Portage Lake
Manistee County (T23N, R16W, Sections 22, 25-28, 33-36)
Last surveyed May 2009

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Environment

Portage Lake is a natural lake formed during the Wisconsin glacial stage (10,000 to 75,000 years ago) that is surrounded by a 15,808-acre watershed (Figure 1) in western Manistee County, in the northwestern Lower Peninsula of Michigan. Portage Lake is 2,110 acres (Figure 2), and the majority of the shoreline is residentially developed. The Village of Onekama lies on the northeastern shore of the lake and contains the majority of the commercial development in the watershed. Approximately 10-15% of the shoreline has been modified with bulkheads, 20-25% remains as undeveloped wetlands, and the remainder is residentially developed (Tonello 2000). Shoal areas less than 20 feet deep account for much of the area of the lake (65%), and depths of up to 60 feet deep can be found in each of the two basins (Tonello 2000). Bottom substrate is mostly sand, gravel, and marl.

Most of the land in the watershed is privately owned. The area immediately surrounding the lake is a mix of residential and commercial land, and the surrounding area is composed of deciduous forests and an agricultural mix of crops and grass rangeland (Figure 3). The land in the watershed is rolling hills comprised of sandy, well drained Kalkaska series soils (Tonello 2000). Adjacent to Portage Lake are some wetlands consisting of organic soils and old dune formations near Lake Michigan (Tonello 2000).

Portage Lake is considered to be a "drowned river mouth lake" because of its original connection to Lake Michigan, Portage Creek, which no longer exists. Portage Creek was a winding, fast-flowing stream located approximately one mile north of where the channel is today (Chaney 1960). According to Chaney (1960), a dam had been built on Portage Creek in the late 1860's to provide water power for lumber mill operations. This dam caused water levels in Portage Lake to rise by up to 6 feet in a peaking operation and flooded riparian lands. Riparians, frustrated with their lands being flooded, took the mill operation to court and won their case. The mill refused to cease the peaking operations, so in May of 1871 the riparians began to dig a ditch connecting Portage Lake to Lake Michigan in an effort to reclaim their flooded lands and put the mill out of business (Chaney 1960). Once the digging was complete, the barrier holding the water of Portage Lake was removed, and water began rushing out into Lake Michigan. By the time the water had slowed, the new connection to Lake Michigan was 500 feet wide and 12 feet deep. Prior to the mill dam being constructed, the level of Portage Lake was reported to be 4-5 feet higher than that of Lake Michigan, however when the channel rushed open the Portage Lake level dropped to the level of Lake Michigan.

Portage Lake is fed by twelve small groundwater-fed tributaries (Figure 4), most of which are designated trout streams. In 1966, the Michigan Department of Natural Resources (MDNR) Surface Water Quality Division (SWQD)collected brook trout in an unnamed tributary, McCormick's, Glenn, Hansen, Schimke, and Dare creeks. They also collected rainbow trout and brown trout in Schimke Creek (the largest of the Portage Lake tributaries). In 1993 the Michigan Department of Environmental Quality (MDEQ) collected brook, brown, and rainbow trout in Schimke Creek (Walterhouse 1994).

Brook trout were also documented in the 1966, 1987, 1988 SWQD and 2000 MDNR surveys of McGowen's Creek (Creal 1987, Sayles 1988) and low numbers of Coho salmon smolts were collected in the 1987 and 1988 SWQD surveys (Creal 1987, Sayles 1988).

Water quality conditions in Portage Lake were most recently surveyed by the Michigan Department of Natural Resources and Environment (MDNRE) on August 6, 2009. Data was collected from one station in middle of the lake, off of Eagle Point. Secchi disk depth was 9 feet. Surface temperature was 71º F and a thermocline was identified at 26 feet, where the temperature dropped to 69º F. The temperature continued to gradually drop to a depth of 46 feet where the temperature remained a constant 60º F to the bottom (54 feet). The pH ranged from 8.7 at the surface, to 7.9 at 32 feet, and 7.5 at the bottom. Dissolved oxygen levels were between 8.7 ppm and 8.0 ppm from the surface to a depth of 26 feet. At 32 feet dissolved oxygen levels had declined to 5 ppm, and dissolved oxygen continued to decline with depth, reaching 0.14ppm at 54 feet.

Water quality conditions were also surveyed on July 29, 1999. Data was collected at one station. Secchi disk depth was recorded at 12 feet, and the water was described as moderately clear and colorless. Alkalinity through the water column ranged from 132 ppm to 135 ppm. Temperatures remained stable near 79º F from the surface down to about 20 feet. A broad thermocline was detected between 20 and 40 feet where the temperature dropped to 61º F. Beyond the thermocline, the temperature gradually decreased to 59º F near the bottom (50 feet). The pH ranged from 8.9 at the surface, to 8.5 at 25 feet, and 7.7 at the bottom. Dissolved oxygen levels were between 10 ppm and 9 ppm from the surface to a depth of 15 feet. At 20 feet dissolved oxygen levels had declined to 7.8 ppm, to 6.6 ppm at 25 feet, 3.4 ppm at 30 feet, and 2.0ppm at 35 feet.

On August 6, 1976 water quality data was collected at two stations. Station 1 was in the western end in 57 feet of water, and Station 2 was in the middle of the lake off of Eagle Point in 54 feet of water. No Secchi disk readings were collected, but water color was recorded as clear for both stations. At Station 1, water temperature was 67º F at the surface down to a depth of 16 feet. There was a thermocline present between 23 and 33 feet, where the temperature dropped from 61º F to 51º F before finally stabilizing at 48º F below 43 feet. At Station 2, water temperature was 68º F at the surface down to a depth of 16 feet. Here the temperature began to incrementally decrease, reaching 55º F at 33 feet and finally reaching 54º F at 52 feet. At both stations, pH levels were nearly identical, ranging from 8.5 at the surface to 7.5 near the bottom. Dissolved oxygen concentrations for the two stations were also very similar, with the exception that the surface reading at Station 1 was 9 ppm and the surface reading for Station 2 was 8 ppm. Both stations decreased to 1 ppm between 52 and 55 feet in depth. Alkalinities varied slightly, with Station 1 ranging from a surface alkalinity of 137 ppm to 86 ppm at 55 feet, and Station 2 ranging from a surface alkalinity of 120 ppm to 86 ppm at 52 feet.

These three sets of water quality data are very similar, indicating that over time the water chemistry in Portage Lake has changed very little. Minor fluctuations in the pH, dissolved oxygen levels, and temperature profile are present but may be due to the fact that the samples from 1999 were collected in July, but the samples from 2009 and 1976 were collected in August. This may have given the lake more time to stratify before the data was collected in those years.

There are currently two community-based organizations that play active roles in the management of the Portage Lake watershed, the Portage Lake Association (PLA) and the Portage Lake Watershed

Forever Plan (PLWFP) Committee. The Portage Lake Association is an organization designed to promote the health and welfare of Portage Lake and its surrounding area. One of the PLA's most recent projects included a shoreline survey conducted in 2009 to address the colonization of an invasive macrophyte species. The Portage Lake Watershed Forever Plan is a community driven effort started in 2006 with the goal of developing a watershed plan for use as a "living document that will ensure the wise use and enjoyment of the Portage Lake watershed for present and future generations" (Public Sector Consultants 2008). This plan was approved by the MDEQ in 2008, and has opened the door for state and federal funding to be obtained for projects within the watershed.

The introduction of non-native macrophyte species is a management issue on Portage Lake. Phragmites (Phragmites australis) and Eurasian water milfoil (Myriophyllum spicatum) have recently been identified by the Portage Lake Association as species that need to be controlled. The PLA, along with Onekama Township, began implementing a chemical treatment program for these two species in the fall of 2009. Native bulrushes and cattails inhabit near-shore areas and waters less than 3 feet, and curly-leaf pondweed (Potamageton crispus) and coontail (Ceratophyllum sp.) predominate in weed beds from 5-15 feet deep (Tonello 2000). Other aquatic plants found in the watershed include non-native purple loosestrife (Lythrum salicaria), native chara (Chara sp.), and wild celery (Vallisneria americana).

Portage Lake is a very popular recreational lake for pleasure boaters and anglers alike. Because it is connected to Lake Michigan, it is a popular harbor for transient sailboats, personal watercraft, pleasure boats, and fishing boats. Several Lake Michigan charter boats operate out of the port of Onekama. During the summer months Portage Lake is a popular lake for area sportsman's groups to hold bass tournaments, and in the winter months Portage Lake is a very popular ice fishing lake. There are two public boat launches on Portage Lake, a MDNRE-owned boat launch in the northwest corner of the lake, and a launch owned by the Village of Onekama on the north side of the lake. The Village of Onekama launching facility has a universally accessible fishing pier.

History

Until the early 1970's very little documented fisheries management occurred on Portage Lake. In 1952 the Michigan Department of Conservation (precursor to the MDNRE) installed 70 brush shelters, mostly on the eastern end of the lake, for the purpose of "concentrating the rock bass and smallmouth bass" (Michigan Dept. of Conservation, unpublished data). From 1929 to 1964 sporadic stocking of bluegill, smallmouth bass, and rainbow trout occurred, but with no documented evidence of success (Table 1).

When the Great Lakes salmon fishery became established in the early 1970's, stocking in Portage Lake became much more consistent. The primary goal of these salmon plants was to create a fishery in Lake Michigan, but they also produced seasonal salmon angling opportunities in Portage Lake itself. Coho salmon stocking began in 1971 (Table 2), and throughout the rest of the decade coho stocking ranged between 100,000 and 270,000 fish annually. In the 1980's coho stocking was reduced, ranging from 165,000 in 1980 to between 50,000 and 100,000 through 1989. In the 1990's and 2000's coho stocking was sporadic, and occurred annually from 1990-1993, in 1996 and 1997, annually from 1999-2003, and in 2006. The number stocked ranged from 47,000 to 55,000 annually. Chinook salmon

stocking began in 1974 (Table 2), and through the 1990's Chinook stocking ranged from 25,000 to 125,000 annually. Throughout the 2000's numbers stocked remained steady at around 50,000. In 2006, Chinook salmon stocking was discontinued in Portage Lake as part of a lakewide reduction in salmon stocking. The 2006 Chinook salmon stocking reductions were an effort to restore a sustainable predator-prey balance in Lake Michigan by reducing the predatory pressure on alewives, which are the primary food source for Chinook salmon. Although the Chinook salmon stocking cut is likely permanent, coho salmon stocking resumed in Portage Lake in 2010.

Brown trout were first stocked in Portage Lake in 1977 (Table 3), and have been stocked at rates from 10,000 to 15,000 annually since 1983. During the 1980's fall fingerling brown trout were also stocked, though it was never known if these fish contributed to the fishery. Similar to salmon, many of the brown trout that are planted into Portage Lake migrate out to Lake Michigan and provide pier and boat fishing opportunities. Brown trout are often caught by anglers trolling in the deeper western end of the lake, particularly in the late spring when alewives migrate into Portage Lake to spawn.

Lake trout were only stocked in Portage Lake once. In 1989 the MDNRE stocked 174,000 fall fingerlings (Table 3).

Salmonid populations in the Portage Lake watershed have been primarily maintained through stocking, however in some years there may have been some limited natural reproduction occurring in the watershed. Some of the tributaries to Portage Lake have spawning habitat that could be used by coho salmon, Chinook salmon, and steelhead. In the late 1980's, two SWQD surveys of McGowan's Creek (Figure 4) found juvenile coho salmon present, along with brook trout (Creal 1987, Sayles 1988). Development of a golf course (Links of Portage) was extremely detrimental to the salmonid spawning and rearing habitat found in McGowan's Creek and caused significant sedimentation (Sayles 1988). Subsequently, no coho salmon were captured in the 2000 MDNR survey of McGowan's Creek (Mark Tonello-MDNRE, unpublished data). Schimke Creek has the largest amount of potentially suitable spawning habitat.

Walleye may be native to Portage Lake but were sparse until stocking by the MDNR began in 1987 and 1988 (Table 4). Walleye have been stocked into Portage Lake at rates of 14,364-104,150 annually since 1990, with the exceptions of 1991, 1994, and 2007. This stocking program has supported a very popular walleye fishery.

The first fisheries survey of Portage Lake was a gill net and nighttime spearing survey which was conducted on July 27-29, 1948. Seven gill nets were set, and a spearing effort was focused along the entire south shore. Less than 100 fish were captured, and the survey was fairly inconclusive. Species captured included yellow perch, smallmouth bass, bluegill, rock bass, cisco, white sucker, carp, bowfin, walleye, and longnose gar. Of these species, longnose gar was the most abundant with 28 individuals captured.

The next survey occurred in July 1976, and included gill netting, trap netting, and electrofishing. This survey was much more extensive, with over 1,700 fish captured. Twenty-two individual species of fish, as well as "shiners" that were not identified to species were collected in the survey. Alewives were the most abundant species in the catch, with 629 caught in the gill nets alone. Alewives annually migrate into Portage Lake from Lake Michigan to spawn, and some may inhabit the lake year-round.

Pumpkinseed sunfish and bluegill were also abundant in the catch, and redhorse and rock bass were considered common. Other species of panfish caught included black crappie and yellow perch, and all species of panfish exhibited growth rates greater than the State of Michigan averages. Only 14 yellow perch were captured in the survey, however all exhibited above average growth rates and individuals up to 14 inches in length were recorded. Migration of yellow perch into Portage Lake from Lake Michigan is common, especially during the spawning period (Schneider et al. 2007).

Game fish captured in the 1976 survey included largemouth bass, smallmouth bass, northern pike, and brown trout. Three brown trout were caught, one of which weighed 14 pounds, 13 ounces. Largemouth bass up to 18 inches, smallmouth bass up to nearly 17 inches, and northern pike up to 32 inches long were also caught. Additional species abundant in the catch in large numbers included brown bullhead, bowfin, common carp, and white sucker. Less common species included cisco, lake whitefish, menominee whitefish, gizzard shad, shiners, quillback carpsucker, and rainbow smelt. Walleye, although present in the 1948 survey, were notably absent from the 1976 survey.

A third survey of Portage Lake occurred in June 1999 (Tonello 2000), and included the use of trap nets, experimental inland gill nets, and one small mesh fyke net, for a total effort of 20 net-nights. The primary purpose of this survey was to evaluate walleye stockings. Panfish species such as rock bass, yellow perch, bluegill, and pumpkinseed sunfish comprised the majority of the fish sampled in this survey. Rock bass were the most numerous species caught, with 339 individuals from 2 to 11 inches in length. Yellow perch were also abundant in the survey, with 232 individuals ranging from 4 to 12 inches caught. Bluegill and pumpkinseed sunfish were observed in moderate numbers with 119 bluegill caught, ranging from 4 to 9 inches in length. Though not as many were caught in 1999 as were caught in 1976, bluegill growth rates were good and exceeded the State of Michigan average.

Game species collected in 1999 included northern pike, largemouth bass, smallmouth bass, and walleye. Although only eight northern pike were collected, six were age-4 whose size-at-age exceeded the State average by 1 inch. Of the 17 walleye captured, over half were age-2 with a length-at-age 2.3 inches above the State of Michigan average. Largemouth bass and smallmouth bass numbers were lower in the 1999 survey than in the 1976 survey. The 1999 survey did not involve electrofishing, only trap, gill, and fyke nets which are generally not as effective for catching bass. Anglers have historically indicated good numbers of both largemouth and smallmouth bass; therefore the bass numbers observed in the survey may not be representative of the populations in Portage Lake. Additional species captured were brown bullhead, yellow bullhead, shorthead redhorse, golden redhorse, common carp, hybrid sunfish, bowfin, and white sucker.

Serns Index (fall electrofishing) surveys were conducted in 2005, 2006, 2008, and 2009 by the Little River Band of Ottawa Indians (LRBOI), and in 2007 by both the LRBOI and the MDNR (Table 5). The purpose of these surveys was to evaluate year class strength for young-of-the-year and yearling walleye, and followed protocols outlined by Serns (1982, 1983). In 2005 a total of 56 walleye ranging in size from 6 to 11 inches were caught, and of these 37 were age-0 walleye. (LRBOI, unpublished data). This catch results in a year class strength estimate of 2624.8 fish, and a Serns Index of 1.24 age-0 walleye per surface acre (Table 5). In 2006 a total of 23 walleye ranging in size from 7 to 14 centimeters were caught, and of these 5 were age-0 walleye (LRBOI, unpublished data). This catch results in a year class strength estimate of 333.2 fish, and a Serns Index of 0.158 age-0 walleye per surface acre (Table 5). In 2007 the LRBOI survey caught a total of 58 walleye, 57 of which were age-0

(LRBOI, unpublished data). This catch resulted in a year class strength estimate of 5,778.9 fish, and a Serns Index of 2.74 age-0 walleye per surface acre. The 2007 MDNR survey caught a total of 14 walleye ranging in size from 7 to 27 inches, with 13 age-0 walleye (MDNRE, unpublished data). This catch resulted in a year class strength estimate of 1,318 fish, and a Serns Index of 0.63 age-0 walleye per surface acre. In 2008 a total of 89 age-0 walleye were collected which resulted in year class strength of 6,462 fish and a Serns index of 3.063age-0 walleye per surface acre. In 2009, 26 age-0 walleye were collected, resulting in a year class strength estimate of 1,888 fish and a Serns Index of 0.895 age-0 walleye per surface acre. Based on the Serns Index, which looks at the number of walleye per acre, all of these year classes are ranked as "poor" (Serns 1982 and 1983). Although the Serns Index is a good way to assess the potential size of walleye year classes in Michigan lakes, the model should be used with caution as the index may be less accurate when used with populations outside of the original study site in Wisconsin (Serns 1982). The Serns Index results for Portage Lake are considered low, however these numbers may represent the average for Portage Lake due to the differences in water chemistry and lake morphology between Michigan lakes and the Wisconsin lakes used to create the model.

In the years 1987-88 and from 1992 to the present, there has been a MDNRE Creel Census Clerk stationed at the port of Onekama to monitor the non-charter sport fishery of Lake Michigan. Since 2000, the average number of angler hours spent by recreational pier, shore, and boat anglers on Lake Michigan from the port of Onekama was 33,617 hours per year (MDNRE Fishing Report System). Chinook salmon comprised the largest percentage of the Lake Michigan sport catch, with 2,323 to 7,327 fish harvested annually from 2000 to 2007 (MDNRE Fishing Report System). Total trips to Lake Michigan made by recreational anglers in the years 2000 to 2007 was 66,054 (MDNRE Fishing Report System). In addition, between 110 and 207 charter boat trips per year were made out of this port from 2000 to 2008 (MDNRE Fishing Report System). These estimates do not include anglers fishing on Portage Lake itself, but shows the popularity of Lake Michigan fishing excursions out of Portage Lake.

Starting in 2007, it was decided that the Creel Census Clerk would also be responsible for monitoring the sport fishery in Portage Lake in order to supplement the Lake Michigan data that was already being collected. Since 2007, the average number of annual angler hours spent by recreational pier/dock and boat anglers on Portage Lake was 22,861 hours per year (MDNRE, unpublished data). In all three years of creel sampling, yellow perch have comprised the largest percentage of the sport catch, followed by bluegill, rock bass, and largemouth bass. Yellow perch harvest ranged from a low of 7,037 fish in 2007 to a high of 18,472 in 2008 (MDNRE, unpublished data). Other species harvested included walleye, northern pike, black crappie, freshwater drum, smallmouth bass, and pumpkinseed sunfish. This creel survey will be continued into the 2010 sampling season.

The MDNRE Fisheries Division Master Angler program has had 95 entries from Portage Lake since 1990. The majority of these entries have been for rock bass, with 44 individuals over 11 inches submitted. Other entries have been for northern pike, channel catfish, bluegill, freshwater drum, largemouth bass, longnose gar, yellow perch, pumpkinseed sunfish, walleye, bowfin, Chinook salmon, round whitefish, common carp, and burbot. Notable entries have included a 18 pound brown trout, a 21pound channel catfish, and three northern pike over 20 pounds.

Current Status

An inland creel survey was conducted on Portage Lake during the summer months from 2007 to the present. During the 2007 season 7,483 angler trips resulted in 29,911 angling hours (Table 6). In 2008, 6,912 angler trips resulted in 27,004 angling hours and in 2009, 3,334 trips resulted in 11,667 angling hours. A mild and windy summer in 2009 may have accounted for some of the reduced effort for that year, as the large fetch of Portage Lake and it's proximity to Lake Michigan can make it difficult to fish under windy conditions. In 2009 the catch was 28,057 fish, down from the catch of 56,601 fish in 2007. Of these, yellow perch comprised 62% of the total catch with 8,134 harvested and 9,255 released. Bluegill was also a popular target species, making up 14% of the total catch with 620 harvested and 3,382 released. Additional game fish caught in large numbers included rock bass (227 harvested and 1,941 released) and largemouth bass (127 harvested and 2,801 released), as well as some northern pike and walleye.

The most recent Portage Lake fish survey was conducted in 2009 using Status and Trend protocols (Wehrly et al. 2009). Trap nets and inland gill nets were set from May 18 to May 21 for a total of 23 nets nights. Six minnow seine hauls and three 600 second boom shocker electrofishing passes were performed on July 14.

During the 2009 survey a total of 2,266 fish representing 30 species were caught (Table 7). Brown bullhead, rock bass, and sand shiners comprised the largest portion of the catch. A total of 640 brown bullhead made up 28% of the total catch by number, ranging from 8 to 14 inches in length. Additionally, brown bullhead represented 18% of the total catch by weight with 251 total pounds. Rock bass represented 25% of the total catch by number with 561 individuals ranging in size from 3 to 12 inches. Four hundred and sixty-seven sand shiners from 1 to 2 inches were also collected, representing 21% of the total catch by number, but only 0.2% of the total percent by weight.

Game fish caught include yellow perch, northern pike, smallmouth bass, bluegill, walleye, largemouth bass, and black crappie. A total of 83 yellow perch, ranging in size from 2 to 11 inches, represented 4% of the total catch by number. Eighty-one northern pike were caught ranging in size from 15 to 34 inches, with an average length of 22.3 inches. Smallmouth bass represented 8% of the catch by weight, with 56 individuals collectively weighing 116.2 pounds. Forty-seven bluegill representing eight age classes, along with 41 walleye representing seven age classes were also collected.

Most species caught in the May netting survey showed above average growth when compared to Michigan averages (Table 8). Smallmouth bass (ages 2 through 7 and age 9) were all growing above average, and collectively smallmouth bass were 1.8 inches above the state of Michigan average length at age. Fifty-eight walleye from seven year classes were also collected (age -2,-4,-5, -6, and -7 were all growing near the state average lengths at age). Walleye growth was much higher than average, exceeding the state average length at age by 3.7 inches. Not enough (less than five) black crappie or pumpkinseed sunfish were collected from any one inch class to make statistical inferences about their age and growth during the May portion of the survey.

The July electroshocking and seining survey showed almost identical results as the May survey (Table 9). Only age -1 walleye were collected, and they were growing at about the state average, as were the age-1 walleye collected in May. Yellow perch were collected from ages -1,-2,-3,-4,-5, and -7 in May as well as ages -3,-4,-5,-6, and -7 in July. In both surveys yellow perch were found to be growing 0.9 inches below state average length at age. Not enough (less than five) bluegill, largemouth bass,

smallmouth bass, or rock bass were collected from any one inch class to make statistical inferences about their age and growth during the July portion of the survey.

The fish community of Portage Lake has changed in the 33 years since it was first surveyed. Some of the variation observed in these surveys can be attributed to the weather at the time that the surveys were conducted, the month they were conducted in, and variations in the types of gear and amount of effor expended on various surveys. In the surveys conducted in 1976, 1999, and 2009 a total of 38 different species were captured. Of those, eight species were caught only in the 1976 survey (trout perch, brown trout, cisco, lake whitefish, round whitefish, rainbow smelt, black bullhead, and quillback), two species were caught only in the 1999 survey (hybrid bluegill and greater redhorse), and seven species were caught only in the 2009 survey (freshwater drum, round goby, brook silversides, longnose gar, silver redhorse, logperch, and Johnny darter).

Salmonids were not captured in the 2009 or 1999 surveys, although this is most likely because these species are not summer residents of Portage Lake. Salmonids do support a limited spring and fall fishery in Portage Lake as they migrate into the lake in search of spawning habitat. However as Portage Lake has received less salmonid stocking in recent years, anglers have reported catching fewer salmonids. Perch anglers have also noted an interesting trend in recent years. Throughout the summer months, only smaller resident perch are caught. However during the winter months and again after the ice cover thaws, yellow perch appear to move into Portage Lake from Lake Michigan when seeking spawning habitat (Schnieder et al. 2007). Perch fishing for the larger "Lake Michigan" yellow perch can be excellent at times until the water begins to warm in mid-May and the perch begin to move back to Lake Michigan

Analysis and Discussion

The 2009 MDNRE fisheries netting survey showed Portage Lake has a healthy fish population. The species abundance and diversity found in this lake is very similar to nearby drowned river mouth lakes such as Pere Marquette Lake in Mason County and Manistee Lake in Manistee County (MDNRE Fisheries Division, unpublished data). The overall fish population in Portage Lake is highly diverse and dominated by brown bullhead, rock bass, yellow perch, and multiple species of shiners. Portage Lake appears to provide a very good angling opportunity for brown bullhead. They were very abundant in the 2009 survey and had an average length of 12.2 inches. Many individuals were at or above the 14 inch minimum entry length needed for a Master Angler award.

Game fish species were well represented in this survey, and with the exception of yellow perch, all of the game species captured exhibited growth rates above the state average (Tables 8 and 9). Portage Lake appears to have two distinctive perch populations that inhabit the lake at various times of the year. The slower growing resident yellow perch can be found in Portage Lake throughout the year, while the larger faster growing Lake Michigan yellow perch tend to migrate into Portage Lake during the winter months, and back to Lake Michigan in the spring.

Largemouth bass, smallmouth bass, and northern pike were well represented in this survey by number and by size. Thirty-three largemouth bass were collected, and 61% (20 fish) were legal size (14 inches) or above. Fifty-six smallmouth bass were collected and 73% (41 fish) were legal size (14 inches) or

above. Eighty-one northern pike were collected, and 19% (15 fish) were legal size (24 inches) or above, including one that was 34.2 inches long.

One surprising aspect of the 2009 survey was the decline in bluegill and pumpkinseed sunfish collected in comparison to the 1999 fisheries survey. Bluegill declined from a catch of 119 to 47, while pumpkinseed declined from a catch of 103 to 8. This is despite three additional net nights of survey time in the 2009 survey versus the 1999 survey. This sharp decline was also noted in the creel data harvest estimates from 2007 to 2009. Portage Lake has been known to produce excellent catches of these two species at certain times of the year.

Forage fish such as sand shiners, banded killifish, spottail shiners, and spotfin shiners made up almost 25% of the total catch by numbers (Table 5). There appears to be a diverse and abundant prey base for game fish in Portage Lake.

The walleye population in Portage Lake appears to be healthy, even though Serns Index assessments have indicated poor year-class strength. Walleye have been collected in both stocking and non-stocking years, indicating that some natural reproduction is taking place. In Michigan, year-class strength is considered poor if juvenile densities are lower than 11 age-0 fish per acre (Ziegler and Schneider 2000). The highest juvenile density estimate observed in Portage Lake was 3.1 in 2008. Despite this year-class being considered as poor, this ranking may not be applicable to Portage Lake. Sampling methods, such as shoreline distance covered and survey locations have varied from year to year. There appears to be no relationship between the number of walleye fingerlings stocked and the number of age-0 fish collected for any of the years where Serns Index data is available. Adult walleye numbers in Portage Lake are currently sufficient to sustain a consistent fishery, and this is supported by the seven age classes represented in the catch during the 2009 netting survey.

Management Direction

The long term goal for Portage Lake will be to maintain the excellent warmwater and coolwater fish communities that currently exist. Species such as rock bass, yellow perch, largemouth bass, and northern pike should continue to thrive in Portage Lake. None of these species are currently stocked by MDNRE Fisheries Division and they appear to be reproducing well on their own. When walleye are available, Portage Lake should continue to be stocked at the current rate of 25.1 fingerlings/acre or 53,000 annually. In the years that walleye are stocked, a fall Serns Index survey should be completed to access stocking survival.

The movement of species such as walleye, gizzard shad, freshwater drum, and yellow perch from Lake Michigan provides for increased diversity and angling opportunity, as does the migratory movements of salmonids such as coho salmon and brown trout. The next fisheries survey of Portage Lake should be conducted within ten years using the same gear types as used in the 2009 survey, in order to make better comparisons and allow for meaningful analysis of trends in the fish community.

Inland creel surveys should be continued on Portage Lake as long as there is a Great Lakes creel clerk stationed in Onekama. Establishing a long term data set of creel data is essential in understanding the fishing pressure and harvest rates on this popular lake.

Another goal for Portage Lake should be the conservation of any remaining undeveloped riparian areas, most importantly wetland areas. Educating riparian owners in the best management practices for their property is also crucial. These nearshore areas are important habitat for the fish community and are crucial for maintaining the lake's water quality. The marsh area on the eastern end of the lake and the undeveloped shoreline along North Point are two such areas. This goal can be achieved through continuing the cooperative efforts currently underway with the PLA and PLWFP and the implementation of the Portage Lake Watershed Forever Plan.

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Figure 1. The watershed of Portage Lake.

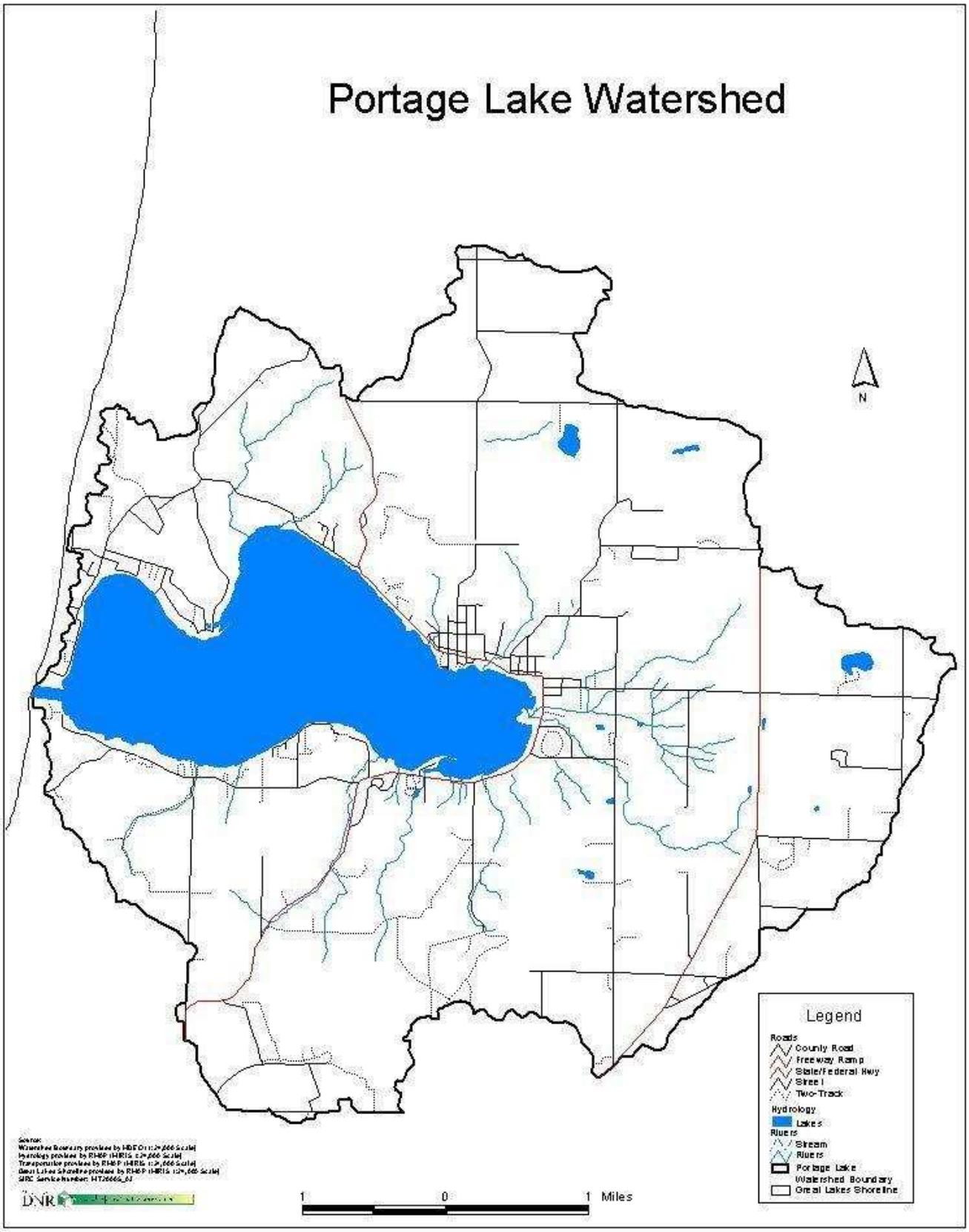
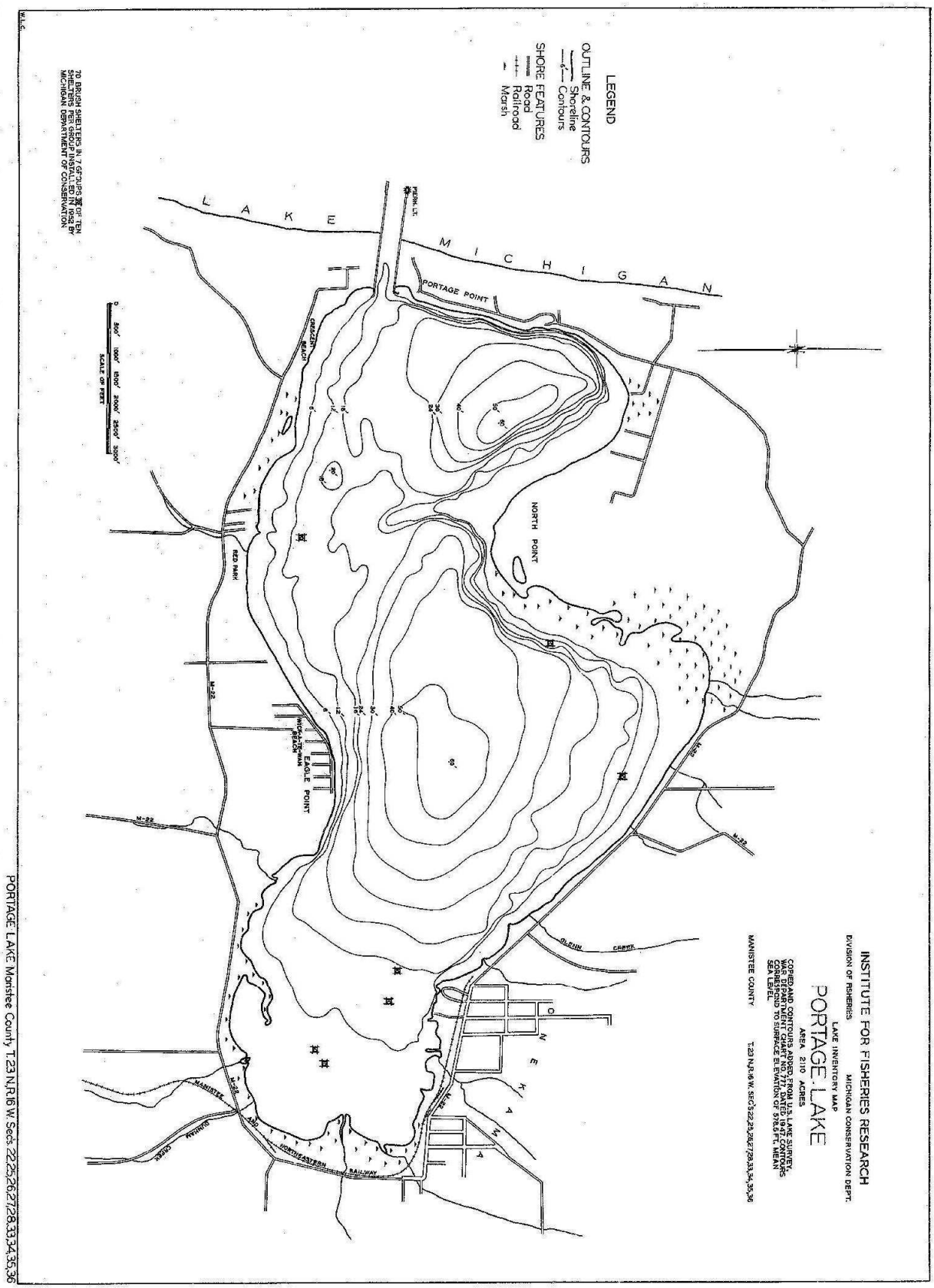


Figure 2. Topographic map of Portage Lake.



PORTAGE LAKE Manistee County, T.23 N.,R.16 W. Secs. 22,25,26,27,28,33,34,35,36

Figure 3. Land use surrounding Portage Lake.

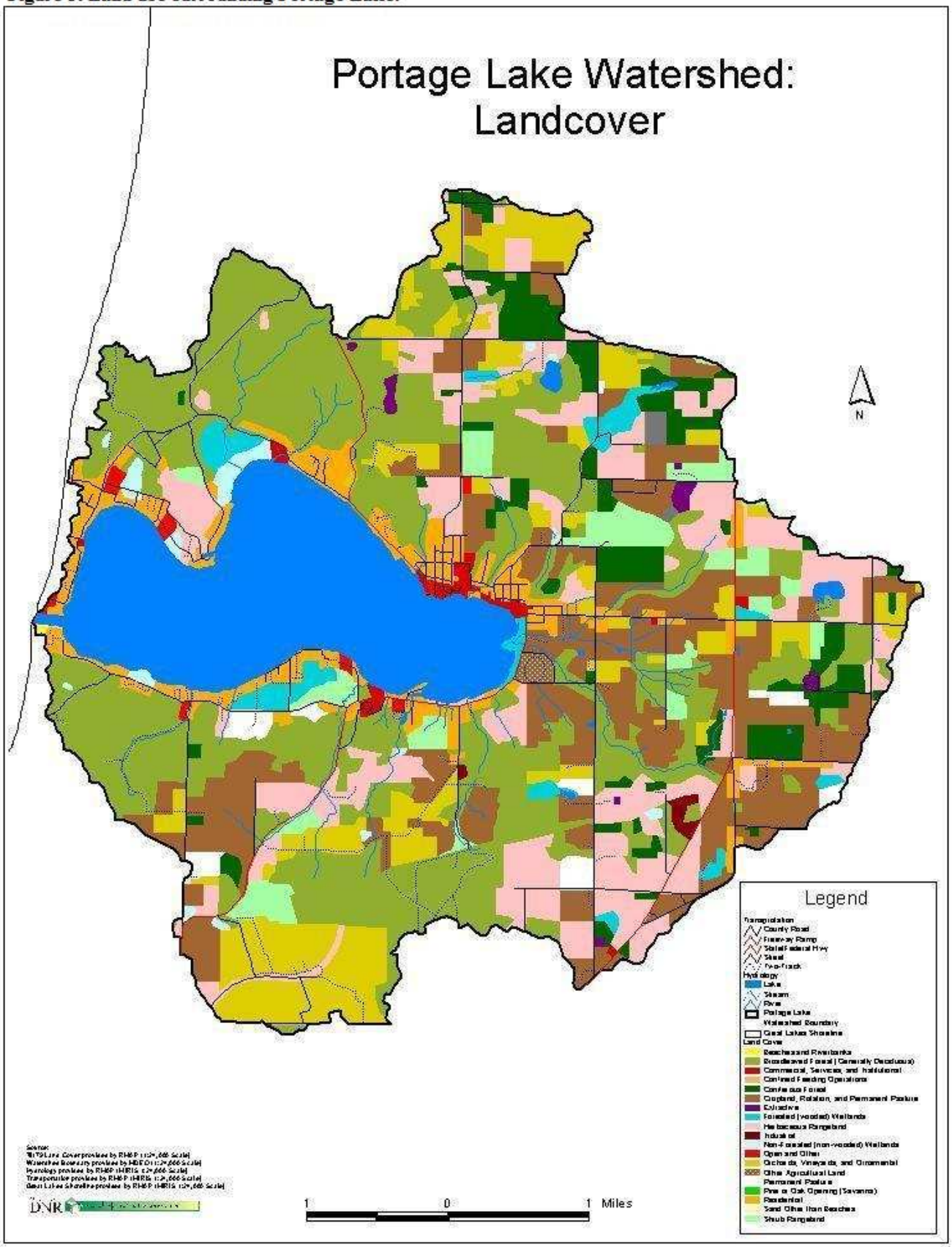


Figure 4. Named tributaries of Portage Lake.

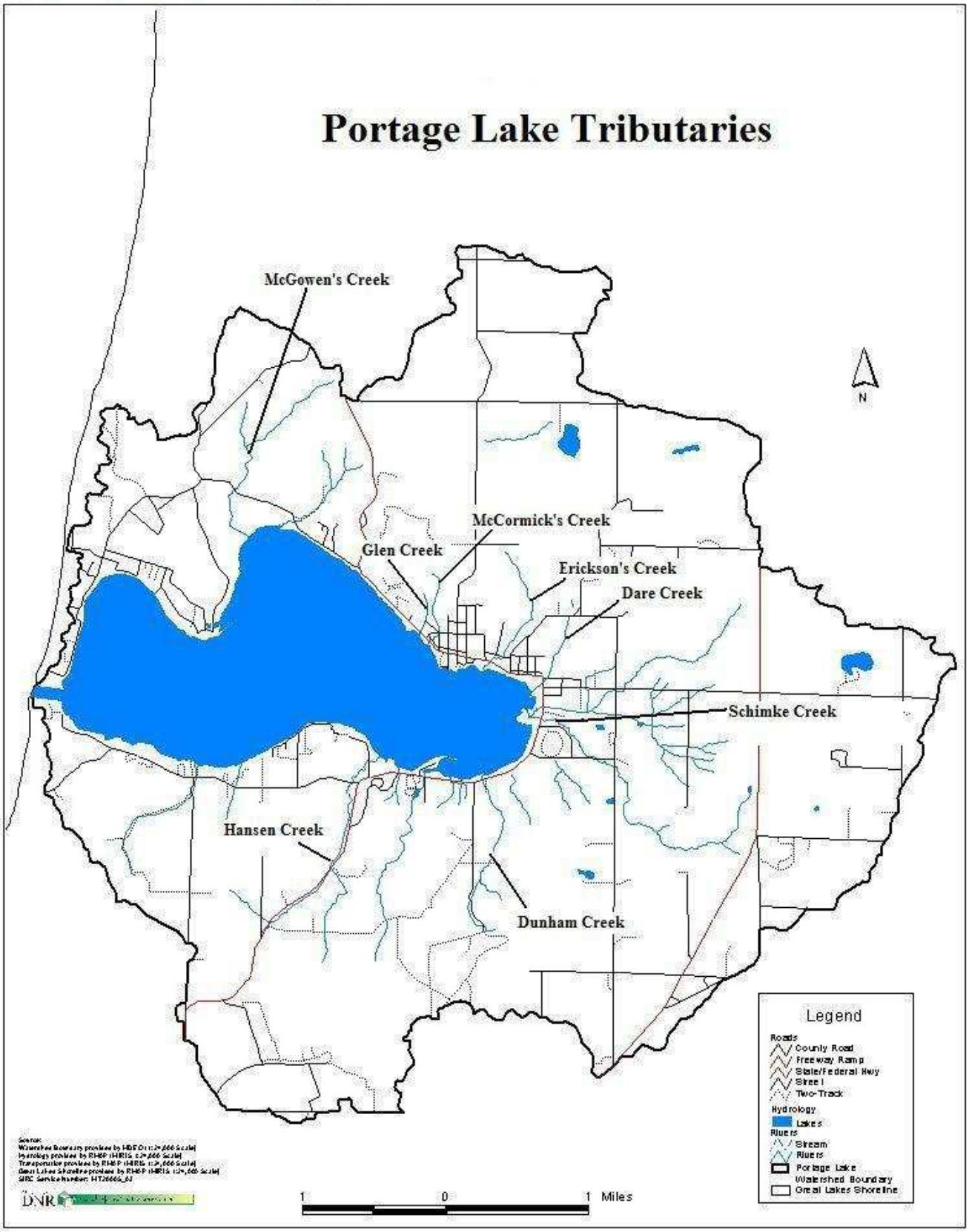


Table 1. Fish stocking in Portage Lake prior to 1970.

Year	Species	Number of Fish	Size
1929	Bluegill	2,400	Unknown
	Smallmouth bass	5,000	Unknown
1931	Bluegill	4,200	Unknown
1957	Rainbow trout	3,000	Legal (7" +)
1958	Rainbow trout	3,600	Legal (7" +)
1964	Rainbow trout	5,000	Legal (7" +)

Table 2. Salmon stocking in Portage Lake, 1971- 2010.

Year	Species	Number of Fish	Size/Strain
1971	Coho	200,000	Yearlings
1972	Coho	200,000	Yearlings
1973	Coho	266,477	Yearlings
1974	Coho	244,653	Yearlings
	Chinook	50,456	Fingerlings
1975	Chinook	51,840	Fingerlings
1976	Coho	151,549	Yearlings
	Chinook	50,374	Fingerlings
1977	Coho	138,809	Yearlings
	Chinook	25,200	Fingerlings
1978	Coho	100,600	Yearlings
	Chinook	50,344	Fingerlings
1979	Coho	150,000	Yearlings *(Michigan)*
	Chinook	50,000	Fingerlings *(Michigan)*
1980	Coho	165,290	Yearlings *(Michigan)*
	Chinook	100,164	Fingerlings *(Michigan)*
1981	Coho	90,013	Yearlings *(Michigan)*
	Chinook	100,000	Fingerlings *(Michigan)*
1982	Coho	45,360	Yearlings *(Michigan)*
	Chinook	100,768	Fingerlings *(Michigan)*
1983	Chinook	100,000	Fingerlings *(Michigan)*
1984	Chinook	125,010	Fingerlings *(Michigan)*
1985	Chinook	75,000	Fingerlings *(Michigan)*
1986	Chinook	75,007	Fingerlings *(Michigan)*
1987	Coho	41,811	Yearlings *(Michigan)*
	Chinook	78,896	Fingerlings *(Michigan)*
1988	Coho	50,009	Yearlings *(Michigan)*
	Chinook	55,000	Fingerlings *(Michigan)*
1989	Coho	50,022	Yearlings *(Michigan)*
	Chinook	77,290	Fingerlings *(Michigan)*
1990	Coho	32,007	Yearlings *(Michigan)*
	Chinook	82,543	Fingerlings *(Michigan)*
1991	Coho	49,503	Yearlings *(Michigan)*
	Chinook	62,937	Fingerlings *(Michigan)*
1992	Coho	50,339	Yearlings *(Michigan)*
	Chinook	75,023	Fingerlings *(Michigan)*
1993	Coho	50,020	Yearlings *(Michigan)*
	Chinook	67,500	Fingerlings *(Michigan)*
1994	Chinook	72,695	Fingerlings *(Michigan)*
1995	Chinook	100,010	Fingerlings *(Michigan)*
1996	Coho	50,008	Yearlings *(Michigan)*
	Chinook	82,805	Fingerlings *(Michigan)*
1997	Coho	50,040	Yearlings *(Michigan)*
	Chinook	64,390	Fingerlings *(Michigan)*
1999	Coho	55,000	Yearlings *(Michigan)*
	Chinook	48,704	Fingerlings *(Michigan)*
2000	Coho	55,000	Yearlings *(Michigan)*
	Chinook	49,245	Fingerlings *(Michigan)*
2001	Coho	55,079	Yearlings *(Michigan)*
	Chinook	49,245	Fingerlings *(Michigan)*
2002	Coho	49,395	Yearlings *(Michigan)*
	Chinook	50,600	Fingerlings *(Michigan)*
2003	Coho	47,000	Yearlings *(Michigan)*
	Chinook	49,115	Fingerlings *(Michigan)*
2004	Chinook	49,018	Fingerlings *(Michigan)*
2005	Coho	41,300	Yearlings *(Michigan)*
	Chinook	49,255	Fingerlings *(Michigan)*
2006	Coho	50,001	Yearlings *(Michigan)*
2010	Coho	51,004	Yearlings *(Michigan)*

Table 3. Trout stocking in Portage Lake 1977-2009.

Year	Species	Number of Fish	Size/Strain
1977	Brown trout	20,000	Yearlings
1983	Brown trout	10,000	Yearlings *(Harrietta)*
	Brown trout	20,000	Fall Fingerlings (*Harrietta)*
1984	Brown trout	10,000	Yearlings *(Harrietta)*
	Brown trout	17,000	Fall Fingerlings *(Plymouth Rock)*
1985	Brown trout	9,260	Yearlings *(Harrietta)*
	Brown trout	15,000	Fall Fingerlings
1986	Brown trout	10,000	Yearlings *(Wild Rose)*
	Brown trout	15,000	Fall Fingerlings *(Plymouth Rock)*
1987	Brown trout	10,000	Yearlings *(Soda Lake)*
	Brown trout	9,240	Fall Fingerlings *(Plymouth Rock)*
1988	Brown trout	15,000	Yearlings *(Plymouth Rock)*
1989	Brown trout	15,000	Yearlings *(Soda Lake)*
	Lake trout	174,000	Fall Fingerlings
1990	Brown trout	15,000	Yearlings *(Soda Lake)*
1991	Brown trout	14,700	Yearlings *(Plymouth Rock)*
1992	Brown trout	14,700	Yearlings *(Soda Lake)*
1993	Brown trout	14,900	Yearlings *(Wild Rose)*
1994	Brown trout	14,900	Yearlings *(St. Croix)*
1995	Brown trout	13,300	Yearlings *(Seeforellen)*
1996	Brown trout	12,780	Yearlings *(Wild Rose)*
1997	Brown trout	13,495	Yearlings *(Seeforellen)*
1998	Brown trout	14,550	Yearlings *(Seeforellen)*
1999	Brown trout	15,000	Yearlings *(Seeforellen)*
2000	Brown trout	19,600	Yearlings *(Seeforellen)*
2001	Brown trout	12,621	Yearlings *(Seeforellen)*
2002	Brown trout	13,500	Yearlings *(Seeforellen)*
	Brown trout	1,520	Yearlings *(Wild Rose)*
2003	Brown trout	20,500	Yearlings *(Wild Rose)*
2004	Brown trout	15,000	Yearlings *(Wild Rose)*
2005	Brown trout	16,000	Yearlings *(Seeforellen)*
2006	Brown trout	18,200	Yearlings *(Seeforellen)*
2007	Brown trout	13,000	Yearlings *(Seeforellen)*
2008	Brown trout	16,100	Yearlings *(Gilchrist Creek)*
	Brown trout	1,562	Yearlings *(Seeforellen)*
2009	Brown trout	20,000	Yearlings *(Gilchrist Creek)*

Table 4. Walleye stocking in Portage Lake 1987-2009.

Year	Species	Number of Fish	Size/Strain
1987	Walleye	1,000	Spring Fingerlings
1988	Walleye	100	Spring Fingerlings
	Walleye	2,469	Fall Fingerlings
1990	Walleye	45,400	Spring Fingerlings *(Muskegon)*
1992	Walleye	83,280	Spring Fingerlings (*Bay De Noc)*
	Walleye	1,898	Fall Fingerlings (Bay De Noc)
1993	Walleye	104,150	Spring Fingerlings *(Bay De Noc)*
1995	Walleye	18,147	Spring Fingerlings *(Bay De Noc)*
1996	Walleye	50,115	Spring Fingerlings *(Bay De Noc)*
1997	Walleye	21,103	Spring Fingerlings *(Muskegon)*
1998	Walleye	14,364	Spring Fingerlings *(Muskegon)*
1999	Walleye	52,977	Spring Fingerlings *(Muskegon)*
2000	Walleye	48,864	Spring Fingerlings *(Muskegon)*
2001	Walleye	74,392	Spring Fingerlings *(Muskegon)*
2002	Walleye	48,007	Spring Fingerlings *(Muskegon)*
2003	Walleye	54,746	Spring Fingerlings *(Muskegon)*
2004	Walleye	53,636	Spring Fingerlings *(Muskegon)*
2005	Walleye	64,676	Spring Fingerlings *(Muskegon)*
2006	Walleye	57,793	Spring Fingerlings *(Muskegon)*
2007	Walleye	0**	
2008	Walleye	64,331	Spring Fingerlings *(Muskegon)*
2009	Walleye	61,477	Spring Fingerlings *(Muskegon)*

** Fish production of walleye halted due to detection of VHS in Lake Michigan waters

Table 5. Comparison of Portage Lake Serns Index survey data.

Year	Age	# Walleye captured	Catch rate (# walleye/mile of shoreline sampled)	Year class strength estimate	Serns Index (# walleye/surface acre)
2005 (LRBOI)	Age 0 Age 1	37 15	5.32 2.16	2624.8 882.2	1.244 0.418
2006 (LRBOI)	Age 0 Age 1	5 2	0.67 0.27	333.2 110.5	0.158 0.052
2007 (MDNR)	Age 0 Age 1 Age 14**	13 0 1	2.67 — —	1318 — —	0.625 — —
2007 (LRBOI)	Age 0 Age 1	57 1	11.7 0.21	5778.9 84.1	2.739 0.04
2008 (LRBOI)	Age 0 Age 1	89 10	13.09 1.47	6462 726	3.063 0.344
2009 (LRBOI)	Age 0 Age 1	26 25	3.82 3.68	1888 1815	0.895 0.86

** No Serns constant exists for age-2 and above.

The Little River Band of Ottawa Indians collected Serns data on Portage Lake walleye in 2005, 2006, 2007, 2008 and 2009, while the Michigan Department of Natural Resources collected Serns data in 2007 only.

Table 6. Portage Lake creel survey data 2007-2009.

	2007	2008	2009
Angler Hours	29,911	27,004	11,667
Angler Trips	7,483	6,912	3,334
Walleye	201	259	26
Northern pike	232	176	25
Largemouth bass	210	674	127
Smallmouth bass	79	51	45
Yellow perch	7,037	18,472	8,134
Bluegill	3,865	3,124	620
Pumpkinseed	543	46	0
Rock bass	1,224	1,238	227
Black crappie	126	0	11
Chinook salmon	9	0	0
Coho salmon	16	0	0
Freshwater drum	86	0	6
Other	22	0	7
Harvested	(13,650)	(24,040)	(9,228)
Walleye	394	87	12
Northern pike	3,665	4,222	733
Largemouth bass	5,152	6,312	2,801
Smallmouth bass	1,560	2,704	380
Yellow perch	25,938	26,013	9,255
Bluegill	3,444	4,057	3,382
Pumpkinseed	166	12	122
Rock bass	2,473	6,470	1,941
Black crappie	4	12	0
White sucker	0	0	3
Carp	0	0	5
Bowfin	6	14	3
Freshwater drum	31	77	186
Rainbow trout	6	0	0
Lake trout	22	0	0
Brown bullhead	13	0	0
Chinook salmon	6	0	0
Channel catfish	69	0	0
Other	0	40	6
Released	(42,950)	(50,021)	(18,829)
Total Catch	56,601	74,061	28,057

Table 7. Number, weight, and length of fish collected from Portage Lake with the use of trap nets, inland gill nets, boom shocking, and minnow seines on May 18-21, 2009.

Species	Number	Percent by number	Weight (lbs)	Percent by weight	Length range (inches)	Average length
Alewife	1	0.0%	0.0	0.0%	5	5
Black crappie	7	0.3%	4.8	0.3%	7 to 12	10.4
Banded killifish	27	1.2%	0.2	0.0%	1 to 3	2.5
Bluegill	47	2.1%	13.8	1.0%	3 to 9	7.2
Bowfin	23	1.0%	128.1	9.1%	17 to 30	24.8
Brown bullhead	643	28.2%	251.4	17.9%	8 to 14	12.2
Brook silverside	1	0.0%	0.0	0.0%	1	1.5
Carps and Minnows	5	0.2%	0.0	0.0%	23 to 29	26.5
Common carp	13	0.6%	128.3	9.1%	21 to 30	27.8
White sucker	29	1.3%	92.0	6.5%	17 to 22	20
Freshwater drum	5	0.2%	13.2	0.9%	14 to 22	17.5
Greater redhorse	1	0.0%	5.6	0.4%	25	25.5
Gizzard shad	1	0.0%	1.2	0.1%	14	14.5
Johnny darter	4	0.2%	0.0	0.0%	2	2.5
Largemouth bass	33	1.5%	58.9	4.2%	5 to 18	14.5
Longnose gar	1	0.0%	6.3	0.5%	39	39.5
Logperch	5	0.2%	0.0	0.0%	2 to 3	3.1
Northern pike	81	3.6%	206.7	14.7%	15 to 34	22.3
Pumpkinseed	8	0.4%	3.4	0.2%	4 to 9	7.6
Round goby	24	1.1%	0.0	0.0%	1 to 2	1.8
Rock bass	561	24.8%	215.0	15.3%	3 to 12	7.5
Sand shiner	467	20.6%	2.3	0.2%	1 to 2	2.5
Spotfin shiner	3	0.1%	0.0	0.0%	2 to 3	2.8
Shorthead redhorse	4	0.2%	6.3	0.4%	11 to 21	14.8
Silver redhorse	42	1.9%	90.3	6.4%	9 to 26	18.2
Smallmouth bass	56	2.5%	116.2	8.3%	1 to 20	14.6
Spottail shiner	46	2.0%	0.4	0.0%	1 to 4	2.6
Walleye	41	1.8%	50.2	3.6%	7 to 26	12.8
Yellow perch	83	3.7%	9.2	0.7%	2 to 11	5.9
Yellow bullhead	4	0.2%	3.0	0.2%	11 to 12	11.8
Total	2266	100%	1406.8	100.0%		

Table 8. Average total weighted length (inches) at age and growth relative to the state average for fish sampled from Portage Lake through May creel survey, and with trap nets and inland gill nets on May 18-21, 2009.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean Growth Index
Black crappie	…	…	7.0 (1)	…	9.1 (2)	11.3 (2)	12.4 (1)	12.3 (1)	…	…	…	…	**
Bluegill	…	…	4.7 (3)	6.5 (19)	7.5 (6)	8.5 (2)	8.7 (2)	8.2 (6)	9.2 (3)	9.8 (1)	…	…	0.7
Largemouth bass	…	8.8 (2)	…	13.2 (7)	14.3 (11)	16.4 (6)	17.2 (4)	17.6 (3)	…	…	…	…	1.5
Northern pike	…	18.0 (7)	21.5 (35)	23.7 (25)	26.1 (2)	26.6 (2)	34.2 (1)	…	…	…	…	…	0.4
Pumpkinseed	…	4.0 (1)	…	6.3 (1)	…	7.8 (3)	8.3 (1)	…	9 (2)	…	…	…	**
Rock bass	…	4.4 (9)	5.2 (9)	5.8 (7)	6.8 (15)	8.2 (9)	8.7 (8)	10.0 (8)	10.3 (8)	10.8 (9)	11.4 (5)	11.9 (2)	0.2
Smallmouth bass	…	9.44 (4)	11.8 (4)	15.1 (13)	16.1 (4)	17.6 (8)	18.0 (9)	…	18.9 (5)	…	20.6 (1)	…	1.8
Walleye	7.8 (3)	13.8 (3)	12.5 (3)	19.8 (3)	21.3 (5)	23.0 (1)	25.0 (4)	…	…	…	…	…	3.7
Yellow perch	…	…	5.6 (5)	6.9 (14)	7.2 (6)	8.7 (5)	10.4 (2)	…	…	…	…	…	-0.9

** Mean growth index can only be calculated for age groups with five or more individuals.
(Numbers in parenthesis are the number of fish in the sample for that age)

Table 9. Average total weighted length (inches) at age and growth relative to the state average for fish sampled from Portage Lake with a boom electroshocking boat and minnow seine on July 14, 2009.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	X	Mean Growth Index
Bluegill	…	3.7 (2)	5.0 (1)	7.1 (2)	7.3 (1)	6.9 (1)	…	…	…	…	**
Largemouth bass	5.5 (1)	…	…	…	…	…	…	…	…	…	**
Rock bass	…	…	…	…	…	…	…	11.0 (1)	…	…	**
Smallmouth bass	…	10.3 (4)	…	…	…	…	…	…	…	…	**
Walleye	7.9 (18)	…	…	…	…	…	…	…	…	…	-0.3
Yellow perch	3.3 (3)	4.8 (19)	5.9 (7)	6.3 (1)	7.8 (2)	…	10.1 (1)	…	…	…	-0.9

** Mean growth index can only be calculated for age groups with five or more individuals.
(Numbers in parenthesis are the number of fish in the sample for that age)