

Crystal Lake
Benzie County
Betsie River Watershed, last surveyed 2014

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Environment

Crystal Lake is the ninth-largest inland lake in Michigan, at 9,854 acres. It is located in western Benzie County, just north of the city of Frankfort (Figure 1). The village of Beulah is located along the eastern shore of Crystal Lake, with the village of Benzonia just to the south. Crystal Lake is a deep, oligotrophic lake with a maximum depth of approximately 165 feet and an average depth of 70 feet. Substrates consist primarily of sand and marl. Crystal Lake is part of the Betsie River watershed. An outlet stream flows out of the south shore and directly feeds the Betsie River. Although there is a lake-level control dam on the outlet, jumping migratory fish from Lake Michigan such as salmon and steelhead can clear the dam and enter the lake. At base flow, the outlet discharges approximately 34 cubic feet per second (cfs; Anonymous 2015).

Crystal Lake lies just east of Lake Michigan, approximately ½ mile from the coast. It has a relatively small watershed for a lake of its size, at just over 28,000 acres (Anonymous 2015). This is due to the topography of the landscape surrounding the lake. Directly to the south and north of Crystal Lake are large glacial moraines that reach elevations 200-300 feet higher than that of the lake. Because of this, there are only a few tributaries to Crystal Lake, most of which are very small spring creeks. The surrounding landscape is hilly and mostly forested with northern hardwoods, although there is a large wetland complex located directly east of the lake, locally known as the Trapp Farm. Point Betsie and its associated sand dunes lie directly west of Crystal Lake, and the Sleeping Bear Dunes National Lakeshore lies to the north. There are also a number of fruit orchards and golf courses in the Crystal Lake watershed.

The shoreline of Crystal Lake (approximately 21 miles) is heavily developed with homes and cottages, and boasts some of the highest property values in the region (Anonymous 2015). Crystal Lake is an extremely popular tourist destination, with fishing, boating, sailing, and swimming all being popular activities. The local economies of Frankfort, Beulah, and Benzonia all benefit significantly from Crystal Lake-based tourism.

The largest tributary to Crystal Lake is Cold Creek, which flows into the eastern end of the lake in the village of Beulah (Figure 1). Cold Creek is a Designated Trout Stream that supports migratory runs of Coho Salmon and steelhead from Crystal Lake, in addition to hosting populations of resident Brown Trout and Brook Trout (Tonello 2007). Cold Creek flows through a wetland area known as the Trapp Farm area before entering the Village of Beulah. On the Trapp Farm property, Cold Creek was significantly affected by historical agricultural practices, including ditching, dredging, and stream re-routing. Cold Creek historically had several dams on it, including the Case Dam (a sawmill dam that dated back to the 1800s). Unfortunately, the Case Dam failed in 1973, releasing sawdust and sediment into Cold Creek. A large sediment trap was then constructed on Cold Creek in 1975 (Daniels and Murphy 2003) to keep the sediment and sawdust from reaching Crystal Lake. The basin is

approximately 90 feet by 350 feet and is emptied as needed by the Village of Beulah. The basin continues to intercept sediment, including that coming off the Trapp Farm property.

There are several different opportunities for public access on Crystal Lake (Figure 2). The largest public access site is the Michigan Department of Natural Resources (MDNR) site located off Mollineaux Road on the south shore, just east of Railroad Point. This site was completed in late 2011 and was first open to the public for the 2012 boating season. The site offers four launch ramps, with paved parking for 36 vehicles with trailers and another 20 vehicles without trailers, plus ample unpaved overflow parking. There are also two ADA car/trailer spaces. The Crystal Lake and Watershed Association co-operatively operates a boat-wash station at the site.

The other primary boat launch on Crystal Lake lies in the village of Beulah, on the east end of the lake (Figure 2). That launch has two ramps and parking for 8-10 vehicles and trailers. Also at this site is an accessible fishing pier, which was installed in the summer of 2014. The Beulah beach area is also popular in the spring and fall for surf-style fishing for Rainbow Trout, Lake Trout, and Coho Salmon. Boat launches with parking for a few vehicles and trailers are also available at the end of Lobb Road on the south shore of the lake, and at the end of Nichols Road on the north shore. Although most of the shoreline of Crystal Lake is privately owned and developed, the Railroad Point Natural Area provides nearly 200 acres and over 3,000 feet of undeveloped shoreline. The Natural Area is owned by Benzie County and jointly administered by the Grand Traverse Regional Land Conservancy.

Crystal Lake is a Designated Trout Lake, and is regulated under Type E fishing regulations. This means that Crystal Lake is open to year-round fishing, with a year-round possession season on trout and salmon. The minimum size limits for Lake, Brook, Brown, and Rainbow Trout are 15 inches, while the minimum size limit for Coho or Chinook Salmon is 10 inches. The daily possession limit is 3 trout or salmon of one species or in combination.

The Crystal Lake and Watershed Association (CLWA) is the primary citizen-based advocacy group for Crystal Lake, and is a 501(c)(3) organization. The CLWA was founded in 2004 through the merger of two groups: the Crystal Lake Association and the Crystal Lake Watershed Fund. Both groups originated back in the 1960s (Anonymous 2015). The CLWA supports a number of programs including water quality sampling, landowner education, student education, operation of the boat wash station at the MDNR boat launch and others.

History

Because of its east-west orientation and susceptibility to Lake Michigan winds, Crystal Lake was originally known as "Cap" Lake, referring to the whitecaps which were and still are, very common on the lake (Case 1915, Brown and Funk 1940). Historically the lake level of Crystal Lake was approximately 20 feet higher than it currently is today. In 1873, an ill-conceived project by a local businessman named Archibald Jones to allow steamboat navigation between Lake Michigan and Crystal Lake via the Betsie River went awry. The project called for straightening and dredging the Betsie River and the Crystal Lake outlet stream, but did not take into account the differences in elevation between Crystal Lake and those waterbodies. When the construction crew attempted to enlarge the Crystal Lake outlet, the force of the water took over and carved a large opening that drained the lake down to its current level over the span of approximately two weeks (Case 1915).

The incident caused Crystal Lake to lose approximately 25% of its volume and surface area, reducing its size by approximately 3,093 acres (Anonymous 2012). The current water level is controlled by a dam that is operated by the Benzie County Drain Commissioner. The court mandated legal lake level was set in 1980. The winter level is six inches lower than the summer level, in order to protect infrastructure from ice damage. The sheer volume of water in Crystal Lake combined with the limited ability of the small outlet stream to convey water makes it difficult at times to meet the legally mandated levels.

One historical fisheries issue on Crystal Lake was that of fish (Rainbow Smelt and Rainbow Trout) supposedly exiting the lake through the outlet (Shetter and Reynolds 1942). Several attempts were made at blocking downstream fish passage, but each time the screens were demolished or broken, either by vandalism or natural conditions (storms, ice floes, etc.). Eventually it became clear that downstream migration, if it was occurring, was not having any impact on the overall fish populations in Crystal Lake.

Other fisheries management of Crystal Lake included the installation of brush shelters in 1958 (DNR files, Cadillac) in an attempt to add fish cover. In the 1960s there was some discussion regarding possible installation of a spawning reef for Lake Trout spawning. Eventually this idea was abandoned as impractical and Lake Trout populations continue to be supported by stocking.

Fish Stocking

The first recorded fish stocking in Crystal Lake was in 1890 when Lake Trout were stocked (Table 1). Since then, Crystal Lake has had a long and varied stocking history. Lake Trout were again stocked in 1895, 1897, and 1905. Between 1905 and 1944, various warmwater and coolwater species were stocked, including Largemouth Bass, Smallmouth Bass, Bluegill, and Yellow Perch. Walleye and Warmouth each were stocked in one instance as well. The first successful introduction of Rainbow Smelt in the Great Lakes region occurred in Crystal Lake in 1912 (Van Oosten 1937). It is believed that the Rainbow Smelt populations in the upper Great Lakes originated from fish that migrated out of Crystal Lake and into Lake Michigan (Beckman 1941).

Since 1945, fish stocking in Crystal Lake has been limited to salmonids, primarily Lake and Rainbow Trout (Table 1). Splake, Brown Trout, and Atlantic Salmon were each stocked in a few years. Since 1993, only Lake and Rainbow Trout have been stocked. Recent stocking regimes have consisted of approximately 60,000 yearling Lake Trout and 20,000 yearling Rainbow Trout annually. Surplus fall-fingerling steelhead (a genetic strain of Rainbow Trout) have also been stocked several times in recent years.

Fisheries Surveys

The first fisheries survey of Crystal Lake was conducted in 1940 by the Michigan Department of Conservation (MDOC; the precursor to today's Department of Natural Resources (MDNR)). In that survey (Brown and Funk 1940) the researchers used seines, experimental gill nets, and fyke nets. Yellow Perch absolutely dominated the catch (at 98.3% by number), with most of those taken in the gill nets. Other species caught included Rock Bass, White Sucker, Lake Whitefish, Cisco (Lake Herring), Lake Trout, Burbot, Northern Pike, Bluegill, Rainbow Smelt, Spottail Shiner, Emerald Shiner, Iowa Darter, Johnny Darter, Logperch, and Bluntnose Minnow (Table 2). The researchers also

caught a species they called "straw-colored shiner". There is no species known as "straw-colored shiner", so it is unknown what species they were actually referring to. Burbot, Northern Pike, and Bluegill were each represented by one individual. Other species not caught in the 1940 survey but reported as being observed or caught by anglers in Crystal Lake included Black Crappie, Bullhead, Redhorse, and Smallmouth Bass.

The 1940 survey report (Brown and Funk 1940) marks the first acknowledgement by MDOC that Crystal Lake is best suited to coolwater and coldwater species. To that point, MDOC had been stocking species like Bluegill, Largemouth Bass, Smallmouth Bass, and Yellow Perch (Table 1). The authors correctly pointed out that stocking of Yellow Perch and Smallmouth Bass was unnecessary, as those species would be able to propagate themselves naturally. They recommended halting the stocking of all but coldwater species, and specifically recommended stocking rainbow trout and lake trout.

The next MDOC fisheries survey was conducted in 1948 (MDNR files, Cadillac) by Fisheries Biologist Stanley Lievens. The 1948 survey was a short effort conducted with experimental gill nets and some seining. The only species captured were Yellow Perch, Rock Bass, White Sucker, and Smallmouth Bass, and Rainbow Smelt (Table 2). Another short gill net effort was conducted in 1956, also by Fisheries Biologist Lievens (MDNR files, Cadillac). Species caught in this effort included Lake Trout, Lake Whitefish, Burbot, Yellow Perch, Rainbow Smelt, and White Sucker (Table 2).

In November of 1960, a fyke net effort was conducted on Crystal Lake, the goal of which was to catch Lake Whitefish for stocking into Glen Lake in Leelanau County. Unfortunately, only one Lake Whitefish was captured in the effort, so no transfer was conducted. Other species caught included Rainbow Trout, Cisco, Burbot, and White Sucker (Table 2).

In 1976, several MDNR Fisheries Biologists took note that no recent comprehensive surveys had been conducted on Crystal Lake. In the report (MDNR files, Cadillac), MDNR Biologist Bernie Ylkanen detailed the existing sparse fisheries knowledge of Crystal Lake. He mentioned that Lake Trout and Rainbow Trout fishing were only fair. He mentioned that the Yellow Perch fishery was good year-round. He also discussed the Lake Whitefish fishery, including the good ice fishery, and spring/fall nearshore fishery, and the November/December spear fishery. Laarman (1976) also recommended surveying the lake with appropriate fisheries sampling gear and forming management recommendations from the results.

In response, in June of 1977, MDNR conducted a fisheries survey of Crystal Lake with Great Lakes gill nets (Hay 1980). Species collected included Lake Trout, Lake Whitefish, Cisco, Yellow Perch, Rainbow Smelt, Burbot, White Sucker, and Slimy Sculpin (Table 2). The survey showed robust populations of Lake Trout, Lake Whitefish, and Cisco. The Lake Trout ranged from 10 to 36 inches in length, with nine different age groups represented. Hay surmised that some natural reproduction was occurring, presumably based on the lack of fin clips on some of the Lake Trout from certain age groups. Four different age classes of Lake Whitefish and nine different year classes of Cisco were present in the catch. While the Yellow Perch catch was very numerous, the vast majority was only six inches in length and came from just two year classes. Age and growth analysis indicated that they were growing slowly.

Subsequent fisheries surveys of Crystal Lake were conducted in 1989 (Hay 1989) and 1997 (MDNR files, Cadillac). Like the 1977 survey, these surveys consisted only of Great Lakes gill nets. Large numbers of Lake Trout representing numerous year classes were caught in both surveys. As in 1977, robust populations of Lake Whitefish and Cisco were present, as were large numbers of Yellow Perch. In the 1989 survey, the yellow perch size structure was better (a larger percentage of the catch was over 7 inches), and growth was improved over 1977. However, in 1997, the vast majority of the Yellow Perch catch was smaller than seven inches. The 1989 survey marked the first documentation of Coho Salmon in Crystal Lake (which had never been stocked). Coho Salmon were also present in 1997. Four Rainbow Trout were caught in 1989, and one was caught in 1997. Seven Brown Trout were caught in 1989, and one was caught in 1997. No Atlantic Salmon were caught in either survey.

The next comprehensive fisheries survey of Crystal Lake was conducted in 2003. The 2003 survey was conducted over an extended time period (May through August) and utilized a number of different gear types, including small and large mesh fyke nets, trap nets, inland gill nets, and Great Lakes gill nets. In the 2003 survey, a total of 7,128 fish representing 16 species and weighing nearly 10,000 lbs. were caught (Table 3). By far, White Sucker and Rock Bass were the most numerous species caught. White Suckers comprised 53.6% of the catch by number and 78.6% by weight. Rock Bass comprised approximately 30% of the catch by number and 10.8% of the catch by weight. Other well-represented species included Yellow Perch, Cisco, and Lake Trout. The contrast between the 2003 survey and the previous three surveys was the use of trapping gear (fyke nets and trap nets). The vast majority of the White Suckers and Rock Bass were captured in the fyke nets and trap nets. Age and growth data from the 2003 survey efforts are in Tables 4-6. Some creel census was conducted during the summer of 2003 as well. Although the catch and effort data is unavailable, age and growth data from fish sampled by creel census is included in Tables 4 and 6.

An ice fishing creel census survey was conducted on Crystal Lake in the winter of 2004 (MDNR Fisheries Division unpublished data; Table 7). During the ice season an estimated 31,703 fish were harvested and 9,831 fish were released by ice anglers. Yellow Perch were the most commonly caught species, with 23,916 kept and 9,520 released. Other species encountered during the winter creel survey included Rainbow Trout, Brown Trout, Lake Trout, Cisco, Lake Whitefish, White Sucker, and Rainbow Smelt. The winter 2004 ice fishery on Crystal Lake generated a total estimate of 41,794 angler hours (10,155, angler trips). Based on a value of \$39/day for daily angler expenditures (U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau 2011) the Crystal Lake ice fishery conservatively generates \$400,000 to the local economy on an annual basis.

In the summer of 2004, an experimental hydro acoustic survey was conducted on Crystal Lake. As part of the survey, Great Lakes gill nets were set to help verify the hydroacoustic fisheries data. The verification nets were set May 17-18, and August 16-17, 2004. A total of 136 fish representing eight species were caught in the Great Lakes gill nets (Tables 2 and 8). Age and growth data was collected from the netted fish (Tables 9 and 10). The results of the hydroacoustic survey showed that Crystal Lake had 1,316 fish/hectare. This result is comparable with that of hydroacoustic surveys of other large, oligotrophic inland lakes in Michigan. According to Claramunt (MDNR, unpublished data), Higgins Lake had 1,181 fish/hectare, and the main body of Lake Charlevoix had 836 fish/hectare in similar hydroacoustic surveys that were conducted in 2011.

Although Lake Sturgeon have never been captured in any of the Crystal Lake fisheries surveys, they have been documented in the lake. In 2005 and 2007 we received reports from riparian landowners of several Lake Sturgeon in the shallows of Crystal Lake. The reports were accompanied by photos. Some of the landowners mentioned that they see Lake Sturgeon in the shallows every spring. The Lake Sturgeon observed and photographed included large adults that were possibly exhibiting spawning behavior. The overall population level of Lake Sturgeon in Crystal Lake is unknown, but it must be assumed that natural reproduction is supporting this population.

From 1994-2015, a total of 121 exceptional fish caught from Crystal Lake have been entered into the DNR Fisheries Division Master Angler program (Table 11). The species with the most entries is Rock Bass, with 43 entries. Smallmouth Bass, Rainbow Smelt, and Burbot were also well-represented with more than 20 entries each. Eleven Lake Trout were entered over the years, along with one Brown Trout. The large number of Master Angler entries for Crystal Lake speaks to the popularity and quality of fishing on Crystal Lake.

Current Status

The most recent comprehensive fisheries survey of Crystal Lake was conducted by MDNR in the summer and fall of 2014. The summer netting portion of the survey took place from June 23 through June 27. Survey gear used included four Great Lakes gill nets (15 net-nights), two straight run gill nets (four net-nights), two experimental graded-mesh inland gill nets (six net-nights), and six trap nets (16 net-nights). The fall netting portion of the survey took place from November 5-7, and it included three Great Lakes gill nets (six net-nights), two straight run gill nets (four net-nights), and two large-mesh fyke nets (two net-nights). The primary purpose of this survey was to assess the status of all fish populations in Crystal Lake, with additional focus on the Lake Trout and Rainbow Trout populations.

During the 2014 June netting survey, a total of 4,263 fish were caught, representing 10 different species (Table 12). Rock Bass were the most frequently collected species, with a total of 3,206 caught. They represented 75.2% of the total catch by number and ranged from 3 to over 12 inches in length. Yellow Perch were also numerous in the June catch, with 784 caught, ranging from 4 to 13 inches in length. Other fish species caught in the 2014 June netting survey included Burbot, Coho Salmon, Lake Trout, Lake Whitefish, Northern Pike, Rainbow Trout, Smallmouth Bass, and White Sucker. A total of 85 Smallmouth Bass were caught, with individuals ranging up to 21 inches. Thirty Lake Trout were caught, averaging 21.5 inches in length and ranging up to 32 inches.

In the November portion of the survey, a total of 197 fish were caught, representing 9 species (Table 13). The one new species encountered was Longnose Sucker, with one caught. No Coho Salmon or Rainbow Trout were caught. The Lake Trout caught in the November portion of the survey averaged over five inches longer than those caught in June (26.7 inches vs. 21.5 inches). Also, the Yellow Perch caught in the November effort were larger than those caught in June (11.3 inches vs. 8.0).

Most species caught in the 2014 Crystal Lake survey showed growth near the State of Michigan length at age average (Tables 14 and 15). In both portions of the survey, Lake Trout exceeded the State Average growth rate. Yellow Perch were growing slightly slower than the State Average in both portions of the survey, although not dramatically so.

Analysis and Discussion

Crystal Lake is a daunting and sometimes dangerous lake to conduct fisheries surveys on. At nearly 10,000 acres, it is a very large lake, and its proximity to Lake Michigan means that it is often subjected to storms and heavy winds coming off Lake Michigan. In both the 2003 and 2014 surveys, weather played a role, sometimes forcing the fisheries crews off the lake and preventing the tending of nets. Despite this, both surveys provided valuable information regarding the fish populations of Crystal Lake.

One of the reasons for conducting the 2014 survey of Crystal Lake was to evaluate the Lake Trout stocking program, which has been ongoing for decades (Table 1). The catch of 55 Lake Trout representing twelve different age classes verifies that the stocking program is successful. Lake Trout exhibit growth rates well above the State average (Tables 14 and 15). This is likely due to the abundant forage available in Crystal Lake in the form of Rainbow Smelt. In the 2004 winter creel survey, effort showed the popularity of Lake Trout fishing in Crystal Lake, with an estimated 3,438 harvested and another 100 released (Table 7).

The 2014 fisheries survey showed that most native fish populations in Crystal Lake are healthy. Rock Bass and Yellow Perch were particularly abundant, with many year classes represented. Many Rock Bass of Master Angler proportions are present in Crystal Lake. Smallmouth Bass were also well-represented in the catch, with 12 different year classes present. Crystal Lake has a reputation as a very good Smallmouth Bass fishing lake, with trophy potential. Yellow Perch are also very popular among Crystal Lake anglers and are heavily pursued in both the open water and ice fishing seasons. Northern Pike are present in the lake and grow very well, but population levels are relatively low.

Crystal Lake is somewhat unique in that it hosts a self-sustaining population of Coho Salmon (Tonello 2007). Glen Lake in Leelanau County is the only other inland lake in Michigan that is also known to host "landlocked" Coho Salmon (Seites et al. 2010). The 2014 fisheries survey was not particularly effective in catching either Coho Salmon or Rainbow Trout (which are stocked into Crystal Lake annually and may also reproduce naturally in Cold Creek and other tributaries). Perhaps different survey methods or a different time of year might be more successful in catching Rainbow Trout and Coho Salmon in assessment gear. Creel census might also be a better method for assessing the Rainbow Trout stocking program and the size of the Coho Salmon population.

Although not native, Rainbow Smelt are a very important species on Crystal Lake, both as a sport fishery and as a forage base for large salmonid predators. No Rainbow Smelt were caught in the 2014 survey. Although the survey gear used is not designed to catch Rainbow Smelt, they had been caught by similar gear in many previous surveys (Table 2). Again, creel census is likely a better tool for assessing the Rainbow Smelt population and fishery. Rainbow Smelt are heavily pursued on Crystal Lake by ice anglers in the winter. Another species that was noticeably absent in the 2014 fisheries survey catch was Cisco. They had been caught in most previous fisheries surveys of Crystal Lake (Table 2). Most recently, 221 were caught in the 2003 fisheries survey and another 67 caught in the 2004 survey.

Management Direction

Crystal Lake is an extremely popular lake for sportfishing. It is well-known for multiple fisheries, including a very popular Rainbow Smelt fishery, the likes of which can only be found on a handful of other inland lakes in Michigan. The large number of Master Angler entries (Table 11) speaks to the quality and popularity of Crystal Lake for anglers. The 2004 creel survey showed that the Crystal Lake fishery was worth nearly \$400,000 to the local economy (U. S. Department of the Interior 2011). Due to inflation rates in the 10+ years since the survey was conducted, it can easily be assumed that the fishery today generates well over \$500,000 to the economy of Benzie County and the Beulah area.

Crystal Lake is a rare natural resource in that it has deep, cold water that can harbor species like Lake Trout, Cisco, and Rainbow Smelt. For over 50 years, Crystal Lake has had a reputation as a good lake for catching Lake Trout. The Lake Trout population is likely entirely dependent on stocking. Therefore, we should continue to annually stock 60,000 yearling Lake Trout (a rate of 6.1 yearlings per acre). Subsequent fisheries surveys should be conducted to monitor Lake Trout growth rates. If Lake Trout growth rates were to drop, then stocking rates should be examined and possibly reduced. Although Rainbow Trout were virtually nonexistent in the 2014 catch, a well-regarded sport fishery exists for this species. For that reason, we should continue to stock 20,000 yearling Eagle Lake strain Rainbow Trout annually.

Native species like Yellow Perch, Rock Bass, Lake Whitefish, and Smallmouth Bass should continue to thrive in Crystal Lake without direct management efforts. Although not native, Rainbow Smelt are very popular with anglers, and they also should continue to provide a quality sportfishery. However, the lack of Cisco in the catch of the 2014 survey is concerning, especially considering that Cisco had been caught in most previous surveys (Table 2). Similar results occurred in surveys of nearby Duck Lake (2008; Tonello 2012) and Green Lake (2013; Tonello 2014). Both lakes have had historically robust Cisco populations, but none were found in the most recent surveys of both of those respective lakes. Future fisheries surveys should make a concerted effort to sample Cisco in particular on Crystal Lake. Cisco are listed as a "Threatened" species by the Michigan Department of Natural Resources.

A year-round creel census survey should be conducted on Crystal Lake as soon as possible. Although the 2004 winter creel census provided valuable data, more recent angler effort, catch, and harvest data from all four seasons would provide more information. Also, the MDNR Public Access Site did not exist in 2004, so access to Crystal Lake was more difficult at that time. A modern creel census survey could incorporate some new components to estimate the economic value of the fishery to the local economy.

Any remaining riparian wetlands adjacent to Crystal Lake should be protected as they are critical to the continued health of the aquatic community. Future riparian development and wetland loss may result in deterioration of the water quality and aquatic habitat. Healthy biological communities in inland lakes require suitable natural habitat. Human development within the lake watershed, along the shoreline, and in the lake proper has a tendency to change and diminish natural habitat. Appropriate watershed management is necessary to sustain healthy biological communities, including fish, invertebrates, amphibians, reptiles, birds and aquatic mammals. For lakes this includes best management practices (BMP's) that ensure high water quality, especially for nutrients; preservation of natural shorelines, particularly shore contours and vegetation; and preservation of bottom contours, vegetation, and wood structure within a lake. Guidelines for protecting fisheries habitat in inland lakes can be found in Fisheries Division Special Report 38 (O'Neal and Soulliere 2006).

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Figure 1. Crystal Lake, Benzie County, Michigan.

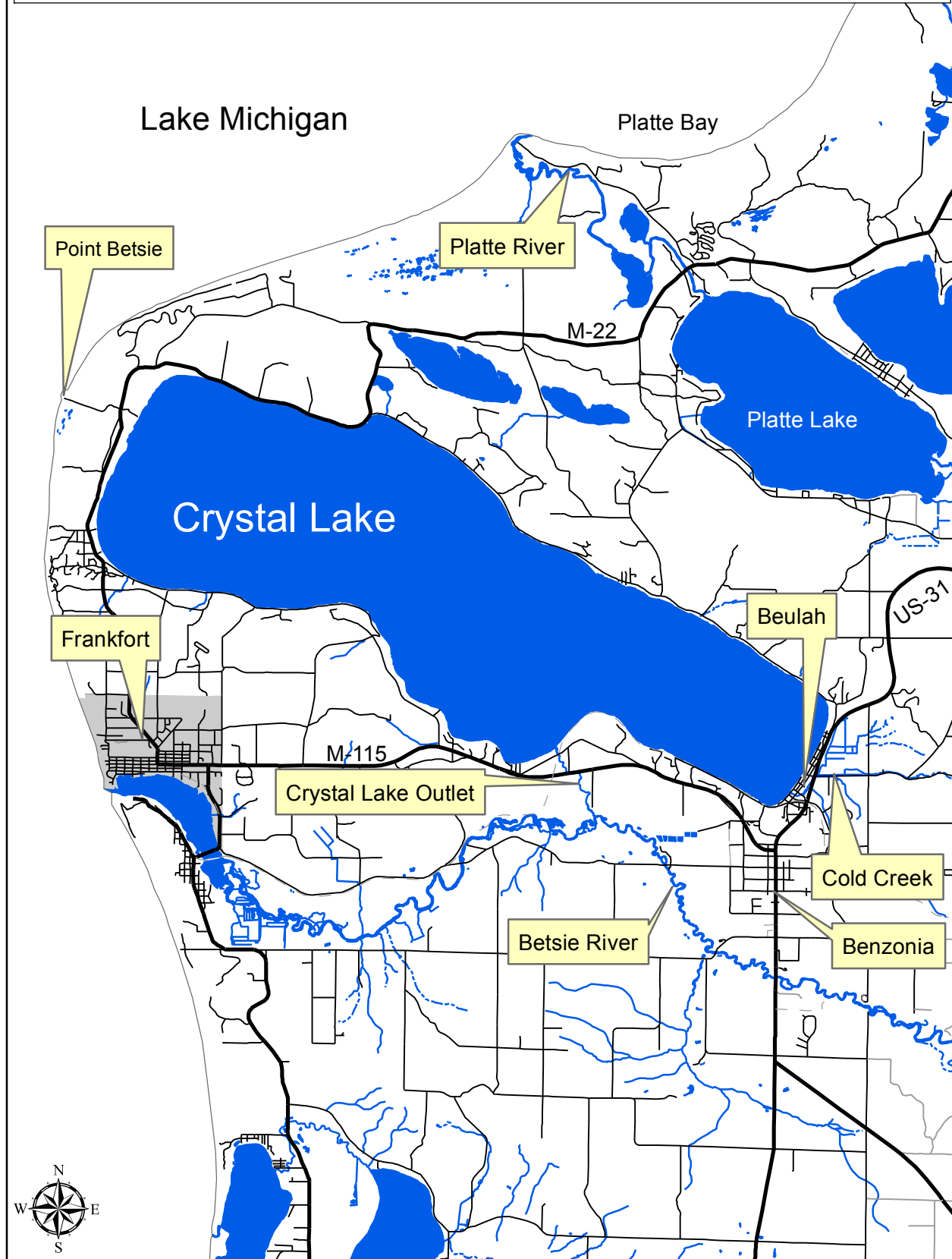


Figure 2. Features and access points of Crystal Lake, Benzie County, Michigan.

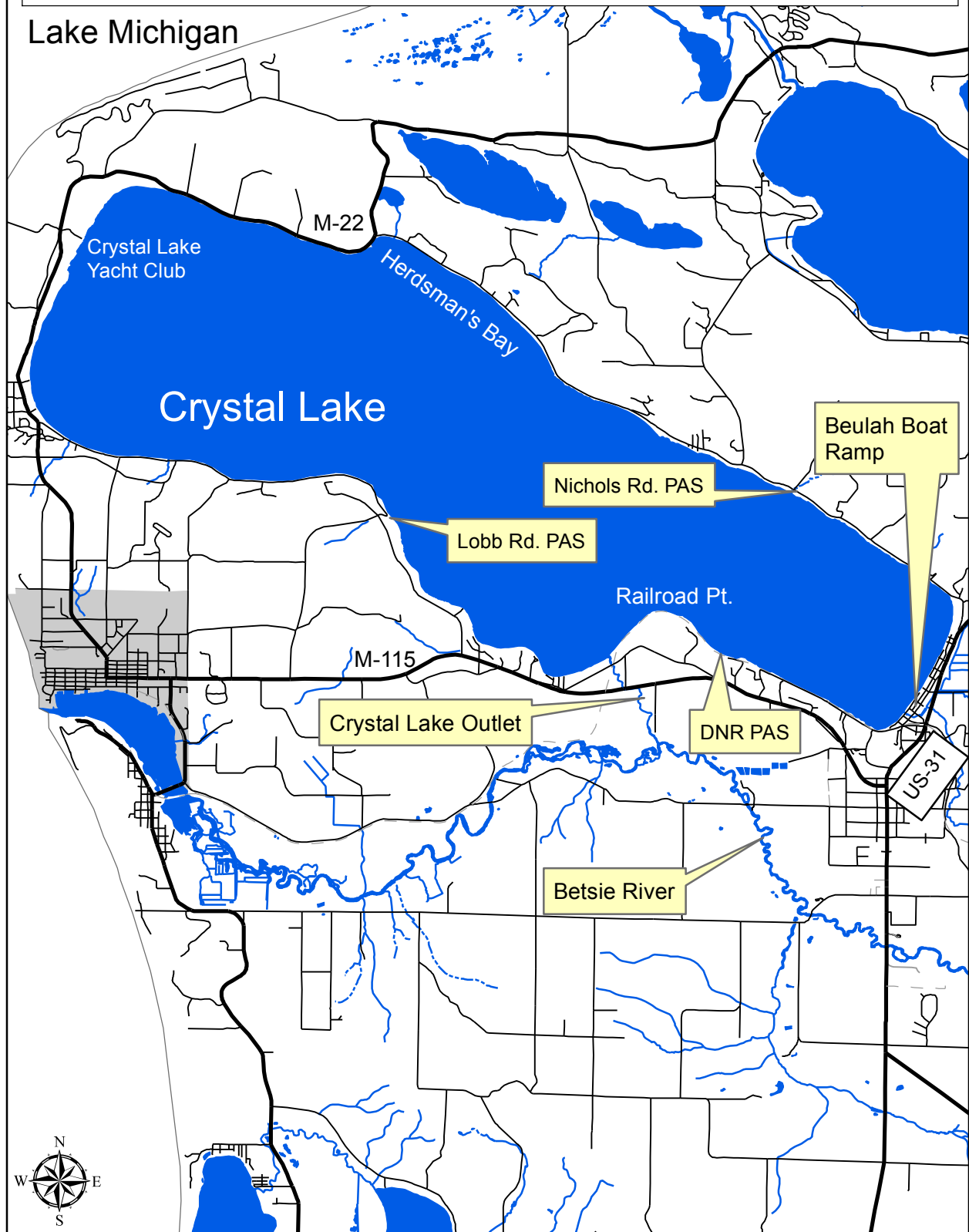


Table 1. Fish stocked in Crystal Lake, Benzie County, 1890-2015.

Year	Species	Number	Size/age	Strain
1890	Lake Trout	460	2 yr.	
1895	Lake Trout	25,000		
1897	Lake Trout	80,000		
	Walleye	800,000	fry	
1905	Lake Trout	30,000	fry	
	Largemouth Bass	600	fingerlings	
1910	Smallmouth Bass	1,000	fingerlings	
	Yellow Perch	500	fingerlings	
	Warmouth	1,000	yearlings and 2 yr.	
1912	Rainbow Smelt	16,400,000	eggs	
1930	Bluegill	280	yearlings	
1932	Largemouth Bass	1,000		
1934	Bluegill	10,000	3 mo.	
1935	Bluegill	10,000	4 mo.	
	Lake Trout	9,000	8 mo.	
	Smallmouth Bass	2,000	4 mo.	
1936	Bluegill	200	yearlings	
	Largemouth Bass	200	yearlings	
1937	Bluegill	10,000	5 mo.	
	Lake Trout	20,000	fry	
	Smallmouth Bass	2,500	5 mo.	
1938	Lake Trout	16,000	3 mo.	
	Yellow Perch	180,000	7 mo.	
1939	Smallmouth Bass	2,100	4 mo.	
	Yellow Perch	30,000	7 mo.	
1940	Lake Trout	5,000	yearlings	
	Smallmouth Bass	1,100	4 mo.	
1941	Lake Trout	7,335	2 yr.	
	Rainbow Trout	9,990	adults	
	Smallmouth Bass	300	4 mo.	
1942	Lake Trout	6,800	2 yr.	
	Rainbow Trout	5,000	yearlings	
	Smallmouth Bass	1,625	4-5 mo.	
1943	Smallmouth Bass	1,200	3 mo.	
1944	Smallmouth Bass	470	4 mo.	
1945	Lake Trout	2,000	2 yr.	
1946	Lake Trout	7,000	2 yr.	
1947	Lake Trout	5,000	adults	
1948	Lake Trout	3,000	9"	
1949	Lake Trout	5,000	7.5"	
1950	Lake Trout	5,000	9"	
1951	Lake Trout	13,400	7.8"	
1952	Lake Trout	3,350	8"	
1953	Lake Trout	8,673	7-8"	
1955	Lake Trout	5,000	legal	
1956	Lake Trout	11,500	legal	
	Rainbow Trout	12,000	sublegal	
1957	Lake Trout	6,500	legal	

Table 1 continued. Fish stocked in Crystal Lake, Benzie County, 1890-2014.

	Rainbow Trout	10,000	legal	
	Rainbow Trout	65,000	sublegal	
1958	Lake Trout	15,000	legal	
	Rainbow Trout	92,000	sublegal	
1959	Lake Trout	15,100	legal	
1960	Lake Trout	15,000	legal	
	Rainbow Trout	10,000	legal	
1961	Lake Trout	15,000	legal	
	Rainbow Trout	10,000	legal	
1962	Lake Trout	5,100	legal	
	Rainbow Trout	10,000	legal	
1963	Lake Trout	6,000	legal	
	Rainbow Trout	10,000	legal	
1964	Lake Trout	400	legal	
	Rainbow Trout	20,000	legal	
1965	Lake Trout	10,000	legal	
	Lake Trout	5,000	sublegal	
	Rainbow Trout	10,000	sublegal	
1966	Rainbow Trout	50,017	spring fingerlings	
	Splake	50,000	spring fingerlings	
1967	Lake Trout	9,330	adults	
	Rainbow Trout	10,000	yearlings	
1968	Lake Trout	2,231	adults	
	Rainbow Trout	47,118	yearlings	
	Rainbow Trout	2,431	adults	
	Rainbow Trout (steelhead)	1,543	adults	Little Manistee
1969	Rainbow Trout	5,000	yearlings	
	Rainbow Trout (steelhead)	10,000	yearlings	Little Manistee
1970	Lake Trout	10,000	fall fingerlings	
	Rainbow Trout	20,017	yearlings	
	Rainbow Trout	2,102	adults	
1971	Lake Trout	10,100	yearlings	
	Rainbow Trout	40,000	yearlings	
	Rainbow Trout	1,850	adults	
1972	Lake Trout	20,000	yearlings	
	Lake Trout	75	adults	
1973	Rainbow Trout	20,000	yearlings	
	Rainbow Trout (steelhead)	20,350	yearlings	Little Manistee
	Splake	100,000	fry	
1974	Lake Trout	100,000	yearlings	
	Lake Trout	8,420	adults	
	Rainbow Trout	561	adults	
1975	Brown Trout	306	adults	
	Lake Trout	131,852	yearlings	
	Rainbow Trout	170	adults	
1976	Lake Trout	88,000	yearlings	
1977	Lake Trout	90,000	yearlings	
1978	Lake Trout	50,000	yearlings	
1979	Lake Trout	65,000	yearlings	

Table 1 continued. Fish stocked in Crystal Lake, Benzie County, 1890-2014.

1980	Lake Trout	50,000	yearlings	
1981	Lake Trout	50,000	yearlings	Marquette
1982	Lake Trout	55,000	yearlings	Marquette
1983	Lake Trout	60,000	yearlings	Marquette
	Lake Trout	30,000	fall fingerlings	
1984	Brown Trout	30,000	yearlings	Harrietta
	Lake Trout	200	adults	Marquette
1985	Brown Trout	25,330	yearlings	Harrietta
	Lake Trout	15,000	yearlings	Marquette
1986	Atlantic Salmon	21,000	fall fingerlings	Landlocked
	Brown Trout	2,000	yearlings	Soda Lake
	Brown Trout	1,600	yearlings	Wild Rose
	Lake Trout	60,000	yearlings	Lake Superior
1987	Brown Trout	26,900	yearlings	Soda Lake
	Brown Trout	3,100	yearlings	Plymouth Rock
	Lake Trout	190,000	fall fingerlings	Marquette
	Lake Trout	59,630	yearlings	Marquette
1988	Brown Trout	30,000	yearlings	Plymouth Rock
	Lake Trout	150,000	spring fingerlings	Marquette
1989	Brown Trout	30,000	yearlings	Plymouth Rock
	Rainbow Trout	20,000	yearlings	Shasta
1990	Atlantic Salmon	19,278	fall fingerlings	Penobscot
	Brown Trout	29,997	yearlings	Soda Lake
	Lake Trout	90,920	yearlings	Marquette
	Rainbow Trout	8,495	yearlings	Shasta
1991	Brown Trout	46,225	yearlings	Plymouth Rock
	Lake Trout	48,700	yearlings	Lake Superior
1992	Atlantic Salmon	50,137	fall fingerlings	Landlocked
	Lake Trout	80,000	yearlings	Lake Superior
	Rainbow Trout	20,000	yearlings	Eagle Lake
1993	Lake Trout	80,000	yearlings	Marquette
	Rainbow Trout	19,500	yearlings	Eagle Lake
1994	Lake Trout	71,000	yearlings	Marquette
	Rainbow Trout	20,000	yearlings	Eagle Lake
1995	Rainbow Trout	20,000	yearlings	Eagle Lake
1996	Lake Trout	90,660	yearlings	Marquette
	Rainbow Trout	9,990	yearlings	Kamloops
	Rainbow Trout	10,000	yearlings	Eagle Lake
1997	Lake Trout	60,850	yearlings	Marquette
	Rainbow Trout	40,000	fall fingerlings	Eagle Lake
	Rainbow Trout	20,436	yearlings	Eagle Lake
	Rainbow Trout	11,118	fall fingerlings	Shasta
1998	Lake Trout	79,008	yearlings	Marquette
	Rainbow Trout	19,975	yearlings	Eagle Lake
1999	Lake Trout	80,800	yearlings	Marquette
	Rainbow Trout	19,500	yearlings	Eagle Lake
2000	Lake Trout	70,500	yearlings	Marquette
	Rainbow Trout	20,700	yearlings	Eagle Lake

Table 1 continued. Fish stocked in Crystal Lake, Benzie County, 1890-2014.

2001	Lake Trout	82,000	yearlings	Marquette
	Rainbow Trout	19,000	yearlings	Eagle Lake
2002	Lake Trout	80,470	yearlings	Marquette
	Rainbow Trout	31,900	yearlings	Eagle Lake
2003	Lake Trout	80,000	yearlings	Marquette
	Rainbow Trout	21,120	yearlings	Eagle Lake
2004	Lake Trout	60,000	yearlings	Marquette
	Rainbow Trout	22,000	yearlings	Eagle Lake
2005	Lake Trout	60,000	yearlings	Marquette
	Rainbow Trout	45,932	yearlings	Eagle Lake
2006	Lake Trout	62,250	yearlings	Marquette
	Rainbow Trout	20,000	yearlings	Eagle Lake
2007	Lake Trout	60,536	yearlings	Marquette
	Rainbow Trout	21,500	yearlings	Eagle Lake
2008	Lake Trout	50,880	yearlings	Lewis Lake
	Rainbow Trout	22,000	yearlings	Eagle Lake
2009	Lake Trout	63,617	yearlings	Lewis Lake
	Rainbow Trout	21,600	yearlings	Eagle Lake
	Rainbow Trout	93,200	fall fingerlings	Eagle Lake
2010	Lake Trout	63,199	yearlings	Lake Superior
	Rainbow Trout	25,008	yearlings	Eagle Lake
2011	Lake Trout	58,798	yearlings	Lake Superior
	Rainbow Trout	31,761	yearlings	Eagle Lake
2012	Lake Trout	48,971	yearlings	Lake Superior
	Rainbow Trout	21,802	yearlings	Eagle Lake
	Rainbow Trout (steelhead)	55,214	fall fingerlings	Little Manistee
2013	Lake Trout	59,228	yearlings	Seneca Lake
	Rainbow Trout	20,452	yearlings	Eagle Lake
	Rainbow Trout (steelhead)	74,061	fall fingerlings	Little Manistee
2014	Lake Trout	40,000	yearlings	Lake Superior
	Rainbow Trout	20,600	yearlings	Eagle Lake
2015	Lake Trout	54,340	yearlings	Lake Superior
	Rainbow Trout	20,700	yearlings	Eagle Lake

Table 2. Presence/absence of fish species in historical fisheries surveys of Crystal Lake, Benzie County, MI.

Species	1940	1948	1956	1960	1977	1989	1997	2003	2004	2014
Black Crappie	x*									
Bluegill	x									
Bluntnose Minnow	x							x		
Brown Bullhead								x		
Brown Trout						x	x			
Bullhead spp.	x*									
Burbot	x		x	x	x		x	x	x	x
Cisco	x			x	x	x	x	x	x	
Coho Salmon						x	x		x	x
Common Shiner								x		
Emerald Shiner	x									
Iowa Darter	x									
Johnny Darter	x									
Lake Trout	x		x		x	x	x	x	x	x
Lake Whitefish	x		x	x	x		x	x	x	x
Logperch	x							x		
Longnose Sucker										x
Mudpuppy								x		
Northern Pike	x									x
Pumpkinseed	x*									
Redhorse spp.	x*									
Rainbow Smelt	x	x	x		x	x	x	x	x	
Rainbow Trout				x		x	x	x		x
Rock Bass	x	x				x	x	x		x
Slimy Sculpin					x					
Smallmouth Bass	x*	x				x	x	x		x
Spottail Shiner	x							x		
White Sucker	x	x	x	x	x	x	x	x	x	x
Yellow Perch	x	x	x		x	x	x	x	x	x

*Reported as present but not caught in the survey.

Table 3. Number, weight, and length of fish collected from Crystal Lake with fyke nets (small and large mesh), trap nets, Great Lakes gill nets, and inland gillnets from May 4 through August 27, 2003.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches) ¹	Average length	Percent legal size ²
Bluntnose Minnow	1	0.0	0.0	0.00	3-3	3.5	
Brown Bullhead	1	0.0	0.9	0.01	12-12	12.5	100 (7")
Burbot	24	0.3	76.7	0.82	13-27	22.0	
Common Shiner	65	0.9	2.1	0.02	3-4	3.7	
Lake Trout	130	1.8	432.7	4.63	10-34	20.1	79 (15")
Cisco	221	3.1	102.6	1.10	7-17	12.2	
Logperch	21	0.3	0.4	0.00	3-4	3.6	
Lake Whitefish	43	0.6	124.8	1.33	13-22	19.5	
Mudpuppy	8	0.1	0.0	0.00	13-14	13.2	
Rainbow Smelt	12	0.2	0.6	0.01	4-7	5.7	
Rainbow Trout	31	0.4	44.1	0.47	5-23	16.2	35 (15")
Rock Bass	2,133	29.9	1,013.1	10.83	1-12	8.1	89 (6")
Smallmouth Bass	55	0.8	106.6	1.14	4-20	14.1	62 (14")
Spottail Shiner	18	0.3	0.2	0.00	3-3	3.5	
White Sucker	3,819	53.6	7,351.6	78.61	10-20	16.5	
Yellow Perch	546	7.7	96.0	1.03	2-13	8.0	43 (7")
Total	7,128	100	9,352.4	100			

¹Note some fish were measured to 0.1 inch, others to inch group: e.g., 5=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

²Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 4. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with trap nets and fyke nets May 5-7, 2003, and by creel census during April and May, 2003. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age													Mean Growth Index	
	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV		
Brown Trout	17.5 (1)					28.4 (1)									-
Coho Salmon	17.3 (4)														-
Lake Trout			18.0 (6)	21.0 (5)	22.9 (2)	26.2 (3)	27.8 (5)	29.9 (2)		33.8 (3)					+0.8
Lake Whitefish							18.2 (1)		19.4 (1)	21.9 (3)		21.8 (1)			*
Rainbow Trout	16.4 (8)	22.2 (17)	23.2 (1)												+6.6
Rock Bass					9.4 (1)	9.7 (1)		10.6 (1)	11.0 (3)	10.8 (2)	11.5 (7)**	11.9 (5)*	12.2 (1)		-
Smallmouth Bass	9.9 (1)		14.1 (3)	15.3 (1)	16.3 (1)	17.5 (1)	18.9 (1)		19.5 (1)						-
Yellow Perch												13.2 (1)			-

*No State of Michigan average has been calculated.

**No State of Michigan average has been calculated for rock Bass older than age VIII.

Table 5. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with trap nets, inland gill nets, straight run gill nets, and Great Lakes gill nets June 9 - July 30, 2003. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age														Mean Growth Index
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	
Cisco				9.9 (12)	11.6 (8)	12.8 (27)	15.2 (10)	14.2 (9)	15.5 (3)						*
Lake Trout			14.0 (20)	17.6 (26)	21.1 (17)	23.0 (15)	27.3 (8)	27.7 (5)	34.3 (2)	31.8 (2)			34.2 (1)		+0.2
Lake Whitefish				14.7 (2)	13.0 (1)	15.3 (2)	14.8 (1)	19.6 (3)	22.1 (5)	19.4 (6)	20.8 (5)	21.3 (2)	21.2 (2)	22.2 (1)	*
Rock Bass		3.3 (12)	5.3 (18)	6.5 (10)	8.2 (9)	8.5 (14)	9.0 (2)	10.0 (1)	10.3 (4)	10.9 (9)*	11.3 (4)	11.4 (6)*	12.1 (7)*	12.6 (1)	+0.1
Smallmouth Bass	5.5 (4)	9.6 (3)	11.7 (10)	14.2 (7)	15.4 (5)	17.0 (6)	17.7 (4)	19.5 (4)	20.1 (1)		19.5 (1)				+1.0
Yellow Perch		3.2 (10)	5.7 (13)	6.3 (20)	8.8 (23)	10.0 (11)	11.1 (11)	11.5 (3)	11.8 (2)	12.6 (1)	13.3 (1)		12.7 (1)		-0.7

*No State of Michigan average has been calculated.

Table 6. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with Great Lakes gill nets August 25 - 27, 2003 and by creel census during August and September, 2003. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age													Mean Growth Index					
	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV						
Lake Trout	12.0 (4)	14.5 (10)	19.0 (3)	21.7 (11)	23.7 (3)	26.2 (4)		29.6 (1)	33.2 (1)								-0.4		
Lake Whitefish							18.5 (1)	20.0 (2)	19.4 (3)	20.6 (2)	21.5 (4)							-*	
Rainbow Trout	17.6 (2)																		-

*No State of Michigan average has been calculated

Table 7. Results of the winter 2004 MDNR creel survey of Crystal Lake (Benzie County), including an evening component targeting Rainbow Smelt anglers.

Species	Estimated harvest, winter 2004	Estimated released, winter 2004
Rainbow Trout	48	9
Brown Trout	11	0
Lake Trout	3,438	100
Cisco	21	0
Lake Whitefish	776	0
Yellow Perch	23,916	9,520
White Sucker	882	202
Rainbow Smelt	2,611	0

Total winter 2004 angler trips: 10,155

Total winter 2004 angler hours: 41,794

Table 8. Number, weight, and length of fish collected from Crystal Lake with Great Lakes gill nets, May 17-18 and August 16-17, 2004, as verification for an experimental hydroacoustic survey.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches) ¹	Average length	Percent legal size ²
Burbot	2	1.5	4.7	2.2	18-21	19.6	
Cisco	67	49.3	19.1	9.0	7-17	9.5	
Coho Salmon	1	0.7	0.6	0.3	12-12	12.5	100 (10")
Lake Trout	32	23.5	115.8	54.9	14-30	21.3	97 (15")
Lake Whitefish	22	16.2	51.2	24.3	10-21	18.9	
Rainbow Smelt	2	1.5	0.1	0.0	4-5	5.0	
White Sucker	9	6.6	19.5	9.2	16-19	17.6	
Yellow Perch	1	0.7	0.2	0.1	7-7	7.5	100 (7")
Total	136	100	211.0	100			

¹Note some fish were measured to 0.1 inch, others to inch group: e.g., 5=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

²Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 9. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with Great Lakes gill nets May 17-18, 2004. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age										Mean Growth Index
	II	III	IV	V	VI	VII	VIII	IX	X		
Cisco				14.5 (3)							*
Lake Trout		16.0 (4)	20.1 (6)	25.3 (6)							+4.1
Lake Whitefish	10.3 (1)		17.0 (1)	20.9 (1)	20.4 (4)						*

*No State of Michigan average has been calculated.

Table 10. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with Great Lakes gill nets August 16-17, 2004. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age							Mean Growth Index
	I	II	III	IV	V	VI	VII	
Cisco	7.3 (1)		11.9 (4)	12.1 (4)	13.1 (9)	15.5 (1)	17.2 (2)	*
Coho salmon	12.0 (1)							-
Lake Trout			16.8 (3)	19.9 (7)	25.6 (4)		30.5 (1)	-0.4
Lake Whitefish				17.2 (7)	20.0 (8)	19.8 (1)		*

*No State of Michigan average has been calculated.

Table 11. Michigan DNR Master Angler awards issued for fish caught from Crystal Lake, Benzie County, 1994-2015.

Species	Number of Master Angler awards issued
Rock Bass	43
Smallmouth Bass	22
Burbot	21
Rainbow Smelt	21
Lake Trout	11
Bluegill	1
Brown Trout	1
Northern Pike	1
Total:	121

Table 12. Number, weight, and length of fish collected from Crystal Lake with experimental gill nets, Great Lakes gill nets, straight run gill nets, trap nets, and inland gillnets on June 23-27, 2014.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches) ¹	Average length	Percent legal size ²
Burbot	10	0.2	35.5	2.1	17-26	22.9	
Coho Salmon	5	0.1	0.8	0.0	7-9	8.5	0 (10")
Lake Trout	30	0.7	124.0	7.4	10-32	21.5	80 (15")
Lake Whitefish	28	0.7	78.9	4.7	14-23	19.1	
Northern Pike	8	0.2	39.3	2.3	20-32	28.2	88 (24")
Rainbow Trout	1	0.0	0.3	0.0	9-9	9.5	0 (15")
Rock Bass	3,206	75.2	899.2	53.4	3-12	8.0	67 (6")
Smallmouth Bass	85	2.0	138.0	8.2	7-21	14.4	45 (14")
White Sucker	106	2.5	256.6	15.2	12-20	17.8	
Yellow Perch	784	18.4	111.4	6.6	4-13	8.0	17 (7")
Total	4,263	100	1684.0	100			

¹Note some fish were measured to 0.1 inch, others to inch group: e.g., 5=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

²Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 13. Number, weight, and length of fish collected from Crystal Lake with Great Lakes gill nets, straight run gill nets, and large mesh fyke nets on November 5-7, 2014.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches) ¹	Average length	Percent legal size ²
Burbot	9	4.6	37	7.6	21-26	24.0	
Lake Trout	25	12.7	183.8	37.7	20-36	26.7	100 (15")
Lake Whitefish	5	2.5	11.9	2.4	18-19	19.0	
Longnose Sucker	1	0.5	3.4	0.7	19-19	19.5	
Northern Pike	5	2.5	31.0	6.4	18-36	28.4	80 (24")
Rock Bass	22	11.2	12.5	2.6	6-12	9.4	100 (6")
Smallmouth Bass	1	0.5	0.8	0.2	11-11	11.5	0 (14")
White Sucker	67	34.0	161.9	33.2	14-21	18.4	
Yellow Perch	62	31.5	45.4	9.3	9-12	11.3	100 (7")
Total	197	100	487.7	100			

¹Note some fish were measured to 0.1 inch, others to inch group: e.g., 5=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

²Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 14. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with trap nets, inland gill nets, straight run gill nets, and Great Lakes gill nets June 23-27, 2014. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age																Mean Growth Index
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVIII	
Burbot				21.1 (1)													-
Lake Trout		10.8 (1)	15.3 (7)	18.0 (5)	18.2 (2)	25.2 (3)	23.9 (4)	24.9 (2)	28.8 (2)			32.9 (1)	28.7 (1)	28.9 (1)	32.0 (1)		+0.4
Lake Whitefish					14.3 (1)	16.8 (1)	18.3 (5)	18.2 (5)	20.4 (3)	20.2 (4)	20.8 (4)	21.1 (1)		22.1 (3)		23.1 (1)	*
Northern Pike		20.0 (1)	26.8 (4)	30.1 (1)	30.5 (2)												-
Rainbow Trout	9.2 (1)																-
Rock Bass			4.5 (7)	5.6 (15)	6.8 (12)	7.7 (6)	8.7 (19)	9.5 (10)	10.5 (7)	11.6 (6)	11.4 (7)	11.9 (8)	12.4 (2)				-0.4
Smallmouth Bass		7.8 (12)	11.6 (25)	14.7 (18)	16.0 (9)	17.6 (3)	18.8 (5)	18.3 (1)	18.2 (1)	17.4 (1)	20.6 (4)	19.8 (2)	20.1 (1)				+0.9
Yellow Perch		4.6 (8)	6.0 (13)	6.5 (27)	7.9 (23)	8.8 (16)	10.2 (11)	10.6 (10)	12.0 (6)	12.2 (7)	12.0 (8)	12.5 (3)					-0.6

*No State of Michigan average has been calculated.

Table 15. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Crystal Lake with fyke nets, straight run gill nets, and Great Lakes gill nets, November 5-7, 2014. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

Species	Age												Mean Growth Index
	I	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XV	
Lake Trout			21.9 (9)	23.6 (6)	27.6 (1)	31.3 (1)	31.6 (1)	31.0 (1)	28.7 (1)	31.6 (3)		35.8 (2)	+2.0
Lake Whitefish						18.7 (3)	18.3 (1)	19.7 (1)					*
Northern Pike	18.5 (1)	27.1 (1)	30.8 (2)	36.1 (1)									-
Smallmouth Bass		11.1 (1)											-
Yellow Perch				9.9 (1)	10.2 (2)	12.1 (3)	11.5 (9)	11.9 (12)	11.8 (5)	11.4 (4)	12.3 (2)		-0.2

*No State of Michigan average has been calculated.