterway (Figure 1 and Table 1). These transects are located in deep flats (5-8 m) and natural and dredged channels. Based on length at age analysis for ruffe in Lake Superior conducted by USGS in the St. Louis River, Minnesota/Wisconsin, ruffe in Pike Bay were age-1 (73 & 79 mm TL) and age-2 ruffe (124 mm TL) during the spring survey, and age-2 (128 mm TL) during the fall survey. One age-0 ruffe was also captured in the Portage River near the south entry to Portage Lake during the fall survey. Ruffe were previously captured from these transects, and no ruffe were captured from the other previous capture transect in the Sturgeon River Sloughs. Seasonal species diversity consisted of 16 taxa from the spring survey and 18 taxa from the fall survey. Both surveys combined, the total catch consisted of 21 fish taxa and one aquatic salamander, with trout-perch dominating the total catch followed by spottail shiner (*Notropis hudsonius*), and yellow perch. Ruffe were first detected in the waterway in 2002. No other AIS were captured.

Pequaming Bay, Michigan This bay was only sampled during the spring survey. A total of six bottom trawls was completed over six established transects located in deep flats (3-7 m) and deep sloping substrate (8-15 m) (Figure 1 and Table 1). Species diversity consisted of seven taxa, with rainbow smelt dominating the catch followed by ninespine stickleback (*Pungitius pungitius*) and slimy sculpin (*Cottus cognatus*). No ruffe or other AIS were captured.

The west part of Pequaming Bay contains potential ruffe habitat that is untrawlable due to the presence of fish cribs; this area was sampled with modified Windermere traps in two locations, each set near a fish crib (Figure 1 and Table 1). Species diversity consisted of six taxa with lake chub (*Couesius plumbeus*) and white sucker (*Catostomus commersoni*), dominating the total catch. No ruffe or other AIS were captured.

Huron Bay, Michigan This bay was sampled only during the fall survey. A total of nine bottom trawls was completed on nine established transects over mud substrate. Species diversity consisted of ten taxa with spottail shiner dominating the total catch followed by rainbow smelt and ninespine

stickleback. No ruffe or other AIS were captured.



Ruffe surveillance also monitors for other AIS such as this round goby detected in Marquette Harbour, MI, 05/06.

Marquette Harbor, Michigan A total of 12 bottom trawls was completed over six established transects located adjacent to commercial vessel docks and a public marina (Figure 1 and Table 1). Seasonal species diversity consisted of 6 fish taxa during the spring survey and 11 fish taxa and two crayfish taxa during the fall survey. Both seasons combined, the total catch consisted of 12 fish taxa and two crayfish taxa. Ninespine stickleback and brook stickleback (*Culaea inconstans*) dominated the total catch. A single round goby (51 mm TL) and several dead zebra mussels were captured in the upper harbor during the spring survey. This was the initial discovery of round goby here. Totals of 26 and three threespine stickleback were also captured during the spring and fall surveys, respectively. Threespine stickleback were previously detected here. No ruffe were captured.

Munising Bay, Michigan A total of six bottom trawls was completed over three established transects located adjacent to a commercial vessel dock, river entry, and along a steep shelf at the 7-8 meter contour level (Figure 1 and Table 1). Seasonal species diversity consisted of five fish taxa during the spring survey and nine fish taxa during the fall survey. Both seasons combined, the total catch consisted of 11 taxa, with slimy sculpin and yellow perch dominating the total catch. A total of two threespine stickleback (previously detected here) was captured during the spring survey. No ruffe were captured.

Some of the potential ruffe habitat in Munising Bay is untrawable due to the presence of fish cribs and a dense bed of macrophytes; during the spring survey, these sites were sampled with modified Windermere traps in two locations and a mini fyke net in one location; during the fall survey, these sites were sampled with modified Windermere traps in three locations and gill nets in two locations (Figure 1 and Table 1). Seasonal species diversity consisted of eight fish taxa during the spring survey and three fish taxa during the fall survey. Both seasons combined, the total catch consisted of 11 taxa, with lake trout and round whitefish (*Prosopium cylindraceum*) dominating the total catch. One threespine stickleback (previously detected here) was captured in the mini fyke net. No ruffe were captured.



Ruffe detected at Grand Marais, MI, 120 Km east of Marquette Harbour, the previous eastern boundary of the ruffe range, 05/06.

Grand Marais, Michigan (West Bay) A total of eight bottom trawls was completed over four established transects located in deep sand flats (10-15 m) and a dredged channel (Figure 1 and Table 1). Seasonal species diversity consisted of 6 fish taxa during the spring survey and 15 fish taxa during the fall survey. Both seasons combined, the total catch consisted of 17 taxa, with spottail shiner dominating the total catch followed by rainbow smelt and trout-perch. One yearling ruffe (66 mm TL) was captured during the spring survey; this was the initial discovery of ruffe here. No other AIS were captured.

Tahquamenon River, Michigan (above estuary) A total of five bottom trawls was completed in natural channels and pools in the lower reach (3 km upriver from the mouth) of the river (Figure 1 and Table 1). Seasonal species diversity consisted of eight fish taxa during the spring survey and four fish taxa during the fall survey. Both seasons combined, a total of ten taxa was captured, with spottail shiner dominating the total catch followed by yellow perch and mimic shiner (*Notropis volucellus*). No ruffe or other AIS were captured.

The Tahquamenon River estuary consists of ruffe habitat that is untrawable due to the presence of large woody debris on the bottom. During the spring survey, the estuary was sampled with mini fyke nets in three locations. During the fall survey, the estuary was sampled with modified Windermere traps in three locations and gill nets in two locations (Figure 1 and Table 1). Seasonal species diversity consisted of eight fish taxa during the spring survey and five fish taxa and one crayfish taxa during the fall survey. During both seasons combined, a total of 11 fish taxa and one crayfish taxa was captured in all trap nets with rock bass (*Ambloplites rupestris*) dominating the total catch followed by mimic shiner and brown bullhead (*Ictalurus nebulosus*). No ruffe or other AIS were captured.

Whitefish Bay (Abandoned harbor) During the spring survey, a total of two mini fyke nets were set for one night in an abandoned harbor adjacent to the mouth of the Shelldrake River (Figure 1 and Table 1). Species diversity consisted of four fish taxa and one crayfish taxa, all of comparable abundance. No ruffe or other AIS were captured.

U.S. and Canadian Reported Fish Sampling Capable of Capturing Ruffe Incidentally

Several organizations including the USFWS, USGS, Fisheries and Oceans Canada, Environment Canada, OMNR, MIDNR, and GLIFWC reported fish sampling, commercial fishing, and sport angling in more than 60 locations that were capable of incidental ruffe capture (Figures 1, 3, 4, and Table 1). These activities captured a total of 178 ruffe in five locations within the periphery of the ruffe range, and three ruffe in two new locations (Little Lake Harbor and the Tahquamenon River, Michigan) outside of the previously detected ruffe range. The two new locations confirmed major

ruffe range expansion, 167 and 226 km, respectively, east of Marquette Harbor, Michigan, the previous eastern boundary of the ruffe range along the south shore.

Near-shore The Lake Superior Biological Station (LSBS) of the USGS-Great Lakes Science Center conducted bottom trawling (11.9 m headrope) across-contour to assess spring fish community abundance. Transects included 40 near-shore stations around the lake, near the periphery and outside of the detected ruffe range (Figure 3 and Table 1). No ruffe were captured at these stations.

Within the detected ruffe range, the LSBS captured totals of 107 ruffe and eight round goby at near-shore stations. With exception of one ruffe captured near Stockton Island (station #2, Figure 3), all ruffe and round goby were captured off the Superior entry (station #210, Figure 3) to the Duluth-Superior Harbor, Minnesota/Wisconsin.

Keweenaw Waterway, Michigan The Michigan DNR confirmed that an angler, Clovis Fortin, captured one adult ruffe (150 mm TL) by hook and line from the Torch Lake Canal during May (Figure 4 and Table 1). The Torch Lake Canal connects Torch Lake with the main waterway. This is the second adult ruffe reported captured from this area of the waterway since 2005.

Isle Royale During June, the Ashland FRO, in cooperation with the NPS, conducted fish assessments in Siskiwit Bay and Tobin Harbor that included a total of 12.7 hours electrofishing (Figure 4 and Table 1). No ruffe were captured or observed. Two three-spine stickleback were captured, one in each location.

Southeastern Lake Superior The Ashland FRO conducted a lake whitefish assessment in July at three locations east of Grand Marais, Michigan (Figure 4 and Table 1). The 30 meter long gill net panels consisted of 50, 63, 75, 88, 100, and 113 mm stretch mesh. Total effort of the shallow sets (< 100 m deep) was 4,389 meters. Seven taxa were captured in these mesh sizes with the majority of the total catch consisting of longnose sucker (*Catostomus catostomus*) and round whitefish. No ruffe were captured.

Little Lake Harbor, Michigan The MIDNR confirmed that an angler captured one adult ruffe (125 mm TL) by hook and line from this harbor, which is located 33 km west of Whitefish Point (Figure 4 and Table 1). This is the initial discovery of ruffe in this location.

Tahquamenon River, Michigan The USFWS confirmed that angler, Dave Pomranky, captured two adult ruffe (130 and 122 mm TL) by hook and line from this river estuary, which drains into western Whitefish Bay (Figure 4 and Table 1). This is the initial discovery of ruffe in this location.

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control in cooperation with GLIFWC, NPS, and private contractors conducted trapping in eight tributaries within the periphery of the ruffe range to assess sea lamprey abundance. (Figure 4 and Table 1). A total of seven ruffe were captured in a sea lamprey portable assessment trap set in the Misery River, a tributary on the west shore of the Keweenaw Peninsula, Michigan, 35 km south of the north entry to the Keweenaw Waterway. Ruffe were first discovered in the Misery River in 2004.

Within the detected ruffe range, Sea Lamprey Control captured a total of two ruffe in a fyke net from the Amnicon River, a tributary 15 km east of the Duluth-Superior Harbor (Figure 4). Ruffe were first discovered here in 1988.

Thunder Bay Harbour, Ontario The OMNR reported that the Northern Wood Preservers Alternative Remediation Concept (NOWPARC) project captured a total of 166 ruffe using electrofishing and gill nets in the northern harbour (Figure 2 and Table 1). This is the first confirmed report of ruffe in the northern harbour. Ruffe were first discovered in the southern harbour in 1991.

Thunder Bay, Ontario The OMNR reported that commercial fisherman, Ron Gerow, captured a total of three large adult ruffe near the Welcome Islands in Thunder Bay, while fishing for lake whitefish. These islands are located 3.5 km east of the Mission River estuary (Figure 2 and Table 1). The ruffe were captured in a 120 mm (4.75 inches) stretch mesh gill net, the largest stretch mesh size reported for a ruffe capture. Ruffe were first captured in the Bay proper in 2005.

Kaministiquia River, Ontario The OMNR captured an adult ruffe with a dipnet, 42 km upriver from the estuary, while conducting a young-of-the-year lake sturgeon assessment (Figure 4 and Table 1). This is the furthest upriver range reported for ruffe in this river. Ruffe were first discovered in the estuary (southern Thunder Bay Harbour) in 1991.

Marathon, Ontario Environment Canada used gill nets and trawling to capture fish for contaminant surveillance. Fisheries and Oceans Canada used gill nets to survey cisco populations in Lake Superior from Marathon to Thunder Bay. Thousands of fish were captured in these surveys; no ruffe were captured.

Unconfirmed Sightings The Michigan DNR reported that the Rainbow Lodge, located near Little Lake Harbor, Michigan, received reports of ruffe captured from the harbor by anglers and guests. However, some of the reports were confusing ruffe with juvenile walleye (*Sander vitreus*).

LAKE MICHIGAN

No ruffe surveillance was conducted. The USFWS, USGS, MIDNR, WDNR, Inland Sea Education Association (ISEA), and tribal communities reported other fish sampling in more than 50 locations that were capable of incidental ruffe capture. The Michigan DNR captured a total of 40 ruffe from Little Bay de Noc, a location where ruffe had been previously detected (Figures 1, 4, and Table 2). This was the only report received of ruffe captures in Lake Michigan.

Reported Fish Sampling Capable of Capturing Ruffe Incidentally

Near-shore/Off-shore The USGS-Great Lakes Science Center conducted fall bottom trawling (12 m headrope) on-contour to assess prey-fish community abundance. Outside and near the periphery of the detected ruffe range (Big and Little bays de Noc), transects included seven locations around the lake (Figure 5 and Table 2). A total of 70 tows were completed comprising 11.8 hours of effort. No ruffe were captured.

The Inland Seas Education Association (ISEA) is a non-profit environmental education organization. Scientific sampling aboard their vessel is conducted by ISEA staff, volunteer instructors, and students (mostly grades 5-7). The ISEA conducted bottom trawling (4.9 m headrope) at ten locations, including Grand Traverse Bay, Little Traverse Bay, and Little Bay de Noc (Figure 4 and Table 2). A total of 146 tows were completed comprising 24.3 hours of effort. No ruffe were captured, but other captured AIS included 1,126 round goby, 519 threespine stickleback, and 1,750 rusty crayfish.

Little Bay de Noc (LBDN) of Northern Green Bay From 2004-2010, the MIDNR is conducting fall assessments to determine the relative contribution of hatchery-raised walleye to year classes of walleye stocks. Each year, a random subset of transects is sampled from a larger set of established transects. The gear includes 25, 38, and 50 mm stretch-mesh gill nets, and boom electrofishing (Figures 4, 6, 7, and Table 2). In 2006, a total of eight transects was electrofished and four transects were gill netted (total gill net effort = 3,840 m). A total of 30 mature ruffe was captured in gill nets, and less than 100 ruffe were observed at a depth less than 0.5 m during electrofishing. Ruffe were first detected here in 2002.

Since 1988, the MIDNR has been conducting summer assessments in LBDN using trawls and experimental gill nets. In 2006, a total of 200 minutes bottom trawling and eight gill net nights was completed. A total of one ruffe was captured in trawls and one ruffe was captured in gill nets (Figure 4 and Table 2).

Big Bay de Noc (BBDN) of Northern Green Bay From 2004-2010, the MIDNR is conducting the same fall walleye assessment in BBDN as in LBDN (described in LBDN). In 2006, a total of 6 transects was electrofished and 12 transects were gill netted (total gill net effort = 11,523 m) (Figures 4, 6, 7 and Table 2). No ruffe were captured or observed. Ruffe were first detected here in 2004.

Since 1988, the MIDNR has been conducting summer assessments in BBDN similar to LBDN (described in LBDN). In 2006, a total of 200 minutes bottom trawling and eight gill net nights were completed (Figure 4 and Table 2). No ruffe were captured.

Southern Green Bay WDNR conducted electrofishing in the lower Menominee, Peshtigo, Oconto, and Fox rivers, set fyke nets in late April in southern Green Bay, seined several sites in June-July around southern Green Bay from Marinette to Sturgeon Bay, and trawled several sites in southern Green Bay. WDNR also reported that a graduate student from Purdue University conducted fish assessment surveys in the lower Peshtigo River. No ruffe were captured or observed in any of this sampling.

Tributaries The USFWS-Marquette and Ludington Biological Stations-Sea Lamprey Control in cooperation with the Little Traverse Bay Band of Ottawa Indians and private contractors conducted trapping in Lake Michigan tributaries to assess sea lamprey abundance. Traps set in nine of the tributaries sampled were capable of incidental ruffe capture (Figure 4 and Table 2). A summary of fish species captured at these locations is available upon request from MBS. No ruffe were captured.

Unconfirmed Sightings None reported.



ST. MARYS RIVER

Ruffe surveillance in Canadian waters during 2006

Sault Ste. Marie Harbour, Ontario The OMNR-Upper Great Lakes Mgt. Unit-Lake Superior and the Ashland FRO completed a total of 23 minutes of trawling in two high-risk sites for ruffe, the Algoma Steel slip upriver of the Soo Locks and the Purvis Marine slip downriver of the Locks (Figure 1 and Table 1). Only rainbow smelt was captured in the Purvis slip, but a total of five fish

were captured.

Ruffe surveillance in U.S. waters during 2006

Various Locations Downriver from the Soo Locks The Alpena FRO conducted ruffe surveillance in four established locations including the Municipal Marina of Sault Ste. Marie, Michigan, the shipping channel south of the Sugar Island Ferry crossing, Munuscong Channel, and DeTour Passage (Figure 1 and Table 3). A total of 17 taxa was captured with the majority of the catch consisting of larval rainbow smelt (46%), mimic shiner (26%), and spottail shiner (15%). The greatest total catch (0.7 fish/hour) occurred at DeTour passage, and the greatest diversity of species (12 species) was represented at the Sault Ste. Marie Municipal Marina. Johnny darter (*Etheostoma nigrum*), mimic shiner, and spottail shiner were the most ubiquitous species, being captured at all four surveillance locations. No ruffe were captured.

Other Canadian AIS sampling that was capable of capturing ruffe incidentally during 2006

Leigh's Bay - St. Joseph's Island, Ontario Fisheries and Oceans Canada-Great Lakes Laboratory for Fisheries and Aquatic Sciences conducted aquatic invasive species surveys using electrofishing gear, trap nets, gill nets, minnow traps and seine nets. Thousands of fish were captured; no ruffe were captured.

LAKE HURON

The Alpena FRO conducted ruffe surveillance during the fall in US waters at eight established locations. Bottom trawling (4.9 m headrope) was conducted in September/October, and targeted deep water areas within shipping channels and river mouths. The Alpena FRO also conducted ruffe population reduction in the Thunder Bay River during spring and fall. MBS and USGS reported other fish sampling that was capable of incidental ruffe capture in 16 locations in Lake Huron. No ruffe were captured during ruffe surveillance, ruffe population reduction, or other reported fish sampling capable of incidental ruffe capture in Lake Huron. A summary of fish species captured is available upon request from the Alpena FRO and MBS.

Ruffe surveillance in U.S. waters during 2006

Western Lake Huron The Alpena FRO conducted ruffe surveillance at Port Dolomite in Cedarville, Cheboygan River, Thunder Bay River and Thunder Bay Shipping Channels in Alpena, National Gypsum port in Tawas City, AuGres River, Saginaw River in Essexville, and Harbor Beach (Figure 1 and Table 3). A total of 24 taxa was captured, and the majority of the catch consisted of round goby (24%), channel catfish (*Ictalurus punctatus*) (18%), and rainbow smelt (17%). The greatest total catch (0.4 fish/hour) occurred at the Saginaw River, and the greatest diversity of species (15 species) was represented at the AuGres River. Round goby was the most ubiquitous species, being captured at all eight surveillance locations. No ruffe were captured.

Ruffe Population Reduction in U.S. waters during 2006

The Alpena FRO conducted ruffe population reduction in the Thunder Bay River during April and September (Figure 1). This annual activity was initiated in 2002 to remove adult ruffe prior to spawning in order to reduce reproduction. Small mesh gillnets were set for three weeks in April and for one week in September for comparison to the April effort (Table 3). No ruffe were captured during the spring or fall reduction activities.

Reported U.S. fish sampling that was capable of capturing ruffe incidentally during 2006

Near-shore/Off-shore The USGS-Great Lakes Science Center conducted fall (October/November) bottom trawling (21 m wing trawl) on-contour to assess the status and trends of the Lake Huron deepwater fish community. A total of 45 tows was completed, comprising 7.5 hours of effort over five U.S. locations and one Canadian location (Figure 8 and Table 3). No ruffe were captured.

The USFWS-Marquette Biological Station-Sea Lamprey Control in cooperation with CORA, Dow Chemical-USA, LSSU, and private contractors conducted trapping in tributaries to assess sea lamprey abundance (Figure 4 and Table 3). Traps set in ten of the tributaries sampled were capable of incidental ruffe capture; no ruffe were captured. A summary of fish species captured at these locations is available upon request from MBS.

Reported Canadian fish sampling that was capable of capturing ruffe incidentally during 2006

OMNR conducted a nearshore community index program in eastern Georgian Bay, an offshore community index program at seven sites, and a commercial fish catch sampling program. Multi-mesh gill nets and trap nets were used to capture over 177,600 fish. No ruffe were captured.

Fisheries and Oceans Canada-Sea Lamprey Control conducted a total of 21 stream fish surveys in the Bighead River watershed using backpack electrofishing gear. Emphasis was on identifying species at risk, as part of an environmental assessment required for a proposed sea lamprey barrier construction project. No ruffe were captured in these surveys.

Fisheries and Oceans Canada-Centre for Inland Waters Fish conducted a species inventory in the Saugeen River tertiary watershed using boat electrofishing and seine netting (30' bag seine). No ruffe were captured in this inventory.

Environment Canada conducted fish contaminant surveillance near Goderich, Ontario, using gill nets and bottom trawling. No ruffe were captured in this surveillance.

Unconfirmed Sightings None Reported.

LAKES ERIE & ST. CLAIR

The Lower Great Lakes FRO conducted ruffe surveillance during spring and fall at seven established locations in U.S. waters of Lake Erie. MBS, USGS, AND OMNR reported other fish sampling that was capable of incidental ruffe capture in several locations in Lakes Erie and St. Clair. No ruffe were captured during ruffe surveillance or other reported fish sampling capable of incidental ruffe capture in Lakes Erie and St. Clair.

Ruffe surveillance in U.S. waters during 2006

The Lower Great Lakes FRO conducted ruffe surveillance in Lake Erie at Sandusky, Toledo, Cleveland, Ashtabula, and Conneaut, Ohio; Erie, Pennsylvania; and Buffalo, New York. All locations were trawled (bottom trawl - 4.9 m headrope) once during May and once during September/October (Figure 9 and Table 4). The total catch from the spring survey consisted of 10 taxa, and the majority of the catch consisted of channel catfish (47%), freshwater drum (*Aplodinotus grunniens*) (14%), white perch (14%), and round goby (10%). The total catch from the fall survey consisted of 11 taxa, and the majority of the catch consisted of emerald shiner (*Notropis atherinoides*) (63%), channel catfish (13%), and rainbow smelt (7%). No ruffe were captured in either survey. A summary of fish species captured at these locations is available upon request from the LGLFRO.

Reported U.S. Fish Sampling That was Capable of Capturing Ruffe Incidentally during 2006

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control and private contractors conducted trapping in three tributaries to assess sea lamprey abundance in Lake Erie (Figure 10 and Table 4). No ruffe were captured. A summary of fish species captured at these locations is available upon request from the MBS.

Near-shore/Off-shore The USGS-Lake Erie Biological Station conducted summer and fall (June, August, September, October) bottom trawling (7.9 m headrope) in U.S. waters to assess the status of fish stocks in western Lake Erie. These trawls were conducted near East Harbor State Park, Ohio, for a total effort of 20.3 hours (Figure 10 and Table 4). No ruffe were captured.

Reported Canadian fish sampling that was capable of capturing ruffe incidentally during 2006

Several fish sampling programs were conducted including community index netting; coldwater assessment; partnership index fishing; juvenile, young of year, and adult index; on water angler survey; a sport fishery diary program; and commercial catch monitoring. The Sport Fishery Diary Program was also implemented for the Detroit and St. Clair Rivers. OMNR captured more than 364,900 fish in these programs. No ruffe were captured.

Fisheries and Oceans Canada-Centre for Inland Waters conducted a species inventory in the littoral zone of Lake St. Clair between northeast Mitchels Bay and the mouth of the Thames River using a 15 m bag seine. No ruffe were captured.

Environment Canada conducted fish contaminant surveillance near Long Point using gill nets and bottom trawling. No ruffe were captured.

OMNR and Trent University completed a joint research project on eastern sand darter (*Ammocrypta pellucida*) habitat modeling (measurement of habitat variables and fish community sampling). The project was conducted in the Thames and Grand Rivers using a bag seine. No ruffe were captured.

Trent University completed a channel darter (*Percina copelandi*) beach survey at 29 sites in Lake Erie. This survey was conducted during June and October using a bag seine. No ruffe were captured.

Unconfirmed Sightings None reported.

LAKE ONTARIO

The Lower Great Lakes FRO conducted ruffe surveillance during spring and fall at one established location. The MBS and USGS reported other fish sampling that was capable of incidental ruffe capture in 14 locations. No ruffe were captured.

Ruffe Surveillance during 2006

Genessee River/Rochester Harbor The Lower Great Lakes FRO conducted bottom trawling (4.9 m headrope) once during June and once during October in established transects located within the dredged shipping channel, approximately 3 km upstream from the lake (Figure 9 and Table 4). During the spring survey, the total catch consisted of six taxa with rainbow smelt (51%) and emerald shiner (38%) comprising the majority of the catch. The smelt were dominated by fry-stage individuals as were five walleye. During the fall survey, the total catch consisted only of two channel catfish.

Reported U.S. Fish Sampling That was Capable of Capturing Ruffe Incidentally

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control contracted with private contractors to conduct trapping in tributaries to assess sea lamprey abundance. Traps set in two of the tributaries sampled were capable of incidental ruffe capture; no ruffe were captured (Figure 10 and Table 4). A summary of fish species captured at these locations is available upon request from MBS.

Near-shore/Off-shore The USGS-Lake Ontario Biological Station and the New York State Department of Environmental Conservation (NYSDEC) conducted bottom trawling (18.0 m headrope) in U.S. waters to assess the status of major prey-fish stocks. A total of 270 tows was completed within 12 transects comprising 45 hours of effort (Figure 11 and Table 4). No ruffe were captured.

Reported Canadian Fish Sampling Capable of Capturing Ruffe Incidentally

Eastern Lake Ontario OMNR conducted many programs including population monitoring using trap nets and gill nets, and an angler survey. Thousands of fish were observed; no ruffe were observed or captured.

Near-shore/In-shore Fisheries and Oceans Canada-Centre for Inland Waters conducted fish community monitoring and aquatic invasive fish species monitoring in Hamilton Harbor using electrofishing, trap nets, hoop nets, gill nets, beach seine, minnow traps and bottom trawling (6 and 12 m headrope). A mark/recapture study to evaluate fish movement through locks in the Trent Severn Waterway was also initiated. Electrofishing was conducted at several locations in and downstream of Balsam Lake. Using trap nets and hoop nets, a joint project was conducted with Concordia University and the University of Guelph in five tributaries to determine interstream movements of fishes in response to sea lamprey barriers. Thousands of fish were observed; no ruffe were observed or captured.

Unconfirmed Sightings None reported.

[Return to top](#)

DISCUSSION

LAKE SUPERIOR

Thunder Bay Harbour, Ontario The catch per unit effort (CPUE) of ruffe in Thunder Bay Harbour (TBH) continues to increase with a substantial increase observed in 2006. From 1991-98, ruffe CPUE remained low, with a range of zero to 11 per hour in trawls. From 1999-2006, ruffe CPUE increased from 61 to 1,665 per hour in trawls. The 2006 ruffe CPUE (1,665/hr.) is a 190% increase over the previous high ruffe CPUE (569/hr.) observed in 2003. The ruffe population trend observed in the Duluth-Superior Harbor, Minnesota/Wisconsin was increasing abundance initially followed by decline toward stabilization; however, as sampled by bottom trawl, the stabilized ruffe population was many times more abundant than other native forage fish populations (unpublished data, USGS-Lake Superior Biological Station). The status of the TBH ruffe population suggests that it is in the initial state of increasing abundance.

Although trawls were only completed south of transect eight, other fish sampling captured a total of 166 ruffe near the mouth of the Current River (Figure 2). This ruffe bycatch confirms a substantial ruffe presence in northern TBH. However, the majority (92% of 2006 ruffe catch) of sub-adult and adult ruffe continue to be captured from the Kaministiquia (Kam) River and two tributaries, the Mission and McKellar Rivers, in the southern part of the harbour. In addition to the one ruffe captured in 2005, five km northeast of the Current River estuary, the capture of three adult ruffe 3.5 km east of the Mission River estuary provides further evidence that the river/harbour population is expanding into Thunder Bay. The expansion of the TBH ruffe population is further reinforced by the capture of an adult ruffe, 42 km upriver from the Kam River estuary.

It is likely that ruffe have migrated to the pool at the bottom of Kakabeka Falls, 47 km upriver from the Kam River estuary; however, the falls form a natural barrier that will prevent further upstream migration of ruffe in the Kam River.

The data continues to suggest that the distribution of ruffe within TBH may be due to seasonal behavior triggered by bottom temperature (BT) and the level of light intensity in the water. Harbour surveillance conducted during early September of 2001 and 2005 (BT 11-18 ° C) resulted in lower ruffe CPUE's of 8 and 85 per hour in trawls, than surveillance conducted in late September/October of 2003 and 2006 (BT 7-11 ° C) with CPUE's of 569 and 1,665 per hour in trawls. Ruffe are known to prefer waters with a low level of light intensity, and the level of light intensity is directly related to water clarity. Generally, the tributary transects have a lower water clarity (secchi disk range <2 m) than the harbour transects (secchi range ≥3 m) with ruffe being more abundant in the tributary transects. In 2006, there was additional data to suggest a ruffe preference for dark water. Although the Kam River estuary, McKellar River, and Mission River are interconnected and separated by only 1-2 km, the secchi disk readings averaged 3.3, 3.3, and 1.4 m respectively. Ruffe CPUE in trawls averaged 63, 44, and 5,976 per hour respectively.

Due to the concentrated abundance (3,457/hr. in trawls in 2006) of adult spawning ruffe in the turning basin site (proximity of transect 31, Figure 2) of the Kam River, a feasibility experiment was proposed to evaluate the potential for an effective (minimum of 90%) short-term population reduction. To begin assessing the feasibility, some trawling spanning a 3-day period was conducted during the fall of 2005. However, after further consultation with the OMNR-Upper Great Lakes Mgt. Unit-Lake Superior, it was concluded that a long term effort to reduce this adult ruffe colony would not likely have any effect in reducing the overall TBH and Thunder Bay ruffe populations. The current widespread distribution of ruffe in TBH and Thunder Bay was a major consideration in arriving at this conclusion. Therefore, the proposal to conduct a ruffe population reduction feasibility experiment in the Kam River turning basin site has been abandoned.

The National Park Service expressed concern about the risk of ruffe introduction into the waters of Isle Royale National Park. Isle Royale is located 28 km (17 miles) south of Thunder Bay, and a commercial shipping lane originating from TBH passes through Park waters. The Ashland FRO responded that the risk was low based on what is known about ruffe habitat and behavior and ruffe control policy. Ruffe are an estuary/in-shore/near-shore fish, generally inhabiting depths less than 30 m. The distance of Isle Royale from the mainland and the depth of the waters should act to deter ruffe from migrating in the direction of Isle Royale. The 1997 Great Lakes Maritime Industry Voluntary Ballast Water Management Plan for the Control of Ruffe in Lake Superior Ports directs commercial shipping departing TBH in ballast not to exchange that ballast unless 15 miles or more from a shoreline and over a depth of at least 40 fathoms (240 feet). The Ashland FRO has requested an assessment of compliance with the plan from the Lake Carriers Association.

Keweenaw Waterway, Michigan Spring and fall surveillance indicate that ruffe abundance and distribution within the Waterway remains nearly constant. Ruffe were discovered here in 2002, and no ruffe were captured in 2003. However, in 2003 surveillance was only conducted in summer (August), and ruffe catches are typically low in summer in peripheral locations. For the three year period 2004-2006, ruffe CPUE in established transects was 3.5, 3.0, and 3.8 per hour in trawls, with an average of 3.4. Ruffe continue to be captured from the same five of eight transects sampled, and the total ruffe catch from any one of these five transects has never exceeded two. From 2004-2006, the total ruffe catch each year has been three, four, and five respectively. In addition, there have been no reports of ruffe captured from new locations within the waterway. Age structure of the captured ruffe consists of one age 0, seven age 1, and four age 2. Ruffe reproduction is occurring, but the catch data suggests that population growth is progressing slowly. A similar event occurred in Chequamegon Bay in southwestern Lake Superior, where biologists suggested that predators may have prevented an early rapid increase in ruffe abundance. Portage Lake in the Keweenaw Waterway has a reputation for supporting walleye and trophy northern pike (*Esox lucius*). Predators may be in part delaying an increase in ruffe abundance within the waterway, as was the scenario suggested for Chequamegon Bay. However, predator diet composition in the St. Louis River estuary showed that predators such as walleye, northern pike, smallmouth bass, and others selected most other prey items over ruffe (Mayo 1997).

Marquette Harbor, Michigan No ruffe were captured from Marquette harbor during spring or fall surveillance in 2006. With only single captures of an age one ruffe in 2005 and an age zero ruffe in 2004, and no capture of adult spawning ruffe during the spring surveys, the status of ruffe here remains undetermined. Both ruffe were captured from the same transect (heavy commercial boat slip) and the same time of year (fall). The high water clarity (secchi disk range 3.1-5.6 m) may be in part preventing or delaying the establishment of a ruffe colony here.

Grand Marais, Little Lake Harbor, & Tahquamenon (Tahq) River Estuary, Michigan With the capture of a small (66 mm TL) yearling ruffe from the small bay near Grand Marais, it is conceivable that this ruffe was spawned in this bay during the previous year as ruffe spawning habitat is very limited along this reach of Lake Superior shoreline. The capture of one adult spawner from Little Lake Harbor and two adult spawners from the Tahq River estuary during the spring survey continues to suggest that adult spawning ruffe (age 2+) are inhabiting and migrating along the near-shore of Lake Superior, and venturing into tributary estuaries, embayments, and other in-shore habitat to spawn.

LAKE HURON

Ruffe have not been discovered in the St. Marys River and were not captured from the Thunder Bay River or discovered at any other locations within Lake Huron in 2006. No ruffe have been captured from Lake Huron for the past three years and were last captured in the spring of 2003.

Thunder Bay, Michigan Within the Thunder Bay area, the absence of YOY ruffe from fall ruffe surveillance trawling from 2001 to present, and the

decline in spring adult spawning ruffe captured in gill nets from 2002 to 2003 followed by the absence of ruffe from 2004 thru 2006 suggests an overall decline in the Lake Huron ruffe population. The absence of YOY was an initial sign that recruitment may not be taking place, and the more recent decline and absence of spawning adults also suggests that recruitment was insufficient to foster the population. It is not known why the large abundance of ruffe captured in 1999 (470 ruffe), an 11 fold increase in abundance over the 1998 catch, did not transfer into a large catch of adult or subsequent YOY in 2000. One reason may be the colonization and subsequent flourishing of the round goby in the Thunder Bay area. The round goby was first captured from the Thunder Bay River in 1999, and although their abundance was low that year (14% of total catch), they became the most abundant species captured from the river the following year, a status which has continued. Round goby are known egg feeders, can spawn multiple times in a season, guard their nests to ensure the development of their young, and are very aggressive. Although direct interactions are unknown between goby and ruffe, we surmise that goby may be feeding on ruffe eggs and/or young that were deposited and/or hatched in the river in the spring and early summer, or that goby may be having some other negative effect on ruffe. Following 2001, ruffe were not captured from the Thunder Bay River or adjacent waters in fall trawling surveys, however, round goby were the most abundant species captured from these waters during fall trawling surveys conducted through 2002 and from 2004 through 2006.

Although YOY ruffe have not been captured from the Thunder Bay River in the fall since 2001, adult spawning phase ruffe were captured from the river through spring 2003. Alpena FRO initiated a spring reduction effort in 2002 to remove adult spawning ruffe prior to reproduction using gill nets. The catch of adults declined from 2002 (96 ruffe) to 2003 (10 ruffe) and no ruffe were captured from 2004 thru 2006. It may be that the removal of spawning adults, coupled with other events, possibly predation effects of round goby, may be contributing to the decline in ruffe abundance.

LAKE MICHIGAN

Bays de Noc of Northern Green Bay Other fish sampling conducted by MIDNR in established transects did not capture ruffe from Big Bay de Noc (BBDN), but the ruffe catch from Little Bay de Noc (LBDN) increased 82% over 2005. For the past two years, no ruffe have been captured from BBDN, since MIDNR assessments captured one mature female (likely age 1+) during the fall of 2004. The history of ruffe range expansion suggests that during their early years of invasion, captures can vary with regard to total number and location. The catch of 40 ruffe in neighboring LBDN is the largest confirmed catch since ruffe were detected there in 2002, and suggests that ruffe recruitment and the overall ruffe population is increasing there. Reported ruffe captures in LBDN from 2002 thru 2006 have totaled 3, 4, 3, 22, and 40 respectively. In 2002 and 2003, all ruffe were captured in trawls. From 2004 thru 2006, the majority of ruffe were captured in 38 mm stretch mesh gill nets (Troy Zorn, MIDNR, Marquette Fisheries Research Station, Marquette; pers. comm.).

Based on the events in the Thunder Bay River, Lake Huron, the presence of round goby may have some effect on ruffe abundance in LBDN, but currently there are no observable trends, although the round goby comprises about 80% of MIDNR trawl catches in LBDN (Troy Zorn, MIDNR, Marquette Fisheries Research Station, Marquette; pers. comm.). The size of the ruffe range and the complexity of habitat in LBDN compared to the Thunder Bay River is significantly greater, and the ruffe may be occupying niches where the goby is not a threat.

Round goby are also abundant in southern Green Bay, and no ruffe were reported captured from WDNR sampling there, although the estuaries of the Menominee and Fox rivers are suitable (dredged channels with low water clarity) for colonization by ruffe (Michael Donofrio, WDNR, Peshtigo Fisheries Office, Peshtigo; pers. comm.).

How Successfully Is Ruffe Range Expansion Being Delayed in the Great Lakes?

The U.S. Geological Survey projected future unassisted range expansion of ruffe based on lake currents and U.S. documented ruffe range expansion through 1994 (unpublished, USGS, Great Lakes Science Center, Lake Superior Biological Station). In Lake Superior, USGS projected 2002 as the most likely year of ruffe arrival in the Keweenaw Waterway, MI, and 2006 as the most likely year of ruffe arrival in Marquette, MI. Documented arrival of ruffe in the Keweenaw Waterway was 2002, and Marquette was 2004. A total of two ruffe have been reported captured from Marquette Harbor since 2004, and no ruffe were reported captured there in 2006. USGS projected the earliest estimated years of arrival for Whitefish Point, Lake Superior, and the St. Marys River to be 2004 and 2005, respectively. Ruffe were discovered in the Tahq River estuary, 26 km south of Whitefish Point in 2006. There have been no reported ruffe captures from the St. Marys River. In Lake Huron, the most likely year of ruffe arrival in Saginaw Bay was projected to be 2003. Ruffe surveillance has not documented the presence of ruffe in Saginaw Bay, or any other location in Lake Huron other than Thunder Bay near Alpena, 93 km north of Saginaw Bay. In Lake Michigan, ruffe were projected to likely arrive in Manistique, Michigan by 2007. Ruffe were documented to arrive in Big Bay de Noc in 2004, 50 km southwest of Manistique. Voluntary ballast exchange conducted by the Lake Carriers Association, educational efforts conducted by Sea Grant and state, tribal, and federal environmental organizations, and early detection of range expansion by ruffe surveillance and other fish sampling, have reduced the potential of human assisted ruffe range expansion. It appears that ruffe are continuing to expand their range unassisted by human activities at a rate very close to USGS projections.

Range of Ruffe

The current range of ruffe in the Great Lakes is as follows (See range map, last page):

Lake Superior

North Shore: From the Duluth/Superior Harbor, Minnesota/Wisconsin, USA, to 5 km northeast of the Current River, Thunder Bay Harbour, Ontario, Canada.

South Shore: From the Duluth/Superior Harbor, Minnesota/Wisconsin, to the Tahquamenon River, Michigan, a tributary in western Whitefish Bay 55 km west of the Soo Locks.

Lake Huron

Thunder Bay River & Thunder Bay Shipping Channel near Alpena, MI. However, no ruffe have been reported captured from Lake Huron since 2003.

Lake Michigan

Little Bay de Noc and Big Bay de Noc of Green Bay.

Lake Erie

Unconfirmed.

Lake Ontario

Undetected.

Great Lakes Basin Inland Lakes & Streams

Undetected.

Proposed Ruffe Surveillance and Ruffe Population Reduction in 2007

Lake Superior

The Ashland FRO will continue to conduct spring and fall ruffe surveillance to detect range expansion, age and/or size composition and changes in fish community near the periphery and outside of the documented ruffe range along the south shore of Lake Superior and in Thunder Bay Harbour, Ontario. Within the periphery of the known range of ruffe along the south shore, the locations include Huron Bay and Marquette Harbor. Outside of the known range of ruffe, the locations include three sites in the St. Marys River above the Soo Locks.

Lake Michigan

No ruffe surveillance is scheduled due to lack of funding.

Lake Huron

Although ruffe were not captured from the Thunder Bay area in 2006, spring removal will continue in the Thunder Bay River. Fall ruffe surveillance will continue in nearshore areas, tributaries, and ports susceptible to ruffe invasion and the St. Marys River as well.

Lakes Erie and Ontario

LGLFRO plans to continue ruffe surveillance in dredged channels adjacent to harbors in U.S. waters of Lakes Erie and Ontario. These surveys will be conducted at Toledo, Sandusky, Cleveland, Ashtabula, Conneaut, Ohio; Erie, Pennsylvania; and Buffalo, New York, in Lake Erie; and the Genesee River (near Rochester, New York) in Lake Ontario. LGLFRO will continue to respond to angler reports of ruffe sightings.

Ruffe surveillance in additional waterways will be conducted as considered appropriate (e.g. to follow-up unconfirmed sightings and/or new reported discoveries).

[Return to top](#)

ACKNOWLEDGMENTS

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Special mention for Amy Benson, USGS-Nonindigenous Aquatic Species Database, Gainesville, Florida, and Frank Stone, USFWS-Ashland FRO. Amy updates and provides the current ruffe range map that appears at the end of this report, and is often used in ruffe presentations and other AIS documents. Frank formats and enhances the images for the Internet version of this report.

Assisted on Ruffe Surveillance Vessels

Jessica Krajniak (USFWS-Ashland FRO)
Matt Moyer (Volunteer-LGLFRO)
Jody Murray (Volunteer-Ashland FRO)
Patrick Herbert (Volunteer-LGLFRO)
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Chris Castiglione (USFWS-LGLFRO)
Jennifer Tait (Volunteer-LGLFRO)
Ray Li (USFWS-LGLFRO)
Eric Snyder (Volunteer-LGLFRO)
Denise Clay (USFWS-LGLFRO)
Mark Russell (Volunteer-LGLFRO)
Melissa Malloy (USFWS-LGLFRO)

Reported Information From Other Fish Sampling Capable of Capturing Ruffe Incidentally

Christine Brousseau (Fisheries & Oceans Can.)
Bill Mattes (GLIFWC)
Michael Bur (USGS-Lake Erie Biol. Stn.)
Lisa O'Connor (Fisheries and Oceans Canada)
Gary Cholwek (USGS-Lake Superior Biol. Stn.)
Robert O'Gorman (USGS-Lake Ontario Biol. Stn.)
Ken Cullis (OMNR)
Joseph Pearce (MIDNR-Baraga Ops. Service Ctr.)
Alan Dextrase (OMNR) Stan Powell (OMNR)
Ivan Dolinsek (Concordia University)
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Michael Donofrio (WIDNR-Peshtigo Fish. Off.)
Henry Quinlan (USFWS-Ashland FRO)
Andrew Drake (Fisheries and Oceans Canada)
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Andrew Treble (Fisheries and Oceans Canada)
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Troy Zorn (MIDNR-Marquette Fisheries Res. Stn.)

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[Summary of Ruffe Surveillance on the Periphery and Outside of the Detected Ruffe Range \(pdf\)](#)

[Return to top](#)

[Return to Aquatic Invasive Species](#)

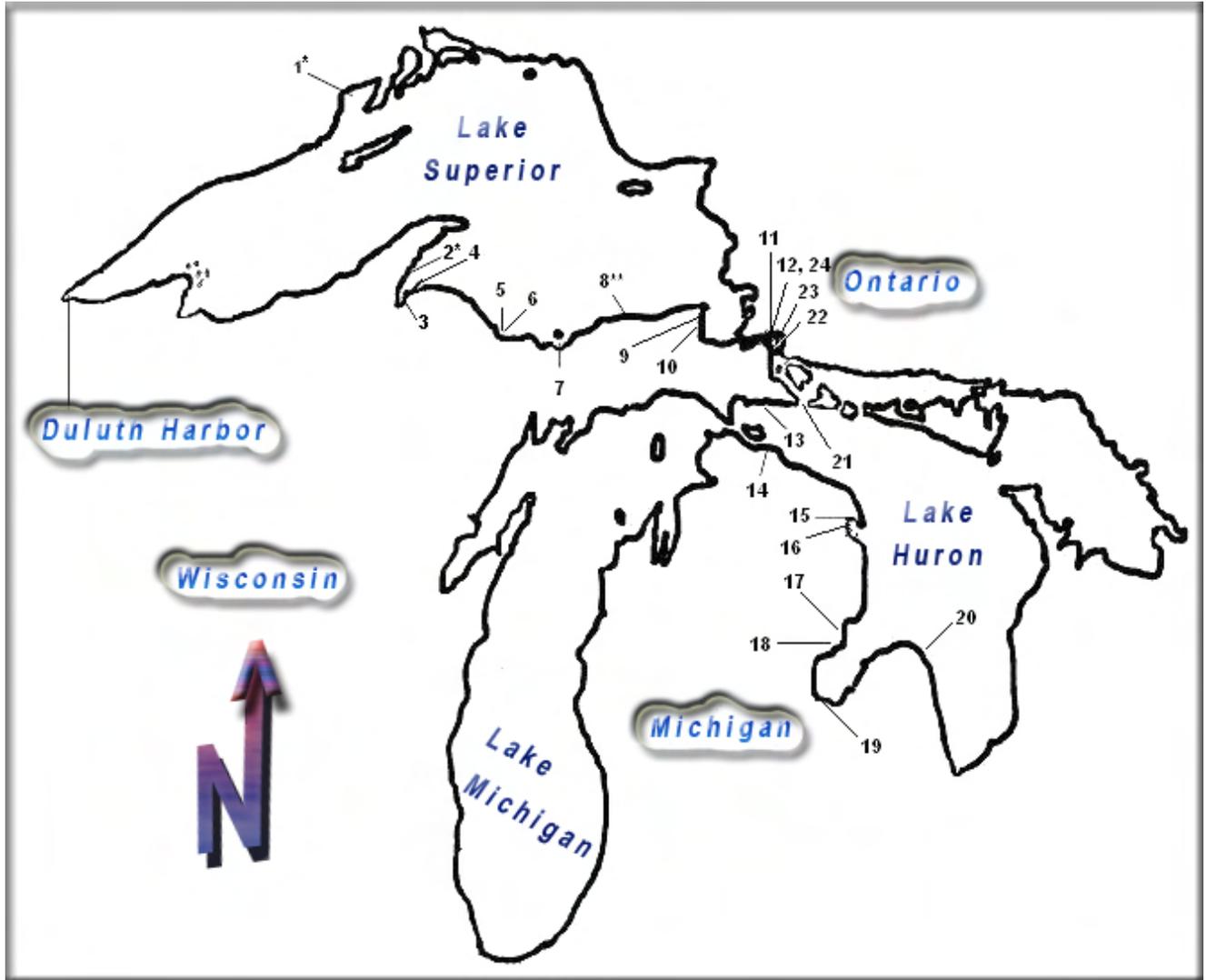
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[Region 3 Home Page](#)

[U.S. Fish and Wildlife Service Home Page](#)



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006



- | | | | |
|--------------------------|-------------------------------------|-------------------------------------|---|
| 1. Thunder Bay Harbour * | 7. Munising Bay | 13. Port Dolomite | 19. Saginaw River |
| 2. Keweenaw Waterway * | 8. West Bay (Grand Marais) ** | 14. Cheboygan River | 20. Harbor Beach |
| 3. Pequaming Bay | 9. Whitefish Bay (Abandoned Harbor) | 15. Thunder Bay River | 21. St. Marys River (De Tour Passage) |
| 4. Huron Bay | 10. Tahquamenon River | 16. Thunder Bay (River Ship. Chan.) | 22. St. Marys River (Munuscong Channel) |

5. Upper
Marquette
Harbor

11. St. Marys River (Algoma Steel)

17. National Gypsum

23. St. Marys
River (South
Sugar Island
Ferry)

6. Lower
Marquette
Harbor

12. St. Marys River (Purvis Marine)

18. Au Gres River

24. St. Marys
River (SSM
Municipal
Harbor)

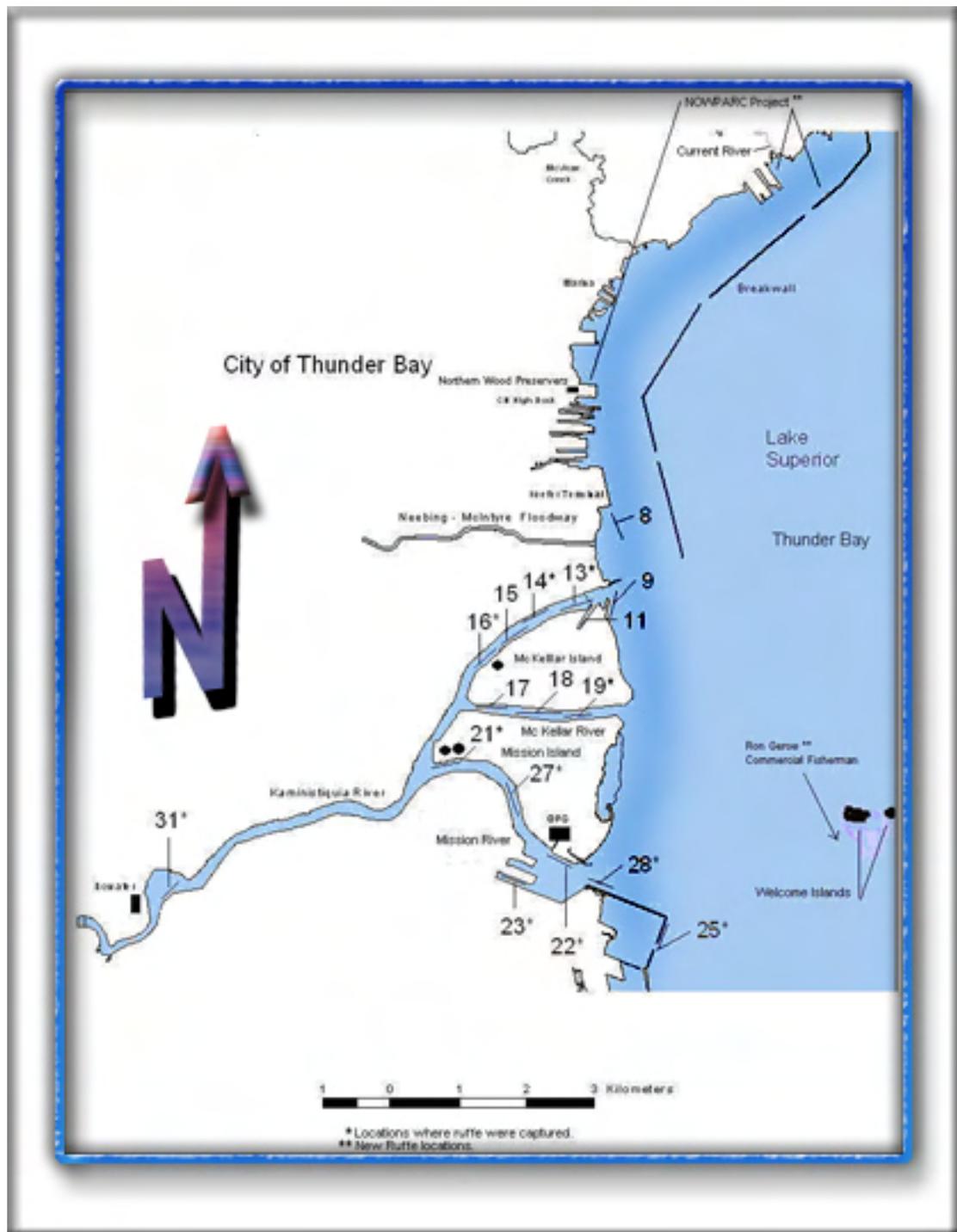
* Locations where ruffe were captured.

** New ruffe discovery.

**Figure 1. Locations surveyed for ruffe in the Upper
Great Lakes, 2006.**



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006



* Locations where ruffe were captured.
** New Ruffe locations.

Figure 2. Locations surveyed for ruffe in Thunder Bay Harbour, Ontario, Lake Superior, 2006.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006

2006 USGS Sample Sites

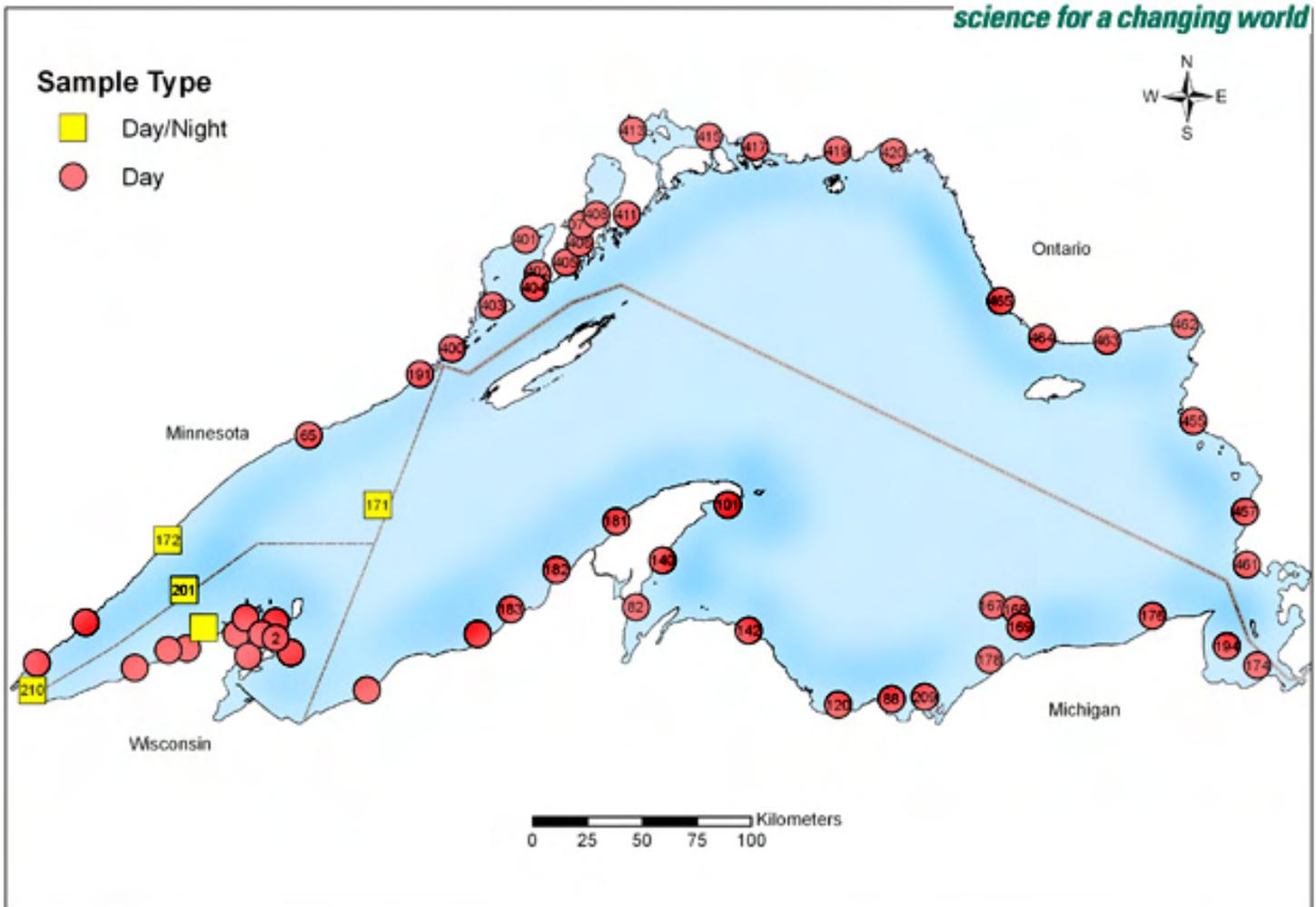
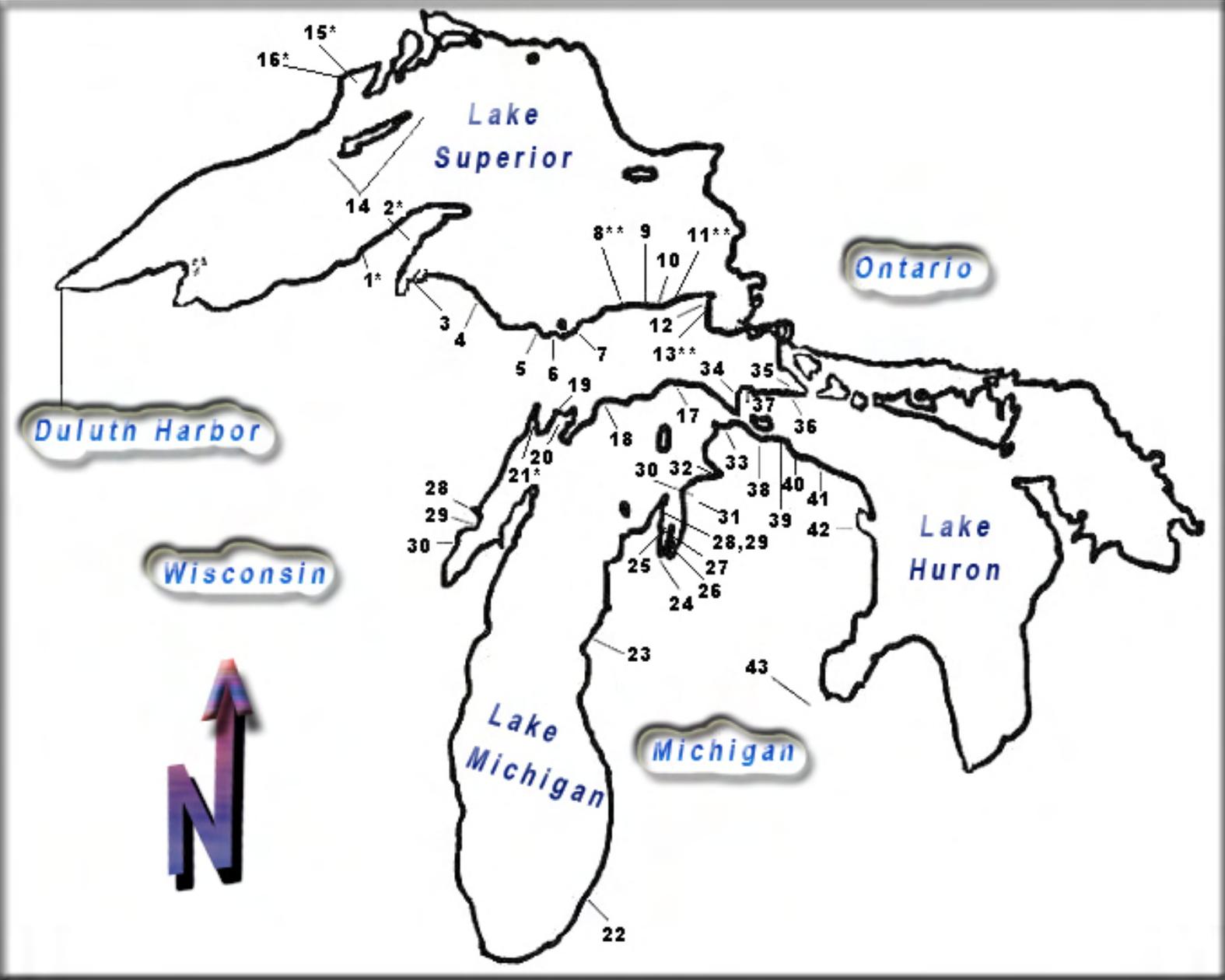


Figure 3. USGS bottom trawling locations in Lake Superior, where ruffe were capable of incidental capture, 2006.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006



- | | | | |
|-----------------------|--------------------------|------------------------|------------------|
| 1. Misery River * | 12. Betsy River | 23. Big Manistee River | 34. Carp River |
| 2. Torch Lake Canal * | 13. Tahquamenon River ** | 24. Boardman River | 35. Albany Creek |

- | | | | |
|----------------------------|---------------------------|--------------------------------|-------------------------|
| 3. Silver River | 14. Isle Royale | 25. Gr. Traverse Bay-West Arm | 36. Trout Creek |
| 4. Big Garlic River | 15. Thunder Bay * | 26. Bowers Harbor | 37. Nunns Creek |
| 5. Rock River | 16. Kaministiquia River * | 27. Suttons Bay | 38. Cheboygan River |
| 6. Furnace Creek | 17. Hog Island Creek | 28. Omena Bay | 39. Greene Creek |
| 7. Miners River | 18. Manistique River | 29. Gr. Traverse Bay-Northport | 40. Ocqueoc River |
| 8. Grand Marais * * | 19. Ogontz River | 30. Lake Charlevoix | 41. Trout River |
| 9. Blind Sucker | 20. Big Bay de Noc | 31. Deer Creek | 42. Devils River |
| 10. Deer Park | 21. Little Bay de Noc * | 32. Little Traverse-Petoskey | 43. Tittabawassee River |
| 11. Little Lake Harbor * * | 22. St. Joseph River | 33. Carp Lake Outlet | |

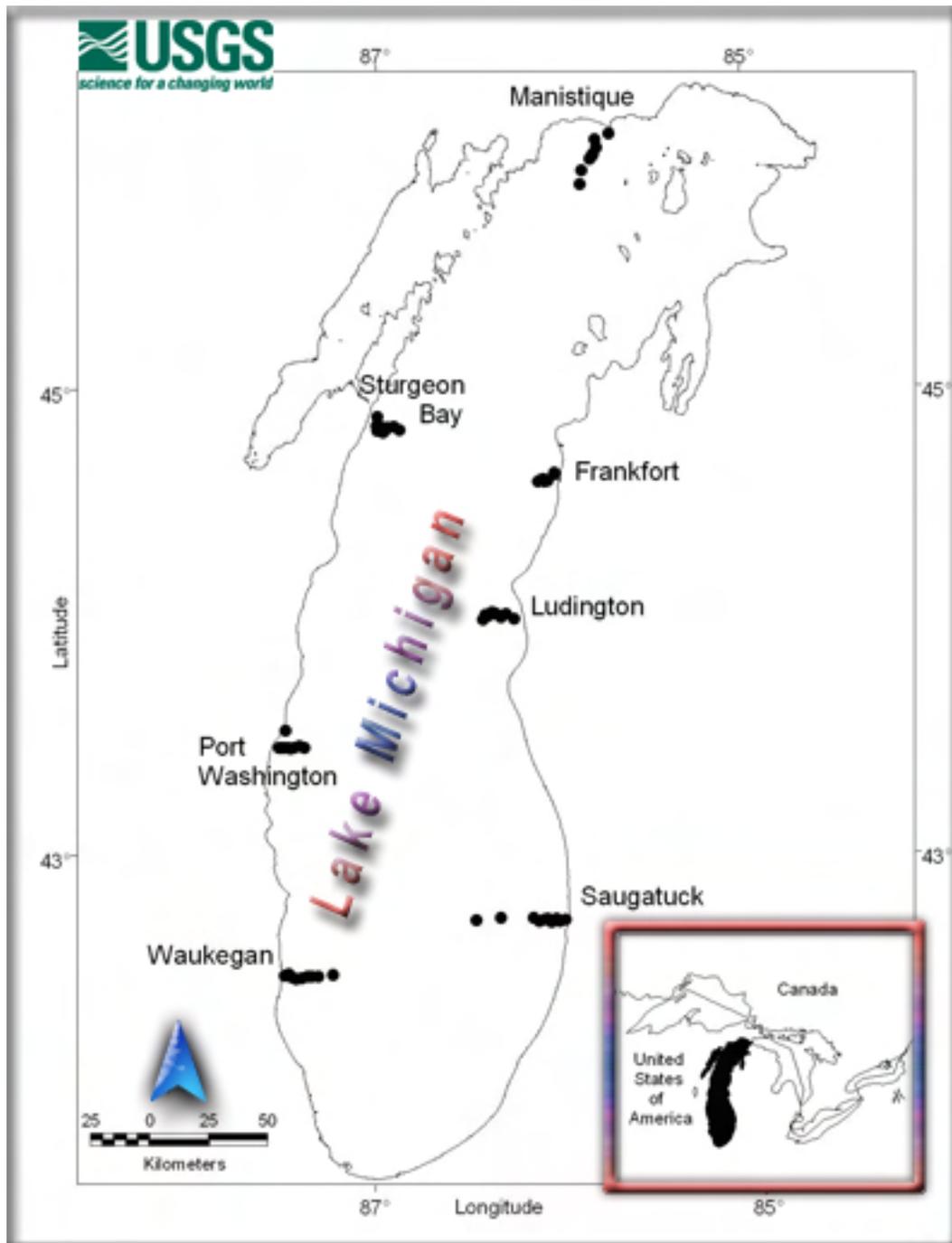
* Locations where ruffe were captured.

** New ruffe discovery.

Figure 4. Reported sampling locations in the Upper Great Lakes, where ruffe were capable of incidental capture, 2006.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006



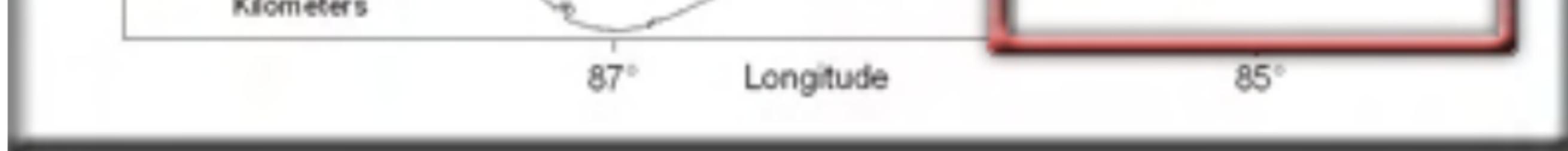
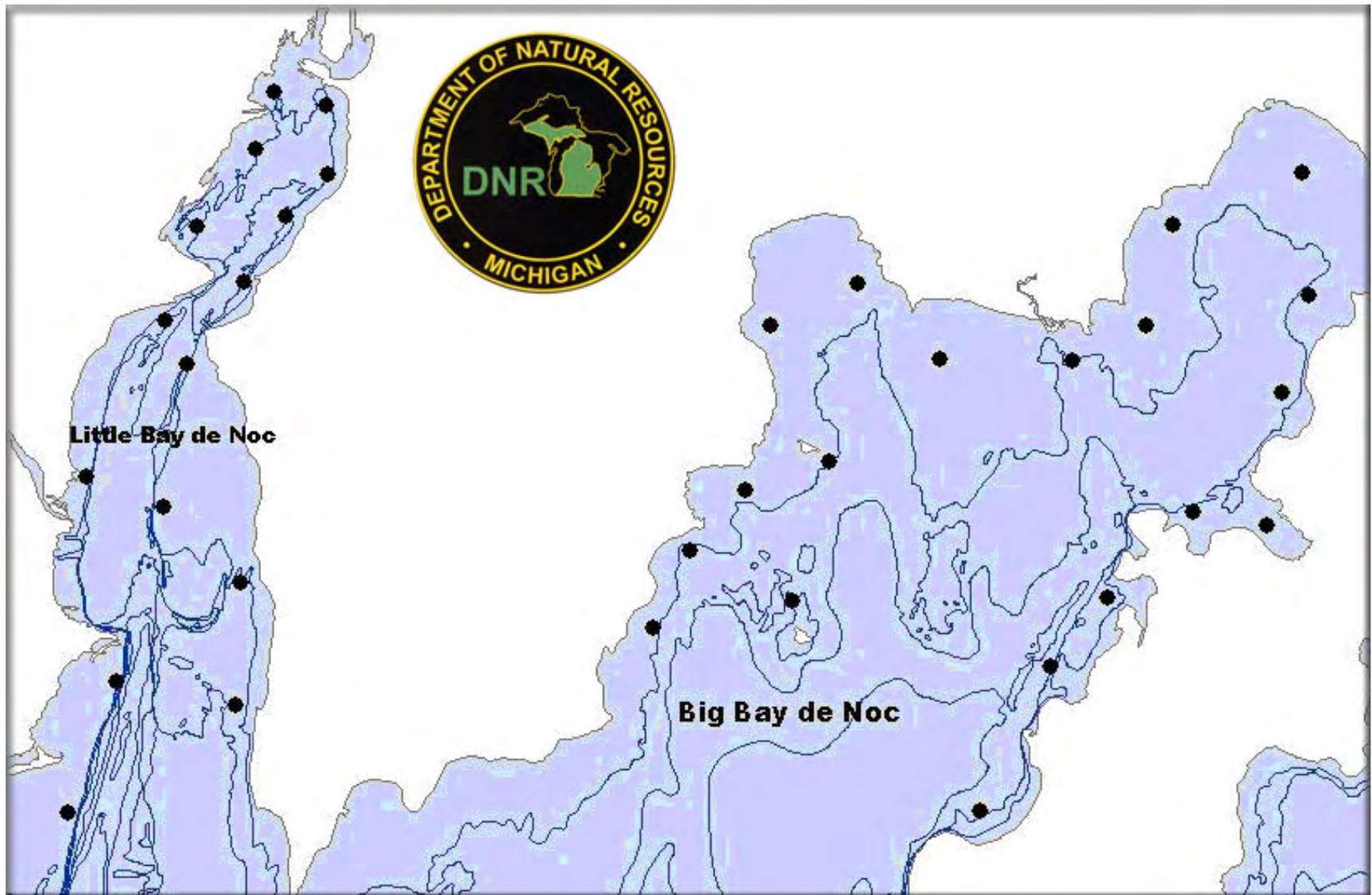


Figure 5. USGS bottom trawl locations in Lake Michigan, where ruffe were capable of incidental capture, 2006.



**SURVEILLANCE
FOR RUFFE IN
THE GREAT LAKES, 2006**



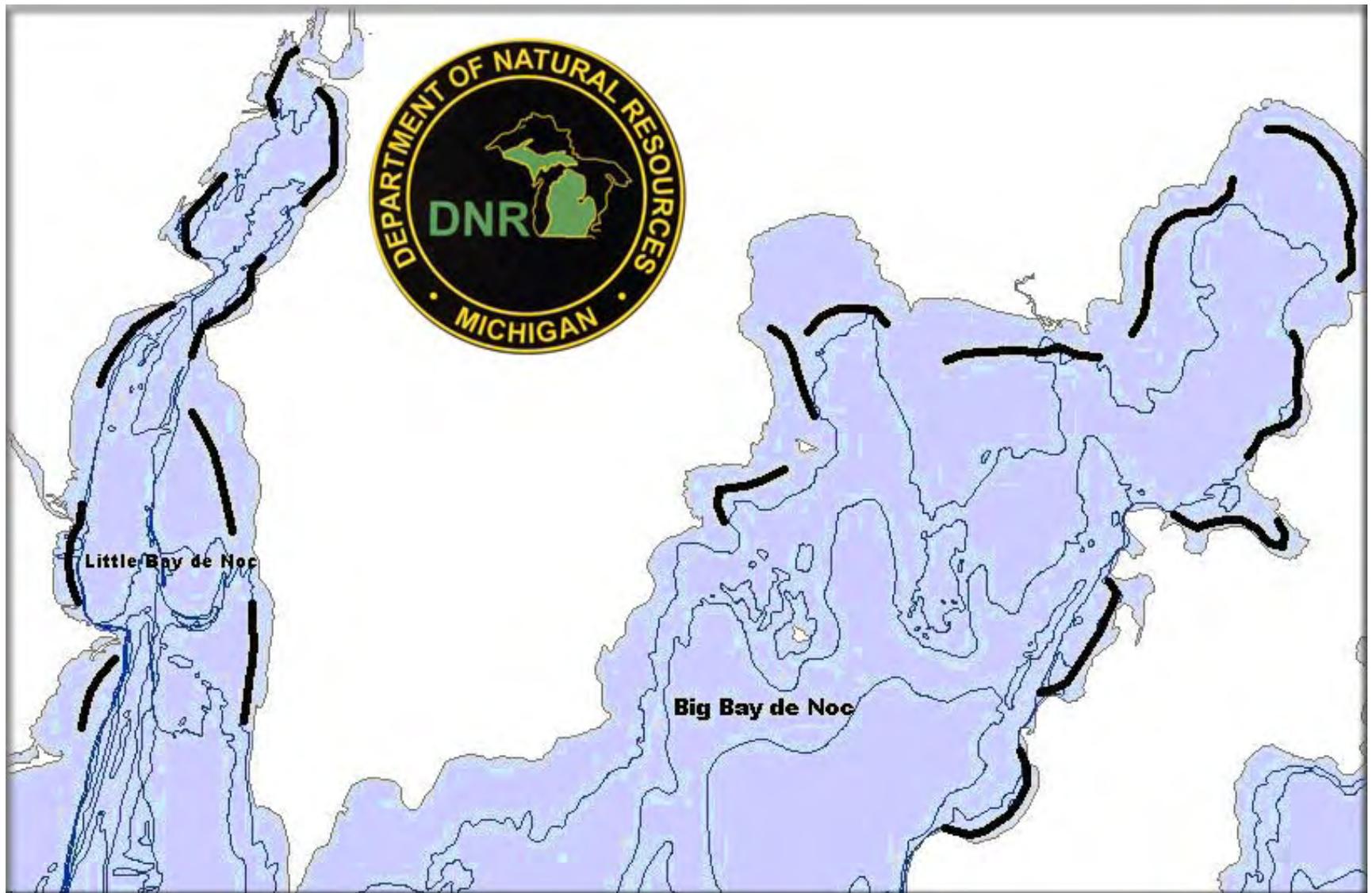


Gill Net Sites, Hatchery-reared Walleye Study, 2004-2010

Figure 6. MIDNR gill net locations in northern Green Bay of Lake Michigan. In 2006, a subset of 12 sites from Big Bay de Noc and four sites from Little Bay de Noc were randomly selected and sampled. Ruffe were capable of incidental capture from this sampling.



**SURVEILLANCE
FOR RUFFE IN
THE GREAT LAKES, 2006**





Electrofishing Transects, Hatchery-reared Walleye Study, 2004-2010

Figure 7. MIDNR electrofishing transects in northern Green Bay of Lake Michigan. In 2006, a subset of six transects from Big Bay de Noc and eight transects from Little Bay de Noc were randomly selected and sampled. Ruffe were capable of incidental observation and capture from this sampling.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006

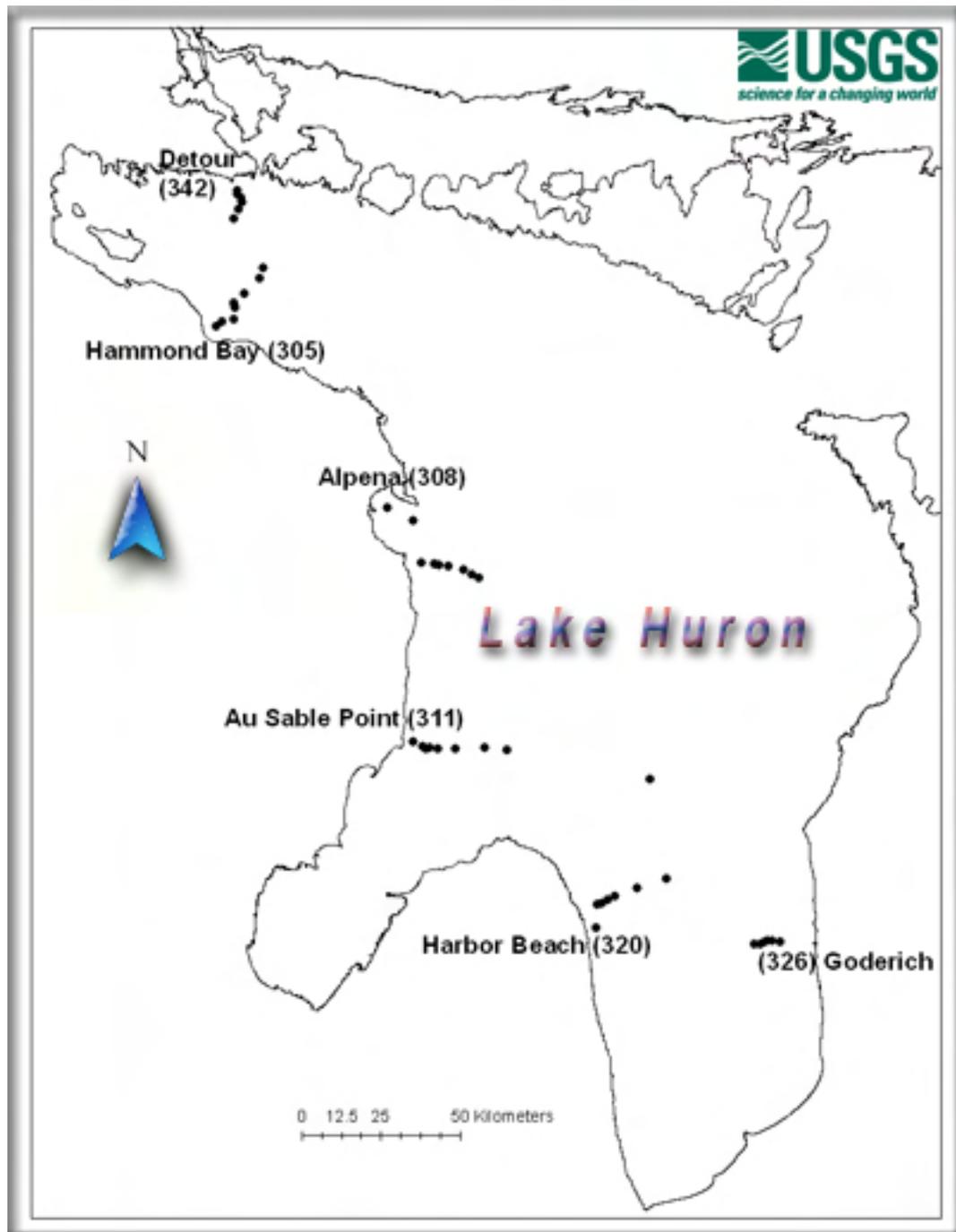




Figure 8. USGS bottom trawl locations in Lake Huron, where ruffe were capable of incidental capture, 2006.

**SURVEILLANCE
FOR RUFFE IN
THE GREAT LAKES, 2006**

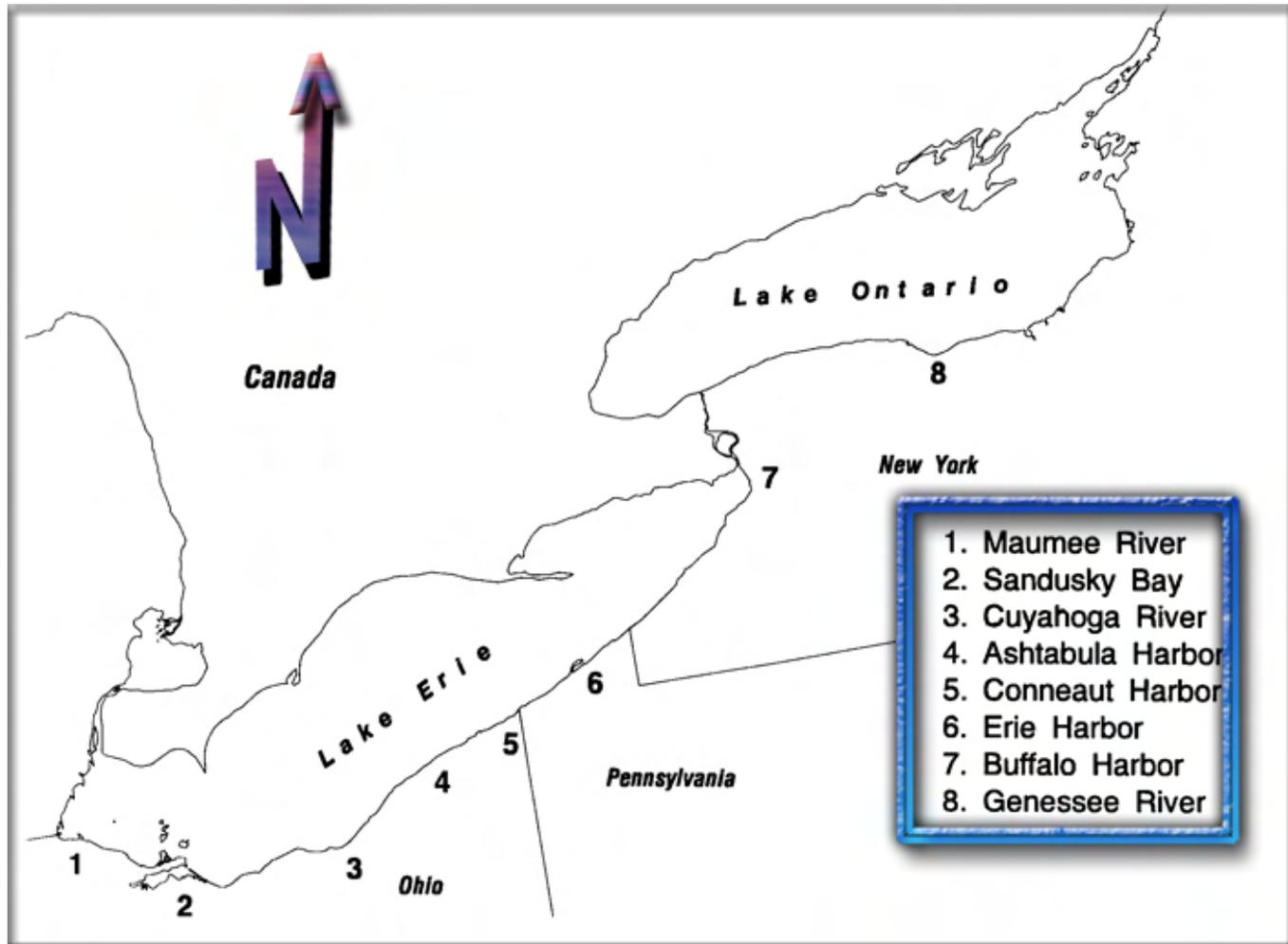
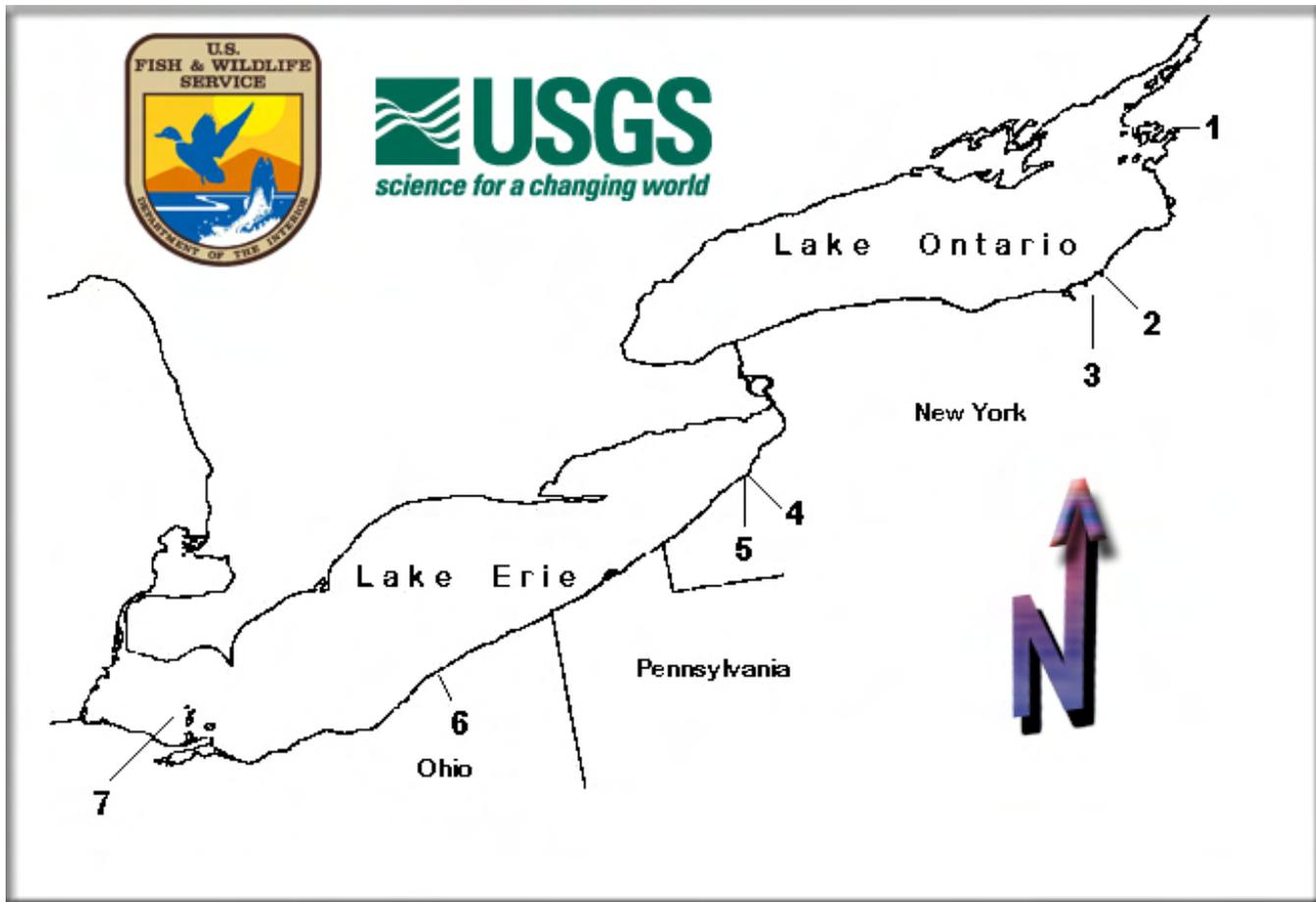


Figure 9. Locations surveyed for ruffe in U.S. waters of the Lower Great Lakes, 2006.

**SURVEILLANCE
FOR RUFFE IN
THE GREAT LAKES, 2006**



**Marquette Biological Station
Sea Lamprey Control (Trapping)**

- | | |
|--------------------------|----------------------|
| 1. Black River | 4. Cattaraugus Creek |
| 2. Sterling Creek | 5. Spooner Creek |
| 3. Sterling Valley Creek | 6. Grand River |

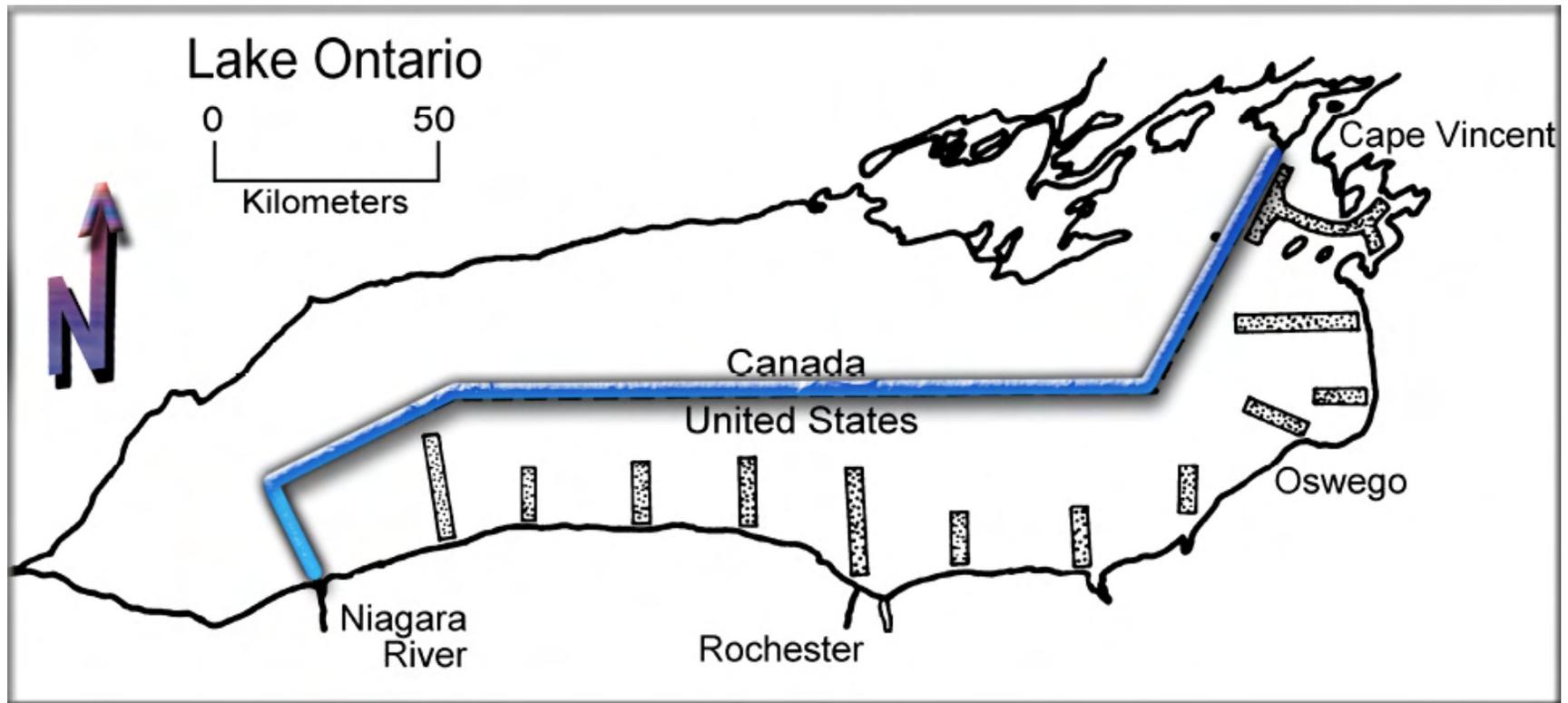
**Great Lakes Science Center
Lake Erie Biological Station (Bottom Trawling)**

7. East Harbor State Park, Ohio

Figure 10. Reported sampling locations in U.S. waters of the Lower Great Lakes, where ruffe were capable of incidental capture, 2006.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2006





**New York State Department of
Environmental Conservation**

Figure 11. USGS/NYSDEC bottom trawl locations in Lake Ontario, where ruffe were capable of incidental capture, 2006.

Table 1. Summary of 2006 ruffe surveillance and other reported fish sampling effort in Lake Superior (on the periphery and outside of the detected ruffe range).

Location	Agency	Effort *	Gear	Date	Ave. btm. Temp (°C)	Ave. depth (m)	Ave. secchi (m)	Ruffe
Ruffe surveillance								
Keweenaw Waterway (Pike Bay)**	FWS	13.00	BT-4.9	5/16/06	10.5	4.6	1.4	3
Keweenaw Waterway (Pike Bay)**	FWS	15.00	BT-3.4 exp	9/26/06	13.0	4.0		1
Keweenaw Waterway (Portage Lake S. Entry)	FWS	15.00	BT-4.9	5/16/06	10.5	5.6	0.9	
Keweenaw Waterway (Portage Lake S. Entry)**	FWS	15.00	BT-3.4 exp	9/26/06	13.5	5.5		1
Keweenaw Waterway (South Entry)	FWS	10.00	BT-4.9	5/16/06	10.5	7.5	0.8	
Keweenaw Waterway (South Entry)	FWS	10.00	BT-3.4 exp	9/26/06	14.0	7.7		
Pequaming Bay	FWS	30.00	BT-4.9	5/17/06	7.0	10.8	4.6	
Pequaming Bay	FWS	2 trapnights	MWT	5/17-18/06	6.8	3.3	4.6	
Pequaming Bay	FWS	1 trapnight	FN	5/17-18/06	7.0	2.3	4.6	
Huron Bay	FWS	45.00	BT-3.4 exp	9/27/06	8.0	10.3		
Marquette Lower Harbor	FWS	25.00	BT-4.9	5/18/06	6.8	7.8	3.3	
Marquette Lower Harbor	FWS	25.00	BT-3.4 exp	9/28/06	13.0	7.4		
Marquette Upper Harbor	FWS	21.50	BT-4.9	5/18/06	6.0	8.5	5.6	
Marquette Upper Harbor	FWS	25.00	BT-3.4 exp	9/28/06	13.0	5.9		
Munising Bay	FWS	15.00	BT-4.9	5/19/06	7.0	9.5	7.6	
Munising Bay	FWS	2 trapnights	MWT	5/19-20/06	7.5	4.3	7.6	
Munising Bay	FWS	1 trapnights	FN	5/19-20/06	7.5	0.5	7.6	
Munising Bay	FWS	15.00	BT-3.4 exp	9/29/06	12.0	10.4		
Munising Bay	FWS	3 trapnights	MWT	9/29-9/30/06	11.8	4.0		
Munising Bay	FWS	22.5 meters	GN-38	9/29-9/30/06	11.8	6.4		
Grand Marais (West Bay)***	FWS	30.00	BT-4.9	5/20/06	9.0	11.0		1
Grand Marais (West Bay)	FWS	28.00	BT-3.4 exp	9/30/06	11.5	9.9		
Tahquamenon River	FWS	12.30	BT-4.9	5/21/06	11.0	3.0		
Tahquamenon River	FWS	3 trapnights	FN	5/21-22/06	11.3	3.6	1.1	
Tahquamenon River	FWS	13.00	BT-3.4 exp	10/1/06	11.0	3.0		
Tahquamenon River	FWS	3 trapnights	MWT	10/1-2/06	11.0	4.6		
Tahquamenon River	FWS	22.5 meters	GN-38	10/1-2/06	11.0	3.4		
Whitefish Bay (Abandoned harbor)	FWS	2 trapnights	FN	5/22-23/06	11.0	2.4	1.7	
St. Marys River (Purvis Marine Dock, Ontario)	FWS/OMNR	8.00	BT-3.4 exp	10/02/06	12.0	7.3		
St. Marys River (Algoma Steel, Ontario)	FWS/OMNR	15.00	BT-3.4 exp	10/02/06	12.0	8.1		
Thunder Bay Harbour, Ontario**	OMNR/FWS	85.00	BT-4.9	10/16-18/06	7.5	7.5	2.5	2345
Totals								Ruffe
		4.28 hours.	BT-4.9					2349
		3.57 hours	BT-3.4 exp					2
		10 trapnights	MWT					0
		7 trapnights	FN					0
		45 meters	GN-38					0
Total ruffe (ruffe surveillance)								2351

(Continued)

Table 1. (Concluded)

Location	Agency	Effort *	Gear	Date	Ave. btm. Temp (°C)	Ave. depth (m)	Ave. secchi (m)	Ruffe
Reported fish sampling capable of capturing ruffe incidentally								
Betsy River	PC	108 trapnights	PAT	5/4-6/27/06	17.6	0.5		
Big Garlic River	PC	58 trapnights	FN	4/26-6/23/06	17.7	0.5-1.0		
Blind Sucker	FWS	1463 meters	GN-50,63,75,88,100,113	7/17-19/06	16.5 (S)	48.0-73.0		
Deer Park	FWS	1463 meters	GN-50,63,75,88,100,113	7/21-23/06	18.0 (S)	45.0-83.0		
Furnace Creek	PC	63 trapnights	PAT	4/21-6/23/06	15.3	0.5		
Grand Marais	FWS	1463 meters	GN-50,63,75,88,100,113	7/19-21/06	18.0 (S)	61.0-75.0		
Isle Royale (Siskiwit Bay)	FWS	7.51 hours	BEL	6/6-7/06				
Isle Royale (Siskiwit Bay)	FWS	0.45 hours	BPEL	6/7/06				
Isle Royale (Tobin Harbor)	FWS	4.78 hours	BEL	6/8-9/06				
Keweenaw Waterway (Torch Lake Canal)**	MIDNR/PA		HL	5/26/06				1
Little Lake Harbor***	MIDNR/PA		HL	7/3/06				1
Miners River	NPS/FWS	108 trapnights	PAT	5/8-7/1/06	13.7	0.5		
Misery River**	GLIFWC	122 trapnights	PAT	5/9-7/9/06	14.5	0.5		7
Near-shore/Off-shore	USGS	15.00 hours	BT-11.9	4/24-6/20/06		10.0-50.0		
Rock River	FWS	116 trapnights	PAT	5/1-6/28/06	14.5	0.5		
Silver River	GLIFWC	38 trapnights	FN	5/23-6/30/06	16.2	0.5-1.0		
Tahquamenon River	PC	165 trapnights	PAT	5/3-6/27/06	17.6	0.5		
Tahquamenon River***	USFWS/PA		HL	5/3, 5/23/06		4.5		2
Kaministiquia River (42 km Upriver)***	OMNR		Dipnet	7/4/06	20.0			1
Thunder Bay (Welcome Islands)***	OMNR/CF		GN-120	5/11/06		18.3		3
Thunder Bay Harbour (Northern)***	NOWPARC		BEL/BPEL/GN	May-Oct.				173
Totals								Ruffe
			HL					4
		4389 meters	GN-50,63,75,88,100,113					0
		OMNR/CF	GN-120					3
		116 trapnights	FN					0
		682 trapnights	PAT					7
		12.29 hours	BEL					0
		0.45 hours	BPEL					0
		15.00 hours	BT-11.9					0
		NOWPARC	BEL/BPEL/GN					173
		OMNR	Dipnet					1
		Total ruffe (reported fish sampling capable of capturing ruffe incidentally)						188
		Total ruffe (ruffe surveillance)						2351
		Total ruffe (all reported fish sampling capable of capturing ruffe on periphery & outside of previous detected range + ruffe surveillance)						2539

Key to agency:

FWS = U.S. Fish & Wildlife Service
 USGS = U.S. Geological Survey
 NPS = National Park Service
 OMNR = Ontario Ministry of Natural Resources
 MIDNR = Michigan Dept. of Natural Resources
 GLIFWC = Great Lakes Indian Fish & Wildlife Commission
 PC = Private contractor
 PA = Private Angler
 CF = Commercial Fisherman
 NOWPARC = Northern Wood Preservers Alternative Remediation Concept

Key to gear:

BT-3.4 exp = Experimental bottom trawl (3.4 m headrope)
 BT-4.9 = Bottom trawl (4.9 m headrope)
 BT-11.9 = Bottom trawl (11.9 m headrope)
 BEL = Boom electrofishing
 BPEL = Backpack electrofishing
 FN = Fyke net
 MWT = Modified Windermere trap
 PAT = Portable assessment trap
 GN-50,63,75,88,100,113 = Gill net (50,63,75,88,100,113 mm stretch mesh panels)
 HL = Hook & line

Key to symbols:

* = Unless specified, effort is in minutes trawl was on bottom.
 ** = Locations where ruffe were captured.
 *** = New ruffe discovery

Table 2. Summary of reported 2006 fish sampling effort capable of incidental ruffe capture in Lake Michigan.

Location	Agency	Effort *	Gear	Date	Ave. btm. temp. (°C)	Ave. depth (m)	Ruffe	
Big Bay de Noc	MIDNR	200	BT	Jun/Jul/Aug/Sep/06				
Big Bay de Noc	MIDNR	293 meters	GN-exp	Jun/Jul/Aug/Sep/06		4.6		
Big Bay de Noc	MIDNR	3,841 meters	GN-25	Sep/Oct/06				
Big Bay de Noc	MIDNR	3,841 meters	GN-38	Sep/Oct/06				
Big Bay de Noc	MIDNR	3,841 meters	GN-50	Sep/Oct/06				
Big Manistee River	FWS/LBS	132 trapnights	PAT	4/16-6/21/06	14.5	0.5		
Boardman River	GTBOCI	59 trapnights	PAT	4/18-6/16/06	15.9 (S)	0.5		
Bowers Harbor	ISEA	30	BT-4.9	6/16/06		6.0-15.0		
Carp Lake Outlet	LTBBOI	59 trapnights	PT	4/25-6/23/06	15.0 (S)	0.8		
Deer Creek	PC	130 trapnights	PAT	4/13-6/17/06	16.9	0.5		
East Twin River	PC	55 trapnights	PAT	4/18-6/12/06	15.4 (S)	0.5		
Grand Traverse Bay (Northport)	ISEA	10	BT-4.9	7/19/06		6.0-15.0		
Grand Traverse Bay (West Arm)	ISEA	420	BT-4.9	May/June/Aug/06		6.0-15.0		
Hog Island Creek	PC	60 trapnights	FN	4/19-6/18/06	14.6	0.5-1.0		
Lake Charlevoix	ISEA	10	BT-4.9	8/21/06		6.0-15.0		
Little Bay de Noc	ISEA	60	BT-4.9	7/12,13,14,16/06		6.0-15.0		
Little Bay de Noc**	MIDNR	200	BT	Jun/Jul/Aug/Sep/06		5.9	1	
Little Bay de Noc**	MIDNR	293 meters	GN-exp	Jun/Jul/Aug/Sep/06		3.8	1	
Little Bay de Noc**	MIDNR	1280 meters	GN-25	Sep/Oct/06		2.1	8	
Little Bay de Noc**	MIDNR	1280 meters	GN-38	Sep/Oct/06		2.6	30	
Little Bay de Noc**	MIDNR	1280 meters	GN-50	Sep/Oct/06		3.1		
Little Traverse Bay (Petoskey)	ISEA	10	BT-4.9	8/19/06		6.0-15.0		
Manistique River	FWS/MBS	47 trapnights	MT	4/27-6/13/06	15.5	0.5		
Near-shore/Off-shore	USGS	710	BT-12	Sep-Oct/06	4.2-17.7	5.0-110.0		
Ogontz River	PC	63 trapnights	FN	4/20-6/22/06	16.3	0.5-1.0		
Omena Bay	ISEA	40	BT-4.9	8/2,15 & 9/20/06		6.0-15.0		
St. Joseph River	PC	162 trapnights	PAT	3/7-5/27/06	11.8 (S)	0.5		
Suttons Bay	ISEA	880	BT-4.9	Apr-Sep/06		6.0-15.0		
Totals							Ruffe	
		6.67 hours	BT				1	
		24.33 hours	BT-4.9				0	
		11.83 hours	BT-12				0	
		123 trapnights	FN				0	
		644 trapnights	Traps				0	
		586 meters	GN-exp				1	
		5,121 meters	GN-25				8	
		5,121 meters	GN-38				30	
		5,121 meters	GN-50				0	
		Total ruffe (all reported fish sampling capable of capturing ruffe on periphery & outside of previous detected range)						40

Key to agency:

FWS = U.S. Fish & Wildlife Service
 USGS = U.S. Geological Survey
 GTBOCI = Grand Traverse Band of Ottawa and Chippewa Indians
 ISEA = Inland Seas Education Association
 LBS = Ludington Biological Station - FWS
 LTBBOI = Little Traverse Bay Band of Ottawa Indians
 MBS = Marquette Biological Station - FWS
 MIDNR = Michigan Department of Natural Resources
 PC = Private contractor

Key to gear:

BT = Bottom trawl
 BT-4.9 = BT (4.9 m headrope)
 BT-12 = BT (12.0 m headrope)
 FN = Fyke net
 GN-exp = Experimental gill net
 GN-25 = Gill net (25 mm stretch mesh)
 GN-38 = Gill net (38 mm stretch mesh)
 GN-50 = Gill net (50 mm stretch mesh)
 MT = Mechanical trap
 PAT = Portable assessment trap
 PT = Permanent trap

Key to symbols:

* = Unless specified, effort is in minutes trawl was on bottom
 ** = Locations where ruffe were captured
 S = Surface temperature

Table 3. Summary of 2006 ruffe surveillance and other fish sampling effort in U.S. waters of Lake Huron and the St. Marys River.

Location	Agency	Effort *	Gear	Date	Ave. btm. Temp (°C)	Ave. depth (m)	Ruffe
Ruffe surveillance							
AuGres River	FWS	30.0	BT-4.9	10/2/06	12.0	2.5	
Cheboygan River	FWS	30.0	BT-4.9	9/19/06	17.2	7.3	
Harbor Beach	FWS	30.0	BT-4.9	10/3/06	15.1	5.3	
National Gypsum	FWS	15.0	BT-4.9	9/21/06	13.9	6.2	
Port Dolomite	FWS	30.0	BT-4.9	9/27/06	9.2	7.4	
Saginaw River	FWS	20.0	BT-4.9	10/4/06	15.2	8.9	
Thunder Bay (Shipping Channel)	FWS	30.0	BT-4.9	9/20/06	11.0	6.1	
Thunder Bay River	FWS	30.0	BT-4.9	9/18/06	19.4	6.7	
Thunder Bay River	FWS	44 nights	GN-38	4/10-28/06	10.8	3.6	
Thunder Bay River	FWS	10 nights	GN-38	9/18-21/06	17.9	2.8	
Totals							Ruffe
		3.58 hours	BT-4.9				0
		54 nights	GN-38				0
		Total ruffe (ruffe surveillance)					0
St. Marys River							
De Tour Passage	FWS	30.0	BT-4.9	9/28/06	12.0	7.8	
Munuscong Channel	FWS	20.0	BT-4.9	9/26/06	9.1	7.3	
Sault Ste. Marie Municipal Marina	FWS	25.0	BT-4.9	9/25/06	13.2	4.2	
South Sugar Island Ferry	FWS	30.0	BT-4.9	9/26-27/06	11.7	7.6	
Totals							Ruffe
		1.75 hours	BT-4.9				0
		Total ruffe (ruffe surveillance)					0
Reported fish sampling capable of capturing ruffe incidentally							
Albany Creek	CORA	67 trapnights	PAT	4/17-6/23/06	13.6	0.5	
Carp River	CORA	159 trapnights	FN	4/24-6/16/06	13.0	0.5-1.0	
Cheboygan River	FWS/MBS	384 trapnights	PT/PAT	4/19-6/22/06	14.1 (S)	1.0	
Devils River	PC	60 trapnights	FN	4/18-6/17/06	17.0	0.5-1.0	
Greene Creek	FWS/MBS	51 trapnights	PAT	4/23-6/13/06	13.8	0.5	
Nunns Creek	CORA	49 trapnights	PAT	4/24-6/12/06	12.1	0.5	
Ocqueoc River	FWS/MBS	146 trapnights	MT	4/19-7/1/06	15.8 (S)	0.4	
Tittabawassee River	DC	17 trapnights	MT	4/28-5/15/06	16.8	0.3-0.5	
Trout Creek	CORA	60 trapnights	FN	4/17-6/16/06	13.7	0.5-1.0	
Trout River	FWS/MBS	50 trapnights	MT	4/26-6/15/06	14.3	0.2	
Near-shore/Off-shore	USGS	7.5 hours	WT-21	10/17-11/05/06	4.0-7.0	9.0-110.0	
Totals							Ruffe
		7.5 hours	WT-21				0
		279 trapnights	FN				0
		764 trapnights	Traps				0
		Total ruffe (sampling capable of capturing ruffe incidentally)					0
		Total ruffe (ruffe surveillance)					0
		Total ruffe (all reported fish sampling capable of capturing ruffe on periphery & outside of previous detected range + ruffe surveillance)					0

Key to agency:

FWS = U.S. Fish & Wildlife Service
MBS = Marquette Biological Station, FWS
USGS = U.S. Geological Survey
CORA = Chippewa Ottawa Resource Authority
DC = Dow Chemical-USA
PC = Private contractor

Key to gear:

BT-4.9 = Bottom trawl (4.9 m Headrope)
WT-21 = 21 m wing trawl
GN-38 = Gill net (38 mm stretch mesh)
FN = Fyke net
PAT = Portable assessment trap
PT = Permanent trap
MT = Mechanical trap

Key to symbols:

* Unless specified, effort is in minutes trawl was on bottom.
(S) = Surface temperature

Table 4. Summary of 2006 ruffe surveillance and other fish sampling effort in U.S. waters of Lower Great Lakes.

Location	Agency	Effort*	Gear	Date	Depth (m)	Sf. temp. (C)	Bt. temp. (C)	Sf. DO (ppm)	Bt. DO (ppm)	Secchi (m)	Ruffe
Lake Erie (ruffe surveillance)											
Ashtabula Harbor	FWS	53.05	BT-4.9	6/15/06	8.70	20.46	19.50	8.02	7.63	2.42	
Ashtabula Harbor	FWS	33.05	BT-4.9	9/20/06	8.92	18.47	18.67	9.30	9.21	0.77	
Buffalo Harbor	FWS	51.24	BT-4.9	6/20/06	7.24	21.22	21.00	7.90	7.79	1.90	
Buffalo Harbor	FWS	32.13	BT-4.9	10/5/06	7.49	16.00	15.85	9.12	9.10	1.14	
Cleveland Harbor	FWS	69.86	BT-4.9	6/14/06	8.30	21.05	20.83	6.78	6.00	0.88	
Cleveland Harbor	FWS	52.15	BT-4.9	9/21/06	8.13	19.50	19.50	8.53	8.48	0.58	
Conneaut Harbor	FWS	42.89	BT-4.9	6/15/06	7.78	20.78	19.30	8.55	7.49	2.18	
Conneaut Harbor	FWS	16.80	BT-4.9	9/20/06	7.68	18.25	18.20	9.33	9.29	0.40	
Erie Harbor	FWS	54.64	BT-4.9	6/16/06	7.76	21.28	19.38	9.21	8.48	2.96	
Erie Harbor	FWS	46.35	BT-4.9	9/29/06	7.97	16.88	16.85	8.92	8.74	1.10	
Sandusky Harbor	FWS	33.37	BT-4.9	6/12/06	7.23	21.77	21.30	7.87	7.54	0.37	
Sandusky Harbor	FWS	31.80	BT-4.9	9/18/06	6.96	20.27	20.20	10.12	9.74	0.53	
Maumee River	FWS	55.08	BT-4.9	6/13/06	8.50	22.70	22.22	7.52	7.03	0.36	
Maumee River	FWS	55.68	BT-4.9	9/19/06	8.45	20.20	20.24	7.50	6.92	0.32	
Totals		10.47 hours	BT-4.9								Ruffe
		Total ruffe (ruffe surveillance)									0
											0
Lake Erie (reported sampling capable of capturing ruffe incidentally)											
Cattaraugus Creek	PC	130 trapnights	PAT	4/26-6/30/06	0.5		18.0				
Grand River	PC	120 trapnights	PAT	4/10-6/9/06	0.5		19.4				
Spooner Creek	PC	130 trapnights	PAT	4/26-6/30/06	0.5		18.7				
Near-shore/Off-shore	USGS	20.3 hours	BT-7.9	Jun, Aug, Sep, Oct	3.0-10.8		12.5-28.0				
Totals		20.3 hours	BT-7.9								Ruffe
		380 trapnights	PAT								0
		Total ruffe (reported sampling capable of capturing ruffe incidentally)									0
		Total ruffe (ruffe surveillance)									0
		Total ruffe (all reported sampling capable of capturing ruffe + ruffe surveillance)									0
Lake Ontario (ruffe surveillance)											
Genesee River	FWS	30.82	BT-4.9	6/21/06	5.70	24.00	22.10	7.37	7.09	0.70	
Genesee River	FWS	53.83	BT-4.9	10/2/06	5.91	13.68	13.50	10.73	10.91	0.23	
Totals		1.41 hours	BT-4.9								Ruffe
		Total ruffe (ruffe surveillance)									0
											0
Lake Ontario (reported sampling capable of capturing ruffe incidentally)											
Black River	PC	180 trapnights	PAT	4/3-6/2/06	UNK	13.0					
Sterling Creek	PC	64 trapnights	PAT	3/31-6/3/06	0.5		15.0				
Sterling Valley Creek	PC	64 trapnights	PAT	3/31-6/3/06	0.5-1.0		14.5				
Near-shore/Off-shore	USGS/ NYSDEC	45.00 hours	BT-18	Apr-Nov/06	170.0		8.0- 3.1-17.0				
Totals		45.00 hours	BT-18								Ruffe
		308 trapnights	PAT								0
		Total ruffe (sampling capable of capturing ruffe incidentally)									0
		Total ruffe (ruffe surveillance)									0
		Total ruffe (all reported sampling capable of capturing ruffe + ruffe surveillance)									0

Key to column headings:
 Sf. temp. = Surface temperature
 Bt. temp. = Bottom temperature
 Sf. DO = Surface dissolved oxygen
 Bt. DO = Bottom dissolved oxygen

Key to agency:
 FWS = U.S. Fish & Wildlife Service
 USGS = U.S. Geological Survey
 NYSDEC = New York State Department of Environmental Conservation
 PC = Private contractor

Key to gear:
 BT-4.9 = Bottom trawl (4.9 m headrope)
 BT-7.9 = Bottom trawl (7.9 m headrope)
 BT-18 = Bottom trawl (18.0 m headrope)
 PAT = Portable assessment trap

Key to symbols:
 UNK = Unknown
 * Unless specified, effort is in minutes trawl was on bottom.