Burt Lake

Cheboygan County, T35N R03W
Chebgoyan River watershed, surveyed 2015

Neal Godby, Senior Fisheries Biologist

Environment

Burt Lake is a 17,395-acre natural lake in western Cheboygan County, in Michigan's northern Lower Peninsula (Figure 1). It is the fourth-largest inland lake in the state, and has 32 miles of shoreline. Maximum depth is 73 feet, although most of the lake is 30 feet deep or less. Major tributaries to Burt Lake include the Sturgeon River, Maple River, Crooked River, and the Little Carp River (Figure 2). The Sturgeon River flows into Burt Lake in the southeast corner of the lake, while the Crooked River flows into Burt Lake at the west shoreline and drains moderate-sized lakes such as Crooked, Pickerel, and Round Lakes, as well as some smaller tributaries. The Maple River also flows into Burt Lake along the west shore, and drains Douglas Lake and some smaller tributaries as well. The Indian River is the outlet for Burt Lake, and flows out of the southeast corner of Burt Lake. The Indian River flows into Mullett Lake, which empties into the Cheboygan River. These lakes and rivers are all parts of the Inland Waterway, which ultimately drains to Lake Huron.

Half of the Burt Lake watershed is forested, while another 17.5% is wetland and 12.8% is grassland or shrubs. Smaller portions of the watershed are agricultural (8.3%) and urban (7.4%). The dominant surficial geology landform in the watershed is moraine (36.4%), followed by ice contact/outwash (29.6%) and lacustrine/dune (25%). The prevalence of coarse-textured surficial geology in the watershed leads to higher levels of groundwater input. This is a main reason why the Burt Lake watershed is home to high quality trout streams such as the Maple River and the Sturgeon River.

There are a number of public access sites on Burt Lake, making it fairly easy to get on the water. Burt Lake State Park is on the south shoreline of the lake, while the Maple Bay Public Access Site is in the northwest. Both of these access sites are operated by the Michigan Department of Natural Resources. Additionally, there are a number of road endings and township launches, such as those near Hoppie's Landing (northeast corner) and Eagle's Nest (east shore).

History

Burt Lake has a long history of fisheries management, with stocking playing a prominent role in much of that history. Records show that Lake Whitefish were stocked in the lake as early as 1876, with Lake Trout also being stocked prior to 1900. Walleye and Lake Trout were stocked on several occasions in the early 1900s and 1910s. Lake Trout, Yellow Perch, Rainbow Trout, and Whitefish were stocked in the 1920s, while stocking in the 1930s focused on Rainbow Trout, Walleye, Yellow Perch, Lake Whitefish, Bluegill, and Rock Bass. The 1940s saw continued stocking of Rainbow Trout, Walleye, Yellow Perch, Bluegill, and Rock Bass, along with Smallmouth and Largemouth Bass. More recent stocking events (since 1980) have included Atlantic Salmon, Rainbow Trout, and Walleye, as well as a focused effort on restoration of Lake Sturgeon (Table 1). Walleye have not been stocked in Burt Lake since 1993.

A netting survey of Burt Lake was done in 1887, reporting a mix of cold- and cool-water fish species. Species captured in that initial survey included Lake Trout, Lake Herring (Cisco), and Lake Whitefish, as well as Northern Pike, Walleye, Yellow Perch, and Rock Bass. Burt Lake has been surveyed periodically through the decades, with many of these surveys documenting the lake's abundant, stable fish community. One study done in 1941 was done to determine how to maximize the return to creel of legal-sized stocked fish. The study results recommended stocking legal-size Rainbow Trout in Burt Lake in the fall, as excellent growth of the Rainbow Trout was noted from the time of stocking to the next trout season. Rainbow Trout are no longer stocked in Burt Lake or its tributaries because natural reproduction is strong, but at the time the survey was done it was an important finding.

Netting surveys over the years have found the fish community to be remarkably stable, with species such as Northern Pike, Walleye, Yellow Perch, Smallmouth Bass and Rock Bass frequently encountered. Coldwater species such as Rainbow Trout and Brown Trout are also commonly found. Surveys in 1925 and 1955 also documented a number of non-game fish species including 12 species of minnows, darters, Logperch, and sculpins, as well as Bowfin, Longnose Gar, and Yellow and Brown Bullhead. Sea Lamprey appeared for the first time in a 1952 survey of the lake. Although no Sea Lamprey were observed or captured during a 1955 survey, the author of that survey's finding noted that an angler had preserved 2 large Sea Lamprey from Burt Lake. Sea Lamprey continue to persist at a low level in Burt Lake, and a recent study found that there is a population that lives its entire life cycle in the Inland Waterway (Johnson et al. 2016). USFWS-Sea Lamprey Control and USGS have begun efforts to eradicate Sea Lamprey from the Upper Cheboygan River Watershed, including Burt Lake and its tributaries. These efforts include back-to-back lampricide (TFM) treatments of tributaries and the release of sterile male Sea Lamprey to reduce the level of natural reproduction in the system.

In addition to assessing the fish community, some fish surveys have been conducted for other reasons. For example, some netting surveys were conducted intermittently from 1939-1945, including a number of Common White Sucker removals. Another survey done in Burt Lake in the 1940s was a demonstration netting project, which also included removal of Common White Suckers. A previous study on Big Bear Lake (Otsego County) had shown that Common White Sucker removal did not harm game fish populations, and may provide some benefit. Commercial fishermen were allowed to remove the suckers, and the public was allowed to watch. Removals of Common White Suckers were again done in 1947, 1948, and 1949. Over 48.4 tons of suckers were removed from Burt Lake over the three-year period. From these efforts, it was determined that removal efforts had little overall effect on the sucker population.

An interesting demonstration netting project also occurred in 1947 on Burt Lake. The Conservation Commission had recently adopted a policy to discontinue stocking warm water fish due to their ability to reproduce sufficiently to replace those removed by anglers. The netting effort was done to show anglers and local residents that adequate numbers of young-of-the-year fish were present and could be maintained without additional stocking.

Survey efforts in the 1950s included hook and line surveys, vegetation surveys, and a netting survey in 1955. An interesting note was made in the report of the 1955 survey. The author noted that crayfish were abundant throughout much of the lake; in fact, the sampling crew would frequently collect a 10-quart pail full of crayfish from 500 feet of gill net. The author also indicated that crayfish were a common prey item in fish stomach contents.

Efforts in the early 1960s were generally hook and line surveys through the ice. Whitefish were caught, as were Cisco. Cisco fishing was reportedly very good in February of 1961. A trap net survey was done in the spring of 1969 to check on the walleye population. The species typical of surveys in this lake were encountered, along with Muskellunge, Cisco, Brook Trout, and Carp. The Brook Trout catch included two 14-inch fish.

Although Burt Lake had always been known as a Walleye lake, management and survey emphasis focused more on that species starting in the late 1960s. Vocal anglers complained about the increased fishing pressure (more Walleye anglers) and that fishing wasn't perceived to be as good as it was in the "good old days." From 1970-1995, Burt Lake was surveyed every 5 years to check on the status of the Burt Lake walleye population. Survey catch rates ranged from a low of just under 5 Walleye per trap net lift in 1970, to a high of about 35 Walleye per trap net lift in 1980. These surveys were done in early spring. Additionally, walleye eggs were taken in the spring of 1970 and 1971. In 1970, 10.3 quarts of eggs were collected from a total catch of 219 Walleye. A total of 82.75 quarts of Walleye eggs were taken from Burt Lake in 1971, from a total of 1,472 fish that were captured in trap nets. Eggs were taken to Oden Fish Hatchery for rearing and to be stocked in other waters. In 1975, a trap net survey was done to check the spawning Walleye population and 945 walleye were captured and tagged in 50 net nights of effort. A gill net survey was also done in 1975 to establish index stations. It was reported that the Brown Trout appeared to be in excellent condition.

The 1980s began with a trap net survey in April of 1980. In 42 net nights of effort, a total of 1,494 Walleye were captured and tagged. A June trap net survey was done to look for tag recaptures. The tag return rate was 17.6%, similar to the return rate from a similar survey in 1975 (17.9% return). Tagged Walleyes were caught almost exclusively in Burt Lake, with the exception of one tagged Walleye caught in Mullett Lake. The increase in catch per net lift and the number of ages III and IV Walleye were attributed to the increased minimum size limit in 1976 from 13 inches to 15 inches. The survey was summarized by indicating Burt Lake has a stable, self-sustaining Walleye population with fish growth slightly below state average. The importance of preserving spawning habitat in the north arm was also emphasized. A 1985 trap net survey found slightly improved Walleye growth, at about the state average growth rate.

Aquatic invasive species have found their way into Burt Lake over the years. As mentioned above, Sea Lamprey first appeared in Burt Lake in 1952. Zebra mussels invaded the Inland Waterway in the early 1990s. Round Gobies were first observed in Burt Lake in the mid-2000s. Alewife have also been found. Eurasian watermilfoil showed up in 2003, and remains isolated to just a few small locations.

The Northern Michigan Walleye Association (NMWA) requested that Burt Lake be stocked with Walleye in the late 1980s and early 1990s. Although the DNR believed the lake provided ample natural reproduction, the agency and group agreed to assess the need for Walleye stocking. According to the plan, up to 20,000 clipped fall fingerling Walleye were to be stocked each year, and the stockings would be assessed through creel surveys, trap net surveys, and incentive programs. An agreement between NMWA and the DNR stated that if by the end of 1995, 7.5% of the fin clipped Walleyes were caught in the sport fishery, it would be concluded that Walleye stocking enhances the sport fishery and should be continued. A 1996 report indicated that only an estimated 0.29% of the

harvested walleye were stocked fish. This means that less than 0.1% of the fish that were stocked were harvested, confirming that Walleye stocking was not necessary in Burt Lake.

An intensive netting and electrofishing survey was done on Burt Lake in April and May 2001. The purpose of this survey was to estimate the abundance of Walleye and Northern Pike in the waterbody; therefore Walleye and pike were jaw-tagged so that subsequent recapture rates of these marked fish could be determined. Survey effort consisted of 321 trap net lifts, 31 fyke net lifts, and six nighttime electrofishing runs. A creel survey was also done during the open-water season of 2001 and the winter of 2002 to estimate fishing effort and harvest, as well as to look for jaw tags and provide the recapture portion of the population abundance estimate. The estimate of legal-size walleye in Burt Lake using the creel survey in the estimate was 32,295 (Hanchin et al. 2005, Hanchin 2017), or about 1.9 per acre. The estimate of adult walleye in Burt Lake was 42,032, showing that some walleye (mostly males) reach maturity before being legal sized.

As a large lake known for its stable and abundant Walleye population, the lake receives a considerable amount of fishing pressure, and a number of creel surveys have been conducted to quantify that effort. From 1955 through 1965, an airplane count was done about once a year (usually in February) of ice shanties on the lake to get an idea of fishing effort. Shanty counts ranged from 114 to 175. A creel survey done in 1975 estimated 79,195 angler hours (25,330 angler trips) of effort in July and August, with a total Walleye harvest of 33,071. A 1993 creel survey (April 24-September 11) estimated 129,423 angler hours (31,242 angler trips) for the season, with 16,828 Walleye harvested (Lockwood 2000). The creel survey done in 2001 estimated 85,570 angler hours (39,465 trips) and a harvest of 5,594 Walleyes (Hanchin et al. 2005). A previous, volunteer creel survey in 1980 documented 2,102.5 hours of fishing to catch 764 legal Walleye. Overall, angler effort has been studied much less than have the fish populations, in part due to the high cost of doing creel surveys. Anecdotally, anglers report that Walleye fishing on Burt Lake is as good as it ever has been, if not better.

Lake Sturgeon are a native species residing in Burt Lake. Observations about the Lake Sturgeon fishery in Burt Lake in the 1980s include: 1981, 2 sturgeon speared (75 in, 57.5 in); 1985, 1 sturgeon speared (79.5 in, 164.5 pounds); 1984, 2 sturgeon speared (largest was 156 pounds); and no sturgeon speared in 1986, `87, or `88. Sturgeon fishing on Burt Lake was closed starting in 1999, when most other lakes in the state were also closed due to concerns over the sturgeon populations. Lake Sturgeon surveys of Burt Lake were done in 2009 and 2011, with the earlier survey consisting of lighter effort. The 2009 survey captured 20 unique Lake Sturgeon, while the expanded efforts in 2011 captured 108 unique Lake Sturgeon. The estimated number of Lake Sturgeon in Burt Lake based on the 2011 survey was 1,535. Both surveys showed that the Burt Lake sturgeon population is made up almost entirely of stocked fish. Another sturgeon study was done by DNR and the Little Traverse Bay Bands of Odawa Indians in 2015. That effort captured 63 unique Lake Sturgeon.

A number of studies were done on Burt Lake starting in 2011 as part of an intensive effort to understand Walleye population dynamics in the Inland Waterway. Studies included Walleye population abundance estimates for each lake, examination of factors that influence survival of larval/juvenile Walleye, Walleye diets, and analysis of the extent of Walleye movement among lakes in the Inland Waterway. From 2011-2013, a total of 8,902 Walleye were tagged in Burt Lake, in addition to 4,004 Walleye tagged elsewhere in the Inland Waterway over that time period (Herbst 2015).

Herbst et al. (2017) estimated the spawning population of Walleye in Burt Lake to be 19,464 (~1.1/acre) in 2011. They also studied Walleye movement dynamics throughout the Inland Waterway, and found that 90% of the fish tagged during the spawning period in Burt Lake stayed in Burt Lake (i.e., they were recaptured there). Eight percent were later recovered in Mullett Lake and 2% were recovered in Crooked Lake. It should be noted that different methods were used for the population estimates in 2001 and 2011, which likely contributed to the difference in abundance estimates. In 2001, a creel survey was used for the recapture phase, whereas in 2011 the recapture phase was done in one night of electrofishing following an abbreviated marking period.

MacWilliams (2013) found that larval Walleye densities in Burt Lake were 87% higher than all other lakes studied in the Inland Waterway, which is indicative of the quality spawning habitat found in the lake. Williams also found that the year-class strength, or relative abundance, of fall fingerling Walleye was positively related to the spring abundance of large-bodied zooplankton taxa (prey).

Walleye are a native predator that are generalists in their feeding preferences, typically eating both native and nonnative prey as they are available. Although Walleye preyed heavily upon macroinvertebrates and native fish species such as yellow perch seasonally, they also took advantage of nonnative prey (Herbst et al. 2016). In fact, Herbst et al (2016) found that Round Goby comprised 42.9% of Walleye diet in Burt Lake during Fall/Winter.

The Walleye population and Walleye reproduction have been remarkably stable in Burt Lake over the years, and are supported entirely by natural reproduction in recent decades. The only Walleye stocking in Burt Lake occurred in 1930s and 1940s , and as part of the study that ended in 1993. A number of fall Walleye evaluations have been conducted over the years, documenting relative abundance of age-0 Walleye (Table 2, Figure 3). Despite the documented stability, anglers and angling groups have periodically requested that Walleye be stocked into Burt Lake.

The Northern Inland Lakes Citizen Fishery Advisory Committee (NILCFAC) was established in 2012. This group reviews survey and research information and provides direction to the DNR Fisheries Division regarding fishery goals, objectives and management plans for lakes and rivers in the Inland Waterway chain, including Burt Lake. This committee has been an effective group for disseminating information about Burt Lake and other waters in the Inland Waterway, and for participating in fisheries management decisions. Burt Lake Preservation Association has been an active member of the NILCFAC.

Current Status

A fish community survey was conducted on Burt Lake in June 2015 by MDNR Fisheries Division's Northern Lake Huron Management Unit. A variety of net types and sizes were deployed using Status and Trends protocol. Status and Trends is a methodology developed by Fisheries Division in which gear is standardized throughout the state and survey effort is a function of lake size (Wehrly et al. in press). The variety of gear types and mesh sizes is intended to sample different sizes of fish, species, and life stages to give a picture of the overall fish community. Survey effort for this large lake survey was considerable, with two boats/crews netting over a two-week period in June. Survey effort consisted of 16 large mesh trap net lifts, 39 large mesh fyke net lifts, 13 small mesh fyke net lifts, 24 experimental gill net lifts, 10 seine hauls, and four 10-minute electrofishing transects. The gill net

effort was deployed to begin to develop an "index" for Yellow Perch. Age and growth of game fish species were determined by collection of fin rays/spines or scale samples from 10 fish per inch group. Weights for each species were calculated using length-weight regressions summarized by Schneider (2000).

Total catch in the survey was 4,845 fish (Table 3, Figure 4). Thirty species representing twelve fish families were captured. Large predators included Walleye, Northern Pike, Smallmouth Bass, Brown Trout, Longnose Gar, Bowfin, Largemouth Bass, Muskellunge, and Burbot. Panfish species included Bluegill, Pumpkinseed Sunfish, Rock Bass, and Yellow Perch. Panfish made up about 23% of the numerical catch (Table 3).

Walleye and Northern Pike were the dominant predators in this survey of Burt Lake. The Walleye comprised 5.1% of the numerical catch and were well distributed across inch groups (Table 4). Both Northern Pike and Walleye were growing below the state average growth rate. Northern Pike had a mean growth index of -1.4, while Walleye had a mean growth index of -1.1 (Table 5). This comparison means that, on average, Northern Pike are 1.4 inches smaller than the statewide average length at age, while Walleye are 1.1 inches smaller than average.

Another predator that was a significant part of the catch was Smallmouth Bass. Smallmouth Bass were likely under-represented in the catch due to the timing of the survey, and are probably more abundant than the survey catch would indicate.

Six species of panfish were present in the 2015 survey of Burt Lake. Yellow Perch were the dominant panfish in the Burt Lake survey, both in terms of numbers and biomass. Perch in the gill net catch were represented by fish from age groups 2-11, with age-4 most abundant in the catch (Figure 5). It should be noted that perch do not fully recruit to the gear (i.e., become fully vulnerable) until age 3 or 4. Rock Bass, Bluegill, Pumpkinseed Sunfish, Green Sunfish, and Black Crappie were also part of the Burt Lake panfish community, but were present in much smaller numbers.

Non-game fish species such as White Suckers, Brown Bullhead, Bowfin, and Burbot were present in the catch. The small-mesh gear deployed as part of the Status and Trends protocol gave us additional information on forage fish species such as darters, shiners, and other minnows species. Although our survey did not collect Cisco, we do get reports of them caught occasionally in Burt Lake.

Limnology measurements were also taken on August 25, 2015, as part of the Status and Trends protocol. Temperature and dissolved oxygen profiles show that the lake stratifies below 48 feet in depth, and that dissolved oxygen levels fall precipitously at that point to levels that would not support fish (Table 6). Chlorophyll-a and phosphorus levels are fairly low, indicative of a mesotrophic/oligotrophic lake (Table 7).

Analysis and Discussion

Burt Lake has a healthy, stable fish community supporting popular fisheries for panfish and predator species.

Burt Lake's panfish community is diverse, with six species represented in the catch. Of these, Yellow Perch were by far the most abundant and in fact support a very popular fishery. Perch numbers were

well distributed across the inch groups, with a large percentage (47%) of the catch 7 inches in length or larger. Yellow Perch up to 14 inches in length were represented in the catch (Table 4). The popularity of the Yellow Perch fishery in Burt Lake is confirmed by the estimated 33,820 that were harvested during the open water season of 2001, and the estimated 47,277 that were harvested during the winter 2002 season, based on the most recent creel survey. As mentioned earlier, gill nets were used in 2015 both as part of the Status and Trends survey protocol as well as to provide a netting index for Yellow Perch catches in our large lakes. Yellow Perch age groups II-XII were present in the catch (Figure 5), but no single year class seemed to be dominant in the catch. These data will continue to be used as a comparative tool as we survey additional large lakes with similar gear.

Burt Lake has a healthy and robust predator fish community, comprised of Walleye, Northern Pike, Muskellunge, Smallmouth Bass, and Rainbow and Brown Trout, as well as several non-game species such as Bowfin, Burbot, and Longnose Gar. Walleye are by far the most abundant predator species in Burt Lake, and provide a popular fishery. The Walleye population that spawns in Burt Lake supports not only the Burt Lake fishery, but 10% of those Walleye also leave Burt Lake and contribute to the fisheries in other lakes in the Inland Waterway.

The Walleye catch per trap net lift in 2015 was 1.3, below the catch per effort (CPE) values documented from 1970-1995. It is important to note, however, that the previous surveys were done earlier in the spring, during the time that Walleye were spawning, making them more vulnerable to the gear. The 2015 survey was done later (June) according to Status and Trends protocol. Although the later survey date increases the number of species captured, it makes it difficult to compare CPE from previous surveys done at different times of the year. The long-term data set of age-0 Walleye catch rates (Figure 3), shows that there is consistent production of Walleye in Burt Lake. The Walleye population in Burt Lake continues to be stable, healthy, and self-sustaining.

Northern Pike and Muskellunge are both important predators in Burt Lake and provide popular fisheries. Northern Pike up to 33 inches in length were captured in this survey. An estimated 246 pike were harvested and 573 were caught and released during the open water season of 2001 according to the creel survey.

Muskellunge fishing is increasing in popularity throughout the Inland Waterway. Although abundance of this species is not high, we do see targeted effort for this species especially in the winter. Since 2000, seven Master Angler awards have been issued for Muskellunge in Burt Lake.

Smallmouth bass provide a popular fishery in Burt Lake. A number of bass-fishing tournaments are held on Burt Lake each year, either as a stand-alone tournament or as a part of a tournament throughout the Inland Waterway. Master Angler entries for Smallmouth Bass also indicate this is a quality fishery, with 40 Master Angler awards for this species since 2000. The 2015 netting survey caught a reasonable number of Smallmouth Bass, up to 21 inches in total length. Of these, 57% were 14 inches (legal size) or larger.

Overall, Burt Lake provides outstanding fishing opportunities for a number of sportfish species. These fish populations are remarkably stable, and depend upon the high-quality spawning habitat that Burt Lake provides.

Management Direction

1. Walleye spawning habitat along the north and east shores should be protected.
2. Maintain statewide fishing regulations, which are adequate for the protection of this fishery.
3. Continue to work with the Northern Inland Lakes Citizen Fisheries Advisory Committee on issues related to Burt Lake and the Inland Waterway.
4. Better understand Muskellunge population.
5. Develop a Lake Sturgeon management plan to guide management in Burt Lake, and continue stocking Lake Sturgeon annually in cooperation with Little Traverse Bay Bands of Odawa Indians and Burt Lake Preservation Association.

References

Godby, N.A., Jr., T.C. Wills, T.A. Cwalinski, and B.J. Bury. 2015. Cheboygan River assessment. Michigan Department of Natural Resources, Fisheries Report 10, Lansing.

Hanchin, P.A., R.D. Clark, Jr., R.N. Lockwood, and T. Cwalinski. 2005. The fish community and fishery of Burt Lake, Cheboygan County, Michigan in 2001-02 with emphasis on walleyes and northern pike. Michigan Department of Natural Resources, Fisheries Special Report 36, Ann Arbor.

Hanchin, P.A. 2017. A summary and analysis of the Large Lakes Survey Prograom in Michigan in 2001-2010, Michigan Department of Natural Resources, Fisheries Report 25, Lansing.

Herbst, S. 2015. Walleye (Sander vitreus) dynamics in the Inland Waterway, Michigan. Dissertation. Michigan State University, East Lansing.

Herbst, S.J., B.S. Stevens, D.B. Hayes, and P.A. Hanchin. 2016. Estimating walleye (Sander vitreus) movement and fishing mortality using state-space models: implications for management of spatially structured populations. Canadian Journal of Fisheries and Aquatic Sciences 73: 330-348.

Herbst, S.J., B.M. Roth, D.B. Hayes, and J.D. Stockwell. 2016. Walleye foraging ecology in an interconnected chain of lakes influenced by nonnative species. Transactions of the American Fisheries Society, 145:2, 319-333.

Herbst, S.J., B.S. Stevens, D.B. Hayes, and P.S. Hanchin. 2017. Influence of movement dynamics on walleye harvest management in intermixed fisheries in a chain of lakes. North American Journal of Fisheries Management 37:467-479.

Johnson, N.S., M.B. Twohey, S.M. Miehls, T.A. Cwalinski, N.A. Godby, A. Lochet, J.W. Slade, A.K. Juvbar, and M.J. Siefkes. 2016. Journal of Great Lakes Research 42:90-98.

Lockwood, R. 2000. Sportfishing angler surveys on Michigan inland waters, 1993-99. Michigan Department of Natural Resources Fisheries Division Technical Report Number 2000-3. Ann Arbor.

MacWilliams, R.D. 2013. Limitations of larval walleye (Sander vitreus) production in Michigan's Inland Waterway. Masters thesis. Michigan State University, East Lansing.

Schneider, J.C., P.W. Laarman, and H. Gowing. 2000. Length-weight relationships. Chapter 17 in Schneider, J.C., editor. 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

Wehrly, K.E., G.S. Carter, and J.E. Breck. In press. Standardized sampling methods for inland lakes status and trends program. Michigan Department of Natural Resources, Fisheries Special Report, Ann Arbor.

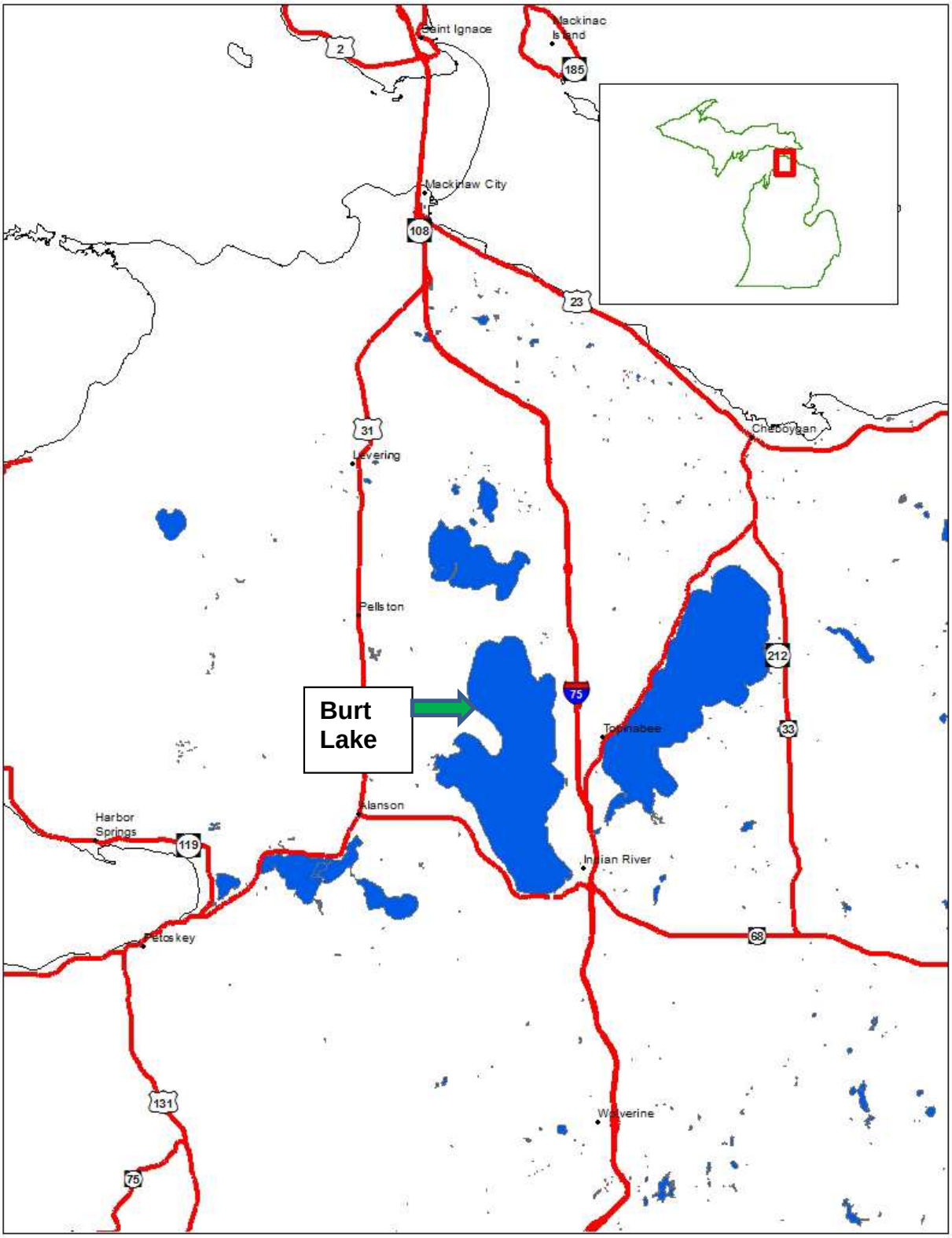

Figure 1. Burt Lake locator map.

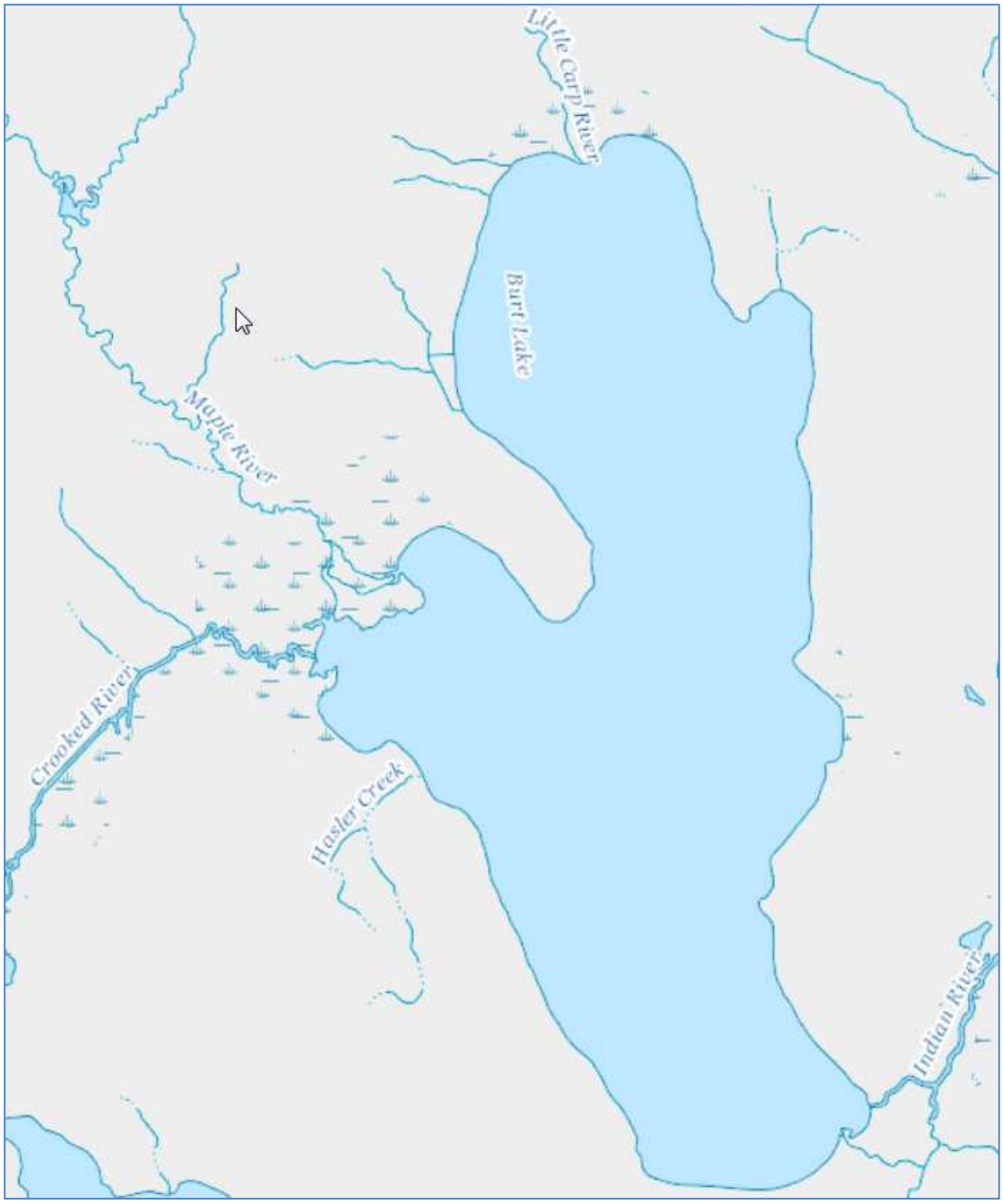

Figure 2. Burt Lake and its major tributaries and outlet.

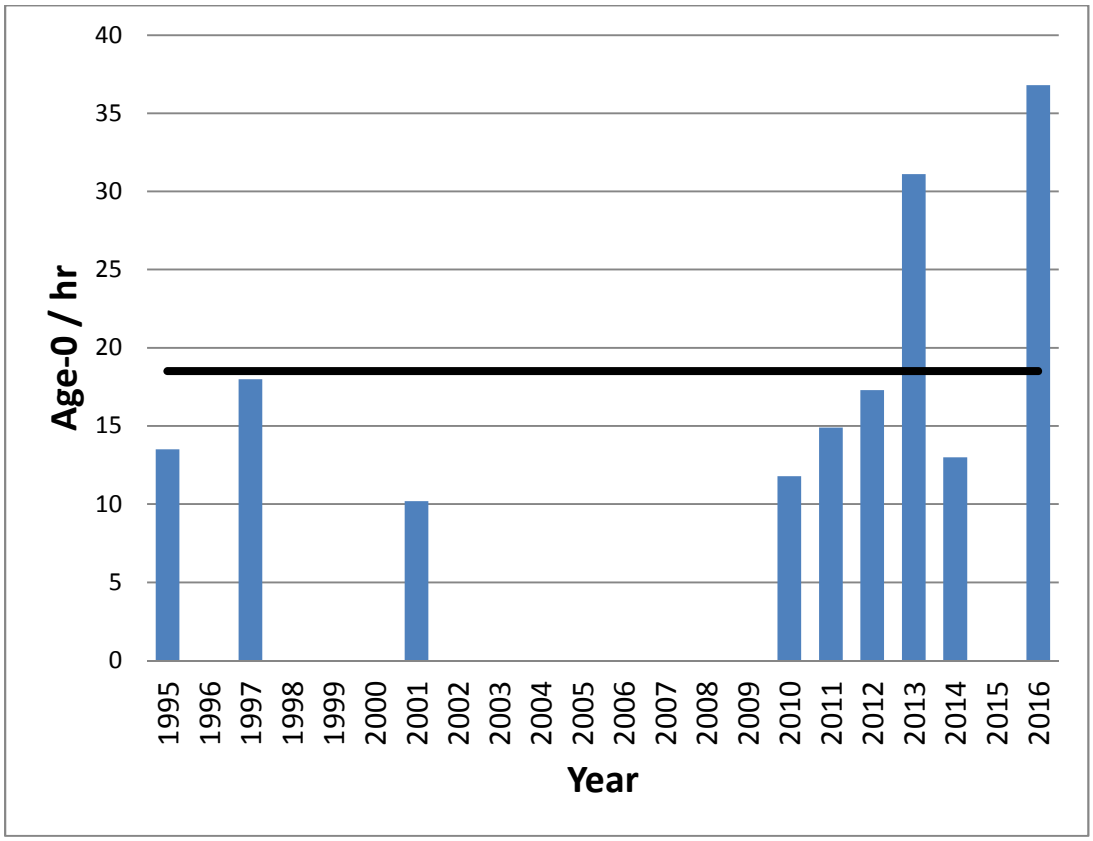

Figure 3. Number of age-0 Walleye captured per hour of electrofishing, by year, in Burt Lake. The mean catch per hour for sampled years over this time period is shown as the black horizontal line.

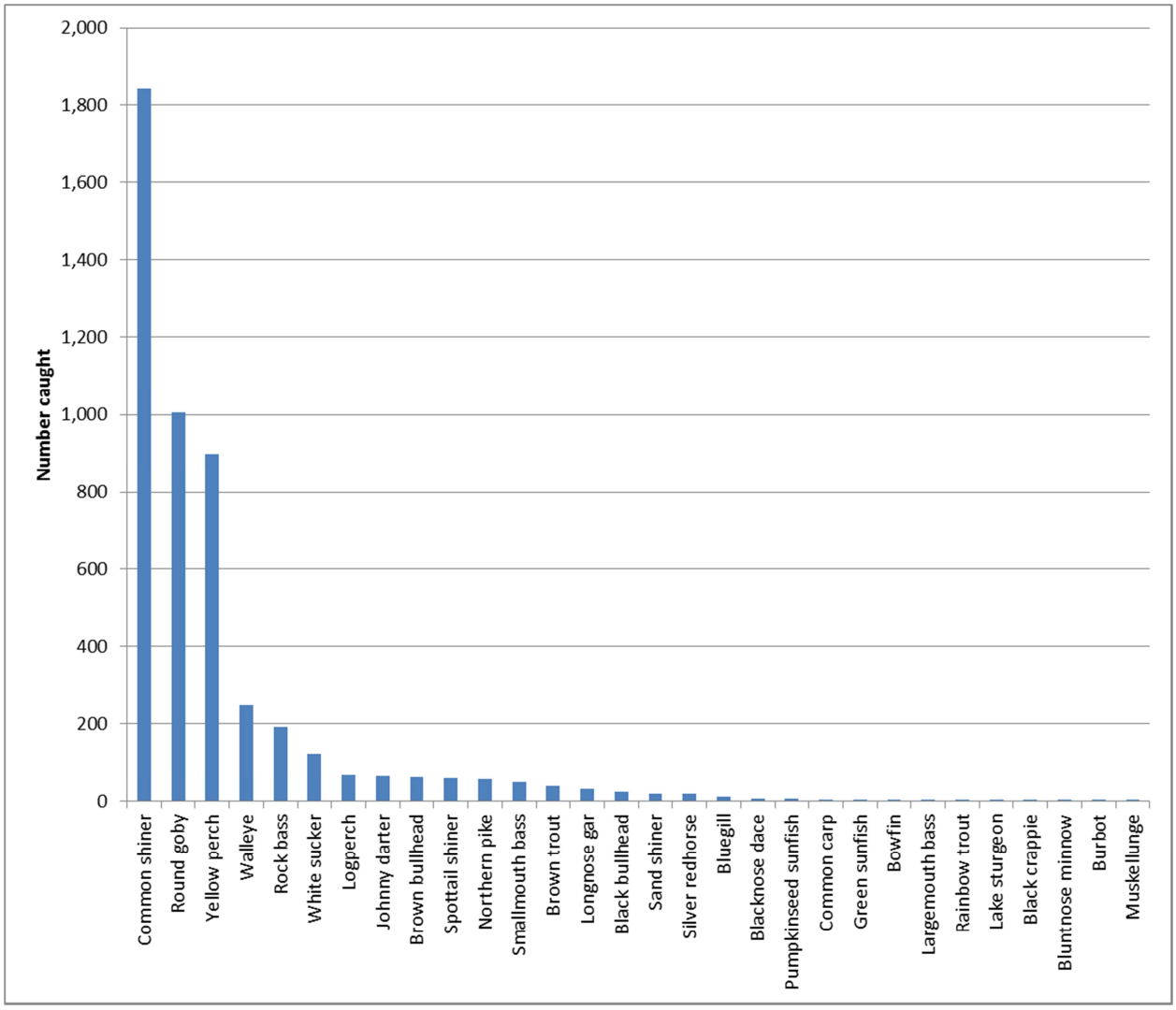

Figure 4. Number of each species caught during the June 2015 Status and Trends survey of Burt Lake, Cheboygan County.

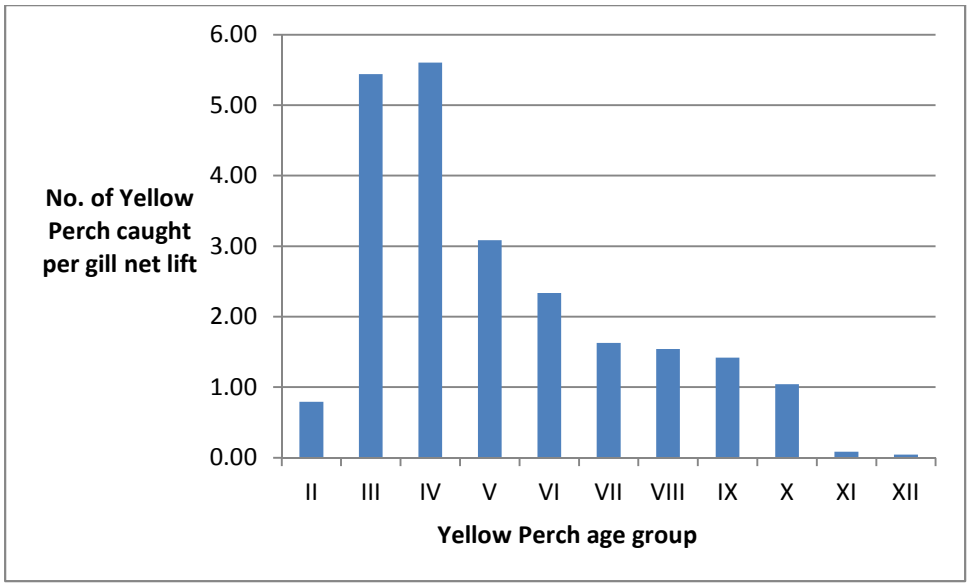

Figure 5. Number of Yellow Perch caught per gill net per age group.

Figure 6. Photo from Burt Lake survey.

Figure 7. Photo from Burt Lake survey.

Figure 8. Photo from Burt Lake survey.

Table 1. Burt Lake stocking history (1983-2015). Fin clips include: right ventral (RV), left ventral (LV), right pectoral (RP), and left pectoral (LP). Tags include: coded wire tags (CWT) and passive integrated transponder (PIT).

Year	Species	Number	Length (in)	Mark
1983	Sturgeon	1835	0	None
1984	Sturgeon	6698	5.2	None
1986	Atlantic Salmon	38	24.6	None
1987	Rainbow Trout	56434	2.32	None
1987	Rainbow Trout	43529	2.32	None
1987	Rainbow Trout	95000	2.68	None
1989	Walleye	3000	3.05	RV
1989	Walleye	3000	3.05	RV
1989	Walleye	7000	3.05	RV
1989	Walleye	3000	3.05	RV
1989	Walleye	4350	3.05	RV
1990	Sturgeon	5010	3.36	None
1990	Walleye	18346	4.56	LV
1991	Walleye	17000	4.56	RP
1992	Walleye	17000	3.56	LP
1993	Walleye	16280	3.56	RP
2009	Sturgeon	100	6.10	CWT
2010	Sturgeon	584	4.8	CWT
2011	Sturgeon	197	3.88	CWT
2012	Sturgeon	1663	4.48	CWT
2013	Sturgeon	490	4.16	CWT
2015	Sturgeon	344	6.48	CWT
2015	Sturgeon	150	6.48	CWT/PIT

Table 2. Location, agency, date, effort (hours and miles), and catch rates of age-0 Walleye in Burt Lake.

Location	Agency	Year	Month	Day	Hours shocked	Miles shocked	No. age-0	No. age-0 per hr	No. age-0 per mile
East side of Greenman Point, west and north past access site for 3 miles	MDNR	1995	9	7		3	27	--	**9**
Greenman's Point north and east to beyond Little Carp River mouth	MDNR	1997	9	10	2.00	3	36	**18**	**12**
Burt L State Park North and vicinity of landing near Hoppie's	MDNR	2001	8	28	2.35		24	**10.21**	--
From b/t Indian and Hardwood Rds (NW side of Lake) to Greenman's Point	MDNR	2010	10	11	2.00	4.62	24	**12**	**5.19**
Greenman's Point south to near Cedar Point	MDNR	2010	10	11	2.00	4.37	15	**7.5**	**3.43**
From Indian Road North and East for 2 miles	MDNR	2011	9	27	1.00	2	22	**22.00**	**11**

Table 2. Continued.

Location	Agency	Year	Month	Day	Hours shocked	Miles shocked	No. age-0	No. age-0 per hr	No. age-0 per mile
2 Miles NE from Indian Rd (approx. Little Carp R.) to Greenmans Point	MDNR	2011	9	27	1.00	2	17	**17.00**	**8.5**
Greenman Pt. S for 2 miles (White Goose Bay)	MDNR	2011	9	27	1.00	2	4	**4.00**	**2**
White Goose Bay South to just North of Cedar Point	MDNR	2011	9	27	1.00	2	10	**10.00**	**5**
Large House near Dagwell Pt South to just north of Indian River	MSU	2011	10	8	1.00	1.2	19	**19.00**	**15.8**
Just north of Indian River to State Park	MSU	2011	10	8	0.57	1.3	25	**43.86**	**19.2**
State Park west to about Fisher Trail Rd	MSU	2011	10	8	1.00	2.1	19	**19.00**	**9.0**
From Maple Bay Launch to tip of Colonial Pt	LTBB	2011	10	12	1.10	2	20	**18.18**	**10.0**
From Tip of Colonial Pt. NW to Mundt Rd.	LTBB	2011	10	12	1.02	2	16	**15.69**	**8.0**
Maple Bay launch south to Bullhead Bay	LTBB	2011	10	18	1.37	2	22	**16.06**	**11.0**
Bullhead Bay south to Kings Point	LTBB	2011	10	18	0.98	2	4	**4.08**	**2.0**
Kings Point south to Rotter Rd	LTBB	2011	10	18	0.96	2.0	6	**6.25**	**3.0**
Rotter Rd south to King Rd	SSMT	2011	10	26	0.93	2.1	10	10.75	4.8
Mundt Rd north to Indian Rd.	SSMT	2011	10	26	0.98	2.1	15	15.31	7.1
Eagle's Nest PAS south to Sturgeon River	MDNR-G	2012	10	3	2.50	5.2	9	**3.60**	**1.7**
Eagle's Nest PAS north to Hoppies	MDNR-BC	2012	10	3	2.83	5.6	12	**4.24**	**2.1**
State Park west then north to Springwell Hts.	MDNR-G	2012	10	4	1.83	5.7	36	**19.67**	**6.3**
Indian Point Rd north and east to Hoppies	MDNR-BC	2012	10	4	2.72	5.6	119	**43.75**	**21.3**
Maple Bay PAS south and west thru Bullhead Bay and Poverty Bay, to W. Resort Rd	MSU	2012	10	6	3.50	5.5	56	**16.00**	**10.2**
Little Carp R mouth south along west shore	MDNR-BC	2013	10	2	4.52	9.16	193	**42.7**	**21.1**
State Park north along west shore	MDNR-G	2013	10	2	4.97	10.8	172	**34.61**	**15.9**
State Park north along east shore	MDNR-G	2013	10	3	1.88	4.7	10	**5.32**	**2.1**
Little Carp R mouth east and south along east shore	MDNR-BC	2013	10	3	1.93	4.33	39	**20.21**	**9.0**
Eagles Nest landing north	MDNR-G	2016	9	28	1.03	2.0	43	**41.75**	**21.5**

Table 2. Continued.

Location	Agency	Year	Month	Day	Hours shocked	Miles shocked	No. age-0	No. age-0 per hr	No. age-0 per mile
NW corner of lake shock east	MDNR-G	2016	9	28	1.05	2.0	46	**43.81**	**22.8**
NE corner of lake shock south	MDNR-G	2016	9	28	0.97	2.02	60	**61.86**	**29.7**
Kings Point sourth to Rotter Rd.	MDNR-TCU	2016	9	28	0.96	2.0	15	**15.63**	**7.5**
Rotter Rd. south to King Rd.	MDNR-TCU	2016	9	28	0.88	2.0	16	**18.18**	**8.0**

Table 3. Total number captured, total weight (pounds), and length range (inches) by species for fish collected during the Burt Lake Status and Trends survey June 2015. *Weights not available. For origin (native, colonized, introduced) of each species in the watershed, see Table 16 of the Cheboygan River Assessment (Godby et al. 2015).

Species	Number	Weight (pounds)	Length Range (in.)
Common Shiner	1,842	51.1	2-5
Round Goby	1,006	*	1-4
Yellow Perch	898	211.2	0-14
Walleye	248	277.6	5-27
Rock Bass	191	59.2	2-11
White Sucker	122	182.2	3-22
Logperch	69	0.3	1-3
Johnny Darter	67	0.1	1-2
Brown Bullhead	62	64.6	3-17
Spottail Shiner	60	0.3	2-4
Northern Pike	56	200.5	11-33
Smallmouth Bass	49	100.7	6-21
Brown Trout	38	55.3	5-26
Longnose Gar	32	78.4	24-36
Black Bullhead	25	32.1	7-16
Sand Shiner	20	0.1	2-2
Silver Redhorse	18	88.2	17-29
Bluegill	11	1.8	2-8
Pumpkinseed Sunfish	5	1.4	5-7
Blacknose Dace	5	0	1-2
Common Carp	4	47.3	28-31
Green Sunfish	4	0	2-2
Bowfin	3	17.3	22-28
Lake Sturgeon	2	57.3	49-49
Largemouth Bass	2	3.9	15-15
Rainbow Trout	2	0.3	7-7
Muskellunge	1	19	40-40
Burbot	1	3.2	22-22
Black Crappie	1	0	12-12
Bluntnose Minnow	1	0	2-2

Table 4. Number captured per inch group of important sport fishes collected during the 2015 Burt Lake Status and Trends survey.

Inch group	Bluegill	Brown Trout	Northern Pike	Smallmouth Bass	Walleye	Yellow Perch
0						155
1						
2	3					83
3	2					4
4						15
5	1	1			7	52
6	2			1	17	166
7	1	1		1	3	103
8	2			5	7	105
9		1		2	19	55
10		1			44	46
11		8	1	1	6	33
12		5		7	5	62
13		4		4	13	17
14		6		1	23	2
15		4		7	18	
16		3		2	24	
17		1		4	17	
18				6	10	
19			2	4	12	
20			5	2	12	
21		1	5	2	3	
22			7		5	
23		1	7		2	
24			5			
25			4			
26		1	5			
27			6		1	
28			3			
29						
30			1			
31			3			
32			1			
33			1			

Table 5. Comparison of mean length (inches) at age for various sport fishes captured in Burt Lake in select surveys from 1980-2015. Number in parentheses represents number of fish aged. Growth comparisons were across all ages.

Species	Age Group	1980	1995	2001	2015	2015 growth compared to state average
Black Crappie	XI				12.7 (1)	--
Bluegill	I				2.9 (4)	--
	III				5.5 (1)	
	IV				6.5 (1)	
	V				6.5 (1)	
	VI				7.2 (1)	
	VII				8.3 (1)	
	VIII				8.1 (1)	
Brown Trout	I				6.6 (2)	--
	IV				17.9 (1)	
Largemouth Bass	V				15.4 (1)	--
Muskellunge	V				40.4 (1)	--
Northern Pike	II		17.1 (1)	17.4 (4)	19.4 (1)	-1.1
	III			21.6 (43)	21.0 (4)	
	IV	23.4 (2)		23.5 (20)	22.7 (10)	
	V			24.2 (14)	23.9 (24)	
	VI			28.6 (10)	28.1 (11)	
	VII			28.8 (7)	29.2 (8)	
	VIII			29.6 (9)	32.6 (2)	
	IX			37.0 (2)		
Pumpkinseed sunfish	III				5.4 (1)	--
	IV				6.3 (1)	
	VI				7.0 (2)	
	VII				7.5 (1)	
Rainbow trout	II				7.6 (2)	--
Smallmouth bass	I				7.3 (4)	+1.6
	II				9.7 (7)	
	III				12.4 (8)	
	IV				15.2 (11)	
	V				17.1 (3)	
	VI				17.0 (1)	
	VII		18.5 (1)		18.5 (5)	
	VIII				19.0 (2)	
	IX				18.3 (1)	

Table 5. Continued.

Species	Age Group	1980	1995	2001	2015	2015 growth compared to state average
	X				19.0 (1)	
	XI				19.4 (4)	
	XII				20.9 (2)	
	XIV				21.9 (1)	
Walleye	I			6.8 (3)	6.1 (19)	-1
	II			11.0 (14)	9.4 (30)	
	III	14.4 (25)	13.4 (59)	14.1 (64)	13.5 (37)	
	IV	16.2 (24)	15.7 (76)	16.1 (34)	16.0 (15)	
	V	18.0 (17)	17 (42)	17.3 (22)	17.4 (14)	
	VI	18.9 (8)	18.7 (67)	17.8 (65)	18.7 (13)	
	VII	19.8 (12)	20.4 (69)	19.0 (44)	20.5 (9)	
	VIII	21.1 (23)	19.7 (39)	19.4 (14)	20.7 (8)	
	IX	23.0 (13)	20.4 (22)	20.7 (13)	20.9 (3)	
	X	23.3 (1)	21.4 (28)	21.8 (12)	24.6 (4)	
	XI XII		22.2 (17) 24.8 (4)	20.3 (7) 21.5 (7)	22.4 (1)	
	XIII			21.9 (7)		
	XIV			22.1 (2)		
	XV			23.0 (4)		
	XVI			21.3 (1)		
	XVII			22.4 (1)		
	XVIII			22.7 (2)		
	XIX			-		
	XX			22.2 (1)		
Yellow Perch	I				2.7 (13)	-0.4
	II				4.7 (15)	
	III				6.0 (13)	
	IV				7.4 (14)	
	V				8.4 (8)	
	VI				9.7 (12)	
	VII				10.0 (9)	
	VIII				11.3 (11)	
	IX				12.5 (9)	
	X				12.9 (7)	
	XI				13.7 (3)	
	XII				14.5 (2)	

Table 6. Water temperature, dissolved oxygen, and pH profile of Burt Lake, Cheboygan County, measured on August 25, 2015.

Depth (ft)	Temperature (°F)	Oxygen (ppm)	pH
0	71.4	11.95	8.17
3	71.4	11.73	8.21
6	71.4	11.62	8.23
9	71.4	11.6	8.23
12	71.4	11.57	8.24
15	71.4	11.56	8.24
18	71.4	11.62	8.25
21	71.4	11.65	8.26
27	71.4	11.65	8.27
30	71.4	11.72	8.33
33	71.4	11.73	8.34
36	71.4	11.7	8.35
39	71.4	11.64	8.36
42	71.2	11.42	8.36
45	70.1	11.11	8.35
48	69.1	9.28	8.24
51	63	1.71	7.9
54	59.7	1.05	7.87
57	58	0.06	7.83
60	56.9	0.2	7.8
63	56.2	0.11	7.79
66	55.1	0.07	7.75
69	54.9	0.06	7.74

Table 7. Water chemistry measurements for Burt Lake, Cheboygan County. Water samples collected August 25, 2015. * denotes sample was collected as an integrated epilimnetic sample; all other parameters were measured at the surface.

Parameter	Concentration
Alkalinity, total (mg/L)	146
Chlorophyll a (ug/L)*	0.88
Nitrogen, ammonia (mg/L)	0.020
Nitrogen, nitrate + Nitrite (mg/L)	0.016
Nitrogen, Kjeldahl (mg/L)	0.277
Phosphorus, total (mg/L)	0.004