

# **Inventory of Nearshore Fish and Mud Puppy (Amphibian) in Lake Superior, Pictured Rocks National Lakeshore**

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## **INTRODUCTION**

Seventy-three species of fish have been identified by PIRO personnel and the author as having natural ranges that could include the area of Pictured Rocks National Lakeshore, Michigan (Appendix 1). Many species occupy lotic and inland lake habitats, and surveys of these habitats are spatially and temporally extensive. However, a fishery inventory has not been conducted on waters of Lake Superior within the boundary of Pictured Rocks National Lakeshore (PIRO) (Jerry Belant, personal communication, PIRO). This Lake Superior inventory has been identified as a high priority by PIRO (National Park Service 2000) and by National Park Service staff and fish biologists at the National Park Service Great Lakes Network Inventory and Monitoring Workshop in 2000. Consequently, PIRO entered into an interagency agreement with the Ashland Fishery Resources Office (AFRO) to conduct a species inventory study in Lake Superior waters of PIRO during 2002. This report describes the inventory and its findings.

Lake Superior fishery habitat is categorized by depth zones (US Fish and Wildlife Service 1995). Offshore habitat includes waters deeper than 73 m (240 ft). Inshore habitat is defined as waters intermediate between offshore and nearshore habitats, defined as 9-73 m (30-240 ft) in depth. Nearshore habitat comprises waters less than 9 m (30 ft) in depth. Nearshore habitat is the most productive and biologically diverse of these habitats (Becker 1980). Fifty-two species have been recorded from the nearshore habitat of Lake Superior (Appendix 1). Fish species assemblages in the nearshore waters of Lake Superior vary substantially, both spatially and temporally. Movement of anadromous (migratory) species and changes in water temperature in the nearshore habitat affect the occurrence of species at different times of the year. This study was designed to provide maximal temporal and spatial coverage, given the scope of the project.

### **Objective**

The objective of the survey was to determine presence and relative abundance of fish species and of mud puppy, *Necturus maculosus* (Amphibian), occupying Lake Superior waters of Pictured Rocks National Lakeshore.

## **STUDY AREA**

The study area encompassed Lake Superior waters within the boundaries of PIRO, which includes the area 0.25 mi perpendicular to shore along approximately 42 mi of the length of the park. It includes about 3.45 mi of shoreline in South Bay, which is partially sheltered from the open lake and has sandy substrate. Macrophytes occur sparsely in beds <1 acre and in water depths 10-20 ft in this embayment.

The remainder of the shoreline to the east is fully exposed to open waters of Lake Superior and consists of approximately 23.34 mi of predominantly sandy beach, 10.22 mi of cliff face, and 1.87 mi of large boulder shoals.

## **METHODS**

**Sampling period.** Sampling was conducted during three periods: spring (May 23-29, 2002), summer (July 15-21, 2002), and fall (September 26-October 1, 2002) to maximize the potential of documenting diverse species.

**Sample design.** Sample sites were randomly selected from four diverse habitat types: embayment, rocky point, cliff face, and beach to the extent possible (Fig.1). Randomization was achieved by selecting locations within segments based on selections of random numbers representing shoreline distances. However, when a selected spot had characteristics that made use of a certain gear type impossible, the proximate suitable area was sampled (*e.g.* boulder bottoms are not suitable for trawl or seine). High fish diversity was presumed to occur in embayment and rocky point habitats, medium fish diversity along cliff face habitat and low fish diversity along beach habitat. Sampling design within each habitat incorporated various substrates, depths, and tributary stream mouths.

Locations of sampling sites were recorded as Global Positioning System (GPS) coordinates. Beginning and ending coordinates were recorded (*Eagle Acu-Nav*, hand held units, accuracy +/- 50 ft) during trawling, electrofishing, and at gill net sets. Coordinate points were also recorded at sampling sites where fyke nets, Windermere traps, and beach seines were set.

**Sampling equipment.** Sampling equipment consisted of bottom trawls, size-graded and large mesh gill nets, fyke nets, beach seines, portable fish traps (modified Windermere traps) and a Direct Current (DC) electrofishing boat.

**Trawl:** Trawling was conducted with a standard 16 ft bottom trawl during daylight hours. Trawling within the four shoreline habitat diversity segments began at water depths of 6 ft, extending cross-contour no further than the 0.25 mi from shore boundary of PIRO. Ten transects were sampled during each season and tows were 5 minutes (min) in duration unless the trawl snagged on bottom. When this occurred samples were used if the trawl fishing time was at least 3 min in duration. Trawl sites were randomly selected each season within four of the five habitat segments. Trawling was not conducted in segment #2 (high diversity, rock shoal habitat) because of the presence of boulders at all locations.

**Gill nets:** Gill nets were of two types. A single 200-ft gang of large mesh (10 inch stretch measure) was employed to sample lake sturgeon (*Acipenser fulvescens*). Graded mesh nets, consisting of nine 100-ft panels with mesh sizes ranging from 2-6.5 inch (in) stretch measure, were set to sample a variety of fish smaller than adult lake sturgeon.

Large-mesh and graded-mesh gill nets were set as paired sets and fished for one night on each occasion. During each sampling period, bottom set gill nets were fished at four locations at sites randomly selected in each of the four habitats. Sets began at the 10 ft contour line and extended toward open water perpendicular to shore. Gill nets were lifted daily. Sampling effort with gill nets totaled eight net-nights during each sampling period.

Trap nets: Trap nets included fyke and Windermere traps. Standard fyke nets were 4 by 6 ft with 50-75 ft leads, depending on slope and depth of substrate. Windermere traps are double-funnel traps with 0.25 in mesh, resembling large minnow traps. Pairs of fyke nets and Windermere traps were set at the mouths of six streams with available habitat upstream for anadromous fish: Sable Creek, Hurricane River, Sullivan Creek, Sevenmile Creek, Mosquito River, and Miners River. Nearshore habitat at the mouth of Beaver Creek was not sampled due to research by another investigator. Lead ends of trap nets were set in water 1-2 ft deep and bag ends set in water 3-7 ft deep. Sampling effort with this method was twelve trap net nights (six fyke-net-nights and six Windermere-trap-nights) for each sampling period. Total sampling effort for the project was 36 trap-nights, however, data from only 30 trap-nights were available as storms destroyed 6 trap net sets.

Beach seine: Beach seining of nearshore water (0-3.0 ft deep) was conducted during daylight hours with standard 50 ft by 4 ft bag-type beach seines with 0.25 in mesh. Sampling stations were chosen at boulder free sites proximate to the inshore end of trawling tows described above. One end of the seine was held in water approximately 3 ft deep, and other end pulled tight parallel to shore. The seine was then pulled directly to the shore.

Boat electrofishing: Nearshore electrofishing was conducted after dusk along shore at a water depth of approximately six ft with a 20 ft aluminum electrofishing boat with *Smith-Root GPP™ (Gas Powered Pulsators)* control unit and 5000 watt generator. Three shoreline transects, each 1 mi in length, were sampled during each sampling period. The transects were pre-selected based on safe accessibility and diversity of habitats and included: western-most extent of Lake Superior shoreline within boundary of PIRO, sand and rocky habitats centered on the mouth of Miners River, and sand/gravelly habitat centered on the mouth of Sable Creek.

Inventory of fish and mud puppy: Fish captured were enumerated by species. Length measurements of the first 50 specimens of each species captured from each sampling site were recorded before returning the fish to Lake Superior. Specimens requiring laboratory identification were preserved and returned to Ashland Fisheries Resources Office (AFRO). At the request of the Michigan Department of Natural Resources, all specimens of hybrid splake (*Salvelinus fontinalis* x *S. namaycush*) were killed and preserved for genetic and morphological study. Fish captured were not weighed.

## **RESULTS**

Mud puppy were not captured or observed during the inventory.

Twenty-nine species of fish and one hybrid fish (splake) were collected in the inventory (Table 1). The graded mesh gill net sets captured 12 species in addition to hybrid splake, with long nose suckers and round whitefish dominating the gill net catch (Table 2). No fish were captured in the large mesh (10 in diagonal stretch mesh) gill net. Fyke and Windermere nets combined captured 13 species and beach seining captured 6 species. Boat electrofishing captured 16 species. Trap nets set at the river mouths captured large numbers of adult white and longnose suckers (Table 2).

Data are reported by sampling (gear) type, habitat type, and sample period (Tables 2-6). Scientific names of fish are presented in Appendix 1. Relative abundances for each habitat type and sampling

(gear) type are presented as catch per unit-of-effort (CPUE) (Table 7). Data recorded in the field are included in electronic format with the final report.

Although no weight data were collected, two sucker species at the river mouths were observed to have constituted the majority of the biomass.

Twelve splake were captured during this study. All were sacrificed and preserved for genetic and taxonomic examination. Preliminary pyloric caeca counts of two splake are not within published ranges, suggesting that splake may reproduce and produce offspring with pyloric caeca counts intermediate between those of brook trout and lake trout.

## **DISCUSSION**

Seventy-three species of fish were previously identified as likely to occur in the region of PIRO. Many occur in lotic and inland lake environments and have been documented by numerous temporally and spatially extensive surveys. However, several fish species that had not been documented within PIRO waters were considered likely to inhabit the nearshore area of Lake Superior. This reasonably comprehensive inventory documents the presence of 29 fish species in Lake Superior within the boundary of Pictured Rocks National Lakeshore. Nine of the 29 species and one hybrid had not been confirmed previously from PIRO (Appendix 1).

The use of multiple gear types and multi-season sampling proved to be advantageous. Each gear type and seasonal effort contributed to the capture of species not caught by other methods or during other sampling periods.

Gill nets are the primary method available for capturing fish in deep water habitats. A very small area in Munising Bay has depths approaching 150 ft. This area produced most of the deep water species captured, such as lake trout, chinook salmon, and whitefish.

Trap netting effort at the river mouths captured high numbers and biomass of fish because white suckers and longnose suckers congregate at river mouths in spring for spawning and in summer/fall for feeding.

Daytime beach seining was the least effective method of capturing either numbers of fish or numbers of species, however, this method captured alewife, a species documented by no other method.

Nocturnal electrofishing was highly effective. Most fish species avoid shallow, clear water habitats, typical of nearshore, in daylight hours, but at night active foraging activity occurs. Two of the electrofishing transects were centered on mouths of streams, where turbidity provides some cover and where productivity is greater than in clear water.

The use of gear types that are highly size-selective precludes use of the data to statistically describe age or length structures of the populations sampled. However, the relative abundance of species found in this study provides a baseline for future comparison.

Fish species known to occur in nearshore waters of Lake Superior, but which were neither captured

nor observed at PIRO during this or previous surveys, are lake sturgeon, shorthead redhorse, pygmy whitefish and common carp. While we cannot conclude that they do not utilize this portion of Lake Superior occasionally or in small numbers, the following habitat characteristics may reduce the likelihood that they are found in the study area in significant numbers:

- Water depth within the boundary of PIRO is generally less than 100 ft less than the depth preferred by species like the pygmy whitefish.
- PIRO lacks warm, fertile, shallow bays that are the preferred habitat for a number of nearshore species like carp and redhorse.
- Soft, silty substrate, the preferred habitat for mud puppy, was limited.

Five segments of PIRO's Lake Superior nearshore area, comprising four habitat types, are illustrated in Figure 1. Segments are defined broadly. Diverse physical habitats are present within each segment. For example, "high fish diversity embayment" (#1) is characterized by shallow and relatively warm water, however segment #1 included habitat 150 ft deep, and was the only segment with habitat deeper than 60 ft.

### **ACKNOWLEDGEMENTS**

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Figure 1. Pictured Rocks National Lakeshore Fish Species Inventory. Study area of Lake Superior waters under PIRO jurisdiction (from shoreline out 0.25 mi.) Habitat Diversity Segments (strata) by code number.



**Table 1. Pictured Rocks National Lakeshore fish species inventory, nearshore waters of Lake Superior, 2002. Total fish catch for project, all species and gear types.**

<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>
Longnose sucker	535	480	41	287.48
Trout-perch	245	103	44	80.55
Rainbow trout (Steelhead)	210	670	99	404.70
Lake chub	197	236	88	132.89
White sucker	101	593	75	373.88
Longnose dace	79	100	46	69.31
Round whitefish	70	415	108	268.93
Ninespine stickleback	65	93	37	49.74
Logperch	60	105	74	90.00
Yellow perch	42	279	24	87.93
Slimy sculpin	31	82	24	46.34
Splake (brook trout x lake trout)	14	475	235	357.00
Coho salmon	13	558	105	219.00
Lake whitefish	11	445	339	397.82
Alewife	9	49	38	42.44
Burbot	9	565	45	283.56
Emerald shiner	6	56	44	47.83
Spottail shiner	6	47	19	33.00
Johnny darter	5	68	38	49.80
Mottled sculpin	4	83	49	68.50
Walleye	4	505	398	472.75
Brook stickleback	4	62	27	41.75
Northern pike	1	685	685	685.00
Pink salmon	1	362	362	362.00
Lake herring	1	489	489	489.00
Chinook salmon	1	586	586	586.00
Brook trout	1	391	391	391.00
Blacknose shiner	1	55	55	55.00
Pumpkinseed	1	80	80	80.00

**Table 2. Pictured Rocks National Lakeshore fish species inventory, nearshore waters of Lake Superior, 2002. Total fish catch for project by gear types.**

<b>Gear Type</b>	<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>
16' Bottom Trawl					
	Ninespine stickleback	63	93	37	49.22
	Sculpin	30	82	24	46.34
	Yellow perch	9	65	24	33.67
	White sucker	8	562	75	146.5
	Trout-perch	7	70	44	52.57
	Brook stickleback	3	62	27	42.33
	Johnny darter	3	68	38	48.33
	Mottled sculpin	1	49	49	49.00
	Spottail shiner	1	33	33	33.00
Boat Electroshocker					
	Trout-perch	212	103	67	82.59
	Rainbow trout (Steelhead)	207	546	99	33.00
	Logperch	59	105	80	94.00
	Longnose dace	33	90	71	76.20
	Yellow perch	24	80	52	64.46
	Round whitefish	17	292	108	173.18
	White sucker	15	544	79	271.79
	Spottail shiner	3	47	47	47.00
	Emerald shiner	3	46	44	45.45
	Coho salmon	2	515	158	336.50
	Johnny darter	1	58	58	58.00
	Mottled sculpin	1	82	82	82.82
	Pink salmon	1	362	362	362.00
	Brook trout	1	391	391	391.00
	Lake chub	1	236	236	236.00
	Splake (hybrid)	1	317	317	317.00
Fyke Net					
	Longnose sucker	283	445	97	332.39
	White sucker	59	593	93	442.49
	Lake chub	35	164	116	137.74
	Trout-perch	21	100	85	91.75
	Coho salmon	8	189	105	138.75
	Burbot	4	565	260	407.5
	Round whitefish	3	225	147	182.33
	Rainbow trout	1	670	670	670.00
	Pumpkinseed	1	80	80	80.00
	Walleye	1	398	398	398.00

**Table 2 (continued).**

<b>Gear Type</b>	<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>	
Gill Net (variable mesh sizes)	Longnose sucker	225	480	207	303.00	
	Round whitefish	50	415	242	307.45	
	White sucker	15	497	241	376.00	
	Splake (hybrid)	13	475	235	360.08	
	Lake whitefish	11	445	339	397.82	
	Yellow perch	7	279	224	253.86	
	Walleye	3	505	488	497.67	
	Coho salmon	2	558	378	468.00	
	Rainbow trout (Steelhead)	2	592	412	502.00	
	Lake herring	1	489	489	489.00	
	Chinook salmon	1	586	586	586.00	
	Burbot	1	370	370	370.00	
	Northern pike	1	685	685	685.00	
Modified Windermere Trap	Longnose dace	46	100	46	68.57	
	Lake chub	44	151	88	124.24	
	Longnose sucker	27	124	41	64.92	
	Trout-perch	5	95	73	81.00	
	White sucker	4	254	85	166.00	
	Burbot	4	360	45	138.00	
	Ninespine stickleback	2	70	62	66.00	
	Mottled sculpin	2	83	60	71.50	
	Coho salmon	1	128	128	128.00	
	Logperch	1	74	74	74.00	
	Brook stickleback	1	40	40	40.00	
	Slimy sculpin	1	70	70	70.00	
	Blacknose shiner	1	55	55	55.00	
	Beach Seine	Lake chub	117	116	116	116.00
		Alewife	9	49	38	42.44
Emerald shiner		3	56	47	50.67	
Spottail shiner		2	33	19	26.00	
Yellow perch		2	33	33	33.00	
Johnny darter		1	46	46	46.00	

**Table 3. Pictured Rocks National Lakeshore fish species inventory, 2002. Total fish catch for project by habitat type.**

<b>Habitat Type</b>	<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>
<i>High fish diversity embayment</i>					
	Trout-perch	65	70	44	53.83
	Yellow perch	32	273	33	85.00
	Slimy sculpin	25	82	24	47.25
	White sucker	21	562	75	203.81
	Round whitefish	14	316	108	174.50
	Splake (hybrid)	12	475	310	377.25
	Lake whitefish	11	445	339	397.82
	Johnny darter	5	68	38	49.80
	Ninespine stickleback	5	61	43	49.80
	Emerald shiner	4	56	44	47.75
	Brook stickleback	3	62	27	42.33
	Spottail shiner	3	47	19	33.00
	Longnose sucker	3	411	356	389.33
	Walleye	2	505	488	496.50
	Northern pike	1	685	685	685.00
	Chinook salmon	1	586	586	586.00
<i>High fish diversity rocky point</i>					
	Longnose sucker	89	460	215	284.61
	Round whitefish	28	415	281	312.25
	White sucker	11	497	241	385.91
	Burbot	1	370	370	370.00
<i>Low fish diversity beach</i>					
	Longnose sucker	285	480	41	265.19
	Lake chub	194	164	88	130.89
	Trout-perch	161	103	45	83.16
	Ninespine stickleback	52	93	40	49.98
	Longnose dace	45	100	46	68.95
	Round whitefish	13	415	147	244.58
	White sucker	12	356	83	176.45
	Alewife	9	49	38	42.44
	Yellow perch	7	29	24	25.86
	Rainbow trout (Steelhead)	7	670	213	443.86
	Coho salmon	6	558	128	272.00
	Burbot	6	422	45	257.50
	Mottled sculpin	4	83	49	68.50
	Logperch	4	105	80	94.00
	Slimy sculpin	3	54	34	44.00
	Spottail shiner	3	33	33	33.00

**Table 3 (continued).**

<b>Habitat Type</b>	<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>
<i>Low fish diversity beach, continued</i>					
	Emerald shiner	2	49	47	48.00
	Walleye	2	500	398	449.00
	Pink salmon	1	362	362	362.00
	Brook stickleback	1	40	40	40.00
	Blacknose shiner	1	55	55	55.00
<i>Medium fish diversity cliff face</i>					
	Rainbow trout (Steelhead)	203	546	99	313.33
	Longnose sucker	158	445	207	328.90
	White sucker	57	593	148	472.32
	Logperch	56	74	74	74.00
	Longnose dace	27	87	50	71.57
	Trout-perch	19	74	74	74.00
	Round whitefish	15	335	254	295.67
	Ninespine stickleback	8	65	37	48.13
	Coho salmon	7	378	105	173.57
	Lake chub	3	236	142	174.33
	Yellow perch	3	279	247	264.00
	Splake (hybrid)	2	236	235	235.50
	Mottled sculpin	2	41	37	39.00
	Burbot	2	565	72	318.50
	Slimy sculpin	3	70	70	70.00
	Pumpkinseed	1	80	80	80.00
	Lake herring	1	489	489	489.00
	Brook trout	1	391	391	391.00

**Table 4. Pictured Rocks National Lakeshore fish species inventory, 2002.  
Total fish catch for project by season. Spring catch.**

<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length</b>
Longnose sucker	182	445	97	365.39
White sucker	55	593	109	472.84
Round whitefish	35	406	108	231.03
Coho salmon	11	378	105	161.27
Ninespine stickleback	10	93	40	64.60
Rainbow trout (Steelhead)	7	670	99	404.29
Lake chub	4	236	124	164.00
Slimy sculpin	2	54	44	49.00
Walleye	1	398	398	398.00
Mottled sculpin	1	60	60	60.00
Longnose dace	1	100	100	100.00
Lake herring	1	489	489	489.00
Brook trout	1	391	391	391.00
Brook stickleback	1	40	40	40.00

**Table 5. Pictured Rocks National Lakeshore fish species inventory, 2002.  
Total fish catch for project by season. Summer catch.**

<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length</b>
Longnose sucker	278	460	41	193.55
Trout-perch	245	103	44	80.55
Lake chub	193	151	88	130.85
Longnose dace	70	87	46	68.81
Logperch	60	105	74	90.00
Ninespine stickleback	52	64	37	47.12
White sucker	17	562	148	338.53
Lake whitefish	10	445	339	397.10
Yellow perch	9	33	24	27.44
Round whitefish	7	335	175	287.00
Burbot	6	565	72	283.67
Splake (hybrid)	5	445	235	343.20
Slimy sculpin	2	81	70	75.50
Brook stickleback	2	62	38	50.00
Spottail shiner	2	33	19	26.00
Mottled sculpin	2	83	49	66.00
Pumpkinseed	1	80	80	80.00
Johnny darter	1	46	46	46.00

**Table 6. Pictured Rocks National Lakeshore fish species inventory, 2002. Total fish catch for project by season. Fall catch.**

<b>Fish Species</b>	<b>Number of Fish Captured</b>	<b>Maximum Total Length (mm)</b>	<b>Minimum Total Length (mm)</b>	<b>Average Total Length (mm)</b>
Longnose sucker	75	480	191	274.95
Yellow perch	33	279	52	104.42
White sucker	29	497	75	200.96
Round whitefish	28	415	254	310.43
Slimy sculpin	27	82	24	46.15
Splake (hybrid)	9	475	310	364.67
Alewife	9	49	38	42.44
Longnose dace	8	90	50	68.13
Emerald shiner	6	56	44	47.83
Spottail shiner	4	47	33	40.00
Johnny darter	4	68	38	50.75
Burbot	3	422	45	283.33
Ninespine stickleback	3	49	43	45.67
Rainbow trout (Steelhead)	3	592	213	405.67
Walleye	3	505	488	497.67
Coho salmon	2	558	515	536.50
Northern Pike	1	685	685	685.00
Lake whitefish	1	405	405	405.00
Pink salmon	1	362	362	362.00
Chinook salmon	1	586	586	586.00
Brook stickleback	1	27	27	27.00
Blacknose shiner	1	55	55	55.00
Mottled sculpin	1	82	82	82.00

Table 7. Pictured Rocks National Lakeshore fish species inventory, 2002. Catch per unit of effort (CPUE) summary by gear type/habitat type. Length of shoreline (miles) for each habitat type is as follows: code 1 = 3.45, 2 = 1.87, 3 = 10.22, 4 = 23.34.

**GILL NET**

Habitat Code	Number of Species Captured	Total Fish Captured	Feet of Net Deployed	<sup>1</sup> CPUE
1	12	39	2400	16.25
2	12	129	4400	29.31
3	11	148	3300	44.85
4	6	16	2200	7.27

**16-FOOT TRAWL**

Habitat Code	Number of Species Captured	Total Fish Captured	# Trawl Nights	<sup>2</sup> CPUE
1	16	52	6	8.67
2	No Trawling Effort for Habitat 2			
3	4	7	7	1
4	12	64	17	3.76

**FYKE NET**

Habitat Code	Number of Species Captured	Total Fish Captured	# Net Nights	<sup>3</sup> CPUE
1	No Fyke Net Effort for Habitat Types 1 and 2			
2				
3	10	108	4	27
4	25	309	10	23.77

**WINDERMERE TRAP**

Habitat Code	Number of Species Captured	Total Fish Captured	# Net Nights	<sup>4</sup> CPUE
1	No Windermere Effort for Habitat Types 1 and 2			
2				
3	5	11	4	2.75
4	25	128	12	9.14

**BOAT ELECTROFISHING**

Habitat Code	Number of Species Captured	Total Fish Captured	Seconds Fished	<sup>5</sup> CPUE
1	11	107	5260	20.34
2	No Boat Electrofishing for Habitat Type 2			
3	9	289	6470	47.66
4	15	175	8670	20.18

Table 7 (continued).

**BEACH SEINE**

Habitat Code		Number of Species Captured	Total Fish Captured	# Seine Pulls	<sup>6</sup> CPUE
1		4	6	9	0.67
2	No Beach Seine Effort for Habitat Type 2			0	
3			0	2	0
4		4	128	16	8

<sup>1</sup>CPUE Defined as 1000 feet of gill net fished for 1 overnight set

<sup>2</sup>CPUE Defined as 1 trawl, 5 minute duration

<sup>3</sup>CPUE Defined as 1 net  
night

<sup>4</sup>CPUE Defined as 1 night

<sup>5</sup>CPUE Defined as 1000 seconds of boat electrofishing effort

<sup>6</sup>CPUE Defined as 1 seine haul

**Appendix 1. Lake Superior basin fish species confirmed or considered as possibly to occur in PIRO waters.**

<b>Family</b>	<b>Standard Scientific Name</b>	<b>Standard Common Name</b>
Acipenseridae	Acipenser fulvescens	lake sturgeon
<b><u>1*Clupeidae</u></b>	<b><u>Alosa pseudoharengus</u></b>	<b><u>alewife</u></b>
Clupeidae	Dorosoma cepedianum	American gizzard shad
<b><u>2Catostomidae</u></b>	<b><u>Catostomus catostomus</u></b>	<b><u>longnose sucker</u></b>
<b><u>Catostomidae</u></b>	<b><u>Catostomus commersoni</u></b>	<b><u>white sucker</u></b>
Catostomidae	Moxostoma anisurum	silver redhorse
Catostomidae	Moxostoma macrolepidotum	shorthead redhorse
<b><u>*Cyprinidae</u></b>	<b><u>Clinostomus elongatus</u></b>	<b><u>redside dace</u></b>
<b><u>*Cyprinidae</u></b>	<b><u>Couesius plumbeus</u></b>	<b><u>lake chub</u></b>
Cyprinidae	Hybognathus hankinsoni	brassy minnow
Cyprinidae	Notemigonus crysoleucas	golden shiner
<b><u>*Cyprinidae</u></b>	<b><u>Notropis atherinoides</u></b>	<b><u>emerald shiner</u></b>
Cyprinidae	Notropis cornutus	common shiner
Cyprinidae	Notropis heterodon	blackchin shiner
<b><u>Cyprinidae</u></b>	<b><u>Notropis heterolepis</u></b>	<b><u>blacknose shiner</u></b>
<b><u>Cyprinidae</u></b>	<b><u>Notropis hudsonius</u></b>	<b><u>spottail shiner</u></b>
Cyprinidae	Notropis rubellus	rosyface shiner
Cyprinidae	Notropis stramineus	sand shiner
Cyprinidae	Notropis volucellus	mimic shiner
Cyprinidae	Phoxinus eos	northern redbelly dace
Cyprinidae	Phoxinus neogaeus	finescale dace
Cyprinidae	Pimephales notatus	bluntnose minnow
Cyprinidae	Pimephales promelas	fathead minnow
Cyprinidae	Rhinichthys atratulus	blacknose dace
<b><u>Cyprinidae</u></b>	<b><u>Rhinichthys cataractae</u></b>	<b><u>longnose dace</u></b>
Cyprinidae	Semotilus atromaculatus	creek chub
Cyprinidae	Semotilus margarita	pearl dace
Fundulidae	Fundulus diaphanous	banded killifish
<b><u>Esocidae</u></b>	<b><u>Esox lucius</u></b>	<b><u>northern pike</u></b>
Umbridae	Umbra limi	central mudminnow
Lotidae	Lota lota	burbot, eelpout
Gasterosteidae	Culaea inconstans	brook stickleback
<b><u>*Gasterosteidae</u></b>	<b><u>Pungitius pungitius</u></b>	<b><u>ninespine stickleback</u></b>
Osmeridae	Osmerus mordax	rainbow smelt
Centrarchidae	Ambloplites rupestris	rock bass
Centrarchidae	Lepomis cyanellus	green sunfish
<b><u>Centrarchidae</u></b>	<b><u>Lepomis gibbosus</u></b>	<b><u>pumpkinseed</u></b>
Centrarchidae	Lepomis macrochirus	bluegill
Centrarchidae	Micropterus dolomieu	smallmouth bass

Appendix 1 (continued).

<b>Family</b>	<b>Standard Scientific Name</b>	<b>Standard Common Name</b>
Centrarchidae	Micropterus salmoides	largemouth bass
Centrarchidae	Pomoxis nigromaculatus	black crappie
Moronidae	Morone chrysops	white bass
Percidae	Etheostoma exile	Iowa darter
<b>Percidae</b>	<b>Etheostoma nigrum</b>	<b>johnny darter</b>
<b>Percidae</b>	<b>Perca flavescens</b>	<b>yellow perch</b>
<b>Percidae</b>	<b>Percina caprodes</b>	<b>logperch</b>
<b>Percidae</b>	<b>Stizostedion vitreum</b>	<b>walleye</b>
<b>*Percopsidae</b>	<b><u>Percopsis omiscomaycus</u></b>	<b><u>trout-perch</u></b>
Petromyzontidae	Ichthyomyzon fossor	northern brook lamprey
Petromyzontidae	Ichthyomyzon unicuspis	silver lamprey
Petromyzontidae	Lampetra appendix	American brook lamprey
Petromyzontidae	Petromyzon marinus	sea lamprey
<b>Salmonidae</b>	<b>Coregonus artedii</b>	<b>lake herring</b>
<b>*Salmonidae</b>	<b><u>Coregonus clupeaformis</u></b>	<b><u>lake whitefish</u></b>
Salmonidae	Coregonus kiyi	kiyi
<b>Salmonidae</b>	<b>Oncorhynchus gorbuscha</b>	<b>pink salmon</b>
<b>Salmonidae</b>	<b>Oncorhynchus kisutch</b>	<b>coho salmon</b>
<b>Salmonidae</b>	<b>Oncorhynchus tshawytscha</b>	<b>chinook salmon</b>
Salmonidae	Prosopium coulteri	pygmy whitefish
<b>*Salmonidae</b>	<b><u>Prosopium cylindraceum</u></b>	<b><u>round whitefish</u></b>
<b>Salmonidae</b>	<b>Salmo gairdnerii</b>	<b>rainbow trout/steelhead</b>
Salmonidae	Salmo trutta	brown trout
<b>Salmonidae</b>	<b>Salvelinus fontinalis</b>	<b>brook trout</b>
<b>Salmonidae</b>	<b>Salvelinus fontinalis X namaycush</b>	<b>splake</b>
<b>Salmonidae</b>	<b>Salvelinus namaycush</b>	<b>lake trout</b>
<b>Cottidae</b>	<b>Cottus bairdii</b>	<b>mottled sculpin</b>
<b>*Cottidae</b>	<b><u>Cottus cognatus</u></b>	<b><u>slimy sculpin</u></b>
Cottidae	Cottus ricei	spoonhead sculpin
Cottidae	Myoxocephalus quadricornis	fourhorn sculpin
Ictaluridae	Ictalurus melas	black bullhead
Ictaluridae	Ictalurus natalis	yellow bullhead
Ictaluridae	Ictalurus nebulosus	brown bullhead
Percidae	Gymnocephalus cernuus	ruffe

1 Asterisk indicated new confirmation of species at PIRO (inland and Lake Superior)

2 Species in bold were confirmed in Lake Superior waters under PIRO jurisdiction in this study

**APPENDIX 1 (continued).**

**References used to construct list of possible and confirmed species in PIRO waters.**

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