SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2007

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BACKGROUND

The ruffe (*Gymnocephalus cernuus*), an Eurasian percid, was likely introduced to the St. Louis River Estuary (SLRE), Minnesota/Wisconsin, during the mid 1980s in the ballast water of an ocean-going ship (Pratt *et al*. 1992). Ruffe increased rapidly and became the most abundant fish in the SLRE by 1990, based on bottom trawl assessment. The population peaked at about eight million in trawls by 1995 and subsequently declined to about two million in trawls by 2004; however, ruffe remained the most abundant species in trawls through 2004; the U.S. Geological Survey (USGS) terminated bottom trawl assessments in the SLRE after 2004 (unpublished, USGS, Great Lakes Science Center, Lake Superior Biological Station, Ashland, Wisconsin). In 1991, ruffe were detected in Thunder Bay Harbour, Ontario, (Busiahn 1997). Due to potential competition for food and space, ruffe pose a threat to native fish populations (Ruffe Task Force 1992).

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

significant relationship between an increasing ruffe population and declining native fish populations in the St. Louis River, Minnesota/Wisconsin (Bronte *et al*. 1998).

In three Wisconsin tributaries just east of the St. Louis River, 1995-2002 trawl data suggest that yellow perch abundance declines in years that ruffe abundance increases (Evrard *et al*. 1998), (Czypinski *et al*. 2002). This trend was analyzed and found to be weakly significant for all three tributaries combined (unpublished, D. H. Ogle, Department of Mathematics, Northland College, Ashland, WI).

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

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

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

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

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

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

1991: Major ruffe range expansion was detected. A crew from Ashland FRO discovered ruffe in Thunder Bay Harbour, Ontario, 293 km northeast of the SLRE along the north shore of

Lake Superior. This introduction was likely a ballast water transfer from shipping operating between the Duluth/Superior Harbor, Minnesota/Wisconsin and Thunder Bay Harbour.

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

1993: Major ruffe range expansion was detected. Ashland FRO discovered eight new locations colonized by ruffe in Lake Superior. Ruffe 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. USFWS - Lower Great Lakes Fishery Resources Office (LGLFRO) initiated ruffe surveillance in U.S. waters of Lakes Erie and Ontario (Slade *et al*. 1994). No ruffe were detected in the Lower Great Lakes.

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

1995: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Huron near the mouth of the Thunder Bay River, 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. No ruffe were detected in the Lower Great Lakes.

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

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

1998: No ruffe range expansion was detected, but ruffe became the most abundant species captured during fall bottom trawling ruffe surveillance in the Thunder Bay River, Michigan,

a peripheral range location. OMNR expanded ruffe surveillance into Canadian waters of Lake Erie, and LGLFRO added fall surveys to their ruffe surveillance locations. However, no ruffe were detected in the Lower Great Lakes.

1999: Only minor ruffe range expansion was detected. Ashland FRO detected ruffe in one new location in Lake Superior, the Firesteel River, Michigan, representing a range expansion of 12 km eastward along the south shore of Lake Superior. The catch per unit effort (CPE) of ruffe in the Thunder Bay River Estuary, Lake Huron, increased from 1 per minute bottom trawling in 1998 to 11 per minute bottom trawling. The majority of the Thunder Bay River ruffe catch was YOY, and ruffe remained the most abundant species captured in trawls from this location. Round goby (*Apollonia* (*Neogobius) melanostomus*) were first captured from the Thunder Bay River, Lake Huron. No ruffe were detected in the Lower Great Lakes.

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

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

2002: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Michigan near Escanaba, Michigan, and in the Keweenaw Waterway, Lake Superior, 101 km east of the Ontonagon, River, Michigan, the previous eastern boundary of the ruffe range along the south shore of Lake Superior. In the Ontonagon River, although trawling indicated a decline in ruffe abundance from 2001, the overall trend in ruffe abundance continues to increase. No ruffe expansion was detected in Lake Huron, and no ruffe were captured in trawls within the ruffe range in Lake Huron.

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

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

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

The Red Cliff Tribal Fisheries Dept. in cooperation with Ashland FRO continued a ruffe capture effort during lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*) spawning near the Apostle Islands, Lake Superior. 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 Lake Huron, the Alpena FRO continued reduction of spawning ruffe in the Thunder Bay River, removing a total of ten ruffe in 74 nights of gill net effort. In Lake Superior, a combination of bottom trawling, gill netting, and trapping conducted by the Ashland FRO failed to effectively (achieve a minimum reduction of 90% of the ruffe population) reduce the ruffe spawning population in the Ontonagon River Estuary, Michigan. Totals of 65, 16, and 4 ruffe were removed in 5.2 hours of trawling effort, 23 nights of trapping effort, and 2.9 hours of gill netting (30.5 m panel) effort respectively. A bycatch of 62 stocked juvenile lake sturgeon (*Acipenser fulvescens*) were also captured, standard data was recorded, and all sturgeon were released alive.

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

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

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

2006: Along the south shore of Lake Superior, surveillance activity confirmed major ruffe expansion 226 km east of Marquette Harbor, Michigan, the previous eastern boundary of the ruffe range. A USFWS crew captured one adult ruffe near Grand Marais, Michigan, 120 km east of Marquette Harbor. The MIDNR confirmed one adult ruffe captured by an angler in Little Lake Harbor, Michigan, 167 km east of Marquette Harbor. The USFWS confirmed two adult ruffe captured by an angler in the Tahquamenon River estuary, a tributary on the west shore of Whitefish Bay, 226 km east of Marquette Harbor and 55 km west of the Soo Locks. The OMNR confirmed that ruffe span the entire length (13 km) of Thunder Bay Harbour of Thunder Bay, Ontario, the eastern boundary of the ruffe range along the north shore. OMNR also reported that a commercial fisherman captured three adult ruffe in a 120 mm (4.75 inches) stretch mesh gill net near the Welcome Islands in Thunder Bay, 3.5 km east of the Mission River estuary. OMNR also captured one adult ruffe 42 km upriver from the mouth of the Kaministiquia River, a tributary of Thunder Bay Harbour. In Lake Huron, ruffe were first detected in the Thunder Bay River in 1995, with expansion into Thunder Bay confirmed in 1998. In 1999, the river catch rate peaked to 11 ruffe per minute in trawls, then declined to 0.3 ruffe per minute in trawls in 2000. No ruffe have been captured from Lake Huron since 2003. In Lake Michigan, no ruffe were reported from new locations or Big Bay de Noc, where they were first detected in 2004. However, MIDNR captured a total of 40 ruffe from Little Bay de Noc, 18 more than were captured there in 2005. Little Bay de Noc and Big Bay de Noc of Green Bay continue to comprise the ruffe range in Lake Michigan. No ruffe were captured from the Lower Great Lakes. Ruffe remain undetected in the Lower Great Lakes, and in all inland lakes and streams within the Great Lakes Basin.

2007: In Lake Superior, the ruffe range spans the entire south shore from the Duluth-Superior Harbor, Minnesota/Wisconsin to Whitefish Bay, Michigan; and along the north shore from the Duluth-Superior Harbor to Thunder Bay, Ontario. Within this range, MIDNR captured ruffe in the Portage Canal of the Keweenaw Waterway. Ruffe remain undetected in the St. Marys River since surveillance was initiated in 2000. In Lake Huron, no ruffe were captured from new or previously detected locations, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995. No ruffe have been captured from Lake Huron since 2003. In Lake Michigan, WIDNR reported one ruffe captured in southern Green Bay, 1.5 miles southeast of Marinette, Wisconsin, by commercial fisherman, Jim Benson. This is a range expansion of 88 kilometers (55 miles) south from Little Bay de Noc of northern Green Bay. MIDNR captured a total of 13 ruffe from Little Bay de Noc, where they were first detected in 2002. No ruffe were reported from Big Bay de Noc 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 consists of Green Bay. No ruffe were captured from the Lower Great Lakes. Ruffe remain undetected in the Lower Great Lakes, and in all inland lakes and streams within the Great Lakes Basin.

The following report summarizes ruffe surveillance and other reported fish sampling capable of capturing ruffe incidentally, on the periphery and outside of the detected range of ruffe in the Great Lakes Basin during 2007.

OBJECTIVES

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

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

METHODS

U.S. Waters of the Great Lakes

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

The primary gear used in each of the Great Lakes was a nylon bottom trawl (4.9 m headrope), commercially manufactured with a 3.8 cm stretch-mesh body, a 31.8 mm stretch-mesh cod end, and a 6.25-12.5 mm stretch-mesh inner liner to hold small specimens.

Bottom trawls were pulled with a variety of vessels and were deployed and retrieved either by hand or with a winch powered hydraulically, electrically, or by gasoline engine. The target time

for trawl tows was 5 to 10 minutes per tow, but varied in duration depending on the size of the area trawled, the presence of submerged obstacles, and numbers of fish captured. Tow speed was maintained at approximately 4 km/hour, and was monitored by commercially manufactured ground position systems (GPS) or engine tachometer readings.

In addition to bottom trawls, other gear employed included mini fyke nets, gill nets, and experimental perch traps (called modified Windermere traps) (Edwards *et al*. 1998). The mini fyke nets consisted of 0.7 m x 1.0 m rectangular hoops interconnected with 6.25 bar-length x 12.5 mm stretch-mesh netting and a 15 m lead net. The gill nets consisted of a 0.6 m x 11.0 m panel of 38 mm multifilament stretch mesh. The modified Windermere traps measure 0.6 m x 1.2 m with netting consisting of a 6.25 mm bar-length x 12.5 mm stretch-mesh. The diameter of the trap entrance holes measures 5.08 to 6.35 cm. The modified Windermere traps were baited with nightcrawlers.

The term *established location*, as used herein, refers to a geographic body of water that was selected for ruffe surveillance based on the risk of invasion by ruffe. The risk was assessed by the amount of habitat known to be attractive to ruffe (i.e. deep channels and pools, low water clarity, soft substrate).

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

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

The LGL National Fish and Wildlife Conservation Office (NFWCO, formerly Fishery Resources Office (FRO)) recorded depths at several additional intervals (e.g. 2, 5, and 7 minutes) to determine the mean depth for each tow. Surface temperature, surface and bottom dissolved oxygen levels, and water transparency were also recorded at each location sampled in Lakes Erie and Ontario, (Table 4).

Catches of fish were sorted by species and counted, and the total length of up to 50 specimens of each species were measured to the nearest millimeter. All captured species were released, except aquatic invasive species (AIS) (i.e. ruffe, round goby, white perch, sea lamprey, tubenose goby (*Proterorhinus marmoratus*), threespine stickleback (*Gasterosteus aculeatus*), fourspine stickleback (*Apeltes quadracus*), common carp (*Cyprinus carpio*), rudd (*Scardinius erythrophthalmus*), rusty crayfish **(***Orconectes rusticus***),** zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis*), and Eurasian watermilfoil (*Myriophyllum spicatum*)).

Captured AIS were either destroyed, or preserved in 95% ethyl alcohol (EtOH). Specimens of unidentified species were retained frozen for later identification.

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

Cooperation from agency partners and the public continued to expand the coverage and frequency of ruffe observations. Private anglers continued to report ruffe catches within the detected ruffe range, and many agencies and organizations reported fish sampling that was capable of incidental ruffe capture.

Canadian Waters of the Great Lakes

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

RESULTS

LAKE SUPERIOR

On the periphery and outside of the detected ruffe range, the Ashland NFWCO conducted ruffe surveillance during spring at seven established locations and two of the three SOO Locks, Sault Ste. Marie, Michigan. A summary of fish species captured at these locations is available upon request from the Ashland NFWCO.

Huron Bay, Michigan A total of six bottom trawls was completed on six established transects over mud substrate (Figure 1 and Table 1) . Species diversity consisted of 13 fish taxa and 1 crayfish taxa. Spottail shiner (*Notropis hudsonius*) dominated the total catch followed by trout-perch (*Percopsis omiscomaycus*) and rainbow smelt (*Osmerus mordax*). One sea lamprey was the only AIS captured.

Marquette Harbor, Michigan A total of six bottom trawls was completed over six established transects located adjacent to commercial vessel docks and a public marina (Figure 1 and Table 1). Species diversity consisted of ten fish taxa and three crayfish taxa. No species dominated the total catch, but ninespine stickleback (*Pungitius pungitius*) and the invasive threespine stickleback were the two most abundant species, totaling 11 and 10 respectively. Threespine stickleback were initially detected here in 1995. No ruffe were captured.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

Several organizations including the USFWS, USGS, MIDNR, and GLIFWC reported fish sampling in a total of 62 locations that were capable of incidental ruffe capture (Figures 2 and 3, and Table 1). These sampling activities captured a total of 103 ruffe in three locations within the periphery of the ruffe range, including 1 ruffe in a new location within the ruffe range.

Lake Superior Near-shore The Lake Superior Biological Station (LSBS) of the USGS-Great Lakes Science Center conducted bottom trawling (11.9 m headrope) across-contour to assess spring forage fish community abundance. Transects included 41 near-shore stations around the lake, near the periphery and outside of the detected ruffe range (Figure 3 and Table 1). No ruffe were captured at these stations.
Within the heart of the ruffe range (near-shore and in-shore waters from Duluth, Minnesota, to the Bad River, Wisconsin) the LSBS captured a total of 114 ruffe. With exception of five ruffe captured around the Apostle Islands, Wisconsin, all ruffe were captured off the Superior entry to the Duluth-Superior Harbor, Minnesota/Wisconsin (Figure 3).

Keweenaw Waterway, Michigan The Michigan DNR conducted a fish assessment using traps, that included the Portage Canal, Portage Lake, Portage River, Torch Lake, and the Sturgeon River. A total of 102 ruffe were captured from Portage and Torch Lakes, and one ruffe was captured from the Portage Canal, a new discovery (Figure 2 and Table 1). Ruffe were first discovered in the Waterway in 2002.

Isle Royale During June, the Ashland NFWCO, in cooperation with the NPS and MIDNR, conducted fish assessments in Siskiwit Bay, Washington Harbor, and Tobin Harbor that included a total of 12.06 hours electrofishing (Figure 2 and Table 1). No ruffe were captured or observed.

Southeastern Lake Superior The Ashland NFWCO conducted a lake whitefish assessment in late July at three locations east of Grand Marais, Michigan (Figure 2 and Table 1). The 30 meter long gill net panels consisted of 50, 63, 75, 88, 100, and 113 mm stretch mesh. Total effort of these mesh sizes was 6,828 meters. No ruffe were captured.

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control in cooperation with GLIFWC, NPS, and private contractors conducted trapping to assess sea lamprey abundance in 11 tributaries, that were capable of incidental ruffe capture within the periphery of the ruffe range (Figure 2 and Table 1). No ruffe were captured.

Within the heart of the ruffe range, Sea Lamprey Control captured a total of one ruffe in a fyke net from the Amnicon River, Wisconsin, and two ruffe in a portable assessment trap from the Middle River, Wisconsin. The Amnicon River is a tributary 15 km east of the Duluth-Superior Harbor; ruffe were first discovered in the Amnicon in 1988. The Middle River is a tributary 2.25 km east of the Amnicon River; ruffe were first discovered in the Middle in 1991 (Ruffe Range Map).

Unconfirmed Sightings None reported.

LAKE MICHIGAN

The Green Bay NFWCO conducted ruffe surveillance in one tributary. Federal and state agencies, tribal communities, and the Inland Sea Education Association (ISEA) reported other fish sampling in more than 50 locations, that was capable of incidental ruffe capture. The Michigan DNR captured a total of 13 ruffe from Little Bay de Noc, a location where ruffe had been initially detected in 2002. The Wisconsin DNR reported a new ruffe discovery by a commercial fisherman in Green Bay, near Marinette, Wisconsin.

Ruffe Surveillance

Fox River, Wisconsin The Green Bay NFWCO completed 16 minutes of bottom trawling near the mouth of this dredged tributary, located at the southern end of Green Bay (Figure 1 and Table 2). Species diversity consisted of seven taxa, with trout-perch, gizzard shad (*Dorosoma cepedianum*), and channel catfish (*Ictalurus punctatus*) as the three most abundant species in the total catch. Totals of 13 invasive white perch and 5 round goby were also collected. No ruffe were captured.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

Lake Michigan Near-shore/Off-shore The USGS-Great Lakes Science Center conducted fall bottom trawling (12 m headrope) on-contour to assess prey-fish community abundance at seven locations, outside and near the periphery of the detected ruffe range (Green Bay) (Figure 4 and Table 2). A total of 70 tows were completed comprising 11.8 hours of effort. No ruffe were captured.

Grand Traverse Bay and Little Bay de Noc The Inland Seas Education Association (ISEA) is a non-profit environmental education organization. Scientific sampling aboard their vessel is conducted by ISEA staff, volunteer instructors, and students (mostly grades 5-7). The ISEA completed over 33 hours of bottom trawling (4.9 m headrope) effort in Grand Traverse Bay and Little Bay de Noc (Figure 2 and Table 2). No ruffe were captured,

Little Bay de Noc (LBDN) of Northern Green Bay From 2004-2010, the MIDNR is conducting fall assessments to determine the relative contribution of hatchery-raised walleye to year classes of walleye stocks. Each year, a random subset of transects are sampled from a larger set of established transects. The gear includes 25, 38, and 50 mm stretch-mesh gill nets, set in a total of 4 transects, and comprising 2,195 m of effort (Figures 2 and 5, and Table 2). A total of 10 ruffe was captured from 2 of the transects. Ruffe were first detected here in 2002.

Since 1988, the MIDNR has been conducting summer assessments in LBDN using bottom trawls and experimental gill nets. Total effort consists of 3.33 hours trawling and 10 gill net nights. A total of three ruffe was captured in gill nets (Figure 2 and Table 2).

Big Bay de Noc (BBDN) of Northern Green Bay From 2004-2010, the MIDNR is conducting the same fall walleye assessment in BBDN as in LBDN (described in LBDN). A total of 12

transects were sampled with gill nets with a total effort of 6,585 m (Figures 2 and 5, and Table 2). No ruffe were captured. Ruffe were first detected here in 2004.

Since 1988, the MIDNR has been conducting summer assessments in BBDN similar to LBDN (described in LBDN). Total effort consists of 3.33 hours bottom trawling and 10 gill net nights. (Figure 2 and Table 2). No ruffe were captured.

Green Bay The Wisconsin DNR reported the capture of one ruffe by commercial fisherman, Jim Benson, 2.5 km southeast of Marinette, Wisconsin. The ruffe was an adult male, 190 mm total length, and weighed 98 gr (frozen weight).

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

Unconfirmed Sightings None reported.

ST. MARYS RIVER

Ruffe surveillance in Canadian waters

The OMNR-Upper Great Lakes Mgt. Unit-Lake Superior and the USFWS-Ashland NFWCO conducted bottom trawling in a heavy boat slip operated by the Algoma Steel Co., Sault Ste. Marie, Ontario. However, bottom obstructions prevented successful completion of two attempted tows in the slip. One tow was completed successfully in a shallow flat area adjacent to the slip. No ruffe were captured in that tow.

Ruffe surveillance in U.S. waters

Various Locations Upriver from the Soo Locks A total of six bottom trawls were completed upriver from the SOO Locks with a small total catch consisting of three fish taxa and two crayfish taxa. In cooperation with the U.S. Army Corps of Engineers, one bottom trawl was completed in each of two locks. No fish were captured in the locks. A total of three modified Windermere traps and two mini-fyke nets were fished over one night in Ashmun Bay, located about 1 km upriver from the Locks (Figure 1 and Table 1). The total trap catch consisted of 13 fish taxa and 2 crayfish taxa, with white sucker (*Catostomus commersoni*) and rock bass (*Ambloplites rupestris*) the two most abundant species. No ruffe or other AIS were captured.

Various Locations Downriver from the Soo Locks The Alpena NFWCO conducted ruffe surveillance during early October in six established locations including the Municipal Marina of Sault Ste. Marie, Michigan, the shipping channel south of the Sugar Island Ferry crossing, Baie

de Wasai, Munuscong Channel, and two locations in DeTour Passage (Figure 1 and Table 3). A total of 17 taxa were captured with the majority of the total catch consisting of mimic shiner (*Notropis volucellus*) (89%). The greatest total catch (983.8 fish/minute) occurred in the Munuscong Channel, and the greatest diversity of species (13 species) were represented from the Sault Ste. Marie Municipal Harbor. Mimic shiners were the most ubiquitous species, being captured from all six surveillance locations. No ruffe were captured. A summary of fish species captured is available upon request from the Alpena NFWCO.

LAKE HURON

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

Western Lake Huron The Alpena NFWCO conducted ruffe surveillance in established locations at the following locations: the AuGres River, Cheboygan River, Saginaw River, Thunder Bay River, Harbor Beach, Port Dolomite (Cedarville), and within the shipping channel in Thunder Bay (Figure 1 and Table 3). A total of 28 taxa were captured and the majority of the catch consisted of mimic shiner. The greatest total catch (188.4 fish/minute) occurred at Harbor Beach, and the greatest diversity of species (20 species) was represented at the AuGres River. Alewife (*Alosa pseudoharengus*), emerald shiner (*Notropis atherinoides*), and yellow perch were the most ubiquitous species, being captured at five of the seven surveillance locations. No ruffe were captured.

Ruffe Population Reduction

The Alpena NFWCO conducted efforts to detect and reduce the ruffe population in the Thunder Bay River and Thunder Bay area during April and September. This annual activity was initiated in 2002. Small mesh gillnets were set over a period of three weeks in April and one week in September. The objective is to minimize recruitment by removing adult ruffe prior to spawning in the spring. Fall sampling is conducted to determine if recruitment is taking place. No ruffe were captured during spring or fall detection and reduction activities in western Lake Huron.

Reported fish sampling that was capable of capturing ruffe incidentally

Lake Huron Near-shore/Off-shore The USGS-Great Lakes Science Center conducted fall (October/November) bottom trawling (21 m wing trawl) on-contour to assess the status and trends of the Lake Huron deepwater fish community.

A total of 45 tows was completed, comprising 7.5 hours of effort over five U.S. locations and one Canadian location (Figure 6 and Table 3). No ruffe were captured.

The USFWS-Marquette Biological Station-Sea Lamprey Control in cooperation with the Chippewa Ottawa Resource Authority and private contractors conducted trapping in tributaries to assess sea lamprey abundance (Figure 2 and Table 3). Traps set in ten of the tributaries sampled were capable of incidental ruffe capture. No ruffe were captured. A summary of fish species captured at these locations is available upon request from MBS.

Unconfirmed Sightings None Reported.

LAKE ERIE

The Lower Great Lakes NFWCO completed surveys at seven previously established locations. The Marquette Biological Station and USGS reported other fish sampling that was capable of incidental ruffe capture in four locations. No ruffe were captured during ruffe surveillance or other reported fish sampling capable of incidental ruffe capture in Lake Erie.

Ruffe surveillance

The Lower Great Lakes NFWCO used a 4.9m bottom trawl to collect fish from each of seven sites, including Ashtabula, Buffalo, Cleveland, Conneaut, Erie, Sandusky, and Toledo (Figure 7 and Table 4). All sites were sampled once in spring (May) and again in the fall (September). The spring catch was comprised of eight species. Emerald shiner dominated the spring catch (98%) with channel catfish being the second most abundant (1%). Over 2,000 emerald shiners were captured primarily from Conneaut and Cleveland harbors. Freshwater drum (*Aplodinotus grunniens*), white perch, round goby, trout-perch, rainbow smelt, and spottail shiner made up the remainder of the catch. The fall survey included 12 species, comprised mostly of rainbow smelt (77%). Freshwater drum (11%) and emerald shiner (4%) were the next most abundant. A summary of all fish species captured at these locations is available upon request from the LGLNFWCO.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control and private contractors conducted trapping in three tributaries to assess sea lamprey abundance (Figure 8 and Table 4). No ruffe were captured. A summary of fish species captured at these locations is available upon request from the MBS.

Western Lake Erie Near-shore/Off-shore The USGS-Lake Erie Biological Station conducted summer and fall (June, August, September, October) bottom trawling (7.9 m headrope) to assess the status of fish stocks in western Lake Erie. These trawls were conducted near East Harbor State Park, Ohio, for a total effort of 20.3 hours (Figure 8 and Table 4). No ruffe were captured.

Unconfirmed Sightings None reported.

LAKE ONTARIO

The Lower Great Lakes NFWCO conducted ruffe surveillance at Rochester, NY (Genesee River) during May and October. The Marquette Biological Station and USGS reported other fish sampling that was capable of incidental ruffe capture in 14 locations. No ruffe were captured during ruffe surveillance or other reported fish sampling capable of incidental ruffe capture in Lake Ontario.

Ruffe Surveillance

Genessee River/Rochester Harbor The Lower Great Lakes NFWCO conducted bottom trawling along the south shore of Lake Ontario at Rochester Harbor in the Genesee River near the mouth at Lake Ontario (Figure 7 and Table 4). These transects are located within the dredged shipping channel no more than 3 km upstream from the lake. During May, only emerald shiner and alewife were collected. Alewife made up 96% of the total catch. In October, eight species made up the catch with spottail shiner (43%) and trout-perch (26%) being the two most abundant. We collected an unusually high number of round goby at one of the more upstream sites. Twenty-seven goby were collected in a 9 minute trawl.

Typically, few goby are collected during our ruffe surveillance; however the reduced clarity of the Genesee River may have hindered the ability of goby to evade the net.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

South Shore Tributaries The USFWS-Marquette Biological Station-Sea Lamprey Control contracted with private contractors to conduct trapping in tributaries to assess sea lamprey abundance. Traps set in three of the tributaries sampled were capable of incidental ruffe capture; no ruffe were captured (Figure 8 and Table 4). A summary of fish species captured at these locations is available upon request from MBS.

U.S. Waters of Lake Ontario Near-shore/Off-shore The USGS-Lake Ontario Biological Station and the New York State Department of Environmental Conservation (NYSDEC) conducted bottom trawling (18.0 m headrope) in U.S. waters to assess the status of major prey-fish stocks. A total of 373 tows was completed within 12 transects comprising 62.2 hours of effort (Figure 9 and Table 4). No ruffe were captured.

Unconfirmed Sightings None reported.

DISCUSSION

LAKE SUPERIOR

Keweenaw Waterway, Michigan The Michigan DNR fish assessment supports an earlier hypothesis that this established ruffe population would continue to increase and eventually spread throughout the Waterway. The DNR assessment also confirmed that both relative abundance and distribution of ruffe in the Waterway is more advanced than assessed by USFWS surveys. Past USFWS surveys targeted the Portage Canal, a small embayment within Portage Lake, the Portage River, and the Sturgeon River Sloughs. The majority of the DNR ruffe catch was captured from Portage and Torch Lakes, where the USFWS did not sample. Portage Lake has a reputation for supporting walleye (*Sander vitreus*) and trophy northern pike (*Esox lucius*), but research has demonstrated that top-down control strategy is not effective in controlling ruffe (Mayo *et al*. 1998).

Huron Bay, Michigan No ruffe have ever been captured in Huron Bay since surveillance began here in 2003. Ruffe have been detected in four locations east of the bay, and an established ruffe population exists in the Keweenaw Waterway just west of the bay. The northern and central waters of the bay are deep (preferred by ruffe), but clear and cold (less preferred by ruffe). The southern waters of the bay are darker and warmer (more preferred by ruffe), but relatively shallow (mostly less than 3 m, less preferred by ruffe).

Marquette Harbor, Michigan No ruffe were captured from Marquette harbor during spring surveillance in 2007. With only single captures of an age one ruffe in 2005 and an age zero ruffe in 2004, and no capture of adult spawning ruffe during the spring surveys, the status of ruffe here remains undetermined. Both ruffe were captured from the same transect (heavy commercial boat slip) and the same time of year (fall). The high water clarity (secchi range 3.6-6.9 m) may be in part preventing or delaying the establishment of a ruffe population here.

ST. MARYS RIVER

Although ruffe were detected in Whitefish Bay, eastern Lake Superior, in 2006, they have not been captured from the St. Marys River above or below the SOO Locks, Sault Ste. Marie, Michigan.

LAKE HURON

Surveillance efforts conducted in 2007 did not capture any ruffe from the Thunder Bay River or any other locations within Lake Huron. Ruffe have not been captured from Lake Huron for the past four years and were last captured in the spring of 2003.

Thunder Bay, Michigan

Within the Thunder Bay area, the absence of young of year (YOY) ruffe from fall ruffe surveillance trawling from 2001 to present, and the decline in spring adult spawning ruffe captured in gill nets from 2002 to 2003 followed by the absence of ruffe from 2004 thru 2006 suggests an overall decline in the Lake Huron ruffe population. The absence of YOY was an initial sign that recruitment may not be taking place, and the more recent decline followed by the absence of spawning adults also suggests that recruitment was insufficient to foster the population. It is not known why the large abundance of ruffe captured in 1999 (470 ruffe), an 11 fold increase in abundance over the 1998 catch, did not transfer into a large catch of adult or

subsequent YOY production in 2000. One reason may be the colonization and subsequent flourishing of the round goby in the Thunder Bay area. The round goby was first captured from the Thunder Bay River in 1999, and although their abundance was low that year (14% of total catch), they became the most abundant species captured from the river the following year, a status which has continued. Round goby are known egg feeders, can spawn multiple times in a season, guard their nests to ensure the development of their young, and are very aggressive. Although direct interactions are unknown between goby and ruffe, we surmise that goby may have fed on ruffe eggs and/or young that were deposited and/or hatched in the river in the spring and early summer, or that goby may have had some other negative effect on ruffe. Following 2001, ruffe were not captured from the Thunder Bay River or adjacent waters in fall trawling surveys, however, round goby were the most abundant species captured from these waters during fall trawling surveys conducted through 2002 and from 2004 through 2007.

Although YOY ruffe have not been captured from the Thunder Bay River in the fall since 2001, adult spawning phase ruffe were captured from the river through spring 2003. Alpena NFWCO initiated a spring reduction effort in 2002 to remove adult spawning ruffe prior to reproduction using gill nets. The catch of adults declined from 2002 (96 ruffe) to 2003 (10 ruffe) and no ruffe were captured from 2004 thru 2007. It may be that the removal of spawning adults, coupled with other events, possibly predation effects of round goby, may have contributed to the decline in ruffe abundance.

LAKE MICHIGAN

Bays de Noc of Northern Green Bay Other fish sampling conducted by MIDNR in established transects did not capture ruffe from Big Bay de Noc (BBDN). The ruffe catch from Little Bay de Noc (LBDN) declined by 2/3 over 2006 with the same level of sampling. For the past three years (2005-2007), no ruffe have been captured from BBDN, since MIDNR assessments captured one mature female (likely age 1+) during the fall of 2004. The history of ruffe range expansion suggests that during their early years of invasion, captures can vary with regard to total number and location. The catch of 40 ruffe in neighboring LBDN in 2006 was the largest confirmed catch since ruffe were detected there in 2002, and suggested that ruffe recruitment was occurring successfully and the ruffe population was increasing there. The capture of only 13 ruffe in 2007 mostly in the 100 mm length range (likely yearlings) suggests a poor 2006 year class. Reported ruffe captures in LBDN from 2002 thru 2007 have totaled 3, 4, 3, 22, 40, and 13 respectively. In 2002 and 2003, all ruffe were captured in trawls. From 2004 thru 2007, the majority of ruffe were captured in 38 mm stretch mesh gill nets (Troy Zorn, MIDNR, Marquette Fisheries Research Station, Marquette, Michigan; pers. comm.). For five years, the ruffe range in Lake Michigan has been confined to LBDN of Green Bay. In 2007, the ruffe range expanded 88 km southward in Green Bay when a commercial fisherman reported a capture of one adult ruffe, near Marinette, Wisconsin. No ruffe have ever been detected outside of Green Bay.

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

The U.S. Geological Survey projected future unassisted range expansion of ruffe based on lake currents and U.S. documented ruffe range expansion through 1994 (unpublished presentation, Andrew J. Edwards, USGS, Great Lakes Science Center, Lake Superior Biological Station, Ashland, Wisconsin).

In Lake Superior, USGS projected 2002 as the most likely year of ruffe arrival in the Keweenaw Waterway, MI, and 2006 as the most likely year of ruffe arrival in Marquette, MI. Documented arrival of ruffe in the Keweenaw Waterway was 2002, and Marquette was 2004. A total of two ruffe have been reported captured from Marquette Harbor since 2004, and no ruffe were reported captured there in 2007. USGS projected 2004 as the earliest estimated year of arrival of ruffe at Whitefish Point and the Tahquamenon River, 26 km south of Whitefish Point. Documented arrival of ruffe in the Tahquamenon River estuary was 2006.

In the St. Marys River, ruffe were estimated to arrive as early as 2005. No ruffe have been captured from the St. Marys River.

In Lake Huron, the most likely year of ruffe arrival in Saginaw Bay was projected to be 2003. Ruffe surveillance has not documented the presence of ruffe in Saginaw Bay, or any other location in Lake Huron other than Thunder Bay near Alpena, Michigan, 93 km north of Saginaw Bay.

In Lake Michigan, ruffe were projected most likely to arrive in Manistique, Michigan by 2007, and in Marinette, Wisconsin by 2011. Ruffe were documented 50 km southwest of Manistique in 2004, and near Marinette in 2007.

In Lake Erie, ruffe were projected to arrive as early as 2003. No confirmation of a ruffe capture has been reported in Lake Erie.

Voluntary ballast exchange conducted by the Lake Carriers Association, educational efforts conducted by Sea Grant and state, tribal, and federal environmental organizations, and early detection of range expansion by ruffe surveillance and other fish sampling, have reduced the potential of human assisted ruffe range expansion. It appears that ruffe are continuing to expand their range unassisted by human activities at a rate very close to USGS projections.

Ruffe have not been detected in inland lakes and streams within the Great Lakes Basin, but ruffe have the potential to migrate up Great Lakes tributaries, until they encounter a natural or man-made barrier. In Ontario, Canada, OMNR captured one ruffe, 42 km (26 miles) upriver from the mouth of the Kaministiquia River, a tributary of Thunder Bay, Lake Superior. It is likely that ruffe have migrated to the pool at the bottom of Kakabeka Falls, 47 km upriver from the mouth of the Kaministiquia River. The falls form a natural barrier that prevents further upstream migration of ruffe. In the White River, Wisconsin, a tributary of the Bad River, a Lake Superior tributary, ruffe have been captured in the pool below the White River Dam, 35 km (22 miles) upriver from the mouth of the Bad River. The dam is a man-made barrier that prevents further upstream migration of ruffe.

Range of Ruffe

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

Lake Superior

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

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

Lake Huron

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

Lake Michigan

Green Bay.

Lake Erie	**Lake Ontario**	**Great Lakes Basin Inland Lakes & Streams**
Unconfirmed.	Undetected.	Undetected.

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Reported Ruffe Surveillance Information

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Reported Information From Other Fish Sampling Capable of Capturing Ruffe Incidentally

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