

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2015

Anjanette Bowen
U.S. Fish and Wildlife Service
Alpena Fish and Wildlife Conservation Office
480 W. Fletcher Street
Alpena, MI 49707
989-356-5102 Ext. 1014
Anjanette_Bowen@fws.gov

Sandra Keppner
U.S. Fish and Wildlife Service
Lower Great Lakes Fish and Wildlife
Conservation Office
1101 Casey Road
Basom, NY 14013
585-948-5445 Ext. 7039
Sandra_Keppner@fws.gov

BACKGROUND

The Ruffe *Gymnocephalus cernua* is an Eurasian percid that was likely introduced to the Great Lakes during the mid-1980s with ballast water that was discharged from an ocean-going ship (Pratt et al. 1992). Ruffe were first discovered in Lake Superior at the St. Louis River Estuary (SLRE), Minnesota/Wisconsin, where their population increased rapidly and by 1990 Ruffe became the most abundant fish captured from the SLRE in bottom trawls. According to U.S. Geological Survey (USGS) sampling records, the SLRE Ruffe population peaked in 1995 with about eight million Ruffe captured in trawls, then subsequently declined to about two million in trawls by 2004. 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the most abundant species captured in trawls through 2004 (the USGS terminated SLRE trawl assessments after 2004 – USGS unpublished information).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).

Ruffe pose a threat to native fish populations due to potential competition for food and space (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 and Forestry-Upper Great Lakes Management Unit (OMNRF-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 within the Great Lakes Basin is available in the Appendix. Currently, dedicated Ruffe surveillance efforts are conducted in Lake Huron by the USFWS-Alpena Fish and Wildlife Conservation Office (USFWS-Alpena) and in Lake Erie and Lake 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 2015, and documents fish sampling that was reported by partner 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 (LBDN) 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 otter trawl (4.9 m head rope) that was fished on the bottom (bottom trawl). The bottom trawl was 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 Lake Erie and Lake Ontario. Depth was recorded at the start and finish of individual tows (and at several additional intervals on Lake Erie and Lake 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 fyke nets, mini-fyke nets, modified Windermere traps (experimental perch traps, Edwards et al. 1998), boat electrofishing, and backpack electrofishing. Sampling location, water depth, and water temperature were recorded during each sampling effort. Fyke nets were set overnight and consisted of two 1.2 m x 1.2 m rectangles and five 0.8 m rings interconnected with 25.4 mm stretch mesh netting and a 7.6 m lead. Mini-fyke nets were set overnight and 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. Modified Windermere traps were baited with cheese and fished overnight. Modified Windermere traps consisted of a 0.8 m x 0.6 m x 0.3 m rectangular frame with 12.7 mm stretch mesh netting and openings on each end. Electrofishing used pulsed DC current and boat electrofishing was conducted during the night and backpack electrofishing was conducted during the day.

Catches of fish were sorted by species and counted, and individual lengths 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 subsequent identification.

Efforts to increase public awareness about 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. Information summaries, newsletter articles, and presentations were also provided.

Agency partners reported their sampling to which Ruffe were vulnerable. This sampling helped to provide coverage for Ruffe detection across the Great Lakes. Agency partners also expanded Ruffe awareness and promoted public reporting of Ruffe sightings.

RESULTS

RUFFE SURVEILLANCE

Dedicated Ruffe surveillance was conducted by the USFWS in Lakes Huron, Erie, and Ontario in 2015; no Ruffe were captured (Figures 2 and 3, and Tables 1, 2, and 3). No dedicated Ruffe surveillance was conducted in Lake Michigan or Lake Superior.

LAKE HURON

The USFWS-Alpena conducted Ruffe surveillance bottom trawling (4.9 m head rope) at five previously established locations in U.S. waters on Lake Huron during the summer and fall (July, September) including the Au Gres River mouth in Au Gres, Michigan; Cheboygan River in Cheboygan, Michigan; Port Dolomite in Cedarville, Michigan; the Thunder Bay River mouth/shipping channel in Alpena, Michigan; and the Saginaw River mouth (Figure 2 and Table 1). No Ruffe were captured. A total of 33 tows were completed in July and September, comprising 2.73 hours of effort. Twenty-eight taxa were collected. Round Gobies accounted for 86% of the catch across all locations. The remainder of the catch was composed of Alewife *Alosa pseudoharengus*, Bigmouth Buffalo *Ictiobus cyprinellus*, Black Crappie *Pomoxis nigromaculatus*, Blackside Darter *Percina maculata*, Bluegill *Lepomis macrochirus*, Brook Stickleback *Culaea inconstans*, Channel Catfish *Ictalurus punctatus*, Common Carp, Emerald Shiner *Notropis atherinoides*, Freshwater Drum *Aplodinotus grunniens*, Gizzard Shad *Dorosoma cepedianum*, Logperch *Percina caprodes*, Mimic Shiner *Notropis volucellus*, Mottled Sculpin *Cottus bairdii*, Quillback *Carpoides cyprinus*, Rainbow Smelt *Osmerus mordax*, Rock Bass *Ambloplites rupestris*, Slimy Sculpin *Cottus cognatus*, Smallmouth Bass *Micropterus dolomieu*, Spottail Shiner *Notropis hudsonius*, Threespine Stickleback, Trout-perch *Percopsis omiscomaycus*, Walleye *Sander vitreus*, White Bass *Morone chrysops*, White Perch, White Sucker *Catostomus commersonii*, and Yellow Perch.

Additional sampling was conducted by the USFWS-Alpena in historic Ruffe capture locations during the spring and fall 2015 using backpack electrofishing, boat electrofishing, 1.2 m fyke nets, mini-fyke nets, and modified Windermere traps (Figure 2 and Table 1). No Ruffe were captured as a result of sampling at the Cheboygan River in Cheboygan, Michigan; Trout River, Port of Calcite, and Rogers City harbor in Rogers City, Michigan; Thunder Bay River, Lafarge port, and Squaw Bay in Alpena, Michigan; or Devils River in Ossineke, Michigan.

LAKE ERIE

The USFWS-Lower Great Lakes conducted Ruffe surveillance bottom trawling (4.9 m head rope) at seven previously established harbor locations in U.S. waters on Lake Erie including Ashtabula, Ohio; Buffalo, New York; Cleveland, Ohio; Conneaut, Ohio; Erie, Pennsylvania; Sandusky, Ohio; and the Maumee River in Toledo, Ohio (Figure 3 and Table 2). No Ruffe were captured. All sites were sampled once in spring (May-June) and once in fall (September).

The spring catch across all locations sampled was composed of 13 species. Three species accounted for greater than 60% of the spring catch; Round Goby (24%), Walleye (24%), and Rock Bass (15%). The remainder of the catch was composed of Banded Killifish *Fundulus diaphanus*, Channel Catfish, Emerald

Shiner, Freshwater Drum, Gizzard Shad, Pumpkinseed *Lepomis gibbosus*, Rainbow Smelt, Yellow Perch, Cyprinidae species, and *Moxostoma* species.

The fall catch was composed of 24 species. Four species composed greater than 80% of the catch; White Perch (33%), Channel Catfish (21%), Freshwater Drum (17%), and Round Goby (10%). The remainder of the catch was composed of Alewife, Bluegill, Common Carp, Emerald Shiner, Gizzard Shad, Golden Redhorse *Moxostoma erythrurum*, Pumpkinseed, Rock Bass, Silver Chub *Macrhybopsis storeriana*, Smallmouth Bass, Rainbow Smelt, Spottail Shiner, Trout-perch, Walleye, White Bass, White Crappie *Pomoxis annularis*, White Sucker, Yellow Perch, and a specimen identified by genetic barcode as either Mimic Shiner or Ghost Shiner *Notropis buchmanii*. A more detailed summary of effort and fish captured at these locations is available upon request from the USFWS-Lower Great Lakes.

LAKE ONTARIO

The USFWS-Lower Great Lakes conducted bottom trawling for Ruffe surveillance during the spring and fall on the southern shore of Lake Ontario at Rochester Harbor on the Genesee River (Figure 3 and Table 3). No Ruffe were captured. The spring catch was composed of four species represented by a total of seven specimens: Alewife, Channel Catfish, Round Goby, and Trout-perch. The fall catch was composed of five species, one of which, Trout-perch, accounted for 78%. The remainder of the catch was Round Goby, Spottail Shiner, White Sucker, and Yellow Perch. A more detailed summary of effort and fish captured at this location is available upon request from the USFWS-Lower Great Lakes.

REPORTED FISH SAMPLING CAPABLE OF INCIDENTALLY CAPTURING RUFFE

Several agencies and organizations reported their fish sampling that was capable of capturing Ruffe incidentally during 2015. 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), Department of Fisheries and Oceans-Great Lakes Laboratory for Fisheries and Aquatic Sciences (DFO-GLLFAS), Wisconsin Department of Natural Resources-Lake Superior Field Unit (WIDNR-Superior), Michigan Department of Natural Resources-Marquette Fisheries Research Station (MIDNR-Marquette), Bay Mills Indian Community (BMIC), Lake Superior State University (LSSU), USFWS-Marquette Biological Station (USFWS-MBS), USFWS-Ashland, and OMNRF-UGLMU reported fish sampling that was capable of capturing Ruffe in Lake Superior (Figures 4, 5, 6, and 7; and Table 4). These activities captured a total of 885 Ruffe across Lake Superior at Black Bay, Kaministiquia River, Thunder Bay Harbour, St. Louis River, Apostle Islands, Chequamegon Bay, Misery River, Keweenaw Bay, Huron Bay, and Roxbury Creek, a tributary to Whitefish Bay. The Ruffe finding in eastern Lake Superior at Roxbury Creek (18 Ruffe) was a new sighting within a tributary to the existing Ruffe range on Whitefish Bay.

Black Bay, Ontario Personnel from the USFWS-Ashland and OMNRF-UGLMU conducted sampling at Black Bay from August-September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 4). A total of three Ruffe

were captured (in trawls) within the existing Ruffe range. Sampling consisted of 10 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 1.25 hour bottom trawling (4.9 m head rope), and 3.3 hours electrofishing.

Thunder Bay Harbour, Ontario Personnel from the USFWS-Ashland and OMNRF-UGLMU conducted sampling at Thunder Bay Harbour from August-September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 4). A total of 14 Ruffe were captured (2 in trawls and 12 in fyke nets), all within the existing Ruffe range. Sampling consisted of 19 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 0.8 hour bottom trawling (4.9 m head rope), and 3.3 hours electrofishing.

Kaministiquia River and Goulais River, Ontario Personnel from the DFO-GLLFAS conducted sampling at the Kaministiquia River and Goulais River in Ontario, Canada during August 2015 (Figure 5 and Table 4). Thirteen ruffe were captured (7 electrofishing, 2 in fyke nets, and 4 in a beach seine), all from the Kaministiquia River and within the existing ruffe range. Boat electrofishing, fyke nets (1.3 m box fyke net), beach seines (15 m beach seine), trawls, and trap nets (1.2 m trap net) were used to sample the fish community. A total effort of 2.6 hours electrofishing, 7 fyke net lifts, 4 seine hauls, 0.6 hour trawling effort, and 4 trap net lifts were conducted.

St. Louis River, Wisconsin Personnel from the USFWS-Ashland conducted sampling at the St. Louis River during August 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 4). A total of 66 Ruffe were captured (5 in fyke nets and 61 in trawls), all within the existing Ruffe range. Sampling consisted of 20 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 0.8 hour bottom trawling (4.9 m head rope), and 3.3 hours electrofishing.

Western Lake Superior, Wisconsin Management Unit W-1 Personnel from the WIDNR-Superior conducted sampling to index the fish community in western waters of Lake Superior at Wisconsin Management Unit W-1 in Wisconsin (Figure 4 and Table 4). A total of 30 Ruffe were captured, all within the existing Ruffe range. Sampling took place during July 2015 at 19 locations and consisted of 19 net lifts of a 1,097 m graded mesh gill net that included two panels (38.1 mm and 50.8 mm mesh) to which Ruffe were vulnerable.

Apostle Islands, Wisconsin Personnel from the USGS-LSBS conducted bottom trawling (11.9 m head rope) in the Apostle Islands during August and September 2015 (Figure 6 and Table 4). A total of 98 Ruffe were captured following one ten minute tow conducted at each of 25 locations for 8.1 hours of effort. All Ruffe captured were within the existing range.

Chequamegon Bay, Wisconsin Personnel from the USFWS-Ashland conducted sampling at Chequamegon Bay during August-September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 4). A total of 114 Ruffe were captured (87 in fyke nets and 27 electrofishing), all within the existing Ruffe range. Sampling consisted of 15 paired fyke net lifts (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 2.5 hours electrofishing.

Personnel from the USGS-LSBS conducted bottom trawling (5.5 m head rope and 11.9 m head rope) in Chequamegon Bay during July and August 2015 (Figure 6 and Table 4). A total of 480 Ruffe were captured with the 5.5 m trawl following one ten minute tow conducted at each of 32 locations within the bay for 5.3 hours of effort. A total of 36 Ruffe were captured with the 11.9 m trawl following one ten minute tow conducted at each of eight locations within the bay for 1.3 hours of effort. All Ruffe captured were within the

existing range.

Keweenaw Bay and Huron Bay, Michigan Personnel from the MIDNR-Marquette office initiated a fall fishery survey (August-September 2015) to assess the fish community of Keweenaw Bay and Huron Bay in Michigan (Figure 7 and Table 4). Sampling gear consisted of 97.5 m graded mesh gill nets that included a 25 mm stretch mesh panel to which Ruffe were vulnerable. Four Ruffe were captured (one in Keweenaw Bay and three in Huron Bay) following 12 net lifts at each location. A similar survey has been ongoing in Lake Michigan since 2009 (see below for LBDN and Big Bay de Noc, BBDN).

Whitefish Bay, Michigan Personnel from LSSU and BMIC conducted monthly sampling from April 2015-January 2016 in tributaries to Whitefish Bay at Grant Creek, Halfaday Creek, and Roxbury Creek (Figure 4 and Table 4). Sampling was conducted 250 m upstream of the creek mouth with fyke nets (6.35 mm mesh) set back to back, capturing up and downstream fish movement. A total of 18 Ruffe were captured from Roxbury Creek following 140 net lifts, all captured between August 18 and September 3. No Ruffe were captured in Grant Creek or Halfaday Creek following a total of 146 net lifts and 160 net lifts, respectively.

Captures of Ruffe from Roxbury Creek were new sightings from this tributary to the existing Ruffe range on Whitefish Bay. Ruffe were first captured from the Tahquamenon River in the spring of 2006 and then in Tahquamenon Bay in 2011. Ruffe were captured from nearshore areas of Whitefish Bay in 2014 and recent years.

Lake Superior Nearshore/Offshore Personnel from the USGS-LSBS conducted spring nearshore and summer offshore bottom trawling (11.9 m head rope) in U.S. and Canadian waters of Lake Superior (Figure 6 and Table 4). Nearshore sampling was conducted during spring 2015 (May-June) at 76 locations for a total of 30.6 hours of effort. Offshore sampling was conducted during summer 2015 (July) at 33 locations for a total of 11.0 hours of effort. Seven Ruffe were captured during nearshore sampling, all within the existing Ruffe range.

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) and private contractors to assess sea lamprey abundance in eight southern Lake Superior tributaries (Wisconsin and Michigan) (Figure 4 and Table 4). Two Ruffe were captured from the Misery River, a known location where Ruffe were last captured in 2014. Sampling was conducted from April-July 2015 with fyke nets, permanent traps, and portable assessment traps for a total of 799 net/trap lifts 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), MIDNR-Marquette, USFWS-MBS with USFWS-Ludington Biological Station (USFWS-LBS), USFWS-Green Bay, and WIDNR-Peshtigo Service Center (WIDNR-Peshtigo) reported fish sampling capable of capturing Ruffe in Lake Michigan (Figures 4, 8, and 9; and Table 5). The MIDNR-Marquette was the only agency to report capturing Ruffe, all from LBDN in northern Green Bay where they were first detected in 2002. A total of nine Ruffe were captured. Ruffe were not reported from outside of the known range.

Little Bay de Noc, Michigan Since 1988, personnel from the MIDNR-Marquette office have conducted

annual summer fishery assessments in Green Bay at LBDN using bottom trawls (3.7 m head rope) (Figure 8 and Table 5). Ten trawl tows for 1.66 hours effort were conducted from June-October 2015. No Ruffe were captured.

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 (Figure 8 and Table 5). Sampling gear consisted of 97.5 m graded mesh gill nets that included a 25 mm stretch mesh panel to which Ruffe were vulnerable. A total of 32 net lifts were conducted from August-September 2015. Nine Ruffe were captured, all within the existing range.

Big Bay de Noc, Michigan Personnel from the MIDNR-Marquette office conducted summer assessments in Green Bay at BBDN that were similar to those conducted in LBDN (described above) using bottom trawls (Figure 8 and Table 5). Ten trawl tows for 1.66 hours effort were conducted from June-October 2015. No Ruffe were captured.

Personnel from the MIDNR-Marquette office also conducted an annual fall fishery survey at BBDN that was similar to that conducted in LBDN (described above) to assess the fish community of northern Lake Michigan (Figure 8 and Table 5). A total of 48 net lifts were conducted from August-September 2015. No Ruffe were captured.

Cedar River and Menominee, Michigan Personnel from the MIDNR-Marquette office conducted summer bottom trawling and fall gill netting in Lake Michigan at Cedar River and Menominee, Michigan (described above for LBDN and BBDN) (Figure 8 and Table 5). No Ruffe were captured following 10 trawl tows for 1.66 hours trawling effort at each location and 12 net lifts at each location.

Green Bay, Wisconsin Personnel from the WIDNR-Peshtigo office conducted fish sampling in Green Bay with a beach seine during June 2015 and trawl during August 2015 (Figure 4 and Table 5). No Ruffe were captured following 22 shoreline seine hauls (15.2 m beach seine) at 12 locations and 75 trawl tows for 6.25 hours of trawling effort at 12 locations.

Green Bay, Wisconsin; Milwaukee, Wisconsin; Chicago, Illinois; Calumet, Illinois; and Burns Harbor, Indiana Personnel from the USFWS-Green Bay conducted sampling in Green Bay, Milwaukee, Chicago, Calumet, and Burns Harbor from June-October 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 5). No Ruffe were captured. Sampling gear consisted of paired fyke nets (0.9 m x 1.5 m box, 12.7 mm #126 mesh), paired mini-fyke nets (0.7 m x 1.0 m box, 3.175 mm #35 mesh), micromesh gill nets, 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 22 fyke net lifts, 22 mini-fyke net lifts, 23 micromesh gill net lifts, and 90 electrofishing runs for a total of 15.0 hours electrofishing effort. Milwaukee sampling consisted of 16 fyke net lifts, 16 mini-fyke net lifts, 10 micromesh gill net lifts, and 47 electrofishing runs for 7.8 hours electrofishing effort. Chicago Harbor sampling consisted of 12 fyke net lifts, 12 mini-fyke net lifts, 13 micromesh gill net lifts, 18 minnow trap array lifts, and 41 electrofishing runs for a total of 6.8 hours electrofishing effort. Calumet Harbor sampling consisted of 12 fyke net lifts, 12 mini-fyke net lifts, 14 micromesh gill net lifts, 12 minnow trap array lifts, and 52 electrofishing runs for a total of 8.7 hours electrofishing effort. Burns Harbor sampling consisted of 14 fyke net lifts, 13 mini-fyke net lifts, 12 micromesh gill net lifts, and 51 electrofishing runs for a total of 8.5 hours electrofishing effort.

Lake Michigan Tributaries in Wisconsin and Michigan Personnel from the USFWS-MBS/LBS with staff from the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI) and private contractors conducted sampling in eight Lake Michigan tributaries to assess sea lamprey abundance (Figure 4 and Table 5). No Ruffe were captured. Sampling was conducted from April-July 2015 using permanent traps, portable assessment traps, and semi-permanent traps for a total of 630 net/trap lifts 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.

Lake Michigan Nearshore Personnel from the USFWS-Green Bay conducted sampling at a number of nearshore locations including Arcadia, Michigan; Benton Harbor, Michigan; Ludington, Michigan; Manitowoc, Wisconsin; Racine, Wisconsin; Saugatuck, Michigan; Sturgeon Bay, Wisconsin; and Winthrop Harbor, Illinois from June-October 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 5). No Ruffe were captured. Sample gear consisted of micromesh gill nets fished 0.5-1.0 hour at night for a combined total effort of 151 net lifts.

Lake Michigan Nearshore/Offshore Personnel from the USGS-GLSC conducted annual fall bottom trawling (12 m head rope) at seven locations in Lake Michigan including Manistique, Michigan; Frankfort, Michigan; Ludington, Michigan; Saugatuck, Michigan; Waukegan, Illinois; Port Washington, Wisconsin; and Sturgeon Bay, Wisconsin to assess prey fish community abundance during September 2015 (Figure 9 and Table 5). No Ruffe were captured. Ten minute trawl tows were conducted at 5-128 m depths for a total of 78 tows and 12.9 hours of effort.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Michigan.

ST. MARYS RIVER

The USFWS-Ashland, OMNRF-UGLMU, DFO-GLLFAS, St. Marys River Fisheries Task Group (SMRFTG), USFWS-MBS, and USFWS-Alpena reported fish sampling that was capable of capturing Ruffe in the St. Marys River (Figure 4 and Tables 4 and 6). No Ruffe were captured.

St. Marys River-Upstream of Locks Personnel from the USFWS-Ashland and OMNRF-UGLMU conducted sampling in U.S. and Canadian waters of the St. Marys River upstream of the Soo Locks during August and October-November 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 4). No Ruffe were captured. Sampling consisted of 20 paired fyke net lifts (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 2.8 hours electrofishing.

St. Marys River- Locks Downstream Personnel from the USFWS-Alpena and OMNRF-UGLMU conducted sampling in U.S. and Canadian waters of the St. Marys River downstream of the Soo Locks to De Tour Village, Michigan during July-September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 4 and Table 6). No Ruffe were captured. Sampling was similar to sampling conducted in the upper St. Marys River by the USFWS-Ashland (see above). Effort consisted of 15 paired fyke net lifts (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 1.8 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, OMNRF,

DFO, Inter-Tribal Fisheries and Assessment Program (ITFAP), USGS, USFWS, and others. The SMRFTG conducted annual fall nighttime boat electrofishing in September 2015 to assess juvenile walleye at seven locations across U.S. and Canadian waters of the St. Marys River (Figure 4 and Table 6). No Ruffe were captured following 21.5 hours of effort. Sampling locations included the Sault area, Lake Nicolet, Lake George, Lake Munuscong, Raber Bay, Potagannissing Bay, and St. Joseph Channel.

Personnel from the DFO-GLLFAS conducted nighttime boat electrofishing in the St. Marys River during June 2015 (Figure 4 and Table 6). No ruffe were captured following 7.7 hours of effort.

Personnel from the USFWS-MBS conducted sampling in the St. Marys River to assess sea lamprey abundance (Figure 4 and Table 6). No Ruffe were captured. Sampling was conducted from June-July 2015 using portable assessment traps. A total of 202 trap lifts were 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 Michigan Department of Natural Resources-Alpena Fisheries Research Station (MIDNR-Alpena), Michigan Department of Natural Resources-Gaylord Field Office (MIDNR-Gaylord), Michigan Department of Natural Resources-Lake St. Clair Fisheries Research Station (MIDNR-Lake St. Clair), DFO-GLLFAS, USFWS-MBS/LBS, and USFWS-Alpena reported fish sampling that was capable of capturing Ruffe in Lake Huron (Figures 4 and 5; and Table 6). 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 to gauge trends and assess the current status of the fisheries resources (Figure 4 and Table 6). No Ruffe were captured following 16 gill net lifts during October 2015. Each gill net included a 30.5 m panel of 38 mm stretch mesh to which Ruffe would be vulnerable.

Northern Lake Huron Harbors and Au Sable River in Michigan Personnel from the MIDNR-Gaylord office conducted spring electrofishing (April and June 2015) at select northern Lake Huron harbors in Michigan and in the lower Au Sable River to evaluate the fish community (particularly Salmonids) and the potential for angler use of those areas (Figure 4 and Table 6). No Ruffe were captured. Sampling was conducted on two events at harbors in each of the following areas, Hammond Bay, Rogers City, and Presque Isle; and on one event in the lower Au Sable River. A total of 1.3 hours of effort was conducted at Hammond Bay harbor, 1.1 hours of effort at Rogers City harbor, 1.0 hour of effort at Presque Isle harbor, and 4.1 hours of effort in the lower Au Sable River.

Thunder Bay, Michigan Personnel from the MIDNR-Alpena office conducted bottom trawling during July 2015 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 6). 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).

Saginaw Bay, Michigan Personnel from the MIDNR-Lake St. Clair office conducted fall 2015 (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 6). No Ruffe were captured following a total of 23 tows for 3.6 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 2015 to assess the fish community (Figure 4 and Table 6). 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 16 net lifts were conducted.

Lake Huron Tributaries in Michigan Personnel from the USFWS-MBS/LBS and private contractors conducted sampling in three Lake Huron tributaries to assess sea lamprey abundance (Figure 4 and Table 6). No Ruffe were captured. Sampling was conducted from April-June 2015 using permanent traps and portable assessment traps. A total of 327 trap lifts were conducted. A summary of fish species captured at trap locations is available upon request from the USFWS-MBS.

Lake Huron Tributaries in Ontario Personnel from the DFO-GLLFAS conducted sampling at eight Lake Huron tributaries in Ontario, Canada during July-August 2015 (Figure 5 and Table 6). No ruffe were captured. Sampling locations included Coldwater Creek, Magnettawan River, Mississagi River, Nottawasaga River, Serpent River, Shebeshekong River, Spanish River, and Sturgeon River. Boat electrofishing, seining (15 m beach seine), trawling, trammel netting, fyke netting (1.3 m box fyke net), and trap netting (1.2 m trap net) gear was used to sample the fish community. Sampling effort consisted of 12.7 hours electrofishing, 3 seine hauls, 2.8 hours trawling effort, 2.1 hours trammel netting, 33 fyke net lifts, and 12 trap lifts.

Southern Lake Huron in Ontario Personnel from the USFWS-Alpena office conducted sampling in June 2015 using baited Gee minnow traps in an effort to collect a variety of benthic species in Ontario waters of southern Lake Huron (Figure 4 and Table 6). No Ruffe were captured following 18 trap lifts at six locations.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Huron.

ST. CLAIR/DETROIT RIVER SYSTEM

The MIDNR-Lake St. Clair and USFWS-Alpena reported fish sampling capable of capturing Ruffe in the St. Clair/Detroit River System (SCRDS) which includes the St. Clair River, Lake St. Clair, and Detroit River (Figure 10 and Table 7). 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 were vulnerable) to capture young-of-year and juvenile lake sturgeon in U.S. and Canadian waters of the St. Clair River (Figure 10 and Table 7). No Ruffe were captured following 54 gill net lifts at 21 locations during April-June and November-December 2015. Baited Gee minnow traps were also used in an effort to collect a variety of benthic species in U.S. and Canadian waters of the St. Clair River (Figure 10 and Table 7). No Ruffe were captured following 108 trap lifts at 21 locations during April-June and November-December 2015.

Lake St. Clair, Michigan Personnel from the MIDNR-Lake St. Clair office conducted bottom trawling (10 m head rope) at one location in Lake St. Clair as part of an annual survey to assess the fish community (Figure 10 and Table 7). No Ruffe were captured following a total of 9 tows for 1.3 hours of effort during May and September 2015.

Personnel from the MIDNR-Lake St. Clair office also conducted small mesh trap netting at four locations in Lake St. Clair during April and May 2015 (Figure 10 and Table 7). No Ruffe were captured following a total of 36 net lifts.

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) to capture young-of-year and juvenile lake sturgeon in U.S. and Canadian waters of the Detroit River (Figure 10 and Table 7). No Ruffe were captured following 48 gill net lifts at 12 locations during April-June and October-December 2015. Baited Gee minnow traps were also used in an effort to collect a variety of benthic species in U.S. and Canadian waters of the St. Clair River (Figure 10 and Table 7). No Ruffe were captured following 239 trap lifts at 16 locations during April-June and October-December 2015.

Personnel from the USFWS-Alpena conducted sampling in U.S. and Canadian waters of the Detroit River during July-August 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 10 and Table 7). No Ruffe were captured. Sampling consisted of 15 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 0.33 hours electrofishing, and 16 baited minnow trap arrays.

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

LAKE ERIE

The Ohio Department of Natural Resources-Sandusky Fisheries Research Unit (ODNR-Sandusky), ODNR-Fairport Harbor Fisheries Research Unit (ODNR-Fairport Harbor), MIDNR-Lake St. Clair, USGS-Lake Erie Biological Station (USGS-LEBS), DFO-GLLFAS, USFWS-MBS/LBS, USFWS-Lower Great Lakes, and USFWS-Alpena reported fish sampling that was capable of capturing Ruffe in Lake Erie (Figures 5, 10, 11, and 12; and Table 7). No Ruffe were captured.

Western Basin of Lake Erie in 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) to capture young-of-year and juvenile lake sturgeon in U.S. and Canadian waters of the western basin of Lake Erie (Figure 10 and Table 7). No Ruffe were captured following 96 gill net lifts at 24 locations during September-October 2015.

Personnel from the USGS-LEBS conducted annual bottom trawling (7.9 m head rope) in U.S. and Canadian water of the western basin of Lake Erie to assess the status of fish stocks (Figure 11 and Table 7). No Ruffe were captured. A total of 93, ten minute trawl tows were conducted through the months of June, September, and October 2015 for a total of 15.5 hours of sampling effort.

Western Basin of Lake Erie in Michigan Personnel from the MIDNR-Lake St. Clair office conducted bottom trawling (10 m head rope) at eight locations in Michigan waters of Lake Erie during August 2015 to assess the fish community (Figure 10 and Table 7). No Ruffe were captured following 8 tows for 1.3 hours of effort.

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 2015 to assess the relative abundance and growth of predator and forage fish species (Figure 10 and Table 7). No Ruffe were captured. Ten minute trawl tows were conducted at water depths ranging from 4-12 m. A total of 131 tows were conducted for a total of 21.8 hours of effort.

ODNR-Sandusky staff also conducted a nearshore electrofishing survey at 10 locations (transects) in the western basin of Lake Erie during June-July 2015 (Figure 10 and Table 7). No Ruffe were captured following ten 500 m transects for a total of 5,000 m of effort.

Maumee Bay and Sandusky Bay in Ohio Personnel from the USFWS-Alpena conducted sampling in Maumee and Sandusky bays from September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 10 and Table 7). No Ruffe were captured. Maumee Bay and Sandusky Bay effort each consisted of 15 paired fyke net lifts (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).

Central Basin of Lake Erie in Ohio Personnel from the ODNR-Fairport Harbor office conducted bottom trawling (10.4 m head rope, Yankee two seam) in the central basin of Lake Erie during November 2015 to assess the relative abundance and growth of predator and forage fish species (Figure 12 and Table 7). 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 23 trawl tows were conducted at two locations for 3.4 hours of effort.

Personnel from the ODNR-Fairport Harbor office also conducted gill netting (bottom set) in the central basin of Lake Erie from September-November 2015 to assess the adult abundance of walleye and smallmouth bass (Figure 12 and Table 7). 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. Ten locations were sampled and a total of 28 net lifts 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 two Lake Erie tributaries to assess sea lamprey abundance (Figure 10 and Table 7). No Ruffe were captured. Sampling was conducted from April-June 2015 using portable assessment traps and semi-permanent traps. A total of 176 trap lifts were conducted. A summary of fish species captured at these locations is available upon request from the USFWS-MBS.

Buffalo, New York and the Upper Niagara River Personnel from the USFWS-Lower Great Lakes conducted sampling in Buffalo and the Upper Niagara River from May-October 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 10 and Table 7). No Ruffe were captured. Sampling effort consisted of 14 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 7.0 hours electrofishing, and 1.3 hours bottom trawling (4.9 m head rope with a 3.8 cm stretch mesh body).

Personnel from the USFWS-Lower Great Lakes also conducted sampling in Tonawanda Creek, a tributary to the upper Niagara River, from May-October 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish in the Erie Canal (Figure 10 and Table 7). No Ruffe were captured. Sampling effort consisted of 1.7 hours electrofishing.

The Grand River in Ontario Personnel from the DFO-GLLFAS conducted sampling in the Grand River tributary to eastern Lake Erie in Ontario, Canada during July 2015 (Figure 5 and Table 7). No ruffe were captured following 3.3 hours boat electrofishing, 0.9 hours trawling, and 0.5 hours trammel netting.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Erie.

LAKE ONTARIO

The USFWS-Lower Great Lakes, DFO-GLLFAS, and USFWS-MBS/LBS reported fish sampling that was capable of capturing Ruffe incidentally in Lake Ontario (Figure 5 and 10; and Table 8). No Ruffe were

captured.

Lower Niagara River in New York Personnel from the USFWS-Lower Great Lakes conducted sampling in the lower Niagara River from May-October 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 10 and Table 8). No Ruffe were captured. Sampling effort consisted of 7 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end) and 2.8 hours electrofishing.

Rochester and Irondequoit Bay in New York Personnel from the USFWS-Lower Great Lakes conducted sampling in Rochester at the Genesee River and Irondequoit Bay from June-November 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish (Figure 10 and Table 8). No Ruffe were captured. Sampling effort consisted of 14 paired fyke net lifts (paired fyke nets consist of one lead with a fyke net at each end), 3.8 hours electrofishing, and 1.5 hours bottom trawling (4.9 m head rope with a 3.8 cm stretch mesh body).

Personnel from the USFWS-Lower Great Lakes also conducted sampling upstream in the Genesee River from May-September 2015 as part of an early detection and monitoring program to locate the presence and relative abundance of new nonindigenous fish in the Erie Canal (Figure 10 and Table 8). No Ruffe were captured. Sampling effort consisted of 0.8 hours electrofishing.

Lake Ontario South Shore Tributaries in New York Personnel from the USFWS-MBS/LBS worked with private contractors to conduct sampling in three Lake Ontario tributaries to assess sea lamprey abundance (Figure 10 and Table 8). No Ruffe were captured. Sampling was conducted from April-June 2015 using portable assessment traps and permanent traps for a total of 234 trap lifts. A summary of fish species captured at these locations is available upon request from USFWS-MBS.

Bay of Quinte in Ontario Personnel from the DFO-GLLFAS conducted sampling in the Bay of Quinte on Lake Ontario in Ontario, Canada during May 2015 (Figure 5 and Table 8). No ruffe were captured following 9.9 hours boat electrofishing.

Unconfirmed Sightings No unconfirmed sightings were reported for Lake Ontario.

ST. LAWRENCE RIVER

The DFO-GLLFAS reported fish sampling that was capable of capturing Ruffe incidentally in the St. Lawrence River (Figure 5 and Table 9). No Ruffe were captured.

Brockville in Ontario Personnel from the DFO-GLLFAS conducted sampling in Brockville, Ontario on the St. Lawrence River during May 2015 (Figure 5 and Table 9). No ruffe were captured following 6.6 hours boat electrofishing.

DISCUSSION

The summary of information gathered in 2015 indicates that Ruffe continue to persist in areas where they have become established. A synopsis by water body follows.

LAKE SUPERIOR

Although dedicated Ruffe surveillance was not conducted within Lake Superior, reports from other sampling conducted during 2015 indicated that Ruffe continue to persist in Lake Superior. No major range expansion was detected- even so, Ruffe continue to expand within their existing range on Whitefish Bay.

Western and South Shore Areas Sampling conducted by USGS-LSBS, OMNRF-UGLMU, DFO-GLLFAS, USFWS-Ashland, MIDNR-Marquette, and WIDNR-Superior indicated that Ruffe continued to persist in areas of western Lake Superior and along the south shore where they were previously established. Ruffe were reported from Black Bay, Kaministiquia River, and Thunder Bay Harbour (Ontario); St. Louis River (Minnesota/Wisconsin); Apostle Islands, Chequamegon Bay, and Misery River (Wisconsin); and Huron and Keweenaw bays (Michigan). No range expansion was detected in these areas based on incidental reports.

Whitefish Bay Ruffe were reported from Whitefish Bay (Michigan) tributaries in eastern Lake Superior according to sampling conducted by LSSU and BMIC. A total of 18 Ruffe were captured 250 m upstream in Roxbury Creek during August and September. Roxbury Creek was a new sighting among Whitefish Bay tributaries within the existing Ruffe range.

Ruffe were first captured from the Whitefish Bay area in 2006 when two Ruffe were reported from the Tahquamenon River. Ruffe were also captured in 2011 at two areas within Whitefish Bay by the USGS-LSBS during nearshore sampling. Although fish sampling was not conducted in the Tahquamenon River during 2013, Ruffe eDNA was detected during spring 2013 at the Tahquamenon River in water samples collected by The Nature Conservancy (Tucker et al. in press). During 2014, new sightings were discovered within the existing ruffe range at Naomikong Creek (five Ruffe) and Pendills Creek (one Ruffe). Currently Ruffe continue to persist in the Whitefish Bay area and are increasingly inhabiting/using bay tributaries.

ST. MARYS RIVER

No Ruffe surveillance activities were conducted in the St. Marys River during 2015. Ruffe surveillance was initiated in the St. Marys River by the USFWS-Alpena in 2000 and these efforts were morphed into a comprehensive USFWS early detection and monitoring program in 2013-2015 to locate the presence and relative abundance of new nonindigenous fish. Ruffe were not detected in the St. Marys River as a result of this sampling or other fish sampling that was conducted by the SMRFTG, USFWS-Ashland, OMNRF-UGLMU, DFO-GLLFAS, and USFWS-MBS.

Ruffe eDNA was detected in water samples collected by The Nature Conservancy during spring 2013 in the Waiska River, a tributary to the upper St. Mary River (Tucker et al. in press). No fish were sampled from the Waiska River in 2013 and there have been no reports of ruffe captures from the St. Marys River or its tributaries to date. Ruffe detections in recent years within nearby Whitefish Bay, Lake Superior have raised concerns that Ruffe could move into the St. Marys River from Whitefish Bay. The St. Marys River may provide ideal habitat that allow Ruffe to thrive. The river has warmer habitats, tributaries, and estuary areas that are adjacent to deeper dredged channels. 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.

LAKE MICHIGAN

Although dedicated Ruffe surveillance was not conducted on Lake Michigan, 2015 reports from other fish surveys conducted by MIDNR-Marquette indicated that Ruffe continued to persist in northern Green Bay at LBDN (Michigan). Ruffe were not captured outside of LBDN in 2015, and no expansion out of Green Bay was detected based on reports from other agencies including the WIDNR, USGS, and USFWS.

Green Bay, Little Bay de Noc and Big Bay de Noc In 2002 Ruffe (three Ruffe) were captured in Green Bay at LBDN in Escanaba, Michigan during Ruffe surveillance conducted by USFWS-Ashland. In 2004, one Ruffe was detected at BBDN by the MIDNR-Marquette. In 2007, one Ruffe was captured and reported from near Marinette, Wisconsin by the WIDNR and commercial fishermen. Annual sampling by the MIDNR-Marquette to assess the fish communities of LBDN and BBDN continued to capture Ruffe in LBDN through 2015. The Ruffe were captured with gill nets in low numbers (nine Ruffe) 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 (2011-2015) have ranged between two Ruffe captured in 2011 to nine captured in 2013 and 2015. Ruffe continued to be absent from the MIDNR-Marquette catch in BBDN during 2015. Their personnel have not captured Ruffe from BBDN since their initial discovery there in the fall of 2004.

LAKE HURON

No Ruffe were captured during dedicated Ruffe surveillance conducted by the USFWS-Alpena or other fish sampling reported by the MIDNR-Alpena, MIDNR-Gaylord, MIDNR-Lake St. Clair, DFO-GLLFAS, and USFWS-MBS on Lake Huron during 2015. 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 In 2011 and 2012 Ruffe were detected in the Cheboygan River at the first upstream dam from Lake Huron. The Ruffe (one in each year) were incidentally captured by the USFWS-MBS in a permanent sea lamprey trap at the dam. Ruffe have not been captured during 2013-2015 as a result of targeted sampling conducted by USFWS-Alpena in the area using electrofishing and trap nets. The status of Ruffe in the Cheboygan River is unknown. It is not known whether the Ruffe captured in 2011 and 2012 were random individuals, or part of a colony populating the river. If Ruffe are present in the river, they are likely low in number because they have not been reported by local recreational anglers, who are often first to detect new species. One may speculate that Ruffe found in the Cheboygan River may have been transferred via ship ballast water from other infested areas of the Great Lakes or migrated north from historically infested areas of Thunder Bay.

Trout River, Michigan In 2008 Ruffe were detected in the Trout River at the first upstream barrier from Lake Huron. The Ruffe (two Ruffe) were incidentally captured by the USFWS-MBS in a semi-permanent sea lamprey trap at the barrier. Ruffe have not been captured during 2013-2015 as a result of targeted sampling conducted by USFWS-Alpena in the area using backpack electrofishing in the Trout River and boom electrofishing at the nearby Port of Calcite, mouth of the Swan River, and Rogers City marina. Like the Cheboygan River, the status of Ruffe in the Trout River is unknown. The 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 from migration originating at the historically infested area of Thunder Bay.

Thunder Bay River, Michigan In 1995 Ruffe were detected in the Thunder Bay River upstream from the river mouth. The Ruffe (three Ruffe) were targeted and captured with a bottom trawl by the USFWS-Ashland during Ruffe surveillance efforts in Lake Huron. Subsequent targeted sampling was conducted by the USFWS-Alpena during 1996-2015. The 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 targeted surveillance.

LOWER GREAT LAKES AND ST. LAWRENCE RIVER

Ruffe have not been detected in the St.Clair/Detroit River system, lower Great Lakes (Lakes Erie and Ontario), or the St. Lawrence River despite dedicated Ruffe surveillance efforts in Lakes Erie and Ontario by the USFWS and other fish sampling that was reported by the ODNR, MIDNR, USGS, DFO, and the USFWS.

KNOWN RANGE OF RUFFE IN THE GREAT LAKES

The 2015 range of Ruffe in the Great Lakes is as follows (Figure 13):

Lake Superior North Shore: U.S. waters of the Duluth/Superior Harbor, Minnesota/Wisconsin, north to Canadian waters of Black Bay in Ontario.

South Shore: U.S. waters of the Duluth/Superior Harbor, Minnesota/Wisconsin, east to Whitefish Bay where there were captures in Pendills Creek, Michigan.

Lake Michigan Captures within Green Bay.

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

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

Thunder Bay River/Thunder Bay Shipping Channel (Alpena, Michigan): Captured downstream of the first upstream barrier (dam) on the Thunder Bay River; however, no Ruffe have been captured or reported from this area of Lake Huron since 2003.

St. Clair/Detroit River System Undetected.

Lake Erie, Lake Ontario, and St. Lawrence River 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 their fish sampling information and/or permitted Ruffe surveillance within their jurisdictions, and to volunteers and staff members who assisted with Ruffe surveillance or data analysis.

Agencies and Offices that Contributed Fish Sampling Information

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
Tim Cwalinski, Michigan Department of Natural Resources-Gaylord Field Office
John Deller, Ohio Department of Natural Resources-Fairport Harbor Fisheries Research Unit
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
Ji He, Michigan Department of Natural Resources-Alpena Fisheries Research Station
Stephen Hensler, U.S. Fish and Wildlife Service-Alpena Fish and Wildlife Conservation Office
Heidi Himes, U.S. Fish and Wildlife Service-Lower Great Lakes 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
Jared Myers, U.S. Fish and Wildlife Service-Ashland Fish and Wildlife Conservation Office
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
Bradley Ray, Wisconsin Department of Natural Resources-Lake Superior Field Unit
Mike Seider, U.S. Fish and Wildlife Service-Ashland Fish and Wildlife Conservation Office
Darin Simpkins, 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
Jake Van Effen, U.S. Fish and Wildlife Service-Marquette Biological Station
Eric Weimer, Ohio Department of Natural Resources-Sandusky Fisheries Research Unit
Frank Zomer, Bay Mills Indian Community
Troy Zorn, Michigan Department of Natural Resources-Marquette Fisheries Research Station

Volunteers and Staff Members that assisted with Ruffe Surveillance or Data Analysis

Lindsey Adams (USFWS-Alpena)	Heidi Himes (USFWS-Lower Great Lakes)
Joe Curtis (Volunteer USFWS-Alpena)	Thomas Hoffman (USFWS-Lower Great Lakes)
Shana DiPalma (USFWS-Lower Great Lakes)	Scott Koproski (USFWS-Alpena)
Daniel Drake (USFWS-Lower Great Lakes)	Joseph Luttrell (USFWS-Alpena)
Brittany Forslund (Volunteer USFWS-Lower Great Lakes)	Cathy Marion (Volunteer USFWS-Lower Great Lakes)
Stacy Furgal (USFWS-Lower Great Lakes)	Kelly McDonald (USFWS-Lower Great Lakes)
Maureen Gallagher (USFWS-Region 3)	Ryan Pokoryznski (USFWS-Alpena)
Steven Gambicki (USFWS-Alpena)	Brandon Trainer (Volunteer USFWS-Alpena)
Kaley Genther (USFWS-Alpena)	Darren Vercnocke (USFWS-Alpena)
Robert Haltner (USFWS-Lower Great Lakes)	

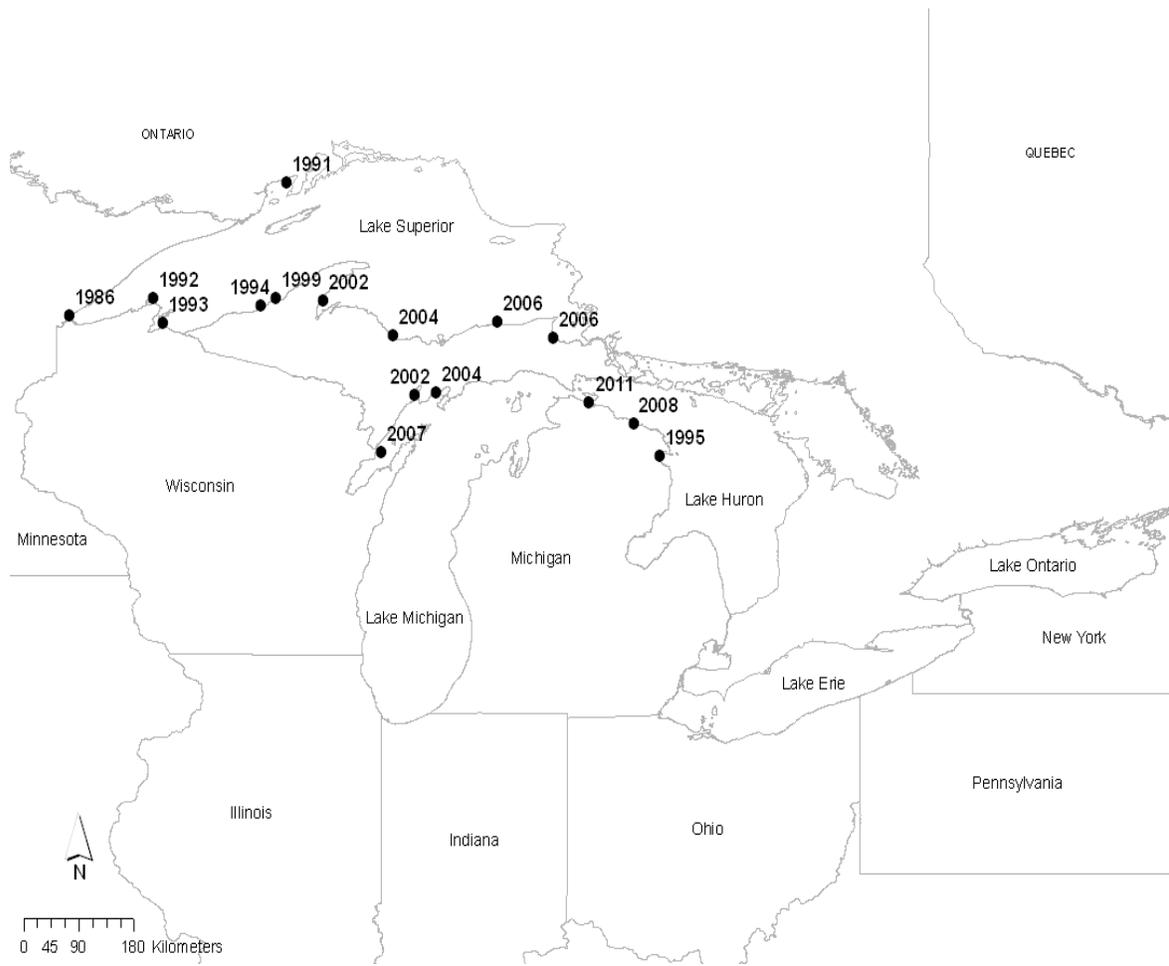
BIBLIOGRAPHY

- Bowen, A. K. and M. A. Goehle. 2011. Surveillance for Ruffe in the Great Lakes, 2008 to 2010. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 51 pp. Available <http://www.fws.gov/midwest/alpena/documents/2008-2010-GL-Ruffe-Surveillance.pdf>.
- Bowen, A. K. and M. A. Goehle. 2012. Surveillance for Ruffe in the Great Lakes, 2011. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 43 pp. Available <http://www.fws.gov/midwest/alpena/documents/2011-GL-Ruffe-Surveillance.pdf>.
- Bowen, A. K. and M. A. Goehle. 2013. Surveillance for Ruffe in the Great Lakes, 2012. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 43 pp. Available <http://www.fws.gov/midwest/alpena/documents/2012-GL-Ruffe-Surveillance.pdf>.
- Bowen, A. and S. Keppner. 2014. Surveillance for Ruffe in the Great Lakes, 2013. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 46 pp. Available <http://www.fws.gov/midwest/alpena/documents/2013-GL-Ruffe-Surveillance.pdf>.
- Bowen, A. and S. Keppner. 2015. Surveillance for Ruffe in the Great Lakes, 2014. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 45 pp. Available <http://www.fws.gov/midwest/alpena/documents/2014-GL-Ruffe-Surveillance.pdf>.
- Bronte, C. R., L. M. Evrard, W. P. Brown, K. R. Mayo and A. J. Edwards. 1998. Fish community changes in the St. Louis River estuary, Lake Superior, 1989-1996: is it Ruffe or population dynamics? *Journal of Great Lakes Research* 24(2):309-318.
- Busiahn, T. R. 1997. Ruffe control: a case study of an aquatic nuisance species control program. F. M. D'Itri, ed. *Zebra mussels and aquatic nuisance species*. Ann Arbor Press Inc., Chelsea, MI. Pages 69-86.
- Czypinski, G. D., A. K. Bowen, S. Cogswell, M. A. Goehle, and B. MacKay. 2004. Surveillance for Ruffe in the Great Lakes, 2003. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 40 pp.
- Czypinski, G. D., A. K. Bowen, and M. A. Goehle. 2008. Surveillance for Ruffe in the Great Lakes, 2007. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 36 pp.
- Czypinski, G. D., M. A. Goehle, A. K. Bowen, and B. Brownson. 2006. Surveillance for Ruffe in the Great Lakes, 2005. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 41 pp.
- Czypinski, G. D., M. A. Goehle, A. K. Bowen, and B. Brownson. 2007. Surveillance for Ruffe in the Great Lakes, 2006. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 44 pp.
- Czypinski, G. D., M. A. Goehle, A. K. Bowen, and B. MacKay. 2005. Surveillance for Ruffe in the Great Lakes, 2004. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 29 pp.
- Czypinski, G. D., G. Johnson, A. K. Hintz and S. M. Keppner. 1997. Surveillance for Ruffe in the Great Lakes, 1996. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 23 pp.
- Czypinski, G. D., S. M. Keppner, A. K. Hintz, and G. Johnson. 1998. Surveillance for Ruffe in the Great Lakes, 1997. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 22 pp.

- Czypinski, G. D., S. M. Keppner, A. K. Hintz, and E. Paleczny. 1999. Surveillance for Ruffe in the Great Lakes, 1998. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 22 pp.
- Czypinski, G. D., M. P. Sowinski, A. K. Bowen, and B. MacKay. 2003. Surveillance for Ruffe in the Great Lakes, 2002. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 34 pp.
- Czypinski, G. D., M. T. Weimer, A. K. Bowen, and A. Dextrase. 2002. Surveillance for Ruffe in the Great Lakes, 2001. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 36 pp.
- Czypinski, G. D., M. T. Weimer, A. K. Hintz, and A. Dextrase. 2000. Surveillance for Ruffe in the Great Lakes, 1999. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 29 pp.
- Czypinski, G. D., M. T. Weimer, A. K. Hintz, and A. Dextrase. 2001. Surveillance for Ruffe in the Great Lakes, 2000. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 32 pp.
- Edwards, A. J., G. D. Czypinski, and J. H. Selgeby. 1998. A collapsible trap for sampling ruffe. *North American Journal of Fisheries Management* 18:465-469.
- Evrard, L. M., A. J. Edwards, M. H. Hoff and C. R. Bronte. 1998. Ruffe population investigations in Lake Superior tributaries. U.S. Geological Survey, Great Lakes Science Center, Lake Superior Biological Station, Ashland, WI. 44 pp.
- Gorman, O. T. and B. C. Weidel. 2016. Great Lakes prey fish populations: A cross-basin overview of status and trends based on bottom trawl surveys, 1978-2015. In *Compiled reports to the Great Lakes Fishery Commission of the annual bottom trawl and acoustic surveys, 2015*. U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI. 75 pp. Available http://www.glfsc.org/lakecom/common_docs/Compiled%20Reports%20from%20USGS%202016.pdf.
- Haltner, R., S. Furgal, and D. Drake. 2016. Early detection and monitoring of non-native fishes in the lower Great Lakes: Lake Erie, Niagara River, and Lake Ontario assessments, 2015. U.S. Fish and Wildlife Service, Lower Great Lakes Fish and Wildlife Conservation Office, Basom, NY. 19 pp.
- Henson, F. G. 1999. Competition between Ruffe (*Gymnocephalus cernuus*) and yellow perch (*Perca flavescens*) and the influence of temperature on growth and gastric evacuation of Ruffe. MS Thesis, University of Minnesota, St. Paul, MN.
- Kindt, K. J., S. M. Keppner and G. Johnson, 1996. Surveillance for Ruffe in the Great Lakes, 1995. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 23 pp.
- Madenjian, C. P., D. B. Bunnell, T. J. Desorcie, M. J. Kostich, M. A. Chriscinske, and J. V. Adams. 2016. Status and trends of prey fish populations in Lake Michigan, 2015. In *Compiled reports to the Great Lakes Fishery Commission of the annual bottom trawl and acoustic surveys, 2015*. U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI. 75 pp. Available http://www.glfsc.org/lakecom/common_docs/Compiled%20Reports%20from%20USGS%202016.pdf.
- Ohio Division of Wildlife. 2016. Ohio's Lake Erie Fisheries, 2015. Annual status report. Federal Aid in Fish Restoration Project F-69-P. Ohio Department of Natural Resources, Division of Wildlife, Lake Erie Fisheries Units, Fairport and Sandusky. 106 pp. Available <http://wildlife.ohiodnr.gov/portals/wildlife/pdfs/fishing/LakeErieStatus.pdf>.

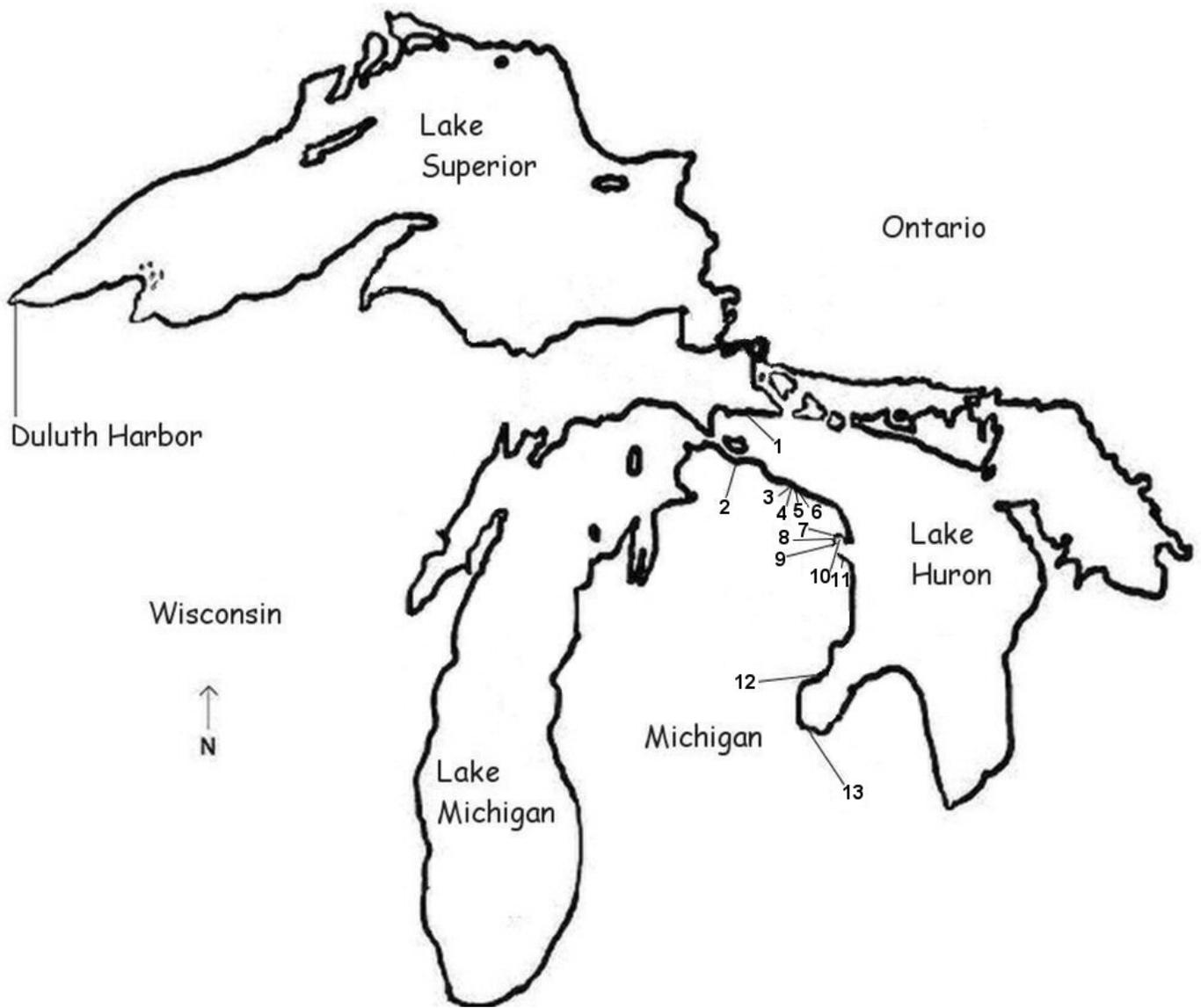
- Pratt, D. M., W. H. Blust and J. H. Selgeby. 1992. Ruffe, *Gymnocephalus cernuus*: newly introduced in North America. Canadian Journal of Fisheries and Aquatic Sciences 49:1616-1618.
- Roseman, E. F., M. A. Chriscinske, D. K. Castle, and C. Prichard. 2016. Status and trends of the Lake Huron offshore demersal fish community, 1976-2015. In Compiled reports to the Great Lakes Fishery Commission of the annual bottom trawl and acoustic surveys, 2015. U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI. 75 pp. Available http://www.glfsc.org/lakecom/common_docs/Compiled%20Reports%20from%20USGS%202016.pdf.
- Ruffe Control Committee. 1996. Revised Ruffe control program. Submitted to the Aquatic Nuisance Species Task Force by the Ruffe Control Committee, Thomas R. Busiahn, Chairman, October, 1996. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 30 pp.
- Ruffe Task Force. 1992. Ruffe in the Great Lakes: a threat to North American fisheries. Great Lakes Fishery Commission, Ann Arbor, MI. 144 pp.
- Schloesser, J. T. and J. T. Myers. 2016. Fish community monitoring for early detection of invasive fishes in Lake Superior: St. Louis River, Upper St. Marys River, Thunder Bay, and Chequamegon Bay assessments, 2015. U.S. Fish and Wildlife Service, Ashland Fish and Wildlife Conservation Office, Technical Report No. 08. Ashland, WI. 34 pp.
- Schuldt, J. A., C. Richards and R. M. Newman. 1999. Effects of Eurasian Ruffe on food resources and native yellow perch in experimental mesocosms. Bulletin of the North American Benthological Society 16(1):163.
- Slade, J. W., S. M. Keppner and W. R. MacCallum. 1995. Surveillance for Ruffe in the Great Lakes, 1994. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 27 pp.
- Slade, J. W. and K. J. Kindt. 1992. Surveillance for Ruffe in the upper Great Lakes, 1992. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 8 pp.
- Slade, J. W., S. M. Pare' and W. R. MacCallum. 1994. Surveillance for Ruffe in the Great Lakes, 1993. U.S. Fish and Wildlife Service, Fishery Resources Office, Ashland, WI. 14 pp.
- Tucker, A. J., W. L. Chadderton, C. L. Jerde, M. A. Reshaw, K. Uy, C. Gantz, A. R. Mahon, A. Bowen, T. Strakosh, J. M. Bossenbroek, J. L. Sieracki, D. Beletsky, J. Bergner, and D. M. Lodge. In Press. A sensitive environmental DNA (eDNA) assay leads to new insights on Eurasian Ruffe (*Gymnocephalus cernua*) spread in North America. Biological Invasions.
- U. S. Fish and Wildlife Service. 2016. Early detection and monitoring of non-native fishes in Lake Erie, 2013-2015. U.S. Fish and Wildlife Service, Lower Great Lakes Fish and Wildlife Conservation Office, Basom, NY and U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 59 p. Available <http://www.fws.gov/midwest/alpena/documents/Lake-Erie-Report-2013-2015-Final-3-18-16.pdf>.
- U. S. Fish and Wildlife Service. 2016. Early detection and monitoring of non-native fishes in Lake Huron, 2013-2015. U.S. Fish and Wildlife Service, Alpena Fish and Wildlife Conservation Office, Alpena, MI. 30 p. Available <http://www.fws.gov/midwest/alpena/documents/2013-2015-Lake-Huron-Early-Detection.pdf>.

Vinson, M. R., L. M. Evrard, O. T. Gorman, and D. L. Yule. 2016. Status and trends in the Lake Superior Fish Community, 2015. In Compiled reports to the Great Lakes Fishery Commission of the annual bottom trawl and acoustic surveys, 2015. U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI. 75 p. Available http://www.glf.com/common_docs/Compiled%20Reports%20from%20USGS%202016.pdf.



Progression of Ruffe Across the Great Lakes

Figure 1. Progression of ruffe across the Great Lakes. Note: Not all ruffe sightings are represented; only first sightings are referenced in this progression of spread across the Great Lakes.



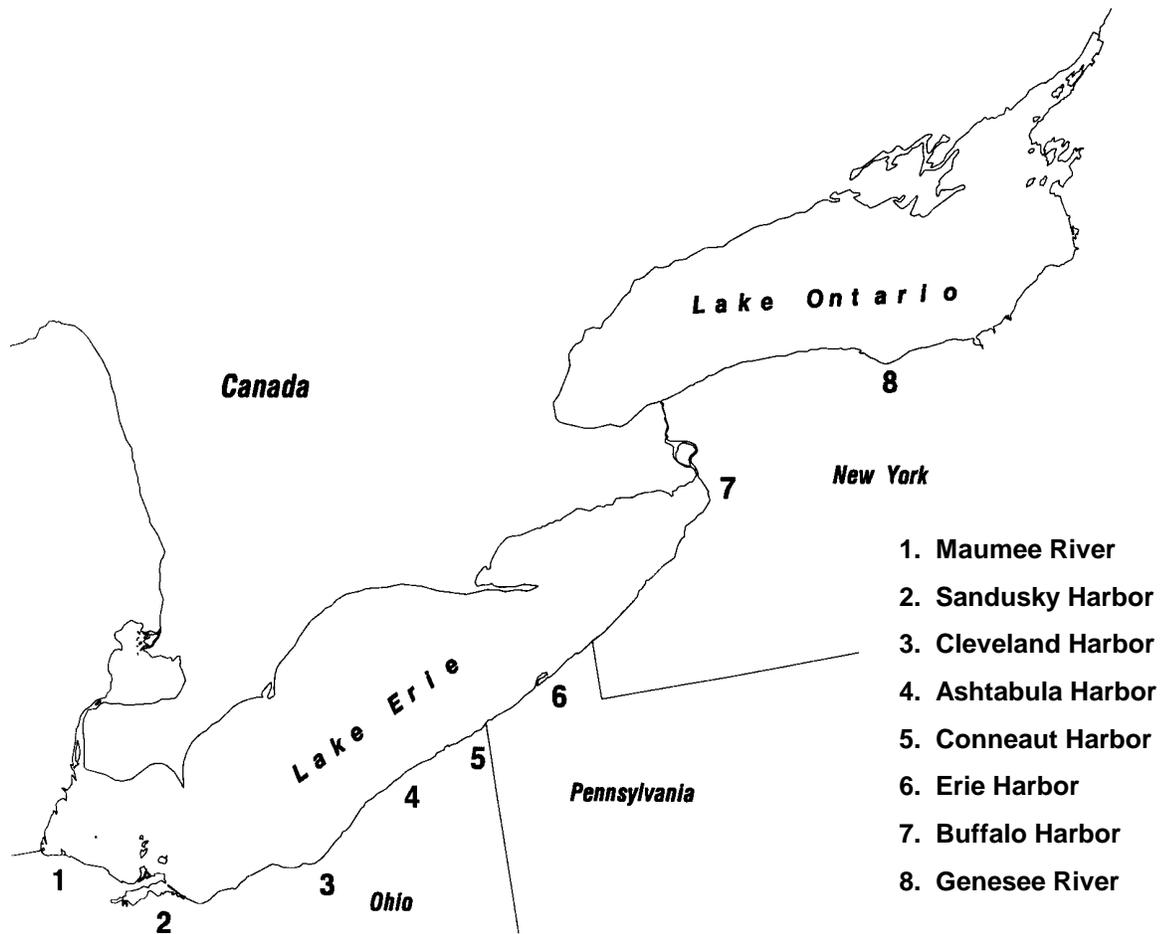
Ruffe Surveillance, Lake Huron, 2015



U. S. Fish and Wildlife Service

- | | | |
|-----------------------|--------------------------------------|-------------------|
| 1. Port Dolomite | 6. Swan River | 11. Devils River |
| 2. Cheboygan River | 7. Thunder Bay – Lafarge Corporation | 12. Au Gres River |
| 3. Trout River | 8. Thunder Bay River | 13. Saginaw River |
| 4. Rogers City Harbor | 9. Thunder Bay – Squaw Bay | |
| 5. Port of Calcite | 10. Thunder Bay – Shipping Channel | |

Figure 2. Locations surveyed for ruffe in the upper Great Lakes during 2015.



Ruffe Surveillance, Lake Erie/Lake Ontario, 2015



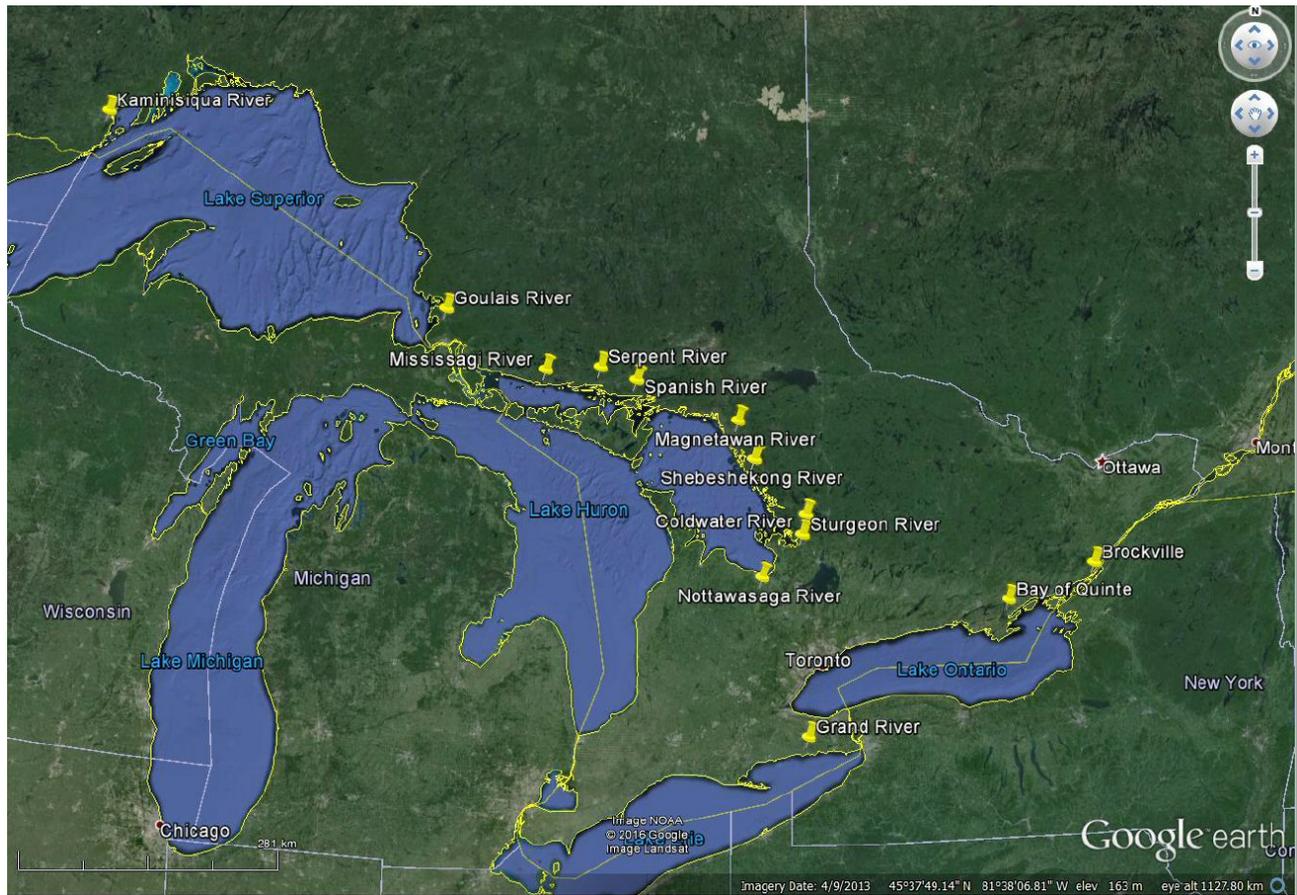
U. S. Fish and Wildlife Service

Figure 3. Locations surveyed for ruffe in the lower Great Lakes during 2015.



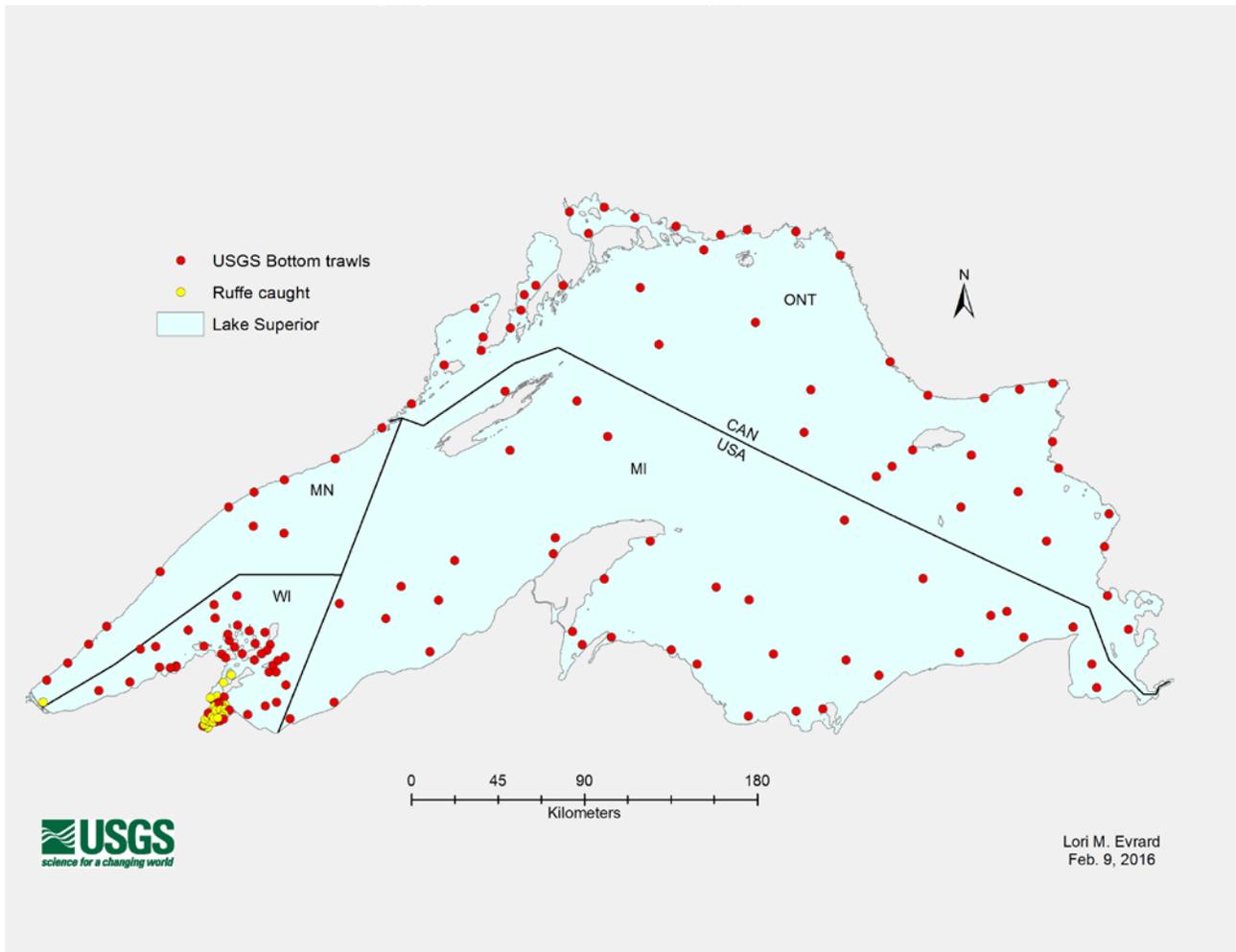
- | | | | |
|----------------------------------|-----------------------------|-------------------------------|--------------------------|
| 1. Black Bay * | 15. Betsy River | 29. Racine, Wisconsin | 43. Carp Lake River |
| 2. Thunder Bay Harbour * | 16. Tahquamenon River | 30. Winthrop Harbor, Illinois | 44. Les Cheneaux Islands |
| 3. St. Louis River * | 17. Roxbury Creek * | 31. Chicago Harbor | 45. Cheboygan River |
| 4. Middle River | 18. Halfaday Creek | 32. Calumet Harbor | 46. Hammond Bay Harbor |
| 5. Brule River | 19. Grant Creek | 33. Burns Harbor | 47. Ocqueoc River |
| 6. Lake Superior District WI-1 * | 20. St. Marys River | 34. Trail Creek | 48. Rogers City Harbor |
| 7. Apostle Islands * | 21. Manistique River | 35. St. Joseph River | 49. Presque Isle Harbor |
| 8. Chequamegon Bay * | 22. Big Bay de Noc | 36. Benton Harbor, Michigan | 50. Thunder Bay |
| 9. Bad River | 23. Little Bay de Noc * | 37. Saugatuck, Michigan | 51. Black River |
| 10. Misery River * | 24. Peshtigo River | 38. Ludington, Michigan | 52. Au Sable River |
| 11. Keweenaw Bay * | 25. Green Bay | 39. Big Manistee River | 53. East Au Gres River |
| 12. Huron Bay * | 26. Sturgeon Bay, Wisconsin | 40. Arcadia, Michigan | 54. Saginaw Bay |
| 13. Silver River | 27. Manitowoc, Wisconsin | 41. Betsie River | 55. Southern Lake Huron |
| 14. Rock River | 28. Milwaukee, Wisconsin | 42. Boardman River | |

Figure 4. Upper Great Lakes fish sampling conducted in 2015 and reported by agency and university personnel. Ruffe were vulnerable to gear used during sampling. The * denotes locations where ruffe were captured.



Fisheries and Oceans Canada

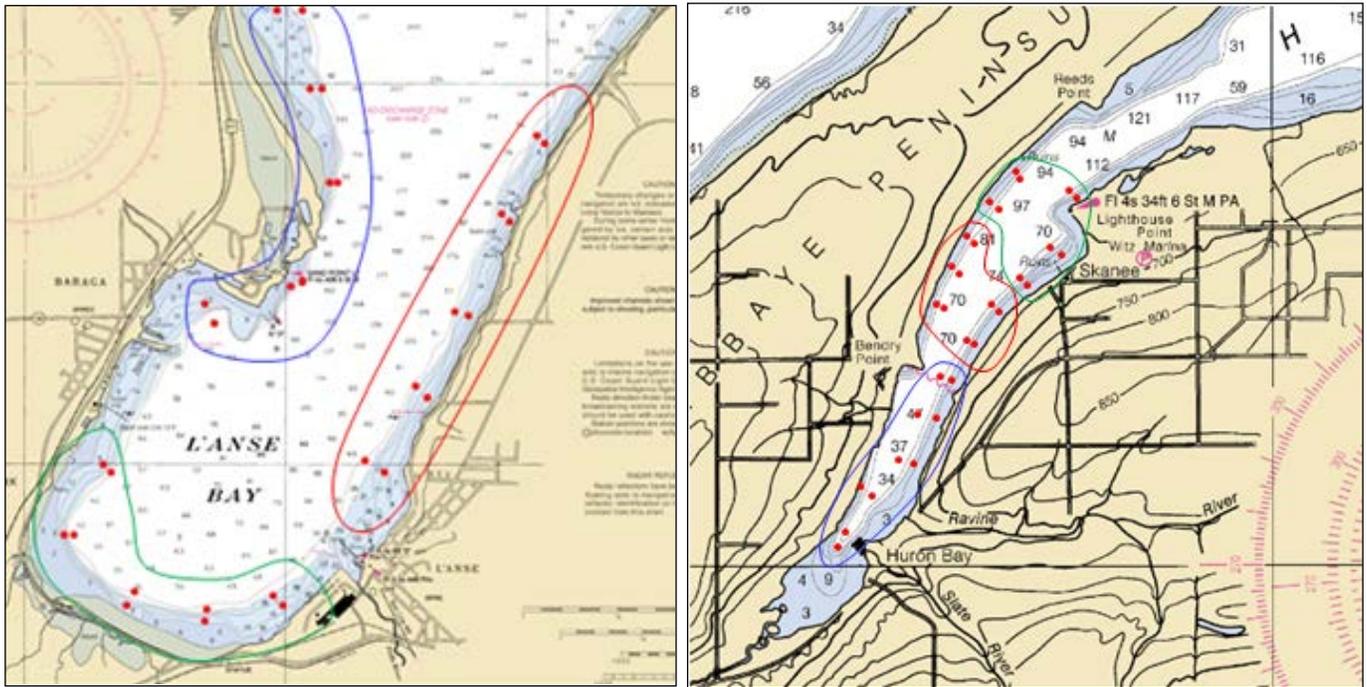
Figure 5. The Department of Fisheries and Oceans Canada-Great Lakes Laboratory for Fisheries and Aquatic Sciences reported boat electrofishing, beach seining, trawling, trammel netting, trap netting, and fyke netting at the Kaministiquia and Goulais Rivers on Lake Superior, the St. Marys River, Canadian tributaries of Lake Huron, the Grand River on Lake Erie, the Bay of Quinte on Lake Ontario, and Brockville on the St. Lawrence River during 2015. Ruffe were vulnerable to gears used during sampling.



Lake Superior Fish Community Sampling

 U. S. Geological Survey

Figure 6. The USGS-Lake Superior Biological Station reported annual bottom trawling at locations in Lake Superior during 2015. Ruffe were vulnerable to gear used during sampling.

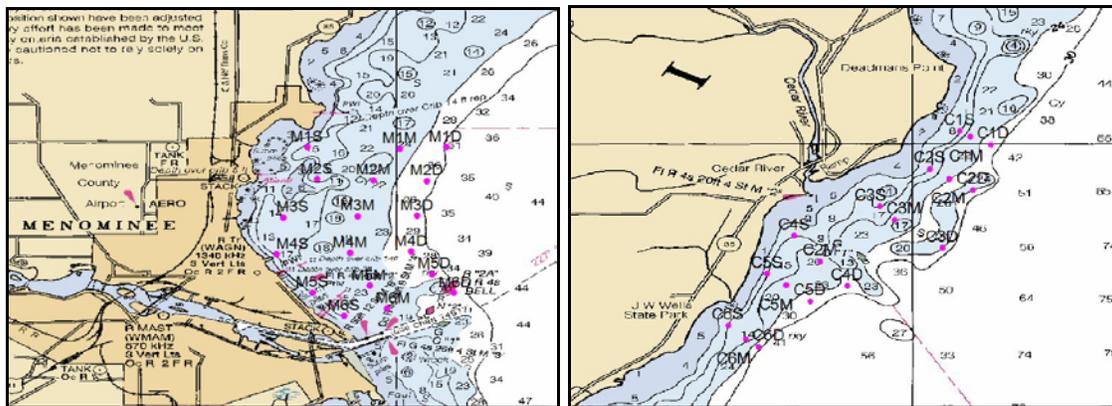
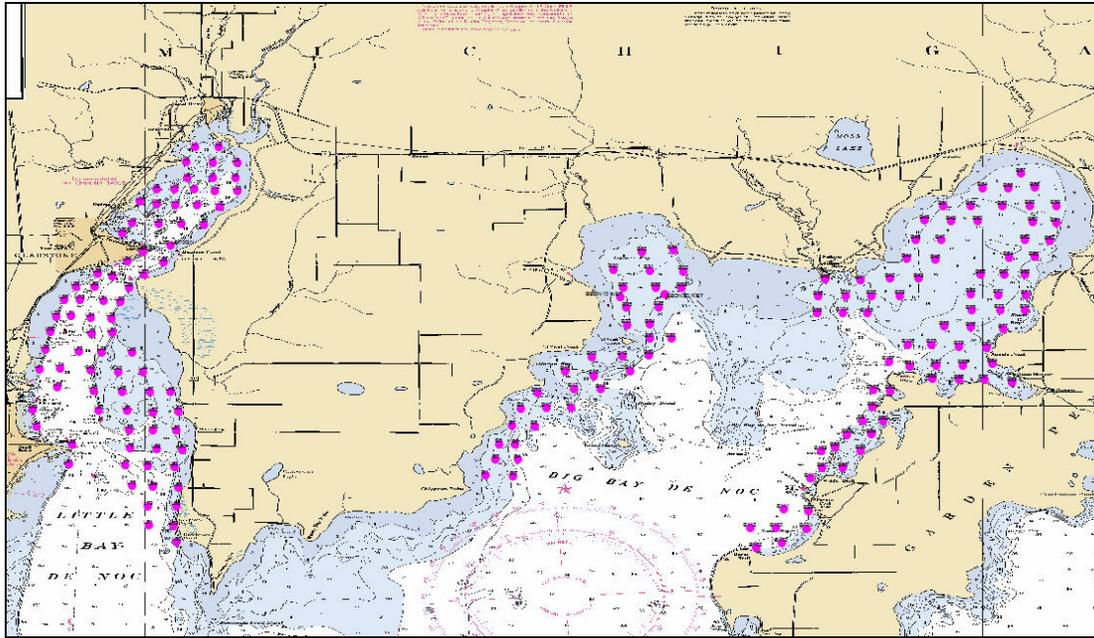


Potential Netting Locations, Fall Assessment Survey, 2015



Michigan Department of Natural Resources

Figure 7. The Michigan DNR-Marquette Fisheries Research Station reported gill netting at locations in Huron Bay (left) and Keweenaw Bay (right) in Lake Superior. A stratified random sample is obtained from each grid of potential sites. Similar nearshore sampling is conducted in Lake Michigan. Ruffe were vulnerable to the gear used during sampling.

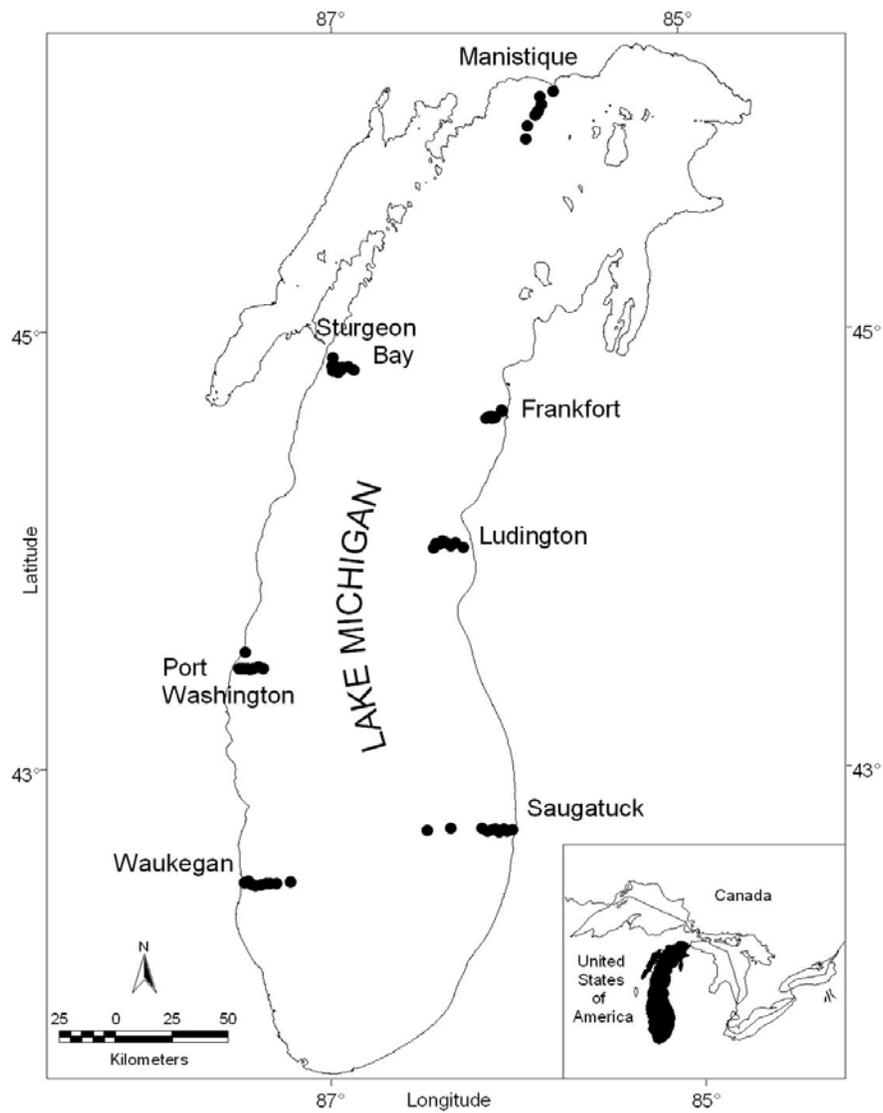


Potential Netting Locations, Fall Assessment Survey, 2009-2015



Michigan Department of Natural Resources

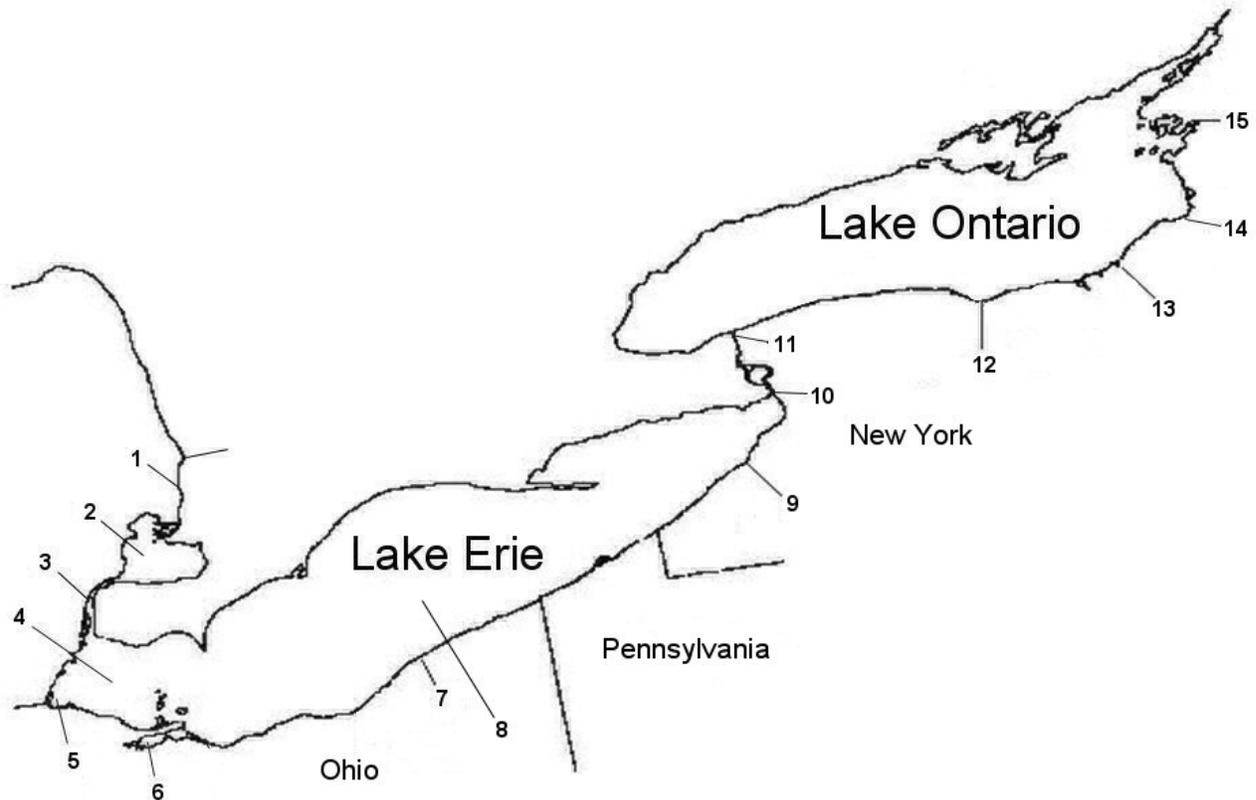
Figure 8. The Michigan DNR-Marquette Fisheries Research Station conducted gill netting and bottom trawling at locations in northern Green Bay (top), near the Menominee River (bottom left) and the Cedar River (bottom right) in Lake Michigan. Each year a stratified random sample is obtained for each Bay de Noc from the northern Green Bay grid of potential sites. Other nearshore sampling areas (Manistique and Naubinway) cycle from year to year. Ruffe were vulnerable to gear used during sampling.



Lake Michigan Prey Fish Sampling

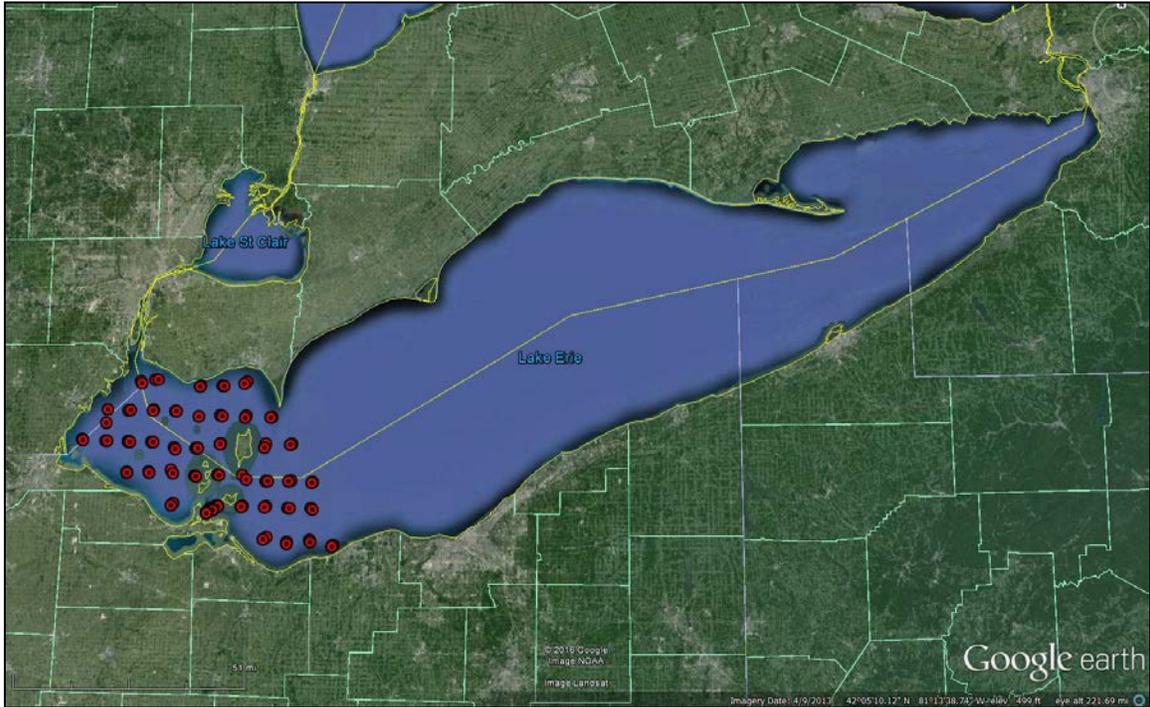


Figure 9. The USGS-Great Lakes Science Center reported bottom trawling at locations in Lake Michigan during 2015. Ruffe would have been vulnerable to gear used during sampling.



- | | | |
|--------------------|-------------------------|-----------------------------------|
| 1. St. Clair River | 6. Sandusky Bay | 11. Lower Niagara River |
| 2. Lake St. Clair | 7. Grand River | 12. Genesee River/Irondequoit Bay |
| 3. Detroit River | 8. Central Basin | 13. Sterling Creek |
| 4. Western Basin | 9. Cattaraugus Creek | 14. Salmon River |
| 5. Maumee Bay | 10. Upper Niagara River | 15. Black River |

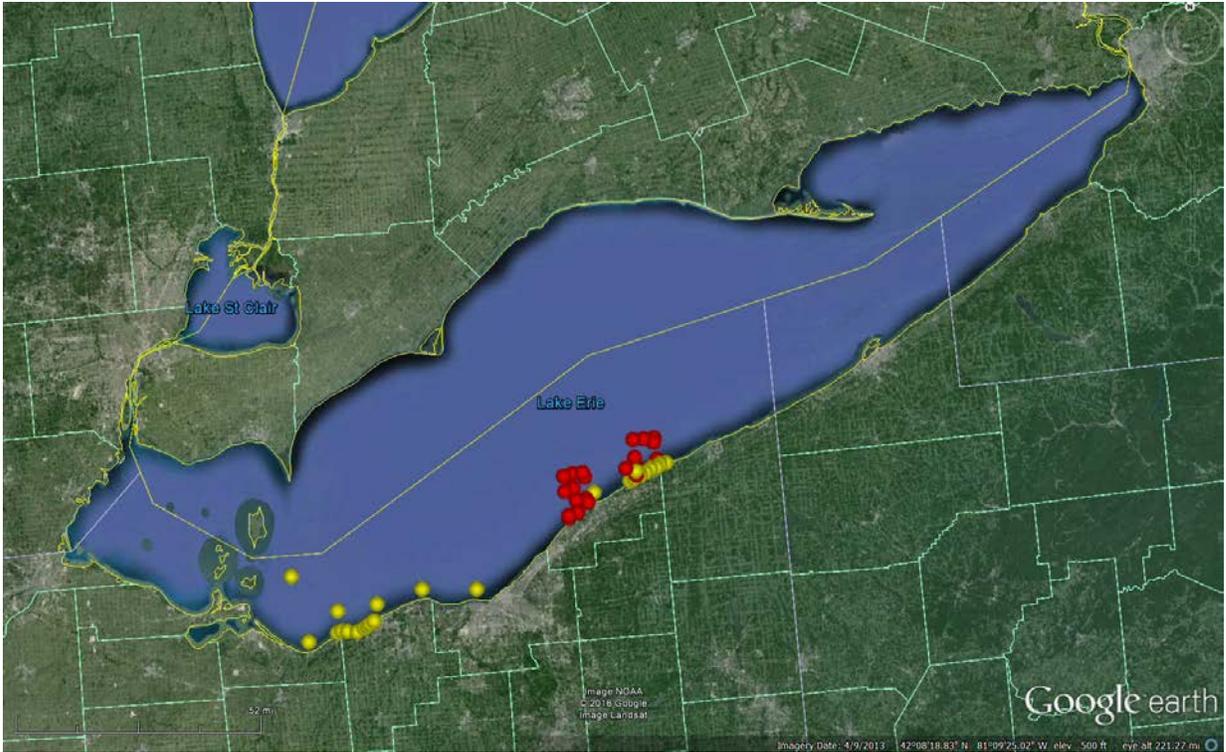
Figure 10. Lower Great Lakes fish sampling conducted in 2015 and reported by agency personnel. Ruffe would have been vulnerable to gears used during sampling.



Lake Erie Bottom Trawling Locations



Figure 11. The USGS-Lake Erie Biological Station conducted annual bottom trawling at locations in western Lake Erie during 2015. Ruffe would have been vulnerable to gear used during sampling.



Lake Erie Central Basin Sampling Locations

Ohio Department of Natural Resources

Figure 12. The Ohio DNR- Fairport Fish Research Unit reported annual bottom trawling (red) and nearshore gillnetting (yellow) at locations in Lake Erie during 2015. Ruffe would have been vulnerable to gear used during sampling.

Table 1. Summary of dedicated ruffe surveillance in U.S. waters of Lake Huron in 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>Ruffe</u>
Au Gres River	FWS	0.25 hours	BT-4.9	9/22/2015	3.3	22.0	19.1	0
Cheboygan River	FWS	0.50 hours	BT-4.9	9/10/2015	7.6	20.8	20.8	0
Port Dolomite	FWS	0.50 hours	BT-4.9	9/23/2015	6.8	17.1	14.0	0
Saginaw River	FWS	0.25 hours	BT-4.9	7/1/2015	6.9	23.3	22.7	0
Saginaw River	FWS	0.23 hours	BT-4.9	9/24/2015	8.5	21.9	20.7	0
Thunder Bay-Shipping Channel	FWS	0.50 hours	BT-4.9	9/8/2015	6.6	20.8	17.6	0
Thunder Bay River	FWS	0.08 hours	BT-4.9	9/9/2015	6.6	20.9	18.0	0
Thunder Bay River	FWS	0.42 hours	BT-4.9	9/11/2015	7.0	19.7	16.8	0
Totals		2.73 hours	BT-4.9					0
		Total ruffe (ruffe surveillance)						0

Key to column headings:

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

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

Gear = Bottom trawl (4.9 m head rope).

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

Depth = Average water depth (m).

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>Ruffe</u>
Cheboygan River	FWS	12 net lifts	FN1	5/12/2015-5/14/2015	3.0	12.1	12.0	0
Cheboygan River	FWS	6 trap lifts	MWT	5/12/2015-5/14/2015	2.5	11.8	12.3	0
Cheboygan River	FWS	16 net lifts	FN1	10/2015	2.9	13.7	-----	0
Cheboygan River	FWS	8 trap lifts	MWT	10/2015	2.4	13.7	-----	0
Devils River	FWS	4 net lifts	FN1	5/12/2015-5/14/2015	0.7	12.4	12.4	0
Devils River	FWS	0.25 hours	EF2	5/7/2015	0.5	17.2	17.2	0
Port of Calcite	FWS	0.36 hours	EF1	11/9/2015	3.2	7.8	8.3	0
Rogers City Harbor	FWS	0.75 hours	EF1	11/9/2015	2.3	7.3	8.1	0
Swan River-Mouth	FWS	0.67 hours	EF1	11/9/2015	1.8	7.7	8.1	0
Thunder Bay-Lafarge Corporation	FWS	1.30 hours	EF1	5/13/2015	2.1	9.6	10.4	0
Thunder Bay-Squaw Bay	FWS	16 trap lifts	MWT	9/2015	1.2	20.3	-----	0
Thunder Bay River	FWS	0.79 hours	EF1	5/14/2015	1.8	11.3	14.0	0
Thunder Bay River	FWS	12 net lifts	FN2	5/5/2015-5/8/2015	2.7	15.0	15.1	0
Thunder Bay River	FWS	8 trap lifts	MWT	5/5/2015-5/8/2015	4.1	15.6	15.9	0
Thunder Bay River	FWS	8 net lifts	FN1	9/10/2015-9/11/2015	2.5	21.7	-----	0
Trout River	FWS	0.41 hours	EF2	5/5/2015	1.4	12.0	12.0	0
Totals		3.87 hours	EF1					0
		0.66 hours	EF2					0
		40 net lifts	FN1					0
		12 net lifts	FN2					0
		38 trap lifts	MWT					0
		Total ruffe (ruffe surveillance)						0

Key to column headings:

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

Depth = Average water depth (m).

Gear = EF1 = Electrofishing (boat).

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

EF2 = Electrofishing (backpack).

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

FN1 = Mini-fyke net (0.8 m x 0.6 m x 0.3 m).

FN2 = Fyke net (1.2 m x 1.2 m, 25.4 mm mesh).

MWT = Modified Windermere trap, baited with cheese.

Table 2. Summary of dedicated ruffe surveillance in U.S. waters of Lake Erie in 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>S. DO</u>	<u>B. DO</u>	<u>Secchi</u>	<u>Ruffe</u>
Ashtabula Harbor	FWS	0.66 hours	BT-4.9	6/4/2015	7.0	15.6	11.0	9.1	10.5	0.9	0
Ashtabula Harbor	FWS	0.70 hours	BT-4.9	9/24/2015	6.0	20.6	20.3	8.1	7.4	1.6	0
Buffalo Harbor	FWS	1.02 hours	BT-4.9	5/2/2015	7.2	17.7	16.7	9.1	8.9	1.8	0
Buffalo Harbor	FWS	0.66 hours	BT-4.9	9/29/2015	7.6	20.3	20.3	7.7	7.5	2.1	0
Cleveland Harbor	FWS	0.85 hours	BT-4.9	6/3/2015	7.8	16.7	16.2	8.0	8.1	0.6	0
Cleveland Harbor	FWS	0.87 hours	BT-4.9	9/23/2015	6.1	21.0	20.8	7.8	7.3	1.2	0
Conneaut Harbor	FWS	0.50 hours	BT-4.9	6/4/2015	9.1	15.3	11.4	9.3	10.6	0.8	0
Conneaut Harbor	FWS	0.47 hours	BT-4.9	9/24/2015	5.9	21.1	20.8	8.4	7.9	1.1	0
Erie Harbor	FWS	0.98 hours	BT-4.9	6/5/2015	7.2	18.2	14.3	9.1	10.1	2.2	0
Erie Harbor	FWS	0.50 hours	BT-4.9	9/25/2015	8.1	20.4	20.4	8.1	7.7	1.2	0
Maumee River	FWS	0.83 hours	BT-4.9	6/2/2015	9.3	16.2	16.0	6.5	6.4	0.1	0
Maumee River	FWS	0.83 hours	BT-4.9	9/22/2015	5.3	21.2	20.8	6.0	5.6	0.4	0
Sandusky Harbor	FWS	0.50 hours	BT-4.9	6/1/2015	7.6	17.3	16.9	8.2	8.0	0.3	0
Sandusky Harbor	FWS	0.50 hours	BT-4.9	9/21/2015	7.5	20.3	19.9	8.6	9.0	0.6	0
Totals		9.88 hours	BT-4.9								0
		Total ruffe (ruffe surveillance)									0

Key to column headings:

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

Gear = 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 (mg/L).

B. DO = Bottom dissolved oxygen (mg/L).

Secchi = Turbidity (m).

Table 3. Summary of dedicated ruffe surveillance in U.S. waters of Lake Ontario in 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>S. Temp</u>	<u>B. Temp</u>	<u>S. DO</u>	<u>B. DO</u>	<u>Secchi</u>	<u>Ruffe</u>
Genesee River	FWS	0.50 hours	BT-4.9	5/27/2015	6.4	19.73	19.07	-----	-----	0.28	0
Genesee River	FWS	0.67 hours	BT-4.9	9/28/2015	6.5	18.63	10.28	8.16	9.36	0.41	0
Totals		1.17 hours	BT-4.9								0
		Total ruffe (ruffe surveillance)									0

Key to column headings:

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

Gear = 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 (mg/l).

B. DO = Bottom dissolved oxygen (mg/l).

Secchi = Turbidity (m).

Table 4. Summary of other fish sampling conducted in Lake Superior that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>	
Apostle Islands*	USGS	8.1 hours	BT-11.9	8/2015,9/2015	44.0	6.5	98	
Bad River	GLIFWC	180 trap lifts	PAT	4/2015-7/2015	0.5	13.9	0	
Betsy River	PC	76 trap lifts	PAT	4/2015-6/2015	0.5	15.3	0	
Black Bay *	FWS/OMNRF	1.3 hours	BT-4.9	9/2015	3.4	16.8	3	
Black Bay	FWS/OMNRF	3.3 hours	EF	9/2015	-----	-----	0	
Black Bay	FWS/OMNRF	10 net lifts	FN2	8/2015	-----	15.1	0	
Brule River	GLIFWC/FWS	47 trap lifts	PT	4/2015-6/2015	0.8	13.6	0	
Chequamegon Bay *	USGS	5.3 hours	BT-5.5	7/2015,8/2015	5.6	-----	480	
Chequamegon Bay *	USGS	1.3 hours	BT-11.9	7/2015	13.0	5.6	36	
Chequamegon Bay	FWS	1.3 hours	BT-4.9	9/2015	7.4	14.2	0	
Chequamegon Bay *	FWS	2.5 hours	EF	8/2015-9/2015	1.3	16.8	27	
Chequamegon Bay *	FWS	15 net lifts	FN2	8/2015	-----	14.6	87	
Goulais River	DFO	0.7 hour	EF	8/2015	-----	-----	0	
Goulais River	DFO	4 net lifts	FN4	8/2015	-----	-----	0	
Goulais River	DFO	2 hauls	SEN	8/2015	-----	-----	0	
Goulais River	DFO	0.2 hour	TRL	8/2015	-----	-----	0	
Goulais River	DFO	2 trap lifts	TN	8/2015	-----	-----	0	
Grant Creek	BMIC/LSSU	146 net lifts	FN3	4/2015-1/2016	0.3-1.2	0.1-19.8	0	
Halfaday Creek	BMIC/LSSU	160 net lifts	FN3	4/2015-1/2016	0.3-1.2	0.0-16.8	0	
Huron Bay *	MIDNR	12 net lifts	GN2	8/2015-9/2015	4.5-11.2	18.2	3	
Kaministiquia River*	DFO	1.9 hours	EF	8/2015	-----	-----	7	
Kaministiquia River*	DFO	3 net lifts	FN4	8/2015	-----	-----	2	
Kaministiquia River*	DFO	2 hauls	SEN	8/2015	-----	-----	4	
Kaministiquia River	DFO	0.4 hour	TRL	8/2015	-----	-----	0	
Kaministiquia River	DFO	2 trap lifts	TN	8/2015	-----	-----	0	
Keweenaw Bay *	MIDNR	12 net lifts	GN2	8/2015-9/2015	5.3-12.6	21.4	1	
Middle River	GLIFWC/FWS	196 trap lifts	PAT	4/2015-6/2015	0.5	13.5	0	
Misery River *	GLIFWC	48 trap lifts	PAT	5/2015-7/2015	0.5	12.8	2	
Nearshore*	USGS	30.6 hours	BT-11.9	5/2015-6/2015	40.0	4.3	7	
Offshore	USGS	11.0 hours	BT-11.9	7/2015	183.0	3.6	0	
Rock River	FWS	128 trap lifts	PAT	4/2015-7/2015	0.5	10.5	0	
Roxbury Creek*	BMIC/LSSU	140 net lifts	FN3	4/2015-1/2016	0.3-1.2	0.1-20.0	18	
Silver River	GLIFWC	22 net lifts	FN1	5/2015-7/2015	0.5	13.5	0	
St. Louis River *	FWS	0.8 hour	BT-4.9	8/2015	6.5	16.2	61	
St. Louis River	FWS	3.3 hours	EF	8/2015	1.5	21.3	0	
St. Louis River *	FWS	20 net lifts	FN2	8/2015	-----	20.7	5	
St. Marys River-Upper	FWS/OMNRF	0.8 hour	BT-4.9	8/2015	5.0	18.6	0	
St. Marys River-Upper	FWS/OMNRF	2.8 hours	EF	10/2015-11/2015	-----	5.4	0	
St. Marys River-Upper	FWS/OMNRF	20 net lifts	FN2	8/2015	-----	-----	0	
Tahquamenon River	PC	102 trap lifts	PAT	5/2015-6/2015	0.5	16.2	0	
Thunder Bay Harbour *	FWS/OMNRF	0.8 hour	BT-4.9	9/2015	7.4	16.0	2	
Thunder Bay Harbour	FWS/OMNRF	3.3 hours	EF	9/2015	-----	-----	0	
Thunder Bay Harbour *	FWS/OMNRF	19 trap lifts	FN2	8/2015	-----	19.7	12	
Western Lake Superior-WI-1 *	WIDNR	19 trap lifts	GN1	7/2015	3.7-109.7	-----	30	
Totals		5.0 hours	BT-4.9				66	
		5.3 hours	BT-5.5				480	
		51.0 hours	BT-11.9				141	
		17.8 hours	EF				34	
		22 net lifts	FN1				0	
		84 net lifts	FN2				104	
		446 net lifts	FN3				18	
		7 net lifts	FN4				2	
		19 net lifts	GN1				30	
		24 net lifts	GN2				4	
		730 trap lifts	PAT				2	
		47 trap lifts	PT				0	
		4 hauls	SEN				4	
		4 trap lifts	TN				0	
		0.6 hours	TRL				0	
		Total ruffe (captured incidentally)						885

Key to column headings:

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

Key to agency:

BMIC = Bay Mills Indian Community.
DFO = Department of Fisheries and Oceans.
FWS = U. S. Fish and Wildlife Service.
GLIFWC = Great Lakes Indian Fish and Wildlife Commission.
LSSU = Lake Superior State University.
MIDNR = Michigan Department of Natural Resources.
OMNRF = Ontario Ministry of Natural Resources and Forestry.
PC = Private contractor.
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 (boat, day and night).
FN1 = Fyke net.
FN2 = Fyke nets (paired, 0.9 m x 1.2 m attached by 15 m lead, 4.7 mm mesh).
FN3 = Fyke net (6.3 mm mesh).
FN4 = Fyke net (1.3 m box).
GN1 = Gill net (1097 m with 91 m panels of 38 to 178 mm stretch mesh).
GN2 = Gill net (97 m with panels of 25, 38, and 50 mm mesh).
PAT = Portable assessment trap.
PT = Permanent trap.
SEN = Beach seine (15 m length).
TN = Trap net (1.2 m trap).
TRL = Trawl.

Key to symbols:

* Locations where ruffe were captured.

Table 5. Summary of other fish sampling conducted in Lake Michigan that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
Arcadia, Michigan	FWS	20 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Benton Harbor, Michigan	FWS	10 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Betsie River	GTBOCI	88 trap lifts	PAT	4/2015-7/2015	0.5-1.0	14.2	0
Big Bay de Noc	MIDNR	1.7 hours	BT-3.7	6/2015-10/2015	2.7-12.3	20.1	0
Big Bay de Noc	MIDNR	48 net lifts	GN	8/2015-9/2015	2.7-12.3	20.1	0
Big Manistee River	FWS	44 trap lifts	PT	4/2015-6/2015	0.5-1.0	14.7	0
Boardman River	GTBOCI	94 trap lifts	PAT	4/2015-7/2015	0.5	12.8	0
Burns Harbor	FWS	13 net lifts	FN2	6/2015-10/2015	0.5-12.0	-----	0
Burns Harbor	FWS	14 net lifts	FN1	6/2015-10/2015	0.5-12.0	-----	0
Burns Harbor	FWS	8.5 hours	EF	6/2015-10/2015	0.5-12.0	-----	0
Burns Harbor	FWS	12 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Calumet Harbor	FWS	12 net lifts	FN2	6/2015-10/2015	0.5-12.0	-----	0
Calumet Harbor	FWS	12 net lifts	FN1	6/2015-10/2015	0.5-12.0	-----	0
Calumet Harbor	FWS	8.7 hours	EF	6/2015-10/2015	0.5-12.0	-----	0
Calumet Harbor	FWS	14 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Calumet Harbor	FWS	12 trap array lifts	MT	6/2015-10/2015	0.5-12.0	-----	0
Cedar River	MIDNR	1.7 hours	BT-3.7	6/2015-10/2015	5.4-10.1	17.6	0
Cedar River	MIDNR	12 net lifts	GN	8/2015-9/2015	5.4-10.1	17.6	0
Chicago Harbor	FWS	12 net lifts	FN2	6/2015-10/2015	0.5-12.0	-----	0
Chicago Harbor	FWS	12 net lifts	FN1	6/2015-10/2015	0.5-12.0	-----	0
Chicago Harbor	FWS	6.8 hours	EF	6/2015-10/2015	0.5-12.0	-----	0
Chicago Harbor	FWS	13 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Chicago Harbor	FWS	18 trap array lifts	MT	6/2015-10/2015	0.5-12.0	-----	0
Carp Lake River	FWS	71 trap lifts	PT	4/2015-7/2015	0.8	13.3	0
Green Bay	FWS	22 net lifts	FN2	6/2015-10/2015	0.5-12.0	-----	0
Green Bay	FWS	22 net lifts	FN1	6/2015-10/2015	0.5-12.0	-----	0
Green Bay	FWS	15.0 hours	EF	6/2015-10/2015	0.5-12.0	-----	0
Green Bay	FWS	23 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Green Bay	WIDNR	22 hauls	SEN	6/2015	1.0	21.0	0
Green Bay	WIDNR	6.3 hours	TRL	8/2015	9.8	14.0 B	0
Little Bay de Noc	MIDNR	1.7 hours	BT-3.7	6/2015-10/2015	3.4-12.4	19.6	0
Little Bay de Noc *	MIDNR	32 net lifts	GN	8/2015-9/2015	3.4-12.4	19.6	9
Ludington, Michigan	FWS	12 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Manistique River	FWS	43 trap lifts	SPT	5/2015-6/2015	0.5	16.0	0
Manitowoc, Wisconsin	FWS	24 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Menominee, Michigan	MIDNR	1.7 hours	BT-3.7	6/2015-10/2015	4.6-9.5	20.6	0
Menominee, Michigan	MIDNR	12 net lifts	GN	8/2015-9/2015	4.6-9.5	20.6	0
Milwaukee, Wisconsin	FWS	16 net lifts	FN2	6/2015-10/2015	0.5-12.0	-----	0
Milwaukee, Wisconsin	FWS	16 net lifts	FN1	6/2015-10/2015	0.5-12.0	-----	0
Milwaukee, Wisconsin	FWS	7.8 hours	EF	6/2015-10/2015	0.5-12.0	-----	0
Milwaukee, Wisconsin	FWS	10 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Nearshore/Offshore	USGS	12.9 hours	BT-12.0	9/2015	5.0-128.0	3.8-19.6	0
Peshigo River	FWS	98 trap lifts	PAT	4/2015-6/2015	0.5-1.0	15.8	0
Racine, Wisconsin	FWS	20 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Saugatuck, Michigan	FWS	17 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
St. Joseph River	FWS	129 trap lifts	PAT	4/2015-5/2015	0.5	13.7	0
Sturgeon Bay, Wisconsin	FWS	24 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Trail Creek	PC	63 trap lifts	PT	4/2015-6/2015	0.5	13.1	0
Winthrop Harbor, Illinois	FWS	24 net lifts	GN-M	6/2015-10/2015	0.5-12.0	-----	0
Totals		6.8 hours	BT-3.7				0
		12.9 hours	BT-12.0				0
		46.8 hours	EF				0
		76 net lifts	FN1				0
		75 net lifts	FN2				0
		104 net lifts	GN				9
		223 net lifts	GN-M				0
		30 trap array lifts	MT				0
		409 trap lifts	PAT				0
		178 trap lifts	PT				0
		22 hauls	SEN				0
		43 trap lifts	SPT				0
		6.3 hours	TRL				0
		Total ruffe (captured incidentally)					9

Key to column headings:

Depth = Average water depth (m) or depth range.
 Temp = Average water temperature (°C) or temperature range.
 Bottom temperature indicated by "B".

Key to agency:

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

Key to gear:

BT-3.7 = Bottom trawl (3.7 m head rope).
 BT-12.0 = Bottom trawl (12.0 m head rope).
 EF = Electrofishing (boat).
 FN1 = Fyke nets (paired, 0.9 m x 1.2 m attached by 15 m lead, 13 mm mesh).
 FN2 = Paired mini-fyke net (0.7 m x 1.0 m, 3 mm mesh).
 GN = Gill net (97 m with panels of 25, 38, and 50 mm mesh).
 GN-M = Gill net (micromesh, 12.2 m with panels of 12, 16, 20, and 25 mm mesh).
 MT = Minnow trap array (5 traps - baited/unbaited).
 PAT = Portable assessment trap.
 PT = Permanent trap.
 SEN = Beach seine (15.2 m seine).
 SPT = Semipermanent trap.
 TRL = Trawl.

Key to symbols:

* Location where ruffe were captured.

Table 6. Summary of other fish sampling conducted in Lake Huron that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>
AuSable River-Low er	MIDNR	4.1 hours	EF	2015	0.6-3.6	11.1	0
Black River	MIDNR	5.0 hours	BT-11.0	7/2015	11.6-33.5	----	0
Cheboygan River	FWS	146 trap lifts	PT	4/2015-6/2015	1.0	15.2	0
Coldw ater River	DFO	0.3 hour	TRL	8/2015	----	----	0
Coldw ater River	DFO	1.7 hours	EF	8/2015	----	----	0
Coldw ater River	DFO	2 trap lifts	TN	8/2015	----	----	0
Coldw ater River	DFO	5 net lifts	FN2	8/2015	----	----	0
East Au Gres River	PC	45 trap lifts	PAT	4/2015-6/2015	0.5-1.0	15.2	0
Hammond Bay Harbor	MIDNR	1.3 hours	EF	4/2015,6/2015	0.6-3.6	5.0-17.2	0
Les Cheneaux Islands	MIDNR	6 net lifts	GN	10/2015	----	----	0
Magnettaw an River	DFO	0.3 hour	TRL	7/2015	----	----	0
Magnettaw an River	DFO	5 net lifts	FN2	7/2015	----	----	0
Magnettaw an River	DFO	1.2 hours	EF	7/2015	----	----	0
Magnettaw an River	DFO	2 trap lifts	TN	7/2015	----	----	0
Magnettaw an River	DFO	0.3 hour	TRM	7/2015	----	----	0
Mississagi River	DFO	3.5 hours	EF	7/2015	----	----	0
Mississagi River	DFO	5 net lifts	FN2	7/2015	----	----	0
Mississagi River	DFO	3 hauls	SEN	7/2015	----	----	0
Mississagi River	DFO	0.5 hour	TRL	7/2015	----	----	0
Mississagi River	DFO	2 trap lifts	TN	7/2015	----	----	0
Mississagi River	DFO	0.3 hour	TRM	7/2015	----	----	0
Nottaw asaga River	DFO	0.3 hour	TRL	7/2015	----	----	0
Nottaw asaga River	DFO	6 net lifts	FN2	7/2015	----	----	0
Nottaw asaga River	DFO	2.2 hours	EF	7/2015	----	----	0
Nottaw asaga River	DFO	0.1 hour	TRM	7/2015	----	----	0
Ocqueoc River	FWS	136 trap lifts	PT	4/2015-6/2015	0.4	16.1	0
Presque Isle Harbor	MIDNR	1.0 hour	EF	4/2015,6/2015	0.6-3.6	7.7-18.8	0
Rogers City Harbor	MIDNR	1.1 hours	EF	4/2015,6/2015	0.6-3.6	5.0-17.7	0
Saginaw Bay	MIDNR	3.6 hours	BT-10.0	9/2015	4.5-12.2	18.4-20.5	0
Saginaw Bay	MIDNR	16 net lifts	GN	9/2015	----	----	0
Serpent River	DFO	0.5 hour	EF	8/2015	----	----	0
Serpent River	DFO	2 net lifts	FN2	8/2015	----	----	0
Serpent River	DFO	1 trap lift	TN	8/2015	----	----	0
Serpent River	DFO	0.3 hour	TRM	8/2015	----	----	0
Shebeshekong River	DFO	0.3 hour	TRM	7/2015	----	----	0
Shebeshekong River	DFO	0.5 hour	TRL	7/2015	----	----	0
Shebeshekong River	DFO	2.0 hours	EF	7/2015	----	----	0
Shebeshekong River	DFO	4 net lifts	FN2	7/2015	----	----	0
Shebeshekong River	DFO	2 trap lifts	TN	7/2015	----	----	0
Southern Lake Huron-Ontario	FWS	18 trap lifts	MT	6/2015	9.4-13.5	9.8-10.5	0
Spanish River	DFO	4 net lifts	FN2	8/2015	----	----	0
Spanish River	DFO	0.9 hour	EF	8/2015	----	----	0
Spanish River	DFO	0.8 hour	TRM	8/2015	----	----	0
Spanish River	DFO	2 trap lifts	TN	8/2015	----	----	0
Spanish River	DFO	0.5 hour	TRL	8/2015	----	----	0
St. Marys River	DFO	7.7 hours	EF	6/2015	----	----	0
St. Marys River-Low er	FWS/OMNRF	15 net lifts	FN1	7/2015	0.9-3.0	17.2-26.6	0
St. Marys River-Low er	FWS/OMNRF	1.8 hours	EF	8/2015-9/2015	0.8-2.2	16.7-20.9	0
St. Marys River-Low er	FWS/OMNRF	1.3 hours	BT-4.9	7/2015	4.0-10.1	9.9-24.7	0
St. Marys River-Low er	FWS	202 trap lifts	PAT	6/2015-7/2015	0.5-1.0	10.9	0
St. Marys River-Low er	SMRFTG	21.5 hours	EF	9/2015	----	----	0
Sturgeon River	DFO	0.4 hour	TRL	8/2015	----	----	0
Sturgeon River	DFO	2 net lifts	FN2	8/2015	----	----	0
Sturgeon River	DFO	0.7 hour	EF	8/2015	----	----	0
Sturgeon River	DFO	1 trap lift	TN	8/2015	----	----	0
Thunder Bay	MIDNR	1.3 hours	BT-11.0	7/2015	20.7-29.9	----	0
Totals		1.3 hours	BT-4.9				0
		3.6 hours	BT-10.0				0
		6.3 hours	BT-11.0				0
		51.2 hours	EF				0
		15 net lifts	FN1				0
		33 net lifts	FN2				0
		22 net lifts	GN				0
		18 trap lifts	MT				0
		247 trap lifts	PAT				0
		282 trap lifts	PT				0
		3 hauls	SEN				0
		12 trap lifts	TN				0
		2.8 hours	TRL				0
		2.1 hours	TRM				0
		Total ruffe (captured incidentally)					0

Key to column headings:

Depth = Average w ater depth (m) or depth range.
Temp = Average w ater temperature (°C) or temperature range.

Key to agency:

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

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).
BT-10.0 = Bottom trawl (10.0 m head rope).
BT-11.0 = Bottom trawl (11.0 m head rope).
EF = Electrofishing (boat, day and night).
FN1 = Fyke nets (paired, 0.9 m x 1.2 m attached by 15 m lead, 4.7 mm mesh).
FN2 = Fyke net (1.3 m box).
GN = Gill net (included 30.48 m panel of 38.1 mm mesh).
MT = Gee minnow trap (baited).
PAT = Portable assessment trap.
PT = Permanent trap.
SEN = Beach seine (15 m length).
TN = Trap net (1.2 m trap).
TRL = Trawl.
TRM = Trammel net.

Table 7. Summary of other fish sampling conducted in Lake Erie that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>	
Cattaraugus Creek	FWS	94 trap lifts	SP	4/2015-6/2015	0.5	14.0	0	
Central Basin-Ohio	ODNR	3.4 hours	BT-10.4	11/2015	6.4-21.1	12.4-13.6	0	
Central Basin-Ohio	ODNR	28 net lifts	GN1	9/2015-11/2015	4.9-15.5	12.4-25.3	0	
Grand River-Ohio	PC	82 trap lifts	PAT	4/2015-6/2015	0.5	18.1	0	
Grand River-Ontario	DFO	3.3 hours	EF	7/2015	-----	-----	0	
Grand River-Ontario	DFO	0.9 hour	TRL	7/2015	-----	-----	0	
Grand River-Ontario	DFO	0.5 hour	TRM	7/2015	-----	-----	0	
Maumee Bay	FWS	1.3 hours	BT-4.9	9/2015	3.0-8.6	19.7-23.8	0	
Maumee Bay	FWS	15 net lifts	FN	9/2015	-----	-----	0	
Niagara River-Tonawanda Creek/Erie Canal	FWS	1.7 hours	EF	5/2015-10/2015	-----	20.4-24.1	0	
Niagara River-Upper/Bufalo	FWS	7 hours	EF	5/2015-10/2015	0.1-6.1	14.9-24.1	0	
Niagara River-Upper/Bufalo	FWS	14 net lifts	FN	8/2015-10/2015	0.8-6.9	9.7-11.9	0	
Niagara River-Upper/Bufalo	FWS	1.3 hours	BT-4.9	8/2015-10/2015	1.7-10.7	19.1-24.5	0	
Sandusky Bay	FWS	1.3 hours	BT-4.9	9/2015	2.4-3.6	20.1-24.5	0	
Sandusky Bay	FWS	15 net lifts	FN	9/2015	-----	-----	0	
SCDRS-Detroit River	FWS	48 net lifts	GN2	4/2015-6/2015,10/2015-12/2015	4.5-12.3	4.2-15.5	0	
SCDRS-Detroit River	FWS	239 trap lifts	MT	4/2015-6/2015,10/2015-12/2015	4.5-12.3	4.2-15.4	0	
SCDRS-Detroit River	FWS	0.3 hour	EF	8/2015	1.1-2.3	24.0-24.6	0	
SCDRS-Detroit River	FWS	16 trap lifts	MT	7/2015	1.9-11.6	22.7-24.9	0	
SCDRS-Detroit River	FWS	15 net lifts	FN	8/2015	0.7-2.1	22.3-26.8	0	
SCDRS-Lake St. Clair	MIDNR	1.3 hours	BT-10.0	5/2015,9/2015	3.3-4.3	14.2-23.2	0	
SCDRS-Lake St. Clair	MIDNR	36 trap lifts	TN	4/2015-5/2015	2.7-3.3	8.0-14.0	0	
SCDRS-St. Clair River	FWS	54 net lifts	GN2	4/2015-6/2015,11/2015-12/2015	5.9-18.4	2.3-14.0	0	
SCDRS-St. Clair River	FWS	108 trap lifts	MT	4/2015-6/2015,11/2015-12/2015	5.9-18.4	2.3-14.0	0	
Western Basin	FWS	96 net lifts	GN2	9/2015-10/2015	2.6-7.8	10.8-24.7	0	
Western Basin	USGS	15.5 hours	BT-7.9	6/2015,9/2015,10/2015	10.6-45.0	16.0-22.9	0	
Western Basin-Michigan	MIDNR	1.3 hours	BT-10.0	8/2015	4.3-8.3	23.8-25.1	0	
Western Basin-Ohio	ODNR	21.8 hours	BT-10.7	5/2015-9/2015	4.0-12.0	11.7-26.0 B	0	
Western Basin-Ohio	ODNR	3.5 hours	EF	6/2015-7/2015	<2.0	20.5-25.5 B	0	
Totals		3.9 hours	BT-4.9				0	
		15.5 hours	BT-7.9				0	
		2.6 hours	BT-10.0				0	
		3.4 hours	BT-10.4				0	
		21.8 hours	BT-10.7				0	
		15.8 hours	EF				0	
		59 net lifts	FN				0	
		28 net lifts	GN1				0	
		198 net lifts	GN2				0	
		363 trap lifts	MT				0	
		82 trap lifts	PAT				0	
		94 trap lifts	SP				0	
		36 trap lifts	TN				0	
		0.9 hour	TRL				0	
		0.5 hour	TRM				0	
		Total ruffe (captured incidentally)						0

Key to column headings:

Depth = Average water depth (m) or depth range.
 Temp = Average surface temperature (°C) or temperature range. Bottom temperature indicated by "B".

Key to location:

SCDRS = St. Clair-Detroit River System.

Key to agency:

DFO = Department of Fisheries and Oceans.
 FWS = U.S. Fish and Wildlife Service.
 MIDNR = Michigan Department of Natural Resources.
 ODNR = Ohio Department of Natural Resources.
 PC = Private contractor.
 USGS = U.S. Geological Survey.

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).
 BT-7.9 = Bottom trawl (7.9 m head rope).
 BT-10.0 = Bottom trawl (10.0 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 (boat, day and night).
 FN = Fyke nets (paired, 0.9 m x 1.2 m attached by 15 m lead, 4.7 mm mesh).
 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).
 MT = Gee minnow trap (baited).
 PAT = Portable assessment trap.
 SP = Semi-permanent trap.
 TN = Trap net.
 TRL = Trawl.
 TRM = Trammel net.

Table 8. Summary of other fish sampling conducted in Lake Ontario that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>	
Bay of Quinte	DFO	9.9 hours	EF	5/2015	-----	-----	0	
Black River	PC	144 trap lifts	PAT	4/2015-6/2015	0.5	12.8	0	
Genesee River/Irondequoit Bay-Rochester	FWS	3.8 hours	EF	6/2015-11/2015	0.4-3.2	8.7-27.9	0	
Genesee River/Irondequoit Bay-Rochester	FWS	14 net sets	FN	6/2015-11/2015	0.2-10.7	12.0-19.0	0	
Genesee River/Irondequoit Bay-Rochester	FWS	1.5 hours	BT-4.9	6/2015-11/2015	3.0-21.3	14.1-24.9	0	
Genesee River-Upstream/Erie Canal	FWS	0.8 hour	EF	5/2015-9/2015	-----	21.1-22.8	0	
Niagara River-Low er	FWS	2.5 hours	EF	5/2015-9/2015	0.6-3.7	21.0-23.7	0	
Niagara River-Low er	FWS	7 net sets	FN	8/2015-10/2015	0.8-4.6	10.4-10.9	0	
Salmon River	PC	45 trap lifts	PT	4/2015-6/2015	0.5	14.9	0	
Sterling Creek	PC	45 trap lifts	PAT	4/2015-6/2015	0.5-1.0	16.4	0	
Totals		1.5 hours	BT-4.9				0	
		17.0 hours	EF				0	
		21 net sets	FN				0	
		189 trap lifts	PAT				0	
		45 trap lifts	PT				0	
		Total ruffe (captured incidentally)						0

Key to column headings:

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

Key to agency:

DFO = Department of Fisheries and Oceans.
 FWS = U.S. Fish and Wildlife Service.
 PC = Private contractor.

Key to gear:

BT-4.9 = Bottom trawl (4.9 m head rope).
 EF = Electrofishing (boat, day and night).
 FN = Fyke nets (paired, 0.9 m x 1.2 m attached by 15 m lead, 4.7 mm mesh)
 PAT = Portable assessment trap.
 PT = Permanent trap.

Table 9. Summary of other fish sampling conducted in the St. Lawrence River that was reported as capable of capturing ruffe during 2015.

<u>Location</u>	<u>Agency</u>	<u>Effort</u>	<u>Gear</u>	<u>Date</u>	<u>Depth</u>	<u>Temp</u>	<u>Ruffe</u>	
Brockville-Ontario	DFO	6.6 hours	EF	5/2015	-----	-----	0	
Totals		6.6 hours	EF				0	
		Total ruffe (captured incidentally)						0

Key to column headings:

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

Key to agency:

DFO = Department of Fisheries and Oceans.

Key to gear:

EF = Electrofishing (boat, day and night).

APPENDIX: Chronology of Ruffe detection for the Great Lakes Basin

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

1991 – Lake Superior: Major Ruffe range expansion was detected. A crew from 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 and Forestry – Upper Great Lakes Management Unit (OMNRF-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 OMNRF-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 OMNRF 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 OMNRF 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 *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 OMNRF 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 U.S. Geological Survey-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 OMNRF 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 OMNRF 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 OMNRF 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 *Petromyzon marinus*. 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, Keweenaw 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, OMNRF-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 Keweenaw 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 OMNRF-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.

2014 – 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, USFWS-MBS and Great Lakes Indian Fish and Wildlife Commission (GLIFWC), OMNRF-UGLMU, USFWS-Ashland, Department of Fisheries and Oceans Canada – Great Lakes Laboratory for Fisheries and Aquatic Sciences (DFO-GLLFAS), and WIDNR-Superior captured Ruffe within the known range in western Lake Superior at Kaministiquia River and Thunder Bay Harbour, St. Louis River, Apostle Islands, Chequamegon Bay, and Misery River. A larger number of Ruffe were reported by Lake Superior State University (LSSU) and Bay Mills Indian Community (BMIC) from the known range in eastern Lake Superior at Whitefish Bay than past years. Eleven Ruffe were captured there at Naomikong Creek, Pendills Creek, and the shallows in Tahquamenon Bay. Findings in Naomikong Creek (5 Ruffe) and Pendills Creek (1 Ruffe) were new sightings in tributaries within the known range. **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 (5 Ruffe) incidentally from LBDN in northern Green Bay. **Lower Great Lakes:** No Ruffe were detected.

2015 – 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 Black Bay and Thunder Bay, Ontario, Canada. The USGS-LSBS, USFWS-MBS with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), OMNRF-UGLMU, USFWS-Ashland, WIDNR-Superior, and MIDNR-Marquette captured Ruffe within the known range in western Lake Superior at Black Bay and Thunder Bay Harbour, St. Louis River, Apostle Islands, Chequamegon Bay, Misery River, Keweenaw Bay, and Huron Bay. Ruffe were reported by Lake Superior State University (LSSU) and Bay Mills Indian Community (BMIC) from the known range in eastern Lake Superior at Whitefish Bay where 18 Ruffe were captured 250m upstream in Roxbury Creek, a new sighting within the existing range. **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 in northern Green Bay. **Lower Great Lakes:** No Ruffe were detected.