

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2011

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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through 2004; the U.S. Geological Survey (USGS) terminated bottom trawl assessments in the SLRE after 2004 (USGS, unpublished information).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; Czypinski 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was analyzed and found to be weakly significant for all three tributaries combined (D. H. Ogle, Northland College, unpublished data).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 and expansion outside the SLRE and speculation about potential impacts on native fish populations, the Aquatic Nuisance Species Task Force declared the ruffe to be a "nuisance species" in the spring of 1992. By authority of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, this designation authorized the formation of a control committee charged with the

responsibility of designing and implementing a control plan. The *Ruffe Control Plan* was drafted in 1995 with a revision in 1996 after ruffe were discovered in Lake Huron in 1995 (Kindt et al., 1996). The goal of the *Ruffe Control Plan* 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 the gear used is capable of capturing ruffe. 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 U.S. Fish and Wildlife Service - Lower Great Lakes Fish and Wildlife Conservation Office (USFWS-LGLFWCO) 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 U.S. Fish and Wildlife Service - 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-LGLFWCO 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 (No./Hr. bottom trawling) more than doubled from 5 in 1999 to 11. **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 (No./Hr. bottom trawling) of that colony more than 7 fold to 78. However, no ruffe were captured east of the Ontonagon River along the south shore of Lake Superior. Using a 38 mm stretch mesh gill net (15 m panel), the Red Cliff Tribal Fisheries Department in cooperation with 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 (MIDNR) 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 captured no ruffe in other fish sampling from BBDN, where they were first detected in 2004. However, MIDNR 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 (4.75 inches) 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 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 entire 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 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 entire south shore of the lake 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 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 U.S. Fish and Wildlife Service – 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 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 entire south shore of Lake Superior 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 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 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 entire south shore of the lake 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 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 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 entire south shore of the lake 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 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 continued to capture ruffe (2 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

The following report summarizes dedicated ruffe surveillance conducted in 2011. 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 and Whitefish Bay. In Lake Michigan the peripheral locations include LBDN and BBDN of Green Bay. In Lake Huron the peripheral locations include the Thunder Bay River and shipping lanes, and the Trout River in Rogers City, 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-LGLFWCO 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 2011 (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 conducted by the USFWS-Ashland FWCO were halted in Lake Superior following 2007 because the range extends to the full extent of U.S. waters of the lake.

LAKE HURON

Dedicated ruffe surveillance was conducted at nine locations in U.S. waters of Lake Huron.

The USFWS-Alpena FWCO used a 4.9-m bottom trawl to collect fish at nine locations in U.S. waters of Lake Huron during September (Figure 2 and Table 1). Sampling locations included the following: Au Gres River mouth, Cheboygan River mouth, Harbor Beach DTE port, National Gypsum port, Port Dolomite, Saginaw River mouth, Thunder Bay River mouth, and Thunder Bay shipping channel. One new location,

Calcite port in Rogers City, was included because ruffe were captured from the Trout River by the USFWS-MBS. Efforts targeted deep water areas within shipping channels and river mouths. A total of 54 tows were completed in September, comprising 4.50 hours of effort. Twenty-seven taxa were collected. The majority of the catch consisted of round gobies (28.0%) followed by yellow perch (20.0%) and mimic shiners (11.9%). The greatest catch (30 fish/minute) was experienced at the Saginaw River mouth. The greatest diversity of species (17 species) was represented at the Au Gres River. Rainbow smelt was the most ubiquitous species and were captured at six of the nine 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 with small mesh trap nets and gill nets in the vicinity where ruffe have been captured in the past. Sampling locations included the Thunder Bay River in Alpena and the Trout and Swan Rivers in Rogers City (Figure 2 and Table 1). Sampling in the Thunder Bay River consisted of eight overnight sets for 244 m effort with gill nets during April, and four trap nights effort with trap nets in September. Sampling in the Trout and Swan Rivers consisted of three trap nights effort each during September. No ruffe were captured.

ST. MARYS RIVER

Dedicated ruffe surveillance was conducted at six locations in U.S. waters of the 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 36 tows comprising 3.00 hours effort were conducted. Nineteen taxa were collected. The majority of the total catch consisted of mimic shiners (51.2%) followed by emerald shiners (23.4%). The greatest catch (87 fish/minute) was experienced at the Sault Ste. Marie Municipal Marina. The greatest diversity of species (14 species) was represented at the Munuscong Channel. Emerald shiner was the most ubiquitous species and was captured at five of the 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

Dedicated ruffe surveillance was conducted in U.S. waters of Lake Erie at seven locations.

The USFWS-LGLFWCO used a 4.9-m bottom trawl to collect fish from each of seven sites on Lake Erie, including Ashtabula, Buffalo, Cleveland, Conneaut, Erie, Sandusky, and Toledo (Figure 3 and Table 3). All sites were sampled once in spring (May/June) and again in the fall (September). The spring catch was composed of 10 species. The species composition was predominately emerald shiners (55.0%) with channel catfish (11.9%) and white perch (10.1%) being the next most dominant species. The fall survey was comprised of 11 species, the most abundant being emerald shiners (92.2%). No ruffe were captured. A summary of all fish species captured at all these locations is available upon request from the USFWS-LGLFWCO.

LAKE ONTARIO

Dedicated ruffe surveillance was conducted at one location in U.S. waters of Lake Ontario.

The USFWS-LGLFWCO used a 4.9-m bottom trawl to collect fish along the south shore of Lake Ontario at Rochester Harbor in the Genesee River near the mouth at Lake Ontario (Figure 3 and Table 4). These transects were located in areas where there was a dredged shipping channel, no more than 3km upstream from the lake. Sampling was conducted during both spring (June) and fall (September). The spring catch was composed of 5 species including channel catfish (60.0%) and freshwater drum (20.0%). The fall survey was comprised of three species, the most abundant being emerald shiners (80.0%) with round goby and rainbow smelt having the next highest abundances (10.0% each). A summary of all fish species captured is available upon request from the USFWS-LGLFWCO.

REPORTED FISH SAMPLING THAT WAS CAPABLE OF INCIDENTALLY CAPTURING RUFFE

Several organizations reported fish sampling that was capable of capturing ruffe incidentally during 2011. Information was provided for each of the Great Lakes, including the connecting waters of the St. Marys River.

LAKE SUPERIOR

Several organizations including the USFWS-MBS, USGS-LSBS, OMNR-UGLMU and USFWS-Ashland FWCO 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 143 ruffe (Thunder Bay Harbour, Duluth Harbor, Misery River, within the Apostle Islands, Chequamegon Bay, and in/near Whitefish Bay) – all within the current ruffe range. No ruffe were reportedly captured outside of the ruffe range.

Thunder Bay Harbour The OMNR-UGLMU and USFWS-Ashland FWCO conducted sampling in Thunder Bay Harbour to detect presence and relative abundance of new nonindigenous invasive fish. Sampling consisted of 15 paired fyke net trapnights (paired fyke nets consist of one lead with a fyke net at each end), 1.32 hours bottom trawling (4.9-m headrope), and 5.90 hours electrofishing (Figure 4 and Table 5). A total of 54 ruffe were captured in fyke nets near McKellar Island. One ruffe was captured trawling at Mission Bay. Thirty ruffe were captured electrofishing from the Kaministiquia River south of the confluence of Mission River and near the west end of Mission and McKellar Islands, along the southeast corner of McKellar Island, and north of Whiskeyjack Point.

The OMNR-UGLMU also captured ruffe in the lead of a trapnet fished in the spring during a walleye assessment at the mouth of the Current River.

Nearshore and Offshore The USGS-LSBS conducted bottom trawling (11.9-m headrope, 4.9-m headrope) across-contour and on-contour for various studies in U.S. and Canadian waters around the lake. Transects included nearshore sampling at 166 locations for a total of 56.37 hours of effort and offshore sampling at 51 locations for a total of 18.01 hours of effort (Figure 5 and Table 5). Transects were within, near the periphery and outside of the detected ruffe range. A total of 48 ruffe were captured during April to July within the detected ruffe range in Lake Superior from near the Duluth Harbor, within the Apostle

Islands, Chequamegon Bay, Keweenaw Bay, and Whitefish Bay. This was the first time ruffe were captured the eastern portion of Lake Superior within the detected range. No ruffe were captured outside of the detected range.

Isle Royale The USFWS-Ashland FWCO, in cooperation with the National Park Service (NPS), conducted coaster brook trout assessments at two locations around Isle Royale (Tobin Harbor and Washington Harbor) that included a total of 7.84 hours electrofishing and 4 fyke net trapnights (Figure 4 and Table 5). No ruffe were captured or observed.

South Shore Tributaries The USFWS-MBS worked with the Great Lakes Indian Fish & 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 and May to June and July using fyke nets (FN), permanent traps (PT) and portable assessment traps (PAT). Ten ruffe were captured following a total of 1,488 trapnights. All 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), Michigan Department of Natural Resources – Marquette Fisheries Research Station (MIDNR-Marquette), USFWS-MBS and Ludington Biological Station (USFWS-MBS/LBS) 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 two ruffe were captured. Ruffe were not reported from outside of the known range.

Nearshore/Offshore 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 that were outside or near the periphery of the detected ruffe range (Green Bay) (Figure 6 and Table 6). Ten minute trawl tows were conducted at 5 to 110 m depths for a total of 69 tows. No ruffe were captured following 10.95 hours of sampling.

Grand Traverse Bay and Little/Big Bays de Noc The ISEA is a non-profit environmental education organization. Scientific sampling aboard their vessel is conducted by ISEA staff, volunteer instructors, and students (mostly grades 5-7). The ISEA completed 23.37 hours bottom trawling (4.9-m headrope) in Grand Traverse Bay and Little/Big Bays de Noc (Figure 4 and Table 6). Little and Big Bays de Noc are within or on the periphery of the current ruffe range in Lake Michigan (Green Bay). No ruffe were captured.

Little Bay de Noc (LBDN) of Northern Green Bay Since 1988, the MIDNR-Marquette has 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 3.33 hours trawling effort (20 tows) was conducted at LBDN and one ruffe was captured within the detected range (Figure 4 and Table 6).

Since 2009, the MIDNR-Marquette has 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 gillnets (25 mm to 127 mm stretch mesh). A total of 4,682 m effort (48 net lifts) was conducted at LBDN (Figure 7 and Table 6). One ruffe was captured within the detected range.

Big Bay de Noc (BBDN) of Northern Green Bay The MIDNR-Marquette conducted summer assessments in BBDN that were similar to those conducted in LBDN (described above) using bottom trawls. A total of 4.17 hours trawling effort (25 tows) was conducted at BBDN (Figure 4 and Table 6). No ruffe were captured.

The MIDNR-Marquette 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 4,682 m effort (48 net lifts) was conducted at BBDN (Figure 7 and Table 6). No ruffe were captured.

Northern Lake Michigan The MIDNR-Marquette also conducted summer bottom trawling and fall gillnetting (described above) at the Cedar River and Menominee River (Figure 4 and Table 6). No ruffe were captured following 2.17 hours trawling (13 tows) and 1,170 meters gillnetting (12 lifts) at Cedar River and 3.17 hours trawling (19 tows) and 1,170 meters gillnetting (12 lifts) at Menominee River.

Tributaries The USFWS-MBS/LBS worked with the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI) and private contractors to conduct sampling in 15 Lake Michigan tributaries to assess sea lamprey abundance (Figure 4 and Table 6). Sampling was conducted from April and May to June and July 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 1,267 trapnights. 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), USFWS-Alpena FWCO and USFWS-MBS (Figures 4 and 8, and Table 7). Locations across the river were sampled. No ruffe were captured.

Waiska Bay to Soo Locks The OMNR-UGLMU and USFWS-Ashland FWCO conducted sampling in U.S. and Canadian waters of the upper St. Marys River during August to detect presence and relative abundance of new nonindigenous invasive fish. Sampling consisted of 15 paired fyke net trapnights (paired fyke nets consist of one lead with a fyke net at each end), 1.20 hours bottom trawling (4.9-m headrope), and 2.33 hours electrofishing (Figure 4 and Table 7). No ruffe or other nonindigenous fish 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 Michigan Department of

Natural Resources-Northern Lake Huron Management Unit (MIDNR-NLHMU), Michigan Department of Natural Resources – 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 to assess juvenile walleye at seven locations (23 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 24.55 hours of effort (Figure 4 and Table 7).

In August, the USFWS-Alpena FWCO conducted bottom trawling (4.9-m headrope) at 18 locations across the St. Marys River to document juvenile and prey fishes in partnership with the SMRFTG. This was the second of a two year study (2010-2011). Five minute tows were conducted on-contour at water depths of 1.5-3.0 m, 3.0-4.6 m, 4.6-6.1 m and 6.1-7.6 m at each location, where depths were available. No ruffe were captured following 60 tows for 5.00 hours of sampling effort (Figure 8 and Table 7).

The USFWS-MBS conducted sampling in the St. Marys River to assess sea lamprey abundance (Figure 4 and Table 7). Sampling was conducted from June to July using portable assessment traps (PAT). No ruffe were captured following a total of 201 trapnights. 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, ISEA, MIDNR-Alpena, Michigan Department of Natural Resources – Lake St. Clair Fisheries Research Station (MIDNR-Lk. St. Clair) and USFWS-MBS/LBS (Figures 4 and 9, and Table 7). All agencies, except MIDNR-Lk. St. Clair, conducted efforts near Thunder Bay and Rogers City, the periphery of the ruffe range in Lake Huron.

The USFWS-MBS reported that one ruffe was incidentally captured during sea lamprey trapping in the Cheboygan River in Cheboygan, Michigan. The trap was located at the base of the dam on the Cheboygan River approximately 1.5 km upstream from the river mouth. The ruffe was captured on May 13, 2011. This is a range expansion of 60 km from the last known sighting on the periphery of the range in Lake Huron (Trout River in Rogers City, Michigan). No other ruffe were reportedly captured from Lake Huron or the Lake Huron watershed.

Nearshore/Offshore 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 43 tows comprising 7.17 hours of sampling (Figure 9 and Table 7).

St. Ignace The ISEA conducted similar sampling to that completed in Lake Michigan. No ruffe were captured following 0.50 hours bottom trawling (4.9-m headrope) near St. Ignace (Figure 4 and Table 7).

Thunder Bay and Black River The MIDNR-Alpena conducted summer bottom trawling (11-m headrope, semi-balloon otter trawl with 23-m bridle, and 13 mm stretch mesh cod end) off North Point of Thunder Bay and off Black River to assess young of the year lake trout and juvenile lake whitefish. The survey is also used to index the prey/juvenile fish community of Thunder Bay as cormorant control progresses. Both areas are periphery to locations where ruffe have been collected within the lake (Thunder Bay). No ruffe were captured following a total of 41 tows comprising 6.84 hours of effort (Figure 4 and Table 7).

Saginaw Bay The MIDNR-Lk. St. Clair conducted fall (September) bottom trawling (10-m headrope) in Saginaw Bay as part of an annual survey to assess the fish community. No ruffe were captured following a total of 27 tows comprising 4.08 hours of effort (Figure 4 and Table 7).

The MIDNR-Alpena conducted graded mesh gillnetting at the inner and outer portions of Saginaw Bay during September to assess the fish community. Each net included a 30.48 m (100 ft) panel of 38.1 mm (1 ½”) mesh to which ruffe would be vulnerable. No ruffe were captured following 16 net sets for 488 m (1600 ft) of sampling effort.

U.S. Tributaries The USFWS-MBS/LBS worked with private contractors to conduct sampling in 11 Lake Huron tributaries to assess sea lamprey abundance (Figure 4 and Table 7). Sampling was conducted from April and May to June and July at the majority of sampling locations using fyke nets (FN), permanent traps (PT), portable assessment traps (PAT) and semi-permanent traps (SPT). One ruffe was captured following a total of 860 trapnights.

The ruffe was captured incidentally during trapping upstream in the Cheboygan River in Cheboygan, Michigan during May. This is a new location where ruffe have not previously been captured and is 60 km north of the Trout River in Rogers City where ruffe were sighted in 2008 and 140 km north of the Thunder Bay River in Alpena where ruffe were first captured in 1995. 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 13, 2011. The water depth at the trap location was 0.5 m and the water temperature was 11.0°C on the day of the catch. No other ruffe have been reported from this trap or other trap locations in tributaries in U.S. waters of Lake Huron. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

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 10 and Table 8).

St. Clair River The USFWS-Alpena FWCO conducted bottom trawling (6.1-m headrope, 38.1 mm mesh body and 31.7 mm mesh cod) at 58 locations in the North and Middle Channels during September and October to document young-of-year and juvenile lake sturgeon. No ruffe were captured following 58 tows for a total of 5.47 hours of sampling effort (Figure 10 and Table 8).

Lake St. Clair The MIDNR-Lake St. Clair conducted bottom trawling (10-m headrope and 5-m headrope) at 7 locations as part of an annual survey to assess the fish community. A total of 28 tows for 3.77 hours of

sampling effort was conducted during May, September and October with the 10-m trawl, and 35 tows for 5.37 hours of sampling effort was conducted during August with the 5-m trawl (Figure 10 and Table 8). No ruffe were captured.

Detroit River The USFWS-Alpena FWCO conducted bottom trawling (6.1-m headrope, 38.1 mm mesh body and 31.7 mm mesh cod) at 14 locations east of Fighting Island during August and September to document young-of-year and juvenile lake sturgeon. No ruffe were captured following 43 tows for a total of 3.50 hours of sampling effort (Figure 10 and Table 8).

Corridor wide (excluding Lake St. Clair) The USGS-GLSC used bongo nets, light traps, and minnow traps to sample the St. Clair and Detroit Rivers from March to August (Figure 10 and Table 8). No ruffe were captured following approximately 3500 net/trap lifts.

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) and Ohio Department of Natural Resources- Fairport Harbor Fisheries Research Unit (ODNR-Fairport Harbor) reported other fish sampling that was capable of capturing ruffe incidentally (Figures 10, 11 and 12, and Table 8). No ruffe were captured.

South Shore Tributaries The USFWS-MBS/LBS worked with private contractors to conduct sampling in three Lake Erie tributaries to assess sea lamprey abundance (Figure 10 and Table 8). Sampling was conducted from April to June using portable assessment traps (PAT). No ruffe were captured following a total of 364 trapnights. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Western Basin The ODNR-Sandusky 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 11 and Table 8). Ten minute tows were conducted at water depths ranging from 1.2 to 12.8 m. A total of 135 trawl tows for 22.50 hours of effort were conducted. No ruffe were captured.

The USGS-LEBS conducted annual spring and fall (June and September) bottom trawling (7.9-m headrope) in nearshore and offshore areas to assess the status of fish stocks in the western basin of Lake Erie (Figure 12 and Table 8). Ten minute trawl tows were conducted at 3.7 to 11.0 m depths at a total of 25 locations in Ontario and Michigan waters of western Lake Erie. No ruffe were captured following 8.33 hours of sampling.

The USGS-LEBS also conducted fall (October) bottom trawling (7.9-m headrope) in nearshore areas of the western basin of Lake Erie (Table 8). Ten minute trawl tows were conducted at 3.0 to 6.0 m depths at three locations in Ohio waters of western Lake Erie. Each location was sampled twice during daylight and twice during darkness for two days. No ruffe were captured following 4.00 hours of sampling.

Central Basin The ODNR-Fairport Harbor conducted bottom trawling (10.4-m headrope 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 11 and Table 8). Five minute tows (at < 5 m depths) and ten minute tows were conducted at water depth strata ranging from 5-10 m, 10-15 m, 15-20 m, and > 20 m. Six locations were sampled. A total of 253 trawl tows for 35.00 hours of effort was conducted. No ruffe were captured.

The ODNR-Fairport Harbor 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 (Figure 11 and Table 8). Sampling gear consisted of 182-m monofilament gillnets comprised of 12 panels of 32 mm to 127 mm stretch mesh fished on the bottom. Eight locations were sampled and total of 22 overnight sets were completed. No ruffe were captured.

The USGS-LEBS conducted summer and fall (August and September) bottom trawling (7.9-m headrope) in offshore areas to assess the status of fish stocks in central Lake Erie (Table 8). Ten minute trawl tows were conducted at 13.5 to 23.1 m depths at a total of 45 locations in Ohio waters of central Lake Erie. No ruffe were captured following 7.5 hours of sampling.

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 10 and 13 and Table 9). No ruffe were captured.

South Shore Tributaries The USFWS-MBS/LBS worked with private contractors to conduct sampling in five Lake Ontario tributaries to assess sea lamprey abundance (Figure 10 and Table 9). Sampling was conducted from April to June using portable assessment traps (PAT). No ruffe were captured following a total of 478 trapnights. A summary of fish species captured at these locations is available upon request from USFWS-MBS.

U.S. Waters Nearshore/Offshore The USGS-LOBS conducted annual bottom trawling (18.0-m headrope) in U.S. waters to assess the status of major prey-fish stocks and juvenile lake trout (Figure 13 and Table 9). Twelve to fourteen locations 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). Ten minute trawl tows were completed at 10 m intervals for depths ranging from 8 to 150 m at each location. No ruffe were captured following 54.80 hours of effort.

Bay of Quinte The DFO-GLLFAS conducted boat electrofishing in the Bay of Quinte area and the upper St. Lawrence River to assess for American eel (Figure 10 and Table 9). Sampling was conducted in the spring (May) and fall (September). Four locations within the Bay of Quinte were sampled (26 transects per location in the spring and 28 transects per location in the fall) and three locations within the upper St. Lawrence River were sampled (30 transects per location in the spring and 21 transects per location in the fall). Each transect was fished for 5 minutes. No ruffe were captured following a total of 17.92 hours of effort in the Bay of Quinte and 10.12 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 2011.

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 and Michigan based on reports. However, ruffe were captured from a new location on the periphery of the range within Lake Huron in 2011 – expanding the range of ruffe with Lake Huron. 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, and FWS-Ashland FWCO in 2011 indicated that ruffe continued to persist in areas where they were previously established. Ruffe were reported from western Lake Superior from Thunder Bay Harbour, Ontario to Whitefish Bay, Michigan. No range expansion was detected based on incidental reports. However, the USGS-LSBS captured ruffe for the first time in Whitefish Bay along the eastern boundary of the ruffe range.

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 2011. 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 2011 and expansion out of Green Bay was not detected based on reports from other agencies/offices.

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 (one ruffe was captured per gear type). Ruffe also continued to be absent from the catch in BBDN. The MIDNR has not captured ruffe from BBDN since the initial discovery of one ruffe in the fall of 2004. MIDNR incidental catch numbers for ruffe from LBDN for the time period 2002 thru 2011 have totaled 3, 4, 3, 22, 40, 13, 5, 2, 10, and 2 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 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 ruffe were not captured from the Trout River in Rogers City where they were discovered by USFWS-MBS in 2008. Despite the lack of sightings from known locations, a new ruffe sighting was reported by USFWS-MBS from the Cheboygan River in northwestern Lake Huron. The sighting is 60 km north of the Trout River and 140 km north of the Thunder Bay River. No other ruffe were reportedly captured from Lake Huron during 2011 based on other fish sampling that was capable of incidentally capturing ruffe.

Cheboygan River, Michigan The USFWS-MBS reported a new ruffe sighting in May 2011. One ruffe was captured from a sea lamprey assessment trap fished upstream on the Cheboygan River in Cheboygan, Michigan. The trap is operated in the spring each year (April or May to June). This is the second new sighting of ruffe reported from sea lamprey traps operated on Lake Huron tributaries. The origin of the ruffe from these new sightings is unknown. One may speculate they may have migrated north from Thunder Bay, the only location where ruffe were known to exist in Lake Huron, or they may have been introduced via ship ballast water. Ruffe are thought to have moved across portions of the south shore of Lake Superior via migration, and ship ballast water transfer is suspected to have transferred ruffe into the Great Lakes.

Annual ruffe surveillance 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 will be conducted in the Cheboygan area in 2012.

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. Additional sampling targeting ruffe was conducted in the Rogers City area in fall 2011 by the USFWS-Alpena FWCO at the Trout and Swan Rivers and at the Calcite Port, 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 2011, 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 and fall. 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 and netting efforts through 2011 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): Ruffe were captured in May 2011 near the dam in Cheboygan.

Trout River (Rogers City, Michigan): Ruffe were captured once in 2008 and have not been captured from this location since then.

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 & Streams</u>
Undetected.	Unconfirmed.	Undetected.	Undetected.

ACKNOWLEDGMENTS

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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 and staff members who assisted with ruffe surveillance or data analysis.

Jim Boase (USFWS-Alpena FWCO)	Chris Olds (USFWS-Alpena FWCO)
Michelle Casto-Yerty (USFWS-LGLFWCO)	Scott Sanders (USFWS-LGLFWCO)
Denise Clay (USFWS-LGLFWCO)	Eric Snyder (USFWS-LGLFWCO)
Dimitry Gorsky (USFWS-LGLFWCO)	Betsy Trometer (USFWS-LGLFWCO)
Adam Kowalski (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.

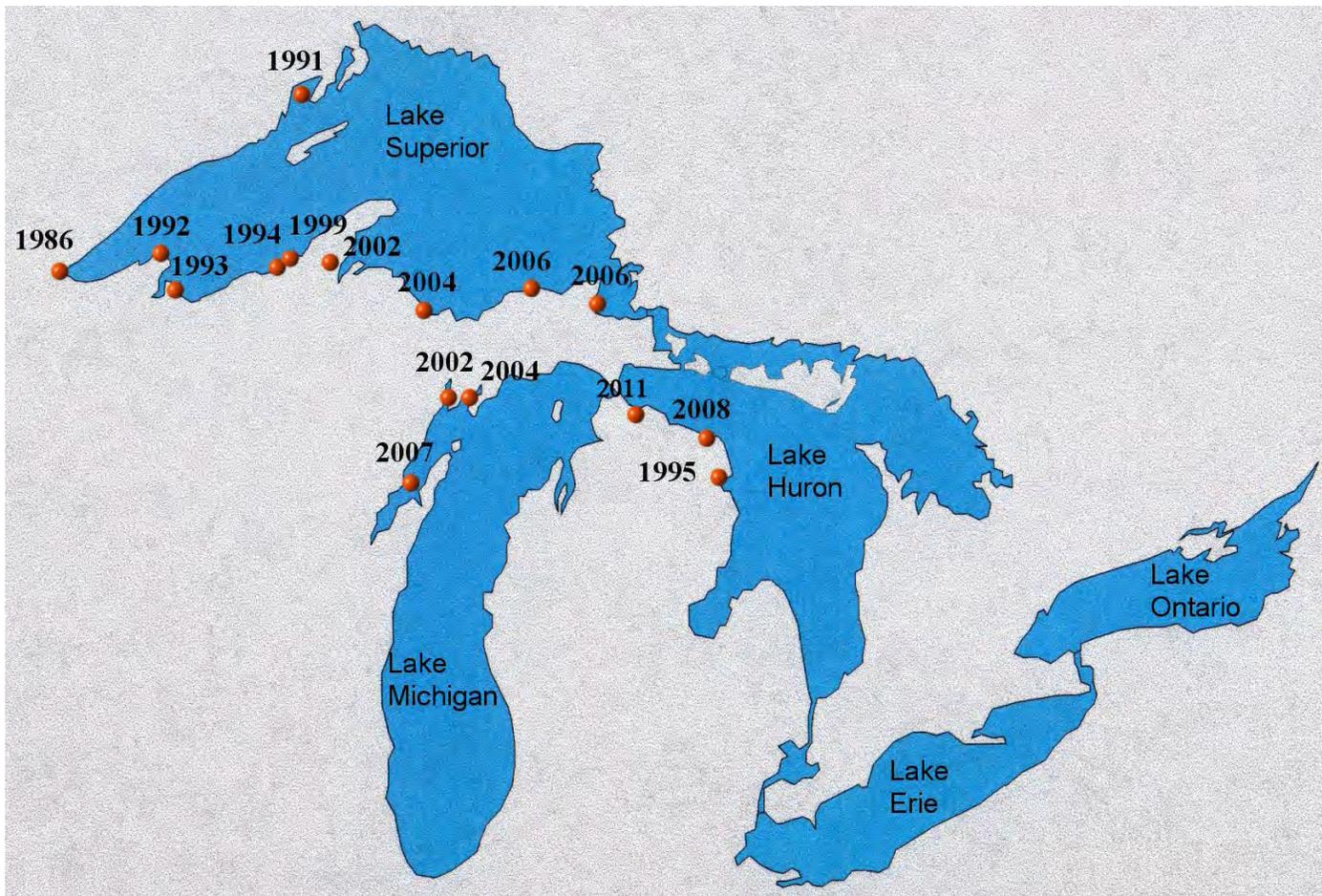
Jessica Barber (USFWS-MBS)	Patrick Kocovsky (USGS-LEBS)
Steve Bobrowicz (OMNR-UGLMU)	Charles Madenjian (USGS-GLSC)
Justin Chiotti (USFWS-Alpena FWCO)	Lisa O'Connor (DFO-GLLFAS)
Gary Czypinski (USFWS-Ashland FWCO)	Henry Quinlan (USFWS-Ashland FWCO)
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Kevin Kayle (ODNR-Fairport Harbor)	Brian Weidel (USGS-LOBS)
Thomas Kelly (ISEA)	Troy Zorn (MIDNR-Marquette)

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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.



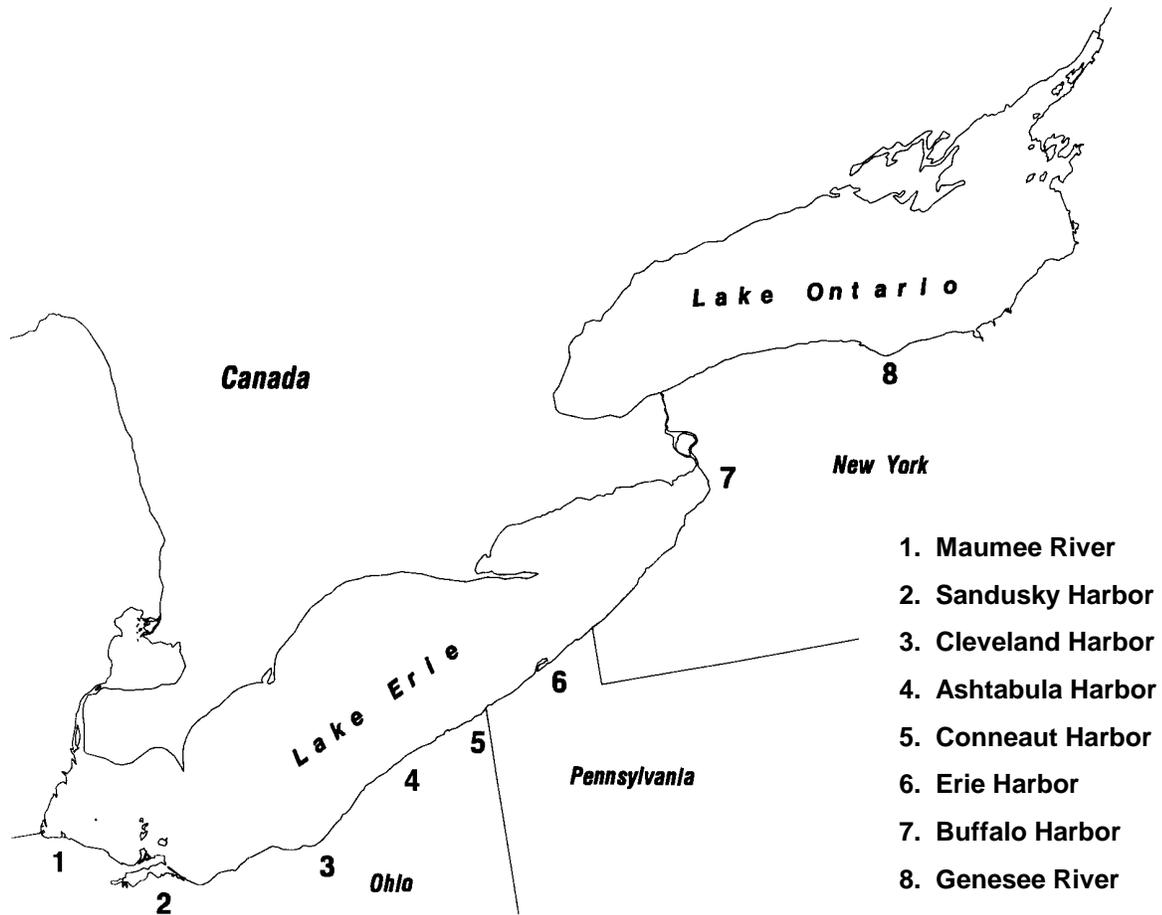
Ruffe Surveillance, St. Marys River/Lake Huron, 2011



U.S. Fish & Wildlife Service

- | | | |
|---|--|------------------------------------|
| 1. St. Marys River (SSM Municipal Marina) | 6. St. Marys River (De Tour Dock Co.) | 11. Thunder Bay (Shipping Channel) |
| 2. St. Marys River (Lake Nicolet) | 7. Port Dolomite | 12. National Gypsum |
| 3. St. Marys River (Munuscong Channel) | 8. Cheboygan River | 13. Au Gres River |
| 4. St. Marys River (Raber Bay) | 9. Calcite Port, Trout River, Swan River | 14. Saginaw River |
| 5. St. Marys River (De Tour – Maud Bay) | 10. Thunder Bay River | 15. Harbor Beach. |

Figure 2. Locations surveyed for ruffe in the upper Great Lakes during 2011.

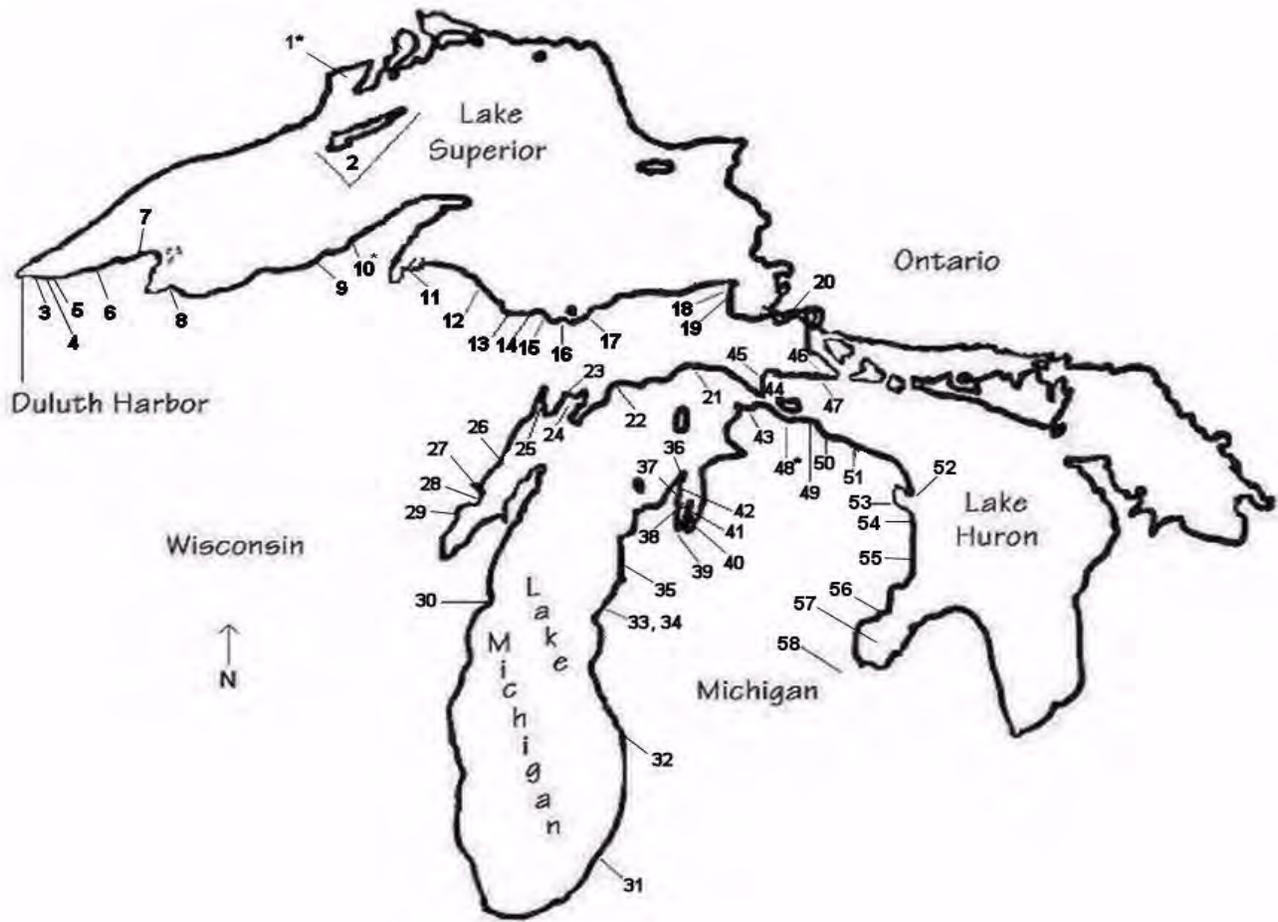


Ruffe Surveillance, Lake Erie/Lake Ontario, 2011



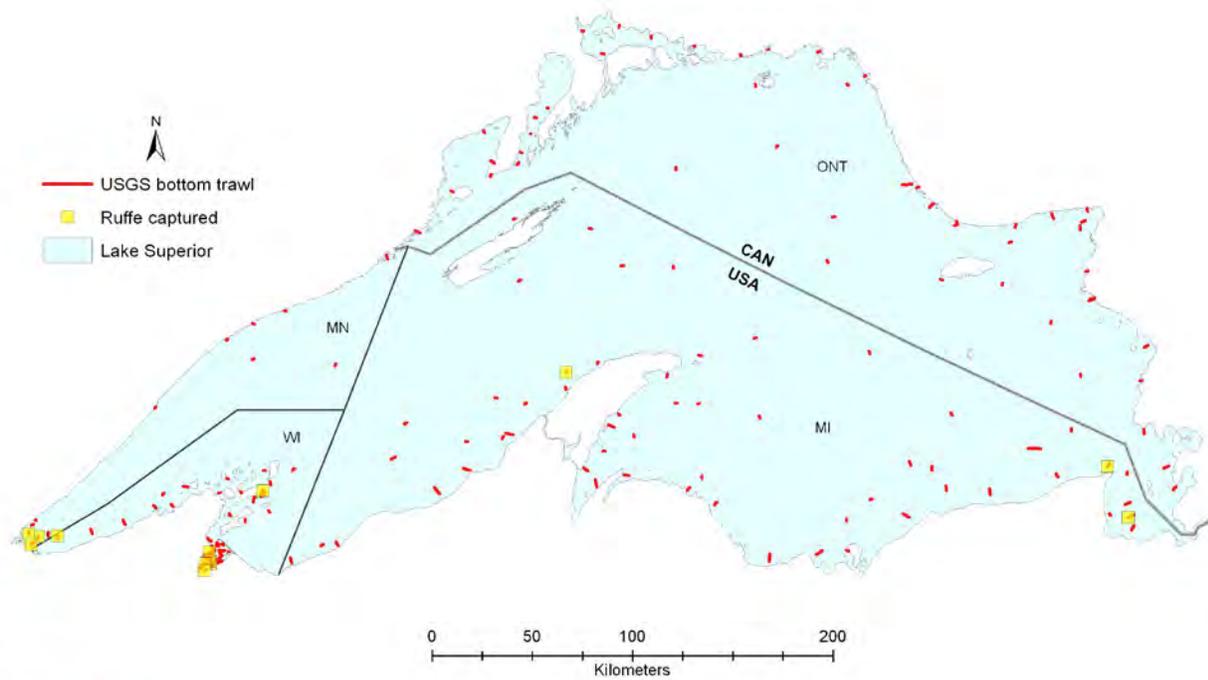
U.S. Fish & Wildlife Service

Figure 3. Locations surveyed for ruffe in the lower Great Lakes during 2011.



- | | | | |
|------------------------------|---------------------------|--------------------------------------|-------------------------------|
| 1. Thunder Bay Harbour * | 18. Betsy River | 35. Betsie River | 52. Thunder Bay (North Point) |
| 2. Isle Royale | 19. Tahquamenon River | 36. Gr. Traverse Bay (Northport) | 53. Devils River |
| 3. Amnicon River | 20. St. Marys River | 37. Gr. Traverse Bay (Suttons Bay) | 54. Black River |
| 4. Middle River | 21. Hog Island Creek | 38. Gr. Traverse Bay (West Arm) | 55. Au Sable River |
| 5. Poplar River | 22. Manistique River | 39. Boardman River | 56. East Au Gres River |
| 6. Brule River | 23. Ogontz River | 40. Gr. Traverse Bay (Bowers Harbor) | 57. Saginaw Bay |
| 7. Red Cliff Creek | 24. Big Bay de Noc | 41. Elk Lake Outlet | 58. Tittabawassee River |
| 8. Bad River | 25. Little Bay de Noc * | 42. Gr. Traverse Bay (Omena Bay) | |
| 9. Firesteel River | 26. Cedar River | 43. Carp Lake River | |
| 10. Misery River * | 27. Menominee River | 44. St. Ignace | |
| 11. Silver River | 28. Peshtigo River | 45. Carp River | |
| 12. Big Garlic River | 29. Oconto River | 46. Albany Creek | |
| 13. Chocolate River | 30. East Twin River | 47. Trout Creek | |
| 14. Laughing Whitefish River | 31. St. Joseph River | 48. Cheboygan River * | |
| 15. Rock River | 32. Muskegon River | 49. Greene Creek | |
| 16. Furnace Creek | 33. Big Manistee River | 50. Ocqueoc River | |
| 17. Miners River | 34. Little Manistee River | 51. Trout River | |

Figure 4. Reported sampling locations in the upper Great Lakes where ruffe were capable of incidental capture during 2011. The * denotes locations where ruffe were captured.

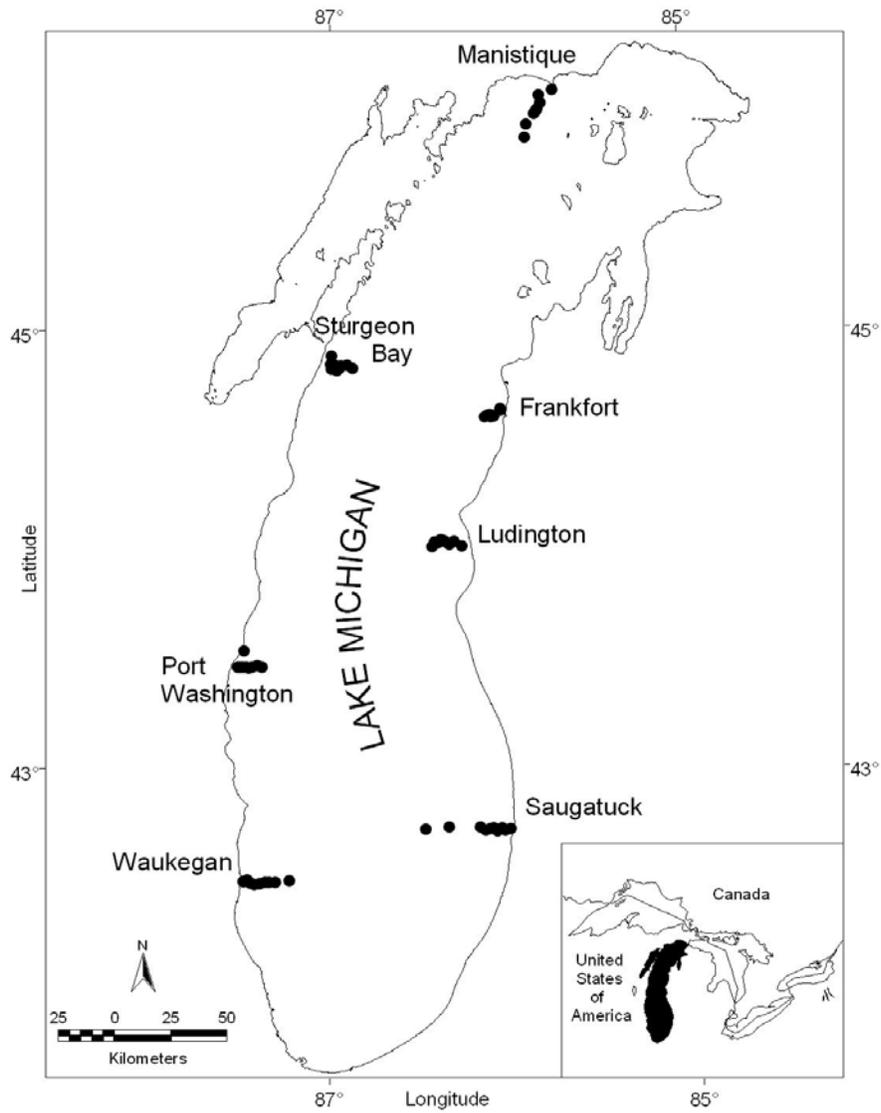


Lori M. Evrard
Jan. 5, 2012



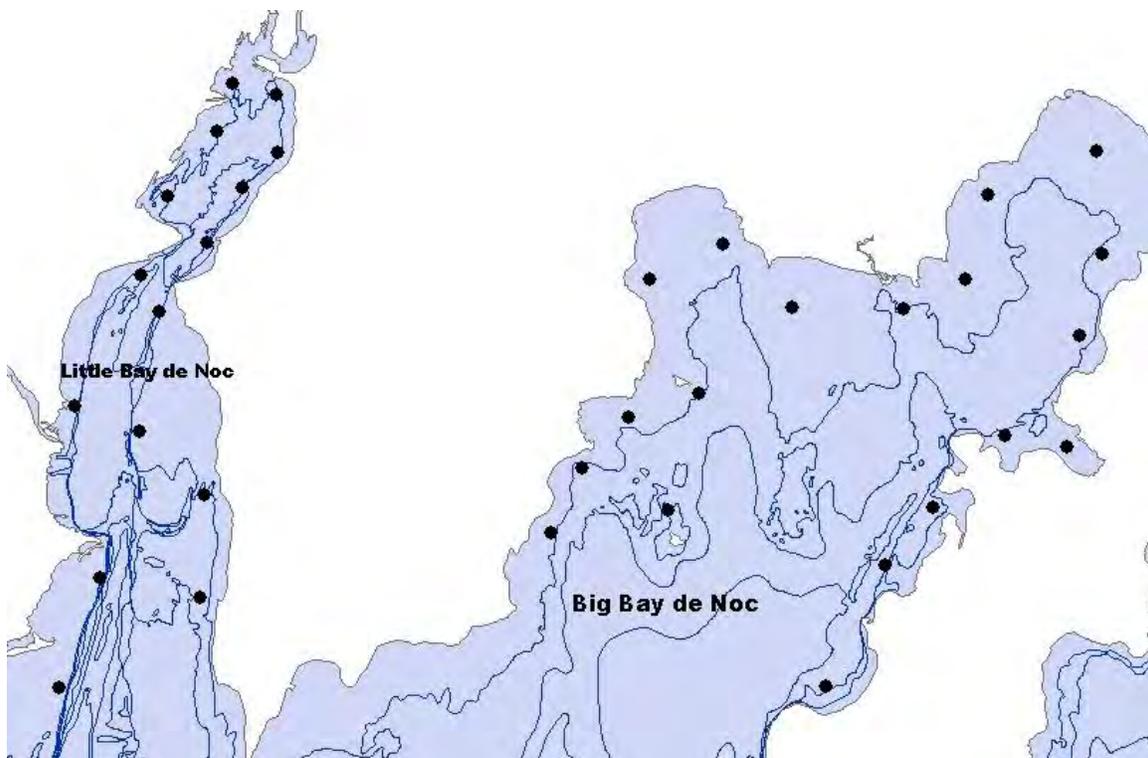
U.S. Geological Survey

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 2011.



U.S. Geological Survey

Figure 6. The USGS - Great Lakes Science Center conducted annual bottom trawling at locations in Lake Michigan where ruffe were capable of incidental capture during 2011.

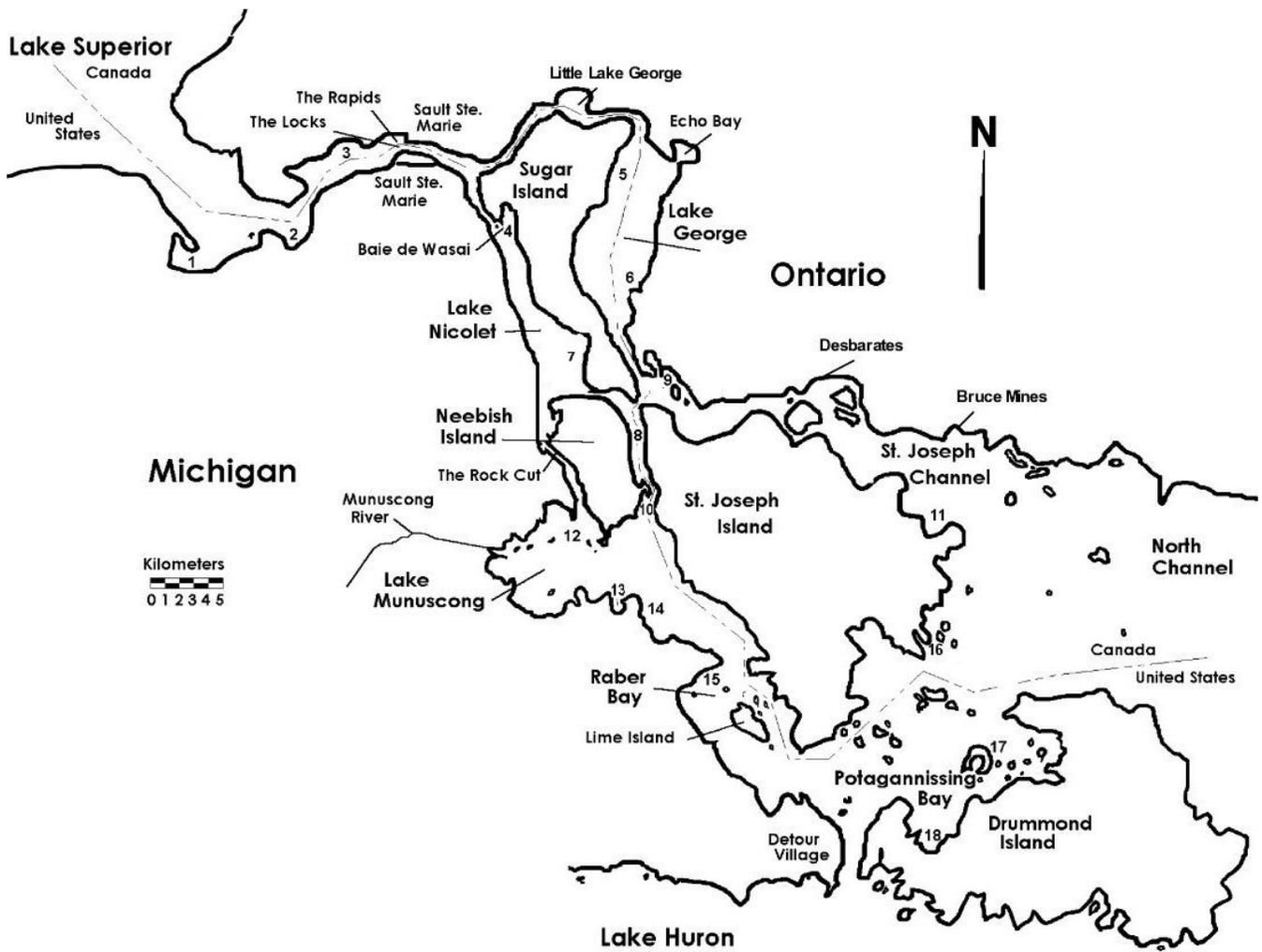


Gill Net Sites, Hatchery-reared Walleye Study, 2004-2011



Michigan Department of Natural Resources

Figure 7. 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. A subset of 12 sites from Big Bay de Noc and four sites from Little Bay de Noc were randomly selected and sampled each year.

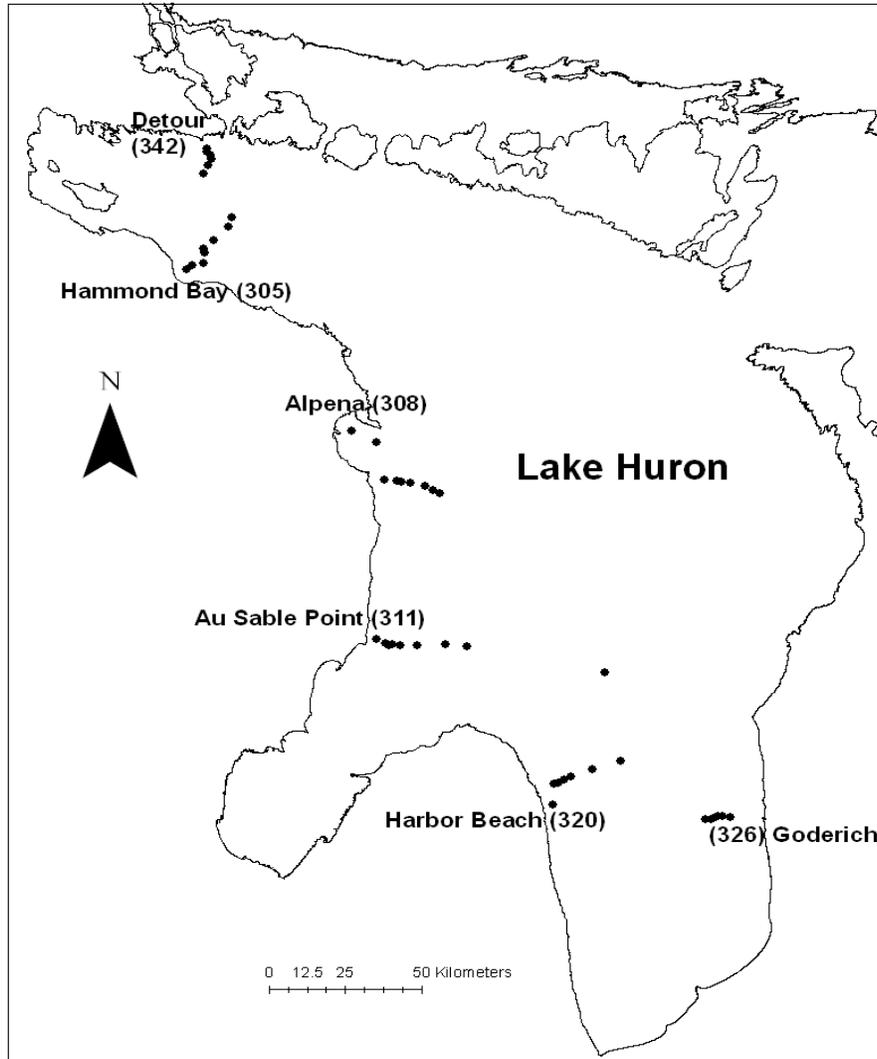


Bottom Trawling Locations, Juvenile and Prey Fish Study, 2010-2011



U.S. Fish and Wildlife Service

Figure 8. The USFWS – Alpena Fish and Wildlife Conservation Office conducted bottom trawling in 2011 at locations in the St. Marys where ruffe were capable of incidental capture.



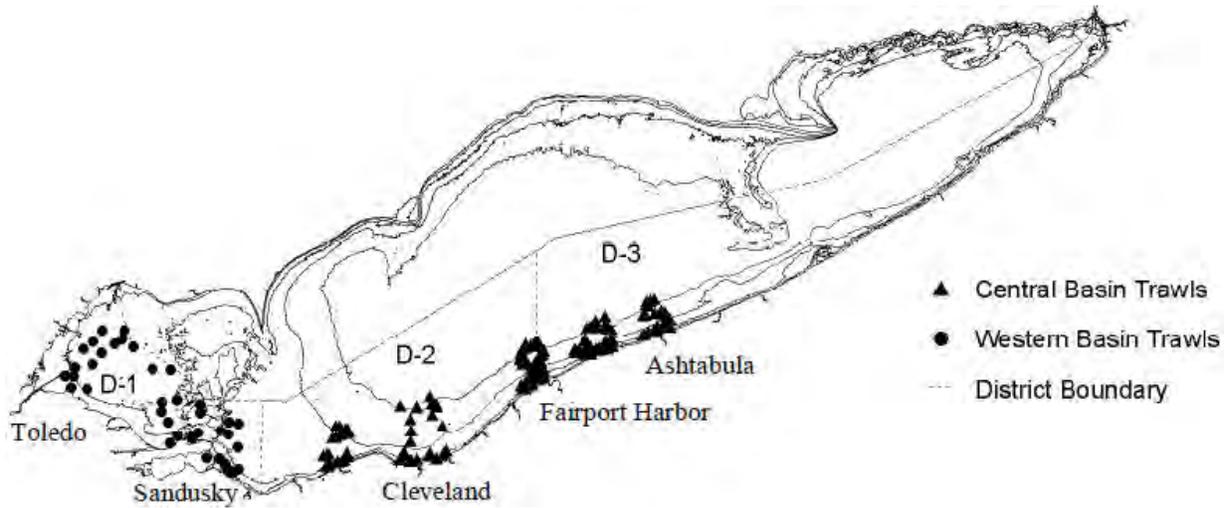
U.S. Geological Survey

Figure 9. The USGS - Great Lakes Science Center conducted annual bottom trawling at locations in Lake Huron where ruffe were capable of incidental capture during 2011.



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

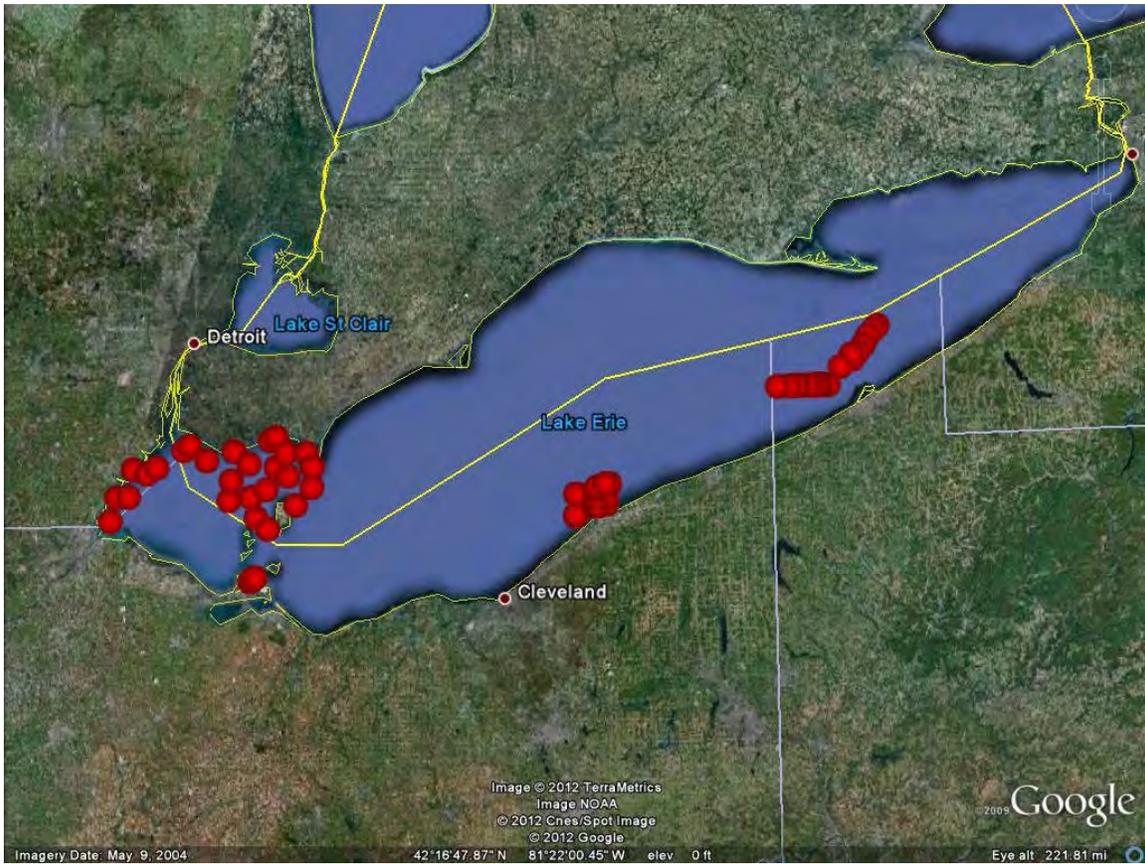
Figure 10. Reported sampling locations in the lower Great Lakes where ruffe were capable of incidental capture during 2011.



Bottom Trawling Locations

Ohio Department of Natural Resources

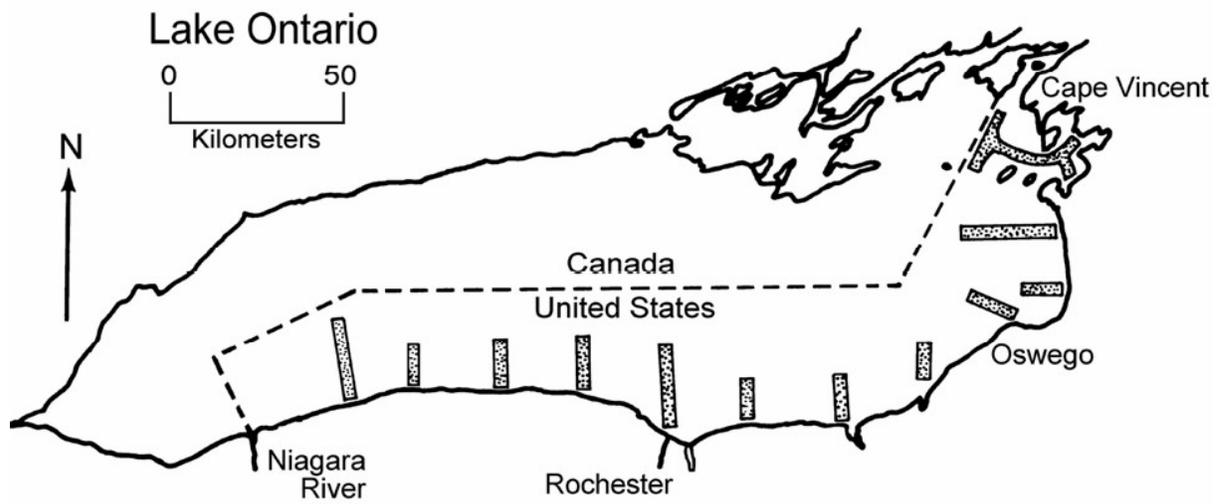
Figure 11. The Ohio DNR – Sandusky and Fairport Harbor Fisheries Research Units conducted annual bottom trawling at locations in Lake Erie where ruffe were capable of incidental capture during 2011.



Bottom Trawling Locations



Figure 12. The USGS – Lake Erie Biological Station conducted annual bottom trawling at locations in Lake Erie where ruffe were capable of incidental capture during 2011.



Great Lakes Science Center – Lake Ontario Biological Stn.

Figure 13. The USGS - Lake Ontario Biological Station conducted annual bottom trawling at locations in Lake Ontario where ruffe were capable of incidental capture during 2011.

Table 1. Summary of dedicated ruffe surveillance in U.S. waters of Lake Huron in 2011.

<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	0.50 hours	BT-4.9	9/19/2011	2.3	17.3	17.9	0
Calcite Port	FWS	0.50 hours	BT-4.9	9/28/2011	7.6	13.0	11.1	0
Cheboygan River	FWS	0.50 hours	BT-4.9	9/7/2011	6.4	19.7	20.0	0
Harbor Beach	FWS	0.50 hours	BT-4.9	9/21/2011	5.7	17.0	17.2	0
National Gypsum	FWS	0.50 hours	BT-4.9	9/20/2011	6.5	17.0	14.8	0
Port Dolomite	FWS	0.50 hours	BT-4.9	9/14/2011	7.2	13.3	11.4	0
Sagianw River	FWS	0.50 hours	BT-4.9	9/22/2011	7.8	16.3	14.6	0
Sw an River	FWS	3 trapnights	TN	9/6-9/9/2011	1.3	-----	-----	0
Thunder Bay River	FWS	0.50 hours	BT-4.9	9/9/2011	5.9	20.5	24.6	0
Thunder Bay River	FWS	244 meters	GN	4/26-4/28/2011	4.2	8.3	-----	0
Thunder Bay River	FWS	4 trapnights	TN	9/8-9/9/2011	2.1	-----	-----	0
Thunder Bay (Shipping Channel)	FWS	0.50 hours	BT-4.9	9/6/2011	6.7	19.0	-----	0
Trout River	FWS	4 trapnights	TN	9/6-9/9/2011	1.3	-----	-----	0
Totals		4.50 hours	BT-4.9					0
		244 meters	GN					0
		11 trapnights	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).

TN=Trap net

GN=Gill net (38.1 mm stretch mesh).

Depth = Average water depth (m).

Table 2. Summary of dedicated ruffe surveillance in U.S. waters of the St. Marys River in 2011.

<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	0.50 hours	BT-4.9	9/15/2011	7.5	15.0	11.8	0
De Tour - Maud Bay	FWS	0.50 hours	BT-4.9	9/15/2011	7.5	16.0	11.6	0
Lake Nicolet	FWS	0.50 hours	BT-4.9	9/12/2011	8.0	20.0	22.3	0
Munuscong Channel	FWS	0.50 hours	BT-4.9	9/16/2011	8.2	16.0	13.2	0
Raber Bay	FWS	0.50 hours	BT-4.9	9/13/2011	7.4	19.0	15.1	0
Salut Ste. Marie Municipal Marina	FWS	0.50 hours	BT-4.9	9/12/2011	3.8	19.3	21.2	0
Totals		3.00 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 2011.

<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	0.77 hours	BT-4.9	5/25/2011	8.45	13.55	13.18	13.63	13.18	1.19	0
Ashtabula Harbor	FWS	0.72 hours	BT-4.9	9/28/2011	8.33	18.73	18.50	7.95	18.50	0.25	0
Buffalo Harbor	FWS	0.94 hours	BT-4.9	6/7/2011	7.88	17.84	17.30	12.28	17.30	1.40	0
Buffalo Harbor	FWS	0.83 hours	BT-4.9	9/19/2011	7.80	19.10	19.10	10.42	19.10	2.00	0
Cleveland Harbor	FWS	1.14 hours	BT-4.9	5/25/2011	8.12	16.33	14.70	10.63	14.70	0.53	0
Cleveland Harbor	FWS	1.11 hours	BT-4.9	9/28/2011	7.85	19.65	19.42	8.59	19.42	0.98	0
Conneaut Harbor	FWS	0.57 hours	BT-4.9	6/8/2011	7.83	19.00	18.60	10.70	18.60	1.12	0
Conneaut Harbor	FWS	0.54 hours	BT-4.9	9/29/2011	7.60	18.63	18.60	7.84	18.60	0.50	0
Erie Harbor	FWS	0.73 hours	BT-4.9	6/8/2011	8.41	21.68	20.95	12.30	20.95	2.25	0
Erie Harbor	FWS	0.73 hours	BT-4.9	9/29/2011	8.00	19.78	19.78	7.79	19.78	1.35	0
Maumee River	FWS	0.77 hours	BT-4.9	5/24/2011	9.38	19.73	19.03	10.30	9.95	0.10	0
Maumee River	FWS	0.92 hours	BT-4.9	9/27/2011	8.68	19.28	19.18	7.77	7.54	0.23	0
Sandusky Harbor	FWS	0.54 hours	BT-4.9	5/23/2011	6.97	17.37	16.95	14.54	14.72	0.10	0
Sandusky Harbor	FWS	0.54 hours	BT-4.9	9/26/2011	6.57	18.63	18.57	9.47	9.24	0.50	0
Totals		10.85 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 2011.

<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	0.58 hours	BT-4.9	6/9/2011	7.16	22.20	22.03	10.87	10.41	0.25	0
Genesee River	FWS	0.55 hours	BT-4.9	9/23/2011	5.57	19.60	19.43	10.75	10.28	0.77	0
Totals		1.13 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 2011.

<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	65 trapnights	FN	4/14-6/17/2011	0.5-1.0	13.7	0	
Bad River	GLIFWC	147 trapnights	PAT	4/25-6/13/2011	0.5	14.1	0	
Betsy River	FWS	110 trapnights	PAT	4/28-6/22/2011	0.5	15.2	0	
Big Garlic River	PC	59 trapnights	FN	4/27-6/25/2011	0.5-1.0	16.6	0	
Brule River	GLIFWC/FWS	59 trapnights	PT	4/19-6/17/2011	0.8	13.4	0	
Chequamegon Bay *	USGS	5.67 hours	BT-4.9	7/28-7/29/2011	1.5-9.1	-----	20	
Chocolay River	PC	55 trapnights	FN	5/4-6/28/2011	0.5-1.0	13.0	0	
Firesteel River	GLIFWC	46 trapnights	FN	5/9-6/24/2011	0.5-1.0	15.4	0	
Furnace Creek	PC	57 trapnights	PAT	4/27-6/23/2011	0.5	13.2	0	
Isle Royale	FWS/NPS	7.84 hours	EF	6/24-6/28/2011	0.6-1.0	-----	0	
Isle Royale	FWS/NPS	4 trapnights	FN	6/24-6/25/2011	-----	-----	0	
Laughing Whitefish River	PC	55 trapnights	FN	5/4-6/28/2011	0.5	14.3	0	
Middle River	GLIFWC/FWS	168 trapnights	PAT	5/6-6/17/2011	0.5	13.9	0	
Miners River	NPS/FWS	118 trapnights	PAT	5/3-7/1/2011	0.5	12.6	0	
Misery River *	GLIFWC	124 trapnights	PAT	4/30-7/1/2011	0.5	12.3	10	
Nearshore/Offshore *	USGS	68.71 hours	BT-11.9	4-7, 9-11/2011	4.7-335.0	1.9-17.7	28	
Poplar River	GLIFWC/FWS	42 trapnights	FN	5/6-6/17/2011	0.5-1.0	13.9	0	
Red Cliff Creek	RCBLSC	53 trapnights	FN	5/2-6/24/2011	0.5-1.0	13.3	0	
Rock River	FWS	118 trapnights	PAT	5/3-7/1/2011	0.5	13.3	0	
Silver River	GLIFWC	62 trapnights	FN	5/5-7/6/2011	0.5-1.0	14.1	0	
Tahquamenon River	FWS	150 trapnights	PAT	5/11-6/30/2011	0.5	17.1	0	
Thunder Bay Harbour *	OMNR/FWS	15 trapnights	FN-2	8-9/2011	0.5-0.8	18.0-21.0	54	
Thunder Bay Harbour *	OMNR/FWS	1.32 hours	BT-4.9	8/2011	4.2-9.8	15.4-17.5	1	
Thunder Bay Harbour *	OMNR/FWS	5.90 hours	EF	8/2011	0.6-5.8	14.0-23.0	30	
Totals		6.99 hours	BT-4.9				21	
		68.71 hours	BT-11.9				28	
		13.74 hours	EF				30	
		441 trapnights	FN				0	
		15 trapnights	FN-2				54	
		992 trapnights	PAT				10	
		59 trapnights	PT				0	
		Total ruffe (captured incidentally)						143

Key to agency:

FWS = U.S. Fish & Wildlife Service
 GLIFWC = Great Lakes Indian Fish & 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

Key to gear:

BT-4.9 = Bottom trawl (4.9-m headrope)
 BT-11.9 = Bottom trawl (11.9-m headrope)
 EF = Electrofishing
 FN = Fyke net
 FN-2 = Paired fyke nets (4.7 mm mesh with 15 m lead)
 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 water temperature (°C) or temperature range.

Table 6. Summary of reported fish sampling conducted in Lake Michigan that was capable of incidentally capturing ruffe during 2011.

<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	154 trapnights	PAT	4/14-6/30/2011	0.5-1.0	15.0	0
Big Bay de Noc	ISEA	0.33 hours	BT-4.9	7/10/2011	5.8-8.8	-----	0
Big Bay de Noc	MIDNR	4.17 hours	BT-3.7	6-10/2011	2.4-12.2	-----	0
Big Bay de Noc	MIDNR	4,682 meters	GN-EX	8-9/2011	2.6-11.5	12.7-21.1	0
Big Manistee River	FWS	63 trapnights	PT	4/19-6/21/2011	0.5-1.0	14.3	0
Boardman River	GTBOCI	154 trapnights	PAT	4/13-6/29/2011	0.5	14.4	0
Carp Lake River	FWS	90 trapnights	PT	4/2-7/1/2011	0.8	13.1	0
Cedar River	MDNR	2.17 hours	BT-3.7	6-10/2011	2.4-12.2	-----	0
Cedar River	MDNR	1,170 meters	GN-EX	8-9/2011	5.4-11.3	14.6-15.4	0
East Tw in River	PC	61 trapnights	PAT	4/15-6/15/2011	0.5	15.0	0
Elk Lake Outlet	PC	63 trapnights	PAT	4/15-6/17/2011	0.5-1.0	10.1	0
Gr. Trav. Bay (Bowers Harbor)	ISEA	0.17 hours	BT-4.9	8/5/2011	5.2-8.8	-----	0
Gr. Trav. Bay (Northport)	ISEA	0.33 hours	BT-4.9	8/4/2011	9.1-14.0	-----	0
Gr. Trav. Bay (Omema Bay)	ISEA	0.17 hours	BT-4.9	8/4/2011	8.5-10.7	-----	0
Gr. Trav. Bay (Suttons Bay)	ISEA	13.78 hours	BT-4.9	4/29-10/7/2011	4.6-20.7	-----	0
Gr. Trav. Bay (West Arm)	ISEA	7.59 hours	BT-4.9	5-6 ,8-9/2011	5.2-18.3	-----	0
Hog Island Creek	PC	59 trapnights	FN	5/4-7/2/2011	0.5-1.0	13.9	0
Little Bay de Noc	ISEA	1.00 hours	BT-4.9	7/6-9/2011	7.3-11.0	-----	0
Little Bay de Noc *	MIDNR	3.33 hours	BT-3.7	6-10/2011	2.4-12.2	-----	1
Little Bay de Noc *	MIDNR	4,682 meters	GN-EX	8-9/2011	2.0-12.8	10.8-18.2	1
Little Manistee River	FWS	136 trapnights	PAT	4/14-6/21/2011	0.5-1.0	14.3	0
Manistique River	FWS	40 trapnights	SPT	5/10-6/19/2011	0.5	16.1	0
Menominee River	FWS	51 trapnights	PAT	4/26-6/16/2011	0.5-1.0	15.1	0
Menominee River	MDNR	3.17 hours	BT-3.7	6-10/2011	2.4-12.2	-----	0
Menominee River	MDNR	1,170 meters	GN-EX	8-9/2011	2.9-10.0	17.4-18.2	0
Muskegon River	FWS	60 trapnights	PAT	4/15-6/14/2011	1.0-5.0	14.0	0
Nearshore/Offshore	USGS	10.95 hours	BT-12	9-10/2010	5.0-110.0	4.1-18.5	0
Oconto River	FWS	50 trapnights	PAT	4/26-6/15/2011	0.5-1.0	15.8	0
Ogontz River	PC	58 trapnights	FN	5/4-7/1/2011	0.5-1.0	13.9	0
Peshtigo River	FWS	102 trapnights	PAT	4/26-6/16/2011	0.5-1.0	15.1	0
St. Joseph River	PC	126 trapnights	PAT	3/31-6/2/2011	0.5	12.0	0
Totals		12.84 hours	BT-3.7				1
		23.37 hours	BT-4.9				0
		10.95 hours	BT-12				0
		117 trapnights	FN				0
		11,704 meters	GN-EX				1
		957 trapnights	PAT				0
		153 trapnights	PT				0
		40 trapnights	SPT				0
		Total ruffe (captured incidentally)					2

Key to agency:

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

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
 GN-EX = Gill net (experimental 25-127 mm stretch mesh panels)
 PAT = Portable assessment trap
 PT = Permanent trap
 SPT = Semipermanent trap

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.

Table 7. Summary of reported fish sampling conducted in Lake Huron that was capable of incidentally capturing ruffe during 2011.

<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	55 trapnights	PAT	4/28-6/22/2011	0.5	11.4	0	
Au Sable River	PC	140 trapnights	PAT	4/14-6/23/2011	0.5-1.0	13.6	0	
Black River	MIDNR	2.67 hours	BT-11	7/2011	12.2-30.5	-----	0	
Carp River	FWS	62 trapnights	FN	5/12-6/15/2011	0.5-1.0	14.8	0	
Cheboygan River *	FWS	77 trapnights	PT	4/14-6/30/2011	1.0	13.6	1	
Devils River	PC	72 trapnights	FN	4/9-6/20/2011	0.5-1.0	15.9	0	
East Au Gres River	PC	70 trapnights	PAT	4/14-6/23/2011	0.5-1.0	14.7	0	
Greene Creek	FWS	79 trapnights	PAT	4/11-6/29/2011	0.5	12.8	0	
Nearshore/Offshore	USGS	7.17 hours	BT-21	10-11/2011	9.0-110.0	-----	0	
Ocqueoc River	FWS	120 trapnights	PT	4/4-7/1/2011	0.4	13.7	0	
St. Ignace	ISEA	0.50 hours	BT-4.9	7/22-8/1/2011	7.9-13.7	-----	0	
St. Marys River	FWS	201 trapnights	PAT	6/1-7/22/2011	0.5-1.0	12.6	0	
St. Marys River	FWS	5.00 hours	BT-4.9	8-9/2011	1.5-9.0	20.0-27.4	0	
St. Marys River	FWS/OMNR	15 trapnights	FN2	8/15-8/17/2011	-----	-----	0	
St. Marys River	FWS/OMNR	1.20 hours	BT-4.9	8/15-8/16/2011	-----	-----	0	
St. Marys River	FWS/OMNR	2.33 hours	EF	8/15-8/18/2011	-----	-----	0	
St. Marys River	SMRFTG	24.55 hours	EF	9-10/2011	0.6-2.0	14.4-22.2	0	
Saginaw Bay	MIDNR	4.08 hours	BT-10	9/2011	4.0-14.0	16.6-20.5	0	
Saginaw Bay	MIDNR	488 meters	GN	9/2011	-----	-----	0	
Thunder Bay (North Point)	MIDNR	4.17 hours	BT-11	7/2011	12.2-30.5	-----	0	
Tittabaw assee River	PC	59 trapnights	SPT	4/11-6/9/2011	1.0	15.0	0	
Trout Creek	FWS	48 trapnights	FN	4/28-6/15/2011	0.5-1.0	13.8	0	
Trout River	FWS	78 trapnights	SPT	4/11-6/28/2011	0.2	14.4	0	
Totals		6.70 hours	BT-4.9				0	
		4.08 hours	BT-10				0	
		6.84 hours	BT-11				0	
		7.17 hours	BT-21				0	
		26.88 hours	EF				0	
		182 trapnights	FN				0	
		15 trapnights	FN2				0	
		488 meters	GN				0	
		545 trapnights	PAT				0	
		197 trapnights	PT				1	
		137 trapnights	SPT				0	
		Total ruffe (captured incidentally)						1

Key to agency:

FWS = U.S. Fish & Wildlife Service
 ISEA = Inland Seas Education Association
 MIDNR = Michigan Department of Natural Resources
 OMNR = Ontario Ministry of Natural Resources
 PC = Private contractor
 SMRFTG = St. Marys River Fisheries Task Group
 USGS = U.S. Geological Survey

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).

Key to gear:

BT-4.9 = Bottom trawl (4.9-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 = Paired fyke nets (4.7 mm mesh with 15 m lead)
 GN = Gill net (graded mesh included 30.48 m panel of 38.1 mm mesh)
 PAT = Portable assessment trap
 PT = Permanent trap
 SPT = Semipermanent trap

Table 8. Summary of reported fish sampling conducted in Lake Erie that was capable of incidentally capturing ruffe in 2011.

<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	122 trapnights	PAT	4/17-6/17/2011	0.5	12.5	0
Central Basin	ODNR	35.00 hours	BT-10.4	4-10/2011	14.0	13.0	0
Central Basin	ODNR	4,004 meters	GN	9-11/2011	9.0	17.0	0
Central Basin	USGS	7.50 hours	BT-7.9	8,9/2011	13.5-23.1	17.6-19.3	0
Grand River	PC	120 trapnights	PAT	4/11-6/10/2011	0.5	15.8	0
HEC-Detroit River	FWS	3.50 hours	BT-6.1	8-9/2011	3.1-9.7	19.4-24.0	0
HEC-Lake St. Clair	MIDNR	5.37 hours	BT-5	8/2011	1.0-2.0	21.9-25.0	0
HEC-Lake St. Clair	MIDNR	3.77 hours	BT-10	5,9-10/2011	1.2-5.2	12.0-20.3	0
HEC-St. Clair & Detroit Rivers	USGS	3500 sets	NET	3-8/2011	1,0-20.0	-----	0
HEC-St. Clair River	FWS	5.47 hours	BT-6.1	9,10/2011	4.1-25.1	12.6-18.6	0
Spooner Creek	PC	122 trapnights	PAT	4/17-6/17/2011	0.5	12.5	0
Western Basin	ODNR	22.50 hours	BT-10.7	5-9/2011	1.2-12.8	11.6-28.0 (B)	0
Western Basin	USGS	8.33 hours	BT-7.9	6,9/2011	3.7-11.0	15.1-21.5	0
Western Basin	USGS	4.00 hours	BT-7.9	10/2011	3.0-6.0	15.0-16.4	0
Totals		5.37 hours	BT-5				0
		8.97 hours	BT-6.1				0
		19.83 hours	BT-7.9				0
		3.77 hours	BT-10				0
		35.00 hours	BT-10.4				0
		22.50 hours	BT-10.7				0
		4,004 meters	GN				0
		3500 sets	NET				0
		364 trapnights	PAT				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 gear:

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

BT-6.1 = Bottom trawl (6.1-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)

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

NET = bongo nets, light traps, minnow traps

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. Bottom temperature is denoted with "B".

Table 9. Summary of reported fish sampling conducted in Lake Ontario that was capable of incidentally capturing ruffe in 2011.

<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	17.92 hours	EF	5, 9/2011	1.5	13.0, 19.0	0
Black River	PC	210 trapnights	PAT	4/3-6/12/2011	0.5	14.7	0
Grindstone Creek	PC	67 trapnights	PAT	4/4-6/10/2011	0.5	15.5	0
Little Salmon River	PC	67 trapnights	PAT	4/4-6/10/2011	0.5	15.3	0
Nearshore/Offshore	USGS	54.80 hours	BT-18	4-7/2010, 10/2011	8.0-150.0	-----	0
Sterling Creek	PC	67 trapnights	PAT	4/4-6/10/2011	0.5-1.0	17.3	0
Sterling Valley Creek	PC	67 trapnights	PAT	4/4-6/10/2011	0.5	17.3	0
Totals		17.92 hours	EF				0
		54.80 hours	BT-18				0
		478 trapnights	PAT				0
		Total ruffe (captured incidentally)					0

Key to agency:

DFO = Department of Fisheries and Oceans
 PC = Private contractor
 USGS = U.S. Geological Survey

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).