

## SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2013

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### BACKGROUND

The Eurasian ruffe *Gymnocephalus cernuus* (ruffe), an Eurasian percid, was likely introduced to the St. Louis River Estuary (SLRE) on the Minnesota/Wisconsin border, during the mid-1980s in the ballast water of an ocean-going ship (Pratt et al. 1992). Ruffe populations increased rapidly in the SLRE and became the most abundant fish captured there in bottom trawls by 1990. According to U.S. Geological Survey (USGS) sampling records, the SLRE ruffe 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the most abundant species captured in trawls through 2004 (the USGS terminated SLRE trawl assessments after 2004 – USGS unpublished information). By 1991, ruffe were detected in Thunder Bay Harbour, Ontario, (Busiahn 1997); and by 1992 ruffe had spread to tributaries along the southern shore of Lake Superior (Slade and Kindt 1992).

Due to potential competition for food and space, ruffe pose a threat to native fish populations (Ruffe Task Force 1992); however the impacts of ruffe in the Great Lakes are not fully known. Experimental research conducted by the University of Minnesota-Duluth revealed that ruffe consume a significant amount of benthic macro invertebrate energy (Schuldt et al. 1999). In a presentation of this research, co-author Carl Richards, University of Minnesota Natural Resources Research Institute, stated: “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.” The experiment also demonstrated significant declines in the growth of yellow perch *Perca flavescens*, when exposed to any ruffe densities (Henson 1999).

Similarly, trawl data from 1995-2002 in three Wisconsin tributaries east of the St. Louis River suggest that yellow perch abundance declined in years that ruffe abundance increased (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trend was analyzed and found to be weakly significant for all three tributaries combined (D.H. Ogle, Northland College unpublished data). In contrast, a statistical analysis of bottom trawl data conducted by USGS showed no significant relationship between the increasing ruffe population and declining native fish populations in the St. Louis River (Bronte et al. 1998).

The Aquatic Nuisance Species Task Force declared the ruffe to be a “nuisance species” in the spring of 1992 due to increasing abundance, expansion outside the SLRE, and speculation about potential impacts on native fish populations. 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 early 1995 and revised following the fall 1995 discovery of ruffe in Lake Huron (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).

Dedicated ruffe surveillance efforts, designed and implemented specifically to find and collect ruffe, 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) and the Ontario Ministry of Natural Resources-Upper Great Lakes Management Unit (OMNR-UGLMU). Since 1992, the range of ruffe has expanded with discoveries in Lake Huron (Thunder Bay River) in 1995, Lake Michigan (northern Green Bay) in 2002, and across the south shore of Lake Superior (to Whitefish Bay) in 2006 (Figure 1). A chronology of ruffe detection for the Great Lakes Basin is available in the Appendix. Currently, dedicated ruffe surveillance efforts are conducted in the St. Marys River and Lake Huron by the USFWS-Alpena Fish and Wildlife Conservation Office (USFWS-Alpena) and in Lakes Erie and Ontario by the USFWS-Lower Great Lakes Fish and Wildlife Conservation Office (USFWS-Lower Great Lakes).

Other management agencies report sampling that may capture ruffe incidentally using fishing gear to which ruffe are vulnerable, even though ruffe are not the target of their efforts. Fishery assessment methods and results were provided to us from fishery management and/or research agencies per our request. Content within this report is not a complete inventory of fishery assessment gear capable of capturing ruffe by all the agencies working in the Great Lakes, only that which was known or reported to us.

The following information summarizes dedicated ruffe surveillance conducted in 2013, and documents fish sampling that was reported by other organizations that were capable of capturing ruffe over the same time period.

## **OBJECTIVES**

The primary objective of ruffe surveillance was early detection and description of age and/or size composition. The secondary objectives were to describe the fish community at each location surveyed, and to monitor locations on the periphery of their range or where ruffe have been reported but populations are unknown. Lake Superior peripheral locations included areas around the established population at Thunder Bay Harbour, Ontario and the Tahquamenon River in Whitefish Bay, Michigan. Lake Michigan peripheral locations included areas around the established population at Little Bay de Noc of northern Green Bay and its tributaries and nearshore areas. Lake Huron peripheral locations included Thunder Bay in Alpena, Michigan; the Trout River and nearshore areas of Rogers City, Michigan; and the Cheboygan River and nearshore areas of Cheboygan, Michigan.

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

## **METHODS**

Ruffe surveillance was focused on areas that ruffe could potentially colonize via ballast water from inter- and intra-lake shipping as well as areas with habitat known to be attractive to ruffe (i.e. deep channels and pools, low water clarity, soft substrate). Surveillance was conducted in natural channels, estuaries, embayments, pools, tributary mouths, canals, dredged shipping channels, and in or near shipping ports. Ruffe surveillance was usually conducted in water depths from 3 to 8 meters (m) and often sampled the deepest habitat at the site as determined by electronic depth sounder. However, shallow areas and areas with vegetation were also surveyed. The primary gear used was a nylon bottom trawl (4.9 m head rope), commercially manufactured with a 3.8 cm stretch mesh body, 31.8 mm stretch mesh cod end, and a 6.25 to 12.5 mm stretch mesh inner liner. Bottom trawls

were pulled with a variety of vessels and were deployed and retrieved either by hand or with a winch (hydraulic and electric) run by generator. 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).

Surface and bottom water temperature was recorded prior to each established trawl tow (transect), except when consecutive tows were conducted in close proximity to each other. Dissolved oxygen levels and water transparency were also recorded at each location sampled in Lakes Erie and Ontario. Depth was recorded at the start and finish of individual tows (and at several additional intervals on Lakes Erie and Ontario), 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 sampling location. Tows were directed along and across contours, but the majority was along contour.

In addition to bottom trawls, other gear employed included mini-fyke nets, boom electrofishing, and backpack electrofishing. Mini-fyke nets consisted of seven 0.7 m x 0.7 m rectangles interconnected with 25.4 mm stretch mesh netting and a 7.6 m lead. Mini-fyke nets were set overnight. Boom electrofishing was conducted during the night and backpack electrofishing was conducted during the day. Sampling location, water depth, and water temperature were recorded during each sampling effort.

Catches of fish were sorted by species and counted, and the individual 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 *Neogobius melanostomus*, white perch *Morone americana*, sea lamprey *Petromyzon marinus*, 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.

Efforts to increase public awareness of ruffe were conducted. *Ruffe Watch* identification cards and other information were distributed to harbor masters, marinas, and bait vendors, as well as individual private citizens near sampling locations on the Great Lakes. Information summaries, newsletter articles, and presentations were also conducted or provided.

Agency partners reported all sampling to which ruffe were vulnerable in addition to dedicated surveillance efforts to help provide coverage for ruffe detection across the Great Lakes. Agency partners also expanded awareness and helped promote reporting ruffe sightings.

## RESULTS

### SURVEILLANCE

Dedicated ruffe surveillance was conducted by the USFWS in Lakes Huron (including connecting waters of the St. Marys River), Erie, and Ontario in 2013 in which no ruffe were captured (Figures 2 and 3, and Tables 1, 2, 3, and 4). No dedicated ruffe surveillance was conducted in Lake Michigan or Lake Superior.

## LAKE HURON

The USFWS-Alpena used a 4.9 m bottom trawl to collect fish at five locations in U.S. waters (Michigan) of Lake Huron during September 2013 (Figure 2 and Table 1). No ruffe were captured. Sampling locations included the following: Au Gres River mouth, Harbor Beach DTE port, Port Dolomite, Saginaw River mouth, and Thunder Bay River mouth/shipping channel. Equipment failure prevented fall sampling at three other dedicated sampling locations. Efforts targeted deep water areas within shipping channels and river mouths. A total of 25 tows were completed in September, comprising 2.1 hours of effort. Thirty taxa were collected. The majority of the catch consisted of gizzard shad *Dorosoma cepedianum* (33%). The greatest overall catch (95 fish/minute) was experienced at the Saginaw River mouth. Round gobies were the most ubiquitous species and were captured at all of the sampling locations. A complete listing of all fish species captured is available upon request from the USFWS-Alpena.

Additional sampling was conducted in historic ruffe capture locations during the spring and fall 2013 using backpack electrofishing, boom electrofishing, and mini-fyke nets. No ruffe were captured. Sampling locations included the Thunder Bay River and Lafarge port in Alpena, Michigan; Trout River in Rogers City, Michigan; and Cheboygan River in Cheboygan, Michigan (Figure 2 and Table 1). Sampling in the Alpena area consisted of nighttime boom electrofishing for 0.8 hours of effort in the Thunder Bay River during June, nighttime boom electrofishing for 1.2 hours of effort at the Lafarge port during June, and 12 trap nights of effort with mini-fyke nets in the Thunder Bay River during October. Sampling in the Rogers City area consisted of daytime backpack electrofishing in the Trout River for 0.7 hours of effort during June. Sampling in the Cheboygan area consisted of nighttime boom electrofishing in the Cheboygan River for 1.1 hours effort during June.

## ST. MARYS RIVER

The USFWS-Alpena used a 4.9 m bottom trawl to collect fish at six locations in U.S. waters (Michigan) downriver from the St. Marys River Soo Locks during September 2013 (Figure 2 and Table 2). No ruffe were captured. 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 22 tows comprising 1.8 hours of effort were conducted. Seventeen taxa were collected. The majority of the catch consisted of mimic shiners *Notropis volucellus* (70%), and the greatest overall catch rate (55 fish/minute) was experienced at Munuscong Channel. Mimic shiners were the most ubiquitous species and were captured at all six sampling locations. A complete listing of all fish species captured is available upon request from the USFWS-Alpena.

## LAKE ERIE

The USFWS-Lower Great Lakes used a 4.9 m bottom trawl to complete surveys at seven previously established harbor locations on Lake Erie including Ashtabula, Ohio; Buffalo, New York; Cleveland, Ohio; Conneaut, Ohio; Erie, Pennsylvania; Sandusky, Ohio; and Toledo, Ohio (Figure 3 and Table 3). No ruffe were captured. All sites were sampled once in spring 2013 (May). Fall sampling did not occur as a result of sequestration and the federal government shutdown in October 2013. The catch was composed of seven species. The majority of the catch consisted of emerald shiners *Notropis atherinoides* (38%) and round goby (26%). Channel catfish *Ictalurus punctatus* accounted for 14%, freshwater drum *Aplodinotus grunniens* was 11%, and white perch, spottail shiners *Notropis hudsonius*, and white bass *Morone chrysops* each accounted for less than 10%. A more detailed summary of all fish species captured at these locations is available upon request from the USFWS-Lower Great Lakes.

## **LAKE ONTARIO**

The USFWS-Lower Great Lakes used a 4.9 m bottom trawl to conduct dedicated bottom trawling along the southern shore of Lake Ontario at Rochester Harbor, New York in the Genesee River during the spring (May) 2013 (Figure 3 and Table 4). No ruffe were captured. Fall sampling did not occur as a result of sequestration and the federal government shutdown in October 2013. Sampling transects were located in areas where there was a dredged shipping channel, no more than 3 km upstream from Lake Ontario. The catch was composed of a single species; alewife *Alosa pseudoharengus*. A more detailed summary of the catch is available upon request from the USFWS-Lower Great Lakes.

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

Several agencies and organizations reported other fish sampling that was capable of capturing ruffe incidentally during 2013. Information was provided for each of the Great Lakes, the St. Marys River, and the St. Clair/Detroit River Waterway.

## **LAKE SUPERIOR**

The USGS-Lake Superior Biological Station (USGS-LSBS), Wisconsin Department of Natural Resources-Lake Superior Field Unit (WIDNR-Superior), Lake Superior State University (LSSU), Bay Mills Indian Community (BMIC), Chippewa Ottawa Resource Authority-Inter-Tribal Fisheries and Assessment Program (ITFAP), USFWS-Marquette Biological Station (USFWS-MBS), USFWS-Ashland, and OMNR-UGLMU reported other fish sampling that was capable of capturing ruffe in Lake Superior (Figures 4 and 5, and Table 5). These activities captured a total of 392 at the Thunder Bay Harbour, St. Louis River, and Chequamegon Bay; all within the current range. A few undocumented but confirmed ruffe were reportedly captured in the tribal fishery located in southwestern Whitefish Bay (Mark Ebener, ITFAP personal communication).

Thunder Bay Harbour, Ontario Personnel from the USFWS-Ashland and OMNR-UGLMU conducted sampling in Thunder Bay Harbour to detect presence and relative abundance of new nonindigenous invasive fish (Figure 4 and Table 5). A total of 74 ruffe were captured (1 in trawls and 73 in fyke nets). Sampling took place from August-September 2013 and consisted of 20 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 0.8 hours bottom trawling (4.9 m head rope), and 3.3 hours electrofishing. This location is within the existing ruffe range.

Isle Royale, Michigan Personnel from the USFWS-Ashland, in cooperation with the National Park Service (NPS), conducted coaster brook trout assessments on Isle Royale during June 2013 (Figure 4 and Table 5). No ruffe were captured following 10.1 hours electrofishing.

St. Louis River, Wisconsin Personnel from the USFWS-Ashland conducted sampling to detect presence and relative abundance of new nonindigenous invasive fish in the St. Louis River (Figure 4 and Table 5). A total of 140 ruffe were captured (36 in fyke nets and 104 in trawls). Sampling took place during June and August 2013 and consisted of 26 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 24 modified Windermere trap nights, 0.8 hours bottom trawling (4.9 m head rope), and 3.3 hours electrofishing. This location is within the existing ruffe range.

Western Lake Superior Personnel from the WIDNR-Superior conducted annual sampling to index the fish

community in western waters of Lake Superior (Figure 4 and Table 5). A total of 113 ruffe were captured. Sampling took place during July 2013 and consisted of 19 net sets of a 1,097 m graded mesh gill net that included one panel of 38 mm mesh to which ruffe were vulnerable. These locations are within the existing ruffe range.

Chequamegon Bay, Wisconsin Personnel from the USFWS-Ashland conducted sampling to detect presence and relative abundance of new nonindigenous invasive fish in Chequamegon Bay (Figure 4 and Table 5). A total of 40 ruffe were captured (22 in fyke nets and 18 in trawls). Sampling took place in August, September, and November 2013 and consisted of 15 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 1.3 hours bottom trawling (4.9 m head rope), and 4.2 hours electrofishing. This location is within the existing ruffe range.

Personnel from the USGS-LSBS conducted bottom trawling (5.5 m head rope) in Chequamegon Bay from July-August 2013 (Figure 5 and Table 5). Twelve ruffe were captured. Effort consisted of one ten minute tow conducted at each of 39 locations within the bay for 6.5 hours of effort. This location is within the existing ruffe range.

Apostle Islands, Wisconsin; Stannard Rock, Michigan; and Superior Shoals, Ontario Personnel from the USGS-LSBS conducted bottom trawling (11.9 m head rope) at the Apostle Islands, Stannard Rock, and at Superior Shoals (Figure 5 and Table 5). No ruffe were captured. Transects included spring 2013 (June) sampling at two locations in the Apostle Islands, summer 2013 (August) sampling of two locations at Stannard Rock, and summer 2013 (August) sampling at one location at Superior Shoals. A total of seven tows and 1.7 hours of effort were conducted.

Lake Superior Nearshore/Offshore Personnel from the USGS-LSBS conducted spring and summer bottom trawling (11.9 m head rope) in U.S. and Canadian waters of Lake Superior (Figure 5 and Table 5). Thirteen ruffe were captured (all at nearshore locations within the existing range). Nearshore sampling was conducted during the spring 2013 (May-June) at 79 locations for a total of 32.1 hours of effort. Offshore sampling was conducted during the summer 2013 (June-July) at 44 locations for a total of 15.5 hours of effort.

Whitefish Bay, Michigan Personnel from LSSU and BMIC conducted spring and summer 2013 sampling in nearshore areas of Whitefish Bay near Naomikong Creek, Pendills Creek, and the Sheldrake River (Figure 4 and Table 5). No ruffe were captured. Sampling was conducted with a beach seine (46 m seine, two hauls) weekly at each location from June to mid-July 2013 for a total of 12 seine hauls at each location. Gill netting was conducted with small mesh (21.3 m, 9.5 mm to 38.1 mm stretch mesh) and large mesh gill nets (36.6 m, 25.4 mm to 63.5 mm stretch mesh) on six occasions from early May to early August 2013 for a total of 24 sets at each location.

A few undocumented but confirmed ruffe were reportedly captured in the tribal fishery located in southwestern Whitefish Bay (Mark Ebener, ITFAP personal communication).

Lake Superior South Shore Tributaries in Wisconsin and Michigan Personnel from the USFWS-MBS worked with staff from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), NPS, Red Cliff Band of Lake Superior Chippewa (RCBLSC), and private contractors to assess sea lamprey abundance in 17 southern Lake Superior tributaries (Wisconsin and Michigan) (Figure 4 and Table 5). No ruffe were captured. Sampling was conducted from March-July 2013 with fyke nets, permanent traps, and portable assessment traps for a total of 943 trap nights of effort. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Superior.

## **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), USFWS-Green Bay Fish and Wildlife Conservation Office (USFWS-Green Bay), WIDNR-Peshtigo Service Center (WIDNR-Peshtigo), and Inland Seas Education Association (ISEA) reported other fish sampling capable of capturing ruffe in Lake Michigan (Figures 4, 6, and 7; and Table 6). The MIDNR-Marquette was the only agency to report capturing ruffe, all from Little Bay de Noc (LBDN) in northern Green Bay where they were first detected in 2002. A total of nine ruffe were captured. Ruffe were not reported from outside of the known range.

Little Bay de Noc, Michigan of Green Bay Since 1988, personnel from the MIDNR-Marquette office have conducted annual summer fishery assessments in LBDN (also Big Bay de Noc (BBDN) and other areas of northern Lake Michigan – see below) using bottom trawls (3.7 m head rope) (Figure 6 and Table 6). No ruffe were captured. A total of 10 trawl tows for 1.7 hours effort was conducted at LBDN.

Since 2009, personnel from the MIDNR-Marquette office have also 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) (Figure 6 and Table 6). Nine ruffe were captured (all within the existing range). Sampling gear consisted of 97.5 m experimental gill nets that included a 25 mm stretch mesh panel to which ruffe were vulnerable. A total effort of 32 net sets was conducted at LBDN.

During July 2013, personnel from ISEA, a nonprofit environmental education organization, conducted bottom trawling (4.9 m head rope) in LBDN as part of their educational efforts targeting school groups (mainly grades 5-7) (Figure 4 and Table 6). No ruffe were captured following 0.8 hours of effort.

Big Bay de Noc, Michigan of Green Bay Personnel from the MIDNR-Marquette office conducted summer 2013 assessments in BBDN that were similar to those conducted in LBDN (described above) using bottom trawls (Figure 6 and Table 6). No ruffe were captured. A total of 11 trawl tows for 1.8 hours effort was conducted at BBDN.

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

Cedar River and Menominee River, Michigan of Green Bay Personnel from the MIDNR-Marquette office conducted summer 2013 bottom trawling and fall 2013 gill netting (described above for LBDN and BBDN) at the Cedar River, Michigan, and the Menominee River, Michigan, in northern Lake Michigan (Figure 6 and Table 6). No ruffe were captured following 10 trawl tows for 1.7 hours trawling effort and 12 net sets at each of the two locations.

Green Bay, Wisconsin Personnel from the WIDNR-Peshtigo office conducted fish sampling in Green Bay from June-August 2013 (Figure 4 and Table 6). No ruffe were captured following seine hauls (15.2 m beach seine) at 15 locations for a total of 51 seine hauls, and trawling at 12 locations for a total of 75 trawl tows and 6.3 hours trawling effort.

Green Bay, Wisconsin; Burns Harbor, Indiana; and Milwaukee, Wisconsin Personnel from the USFWS-Green Bay conducted fall 2013 sampling (late August and September) to detect presence and relative abundance of new nonindigenous invasive fish in Lake Michigan at Green Bay, Burns Harbor, and Milwaukee (Figure 4 and Table 6). No ruffe were captured. Sample gear consisted of fyke nets (0.9 m x 1.5 m box, 12.7 mm #126 mesh), mini-fyke nets (0.7 m x 1.0 m box, 3.175 mm #35 mesh), baited minnow trap arrays (five minnow traps tethered to one line, spaced 7.6 m apart), and electrofishing. A variety of habitats were sampled, but in general fyke and mini-fyke nets were located in 1-2 m of water, minnow trap arrays were deployed in 3-10 m of water, and electrofishing occurred in 1-3 m of water.

Green Bay sampling consisted of six fyke net trap nights, six mini-fyke net trap nights, and four electrofishing events. Burns Harbor sampling consisted of eight fyke net trap nights, eight mini-fyke net trap nights, ten minnow trap arrays, and eight electrofishing runs. Sampling in Milwaukee consisted of six fyke net trap nights, six mini-fyke net trap nights, ten minnow trap arrays, and eight electrofishing runs. In addition to the fall sampling, warm water discharges in Green Bay were sampled in December 2013. Sampling consisted of two electrofishing runs and five minnow trap arrays.

Grand Traverse Bay, Suttons Bay, and Frankfort in Michigan Personnel from ISEA completed 135 trawl tows of 10 minute duration for a total of 22.5 hours bottom trawling effort in Grand Traverse Bay, Suttons Bay, and Frankfort (Figure 4 and Table 6). No ruffe were captured.

Lake Michigan Tributaries in Wisconsin and Michigan Personnel from the USFWS-MBS/LBS worked with staff from the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI) and private contractors to conduct sampling in 18 Lake Michigan tributaries to assess sea lamprey abundance (Figure 4 and Table 6). No ruffe were captured. Sampling was conducted from April-June 2013 using fyke nets, permanent traps, portable assessment traps, and semi-permanent traps for a total of 1,482 trap nights of effort. Four tributaries were located within or on the periphery of the detected ruffe range in Green Bay. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Personnel from the WIDNR-Peshtigo office conducted fish sampling with boom electrofishing gear in the lower portions of the Menominee River, Michigan; Peshtigo River, Wisconsin; and Oconto River, Wisconsin from September-November 2013 (Figure 4 and Table 6). No ruffe were captured following eight sampling events at three locations in the Menominee River, three sampling events at two locations in the Peshtigo River, and two sampling events at two locations in the Oconto River.

Lake Michigan Nearshore/Offshore Personnel from the USGS-GLSC conducted annual fall bottom trawling (12 m head rope) during September 2013 to assess prey fish community abundance at seven locations around Lake Michigan (Manistique, Michigan; Frankfort, Michigan; Ludington, Michigan; Saugatuck, Michigan; Waukegan, Illinois; Port Washington, Wisconsin; and Sturgeon Bay, Wisconsin) (Figure 7 and Table 6). No ruffe were captured. Ten minute trawl tows were conducted at 5-132 m depths for a total of 74 tows and 11.3 hours of effort.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Michigan.

## **ST. MARYS RIVER**

The USFWS-Ashland, OMNR-UGLMU, St. Marys River Fisheries Task Group (SMRFTG), USFWS-MBS, and USFWS-Alpena reported other fish sampling that was capable of capturing ruffe in the St. Marys River (Figures 4 and 8, and Tables 5 and 7). No ruffe were captured.

St. Marys River-Upstream of Locks Personnel from the USFWS-Ashland and OMNR-UGLMU conducted sampling in U.S. and Canadian waters of the St. Marys River upstream of the Soo Locks to detect presence and relative abundance of new nonindigenous invasive fish (Figure 4 and Table 5). No ruffe were captured. Sampling was conducted from August-September 2013 and consisted of 20 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 0.8 hours bottom trawling (4.9 m head rope), and 3.3 hours electrofishing.

St. Marys River- Locks Downstream Personnel from the USFWS-Alpena and OMNR-UGLMU conducted sampling in U.S. and Canadian waters of the St. Marys River downstream of the Soo Locks to De Tour Village, Michigan to detect presence and relative abundance of new nonindigenous invasive fish (Figure 4 and Table 7). No ruffe were captured. Sampling was conducted during August 2013 and was similar to sampling conducted in the upper St. Marys River by the USFWS-Ashland (see above). Effort consisted of 15 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 1.3 hours bottom trawling (4.9 m head rope), and 2.3 hours nighttime electrofishing.

River wide The SMRFTG is an international multiagency group that was established in 1997 by the Great Lake Fishery Commission's Lake Huron Committee (LHC). Member agencies include the MIDNR, OMNR, Department of Fisheries and Oceans Canada (DFO), ITFAP, USGS, USFWS, and others. The SMRFTG conducted annual fall nighttime boat electrofishing in September 2013 to assess juvenile walleye at seven locations for a total of 22 transects across the St. Marys River (Figure 4 and Table 7). No ruffe were captured. Sampling locations included the Sault area, Lake Nicolet, Lake George, Lake Munuscong, Raber Bay, Potagannissing Bay, and St. Joseph Channel. A total of 22.6 hours of effort was conducted.

The SMRFTG also conducted a coordinated river wide gill net survey during August 2013 to assess and provide information on the abundance, growth, mortality, and size structure of important fish populations found in the St. Marys River (Figure 8 and Table 7). No ruffe were captured. Sample gear consisted of multifilament gill nets (304.8 m nets that included a 25 mm stretch mesh panel to which ruffe were vulnerable) fished overnight on the bottom at 37 locations.

Personnel from the USFWS-MBS conducted sampling in the St. Marys River to assess sea lamprey abundance (Figure 4 and Table 7). No ruffe were captured. Sampling was conducted from May-July 2013 using portable assessment traps. A total of 689 trap nights of effort was conducted. A summary of fish species captured at these locations is available upon request from USFWS-MBS.

Unconfirmed Sightings No unconfirmed sightings were reported for the St. Marys River.

## **LAKE HURON**

The MIDNR-Alpena, Michigan Department of Natural Resources-Lake St. Clair Fisheries Research Station (MIDNR-Lake St. Clair), Department of Fisheries and Oceans Canada-Great Lakes Laboratory for Fisheries and Aquatic Sciences (DFO-GLLFAS), USFWS-MBS/LBS, and USFWS-Alpena reported other fish sampling that was capable of capturing ruffe in Lake Huron (Figures 4 and 9, and Table 7). No ruffe were captured.

Les Cheneaux Islands, Michigan Since 1969, personnel from the MIDNR-Alpena office have conducted an annual fall survey in the Les Cheneaux Islands area to gauge trends and assess the current status of the fisheries resources (Figure 4 and Table 7). No ruffe were captured following six gill net sets from September-October 2013. Each gill net included a 30.5 m panel of 38 mm stretch mesh to which ruffe would be vulnerable.

Thunder Bay, Michigan Personnel from the MIDNR-Alpena office conducted bottom trawling from July - August 2013 at locations off North Point and off Black River in Thunder Bay to assess young-of-the-year lake trout and juvenile lake whitefish (Figure 4 and Table 7). No ruffe were captured. A total of 6.3 hours of sampling effort was conducted with an 11 m trawl (11 m head rope, semi-balloon otter trawl with 23 m bridle, and 13 mm stretch mesh cod end) and 2.0 hours of sampling effort was conducted with a 5.3 m trawl (5.3 m head rope, semi-balloon otter trawl with 1.7 m bridle and 6.35 mm stretch mesh cod).

Personnel from the MIDNR-Alpena office also conducted sampling with gill nets in Thunder Bay from June-August 2013 (Figure 4 and Table 7). No ruffe were captured. Effort consisted of 16 sets of a graded mesh nylon gill net that included one panel of 38 mm stretch mesh to which ruffe were vulnerable. A 33.3 m micromesh monofilament gill net (containing 12.7 mm, 15.9 mm, and 19.1 mm stretch mesh) was also used for a total of 18 sets during sampling.

Saginaw Bay, Michigan Personnel from the MIDNR-Lake St. Clair office conducted fall 2013 (September) bottom trawling (10 m head rope) at eight locations in Saginaw Bay as part of an annual survey to assess the fish community (Figure 4 and Table 7). No ruffe were captured following a total of 24 tows for 3.8 hours of effort.

Personnel from the MIDNR-Alpena office conducted graded mesh gill netting at the inner and outer portions of Saginaw Bay during September 2013 to assess the fish community (Figure 4 and Table 7). No ruffe were captured. Each net included a 30.5 m panel of 38 mm stretch mesh to which ruffe were vulnerable. A total of 40 net sets were conducted.

Lake Huron Tributaries in Michigan Personnel from the USFWS-MBS/LBS and private contractors conducted sampling in 12 Lake Huron tributaries to assess sea lamprey abundance (Figure 4 and Table 7). No ruffe were captured. Sampling was conducted from April-June 2013 and May-July 2013 using fyke nets, permanent traps, portable assessment traps, and semi-permanent traps. A total of 786 trap nights of effort were conducted. A summary of fish species captured at trap locations is available upon request from the USFWS-MBS.

Lake Huron East Shore Tributaries, Ontario Personnel from the DFO-GLLFAS conducted sampling at 11 tributaries along the east shore of Lake Huron from July-September 2013 (Figure 9 and Table 7). No ruffe were captured. Sampling locations included the Ausable River, Bayfield River, Coldwater Creek, Hog Creek, Maitland River, Mississagi River, Nottawasaga River, Sable River, Serpent River, Spanish River, and Sturgeon River. Boat electrofishing, seining (15 m beach seine), and fyke netting (1.3 m box fyke net) was used to sample the fish community. A total effort of 8.6 hours electrofishing, 10 seine hauls, and 39 trap nights was conducted.

Southern Lake Huron Personnel from the USFWS-Alpena conducted small mesh gill netting (91 m nets with 15 m panels of 25 mm and 38 mm stretch mesh to which ruffe would be vulnerable) in U.S. and Canadian waters of Lake Huron to capture young-of-year and juvenile lake sturgeon (Figure 4 and Table 7). No ruffe were captured. Sampling was conducted in September 2013 at 16 locations.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Huron.

## **HURON ERIE WATERWAY**

The MIDNR-Lake St. Clair and USFWS-Alpena reported other fish sampling capable of capturing ruffe in the Huron Erie Waterway which includes the St. Clair River, Lake St. Clair, and Detroit River (Figure 10 and Table 8). No ruffe were captured.

St. Clair River, Michigan Personnel from the USFWS-Alpena conducted small mesh gill netting (91 m nets with 15 m panels of 25 mm and 38 mm stretch mesh to which ruffe would be vulnerable) in U.S. waters of the St. Clair River to capture young-of-year and juvenile lake sturgeon (Figure 10 and Table 8). No ruffe were captured. Sampling was conducted in September 2013 at 20 locations. The USFWS-Alpena also set Gee minnow traps baited with cheese in an effort to collect a variety of benthic species at one location within U.S. waters of the St. Clair River during May 2013. No ruffe were captured following six trap sets.

Lake St. Clair, Michigan Personnel from the MIDNR-Lake St. Clair office conducted bottom trawling (10 m head rope and 5 m head rope) at locations in Lake St. Clair as part of an annual survey to assess the fish community (Figure 10 and Table 8). No ruffe were captured. A total of nine tows for 1.3 hours of sampling effort were conducted at one location during May and September 2013 with the 10 m trawl. Four tows for 0.7 hours of sampling effort were conducted at one location during April 2013 with the 5 m trawl.

Personnel from the MIDNR-Lake St. Clair office also conducted small mesh trap netting and experimental gill netting (gill nets contained a panel of 25 mm stretch mesh to which ruffe were vulnerable) in Lake St. Clair (Figure 10 and Table 8). No ruffe were captured. A total of 46 trap sets were conducted at four locations from April-May 2013. Gill net sets were conducted at six locations during October 2013.

Detroit River, Michigan and Ontario Personnel from the USFWS-Alpena conducted small mesh gill netting (91 m nets with 15 m panels of 25 mm and 38 mm stretch mesh to which ruffe were vulnerable) in U.S. and Canadian waters of the Detroit River to capture young-of-year and juvenile lake sturgeon (Figure 10 and Table 8). No ruffe were captured. Sampling was conducted during September 2013 at 14 locations. The USFWS-Alpena also set Gee minnow traps baited with cheese in an effort to collect a variety of benthic species at 15 locations in U.S. and Canadian waters of the Detroit River during April, May, and July 2013. No ruffe were captured following 156 trap sets.

Personnel from the USFWS-Alpena also conducted sampling in U.S. and Canadian waters of the Detroit River to detect presence and relative abundance of new nonindigenous invasive fish (Figure 10 and Table 8). No ruffe were captured. Sampling took place during August 2013 and consisted of 12 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end), 0.5 hours bottom trawling (4.9 m head rope), and 0.8 hours nighttime electrofishing.

Unconfirmed Sightings No unconfirmed sightings were reported for the Huron Erie waterway.

## **LAKE ERIE**

The Ohio Department of Natural Resources-Sandusky Fish Research Unit (ODNR-Sandusky), ODNR-Fairport Fish Research Unit (ODNR-Fairport), USGS-Lake Erie Biological Station (USGS-LEBS), USFWS-MBS/LBS, USFWS-Lower Great Lakes, and USFWS-Alpena reported other fish sampling that was capable of capturing ruffe in Lake Erie (Figures 10, 11, and 12; and Table 8). No ruffe were captured.

Maumee Bay and Sandusky Bay in Ohio Personnel from the USFWS-Alpena conducted sampling in Maumee and Sandusky bays to detect the presence and relative abundance of new nonindigenous invasive fish (Figure 10 and Table 8). No ruffe were captured. Sampling took place from August-October 2013. Maumee Bay effort consisted of 15 paired fyke net trap nights (paired fyke nets consist of one lead with a fyke net at each end) and 1.3 hours bottom trawling (4.9 m head rope with a 3.8 cm stretch mesh body). Sandusky Bay effort consisted of three paired fyke net trap nights, 1.3 hours bottom trawling, and 2.5 hours nighttime electrofishing.

Western Basin of Lake Erie in Ohio Personnel from the ODNR-Sandusky office conducted bottom trawling (10.7 m head rope) in the western basin of Lake Erie from May-September 2013 to assess the relative abundance and growth of predator and forage fish species (Figure 11 and Table 8). No ruffe were captured. Ten minute trawl tows were conducted at water depths ranging from 1.2-12.5 m. A total of 137 tows were conducted over 36 locations for a total of 22.8 hours of effort.

Personnel from the USFWS-Lower Great Lakes conducted spring, summer, and fall 2013 bottom trawling and electrofishing to detect the presence of aquatic invasive species in U.S. waters of the western basin of Lake Erie (Figure 10 and Table 8). No ruffe were captured following a total of 7.8 hours trawling (4.9 m head rope) at 47 locations and a total of 7.7 hours electrofishing at 46 locations.

Personnel from the USFWS-Alpena conducted small mesh gill netting (91 m nets with 15 m panels of 25 mm and 38 mm stretch mesh to which ruffe were vulnerable) in U.S. and Canadian waters of the western basin of Lake Erie to capture young-of-year and juvenile lake sturgeon (Figure 10 and Table 8). No ruffe were captured. Sampling was conducted from August-September 2013 at 15 locations for a total of 27 sets.

Central Basin of Lake Erie in Ohio Personnel from the ODNR-Fairport office conducted bottom trawling (10.4 m head rope, Yankee two seam) in the central basin of Lake Erie from April-October 2013 to assess the relative abundance and growth of predator and forage fish species (Figure 11 and Table 8). No ruffe were captured. Five minute tows (5-10 m depths) and ten minute tows were conducted at water depth strata ranging from 10-15 m, 15-20 m, and > 20 m. A total of 168 trawl tows were conducted at five locations for 24.5 hours of effort.

Personnel from the ODNR-Fairport office also conducted gill netting (bottom set) in the central basin of Lake Erie from September-November 2013 to assess the adult abundance of walleye and smallmouth bass (Table 8). No ruffe were captured. Sampling gear consisted of 182 m monofilament gill nets that included one panel of 32 mm stretch mesh to which ruffe were vulnerable. Eight locations were sampled and a total of 54 overnight sets were completed.

Lake Erie South Shore Tributaries in Ohio and New York Personnel from the USFWS-MBS/LBS worked with private contractors to conduct sampling in four Lake Erie tributaries to assess sea lamprey abundance (Figure 10 and Table 8). No ruffe were captured. Sampling was conducted from April-June 2013 using portable assessment traps. A total of 332 trap nights of effort was conducted. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Lake Erie Nearshore/Offshore in Ohio Personnel from the USGS-LEBS conducted annual bottom trawling (7.9 m head rope) in nearshore and offshore areas to assess the status of fish stocks in Lake Erie (Figure 12 and Table 8). No ruffe were captured. Ten minute trawl tows were conducted in June and from August-October 2013 at 2.6-30.8 m water depths for a total of 23.1 hours of sampling effort.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Erie.

## **LAKE ONTARIO**

The USFWS-MBS/LBS and USGS-Lake Ontario Biological Station (USGS-LOBS) 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.

Lake Ontario South Shore Tributaries in New York Personnel from the USFWS-MBS/LBS worked with private contractors to conduct sampling in six Lake Ontario tributaries to assess sea lamprey abundance (Figure 10 and Table 9). No ruffe were captured. Sampling was conducted from March-June 2013 using portable assessment traps and permanent traps for a total of 385 trap nights of effort. A summary of fish species captured at these locations is available upon request from USFWS-MBS.

Lake Ontario Nearshore/Offshore in New York Personnel from the USGS-LOBS and New York State Department of Environmental Conservation (NYSDEC) conducted annual bottom trawling (18.0 m head rope) in U.S. waters of Lake Ontario to assess the status of major prey fish stocks and juvenile lake trout (Figure 13 and Table 9). No ruffe were captured. Twelve to fourteen transects spanning the U.S. shoreline (25 km intervals) were sampled from March-June 2013, and six sites were sampled from September-October 2013. Bottom trawls depths ranged from 8-175 m at each transect. A total of 310 bottom trawls were conducted which resulted in 43.8 hours of sampling.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Ontario

## **GREAT LAKES**

The Nature Conservancy (TNC), the University of Notre Dame (UND), and Central Michigan University (CMU) conducted a study funded by the Great Lakes Restoration Initiative (GLRI) to test for the presence of ruffe environmental DNA (eDNA) across the Great Lakes at a number of nearshore and tributary locations where ruffe have been sighted or where ballast mediated dispersal models predict high probability of ruffe release. Environmental DNA is DNA that is found as a result of tissue or fluids/excrement that is shed from species into the environment.

The Nature Conservancy, UND, and CMU worked with USFWS to collect water samples in the fall of 2012 and spring of 2013 from 24 locations across the Great Lakes including seven locations on Lake Superior and the upper St. Marys River, seven locations on Lake Huron, eight locations on Lake Michigan, and two locations on Lake Erie. The samples were filtered and analyzed for the presence of ruffe DNA. Samples collected from the Tahquamenon River on Lake Superior, Waiska River on the St. Marys River, Cheboygan River on Lake Huron, and Calumet Harbor on Lake Michigan tested positive for the presence of ruffe eDNA. Positive findings were detected within (Tahquamenon River and Cheboygan River) and outside (Waiska River and Calumet Harbor) of the known range for ruffe. Information on this project will be published at a later date.

## **DISCUSSION**

The summary of information gathered in 2013 indicates that ruffe continue to persist in areas where they have become established. Findings by TNC have yet to determine if their range may have expanded into nearby areas on Lake Superior and into distant areas in Lake Michigan. A synopsis by water body follows.

### **LAKE SUPERIOR**

Although dedicated ruffe surveillance was not conducted within Lake Superior, reports from other sampling conducted in 2013 by the USGS-LSBS, USFWS-MBS, OMNR-UGLMU, USFWS-Ashland, and WIDNR-Superior indicated that ruffe continued to persist in areas where they were previously established. Ruffe were reported in western Lake Superior at the Thunder Bay Harbour (Ontario) to Chequamegnon Bay (Wisconsin). No range expansion was detected based on incidental reports.

The known range of ruffe on the eastern end of Lake Superior is the Tahquamenon River in Whitefish Bay (Michigan), where ruffe were first captured in 2006. Although fish sampling was not conducted in the Tahquamenon River in 2013, ruffe eDNA was detected in water samples collected from the river in the spring by TNC. ITFAP also confirmed reports of ruffe captures from western Whitefish Bay (Mark Ebener, ITFAP personal communication). Fish sampling conducted in Whitefish Bay by LSSU and BMIC at nearshore areas north of the Tahquamenon River and at Naomikong Creek did not detect ruffe.

## **ST. MARYS RIVER**

No ruffe were captured from the St. Marys River as a result of dedicated ruffe surveillance activities conducted by the USFWS, or as a result of other fish sampling that was conducted by the SMRFTG and USFWS in the area. Dedicated ruffe surveillance was initiated in the St. Marys River by the USFWS in 2000 and sampling locations were expanded within the river to provide for better coverage spatially.

There is concern that ruffe may move into the St. Marys River from Whitefish Bay, Lake Superior. Ruffe were first detected in Whitefish Bay (Michigan) at the Tahquamenon River in 2006, and confirmed ruffe sightings from western Whitefish Bay in 2013 (Mark Ebener, ITFAP personal communication) may indicate that ruffe are moving within the area. The warmer habitats, tributaries, and estuary areas adjacent to deeper dredged channels found in the St. Marys River may provide ideal habitat that allow ruffe to thrive. The St. Marys River is a major connecting channel within the Great Lakes and if ruffe reproduce and spread within the river, the river could serve as a vector to allow their migration into northern Lake Huron via connections at DeTour, Michigan, and into Ontario waters of the North Channel.

In the spring of 2013, The Nature Conservancy and partners collected water samples at a number of locations above the Soo Locks and below the Locks near Sugar Island in an effort to determine if ruffe eDNA was present. One location, the Waiska River (Michigan), tested positive for the presence of ruffe eDNA. The Nature Conservancy will be publishing information on this study and their findings in the near future. The vector for the ruffe eDNA is unknown. Recreational and subsistence fishermen use Waiska Bay; and public education, fish sampling, and soliciting angler reports of ruffe sightings will help indicate whether or to what extent ruffe are present.

## **LAKE MICHIGAN**

Although dedicated ruffe surveillance was not conducted on Lake Michigan, 2013 reports from other fish surveys conducted by MIDNR-Marquette indicated that ruffe continued to persist in LBDN (Michigan) of northern Green Bay. Ruffe were not captured outside of LBDN in 2013, and no expansion out of Green Bay was detected based on reports from other agencies including the WIDNR, USGS, ISEA, and USFWS.

Little and Big Bay de Nocs, Michigan of Northern Green Bay Ruffe were first discovered in Green Bay at LBDN in Escanaba, Michigan, during 2002 and also detected at BBDN in 2004, then were found in southern Green Bay near Marinette, Wisconsin, in 2007. Annual sampling by the MIDNR-Marquette to assess the fish communities of LBDN and BBDN continued to capture ruffe in LBDN through 2013. The ruffe were captured with gill nets in low numbers that were comparable to catches of ruffe at the same location in recent years. Personnel from the MIDNR-Marquette have captured ruffe each year since 2002, and catches have ranged from a high of 40 ruffe in 2006 to a low of two ruffe in 2009 and 2011. Catches of ruffe in recent years (2011-2013) have ranged between two ruffe captured in 2001 to nine captured in 2012. Ruffe continued to be absent from the MIDNR-Marquette catch in BBDN during 2013. Their personnel have not captured ruffe from BBDN since they

first discovered one ruffe there in the fall of 2004.

TNC and partners collected water samples from a number of Lake Michigan tributaries in 2013, including areas in Green Bay (Michigan/Wisconsin), in an effort to determine if ruffe eDNA was present. They did not detect ruffe eDNA from the Green Bay area; however samples collected from the Calumet Harbor (Illinois) in southern Lake Michigan tested positive for ruffe eDNA. The Nature Conservancy will be publishing information on this study and their findings in the near future. Ruffe have not been reported from other fish sampling that has been conducted in the area and the source of the eDNA is unknown.

## **LAKE HURON**

No ruffe were captured during dedicated ruffe surveillance conducted by the USFWS or other fish sampling reported by the MIDNR, DFO, or USFWS in Lake Huron during 2013. Ruffe were not captured from the Cheboygan River (Michigan) where sightings were reported in 2011 and 2012 or the Trout River (Michigan) where a sighting was reported in 2008. They also remain absent from the Thunder Bay area (Michigan) where they were captured from 1995 through 2003.

Cheboygan River, Michigan Ruffe were first reported from the Cheboygan River in 2011 where one ruffe was incidentally captured in a trap operated by the USFWS-MBS at the first dam on the river. A second ruffe was reported in 2011 from the same location. Ruffe were not captured during trapping operations conducted by the USFWS-MBS during 2013. The USFWS-Alpena conducted nighttime electrofishing efforts targeting ruffe in the Cheboygan River during the spring, however no ruffe were detected.

The status of ruffe in the Cheboygan River is unknown. It is not known whether the ruffe trapped in 2011 and 2012 were random individuals or if they were part of a ruffe colony populating the river. If ruffe are present, they are likely low in number. Recreational anglers, often the first to detect new species, have not reported capturing ruffe from the area. One may speculate that ruffe found in the Cheboygan River may have migrated north from historically infested areas of Thunder Bay or have been transferred via ship ballast water from other infested areas of the Great Lakes.

Trout River, Michigan Ruffe were first reported from the Trout River in 2008 when two were incidentally captured in a trap operated by the USFWS-MBS at the first barrier on the river. Ruffe were not captured during trapping operations conducted by the USFWS-MBS since that initial discovery. The USFWS-Alpena conducted daytime electrofishing downstream from the barrier during the spring of 2013 in an effort to collect ruffe from the area; however, no ruffe were captured.

Like the Cheboygan River, the status of ruffe in the Trout River is unknown. The origin of ruffe captured from the Trout River in 2008 may have resulted from ballast water transfer to the nearby Port of Calcite in Rogers City, Michigan, from other infested locations around the Great Lakes or migration north from historically infested areas of Thunder Bay.

Thunder Bay River, Michigan Ruffe were first captured from the Thunder Bay River in 1995 during dedicated ruffe surveillance efforts conducted by the USFWS-Ashland. Abundance of ruffe peaked in the river during 1999 when they were the most abundant species captured during bottom trawls. By 2003, the abundance of ruffe had declined, possibly as the result of round goby invasion or targeted efforts to remove spawning adults during the spring. Ruffe have not been captured from the Thunder Bay River or the Alpena area since 2003 despite annual dedicated surveillance. In 2013, ruffe surveillance trawling was conducted by the USFWS-Alpena in the Thunder Bay River and shipping channel during the fall, and additional targeted ruffe sampling using nighttime electrofishing and trapping was conducted in the Thunder Bay River during the spring. However, ruffe continue

to be absent from the catch.

## **LOWER GREAT LAKES**

Ruffe have not been detected in the lower Great Lakes (Lakes Erie and Ontario) or the Huron Erie Waterway despite dedicated ruffe surveillance efforts in Lakes Erie and Ontario by the USFWS and other fish sampling that was reported by the OHDNR, USGS, and the USFWS.

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

The 2013 range of ruffe in the Great Lakes is as follows (Figure 14):

Lake Superior North Shore: U.S. waters from the Duluth/Superior Harbor, Minnesota/Wisconsin, to Canadian waters near the mouth of the Current River near Thunder Bay Harbour, Ontario.

South Shore: U.S. waters from the Duluth/Superior Harbor, Minnesota/Wisconsin, to the Tahquamenon River, Michigan, a tributary in western Whitefish Bay.

Lake Michigan Green Bay.

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

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

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

Huron Erie Waterway Undetected.

Lake Erie and Lake Ontario Undetected.

Great Lakes Basin Inland Lakes and Streams Undetected.

## **ACKNOWLEDGMENTS**

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

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

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

Thank you to personnel from other agencies and offices who provided information on their sampling that was capable of capturing ruffe incidentally and/or assisted with review of this document.

Jessica Barber, U.S. Fish and Wildlife Service- Marquette Biological Station  
 Andrew Briggs, U.S. Fish and Wildlife Service- Alpena Fish and Wildlife Conservation Office  
 Lori Evrard, U.S. Geological Survey- Lake Superior Biological Station  
 David Fielder, Michigan Department of Natural Resources- Alpena Fisheries Research Station  
 Neal Godby, Michigan Department of Natural Resources- Gaylord Field Station  
 Stephen Hensler, U.S. Fish and Wildlife Service- Alpena Fish and Wildlife Conservation Office  
 Kevin Kayle, Ohio Department of Natural Resources- Fairport Fish Research Unit  
 Kenneth King, U.S. Fish and Wildlife Service- Green Bay Fish and Wildlife Conservation Office  
 Patrick Kocovsky, U.S. Geological Survey- Lake Erie Biological Station  
 Charles Madenjian, U.S. Geological Survey- Great Lakes Science Center  
 Ashley Moerke, Lake Superior State University-Department of Biological Sciences  
 Jared Myers, Wisconsin Department of Natural Resources- Lake Superior Field Unit  
 Lisa O'Connor, Fisheries and Oceans Canada- Great Lakes Laboratory for Fisheries and Aquatic Sciences  
 Chris Olds, U.S. Fish and Wildlife Service- Alpena Fish and Wildlife Conservation Office  
 Tammie Paoli, Wisconsin Department of Natural Resources- Peshtigo Service Center  
 Henry Quinlan, U.S. Fish and Wildlife Service- Ashland Fish and Wildlife Conservation Office  
 Tony Rieth, U.S. Fish and Wildlife Service- Green Bay Fish and Wildlife Conservation Office  
 Mike Ripley, Chippewa Ottawa Resource Authority- Inter-Tribal Fisheries and Assessment Program  
 Emily Shaw, Inland Seas Educational Association  
 Timothy Strakosh, U.S. Fish and Wildlife Service- Green Bay Fish and Wildlife Conservation Office  
 Mike Thomas, Michigan Department of Natural Resources- Lake St. Clair Fisheries Research Station  
 Andrew Tucker, The Nature Conservancy- Notre Dame Environmental Change Initiative  
 Mark Turner, Ohio Department of Natural Resources- Sandusky Fish Research Unit  
 Brian Weidel, U.S. Geological Survey- Lake Ontario Biological Station  
 William Wellenkamp, Michigan Department of Natural Resources- Alpena Fisheries Research Station  
 Frank Zomer, Bay Mills Indian Community  
 Troy Zorn, Michigan Department of Natural Resources- Marquette Fisheries Research Station

**Assisted with Ruffe Surveillance or Data Analysis**

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

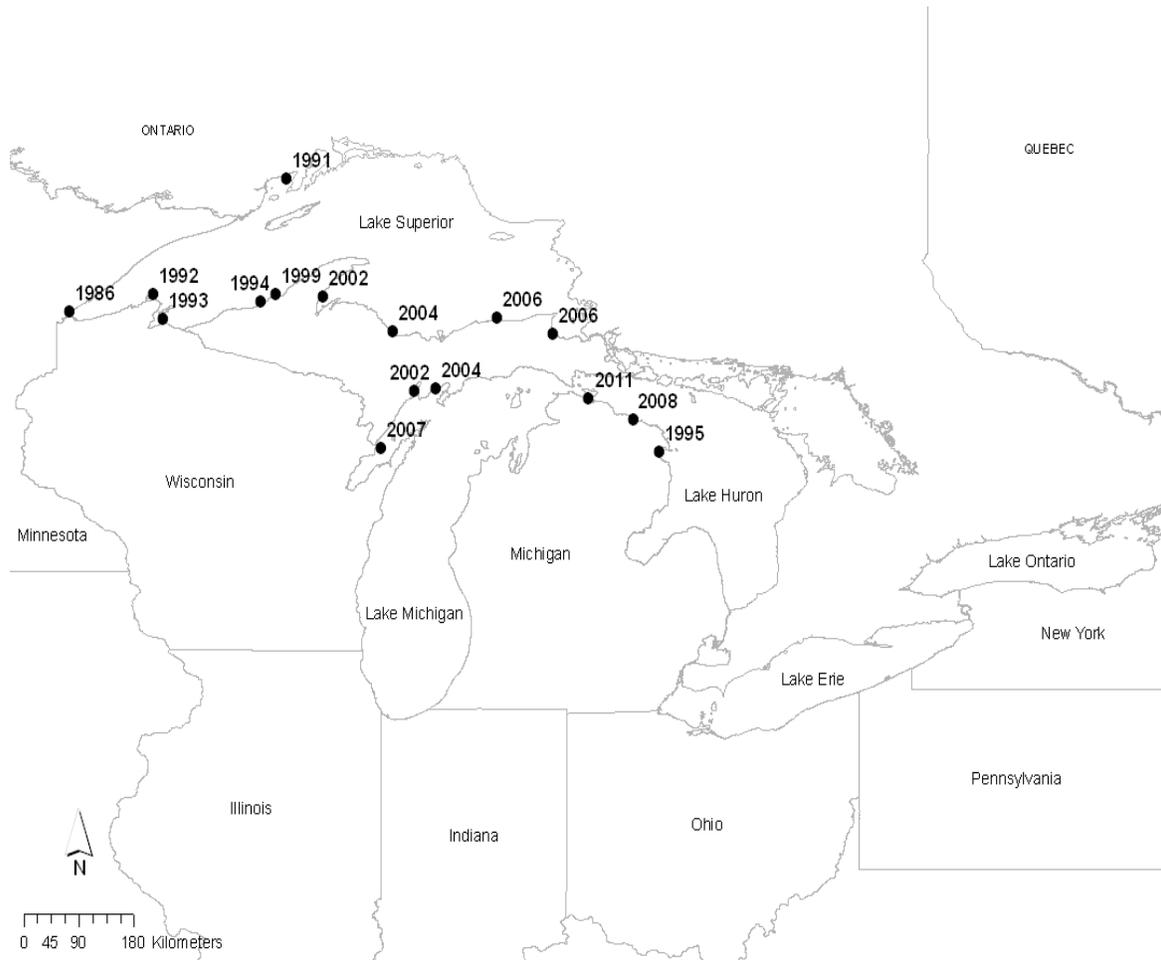
Denise Clay (USFWS-Lower Great Lakes)	Scott Sanders (USFWS-Lower Great Lakes)
Steven Gambicki (USFWS-Alpena)	Eric Snyder (USFWS-Lower Great Lakes)
Robert Haltner (USFWS-Lower Great Lakes)	Joseph Curtis (Volunteer USFWS-Alpena)
Heidi Himes (USFWS-Lower Great Lakes)	Edward Czarnecki (Volunteer USFWS-Alpena)
Kelly McDonald (USFWS-Lower Great Lakes)	Heather Rawlings (USFWS-Alpena)
Joseph Gerbyshak (USFWS-Alpena)	Mel Haas (Volunteer USFWS-Alpena)

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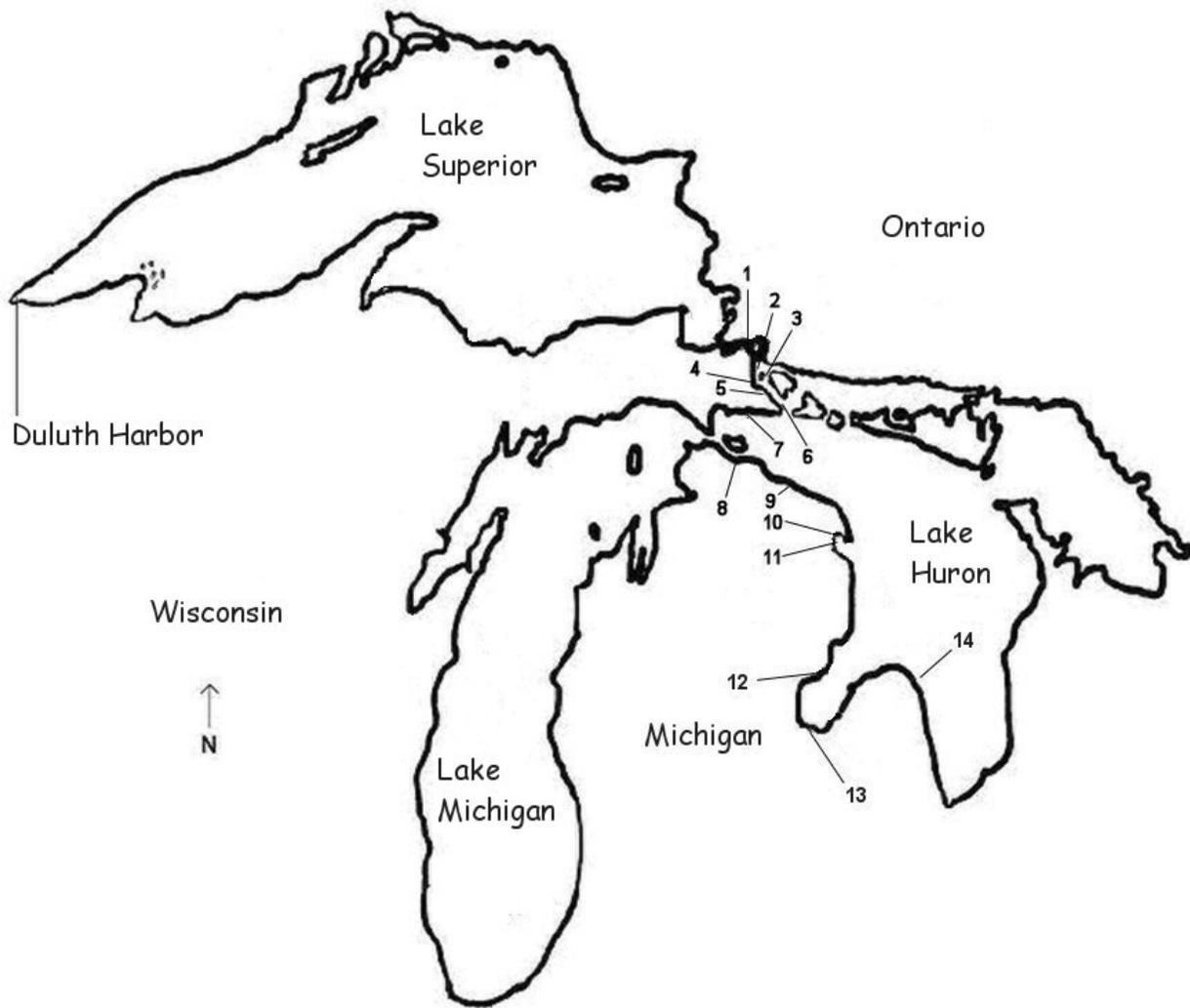
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### Progression of Ruffe Across the Great Lakes

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



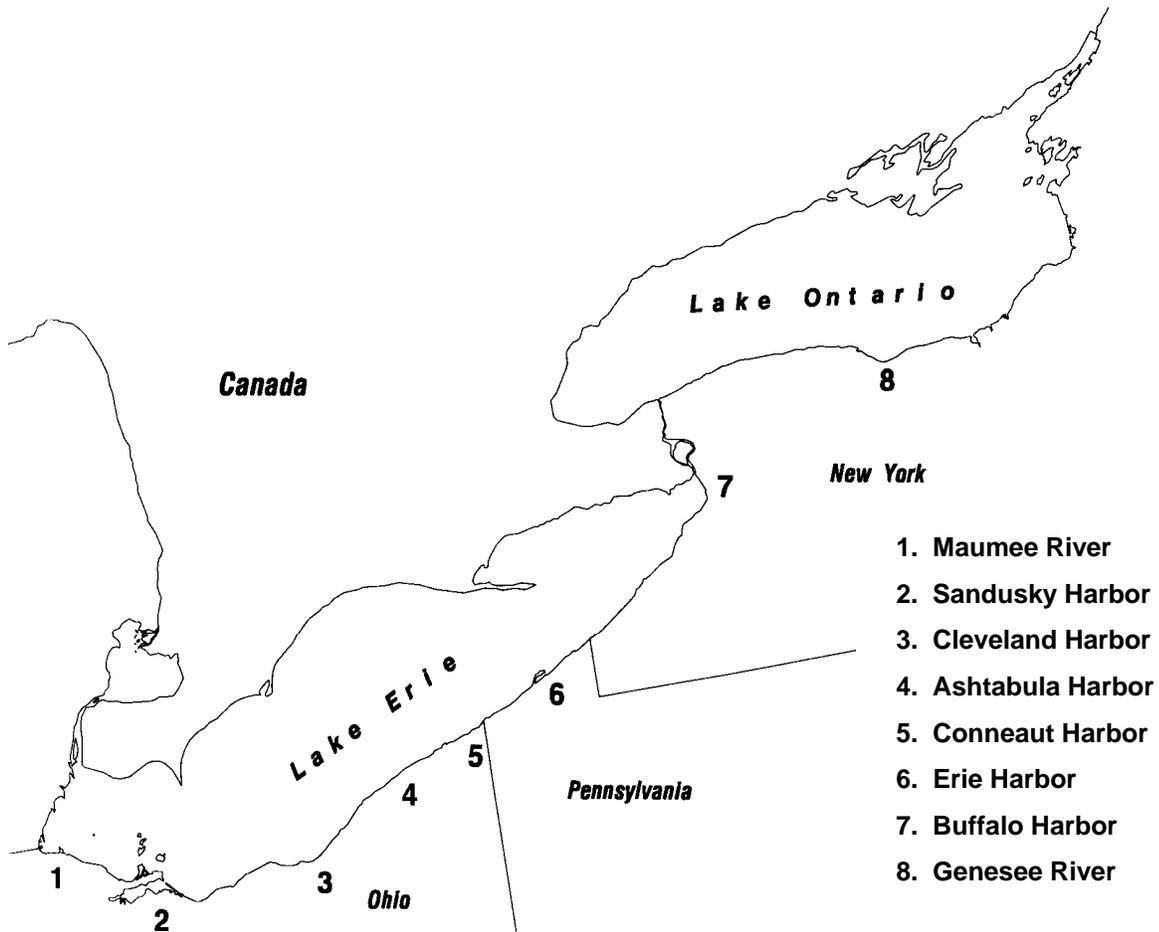
**Ruffe Surveillance, St. Marys River/Lake Huron, 2013**



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

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

**Figure 2.** Locations surveyed for ruffe in the upper Great Lakes during 2013.

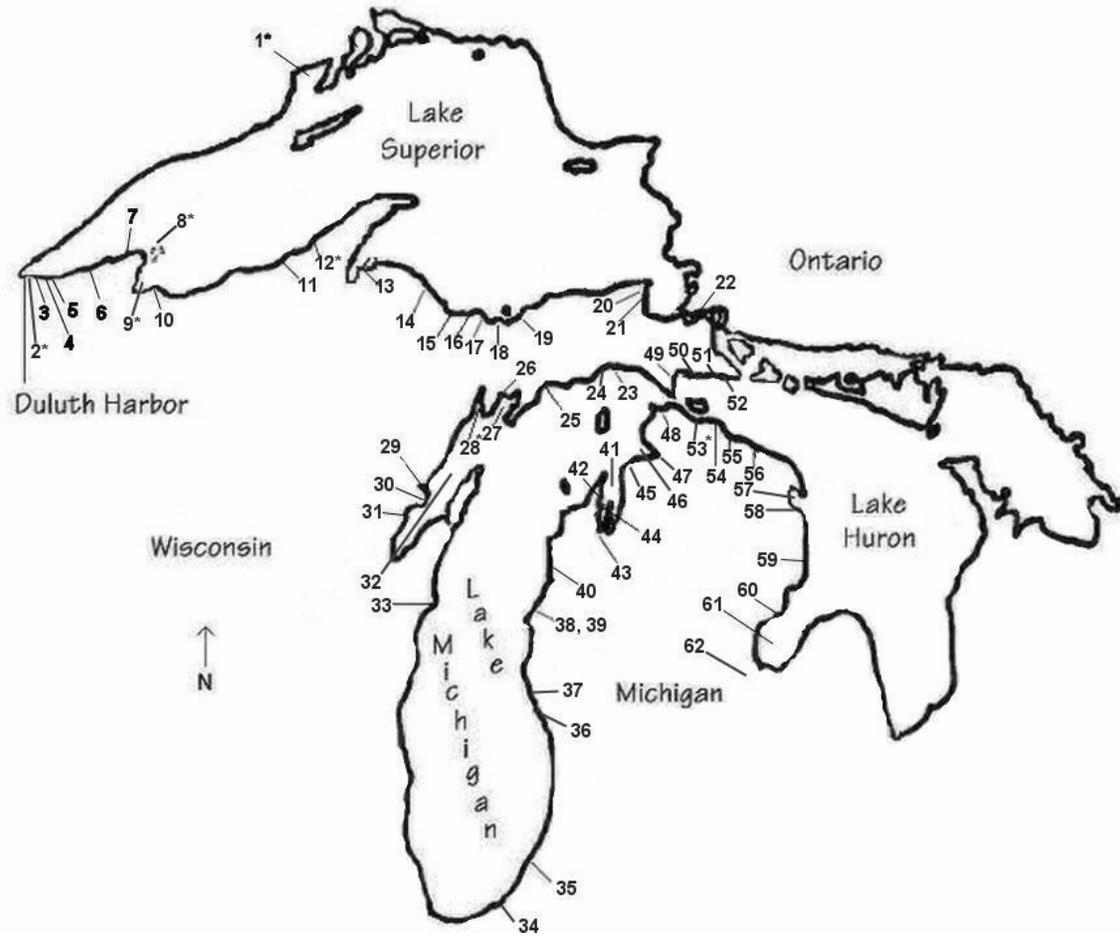


**Ruffe Surveillance, Lake Erie/Lake Ontario, 2013**



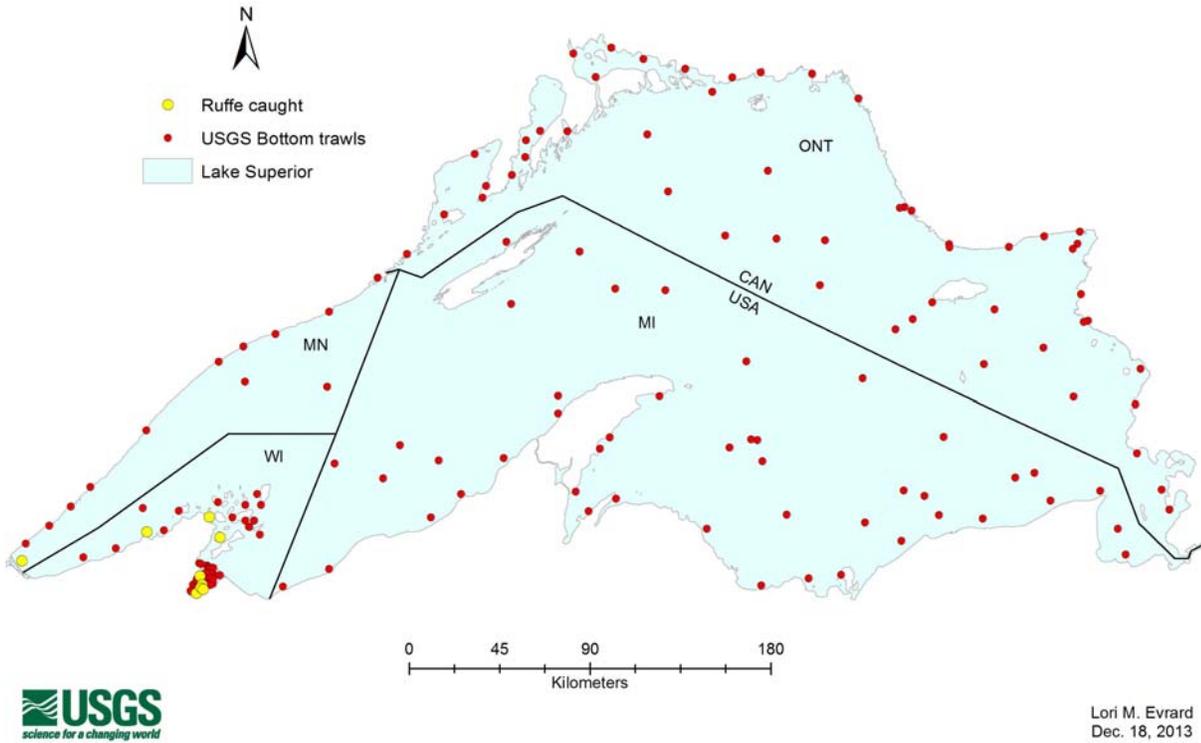
**U. S. Fish and Wildlife Service**

**Figure 3.** Locations surveyed for ruffe in the lower Great Lakes during 2013.



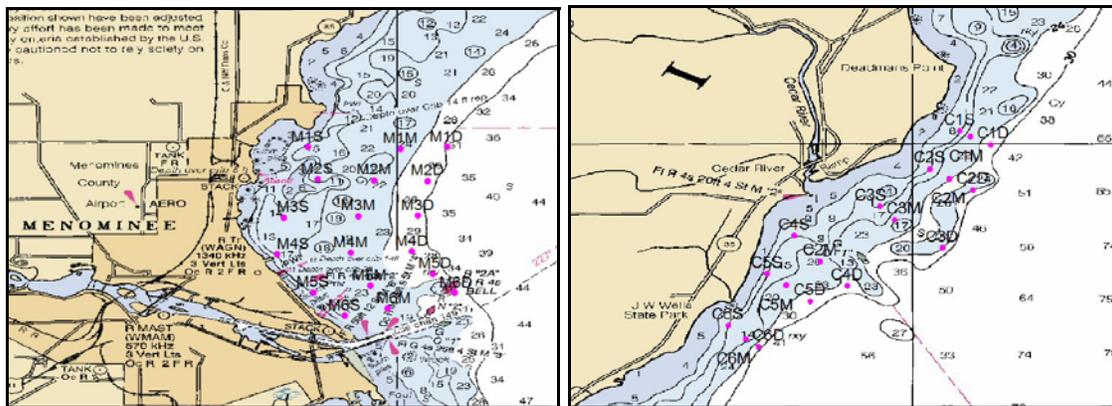
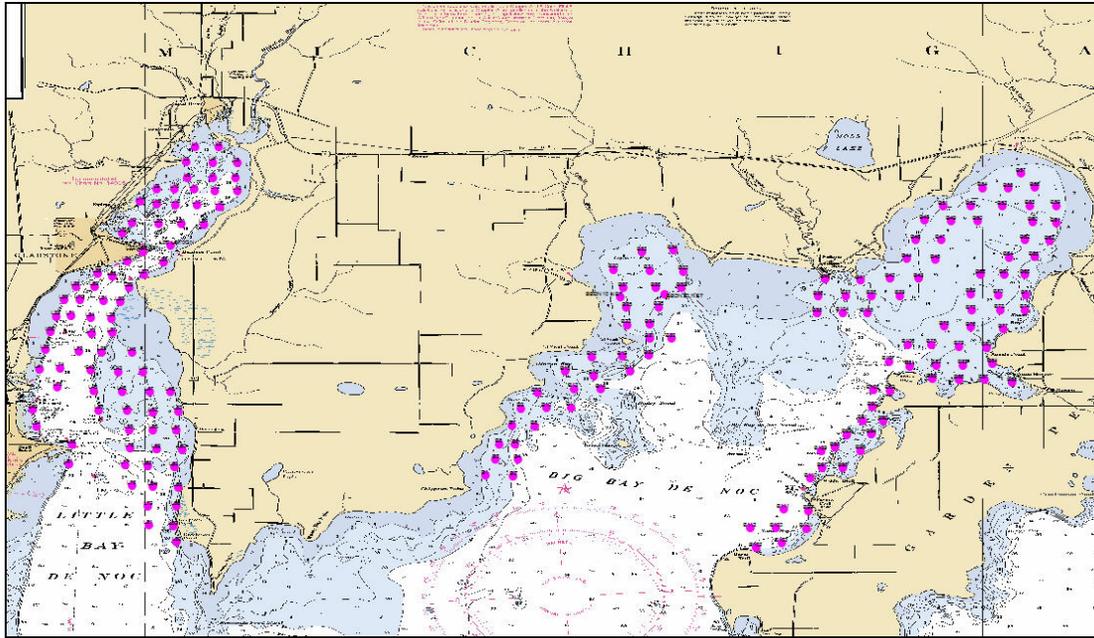
- |                              |                                  |                           |                         |
|------------------------------|----------------------------------|---------------------------|-------------------------|
| 1. Thunder Bay Harbour *     | 18. Furnace Creek    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

**Figure 4.** Reported sampling locations in the upper Great Lakes where ruffe were capable of incidental capture during 2013. The \* denotes locations where ruffe were captured.



U. S. Geological Survey

**Figure 5.** The USGS-Lake Superior Biological Station conducted annual bottom trawling at locations in Lake Superior where ruffe were capable of incidental capture during 2013.

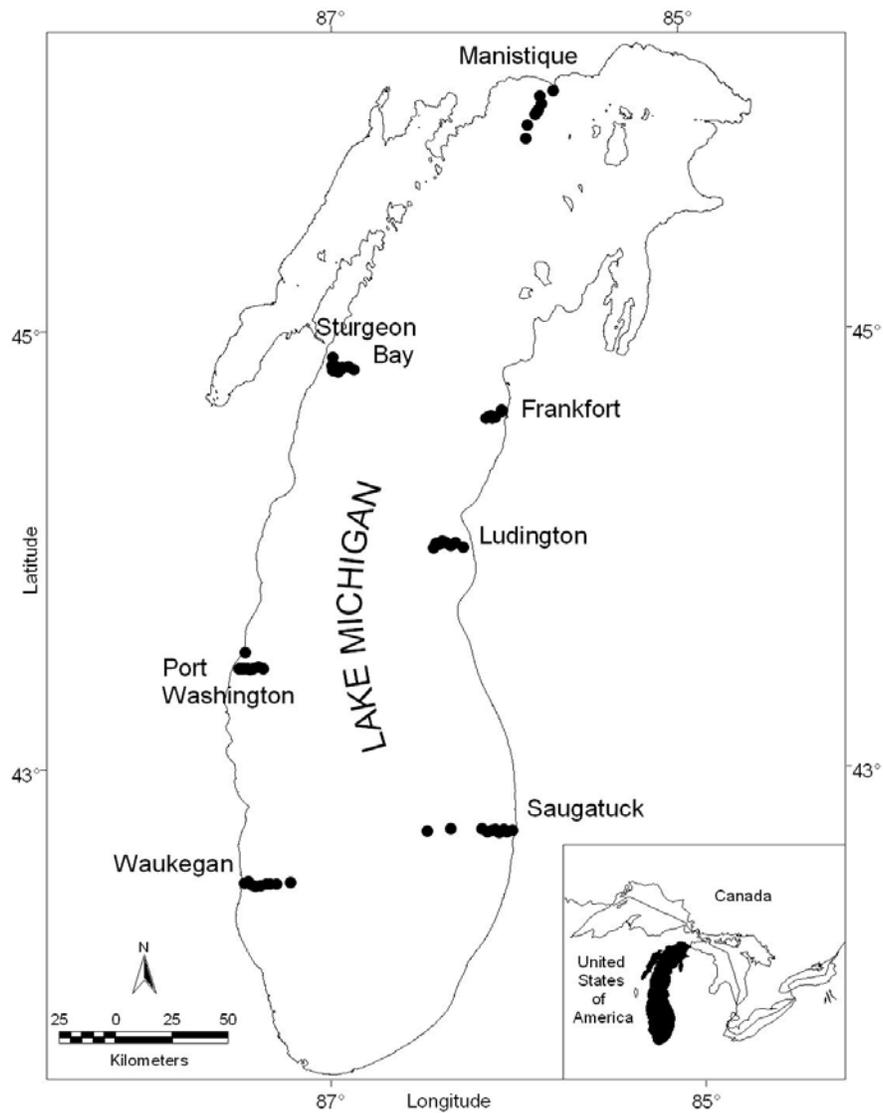


Potential Netting Locations, Fall Assessment Survey, 2009-2013



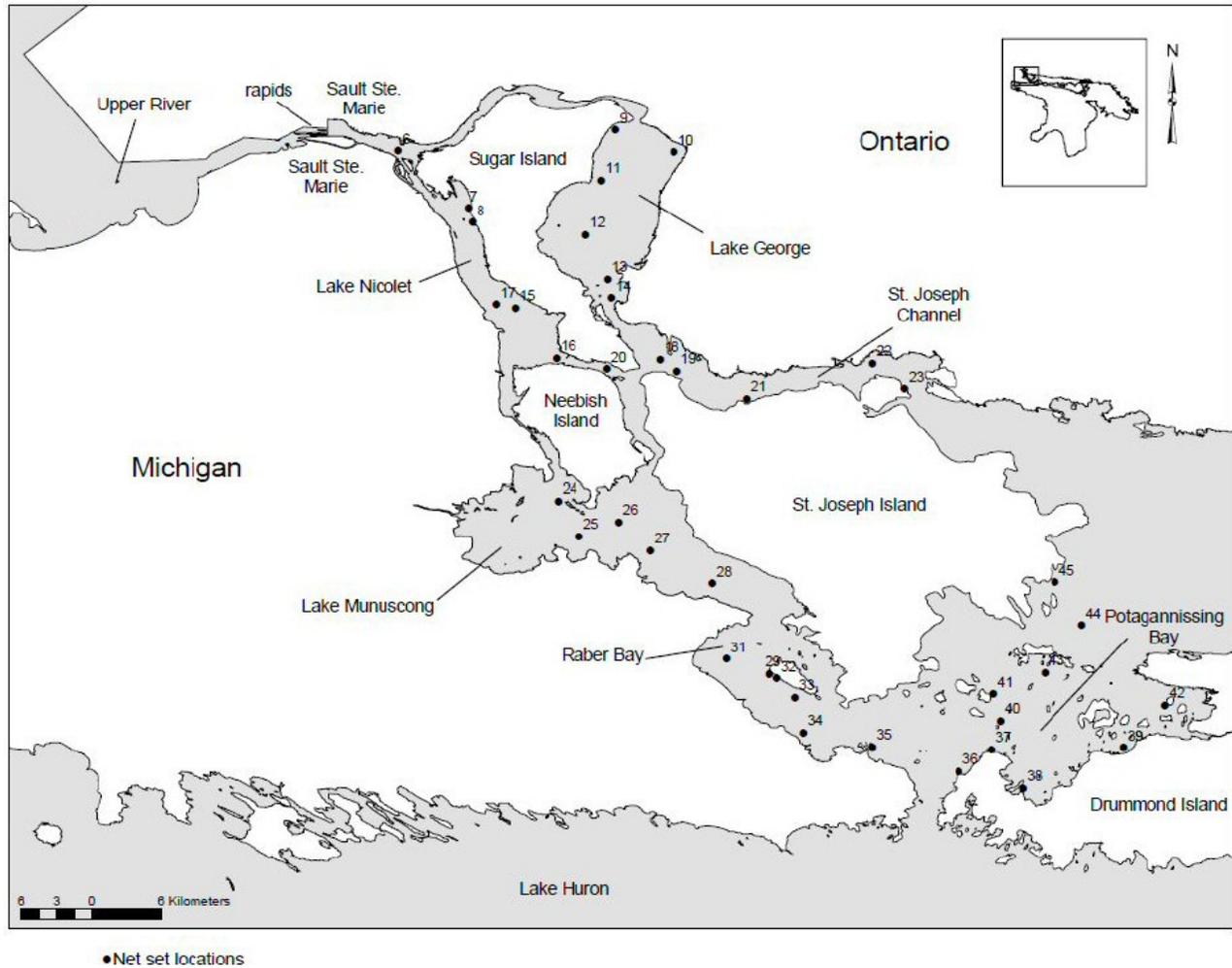
Michigan Department of Natural Resources

**Figure 6.** The Michigan DNR-Marquette Fisheries Research Station conducted gill netting and bottom trawling at locations in northern Green Bay (top), near the Menominee River (bottom left) and the Cedar River (bottom right) in Lake Michigan. Each year a stratified random sample is obtained for each Bay de Noc from this grid of potential sites. Other nearshore sampling areas (Menominee River and Cedar River) cycle from year to year.



U. S. Geological Survey

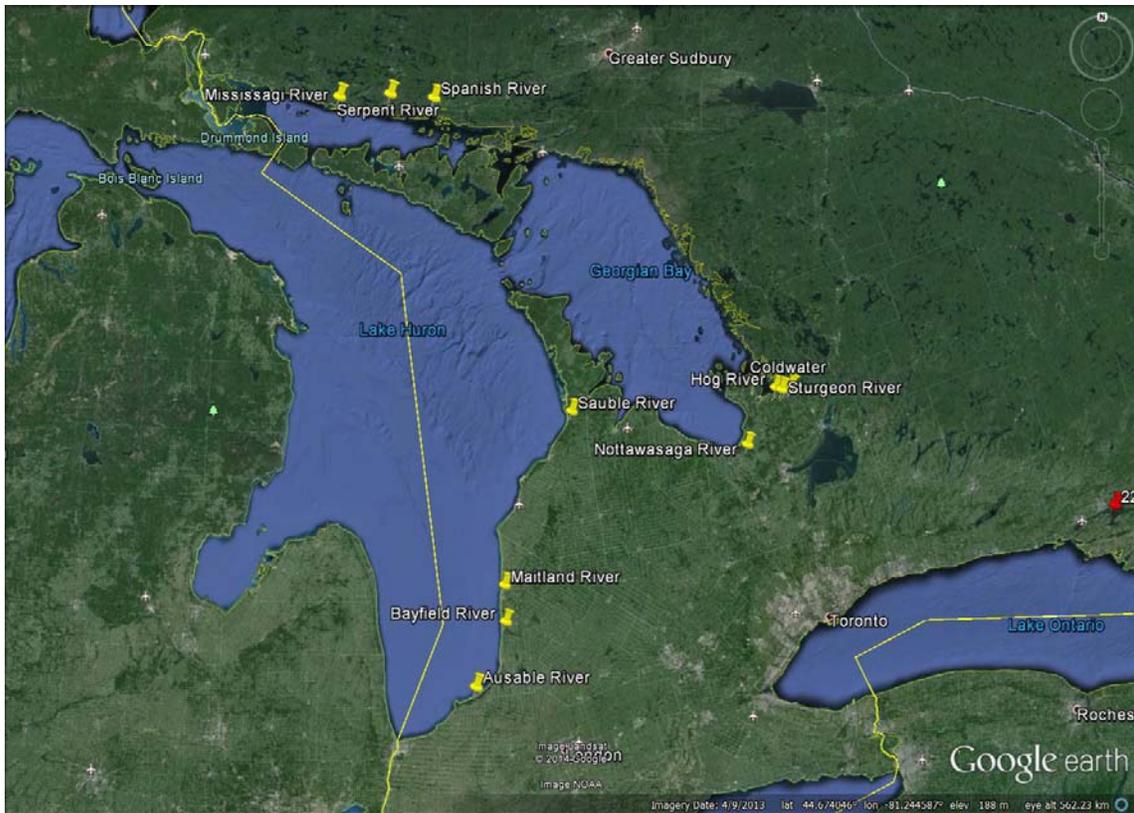
**Figure 7.** The USGS-Great Lakes Science Center conducted annual bottom trawling at locations in Lake Michigan where ruffe were capable of incidental capture during 2013.



### Gill Net Locations, Fish Community Assessment, 2013

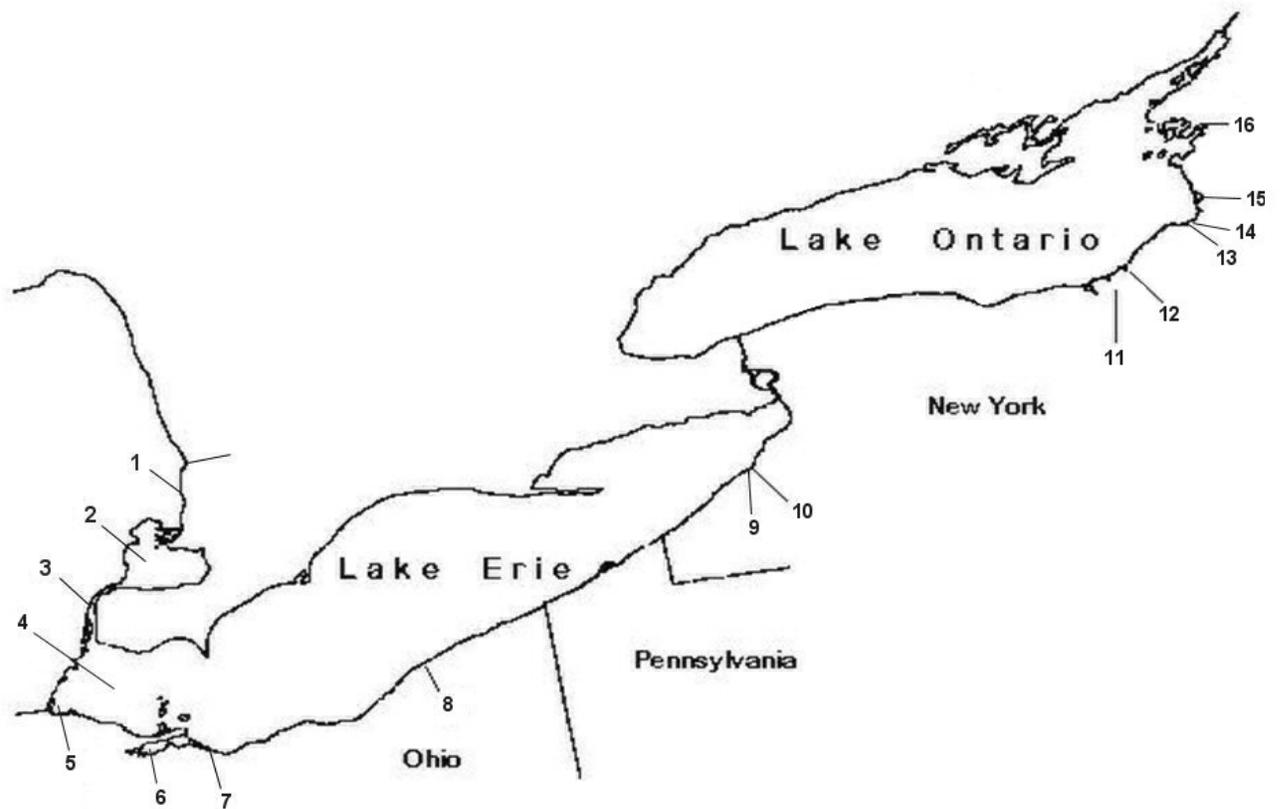
#### St. Marys River Fishery Task Group

**Figure 8.** The St. Marys River Fishery Task Group conducted gill net sampling in 2013 at locations across the St. Marys where ruffe were capable of incidental capture.



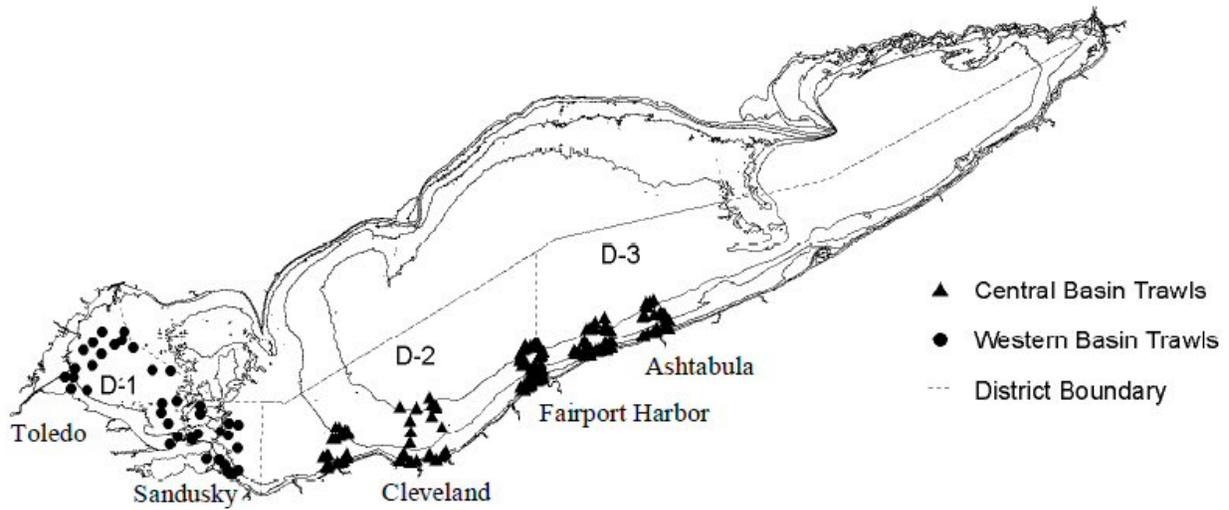
**Fisheries and Oceans Canada**

**Figure 9.** The Fisheries and Oceans Canada-Great Lakes Laboratory for Fisheries and Aquatic Sciences conducted boat electrofishing, seining, and fyke netting at tributaries along the eastern shore of Lake Huron where ruffe were capable of incidental capture during 2013.



- |                    |                           |                         |
|--------------------|---------------------------|-------------------------|
| 1. St. Clair River | 7. Huron River            | 13. Little Salmon River |
| 2. Lake St. Clair  | 8. Grand River            | 14. Salmon River        |
| 3. Detroit River   | 9. Spooner Creek          | 15. Grindstone Creek    |
| 4. Western Basin   | 10. Cattaraugus Creek     | 16. Black River         |
| 5. Maumee Bay      | 11. Sterling Valley Creek |                         |
| 6. Sandusky Bay    | 12. Sterling Creek        |                         |

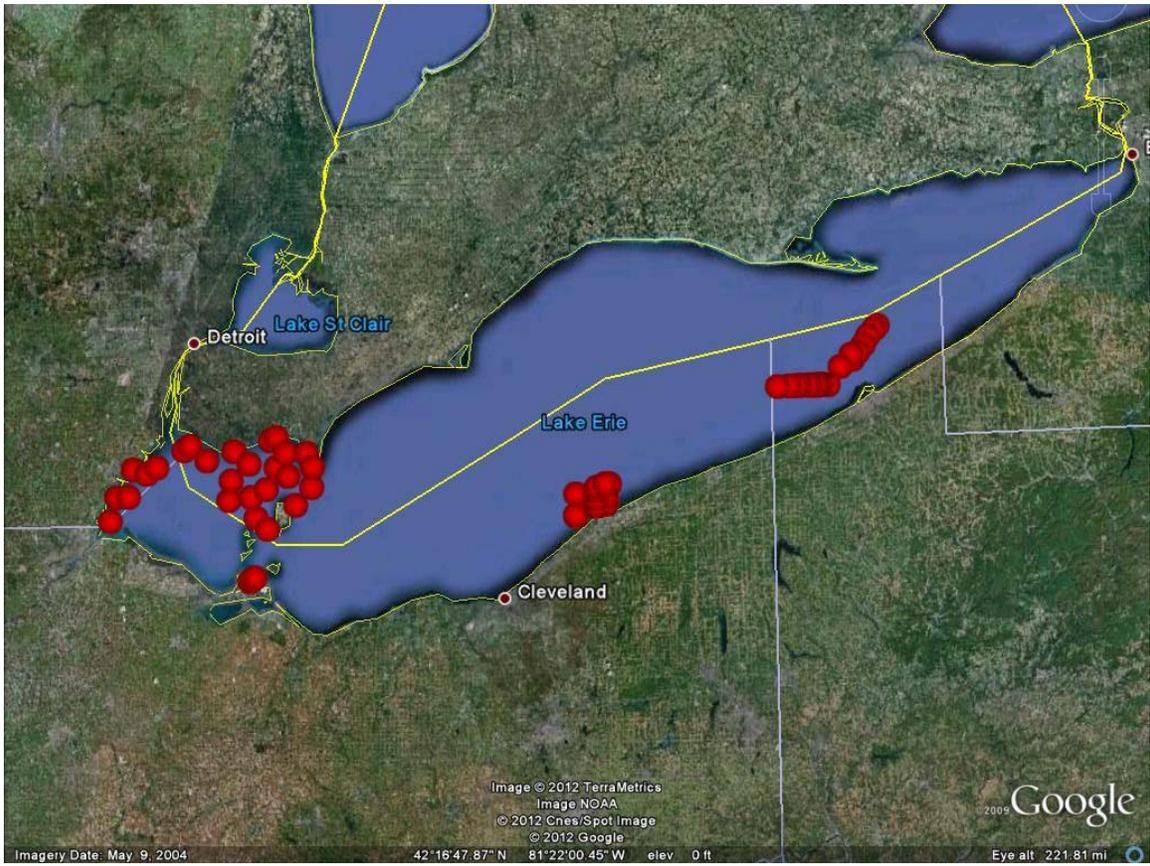
**Figure 10.** Reported sampling locations in the lower Great Lakes where ruffe were capable of incidental capture during 2013.



### Bottom Trawling Locations

### Ohio Department of Natural Resources

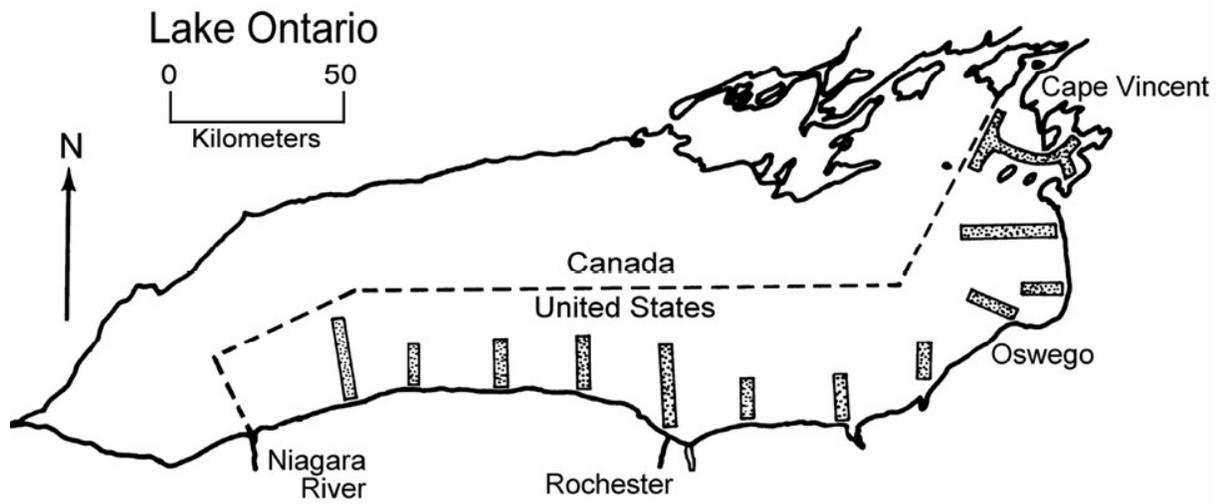
**Figure 11.** The Ohio DNR-Sandusky and Fairport Fish Research Units conducted annual bottom trawling at locations in Lake Erie where ruffe were capable of incidental capture during 2013.



### 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 2013.



U. S. Geological Survey

**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 2013.



**Table 1.** Summary of dedicated ruffe surveillance in U.S. waters of Lake Huron in 2013.

Location	Agency	Effort	Gear	Date	Depth	S. Temp	B. Temp	Ruffe
Au Gres River	FWS	0.25 hours	BT-4.9	9/23/2013	2.2	17.8	17.4	0
Cheboygan River	FWS	1.12 hours	EF	6/25/2013	1.5	22.4	-----	0
Harbor Beach	FWS	0.50 hours	BT-4.9	9/24/2013	5.3	17.7	17.0	0
Port Dolomite	FWS	0.50 hours	BT-4.9	9/19/2013	6.8	14.8	12.5	0
Saginaw River	FWS	0.17 hours	BT-4.9	9/25/2013	7.8	17.9	18.0	0
Thunder Bay River	FWS	0.17 hours	BT-4.9	9/5/2013	6.2	21.1	16.6	0
Thunder Bay River	FWS	0.84 hours	EF	6/18/2013	2.0	20.0	-----	0
Thunder Bay River	FWS	12 trap nights	TN	10/21/2013-10/25/2013	3.5	9.1	-----	0
Thunder Bay (Shipping Channel)	FWS	0.50 hours	BT-4.9	9/3/2013	7.5	21.7	17.3	0
Thunder Bay (Lafarge Corporation)	FWS	1.18 hours	EF	6/18/2013	2.2	20.0	-----	0
Trout River	FWS	0.65 hours	EF2	6/20/2013	0.7	17.1	-----	0
Totals		2.09 hours	BT-4.9					0
		3.14 hours	EF					0
		0.65 hours	EF2					0
		12 trap nights	TN					0
		Total ruffe (ruffe surveillance)						0

## Key to headings:

Agency = U.S. Fish and Wildlife Service (FWS).  
 Gear = BT-4.9=Bottom trawl (4.9 m head rope).  
 EF=Boat electrofishing.  
 EF2=Backpack electrofishing.  
 TN=Trap net (small mesh).

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

**Table 2.** Summary of dedicated ruffe surveillance in U.S. waters of the St. Marys River in 2013.

Location	Agency	Effort	Gear	Date	Depth	S. Temp	B. Temp	Ruffe
De Tour - DeTour Dock Co.	FWS	0.25 hours	BT-4.9	9/18/2013	7.4	16.5	14.9	0
De Tour - Maud Bay	FWS	0.25 hours	BT-4.9	9/18/2013	7.7	16.8	16.1	0
Lake Nicolet	FWS	0.17 hours	BT-4.9	9/17/2013	5.4	17.1	16.9	0
Munuscong Channel	FWS	0.42 hours	BT-4.9	9/17/2013	5.9	16.6	16.6	0
Raber Bay	FWS	0.50 hours	BT-4.9	9/18/2013	8.5	16.8	16.2	0
Salut Ste. Marie Municipal Marina	FWS	0.25 hours	BT-4.9	9/16/2013	3.8	19.0	18.2	0
Totals		1.84 hours	BT-4.9					0
		Total ruffe (ruffe surveillance)						0

## Key to headings:

Agency = U.S. Fish and Wildlife Service (FWS).  
 Gear = BT-4.9=Bottom trawl (4.9 m head rope).  
 Depth = Average water depth (m).

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

**Table 3.** Summary of dedicated ruffe surveillance in U.S. waters of Lake Erie in 2013.

Location	Agency	Effort	Gear	Date	Depth	S. Temp	B. Temp	S. DO	B. DO	Secchi	Ruffe
Ashtabula Harbor	FWS	0.50 hours	BT-4.9	5/30/2013	7.0	16.80	15.90	7.81	7.44	0.67	0
Buffalo Harbor	FWS	0.93 hours	BT-4.9	5/22/2013	7.7	-----	-----	-----	-----	2.53	0
Cleveland Harbor	FWS	0.83 hours	BT-4.9	5/20/2013	7.2	16.34	15.08	7.34	7.45	0.88	0
Conneaut Harbor	FWS	0.45 hours	BT-4.9	5/30/2013	7.4	18.96	16.42	7.39	7.78	0.83	0
Erie Harbor	FWS	0.52 hours	BT-4.9	5/30/2013	7.2	18.50	17.49	7.41	7.14	0.67	0
Maumee River	FWS	0.45 hours	BT-4.9	5/21/2013	8.7	20.68	20.44	6.43	6.37	0.55	0
Sandusky Harbor	FWS	0.47 hours	BT-4.9	5/20/2013	5.7	19.33	18.71	8.41	8.20	0.50	0
Totals		4.15 hours	BT-4.9								0
Total ruffe (ruffe surveillance)											0

Key to headings:

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

Gear = BT-4.9=Bottom trawl (4.9 m head rope).

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 2013.

Location	Agency	Effort	Gear	Date	Depth	S. Temp	B. Temp	S. DO	B. DO	Secchi	Ruffe
Genesee River	FWS	0.58 hours	BT-4.9	5/21/2013	6.3	-----	-----	-----	-----	0.72	0
Totals		0.58 hours	BT-4.9								0
Total ruffe (ruffe surveillance)											0

Key to headings:

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

Gear = BT-4.9=Bottom trawl (4.9 m head rope).

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 other fish sampling conducted in Lake Superior that was reported as capable of capturing ruffe during 2013.

Location	Agency	Effort	Gear	Date	Depth	Temp	Ruffe	
Amnicon River	GLIFWC/FWS	26 trap nights	FN	5/13/2013-6/24/2013	0.5-1.0	12.8	0	
Apostle Islands	USGS	0.67 hours	BT-11.9	6/2013	115.0	3.8 B	0	
Bad River	GLIFWC	75 trap nights	PAT	5/14/2013-6/27/2013	0.5	16.9	0	
Betsy River	PC	74 trap nights	PAT	5/9/2013-7/2/2013	0.5	17.3	0	
Big Garlic River	PC	36 trap nights	FN	5/13/2013-7/1/2013	0.5-1.0	16.8	0	
Brule River	GLIFWC/FWS	35 trap nights	PT	5/8/2013-6/27/2013	0.8	14.3	0	
Chequamegon Bay *	USGS	6.50 hours	BT-5.5	7/2013-8/2013	7.0	-----	12	
Chequamegon Bay *	FWS	1.25 hours	BT-4.9	8/29/2013-8/30/2013	2.0-11.0	-----	18	
Chequamegon Bay	FWS	4.24 hours	EF	9/3-5/2013, 11/7/2013	0.4-3.0	-----	0	
Chequamegon Bay *	FWS	15 trap nights	FN2	9/3/2013-9/5/2013	1.0	-----	22	
Chocolay River	PC	36 trap nights	FN	3/21/2013-7/1/2013	0.5-1.0	13.3	0	
Firesteel River	GLIFWC	9 trap nights	FN	5/27/2013-7/1/2013	0.5-1.0	21.3	0	
Furnace Creek	PC	39 trap nights	PAT	5/9/2013-7/1/2013	0.5	14.8	0	
Isle Royale	FWS/NPS	10.08 hours	EF	6/12/2013-6/17/2013	0.4-3.0	-----	0	
Laughing Whitefish River	PC	36 trap nights	FN	5/13/2013-7/1/2013	0.5	15.2	0	
Middle River	GLIFWC/FWS	140 trap nights	PAT	5/8/2013-6/27/2013	0.5	14.4	0	
Miners River	NPS/FWS	100 trap nights	PAT	5/16/2013-7/6/2013	0.5	15.0	0	
Misery River	GLIFWC	26 trap nights	PAT	5/19/2013-7/8/2013	0.5	13.0	0	
Naomikong Creek	LSSU	12 hauls	SEN	6/2013-7/2013	-----	-----	0	
Naomikong Creek	LSSU	12 sets	GN1	5/2013-8/2013	-----	-----	0	
Naomikong Creek	LSSU	12 sets	GN2	5/2013-8/2013	-----	-----	0	
Nearshore*	USGS	32.05 hours	BT-11.9	5/2013-6/2013	39.0	4.4 B	13	
Offshore	USGS	15.50 hours	BT-11.9	6/2013-7/2013	183.0	3.6 B	0	
Pendills Creek	LSSU	12 hauls	SEN	6/2013-7/2013	-----	-----	0	
Pendills Creek	LSSU	12 sets	GN1	5/2013-8/2013	-----	-----	0	
Pendills Creek	LSSU	12 sets	GN2	5/2013-8/2013	-----	-----	0	
Poplar River	GLIFWC/FWS	24 trap nights	FN	4/15/2013-6/24/2013	0.5-1.0	13.3	0	
Red Cliff Creek	RCBLSC	60 trap nights	FN	6/4/2013-7/17/2013	0.5-1.0	15.3	0	
Rock River	FWS	116 trap nights	PAT	4/30/2013-7/6/2013	0.5	13.8	0	
St. Louis River*	FWS	0.83 hours	BT-4.9	8/8/2013	2.0-11.0	-----	104	
St. Louis River	FWS	3.33 hours	EF	8/20/2013-8/22/2013	0.4-3.0	-----	0	
St. Louis River*	FWS	26 trap nights	FN2	6/19-20/2013, 8/19-22/2013	1.0	-----	36	
St. Louis River	FWS	24 trap nights	MWT	6/19/2013-6/20/2013	0.5	-----	0	
St. Marys River - Above Locks	FWS/OMNR	0.83 hours	BT-4.9	9/3/2013-9/5/2013	2.0-11.0	-----	0	
St. Marys River - Above Locks	FWS/OMNR	3.33 hours	EF	9/4/2013-9/24/2013	0.4-3.0	-----	0	
St. Marys River - Above Locks	FWS/OMNR	20 trap nights	FN2	8/12/2013-8/15/2013	1.0	-----	0	
Shelldrake River	LSSU/BMIC	12 hauls	SEN	6/2013-7/2013	-----	-----	0	
Shelldrake River	LSSU/BMIC	12 sets	GN1	5/2013-8/2013	-----	-----	0	
Shelldrake River	LSSU/BMIC	12 sets	GN2	5/2013-8/2013	-----	-----	0	
Silver River	GLIFWC	15 trap nights	FN	5/23/2013-7/10/2013	0.5-1.0	15.5	0	
Stannard Rock	USGS	0.67 hours	BT-11.9	8/2013	228.0	-----	0	
Superior Shoals	USGS	0.33 hours	BT-11.9	8/2013	230.0	-----	0	
Tahquamenon River	PC	96 trap nights	PAT	5/16/2013-7/2/2013	0.5	17.8	0	
Thunder Bay Harbour *	FWS/OMNR	0.83 hours	BT-4.9	8/27/2013	2.0-11.0	-----	1	
Thunder Bay Harbour	FWS/OMNR	3.30 hours	EF	9/13/2013-9/25/2013	0.4-3.0	-----	0	
Thunder Bay Harbour *	FWS/OMNR	20 trap nights	FN2	9/4/2013-9/11/2013	1.0	-----	73	
Western Lake Superior *	WIDNR	19 sets	GN	7/2013	-----	3.8-21.2	113	
Totals		3.74 hours	BT-4.9				123	
		6.50 hours	BT-5.5				12	
		49.22 hours	BT-11.9				13	
		24.28 hours	EF				0	
		242 trap nights	FN				0	
		81 trap nights	FN2				131	
		19 sets	GN				113	
		36 sets	GN1				0	
		36 sets	GN2				0	
		24 trap nights	MWT				0	
		666 trap nights	PAT				0	
		35 trap nights	PT				0	
		36 hauls	SEN				0	
		Total ruffe (captured incidentally)						392

Key to agency:

BMIC = Bay Mills Indian Community.  
 FWS = U.S. Fish and Wildlife Service.  
 GLIFWC = Great Lakes Indian Fish and Wildlife Commission.  
 LSSU = Lake Superior State University.  
 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.  
 WIDNR = Wisconsin Department of Natural Resources.

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).  
 BT-5.5 = Bottom trawl (5.5 m head rope).  
 BT-11.9 = Bottom trawl (11.9 m head rope).  
 EF = Electrofishing.  
 FN = Fyke net.  
 FN2 = Paired fyke nets (4.7 mm mesh with 15 m lead).  
 GN = Gill net (1,097 m, included panel of 38 mm stretch mesh).  
 GN1 = Gill net (21 m, included panels of 9.5 to 38 mm stretch mesh).  
 GN2 = Gill net (37 m, included panel of 25 mm stretch mesh).  
 MWT = Modified Windermere trap.  
 PAT = Portable assessment trap.  
 PT = Permanent trap.  
 SEN = Seine (46 m length).

Key to headings and symbols:

Depth = Average or range w ater depth (m).  
 Temp = Average surface or bottom (B) w ater temperature (°C).  
 \* Locations w here ruffe w ere captured.

**Table 6.** Summary of other fish sampling conducted in Lake Michigan that was reported as capable of capturing ruffe during 2013.

Location	Agency	Effort	Gear	Date	Depth	Temp	Ruffe
Betsie River	GTBOCI	94 trap nights	PAT	4/10/2013-6/19/2013	0.5-1.0	15.4	0
Big Bay de Noc	MIDNR	1.83 hours	BT-3.7	6/2013-10/2013	2.4-12.2	----	0
Big Bay de Noc	MIDNR	48 sets	GN	8/2013-9/2013	2.7-14.0	16.3-20.9	0
Big Manistee River	FWS	114 trap nights	PT	4/9/2013-6/20/2013	0.5-1.0	13.2	0
Boardman River	GTBOCI	106 trap nights	PAT	4/8/2013-6/23/2013	0.5	15.4	0
Burns Harbor	FWS	8 events	EF	9/2013	0.2-2.5	20.0	0
Burns Harbor	FWS	8 trap nights	FN1	9/2013	0.3-1.5	20.0	0
Burns Harbor	FWS	8 trap nights	FN2	9/2013	0.3-1.5	20.0	0
Burns Harbor	FWS	10 arrays	MT	9/2013	0.3-1.5	20.0	0
Carp Lake River	FWS	66 trap nights	PT	4/9/2013-6/27/2013	0.8	14.6	0
Cedar River	MIDNR	1.67 hours	BT-3.7	6/2013-10/2013	----	----	0
Cedar River	MIDNR	12 sets	GN	8/2013-9/2013	3.0-10.6	15.4	0
Deer Creek	PC	90 trap nights	PAT	4/15/2013-6/14/2013	0.5	14.0	0
East Tw in River	PC	39 trap nights	PAT	4/19/2013-6/14/2013	0.5	13.6	0
Elk Lake Outlet	PC	108 trap nights	PAT	4/13/2013-6/15/2013	0.5-1.0	10.9	0
Frankfort	ISEA	0.17 hours	BT-4.9	8/2013	4.6-11.9	----	0
Grand Traverse Bay	ISEA	7.57 hours	BT-4.9	5/2013-8/2013	4.6-18.3	----	0
Green Bay	WIDNR	51 hauls	SEN	6/2013, 7/2013	0.0-1.0	----	0
Green Bay	WIDNR	6.25 hours	TRL	8/2013	2.0-25.0	7.9-22.8	0
Green Bay	FWS	6 events	EF	8/2013, 12/2013	0.2-1.5	4.0-22.0	0
Green Bay	FWS	6 trap nights	FN1	8/2013	0.4-1.0	27.0	0
Green Bay	FWS	6 trap nights	FN2	8/2013	0.4-1.0	27.0	0
Green Bay	FWS	5 arrays	MT	12/2013	0.4-1.0	27.0	0
Hog Island Creek	PC	54 trap nights	FN	4/24/2013-6/24/2013	0.5-1.0	11.7	0
Little Bay de Noc	MIDNR	1.67 hours	BT-3.7	6/2013-10/2013	2.4-12.2	----	0
Little Bay de Noc *	MIDNR	32 sets	GN	8/2013-9/2013	3.6-11.2	10.6-20.2	9
Little Bay de Noc	ISEA	0.83 hours	BT-4.9	7/2013	7.3-19.2	----	0
Little Manistee River	FWS	108 trap nights	PAT	4/9/2013-6/11/2013	0.5-1.0	13.2	0
Manistique River	FWS	36 trap nights	SPT	5/24/2013-6/19/2013	0.5	17.8	0
Menominee River	WIDNR	8 events	EF	9/2013-11/2013	1.0-2.0	4.0-18.0	0
Menominee River	MIDNR	1.67 hours	BT-3.7	6/2013-10/2013	----	----	0
Menominee River	MIDNR	12 sets	GN	8/2013-9/2013	2.3-9.5	10-14.9	0
Menominee River	FWS	36 trap nights	PAT	4/16/2013-6/17/2013	0.5-1.0	15.7	0
Milwaukee Harbor	FWS	8 events	EF	9/2013	0.2-2.5	15.0	0
Milwaukee Harbor	FWS	6 trap nights	FN1	9/2013	0.3-1.5	15.0	0
Milwaukee Harbor	FWS	6 trap nights	FN2	9/2013	0.3-1.5	15.0	0
Milwaukee Harbor	FWS	10 arrays	MT	9/2013	0.3-1.5	15.0	0
Muskegon River	FWS	104 trap nights	PAT	4/10/2013-6/13/2013	1.0-5.0	13.4	0
Nearshore/Offshore	USGS	11.30 hours	BT-12	9/2013	5.0-132.0	3.9-19.1	0
Oconto River	WIDNR	2 events	EF	9/2013-10/2013	1.0-2.0	4.0-18.0	0
Oconto River	FWS	26 trap nights	PAT	4/16/2013-6/5/2013	0.5-1.0	13.4	0
Ogontz River	PC	33 trap nights	FN	5/12/2013-6/25/2013	0.5-1.0	13.9	0
Peshigo River	WIDNR	3 events	EF	10/2013-11/2013	1.0-2.0	4.0-17.0	0
Peshigo River	FWS	82 trap nights	PAT	4/16/2013-6/17/2013	0.5-1.0	15.8	0
St. Joseph River	FWS	135 trap nights	PAT	3/31/2013-6/1/2013	0.5	15.6	0
Suttons Bay	ISEA	14.73 hours	BT-4.9	4/2013-10/2013	4.9-19.5	----	0
Trail Creek	PC	204 trap nights	PT	4/1/2013-6/7/2013	0.5	14.3	0
White River	FWS	47 trap nights	PAT	4/23/2013-6/13/2013	0.5	14.7	0
Totals		6.84 hours	BT-3.7				0
		23.30 hours	BT-4.9				0
		11.30 hours	BT-12				0
		35 events	EF				0
		87 trap nights	FN				0
		20 trap nights	FN1				0
		20 trap nights	FN2				0
		104 sets	GN				9
		25 arrays	MT				0
		975 trap nights	PAT				0
		384 trap nights	PT				0
		51 hauls	SEN				0
		36 trap nights	SPT				0
		6.25 hours	TRL				0
		Total ruffe (captured incidentally)					9

Key to agency:

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

Key to headings and symbols:

Depth = Average or range of water depth (m).  
 Temp = Average or range of bottom water temperature (°C).  
 \* Locations where ruffe were captured.

Key to gear:

BT-3.7 = Bottom trawl (3.7 m head rope).  
 BT-4.9 = Bottom trawl (4.9 m head rope).  
 BT-12 = Bottom trawl (12 m head rope).  
 EF = Electrofishing.  
 FN = Fyke net.  
 FN1 = Fyke net (0.9 m x 1.5 m box, 12.7 mm #126 mesh).  
 FN2 = Mini-fyke net (0.7 m x 1.0 m box, 3.175 mm #35 mesh).  
 GN = Gill net (97.5 m, included panel of 25 mm stretch mesh).  
 MT = Minnow trap array (5 baited traps spaced 7.6 m apart on one line).  
 PAT = Portable assessment trap.  
 PT = Permanent trap.  
 SEN = Beach seine (15.2 m length).  
 SPT = Semi-permanent trap.  
 TRL = Trawl.

**Table 7.** Summary of other fish sampling conducted in Lake Huron that was reported as capable of capturing ruffe during 2013.

Location	Agency	Effort	Gear	Date	Depth	Temp	Ruffe
Albany Creek	PC	37 trap nights	PAT	5/9/2013-7/2/2013	0.5	12.7	0
Au Sable River	PC	84 trap nights	PAT	4/24/2013-6/20/2013	0.5-1.0	14.3	0
Ausable River	DFO	4 trap nights	FN1	7/3/2013	0.8	27.0	0
Ausable River	DFO	1 haul	SEN	7/3/2013	0.5	27.0	0
Ausable River	DFO	1.14 hours	EF	7/3/2013	1.9	17.0	0
Bayfield River	DFO	4 trap nights	FN1	8/8/2013	0.5	25.0	0
Bayfield River	DFO	1 haul	SEN	8/8/2013	0.5	25.0	0
Carp River	PC	136 trap nights	FN	5/9/2013-7/2/2013	0.5-1.0	15.6	0
Cheboygan River	FWS	146 trap nights	PT	4/8/2013-6/27/2013	1.0	15.5	0
Coldwater Creek	DFO	1.12 hours	EF	7/8/2013	1.3	26.0	0
Coldwater Creek	DFO	6 trap nights	FN1	7/6/2013	0.5	26.0	0
Devils River	PC	56 trap nights	FN	4/15/2013-6/17/2013	0.5-1.0	16.3	0
East Au Gres River	PC	40 trap nights	PAT	4/24/2013-6/20/2013	0.5-1.0	15.8	0
Greene Creek	FWS	55 trap nights	PAT	4/6/2013-6/14/2013	0.5	13.5	0
Hog Creek	DFO	0.80 hours	EF	7/4/2013	1.6	25.0	0
Hog Creek	DFO	1 haul	SEN	7/3/2013	0.5	23.0	0
Hog Creek	DFO	2 trap nights	FN1	7/3/2013	0.6	25.0	0
Les Cheneaux Islands	MIDNR	6 sets	GN1	9/30/2013-10/2/2013	1.8-7.6	15.6-16.7	0
Maitland River	DFO	2 hauls	SEN	8/8/2013	0.5	21.0	0
Maitland River	DFO	4 trap nights	FN1	8/8/2013	0.8	21.0	0
Maitland River	DFO	0.28 hours	EF	9/19/2013	1.5	21.0	0
Mississagi River	DFO	6 trap nights	FN1	7/28/2013	0.7	21.0	0
Mississagi River	DFO	2 hauls	SEN	7/28/2013	0.3	21.0	0
Mississagi River	DFO	1.05 hours	EF	9/24/2013	1.6	16.0	0
Nottawasaga River	DFO	1.23 hours	EF	9/17/2013	1.5	-----	0
Ocqueoc River	FWS	104 trap nights	PT	4/11/2013-6/28/2013	0.4	16.8	0
St. Marys River	FWS	689 trap nights	PAT	5/29/2013-7/18/2013	0.5-1.0	13.7	0
St. Marys River	SMRFTG	22.63 hours	EF	9/2013	0.5-2.0	-----	0
St. Marys River	SMRFTG	37 sets	GN3	8/2013	5.8	19.0	0
St. Marys River	FWS/OMNR	15 trap nights	FN2	8/2013	1.0-2.0	17.7-20.8	0
St. Marys River	FWS/OMNR	1.25 hours	BT-4.9	8/2013	2.7-11.9	11.2-20.1	0
St. Marys River	FWS/OMNR	2.33 hours	EF	8/2013	1.0-3.4	9.9-21.7	0
Saginaw Bay	MIDNR	3.75 hours	BT-10	9/10/2013-9/18/2013	3.9-11.3	15.8-22.1	0
Saginaw Bay	MIDNR	40 sets	GN1	9/2013	3.4-7.6	19.4-21.7	0
Sauble River	DFO	4 trap nights	FN1	8/11/2013	0.8	22.0	0
Sauble River	DFO	2 hauls	SEN	8/11/2013	0.4	22.0	0
Sauble River	DFO	0.47 hours	EF	9/18/2013	1.3	16.0	0
Serpent River	DFO	2 trap nights	FN1	7/27/2013	0.6	22.0	0
Serpent River	DFO	0.25 hours	EF	7/26/2013	1.5	22.0	0
Southern Lake Huron	FWS	16 sets	GN4	9/1/2013	3.7-7.3	17.2-17.7	0
Spanish River	DFO	6 trap nights	FN1	7/23/2013	0.6	23.0	0
Spanish River	DFO	0.93 hours	EF	7/24/2013	2.5	23.0	0
Sturgeon River	DFO	1.30 hours	EF	7/5/2013	1.5	25.0	0
Sturgeon River	DFO	1 trap night	FN1	7/5/2013	0.5	24.0	0
Sturgeon River	DFO	1 haul	SEN	7/6/2013	0.5	24.0	0
Thunder Bay	MIDNR	2.00 hours	BT-5.3	8/21/2013-8/23/2013	4.3-7.6	21.1	0
Thunder Bay	MIDNR	6.33 hours	BT-11	7/2013, 8/2013	15.0-39.0	20.0-24.0	0
Thunder Bay	MIDNR	16 sets	GN1	6/6/2013-8/21/2013	2.1-13.7	11.1-21.1	0
Thunder Bay	MIDNR	18 sets	GN2	7/16/2013-8/21/2013	4.0-21.3	16.7-21.7	0
Tittabawassee River	PC	44 trap nights	SPT	4/8/2013-6/7/2013	1.0	17.4	0
Trout Creek	PC	37 trap nights	FN	5/9/2013-7/2/2013	0.5-1.0	15.4	0
Trout River	FWS	47 trap nights	SPT	4/10/2013-6/25/2013	0.2	15.3	0
Totals		1.25 hours	BT-4.9				0
		2.00 hours	BT-5.3				0
		3.80 hours	BT-10				0
		6.33 hours	BT-11				0
		33.53 hours	EF				0
		229 trap nights	FN				0
		39 trap nights	FN1				0
		15 trap nights	FN2				0
		62 sets	GN1				0
		18 sets	GN2				0
		37 sets	GN3				0
		16 sets	GN4				0
		905 trap nights	PAT				0
		250 trap nights	PT				0
		10 hauls	SEN				0
		91 trap nights	SPT				0
		Total ruffe (captured incidentally)					0

Key to agency:

DFO = Department of Fisheries and Oceans Canada.  
 FWS = U.S. Fish and Wildlife Service.  
 MIDNR = Michigan Department of Natural Resources.  
 OMNR = Ontario Ministry of Natural Resources.  
 PC = Private contractor.  
 SMRFTG = St. Marys River Fisheries Task Group.

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).  
 BT-5.3 = Bottom trawl (5.3 m head rope).  
 BT-10 = Bottom trawl (10 m head rope).  
 BT-11 = Bottom trawl (11 m head rope).  
 EF = Electrofishing.  
 FN = Fyke net.  
 FN1 = Fyke net (1.3 m box).  
 FN2 = Paired fyke net.  
 GN1 = Gill net (graded mesh, included panel of 38.1 mm stretch mesh).  
 GN2 = Gill net (micromesh, included panels of 12.7, 15.9, and 19.1 mm stretch mesh).  
 GN3 = Gill net (304.8 m, included panel of 38 mm stretch mesh).  
 GN4 = Gill net (91 m, included panels of 25 and 38 mm stretch mesh).  
 PAT = Portable assessment trap.  
 PT = Permanent trap.  
 SEN = Beach seine (15 m length).  
 SPT = Semi-permanent trap.

Key to headings and symbols:

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

\* Locations where ruffe were captured.

**Table 8.** Summary of other fish sampling conducted in Lake Erie that was reported as capable of capturing ruffe during 2013.

Location	Agency	Effort	Gear	Date	Depth	Temp	Ruffe	
Cattaraugus Creek	FWS	120 trap nights	PAT	4/14/2013-6/12/2013	0.5	14.6	0	
Central Basin	ODNR	24.50 hours	BT-10.4	4/2013-10/2013	6.1-21.0	9.0-23.9	0	
Central Basin	ODNR	54 sets	GN1	9/2013-11/2013	9.8-14.9	10.1-15.8	0	
Grand River	PC	90 trap nights	PAT	4/8/2013-6/6/2013	0.5	19.0	0	
HEW-Detroit River	FWS	14 sets	GN2	9/2013	3.6-10.6	20.9-22.1	0	
HEW-Detroit River	FWS	0.50 hours	BT-4.9	8/2013	2.5-10.3	20.3-21.5	0	
HEW-Detroit River	FWS	0.83 hours	EF	8/2013	1.3-1.5	22.1-22.8	0	
HEW-Detroit River	FWS	12 trap nights	FN	8/2013	1.0-2.0	20.8-24.2	0	
HEW-Detroit River	FWS	156 sets	MT	4/2013-5/2013, 7/2013	5.4-12.4	2.2-21.4	0	
HEW-Lake St. Clair	MIDNR	0.67 hours	BT-5	4/15/2013	0.9-2.4	3.3-4.2	0	
HEW-Lake St. Clair	MIDNR	1.33 hours	BT-10	5/22/2013, 9/3/2013	2.7-3.9	12.5-22.1	0	
HEW-Lake St. Clair	MIDNR	6 sets	GN3	10/9/2013-10/11/2013	1.5-3.0	15.0-17.0	0	
HEW-Lake St. Clair	MIDNR	46 trap nights	TN	4/22/2013-5/20/2013	2.7-3.4	6.0-15.0	0	
HEW-St. Clair River	FWS	20 sets	GN2	9/2013	4.6-20.7	18.0-19.0	0	
HEW-St. Clair River	FWS	6 sets	MT	5/2013	9.9-11.6	9.7-10.3	0	
Huron River	PC	8 trap nights	PAT	5/8/2013-5/28/2013	0.5	19.9	0	
Maumee Bay	FWS	1.25 hours	BT-4.9	8/2013	3.6-10.7	24.5-26.2	0	
Maumee Bay	FWS	15 trap nights	FN	8/2013-9/2013	1.0-2.0	19.8-26.5	0	
Nearshore/Offshore	USGS	23.14 hours	BT-7.9	6/2013, 8/2013-10/2013	2.6-30.8	5.5-21.8	0	
Sandusky Bay	FWS	1.25 hours	BT-4.9	10/2013	2.3-3.4	10.2-11.6	0	
Sandusky Bay	FWS	3 trap nights	FN	10/2013	0.6-2.1	8.1-8.6	0	
Sandusky Bay	FWS	2.50 hours	EF	9/2013	1.0-2.2	16.9-18.2	0	
Spooner Creek	FWS	114 trap nights	PAT	4/15/2013-6/12/2013	0.5	14.6	0	
Western Basin	ODNR	22.83 hours	BT-10.7	5/2013-9/2013	1.2-12.5	12.9-26.7	0	
Western Basin	FWS	7.80 hours	BT-4.9	2013	0.9-16.5	-----	0	
Western Basin	FWS	7.70 hours	EF	2013	0.1-8.5	-----	0	
Western Basin	FWS	27 sets	GN2	8/2013-9/2013	3.1-12.3	22.3-24.3	0	
Totals		10.80 hours	BT-4.9				0	
		0.67 hours	BT-5				0	
		23.14 hours	BT-7.9				0	
		1.33 hours	BT-10				0	
		24.50 hours	BT-10.4				0	
		22.83 hours	BT-10.7				0	
		11.03 hours	EF				0	
		30 trap nights	FN				0	
		54 sets	GN1				0	
		194 sets	GN2				0	
		6 sets	GN3				0	
		162 sets	MT				0	
		332 trap nights	PAT				0	
		46 trap nights	TN				0	
		Total ruffe (captured incidentally)						0

Key to location:

HEW = Huron Erie Waterway.

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 headings:

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

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

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).

BT-5 = Bottom trawl (5 m head rope).

BT-7.9 = Bottom trawl (7.9 m head rope).

BT-10 = Bottom trawl (10 m head rope).

BT-10.4 = Bottom trawl (10.4 m head rope).

BT-10.7 = Bottom trawl (10.7 m head rope).

EF = Electrofishing.

FN = Paired fyke net.

GN1 = Gill net (182 m, included panel of 32 mm stretch mesh).

GN2 = Gill net (91 m, included panels of 25 and 38 mm stretch mesh).

GN3 = Gill net (experimental, included panel of 25 mm stretch mesh).

MT = Gee minnow trap.

PAT = Portable assessment trap.

TN = Trap net.

**Table 9.** Summary of other fish sampling conducted in Lake Ontario that was reported as capable of capturing ruffe during 2013.

Location	Agency	Effort	Gear	Date	Depth	Temp	Ruffe
Black River	PC	147 trap nights	PAT	3/31/2013-6/1/2013	0.5	16.4	0
Grindstone Creek	PC	45 trap nights	PAT	4/1/2013-5/31/2013	0.5	17.4	0
Little Salmon River	PC	45 trap nights	PAT	4/1/2013-5/31/2013	0.5	17.5	0
Nearshore/Offshore	USGS/NYDEC	43.83 hours	BT-18	3/2013-6/2013, 9/2013-10/2013	8.0-175.0	3.1-25.1	0
Salmon River	FWS	58 trap nights	PT	4/13/2013-6/12/2013	0.5	15.6	0
Sterling Creek	PC	45 trap nights	PAT	4/1/2013-5/31/2013	0.5-1.0	17.0	0
Sterling Valley Creek	PC	45 trap nights	PAT	4/1/2013-5/31/2013	0.5	17.0	0
Totals		43.83 hours	BT-18				0
		58 trap nights	PT				0
		327 trap nights	PAT				0
		Total ruffe (captured incidentally)					0

Key to agency:

FWS = U.S. Fish and Wildlife Service.

NYDEC = New York Department of Environmental Conservation.

PC = Private contractor.

USGS = U.S. Geological Survey.

Key to gear:

BT-18 = Bottom trawl (18 m head rope).

PAT = Portable assessment trap.

PT = Portable trap.

Key to headings:

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

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

## **APPENDIX: Chronology of ruffe detection for the Great Lakes Basin**

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

**1991 – Lake Superior:** Major ruffe range expansion was detected. A crew from U.S. Fish and Wildlife Service-Ashland Fish and Wildlife Conservation Office (USFWS-Ashland) 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 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 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-Lower Great Lakes) 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 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 Ontario Ministry of Natural Resources – Upper Great Lakes Management Unit (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 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) assumed ruffe surveillance for U.S. waters of Lake Huron. **Lower Great Lakes:** No ruffe were detected.

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

rates at peripheral locations in U.S. waters of Lake Huron were approximately less than or equal to previous years. **Lower Great Lakes:** No ruffe were detected.

**1998 – Lake Superior:** No ruffe range expansion was detected. **Lake Huron:** Ruffe became the most abundant species captured during fall bottom trawling ruffe surveillance in the Thunder Bay River, Michigan, a peripheral range location in Lake Huron. **Lower Great Lakes:** The OMNR expanded ruffe surveillance into Canadian waters of Lake Erie and USFWS-Lower Great Lakes 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 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, Michigan, increased from 1 per minute bottom trawling in 1998 to 11 per minute bottom trawling. The majority of the Thunder Bay River ruffe catch was YOY, and ruffe remained the most abundant species captured in trawls from this location. Round goby *Apollonia (Neogobius) melanostomus* were first captured from the Thunder Bay River, Lake Huron. **Lower Great Lakes:** No ruffe were detected.

**2000 – Lake Superior:** No ruffe range expansion was detected. Ruffe catch rates at peripheral locations in Thunder Bay, Harbour, Ontario, were less than or equal to previous years. The exception was the Ontonagon River, Michigan, Lake Superior, where the mean ruffe CPE (number per hour bottom trawling) more than doubled from 5 in 1999 to 11 in 2000. **Lake Huron:** Ruffe catch rates at peripheral locations in the Thunder Bay River, Michigan, were less than or equal to previous years. The CPE of ruffe in the Thunder Bay River estuary declined from 11 to 0.3 per minute bottom trawling. Round goby were the most abundant species captured from the Thunder Bay River during ruffe surveillance. The USFWS-Alpena expanded ruffe surveillance into U.S. waters of 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 represented a range expansion of 8 km eastward along the north shore of Lake Superior. A large catch of YOY ruffe from one bottom trawl tow in the Ontonagon River, Michigan, increased the mean CPE (number per hour bottom trawling) of that colony more than seven fold to 78. However, no ruffe were captured east of the Ontonagon River along the south shore of Lake Superior. Using a 38 mm stretch mesh gill net (15 m panel), the Red Cliff Tribal Fisheries Department in cooperation with USFWS-Ashland 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, Michigan, colony or any other ruffe surveillance location in Lake Huron or the St. Marys River. **Lower Great Lakes:** No ruffe were detected.

**2002 – Lake Superior:** Major ruffe range expansion was detected. The USFWS-Ashland 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 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 or the St. Marys River, and no ruffe were captured in

trawls within the ruffe range in Lake Huron. The USFWS-Alpena initiated reduction of the spawning ruffe population in the Thunder Bay River, Michigan, 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 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 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 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 or the St. Marys River; however, they continued to persist in the Thunder Bay River, Michigan. The USFWS-Alpena 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 USFWS-Ashland and USFWS-Green Bay 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 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 or the St. Marys River, and they were not captured from the Thunder Bay River, Michigan. **Lake Michigan:** The Michigan Department of Natural Resources-Marquette Fisheries Research Station (MIDNR-Marquette) discovered ruffe in Big Bay de Noc (BBDN), Lake Michigan, 15 km east of LBDN. LBDN was the location of initial discovery of ruffe in Lake Michigan in 2002. **Lower Great Lakes:** No ruffe were detected.

**2005 – Lake Superior:** Minor range expansion was detected. The USGS-Lake Superior Biological Station (USGS-LSBS) captured one sub adult ruffe incidentally from Thunder Bay, Ontario, 5 km northeast of Thunder Bay Harbour, Ontario, and 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 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:** No ruffe were captured from new or previously detected locations in Lake Huron, including the Thunder Bay River, Michigan, and Thunder Bay shipping lanes, where they were first detected in 1995. No ruffe have been detected in the St. Marys River. **Lake Michigan:** The MIDNR-Marquette captured no ruffe in other fish sampling from BBDN, where they were first detected in 2004. However, MIDNR-Marquette captured a total of 22 ruffe in other fish sampling from LBDN, where ruffe were first detected in 2002. The Bays de Noc of northern Green Bay continued to comprise the ruffe range in

Lake Michigan. **Lower Great Lakes:** No ruffe were detected.

**2006 – Lake Superior:** Major ruffe range expansion was detected. Surveillance activity along the south shore of Lake Superior confirmed ruffe expansion 226 km east of Marquette Harbor, Michigan, the previous eastern boundary of the ruffe range. A USFWS crew captured one adult ruffe near Grand Marais, Michigan, 120 km east of Marquette Harbor. The MIDNR confirmed one adult ruffe captured by an angler in Little Lake Harbor, Michigan, 167 km east of Marquette Harbor. The USFWS confirmed two adult ruffe captured by an angler in the Tahquamenon River estuary, a tributary on the west shore of Whitefish Bay, Michigan, 226 km east of Marquette Harbor and 55 km west of the Soo Locks. In Thunder Bay, Ontario, the OMNR confirmed that ruffe span the entire length (13 km) of the Thunder Bay Harbour, the eastern boundary of the ruffe range along the north shore. The OMNR also reported that a commercial fisherman captured three adult ruffe in a 120 mm stretch mesh gill net near the Welcome Islands in Thunder Bay, 3.5 km east of the Mission River estuary. The OMNR captured one adult ruffe 42 km upriver from the mouth of the Kaministiquia River, a tributary of Thunder Bay Harbour. **Lake Huron:** No ruffe were captured in Lake Huron from the Thunder Bay River or other areas sampled. Ruffe have not been captured from Lake Huron since 2003. **Lake Michigan:** No ruffe were reported from new locations or BBDN, where they were first detected in 2004. However, MIDNR-Marquette captured a total of 40 ruffe from LBDN, 18 more than were captured there in 2005. LBDN and BBDN of Green Bay continue to comprise the ruffe range in Lake Michigan. **Lower Great Lakes:** No ruffe were detected.

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

**2008 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. Dedicated ruffe surveillance efforts by the USFWS-Ashland were halted in Lake Superior because the range spans U.S. waters along the south shore of the lake. The USGS-LSBS continued to capture ruffe (110 ruffe) within the known range in western Lake Superior from near the Duluth Harbor, west of and within the Apostle Islands and Chequamegon Bay. **Lake Huron:** Ruffe range expansion was detected. The 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, Michigan, 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. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to

capture ruffe (5 ruffe) incidentally during sampling efforts in LBDN. **Lower Great Lakes:** No ruffe were detected.

**2009 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. The USGS-LSBS did not capture ruffe during their sampling efforts in Lake Superior. **Lake Huron:** No ruffe were captured from new or previously detected locations, including the Thunder Bay River, Michigan, and Thunder Bay shipping lanes, where they were first detected in 1995 or the Trout River in Rogers City, Michigan, where they were first captured in a trap in 2008. Ruffe remained undetected in the St. Marys River. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (2 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

**2010 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. The USGS-LSBS captured ruffe (60 ruffe) within the known range in western Lake Superior from near the Duluth Harbor and Chequamegon Bay. **Lake Huron:** No ruffe were captured from new or previously detected locations in Michigan, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995 or the Trout River in Rogers City, where they were first identified in a trap in 2008. Ruffe remained undetected in the St. Marys River. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (10 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.

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

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

known range. **Lower Great Lakes:** No ruffe were detected.

**2013 – Lake Superior:** The range of ruffe spanned the south shore from the Duluth-Superior Harbor on the border of Minnesota and Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth Superior Harbor to Thunder Bay, Ontario, Canada. The USGS-LSBS, WIDNR-Superior, USFWS-Ashland and OMNR-UGLMU captured ruffe within the known range in Lake Superior at Thunder Bay Harbour, St. Louis River and Chequamegon Bay. **Lake Huron:** No ruffe were captured from Lake Huron in Michigan, including the Cheboygan River, Trout River, Thunder Bay River, or Thunder Bay shipping lanes where they had been captured in the past. Ruffe remained undetected in the St. Marys River. **Lake Michigan:** The ruffe range consisted of Green Bay. The MIDNR-Marquette continued to capture ruffe (9 ruffe) incidentally from LBDN, within the known range. **Lower Great Lakes:** No ruffe were detected.