

## SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2012

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### BACKGROUND

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trawls through 2004; the U.S. Geological Survey (USGS) terminated bottom trawl assessments in the SLRE after 2004 (USGS unpublished information). 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).

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 suggest that yellow perch abundance declines in years that ruffe abundance increases (Evrard et al. 1998; Czepinski et al. 2002). This trend was analyzed and found to be weakly significant for all three tributaries combined (D.H. Ogle, Northland College unpublished data).

As a result of increasing abundance, 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* 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-Ashland Fish and Wildlife Conservation Office (USFWS-Ashland FWCO) and the Ontario Ministry of Natural Resources-Upper Great Lakes Management Unit (OMNR-UGLMU).

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 are not specifically the target species, but they are vulnerable to the gear. In reporting other fish sampling, we describe results of fish sampling using gear that is capable of capturing ruffe, but the sampling was not dedicated to that purpose. 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.

The following is a chronology of ruffe detection for the Great Lakes Basin (Figure 1):

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

**1991 – Lake Superior:** Major ruffe range expansion was detected. A crew from USFWS-Ashland FWCO 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 operations between the Duluth/Superior Harbor, Minnesota/Wisconsin and Thunder Bay Harbour.

**1992 – Lake Superior:** Major ruffe range expansion was detected. USFWS-Ashland FWCO 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 – Lake Superior:** Major ruffe range expansion was detected. USFWS-Ashland FWCO discovered eight new locations colonized by ruffe in Lake Superior. Ruffe unexpectedly passed by Chequamegon Bay, Wisconsin, to 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. **Lower Great Lakes:** The USFWS-Lower Great Lakes Fish and Wildlife Conservation Office (USFWS-Lower Great Lakes FWCO) initiated ruffe surveillance in U.S. waters of Lakes Erie and Ontario (Slade et al. 1994). No ruffe were detected.

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

**1995 – Lake Superior:** No major ruffe expansion was detected. **Lake Huron:** Major ruffe range expansion was detected. The USFWS-Ashland FWCO discovered ruffe in Lake Huron near the mouth of the Thunder Bay River, Alpena, Michigan; this discovery was 480 km east of the Ontonagon River, Michigan (Busiahn 1997). The Thunder Bay River, Michigan, was the only confirmed location where ruffe have 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. **Lower Great Lakes:** No ruffe were detected.

**1996 – Lake Superior:** No ruffe range expansion was detected. However, the OMNR-UGLMU 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. **Lake Huron:** The USFWS-Alpena Fish and Wildlife Conservation Office (USFWS-Alpena FWCO) assumed ruffe surveillance for U.S. waters of Lake Huron. **Lower Great Lakes:** No ruffe were detected.

**1997 – Lake Superior:** Some interior ruffe range expansion was detected. Ruffe were discovered in three new locations within their known range in Lake Superior. The OMNR conducted ruffe surveillance in Canadian waters of Lake Huron. No ruffe were collected during those efforts. Ruffe catch rates at peripheral locations in Lake Superior were approximately less than or equal to previous years. **Lake Huron:** Ruffe catch rates at peripheral locations in U.S. waters of Lake Huron were approximately less than or equal to previous years. **Lower Great Lakes:** No ruffe were detected.

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

**1999 – Lake Superior:** Only minor ruffe range expansion was detected. The USFWS-Ashland FWCO 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. **Lake Huron:** The catch-per-effort (CPE) of ruffe in the Thunder Bay River Estuary, Lake Huron, increased from 1 per minute bottom trawling in 1998 to 11 per minute 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 *Apollonia (Neogobius) melanostomus* were first captured from the Thunder Bay River, Lake Huron. **Lower Great Lakes:** No ruffe were detected.

**2000 – Lake Superior:** No ruffe range expansion was detected. Ruffe catch rates at peripheral locations in Thunder Bay, Harbour, Ontario were less than or equal to previous years. The exception was the Ontonagon River, Michigan, Lake Superior, where the mean ruffe CPE (number per hour bottom trawling) more than doubled from 5 in 1999 to 11 in 2000. **Lake Huron:** Ruffe catch rates at peripheral locations in the Thunder Bay River, Michigan were less than or equal to previous years. The CPE of ruffe in the Thunder Bay River Estuary declined from 11 to 0.3 per minute bottom trawling. Round goby were the most abundant species captured from the Thunder Bay River during ruffe surveillance. The Alpena FWCO expanded ruffe surveillance into the St. Marys River. **Lower Great Lakes:** No ruffe were detected.

**2001 – Lake Superior:** Minor ruffe range expansion was detected. The 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 (number per hour bottom trawling) of that colony more than seven 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 USFWS-Ashland FWCO 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. **Lake Huron:** No ruffe were captured from the Thunder Bay River colony or any other ruffe surveillance location in Lake Huron. **Lower Great Lakes:** No ruffe were detected.

**2002 – Lake Superior:** Major ruffe range expansion was detected. The USFWS-Ashland FWCO discovered ruffe in the Keweenaw Waterway, 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 continued to increase. The Red Cliff Tribal Fisheries Department in cooperation with USFWS-Ashland FWCO 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. **Lake Huron:** No ruffe expansion was detected in Lake Huron, and no ruffe were captured in trawls within the ruffe range in Lake Huron. The USFWS-Alpena FWCO initiated reduction of the spawning ruffe population in the Thunder Bay River, Lake Huron, with a 38 mm stretch mesh gill net (30.5 m panel); a total of 96 ruffe were captured in 52 nights effort. **Lake Michigan:** Major ruffe range expansion was detected. The USFWS-Ashland FWCO discovered ruffe in Lake Michigan at Little Bay de Noc (LBDN) near Escanaba, Michigan. **Lower Great Lakes:** No ruffe were detected.

**2003 – Lake Superior:** Minor ruffe range expansion was detected in Thunder Bay Harbour, Ontario, Lake Superior. 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. Near the Apostle Islands, the Red Cliff Tribal Fisheries Department in cooperation with USFWS-Ashland FWCO continued a ruffe capture effort during lake trout *Salvelinus namaycush* and lake whitefish spawning. A total of nine adult ruffe were captured in 19 net-nights; no eggs of any species were found in the ruffe diet analysis. In the Ontonagon River Estuary in Michigan, a combination of bottom trawling, gill netting, and trapping conducted by the USFWS-Ashland FWCO failed to effectively (achieve a minimum reduction of 90% of the ruffe population) reduce the ruffe spawning population. 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 by-catch of 62 stocked juvenile lake sturgeon *Acipenser fulvescens* were also captured, standard data was recorded, and all sturgeon were released alive. **Lake Huron:** Ruffe were not captured from new locations in Lake Huron; however, they continued to persist in the Thunder Bay River, Michigan. The USFWS-Alpena FWCO continued reduction of spawning ruffe in the Thunder Bay River, removing a total of ten ruffe in 74 nights of gill net effort. **Lake Michigan:** Minor ruffe range expansion was detected in LBDN, Lake Michigan. Ruffe surveillance was expanded in Lake Michigan by Ashland and Green Bay FWCOs to include a total of nine major ports, but no ruffe were captured outside of LBDN. **Lower Great Lakes:** No ruffe were detected.

**2004 – Lake Superior:** Major ruffe range expansion was detected. The USFWS-Ashland FWCO 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. **Lake Huron:** Ruffe were not captured from new locations in Lake Huron, nor were they captured from the Thunder Bay River, Michigan. **Lake Michigan:** The Michigan Department of Natural Resources-Marquette Fisheries Research Station (MIDNR-Marquette) discovered ruffe in Big Bay de Noc (BBDN), Lake Michigan,

15 km east of LBDN. LBDN was the location of initial discovery of ruffe in Lake Michigan in 2002. **Lower Great Lakes:** No ruffe were detected.

**2005 – Lake Superior:** Minor range expansion was detected. The USGS-Lake Superior Biological Station (USGS-LSBS) captured one sub-adult ruffe incidentally 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 captured one mature ruffe incidentally from Torch Lake, a new location within the Keweenaw Waterway; ruffe were first detected in the Keweenaw Waterway in 2002. The USFWS-Ashland FWCO captured one mature ruffe from lower Marquette Harbor, Michigan, where ruffe were first detected in 2004. Marquette Harbor continued to be the eastern boundary of the ruffe range along the south shore of Lake Superior. **Lake Huron:** 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. **Lake Michigan:** The MIDNR-Marquette captured no ruffe in other fish sampling from BBDN, where they were first detected in 2004. However, MIDNR-Marquette captured a total of 22 ruffe in other fish sampling from LBDN, where ruffe were first detected in 2002. The Bays de Noc of northern Green Bay continued to comprise the ruffe range in Lake Michigan. **Lower Great Lakes:** No ruffe were detected.

**2006 – Lake Superior:** Major ruffe range expansion was detected. Surveillance activity along the south shore of Lake Superior confirmed ruffe expansion 226 km east of Marquette Harbor, Michigan, the previous eastern boundary of the ruffe range. A USFWS 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 USFWS 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. In Thunder Bay, Ontario, the OMNR confirmed that ruffe span the entire length (13 km) of the Thunder Bay Harbour, the eastern boundary of the ruffe range along the north shore. The OMNR also reported that a commercial fisherman captured three adult ruffe in a 120 mm stretch mesh gill net near the Welcome Islands in Thunder Bay, 3.5 km east of the Mission River estuary. The OMNR captured one adult ruffe 42 km upriver from the mouth of the Kaministiquia River, a tributary of Thunder Bay Harbour. **Lake Huron:** No ruffe were captured in Lake Huron from the Thunder Bay River or other areas sampled. Ruffe have not been captured from Lake Huron since 2003. **Lake Michigan:** No ruffe were reported from new locations or BBDN, where they were first detected in 2004. However, MIDNR-Marquette captured a total of 40 ruffe from LBDN, 18 more than were captured there in 2005. LBDN and BBDN of Green Bay continue to comprise the ruffe range in Lake Michigan. **Lower Great Lakes:** No ruffe were detected.

**2007 – Lake Superior:** The ruffe range spanned the south shore from the Duluth-Superior Harbor, Minnesota/Wisconsin to Whitefish Bay, Michigan; and along the north shore from the Duluth-Superior Harbor to Thunder Bay, Ontario. Within this range, the MIDNR captured ruffe in the Portage Canal of the Keweenaw Waterway. **Lake Huron:** No ruffe were captured from new or previously detected locations of Lake Huron, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995. No ruffe have been captured from Lake Huron since 2003. **Lake Michigan:** Minor ruffe range expansion was detected in Green Bay. The MIDNR reported one ruffe captured in southern Green Bay, 1.5 miles southeast of Marinette, Wisconsin, by commercial fisherman, Jim Benson. This was a range expansion of 88 kilometers (55 miles) south from LBDN of northern Green Bay. The MIDNR-Marquette captured a total of 13 ruffe from LBDN, where they were first detected in 2002. No ruffe were reported from BBDN of northern Green Bay, where they were first detected in 2004. No ruffe were reported outside of Green Bay. In Lake Michigan, the ruffe range consisted of Green Bay. **Lower Great Lakes:** No ruffe were detected.

**2008 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth

Superior Harbor to Thunder Bay, Ontario Canada. Dedicated ruffe surveillance efforts by the USFWS-Ashland FWCO were halted in Lake Superior because the range extends the extent of U.S. waters of the lake. The USGS-LSBS continued to capture ruffe (110 ruffe) within the known range in western Lake Superior from near the Duluth Harbor, west of and within the Apostle Islands, and Chequamegon Bay. **Lake Huron:** Ruffe range expansion was detected. The USFWS-Marquette Biological Station (USFWS-MBS) reported two ruffe captured incidentally from the Trout River in Rogers City, Michigan (80 km north of the Thunder Bay River in Alpena, Michigan - the previous peripheral boundary of the ruffe range in Lake Huron). Both ruffe were captured in the same lift from a semi-permanent trap maintained upstream in the Trout River to assess sea lamprey. No ruffe were captured from other areas of Lake Huron, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995. No ruffe have been captured from these areas of Lake Huron since 2003. Ruffe remained undetected in the St. Marys River, since surveillance was initiated in 2000. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (5 ruffe) incidentally during sampling efforts in LBDN. **Lower Great Lakes:** No ruffe were detected.

**2009 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario Canada. The USGS-LSBS did not capture ruffe during their sampling efforts in Lake Superior. **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 or the Trout River in Rogers City, Michigan where they were first identified in a trap in 2008. Ruffe remained undetected in the St. Marys River, since surveillance was initiated in 2000. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (2 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

**2010 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario Canada. The USGS-LSBS captured ruffe (60 ruffe) within the known range in western Lake Superior from near the Duluth Harbor and Chequamegon Bay. **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 or the Trout River in Rogers City, Michigan where they were first identified in a trap in 2008. Ruffe remained undetected in the St. Marys River, since surveillance was initiated in 2000. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (10 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

**2011 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. The USGS-LSBS captured ruffe (48 ruffe) within the known range in Lake Superior from near the Duluth Harbor, Apostle Islands, Chequamegon Bay, Keewenaw Peninsula, and Whitefish Point/Bay. **Lake Huron:** Ruffe range expansion was detected. The USFWS-MBS reported one ruffe captured incidentally from the Cheboygan River in Cheboygan, Michigan (60 km north of the Trout River in Rogers City, Michigan where ruffe were captured in 2008 and 140 km north of the Thunder Bay River in Alpena, Michigan where ruffe were first captured in 1995). The ruffe was captured in a permanent trap used to assess sea lamprey upstream in the Cheboygan River. No ruffe were captured from other areas of Lake Huron, including the Trout River, Thunder Bay River, or Thunder Bay shipping lanes. Ruffe remained undetected in the St. Marys River, since surveillance was initiated in 2000. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (2 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

**2012 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. The USGS-LSBS, WIDNR-Lake Superior Field Unit (WIDNR-Superior), USFWS-Ashland FWCO, OMNR-UGLMU, and USFWS-MBS captured ruffe within the known range in Lake Superior including Thunder Bay Harbour, Duluth Harbor, Apostle Islands, Chequamegon Bay and Keewenaw Peninsula. **Lake Huron:** The USFWS-MBS reported one ruffe captured incidentally from the Cheboygan River in Cheboygan, Michigan. One other ruffe was captured from the same location in 2011. No ruffe were captured from other areas of Lake Huron, including the Trout River, Thunder Bay River, or Thunder Bay shipping lanes where they had been captured in the past. Ruffe remained undetected in the St. Marys River, since surveillance was initiated in 2000. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (7 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

The following report summarizes dedicated ruffe surveillance conducted in 2012. It also documents other fish sampling reported by several organizations that were capable of capturing ruffe incidentally over the same time period.

## OBJECTIVES

The primary objective of ruffe surveillance 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 along the northwest shore and Whitefish Bay on the south west shore. In Lake Michigan the peripheral locations include LBDN and BBDN within Green Bay. In Lake Huron the peripheral locations include Thunder Bay River and Thunder Bay shipping lanes, the Trout River in Rogers City, Michigan, and the Cheboygan River in Cheboygan, Michigan.

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

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 was usually concentrated in the deepest habitat at the site as determined by electronic depth sounders, but depths from 3-8 meters (m) were targeted when available, which compares to the depth range in the SLRE. This included natural channels, dredged shipping channels, and pools. However, ruffe surveillance was not limited to these areas; shallow areas in rivers and embayments and areas with vegetation were also surveyed.

The primary gear used 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 6.25-12.5 mm stretch-mesh inner liner to hold small specimens.

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 4 km/hour, and was monitored by commercially manufactured global position systems (GPS) or engine tachometer readings.

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 assessed by the amount of habitat known to be attractive to ruffe (i.e. deep channels and pools, low water clarity, soft substrate).

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 was along contour.

The USFWS-Lower Great Lakes FWCO 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.

Catches of fish were sorted by species and counted, and the total length of up to 50 specimens of each species were 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 either frozen or in 95% EtOH for later identification.

Public awareness of ruffe continued to be emphasized. Ruffe Watch identification 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 were encouraged to report ruffe catches and many agencies and organizations reported fish sampling that was capable of incidental ruffe capture.

## RESULTS

### RUFFE SURVEILLANCE

Dedicated ruffe surveillance was conducted by the USFWS in Lakes Huron (including connecting waters of the St. Marys River), Erie and Ontario in 2012 (Figures 2 and 3, and Tables 1, 2, 3 and 4). No ruffe were captured. Ruffe surveillance was not conducted in Lake Michigan and efforts led by the USFWS-Ashland FWCO in Lake Superior were halted following 2007 because the range for ruffe spans the extent of U.S. waters of Lake Superior.

## **LAKE HURON**

The USFWS-Alpena FWCO used a 4.9-m bottom trawl to collect fish at eight locations in U.S. waters of Lake Huron during September (Figure 2 and Table 1). Sampling locations included the following: Au Gres River mouth, Port of Calcite, Cheboygan River mouth, Harbor Beach DTE port, Port Dolomite, Saginaw River mouth, Thunder Bay River mouth, and Thunder Bay shipping channel. Efforts targeted deep water areas within shipping channels and river mouths. A total of 46 tows were completed in September and October, comprising 3.88 hours of effort. Twenty-six taxa were collected. The majority of the catch consisted of round gobies (33%). The greatest catch (38 fish/minute) was experienced at the Saginaw River mouth. The greatest diversity of species (16 species) was represented at the Au Gres River. Yellow perch was the most ubiquitous species and were captured at five of the eight sampling locations. No ruffe were captured. A complete listing of all fish species captured is available upon request from the USFWS-Alpena FWCO.

Additional ruffe surveillance sampling was conducted during the spring and fall using daytime backpack electrofishing, nighttime boat electrofishing, and small mesh trap nets in the vicinity where ruffe have been captured in the past. Sampling locations included the Thunder Bay River in Alpena, near the Port of Calcite/Swan River mouth/Rogers City Marina and the Trout River in Rogers City, and the Cheboygan River (Figure 2 and Table 1). Sampling in the Alpena area consisted of nighttime boat electrofishing in the Thunder Bay River for 0.83 hours of effort in early May and nine trap nights effort with trap nets in September. Sampling in the Rogers City area consisted of nighttime boat electrofishing at the Port of Calcite, Swan River mouth, and Rogers City marina area for a total of 2.00 hours of effort during early May and daytime backpack electrofishing in the Trout River for 0.33 hours of effort in mid-May. Sampling in the Cheboygan area consisted of nighttime boat electrofishing in the Cheboygan River up to the first barrier (dam) for 1.30 hours effort during early May. No ruffe were captured.

## **ST. MARYS RIVER**

The USFWS-Alpena FWCO used a 4.9-m bottom trawl to collect fish at six locations downriver from the Soo Locks during September (Figure 2 and Table 2). Sampling locations included the Municipal Marina of Sault Ste. Marie, Michigan, Lake Nicolet, Munuscong Channel, Raber Bay, and two areas near De Tour. A total of 27 tows comprising 2.20 hours of effort were conducted. Nineteen taxa were collected. The majority of the total catch consisted of mimic shiners (56%) followed by rainbow smelt (13%). The greatest catch (31 fish/minute) was experienced at Raber Bay. The greatest diversity of species (13 species) was represented at the Sault Ste. Marie Municipal Marina and at Raber Bay. Mimic shiner was the most ubiquitous species and were captured at all six sampling locations. No ruffe were captured. A complete listing of all fish species captured is available upon request from the USFWS-Alpena FWCO.

## **LAKE ERIE**

The USFWS-Lower Great Lakes FWCO used a 4.9-m bottom trawl to complete surveys at seven previously established locations including Ashtabula, Buffalo, Cleveland, Conneaut, Erie, Sandusky, and Toledo (Figure 3 and Table 3). All sites were sampled once in spring (May) and once in the fall (September), except for Buffalo in the spring and Erie in the fall were not sampled due to weather and staffing limitations. No ruffe were captured at any of these sites. The spring catch was composed of 200 fish from 10 species. The species composition was predominately emerald shiners (22.5%) with freshwater drum (6.5%) being the next most dominant species. The fall survey was comprised of 920 fish from 11 species, the most abundant being gizzard

shad (24.6%) and white perch (23.8%). A summary of all fish species captured at all these locations is available upon request from the USFWS-Lower Great Lakes FWCO.

## **LAKE ONTARIO**

The USFWS-Lower Great Lakes FWCO used a 4.9-m bottom trawl to conduct dedicated bottom trawling along the south shore of Lake Ontario at Rochester Harbor in the Genessee River near the mouth at Lake Ontario during the spring (May) 2012 (Figure 3 and Table 4), but were unable to conduct the fall survey due to weather and staffing limitations. These transects were located in areas where there was a dredged shipping channel, no more than 3km upstream from the lake. The spring catch was composed of 119 fish from 9 species including emerald shiner (42.0%) and spottail shiner (38.6%). A summary of all fish species captured is available upon request from the USFWS-Lower Great Lakes FWCO.

## **REPORTED FISH SAMPLING THAT WAS CAPABLE OF INCIDENTALLY CAPTURING RUFFE**

Several organizations reported fish sampling that was capable of capturing ruffe incidentally during 2012. Information was provided for each of the Great Lakes, including the connecting waters of the St. Marys River and the St. Clair/Detroit River Waterway.

## **LAKE SUPERIOR**

Several organizations including the USFWS-MBS, USGS-LSBS, USFWS-Ashland FWCO, OMNR-UGLMU and WIDNR-Superior reported other fish sampling that was capable of incidentally capturing or documenting ruffe within, on the periphery and at new locations within Lake Superior (Figures 4 and 5 and Table 5). These activities captured a total of 930 ruffe (Thunder Bay Harbour, Duluth Harbor, Misery River, within the Apostle Islands, Chequamegon Bay, and along the Keweenaw Peninsula) – all within the current ruffe range. No ruffe were reportedly captured outside of the existing ruffe range.

Thunder Bay Harbour Personnel from the USFWS-Ashland FWCO and OMNR-UGLMU conducted sampling in Thunder Bay Harbour to detect presence and relative abundance of new nonindigenous invasive fish. Sampling took place in August and consisted of 15 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 1.25 hours bottom trawling (4.9-m headrope), and 2.59 hours electrofishing (Figure 4 and Table 5). A total of 11 ruffe were captured (one in trawls, one electrofishing and nine in fyke nets). This location is within the existing ruffe range.

St. Louis River Personnel from the USFWS-Ashland FWCO conducted sampling to detect presence and relative abundance of new nonindigenous invasive fish in the St. Louis River. Sampling took place in August and consisted of 20 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 0.83 hours bottom trawling (4.9-m headrope), and 0.33 hours electrofishing (Figure 4 and Table 5). A total of 96 ruffe were captured (62 in trawls and 34 in fyke nets). This location is within the existing ruffe range.

Apostle Islands Personnel from the USGS-LSBS conducted bottom trawling (11.9-m headrope) in the Apostle Islands during November for fall fish collections. Two locations were sampled for a total of 8 trawl tows and 1.33 hours of effort (Figure 5 and Table 5). One ruffe was captured. This location is within the

existing ruffe range.

Apostle Islands and Chequamegon Bay Personnel from the WIDNR-Superior conducted annual sampling to index the fish community in the Apostle Islands and Chequamegon Bay. Sampling took place during July and August and consisted of 38 net lifts of a bottom-set 1,097 m graded mesh net (38 mm to 178 mm mesh, 91 m of mesh per 38 mm increment). Ruffe were vulnerable to small mesh (38 mm and 51 mm mesh, infrequently to 63 mm mesh). A total of 35 net sets were conducted around the Apostle Islands and 3 net sets were conducted in Chequamegon Bay (Figure 4 and Table 5) capturing a total of 42 ruffe, 9 in the Apostle Islands area and 33 in Chequamegon Bay.

Chequamegon Bay Personnel from the USFWS-Ashland FWCO conducted sampling to detect presence and relative abundance of new nonindigenous invasive fish in Chequamegon Bay. Sampling took place in September and consisted of 1.95 hours bottom trawling (4.9-m headrope) (Figure 4 and Table 5). A total of 744 ruffe were captured. This location is within the existing ruffe range.

The USGS-LSBS conducted bottom trawling (5.5-m headrope) in Chequamegon Bay during July and August. Thirty-two locations were sampled for a total of 32 trawl tows and 5.29 hours of effort (Figure 5 and Table 5). Thirty one ruffe were captured. This location is within the existing ruffe range.

Nearshore/Offshore Personnel from the USGS-LSBS conducted summer bottom trawling (11.9-m headrope) in U.S. and Canadian waters of Lake Superior. Transects included nearshore sampling at 72 locations for a total of 72 tows and 31.48 hours of effort and offshore sampling at 42 locations for a total of 42 tows and 15.30 hours of effort (Figure 5 and Table 5). Transects were within, near the periphery and outside of the detected ruffe range. Three ruffe were captured, two at nearshore locations and one at an offshore location. All ruffe were captured from within the known range.

South Shore Tributaries Personnel from the USFWS-MBS worked with staff from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), NPS, Red Cliff Band of Lake Superior Chippewa (RCBLSC), and private contractors to conduct sampling in 17 southern Lake Superior tributaries to assess sea lamprey abundance (Figure 4 and Table 5). Sampling was conducted from April to June or May to June (March to June in the Bad River) using fyke nets (FN), permanent traps (PT) and portable assessment traps (PAT). Two ruffe were captured following a total of 1,456 trap nights. Both ruffe were captured from the Misery River within the known ruffe range. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Unconfirmed Sightings None reported.

## **LAKE MICHIGAN**

The USGS-Great Lakes Science Center (USGS-GLSC), MIDNR-Marquette, USFWS-MBS and Ludington Biological Station (USFWS-MBS/LBS), WIDNR-Peshtigo Field Unit (WIDNR-Peshtigo), and Inland Seas Education Association (ISEA) reported other fish sampling capable of capturing ruffe incidentally (Figures 4, 6, and 7, and Table 6). All sources sampled areas that were within or near the periphery of the current ruffe range (Green Bay). The MIDNR-Marquette was the only agency to report capturing ruffe, all from LBDN in northern Green Bay where they were first detected in 2002. A total of seven ruffe were captured. Ruffe were not reported from outside of the known range.

Little Bay de Noc (LBDN) of Northern Green Bay Since 1988, personnel from the MIDNR-Marquette office have conducted summer fishery assessments in LBDN (also BBDN and other areas of northern Lake Michigan – see below) using bottom trawls (3.7-m headrope). Effort consisted of ten minute tows. A total of 20 trawl tows for 3.33 hours effort was conducted at LBDN (Figure 4 and Table 6). Three ruffe were captured within the detected range.

Since 2009, personnel from the MIDNR-Marquette office have conducted annual fall fishery surveys to assess the fish community of northern Lake Michigan at LBDN (also BBDN and other areas of northern Lake Michigan – see below). Sampling gear consisted of 97.5-m experimental gill nets (25 mm to 127 mm stretch mesh). A total of 48 lifts for 4,682 m effort was conducted at LBDN (Figure 6 and Table 6). Four ruffe were captured within the detected range.

During July, personnel from ISEA, a non-profit environmental education organization, conducted bottom trawling (4.9-m headrope) in LBDN as part of their educational efforts targeting school groups (mainly grades 5-7). No ruffe were captured following 0.30 hours of effort (Figure 4 and Table 6).

Big Bay de Noc (BBDN) of Northern Green Bay Personnel from the MIDNR-Marquette office conducted summer assessments in BBDN that were similar to those conducted in LBDN (described above) using bottom trawls. A total of 20 trawl tows for 3.33 hours effort was conducted at BBDN (Figure 4 and Table 6). No ruffe were captured.

Personnel from the MIDNR-Marquette office also conducted an annual fall fishery survey at BBDN that was similar to that conducted in LBDN (described above) to assess the fish community of northern Lake Michigan. A total of 48 net lifts for 4,682 m effort was conducted at BBDN (Figure 6 and Table 6). No ruffe were captured.

Green Bay Personnel from the WIDNR-Peshtigo office conducted fish sampling in Green Bay from April to August. No ruffe were captured following a total of 51 fyke net nights at 3 locations, 52 seine hauls with a 15.2 m beach seine at 15 sites, and 77 trawl tows (five minute tows) for a total of 6.42 hours trawling at 12 locations (Figure 4 and Table 6).

Northern Lake Michigan Personnel from the MIDNR-Marquette office also conducted summer bottom trawling and fall gill netting (described above) at Manistique and gill netting at Naubinway (Figure 4 and Table 6). No ruffe were captured following 1.67 hours trawling (13 tows) and 1,170 meters gill netting (12 lifts) at Manistique and 975 meters gill netting (10 lifts) at Naubinway.

Grand Traverse Bay, Suttons Bay, Little Traverse Bay, and Petoskey Personnel from ISEA, completed a total of 110 trawl tows of 10 minute duration for a total of 18.3 hours bottom trawling effort in Grand Traverse Bay, Suttons Bay, Little Traverse Bay, and Petoskey (Figure 4 and Table 6). No ruffe were captured.

Nearshore/Offshore Personnel from the USGS-GLSC conducted annual fall bottom trawling (12-m headrope) on-contour to assess prey-fish community abundance at seven locations around Lake Michigan. Ten minute trawl tows were conducted at 5 to 110 m depths for a total of 71 tows (Figure 7 and Table 6). No ruffe were captured following 8.19 hours of sampling.

Tributaries Personnel from the USFWS-MBS/LBS worked with staff from the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI) and private contractors to conduct sampling in 18 Lake Michigan tributaries to assess sea lamprey abundance (Figure 4 and Table 6). Sampling was conducted from April to

May or June (March to May in the St. Joseph River and Trail Creek) using fyke nets (FN), permanent traps (PT), portable assessment traps (PAT) and semi-permanent traps (SPT). Four tributaries were located within or on the periphery of the current ruffe range in Green Bay. No ruffe were captured following a total of 1,670 trap nights. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Unconfirmed Sightings None reported

## **ST. MARYS RIVER**

Incidental sampling capable of capturing ruffe in the St. Marys River was reported by the USFWS-Ashland FWCO, OMNR-UGLMU, St. Marys River Fisheries Task Group (SMRFTG) and USFWS-MBS (Figure 4 and Table 7). Locations across the river were sampled. No ruffe were captured.

Upper St. Marys River Personnel from the USFWS-Ashland FWCO and OMNR-UGLMU conducted sampling in U.S. and Canadian waters of the St. Marys River above the Soo Locks to detect presence and relative abundance of new nonindigenous invasive fish. Sampling took place during August and consisted of 14 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 1.28 hours bottom trawling (4.9-m headrope), and 2.50 hours electrofishing (Figure 4 and Table 5). No ruffe were captured.

River-wide The SMRFTG is an international multi-agency group that was established in 1997 by the Great Lake Fishery Commission's Lake Huron Committee (LHC) to design and recommend a St. Marys River fishery assessment and review program. Member agencies include the MIDNR-Northern Lake Huron Management Unit (MIDNR-NLHMU), MIDNR-Alpena Fisheries Research Station (MIDNR-Alpena), OMNR-UGLMU, Chippewa Ottawa Resource Authority, Department of Fisheries and Oceans-Great Lakes Laboratory of Fisheries and Aquatic Sciences (DFO-GLLFAS), USGS-GLSC, USFWS-MBS, USFWS-Alpena FWCO, and others. The SMRFTG conducted annual fall nighttime boat electrofishing in September and October to assess juvenile walleye at seven locations for a total of 22 transects across the St. Marys River. Sampling locations included the Sault area, Lake Nicolet, Lake George, Lake Munuscong, Raber Bay, Potagannissing Bay and St. Joseph Channel. No ruffe were captured following 23.08 hours of effort (Figure 4 and Table 7).

Personnel from the USFWS-MBS conducted sampling in the St. Marys River to assess sea lamprey abundance). Sampling was conducted from May to July using portable assessment traps (PAT). No ruffe were captured following a total of 204 trap nights of effort (Figure 4 and Table 7). A summary of fish species captured at these locations is available upon request from USFWS-MBS.

Unconfirmed Sightings None reported.

## **LAKE HURON**

Incidental sampling capable of capturing ruffe in Lake Huron was reported by the USGS-GLSC, MIDNR-Alpena, MIDNR-Lake St. Clair Fisheries Research Station (MIDNR-Lake St. Clair), Central Michigan University (CMU) and USFWS-MBS/LBS (Figures 4 and 8, and Table 7). All agencies, except MIDNR-Lake St. Clair, conducted efforts near Thunder Bay and Rogers City, the periphery of the ruffe range in Lake Huron.

The USFWS-MBS reported one ruffe incidentally captured during sea lamprey trapping in the Cheboygan River in Cheboygan, Michigan. The trap is a permanent trap located at the base of the dam, approximately 1.5 km upstream from the mouth of the Cheboygan River. The ruffe was captured on May 27, 2012. Ruffe were first captured from near the Cheboygan River dam in 2011. No other ruffe were reportedly captured from Lake Huron or the Lake Huron watershed and no range expansion was detected since 2011.

U.S. Tributaries Personnel from the USFWS-MBS/LBS and private contractors conducted sampling in 11 Lake Huron tributaries to assess sea lamprey abundance (Figure 4 and Table 7). Sampling was conducted from April or May to June using fyke nets (FN), permanent traps (PT), portable assessment traps (PAT) and semi-permanent traps (SPT). One ruffe was captured following a total of 797 trap nights of effort.

The ruffe was incidentally captured in May during trapping upstream in the Cheboygan River in Cheboygan, Michigan. The ruffe was captured with a permanent trap set at an index location at the base of the dam 1.5 km upstream from the mouth of the Cheboygan River. The trap is fished annually from April to June. The ruffe was captured on May 27, 2012. This is the second consecutive year that ruffe have been captured at this location. No other ruffe were reported from this trap or other trap locations in tributaries in U.S. waters of Lake Huron in 2012. A summary of fish species captured at trap locations is available upon request from the USFWS-MBS.

Les Cheneaux Islands Since 1969, personnel from the MIDNR-Alpena office have conducted annual gill netting in the Les Cheneaux Islands area during September to gauge trends and assess the current status of the fisheries resources. Each gill net included a 30.48 m panel of 38.1 mm mesh to which ruffe would be vulnerable. No ruffe were captured following 6 net sets for 182.88 m of sampling effort (Figure 4 and Table 7).

Thunder Bay Personnel from the MIDNR-Alpena office conducted bottom trawling during July and August with an 11-m trawl (11-m headrope, semi-balloon otter trawl with 23-m bridle, and 13 mm stretch mesh cod end) and a 5.3-m trawl (5.3-m headrope, semi-balloon otter trawl with 1.7-m bridle, and 6.35 mm stretch mesh cod) at 25 locations off North Point and off Black River in Thunder Bay to assess young of the year lake trout and juvenile lake whitefish. No ruffe were captured following a total of 22 tows comprising 3.67 hours of effort with the 11-m trawl and 14 tows comprising 2.33 hours of effort (Figure 4 and Table 7).

Personnel from the MIDNR-Alpena office also conducted sampling in Thunder Bay in 2012 to contribute to the Cooperative Science and Monitoring Initiative (CSMI). Effort consisted of the following: 42 micro mesh (3.33 m nets with 12.7, 15.9, and 19.1 mm stretch mesh monofilament mesh) gill net sets for a total of 1,399 m effort and 61 small mesh (38 mm stretch mesh nylon mesh) gill net sets for a total 1,750 m effort from June to August, 66 trap net (38 mm stretch mesh) sets for a total of 88 net nights over 19 locations from June to October, 60 minnow trap (baited) sets for a total of 60 sets effort over 6 locations during August, and 13 boat electrofishing runs for 4.04 hours of effort over 13 locations from June to August (Figure 4 and Table 7). No ruffe were captured.

Saginaw Bay Personnel from the MIDNR-Lake St. Clair office conducted fall (September) bottom trawling (10-m headrope) at nine locations in Saginaw Bay as part of an annual survey to assess the fish community. No ruffe were captured following a total of 24 tows comprising a total of 3.50 hours of effort (Figure 4 and Table 7).

Personnel from the MIDNR-Alpena office conducted graded mesh gill netting at the inner and outer portions of Saginaw Bay during September to assess the fish community. Each net included a 30.48 m panel of 38.1

mm mesh to which ruffe would be vulnerable (Figure 4 and Table 7). No ruffe were captured following 16 net sets for 488 m of sampling effort.

Nearshore/Offshore Personnel from the USGS-GLSC conducted annual fall (October/November) bottom trawling (21-m wing trawl) on-contour to assess the status and trends of the Lake Huron deepwater prey-fish community at five locations in U.S. waters and one location in Canadian waters. Ten minute trawl tows were conducted at 9 to 110 m depths each year. No ruffe were captured following 41 tows comprising 6.83 hours of sampling (Figure 8 and Table 7).

Nearshore Personnel from CMU and MIDNR-Alpena conducted nearshore fishery assessments from Thunder Bay to Harbor Beach for a Lake Huron beach community and habitat assessment. The project was conducted from May to September and sampling included the use of a seine, modified fyke nets, and minnow traps. No ruffe were captured following sampling at 13 locations for a total of 129 seine hauls (45.7-m seine), 23 net nights, and 25 minnow trap sets (Table 7).

Unconfirmed Sightings None reported.

## **HURON-ERIE CORRIDOR (HEC)**

The USGS-GLSC, MIDNR-Lake St. Clair, and USFWS-Alpena FWCO reported other fish sampling capable of capturing ruffe incidentally in the Huron-Erie Corridor (HEC) which includes the St. Clair River, Lake St. Clair, and Detroit River (Figure 9 and Table 8).

St. Clair River Personnel from the USFWS-Alpena FWCO conducted bottom trawling (4.9-m headrope, 38.1 mm mesh body and 31.7 mm mesh cod) at 21 locations in the North and Middle Channels during October to document young-of-year and juvenile lake sturgeon. No ruffe were captured following 21 tows for a total of 1.78 hours of sampling effort (Figure 9 and Table 8).

Personnel from the USFWS-Alpena FWCO also conducted gill netting (91 m total length, 15 m panels, with stretch mesh sizes of 25, 38, and 51 mm) at 22 locations in the North and Middle Channels of the St. Clair River during October to capture young-of-year and juvenile lake sturgeon. No ruffe were captured following 22 net sets for 2,002 m of sampling effort (Figure 9 and Table 8).

Lake St. Clair Personnel from the MIDNR-Lake St. Clair office conducted bottom trawling (10-m headrope and 5-m headrope) at a number of locations in Lake St. Clair as part of an annual survey to assess the fish community. A total of 14 tows for a total of 1.42 hours of sampling effort was conducted at one location during May and September with the 10-m trawl, and 45 tows for a total of 5.95 hours of sampling effort was conducted at ten locations during April and August with the 5-m trawl (Figure 9 and Table 8). No ruffe were captured.

Personnel from the MIDNR-Lake St. Clair office also conducted small mesh trap netting at six locations in Lake St. Clair. No ruffe were captured following 56 net lifts over 2,885 hours of fishing during April and May (Figure 9 and Table 8).

Detroit River Personnel from the USFWS-Alpena FWCO conducted bottom trawling (4.9-m headrope, 38.1 mm mesh body and 31.7 mm mesh cod) at 19 locations east of Fighting Island and in the Amherstburg

Channel during September to document young-of-year and juvenile lake sturgeon. No ruffe were captured following 19 tows for a total of 1.55 hours of sampling effort (Figure 9 and Table 8).

Personnel from the USFWS-Alpena FWCO conducted gill netting (91 m total length, 15 m panels with stretch mesh sizes of 25, 38, and 51 mm) at five locations east of Fighting Island in the Detroit River during October to capture young-of-year and juvenile lake sturgeon. No ruffe were captured following five net sets for 455 m of sampling effort (Figure 9 and Table 8).

Personnel from the USFWS-Alpena FWCO also conducted minnow trapping at 32 locations in the Detroit River during April, May, and July to monitor the small benthic fish community while conducting setline assessments targeting sub adult and adult lake sturgeon. No ruffe were captured following 187 trap lifts for a total of 4,484.00 hours of sampling effort (Figure 9 and Table 8).

Corridor wide (excluding Lake St. Clair) Personnel from the USGS-GLSC used bongo nets to sample the St. Clair and Detroit Rivers from March to June (Table 8). No ruffe were captured following approximately 1,136 net tows.

Unconfirmed Sightings None reported

## **LAKE ERIE**

The USFWS-MBS/LBS, USGS-Lake Erie Biological Station (USGS-LEBS), Ohio Department of Natural Resources-Sandusky Fisheries Research Unit (ODNR-Sandusky), ODNR-Fairport Harbor Fisheries Research Unit (ODNR-Fairport Harbor) and USFWS-Alpena FWCO reported other fish sampling that was capable of capturing ruffe incidentally (Figures 9, 10 and 11, and Table 8). No ruffe were captured.

South Shore Tributaries Personnel from the USFWS-MBS/LBS worked with private contractors to conduct sampling in four Lake Erie tributaries to assess sea lamprey abundance (Figure 9 and Table 8). Sampling was conducted from April to June using portable assessment traps (PAT). No ruffe were captured following a total of 385 trap nights. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Western Basin Personnel from the ODNR-Sandusky office conducted bottom trawling (10.7-m headrope) in the western basin of Lake Erie from May to September to assess the relative abundance and growth of predator and forage fish species (Figure 10 and Table 8). Ten minute tows were conducted at water depths ranging from 1.2 to 12.8 m. A total of 132 trawl tows for a total of 22.0 hours of effort were conducted at 37 locations. No ruffe were captured.

Personnel from the USFWS-Alpena FWCO conducted bottom trawling (4.9-m headrope with a 3.8 cm stretch-mesh body, a 31.8 mm stretch-mesh cod end, and a 6.25-12.5 mm stretch-mesh inner liner) at 12 locations in the western basin near the mouth of the Detroit River during September and October to capture young-of-year and juvenile lake sturgeon. No ruffe were captured following 12 tows for a total of 1.12 hours of sampling effort (Figure 9 and Table 8).

Central Basin Personnel from the ODNR-Fairport Harbor office conducted bottom trawling (10.4-m head rope, Yankee two-seam) in the central basin of Lake Erie from April to October to assess the relative abundance and growth of predator and forage fish species (Figure 10 and Table 8). Five minute tows (5-10 m

depths) and ten minute tows were conducted at water depth strata ranging from 10-15 m, 15-20 m, and > 20 m. Five locations were sampled for a total of 184 trawl tows and 26.90 hours of effort. No ruffe were captured.

Personnel from the ODNR-Fairport Harbor office also conducted gill netting (bottom set) in the central basin of Lake Erie from September to November to assess the adult abundance of walleye and smallmouth bass (Table 8). Sampling gear consisted of 182-m monofilament gill nets comprised of 12 panels of 32 mm to 127 mm stretch mesh fished on the bottom. Eight locations were sampled and a total of 25 overnight sets were completed. No ruffe were captured.

Nearshore/Offshore Personnel from the USGS-LEBS conducted annual bottom trawling (7.9-m headrope) in nearshore and offshore areas to assess the status of fish stocks in Lake Erie (Figure 11 and Table 8). Ten minute trawl tows were conducted at 3.0 to 35.1 m depths. No ruffe were captured following a total of 25.41 hours of sampling effort.

Unconfirmed Sightings None reported.

## **LAKE ONTARIO**

The USFWS-MBS/LBS, USGS-Lake Ontario Biological Station (USGS-LOBS), and the DFO-GLLFAS reported other fish sampling that was capable of capturing ruffe incidentally in Lake Ontario (Figures 9 and 12 and Table 9). No ruffe were captured.

South Shore Tributaries Personnel from the USFWS-MBS/LBS worked with private contractors to conduct sampling in five Lake Ontario tributaries to assess sea lamprey abundance (Figure 9 and Table 9). Sampling was conducted from April to June using portable assessment traps (PAT). No ruffe were captured following a total of 433 trap nights. A summary of fish species captured at these locations is available upon request from USFWS-MBS.

U.S. Waters Nearshore/Offshore In 2012, USGS-LOBS and New York State Department of Environmental Conservation (NYSDEC) personnel conducted annual bottom trawling (18.0-m headrope) in U.S. waters of Lake Ontario to assess the status of major prey fish stocks and juvenile lake trout (Figure 12 and Table 9). Twelve to fourteen sampling transects spanning the U.S. shoreline (25-km intervals) were sampled during the spring and summer (April to July) and six sites were sampled in the fall (October). Bottom trawls depths ranged from 8 to 180 m at each transect. The total number of bottom trawls was 462 in 2012 which resulted in 56.4 hours the bottom trawl was sampling the lake bottom. No ruffe were captured.

Bay of Quinte Personnel from the DFO-GLLFAS conducted boat electrofishing in the Bay of Quinte area and the upper St. Lawrence River to assess for American eel (Figure 9 and Table 9). Sampling was conducted in May. Four locations within the Bay of Quinte were sampled for a total of 103 transects and three locations within the upper St. Lawrence River were sampled for a total of 59 transects. Each transect was fished for 5 minutes. No ruffe were captured following a total of 8.58 hours of effort in the Bay of Quinte and 4.92 hours of effort in the upper St. Lawrence River.

Unconfirmed Sightings None reported.

## DISCUSSION

Ruffe surveillance activities in Lakes Huron, Erie and Ontario, and the connecting waters of the St. Marys River did not capture ruffe during 2012.

Reporting provided on other fish sampling that was capable of incidentally capturing ruffe indicated that ruffe continue to persist within their range in Lake Superior and within Green Bay, Lake Michigan. No range expansion was apparent on the periphery of the range within Lakes Superior, Michigan and Huron based on reports. Ruffe were again captured from one location in northwestern Lake Huron during 2012. A synopsis by water body follows.

### LAKE SUPERIOR

Dedicated ruffe surveillance was not conducted within Lake Superior; however reports from other sampling conducted by the USGS-LSBS, FWS-MBS, OMNR-UGLMU, FWS-Ashland FWCO, and WIDNR in 2012 indicated that ruffe continued to persist in areas where they were previously established. Ruffe were reported from western Lake Superior at the Thunder Bay Harbour, Ontario to the western edge of the Keweenaw Peninsula in Michigan. No range expansion was detected based on incidental reports.

### LAKE MICHIGAN

Dedicated ruffe surveillance was not conducted within Lake Michigan; however reports from the MIDNR-Marquette indicated that ruffe continued to persist in LBDN of northern Green Bay in 2012. Ruffe were first discovered in Green Bay at LBDN in 2002 and also detected from BBDN in 2004 and southern Green Bay near Marinette, Wisconsin in 2007. Ruffe were not reportedly captured outside of LBDN in 2012 and expansion out of Green Bay was not detected based on reports from other agencies including Wisconsin and Michigan DNR.

Water samples were collected during the fall of 2012 from locations in Green Bay by The Nature Conservancy and USFWS-Green Bay Fish and Wildlife Conservation Office and tested for the presence of ruffe environmental DNA (eDNA). Ruffe eDNA was not confirmed to be present in the samples tested based on the ruffe eDNA marker used for analysis (Andrew Tucker, The Nature Conservancy, personal communication). Additional water collection and ruffe eDNA testing is planned for the spring of 2013.

Little and Big Bays de Noc of Northern Green Bay The MIDNR-Marquette conducted sampling with gill nets and trawls that was capable of incidentally capturing ruffe in Michigan waters of Green Bay. Ruffe continued to be captured from LBDN with both gear types in low numbers (four ruffe were captured in gill nets and three ruffe were captured in trawl tows). Ruffe also continued to be absent from the catch in BBDN. The MIDNR-Marquette has not captured ruffe from BBDN since the initial discovery of one ruffe in the fall of 2004. MIDNR-Marquette incidental catch numbers for ruffe from LBDN for the time period 2002 thru 2012 have totaled 3, 4, 3, 22, 40, 13, 5, 2, 10, 2, and 7 respectively. The 2006 catch of 40 ruffe did not seem to transfer into a strong year class in 2007, and catch rates over the past five years have averaged lower.

### ST. MARYS RIVER

Ruffe surveillance activities were initiated in the St. Marys River in 2000 by the USFWS-Alpena FWCO.

Sampling locations within the river have expanded since that time to provide for better coverage of the river. No ruffe have been captured from the river since surveillance was initiated. The St. Marys River is within close proximity to Whitefish Bay, Lake Superior, where ruffe were captured in 2006 at the mouth of the Tahquamenon River, 55 km (34.1 miles) east of the Soo Locks. Ruffe have not reportedly been captured as a result of other fish sampling that was capable of incidentally capturing ruffe within the St. Marys River.

## **LAKE HURON**

Dedicated ruffe surveillance did not capture ruffe from sampled areas within Lake Huron during 2012. Incidental sampling did capture one ruffe from within the reported range at the Cheboygan River. One ruffe was captured from this same location by USFWS-MBS in 2011. Ruffe remained absent from the Thunder Bay area (Thunder Bay River and Thunder Bay shipping channel) where they had previously been captured from 1995 through 2003, and from the Trout River in Rogers City where two were captured by USFWS-MBS in 2008, or from other locations around Lake Huron based on other fish sampling that was capable of incidentally capturing ruffe.

Water samples were collected during the fall of 2012 from the Cheboygan, Trout and Thunder Bay Rivers by The Nature Conservancy and USFWS-Alpena FWCO to be tested for the presence of ruffe environmental DNA (eDNA). Ruffe eDNA was not confirmed to be present in the samples tested based on the ruffe eDNA marker used for analysis (Andrew Tucker, The Nature Conservancy, personal communication). Additional water collection and ruffe eDNA testing is planned for the spring of 2013.

Cheboygan River, Michigan The USFWS-MBS reported one ruffe captured during May 2012. This is the second year that ruffe have been reported from the sea lamprey assessment trap fished near the dam on the Cheboygan River in Cheboygan, Michigan. The trap is operated in the spring each year (April or May to June). The origin of the ruffe is unknown; however, one may speculate ruffe may have migrated north from Thunder Bay, the only known location where large numbers of ruffe have been captured in past years, in the same way they have moved across portions of the south shore of Lake Superior. Another potential vector is that they may have been transferred via ship ballast water from other infested areas of the Great Lakes.

Annual ruffe surveillance bottom trawling has been conducted during the fall at the mouth of the Cheboygan River since 1996 by the USFWS-Alpena FWCO; no ruffe have been detected during these efforts. Additional sampling targeting ruffe with boat electrofishing gear was conducted during May 2012; however no ruffe were detected during these efforts.

Trout River, Michigan Ruffe have not been reported from the Trout River or Rogers City area since their initial discovery in 2008 by the USFWS-MBS in a sea lamprey trap upstream in the Trout River. Dedicated ruffe surveillance trawling was conducted at the Port of Calcite in Rogers City during the fall by the USFWS-Alpena FWCO and no ruffe were detected. Additional sampling targeting ruffe was conducted by the USFWS-Alpena FWCO in the Rogers City area during the spring of 2012 at the Trout River, Calcite, the Swan River mouth, and Rogers City marina, but ruffe were not captured.

Thunder Bay River, Michigan Ruffe have not been captured from the Thunder Bay River or Alpena area since 2003. In 2012, annual ruffe surveillance trawling was conducted by USFWS-Alpena FWCO in the Thunder Bay River and shipping channels during the fall, and additional sampling targeting ruffe was conducted in the Thunder Bay River during the spring. We surmise that ruffe may be extirpated from the area.

Ruffe were initially discovered in the Thunder Bay River in 1995 during ruffe surveillance trawling and their

abundance in bottom trawls (mainly young-of-the-year) from the Thunder Bay River peaked in 1999 then declined. Ruffe were last captured from bottom trawls in 2001. The USFWS-Alpena FWCO initiated an adult spawning phase ruffe removal effort using gill nets from 2002 to 2008 to remove ruffe prior to spawning. A total of 96 ruffe were removed in 2002, 10 ruffe were removed in 2003 and no ruffe were captured from 2004 to 2008. The absence of young-of-the-year in the catch following 2001, decline in adult spawning phase ruffe in the catch from 2002 to 2003, and the absence of ruffe from the catch of ongoing trawling, netting and electrofishing efforts through 2012 indicate a decline in the Thunder Bay area ruffe population.

The lack of young-of-the-year following 1999 was an initial sign that recruitment may not be taking place and was insufficient to foster the population. It is not known why the large abundance of ruffe captured in 1999 did not transfer into a substantial catch of adult or subsequent young-of-the-year production in 2000. One observation that coincided with the decline in ruffe in the Thunder Bay area was the colonization and subsequent flourishing of the round goby. 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 in 2000, a status which has continued. Round gobies are aggressive, egg predators that may spawn repeatedly during a season and guard their nests to ensure the development of their young – allowing them to become abundant. Although direct interactions between round goby and ruffe are unknown, we surmise that round goby may have fed on ruffe eggs and/or young that were deposited and/or hatched in the river in the spring and early summer, or that round goby may have had some other negative effect on ruffe. Potential predation effects of round goby and the removal of spawning adults in 2002 and 2003 may have contributed to the decline in ruffe abundance. Although ruffe have not been captured from the Thunder Bay area since 2003, round gobies continue to be the most abundant species captured in the Thunder Bay area during ruffe surveillance trawling.

## **LOWER GREAT LAKES**

Ruffe surveillance activities have not detected ruffe in the lower Great Lakes (Lakes Erie and Ontario) or the HEC. Ruffe have not been reported by other agencies/offices that were capable of incidentally capturing ruffe during their sampling efforts.

## **KNOWN RANGE OF RUFFE IN THE GREAT LAKES**

The current range of ruffe in the Great Lakes is as follows:

Lake Superior North Shore: From the Duluth/Superior Harbor, Minnesota/Wisconsin, U.S. A., to near the mouth 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 Michigan Green Bay.

Lake Huron Cheboygan River (Cheboygan, Michigan): At the first upstream barrier (dam) on the Cheboygan River.

Trout River (Rogers City, Michigan): At the first upstream barrier on the Trout River.

Thunder Bay River/Thunder Bay Shipping Channel (Alpena, Michigan): No ruffe have been captured or reported from this area of Lake Huron since 2003.

<u>Huron-Erie Corridor</u>	<u>Lake Erie</u>	<u>Lake Ontario</u>	<u>Great Lakes Basin Inland Lakes and Streams</u>
Undetected.	Unconfirmed.	Undetected.	Undetected.

## **ACKNOWLEDGMENTS**

We are grateful to the National Aquatic Nuisance Species Task Force for financially supporting this work and to the Great Lakes Sport Fishing Council for endorsing this work.

We also thank the many agencies across the Great Lakes that reported other fish sampling information, permitted ruffe surveillance within their jurisdictions, and to those who assisted with ruffe surveillance or data analysis.

### **Assisted with Ruffe Surveillance or Data Analysis**

Thank you to the volunteers, staff members and others who assisted with ruffe sampling activities.

Denise Clay (USFWS-Lower Great Lakes FWCO)	Adric Olsen (USFWS-Alpena FWCO)
Heidi Himes (USFWS-Lower Great Lakes FWCO)	Scott Sanders (USFWS-Lower Great Lakes FWCO)
Chris Olds (USFWS-Alpena FWCO)	

### **Reported Information From Other Fish Sampling Capable of Capturing Ruffe Incidentally**

Thank you to other agencies and offices who provided information on their sampling that was capable of capturing ruffe incidentally.

Jessica Barber (USFWS-MBS)	Jared Myers (WIDNR-Superior)
Justin Chiotti (USFWS-Alpena FWCO)	Lisa O'Connor (DFO-GLLFAS)
John Deller (ODNR-Fairport Harbor)	Tammie Paoli (WIDNR-Peshtigo)
Lori Evrard (USGS-LSBS)	Edward Roseman (USGS-GLSC)
David Fielder (MIDNR-Alpena)	Joshua Schloesser (USFWS-Ashland FWCO)
Neal Godby (MIDNR-NLHMU for SMRFTG)	Mike Thomas (MIDNR-Lake St. Clair)
Jim Johnson (MIDNR-Alpena)	Mark Turner (ODNR-Sandusky)
Thomas Kelly (ISEA)	Brian Weidel (USGS-LOBS)
Patrick Kocovsky (USGS-LEBS)	Bill Wellankamp (MIDNR-Alpena)
Jessica Loughner (CMU)	Troy Zorn (MIDNR-Marquette)
Charles Madenjian (USGS-GLSC)	

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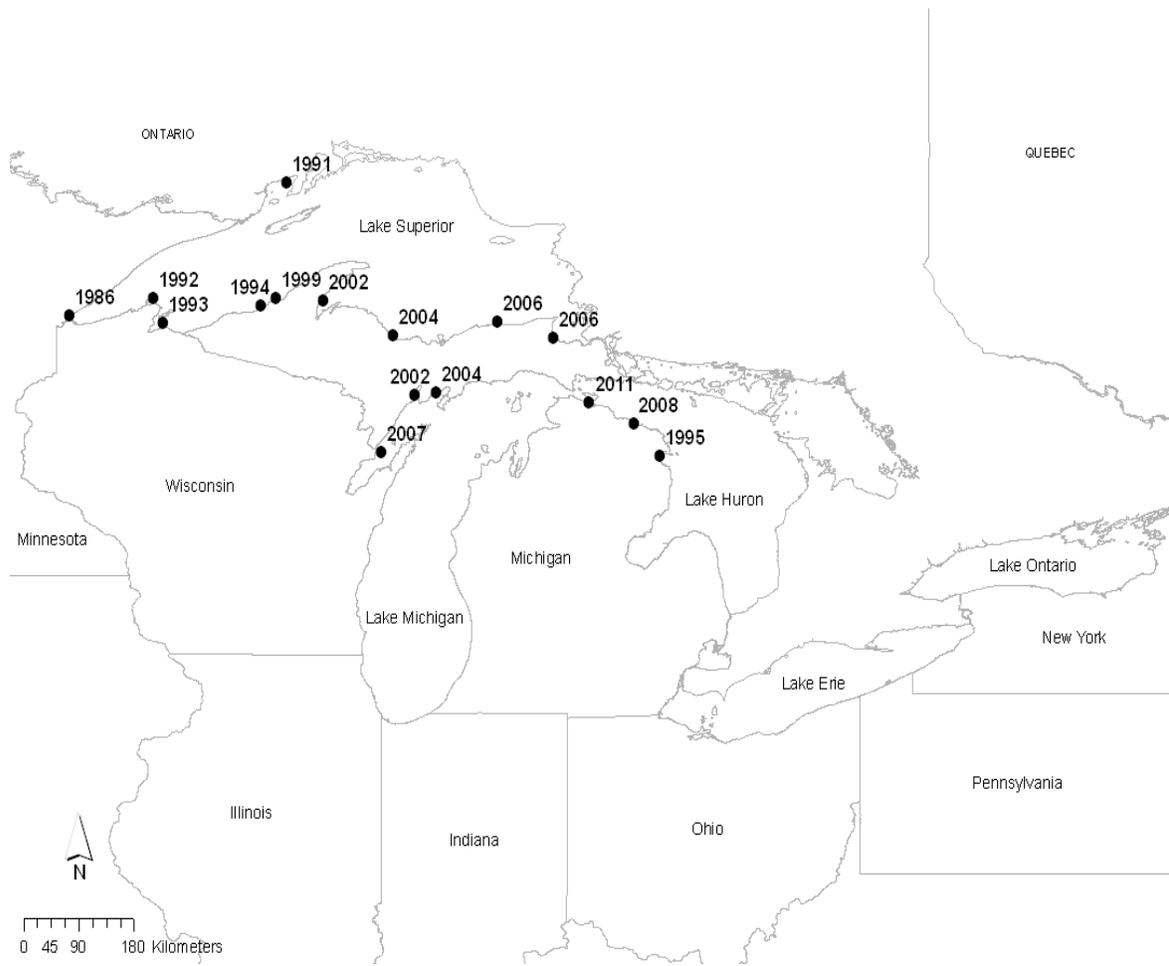
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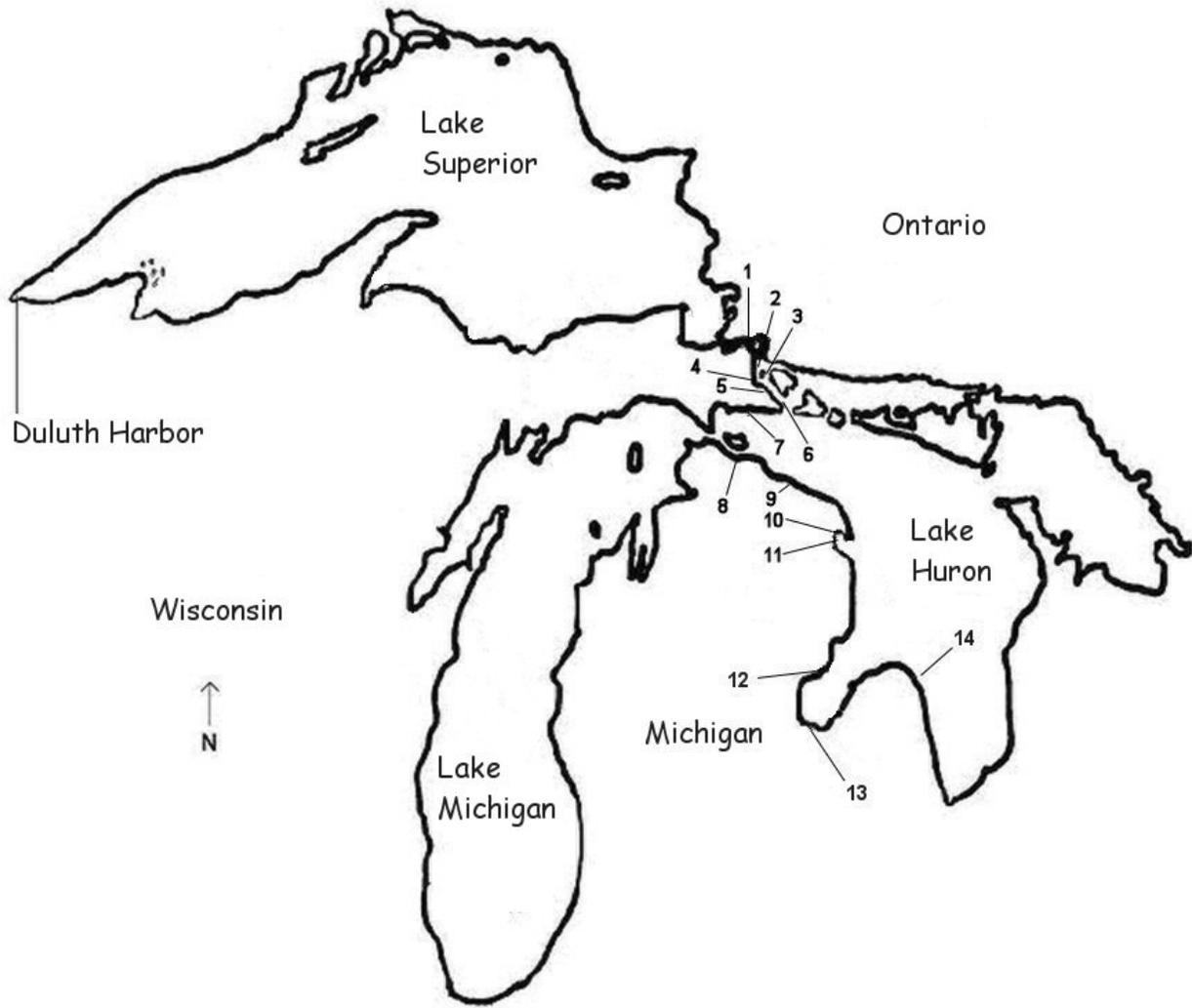
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**Progression of Ruffe Across the Great Lakes**

**Figure 1.** Progression of ruffe across the Great Lakes. Note: Map does not show all ruffe sightings, only new sightings in the progression of their spread across the Great Lakes over time.



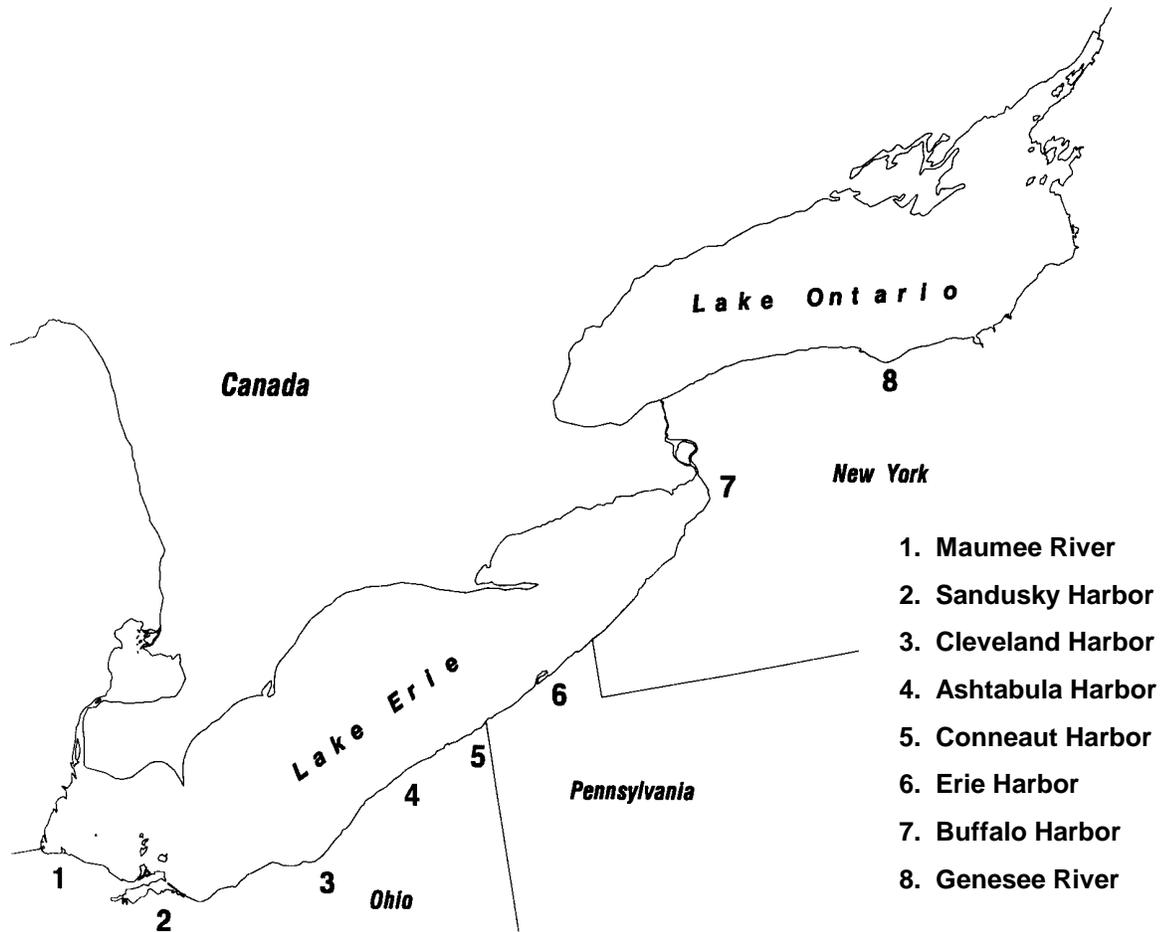
**Ruffe Surveillance, St. Marys River/Lake Huron, 2012**



**U. S. Fish and Wildlife Service**

- |   |   |
|---|---|
| 1. St. Marys River (SSM Municipal Marina) | 8. Cheboygan River  |
| 2. St. Marys River (Lake Nicolet)         | 9. Port of Calcite, Trout River, Swan River, Rogers City Marina |
| 3. St. Marys River (Munuscong Channel)    | 10. Thunder Bay River   |
| 4. St. Marys River (Raber Bay)            | 11. Thunder Bay (Shipping Channel)                              |
| 5. St. Marys River (De Tour – Maud Bay)   | 12. Au Gres River   |
| 6. St. Marys River (De Tour Dock Co.)     | 13. Saginaw River   |
| 7. Port Dolomite                          | 14. Harbor Beach  |

**Figure 2.** Locations surveyed for ruffe in the upper Great Lakes during 2012.

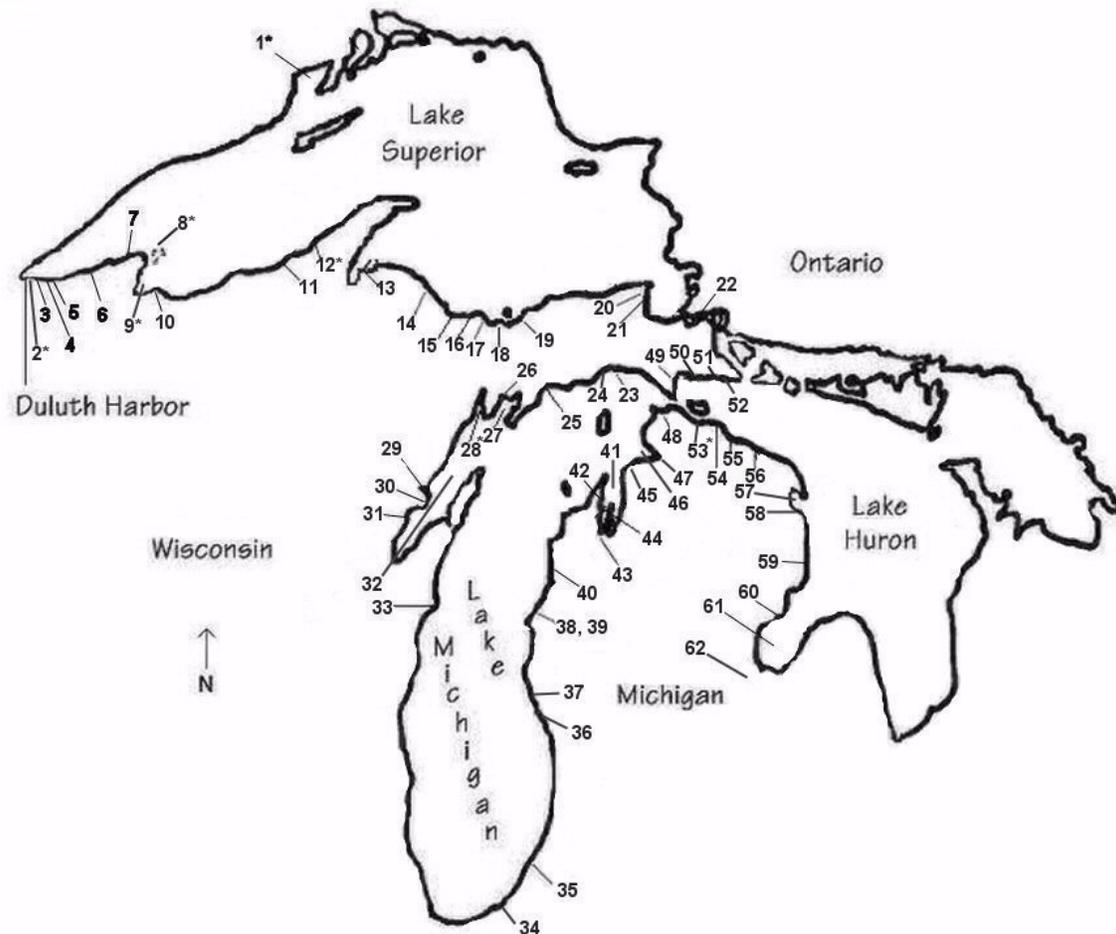


**Ruffe Surveillance, Lake Erie/Lake Ontario, 2012**



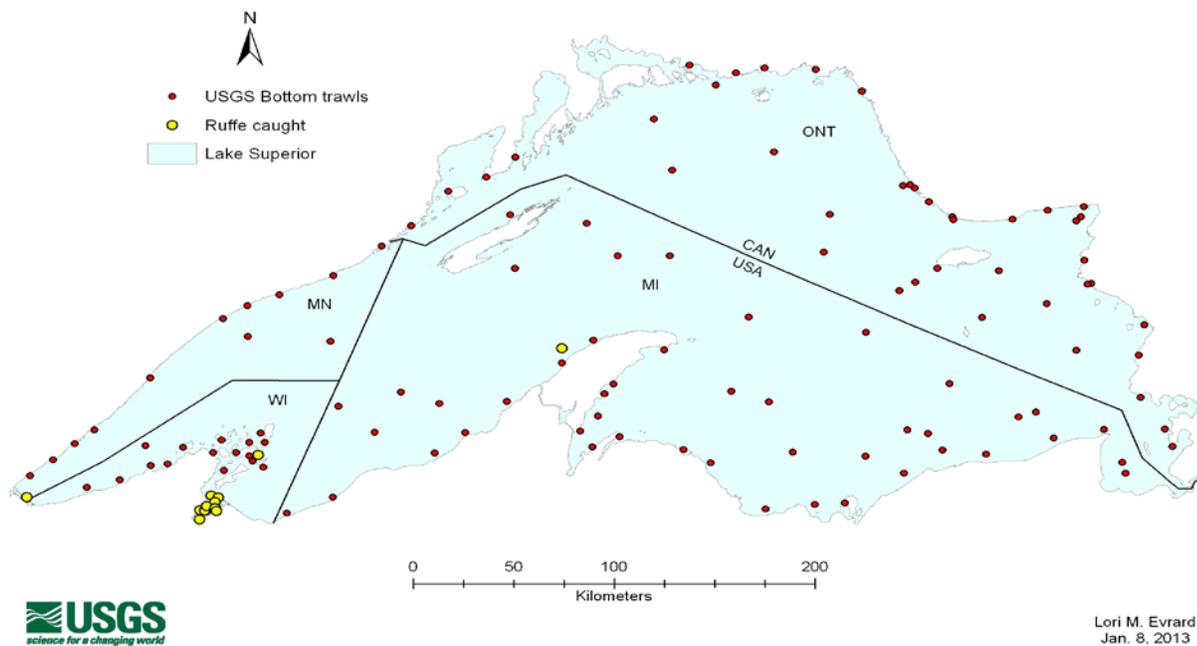
**U. S. Fish and Wildlife Service**

**Figure 3.** Locations surveyed for ruffe in the lower Great Lakes during 2012.



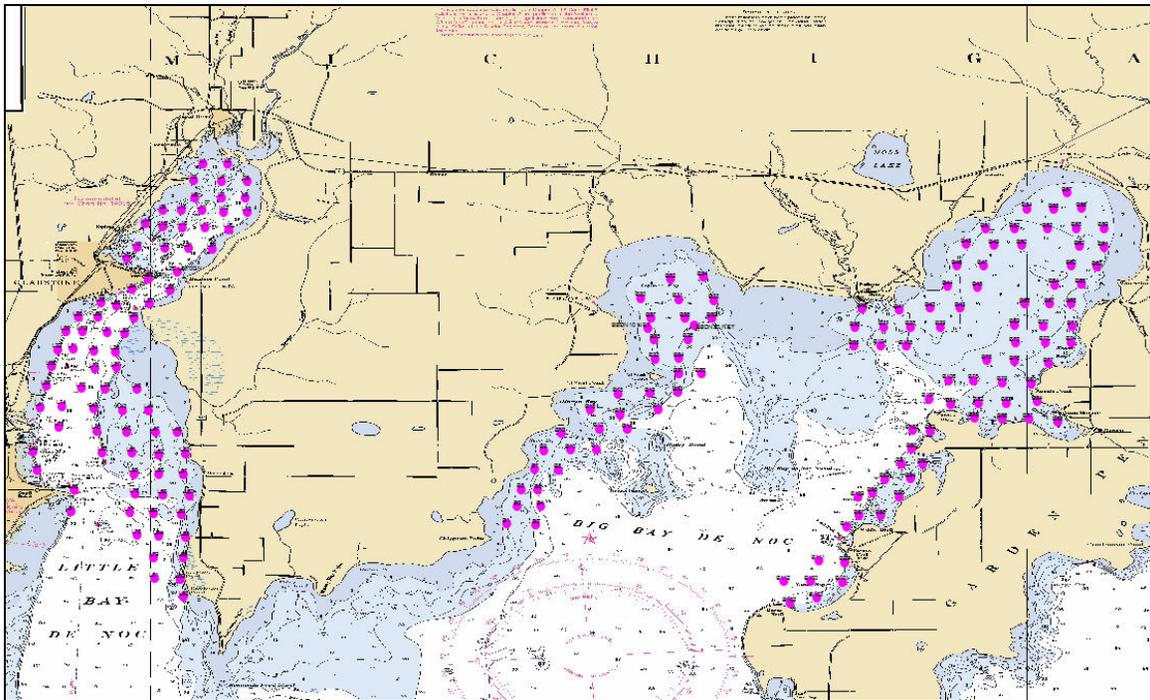
- |                              |                                  |                           |                         |
|------------------------------|----------------------------------|---------------------------|-------------------------|
| 1. Thunder Bay Harbour *     | 18. Furnace Creek                | 35. St. Joseph River      | 52. Trout Creek         |
| 2. St. Louis River *         | 19. Miners River                 | 36. Muskegon River        | 53. Cheboygan River *   |
| 3. Amnicon River             | 20. Betsy River                  | 37. White River           | 54. Greene Creek        |
| 4. Middle River              | 21. Tahquamenon River            | 38. Big Manistee River    | 55. Ocqueoc River       |
| 5. Poplar River              | 22. St. Marys River              | 39. Little Manistee River | 56. Trout River         |
| 6. Brule River               | 23. Hog Island Creek             | 40. Betsie River          | 57. Thunder Bay         |
| 7. Red Cliff Creek           | 24. Naubinway                    | 41. Grand Traverse Bay    | 58. Devils River        |
| 8. Apostle Islands *         | 25. Manistique, Manistique River | 42. Suttons Bay           | 59. Au Sable River      |
| 9. Chequamegon Bay *         | 26. Ogontz River                 | 43. Boardman River        | 60. East Au Gres River  |
| 10. Bad River                | 27. Big Bay de Noc               | 44. Elk Lake Outlet       | 61. Saginaw Bay         |
| 11. Firesteel River          | 28. Little Bay de Noc *          | 45. Deer Creek            | 62. Tittabawassee River |
| 12. Misery River *           | 29. Menominee River              | 46. Little Traverse Bay   |                         |
| 13. Silver River             | 30. Peshtigo River               | 47. Petoskey              |                         |
| 14. Big Garlic River         | 31. Oconto River                 | 48. Carp Lake River       |                         |
| 15. Chocoday River           | 32. Green Bay                    | 49. Carp River            |                         |
| 16. Laughing Whitefish River | 33. East Twin River              | 50. Les Cheneaux Islands  |                         |
| 17. Rock River               | 34. Trail Creek                  | 51. Albany Creek          |                         |

**Figure 4.** Reported sampling locations in the upper Great Lakes where ruffe were capable of incidental capture during 2012. The \* denotes locations where ruffe were captured.



U. S. Geological Survey

**Figure 5.** The USGS-Lake Superior Biological Station conducted annual bottom trawling at locations in Lake Superior where ruffe were capable of incidental capture during 2012.

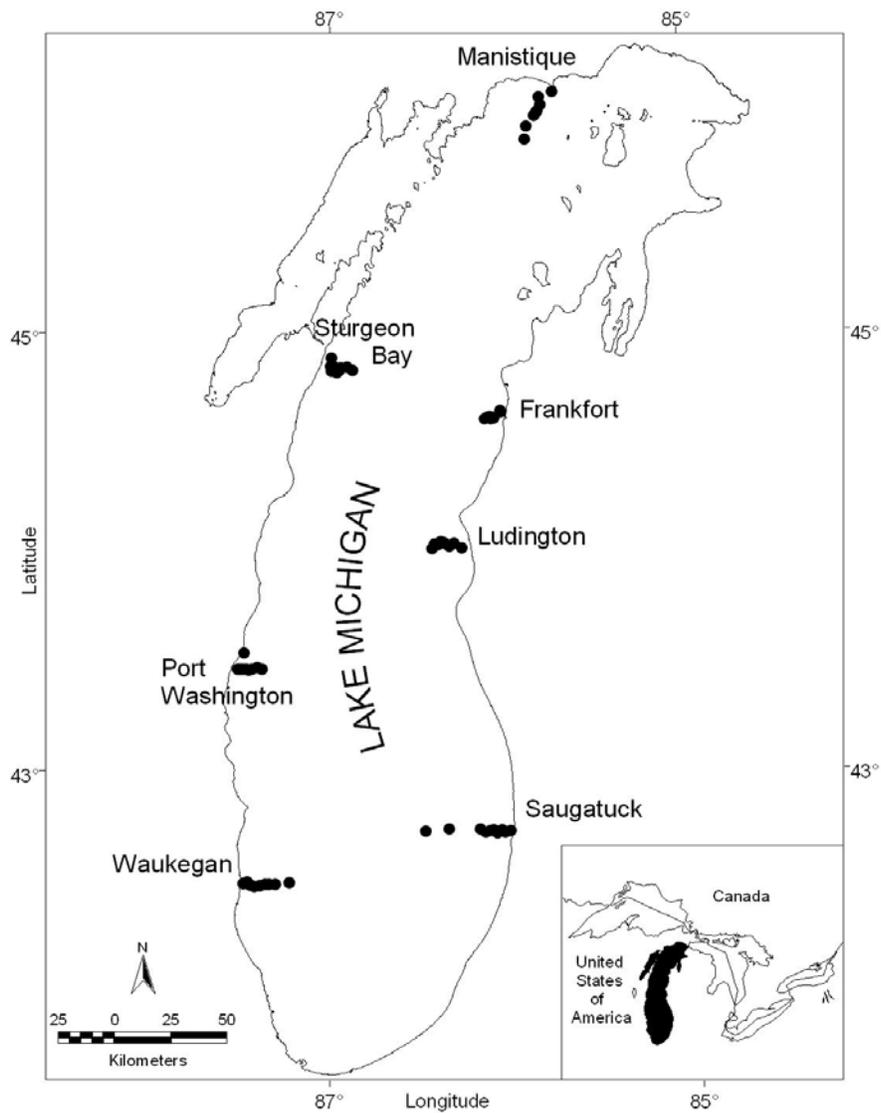


**Potential Netting Locations, Fall Assessment Survey, 2009-2012**



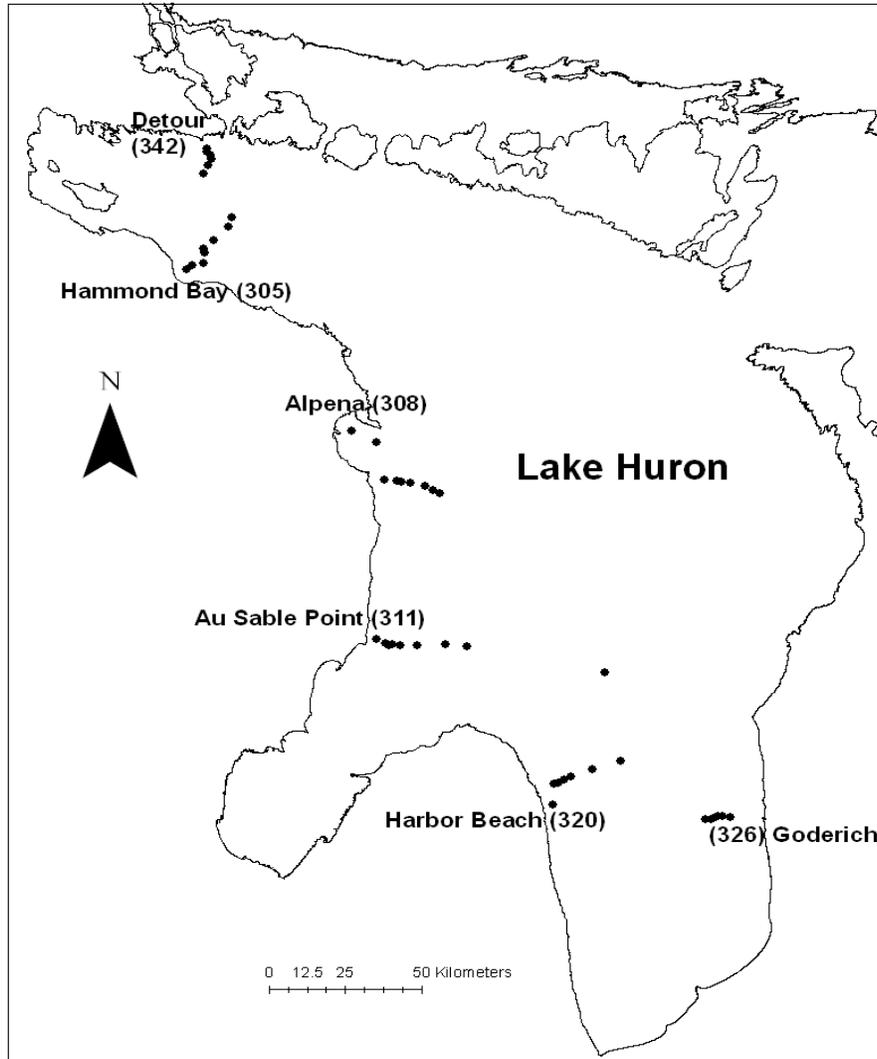
**Michigan Department of Natural Resources**

**Figure 6.** The Michigan DNR-Marquette Fisheries Research Station conducted gill netting at locations in northern Green Bay, Lake Michigan where ruffe were capable of capture incidentally. Each year a stratified random sample is obtained for each Bay de Noc from this grid of potential sites.



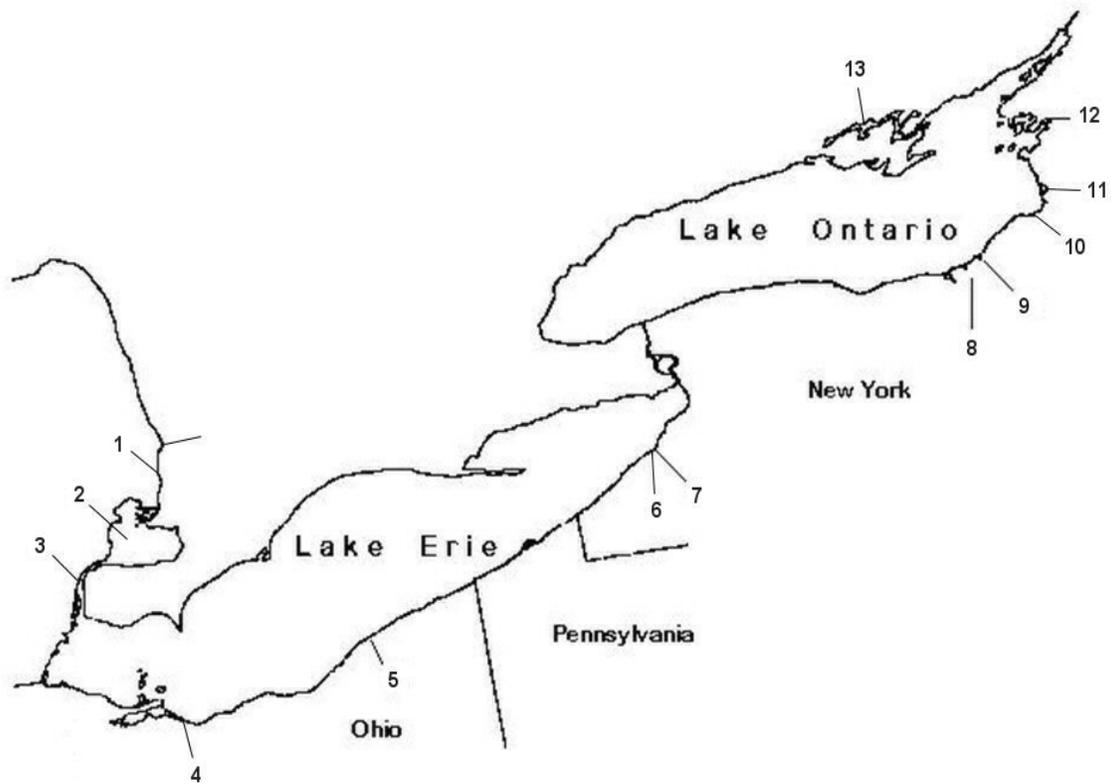
U. S. Geological Survey

**Figure 7.** The USGS-Great Lakes Science Center conducted annual bottom trawling at locations in Lake Michigan where ruffe were capable of incidental capture during 2012.



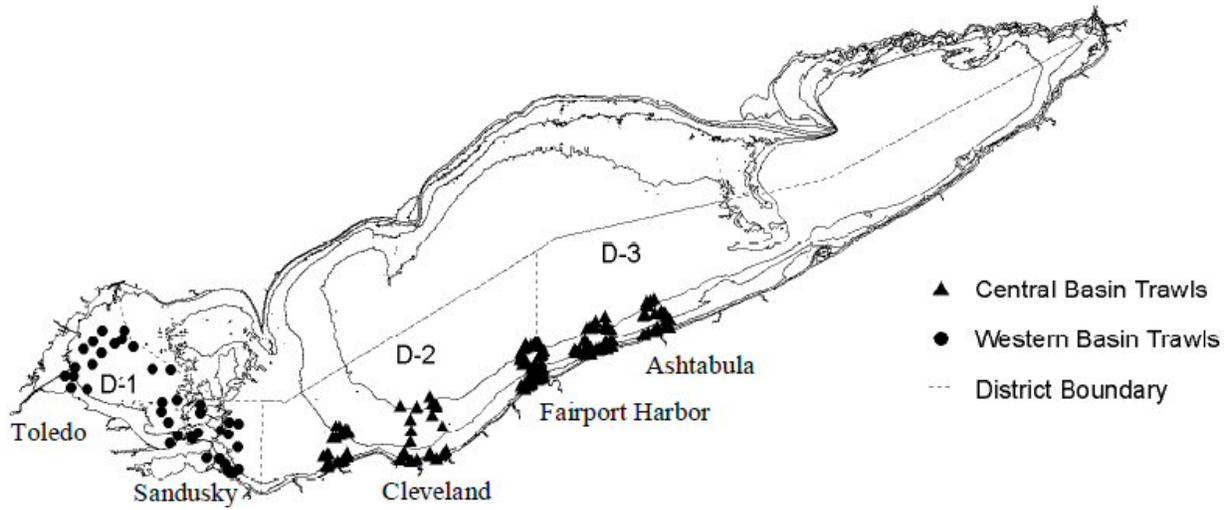
U. S. Geological Survey

**Figure 8.** The USGS-Great Lakes Science Center conducted annual bottom trawling at locations in Lake Huron where ruffe were capable of incidental capture during 2012.



- |                    |                          |                      |
|--------------------|--------------------------|----------------------|
| 1. St. Clair River | 6. Spooner Creek         | 11. Grindstone Creek |
| 2. Lake St. Clair  | 7. Cattaraugus Creek     | 12. Black River      |
| 3. Detroit River   | 8. Sterling Valley Creek | 13. Bay of Quinte    |
| 4. Huron River     | 9. Sterling Creek        |                      |
| 5. Grand River     | 10. Little Salmon River  |                      |

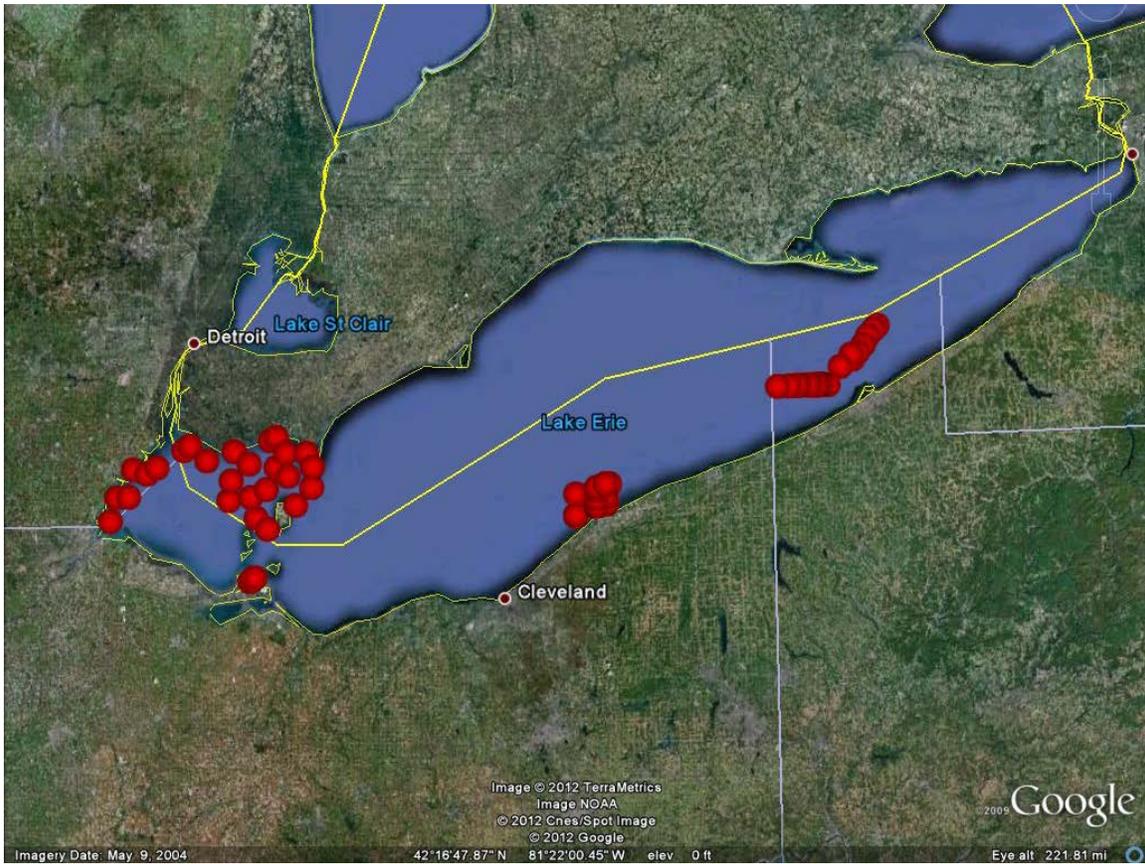
**Figure 9.** Reported sampling locations in the lower Great Lakes where ruffe were capable of incidental capture during 2012.



### Bottom Trawling Locations

### Ohio Department of Natural Resources

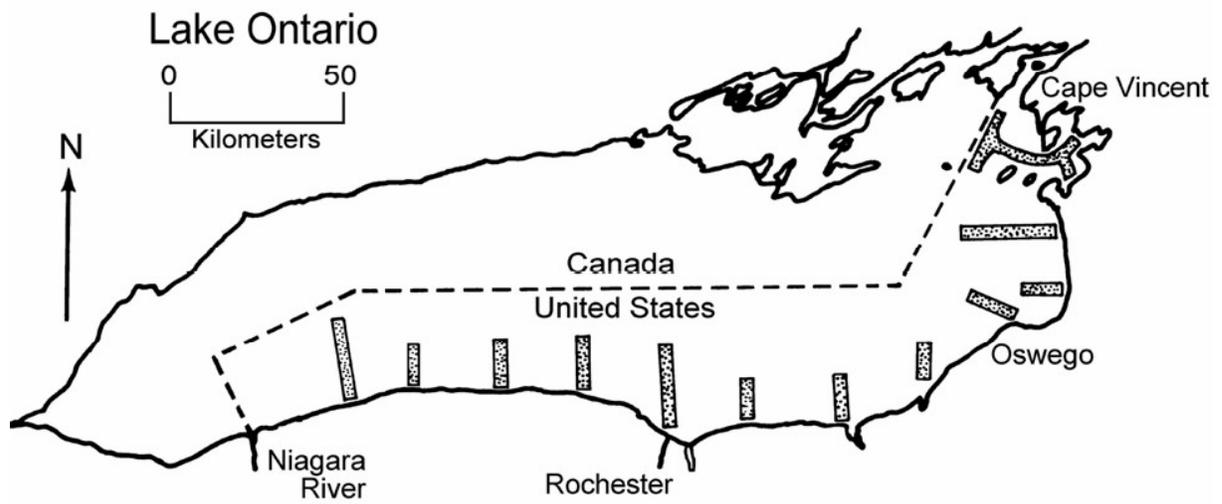
**Figure 10.** The Ohio DNR-Sandusky and Fairport Harbor Fisheries Research Units conducted annual bottom trawling at locations in Lake Erie where ruffe were capable of incidental capture during 2012.



### Bottom Trawling Locations



**Figure 11.** The USGS-Lake Erie Biological Station conducted annual bottom trawling at locations in Lake Erie where ruffe were capable of incidental capture during 2012.



U. S. Geological Survey

**Figure 12.** The USGS-Lake Ontario Biological Station conducted annual bottom trawling at locations in Lake Ontario where ruffe were capable of incidental capture during 2012.

**Table 1.** Summary of dedicated ruffe surveillance in U.S. waters of Lake Huron in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>Ruffe</u>
Au Gres River	FWS	0.30 hours	BT-4.9	9/10/2012	2.1	22.2	21.7	0
Calcite Port	FWS	0.50 hours	BT-4.9	10/4/2012	7.9	15.7	14.7	0
Port of Calcite	FWS	0.85 hours	EF	5/8/2012	1.5-4.0	10.0	-----	0
Cheboygan River	FWS	0.50 hours	BT-4.9	9/13/2012	6.6	19.3	19.1	0
Cheboygan River	FWS	1.30 hours	EF	5/9/2012	1.3	12.0	-----	0
Harbor Beach	FWS	0.50 hours	BT-4.9	9/11/2012	4.6	20.5	19.6	0
Port Dolomite	FWS	0.50 hours	BT-4.9	9/28/2012	7.0	10.8	8.8	0
Rogers City Marina	FWS	0.47 hours	EF	5/8/2012	1.5-3.0	10.0	-----	0
Saginaw River	FWS	0.50 hours	BT-4.9	9/12/2012	7.6	22.7	22.3	0
Swan River	FWS	0.72 hours	EF	5/8/2012	1.0-3.0	10.0	-----	0
Thunder Bay River	FWS	0.58 hours	BT-4.9	9/21/2012, 10/3/2012	5.8	16.7	15.8	0
Thunder Bay River	FWS	0.83 hours	EF	5/7/2012	1.2	15.0	-----	0
Thunder Bay River	FWS	9 trap nights	TN	9/12/2012-9/14/2012	2.1	18.0	-----	0
Thunder Bay (Shipping Channel)	FWS	0.50 hours	BT-4.9	9/14/2012, 9/21/2012	6.0	16.9	18.3	0
Trout River	FWS	0.33 hours	EF2	5/16/2012	0.9	12.0	-----	0
Totals		3.88 hours	BT-4.9					0
		4.17 hours	EF					0
		0.33 hours	EF2					0
		9 trap nights	TN					0
		Total ruffe (ruffe surveillance)						0

Key to headings:

Agency = U. S. Fish and Wildlife Service (FWS).

S. Temp = Average surface water temperature (°C).

Gear = BT-4.9=Bottom trawl (4.9-m headrope).

B. Temp = Average bottom water temperature (°C).

EF=Boat electrofishing.

EF2=Backpack electrofishing.

TN=Trap net (small mesh).

Depth = Average water depth (m).

**Table 2.** Summary of dedicated ruffe surveillance in U.S. waters of the St. Marys River in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>Ruffe</u>
De Tour - DeTour Dock Co.	FWS	0.25 hours	BT-4.9	9/27/2012	6.8	14.2	12.7	0
De Tour - Maud Bay	FWS	0.25 hours	BT-4.9	9/27/2012	6.9	14.3	13.3	0
Lake Nicolet	FWS	0.50 hours	BT-4.9	9/25/2012	8.0	14.0	14.1	0
Munuscong Channel	FWS	0.50 hours	BT-4.9	9/26/2012	6.9	14.1	14.3	0
Raber Bay	FWS	0.50 hours	BT-4.9	9/27/2012	6.9	13.3	13.2	0
Salut Ste. Marie Municipal Marina	FWS	0.20 hours	BT-4.9	9/26/2012	3.1	15.3	15.1	0
Totals		2.20 hours	BT-4.9					0
		Total ruffe (ruffe surveillance)						0

Key to headings:

Agency = U. S. Fish and Wildlife Service (FWS).

S. Temp = Average surface water temperature (°C).

Gear = Bottom trawl (4.9-m headrope).

B. Temp = Average bottom water temperature (°C).

Depth = Average water depth (m).

**Table 3.** Summary of dedicated ruffe surveillance in U.S. waters of Lake Erie in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>S. DO</u>	<u>B. DO</u>	<u>Secchi</u>	<u>Ruffe</u>
Ashtabula Harbor	FWS	0.55 hours	BT-4.9	5/10/2012	8.2	15.20	13.67	7.65	7.96	0.55	0
Ashtabula Harbor	FWS	0.77 hours	BT-4.9	9/19/2012	7.7	19.98	19.63	7.79	7.79	1.09	0
Buffalo Harbor	FWS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Buffalo Harbor	FWS	0.80 hours	BT-4.9	9/21/2012	6.5	19.54	19.42	8.65	8.72	2.19	0
Cleveland Harbor	FWS	0.97 hours	BT-4.9	5/10/2012	7.8	15.90	16.10	7.32	7.20	0.20	0
Cleveland Harbor	FWS	0.79 hours	BT-4.9	9/19/2012	7.1	20.48	20.50	8.96	8.63	0.64	0
Conneaut Harbor	FWS	0.55 hours	BT-4.9	5/11/2012	6.7	15.23	13.47	7.46	7.79	0.53	0
Conneaut Harbor	FWS	0.37 hours	BT-4.9	9/20/2012	7.6	19.05	19.10	7.36	7.35	0.90	0
Erie Harbor	FWS	0.56 hours	BT-4.9	5/11/2012	8.7	14.53	14.43	8.25	8.16	1.17	0
Erie Harbor	FWS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Maumee River	FWS	0.58 hours	BT-4.9	5/9/2012	8.5	19.03	18.90	6.39	6.75	0.47	0
Maumee River	FWS	0.77 hours	BT-4.9	9/18/2012	8.5	21.00	20.95	8.22	8.08	0.10	0
Sandusky Harbor	FWS	0.61 hours	BT-4.9	5/8/2012	7.5	18.90	14.60	12.34	8.39	0.67	0
Sandusky Harbor	FWS	0.60 hours	BT-4.9	9/18/2012	6.4	20.17	20.20	8.30	8.77	0.47	0
Totals		7.91 hours	BT-4.9								0
Total ruffe (ruffe surveillance)											0

Key to headings:

Agency = U. S. Fish and Wildlife Service (FWS).

Gear = Bottom trawl (4.9-m headrope).

Depth = Average water depth (m).

S. Temp = Average surface water temperature (°C).

B. Temp = Average bottom water temperature (°C).

S. DO = Surface dissolved oxygen (ppm).

B. DO = Bottom dissolved oxygen (ppm).

Secchi = Turbidity (m).

**Table 4.** Summary of dedicated ruffe surveillance in U.S. waters of Lake Ontario in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>S. DO</u>	<u>B. DO</u>	<u>Secchi</u>	<u>Ruffe</u>
Genesee River	FWS	0.63 hours	BT-4.9	5/14/2012	5.5	17.43	16.67	8.81	8.97	0.62	0
Genesee River	FWS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals		0.63 hours	BT-4.9								0
Total ruffe (ruffe surveillance)											0

Key to headings:

Agency = U. S. Fish and Wildlife Service (FWS).

Gear = Bottom trawl (4.9-m headrope).

Depth = Average water depth (m).

S. Temp = Average surface water temperature (°C).

B. Temp = Average bottom water temperature (°C).

S. DO = Surface dissolved oxygen (ppm).

B. DO = Bottom dissolved oxygen (ppm).

Secchi = Turbidity (m).

**Table 5.** Summary of reported fish sampling conducted in Lake Superior that was capable of incidentally capturing ruffe during 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
Amnicon River	GLIFWC/FWS	43 trap nights	FN	4/23-6/5/2012	0.5-1.0	13.0	0
Apostle Islands*	WDNR	38,395 meters	GN	7/2012, 8/2012	16.1	8.5 B	9
Apostle Islands*	USGS	1.33 hours	BT-11.9	11/2012	112.0	5.4 B	1
Bad River	GLIFWC	240 trap nights	PAT	3/26-6/14/2012	0.5	14.7	0
Betsy River	FWS	74 trap nights	PAT	5/1-6/7/2012	0.5	16.5	0
Big Garlic River	PC	63 trap nights	FN	4/25-6/27/2012	0.5-1.0	17.4	0
Brule River	GLIFWC/FWS	55 trap nights	PT	4/24-6/18/2012	0.8	15.3	0
Chequamegon Bay *	USGS	5.29 hours	BT-5.5	7/2012-8/2012	5.1	-----	31
Chequamegon Bay *	FWS	1.95 hours	BT-4.9	9/2012	1.9-8.4	20.0-22.0	744
Chequamegon Bay *	WDNR	3,291 meters	GN	7/2012, 8/2012	11.9	8.8 B	33
Chocolay River	PC	63 trap nights	FN	4/25-6/27/2012	0.5-1.0	13.1	0
Firesteel River	GLIFWC	59 trap nights	FN	4/13-6/11/2012	0.5-1.0	15.1	0
Furnace Creek	PC	62 trap nights	PAT	4/26-6/27/2012	0.5	16.3	0
Laughing Whitefish River	PC	63 trap nights	FN	4/25-6/27/2012	0.5	15.6	0
Middle River	GLIFWC/FWS	120 trap nights	PAT	4/23-5/23/2012	0.5	12.8	0
Miners River	NPS/FWS	102 trap nights	PAT	5/2-6/22/2012	0.5	15.0	0
Misery River *	GLIFWC	118 trap nights	PAT	4/13-6/11/2012	0.5	12.9	2
Nearshore*	USGS	31.48 hours	BT-11.9	6/2012-8/2012	41.0	9.0	2
Offshore*	USGS	15.30 hours	BT-11.9	7/2012-8/2012	182.0	3.8	1
Poplar River	GLIFWC/FWS	30 trap nights	FN	4/23-5/23/2012	0.5-1.0	11.8	0
Red Cliff Creek	RCBLSC	51 trap nights	FN	4/30-6/19/2012	0.5-1.0	18.4	0
Rock River	FWS	114 trap nights	PAT	4/26-6/22/2012	0.5	15.4	0
St. Louis River *	FWS	20 trap nights	FN2	8/2012	1.0	21.5-23.0	34
St. Louis River *	FWS	0.83 hours	BT-4.9	8/2012	1.4-9.3	22.0-24.0	62
St. Louis River	FWS	0.33 hours	EF	8/2012	1.3	22.0-24.4	0
St. Marys River - Upper	FWS/OMNR	14 trap nights	FN2	8/2012	0.9	19.8-23.5	0
St. Marys River - Upper	FWS/OMNR	1.28 hours	BT-4.9	8/2012	1.8-11.3	19.0-21.0	0
St. Marys River - Upper	FWS/OMNR	2.50 hours	EF	8/2012	1.4	17.0-21.3	0
Silver River	GLIFWC	88 trap nights	FN	4/12-7/9/2012	0.5-1.0	15.4	0
Tahquamenon River	FWS	111 trap nights	PAT	5/1-6/7/2012	0.5	18.0	0
Thunder Bay Harbour *	FWS/OMNR	15 trap nights	FN2	8/2012	1.1	16.0-23.0	9
Thunder Bay Harbour *	FWS/OMNR	1.25 hours	BT-4.9	8/2012	2.8-12.5	18.0-20.0	1
Thunder Bay Harbour *	FWS/OMNR	2.59 hours	EF	8/2012	1.3	17.0-22.4	1
Totals		5.31 hours	BT-4.9				807
		5.29 hours	BT-5.5				31
		48.11 hours	BT-11.9				4
		5.42 hours	EF				1
		460 trap nights	FN				0
		49 trap nights	FN2				43
		41,686 meters	GN				42
		941 trap nights	PAT				2
		55 trap nights	PT				0
Total ruffe (captured incidentally)							930

Key to agency:

FWS = U. S. Fish and Wildlife Service.  
 GLIFWC = Great Lakes Indian Fish and Wildlife Commission.  
 NPS = National Park Service.  
 OMNR = Ontario Ministry of Natural Resources.  
 PC = Private contractor.  
 RCBLSC = Red Cliff Band of Lake Superior Chippewa.  
 USGS = U. S. Geological Survey.  
 WDNR = Wisconsin Department of Natural Resources.

Key to gear:

BT-4.9 = Bottom trawl (4.9-m headrope).  
 BT-5.5 = Bottom trawl (5.5-m headrope).  
 BT-11.9 = Bottom trawl (11.9-m headrope).  
 EF = Electrofishing.  
 FN = Fyke net.  
 FN2 = Paired fyke nets (4.7 mm mesh with 15 m lead).  
 GN = Gill net (1097 m, 91 m panels of 38 to 178 mm stretch mesh).  
 PAT = Portable assessment trap.  
 PT = Permanent trap.

Key to symbols:

\* Locations where ruffe were captured.

Key to headings:

Depth = Average water depth (m) or depth range.  
 Temp = Average surface or bottom (B) water temperature (°C) or the temperature range.

**Table 6.** Summary of reported fish sampling conducted in Lake Michigan that was capable of incidentally capturing ruffe during 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
Betsie River	GTBOCI	146 trap nights	PAT	4/10-6/22/2012	0.5-1.0	15.6	0
Big Bay de Noc	MIDNR	3.33 hours	BT-3.7	8/2012, 9/2012	2.4-12.2	-----	0
Big Bay de Noc	MIDNR	4,682 meters	GN-EX	8/2012-9/2012	2.4-12.6	19.5-19.9	0
Big Manistee River	FWS	43 trap nights	PT	4/24-6/6/2012	0.5-1.0	14.7	0
Boardman River	GTBOCI	130 trap nights	PAT	4/10-6/14/2012	0.5	15.3	0
Carp Lake River	FWS	73 trap nights	PT	4/2-6/14/2012	0.8	12.7	0
Deer Creek	PC	124 trap nights	PAT	4/11-6/12/2012	0.5	14.1	0
East Tw in River	PC	40 trap nights	PAT	4/19-5/29/2012	0.5	16.1	0
Elk Lake Outlet	PC	124 trap nights	PAT	4/11-6/12/2012	0.5-1.0	12.7	0
Grand Traverse Bay	ISEA	7.2 hours	BT-4.9	5/2012-6/2012	6.1-14.0	-----	0
Green Bay	WIDNR	51 net nights	FN2	4/2012	1.0-4.0	8.0-11.0	0
Green Bay	WIDNR	52 hauls	SEN	6/2012, 7/2012	0.0-1.0	-----	0
Green Bay	WIDNR	6.42 hours	TRL	8/2012	2.0-25.0	10.0-22.0	0
Hog Island Creek	PC	65 trap nights	FN	4/17-6/21/2012	0.5-1.0	12.3	0
Little Bay de Noc *	MIDNR	3.33 hours	BT-3.7	6/2012-10/2012	2.4-12.2	-----	3
Little Bay de Noc *	MIDNR	4,682 meters	GN-EX	8/2012-9/2012	1.4-13.0	13.2-17.6	4
Little Bay de Noc	ISEA	0.3 hours	BT-4.9	7/2012	8.2-16.8	-----	0
Little Traverse Bay	ISEA	0.2 hours	BT-4.9	8/2012	13.4-47.9	-----	0
Little Manistee River	FWS	84 trap nights	PAT	4/24-6/5/2012	0.5-1.0	13.8	0
Manistique River	FWS	150 trap nights	SPT	4/23-6/12/2012	0.5	16.0	0
Manistique	MIDNR	1.67 hours	BT-3.7	6/2012-10/2012	-----	-----	0
Manistique	MIDNR	1,170 meters	GN-EX	8/2012-9/2012	2.4-9.9	-----	0
Menominee River	FWS	38 trap nights	PAT	4/23-5/31/2012	0.5-1.0	15.7	0
Muskegon River	FWS	84 trap nights	PAT	4/24-6/5/2012	1.0-5.0	14.8	0
Naubinw ay	MIDNR	975 meters	GN-EX	8/2012-9/2012	5.2-10.5	-----	0
Nearshore/Offshore	USGS	8.19 hours	BT-12	9/2012-10/2012	5.0-110.0	4.5-19.9	0
Oconto River	FWS	37 trap nights	PAT	4/24-5/31/2012	0.5-1.0	17.2	0
Ogontz River	PC	66 trap nights	FN	4/17-6/22/2012	0.5-1.0	18.7	0
Peshtigo River	FWS	74 trap nights	PAT	4/24-5/31/2012	0.5-1.0	16.6	0
Petoskey	ISEA	0.2 hours	BT-4.9	8/2012	10.4-10.7	-----	0
St. Joseph River	FWS	186 trap nights	PAT	3/29-5/30/2012	0.5	16.1	0
Suttons Bay	ISEA	10.66 hours	BT-4.9	4/27-10/4/2012	5.8-21.0	-----	0
Trail Creek	FWS	122 trap nights	PT	3/29-5/30/2012	0.5	14.8	0
White River	FWS	84 trap nights	PAT	4/24-6/5/2012	0.5	15.8	0
<b>Totals</b>		8.33 hours	BT-3.7				3
		18.56 hours	BT-4.9				0
		8.19 hours	BT-12				0
		131 trap nights	FN				0
		51 net nights	FN2				0
		11,509 meters	GN-EX				4
		1,151 trap nights	PAT				0
		238 trap nights	PT				0
		52 hauls	SEN				0
		150 trap nights	SPT				0
		18.6 hours	TRL				0
<b>Total ruffe (captured incidentally)</b>							<b>7</b>

Key to agency:

FWS = U. S. Fish and Wildlife Service.  
 GTBOCI = Grand Traverse Band of Ottawa and Chippewa Indians.  
 ISEA = Inland Seas Education Association.  
 MIDNR = Michigan Department of Natural Resources.  
 PC = Private contractor.  
 USGS = U. S. Geological Survey.  
 WIDNR = Wisconsin Department of Natural Resources.

Key to symbols:

\* Locations where ruffe were captured.

Key to headings:

Depth = Average water depth (m) or depth range.  
 Temp = Average bottom water temperature (°C) or temperature range.

Key to gear:

BT-3.7 = Bottom trawl (3.7-m headrope).  
 BT-4.9 = Bottom trawl (4.9-m headrope)  
 BT-12 = Bottom trawl (12-m headrope).  
 FN = Fyke net.  
 FN2 = Fyke net.  
 GN-EX = Gill net (experimental 25-127 mm stretch mesh panels).  
 PAT = Portable assessment trap.  
 PT = Permanent trap.  
 SEN = Beach seine (15.2-m seine).  
 SPT = Semipermanent trap.  
 TRL = Trawl.

**Table 7.** Summary of reported fish sampling conducted in Lake Huron that was capable of incidentally capturing ruffe during 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
Albany Creek	FWS	35 trap nights	PAT	5/2-6/6/2012	0.5	15.5	0
Au Sable River	PC	134 trap nights	PAT	4/8-6/14/2012	0.5-1.0	13.8	0
Carp River	FWS	70 trap nights	FN	5/2-6/6/2012	0.5-1.0	17.1	0
Cheboygan River *	FWS	68 trap nights	PT	4/2-6/9/2012	1.0	14.4	1
Devils River	PC	66 trap nights	FN	4/11-6/16/2012	0.5-1.0	15.8	0
East Au Gres River	PC	67 trap nights	PAT	4/8-6/14/2012	0.5-1.0	14.6	0
Greene Creek	FWS	54 trap nights	PAT	4/2-5/26/2012	0.5	12.8	0
Nearshore	CMU	129 hauls	SEN	5-6/2012, 7-8/2012	1.0	20.0-24.0	0
Nearshore	CMU	23 net nights	FN2	9/2012	1.0	20.0-24.0	0
Nearshore	CMU	25 sets	MT	9/2012	1.0	20.0-24.0	0
Nearshore/Offshore	USGS	6.83 hours	BT-21	10/2012, 11/2012	9.0-110.0	4.0-9.0	0
Ocqueoc River	FWS	148 trap nights	PT	4/2-6/15/2012	0.4	15.9	0
Les Cheneaux Island area	MIDNR	183 meters	GN1	9/24, 9/26/2012	2.0-8.0	12.0-14.0	0
St. Marys River	FWS	204 trap nights	PAT	5/22-7/12/2012	0.5-1.0	14.8	0
St. Marys River	SMRFTG	23.08 hours	EF	9/2012-10/2012	0.6-2.0	16.7	0
Saginaw Bay	MIDNR	3.50 hours	BT-10	9/2012	4.0-10.0	15.7-21.4	0
Saginaw Bay	MIDNR	488 meters	GN1	9/2012	3.0-8.0	19.0-23.0	0
Thunder Bay	MIDNR	2.33 hours	BT-5.3	7/2012, 8/2012	3.3-8.8	20.0-24.0 S	0
Thunder Bay	MIDNR	3.67 hours	BT-11	7/2012, 8/2012	15.0-39.0	20.0-24.0 S	0
Thunder Bay	MIDNR	1399 meters	GN2	6/2012, 7/2012, 8/2012	2.0-30.0	19.0-25.0	0
Thunder Bay	MIDNR	1750 meters	GN3	6/2012, 7/2012, 8/2012	2.0-6.0	19.0-25.0	0
Thunder Bay	MIDNR	60 sets	MT	8/2012	4.0-5.0	25.0	0
Thunder Bay	MIDNR	88 trap nights	TN	6/2012-10/2012	2.0	10.0-25.0	0
Thunder Bay	MIDNR/FWS	4.04 hours	EF	6/2012-8/2012	1.0-2.0	15.0-21.0	0
Tittabawassee River	PC	65 trap nights	SPT	4/9-6/13/2012	1.0	17.7	0
Trout Creek	FWS	35 trap nights	FN	5/2-6/6/2012	0.5-1.0	16.2	0
Trout River	FWS	55 trap nights	SPT	4/2-5/27/2012	0.2	14.1	0
<b>Totals</b>							<b>0</b>
		3.50 hours	BT-10				0
		3.67 hours	BT-11				0
		6.83 hours	BT-21				0
		27.12 hours	EF				0
		171 trapnights	FN				0
		23 netnights	FN2				0
		671 meters	GN1				0
		1399 meters	GN2				0
		1750 meters	GN3				0
		85 sets	MT				0
		494 trap nights	PAT				0
		216 trap nights	PT				1
		129 hauls	SEN				0
		120 trap nights	SPT				0
		88 trap nights	TN				0
<b>Total ruffe (captured incidentally)</b>							<b>1</b>

Key to agency:

CMU = Central Michigan University.  
 FWS = U. S. Fish and Wildlife Service.  
 MIDNR = Michigan Department of Natural Resources.  
 PC = Private contractor.  
 SMRFTG = St. Marys River Fisheries Task Group.  
 USGS = U. S. Geological Survey.

Key to gear:

BT-5.3 = Bottom trawl (5.3-m headrope).  
 BT-10 = Bottom trawl (10-m headrope).  
 BT-11 = Bottom trawl (11-m headrope).  
 BT-21 = Wing trawl (21-m headrope).  
 EF = Electrofishing.  
 FN = Fyke net.  
 FN2 = Fyke net (modified fyke net).  
 GN1 = Gill net (graded mesh included 30.48 m panel of 38.1 mm mesh).  
 GN2 = Gill net (micromesh, 11.0 m panels of 12.7, 15.9, and 19.1 mm stretch mesh).  
 GN3 = Gill net (38 mm stretch mesh).  
 MT = Minnow trap (baited).  
 PAT = Portable assessment trap.  
 PT = Permanent trap.  
 SEN = Seine (45.7-m length).  
 SPT = Semipermanent trap.  
 TN = Trap net (38.1 mm stretch mesh).

Key to symbols:

\* Locations where ruffe were captured.

Key to headings:

Depth = Average water depth (m) or depth range.  
 Temp = Average bottom water temperature (°C) or temperature range. Surface temperature is denoted with "S".

**Table 8.** Summary of reported fish sampling conducted in Lake Erie that was capable of incidentally capturing ruffe in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
Cattaraugus Creek	PC	118 trap nights	PAT	4/29-6/22/2012	0.5	15.8	0
Central Basin	ODNR	26.90 hours	BT-10.4	4/2012-10/2012	6.1-21.0	9.0-23.9	0
Central Basin	ODNR	4,550 meters	GN1	9/2012-11/2012	9.8-14.9	10.1-15.8	0
Grand River	PC	118 trap nights	PAT	4/9-6/7/2012	0.5	14.6	0
HEC-Detroit River	FWS	1.55 hours	BT-4.9	9/2012	4.8-10.1	-----	0
HEC-Detroit River	FWS	455 meters	GN2	10/2012	5.5-9.5	-----	0
HEC-Detroit River	FWS	187 lifts	MT	4/2012, 5/2012, 7/2012	5.9-12.3	-----	0
HEC-Lake St. Clair	MIDNR	5.95 hours	BT-5	4/2012, 8/2012	1.0-2.0	6.4-23.4	0
HEC-Lake St. Clair	MIDNR	1.42 hours	BT-10	5/2012, 9/2012	3.0-4.0	15.3-23.6	0
HEC-Lake St. Clair	MIDNR	56 trap nights	TN	4/2012, 5/2012	3.0-4.0	9.0-16.0	0
HEC-St. Clair & Detroit Rivers	USGS	1,136 tow s	NET	3/2012-6/2012	-----	-----	0
HEC-St. Clair River	FWS	1.78 hours	BT-4.9	10/2012	7.0-18.7	-----	0
HEC-St. Clair River	FWS	2,002 meters	GN2	10/2012	7.1-19.2	-----	0
Huron River	PC	90 trap nights	PAT	4/20-6/4/2012	0.5	17.3	0
Nearshore/Offshore	USGS	25.41 hours	BT-7.9	5/2012-6/2012, 8/2012-10/2012	3.0-35.1	5.4-24.1	0
Spooner Creek	PC	59 trap nights	PAT	4/29-6/22/2012	0.5	13.7	0
Western Basin	ODNR	22.00 hours	BT-10.7	5/2012-9/2012	1.2-12.8	14.8-26.8 B	0
Western Basin	FWS	1.12 hours	BT-4.9	9/2012, 10/2012	2.9-7.0	-----	0
Totals		4.45 hours	BT-4.9				0
		5.95 hours	BT-5				0
		25.41 hours	BT-7.9				0
		1.42 hours	BT-10				0
		26.90 hours	BT-10.4				0
		22.00 hours	BT-10.7				0
		4,550 meters	GN1				0
		2,457 meters	GN2				0
		187 lifts	MT				0
		1,136 tow s	NET				0
		385 trap nights	PAT				0
		56 trap nights	TN				0
		Total ruffe (captured incidentally)					0

Key to location:

HEC = Huron-Erie Corridor.

Key to agency:

FWS = U. S. Fish and Wildlife Service.

MIDNR = Michigan Department of Natural Resources.

ODNR = Ohio Department of Natural Resources.

PC = Private contractor.

USGS = U. S. Geological Survey.

Key to column headings:

Depth = Average water depth (m) or depth range.

Temp = Average surface water temperature (°C) or temperature range. Bottom temperature is denoted with "B".

Key to gear:

BT-4.9 = Bottom trawl (4.9-m headrope).

BT-5 = Bottom trawl (5.0-m headrope).

BT-7.9 = Bottom trawl (7.9-m headrope).

BT-10 = Bottom trawl (10.0-m headrope).

BT-10.4 = Bottom trawl (10.4-m headrope).

BT-10.7 = Bottom trawl (10.7-m headrope).

GN1 = Gill net (182 m = 12 panels of 32-127 mm stretch mesh).

GN2 = Gill net (91 m = 15 m panels with 25, 38, and 51 mm stretch mesh).

MT = Minnow trap (baited).

NET = bongo net.

PAT = Portable assessment trap.

TN = Small mesh trap net.

**Table 9.** Summary of reported fish sampling conducted in Lake Ontario that was capable of incidentally capturing ruffe in 2012.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>	
Bay of Quinte	DFO	8.58 hours	EF	5/2012	1.5	9.6-16.8	0	
Black River	PC	189 trap nights	PAT	4/5-6/7/2012	0.5	15.0	0	
Grindstone Creek	PC	61 trap nights	PAT	4/1-6/1/2012	0.5	17.8	0	
Little Salmon River	PC	61 trap nights	PAT	4/1-6/1/2012	0.5	17.1	0	
Nearshore/Offshore	USGS/NYDEC	56.40 hours	BT-18	4/2012-7/2012, 10/2012	8.0-180.0	-----	0	
Sterling Creek	PC	61 trap nights	PAT	4/1-6/1/2012	0.5-1.0	17.2	0	
Sterling Valley Creek	PC	61 trap nights	PAT	4/1-6/1/2012	0.5	15.4	0	
Totals		56.40 hours	BT-18				0	
		8.58 hours	EF				0	
		433 trap nights	PAT				0	
		Total ruffe (captured incidentally)						0

Key to agency:

DFO = Department of Fisheries and Oceans.

PC = Private contractor.

USGS = U. S. Geological Survey.

NYDEC = New York Department of Environmental Conservation.

Key to gear:

BT-18 = Bottom trawl (18.0-m headrope).

EF = Electrofishing.

PAT = Portable assessment trap.

Key to column headings:

Depth = Average water depth (m) or depth range.

Temp = Average surface water temperature (°C) or temperature range.