Muskallonge Lake
Luce County, T49N, R11W, Sec. Many
Lake Superior watershed, last surveyed 2006

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Environment

Muskallonge Lake lies immediately south of the Lake Superior shoreline in central Luce County, about 27 mi north of Newberry. The majority of the shoreline is undeveloped. The north central shoreline is state owned and lies within Muskallonge Lake State Park. The east shoreline is owned by several private riparians and a resort with a small grocery/sporting goods store. The northwest section is also owned by several private riparians, with another, smaller grocery store. In addition, the southwest section has several private riparian residences. Vegetation on most of the shoreline is primarily coniferous with some hardwoods. The western shoreline, the lowest area of the perimeter, is dominated by cedars, with some black spruce. Trout Creek, the primary water source, enters the lake through a cedar swamp, while a small overflow stream nearby drains westerly into Cranberry Lake. From Cranberry Lake a high water drainage flows north under the Deer Park Truck Trail and then east to Lake Superior. Because of an extended duration of relative drought conditions, the high water drainage stream under the truck trail has not flowed for many years. There only public boat access is located north-centrally within the Muskallonge Lake State Park.

Muskallonge Lake is 785 acres, with a maximum depth of about 20 ft (Figure 1). Shorelines are generally wide and shallow, while the littoral zone (0-15 ft) comprises roughly 85% of the surface area. Sand is the predominant substrate, with some organic peat in the shallow north central bay and in the deep hole located in the south central area. Shoreline perimeter is sparsely vegetated with bulrush (Scirpus) and spikerush (Eleocharis). The central basin is dominated by a series of many parallel shallow ridges running roughly southwest to northeast, with the tops about 6 ft deep and the valleys about 12 ft. Although some submerged pipewort (Eriocaulon) colonies exist, fern pondweed (Potamogeton robbinsii) comprises the majority of submerged macrophyte colonies. Fern pondweed completely covers much of the central basin, providing a coarse bottom carpeting as one drifts over the undulating substrate.

Muskallonge Lake does not stratify during the summer. An August 2004 limnological profile found 73 (degrees F) at the surface with 9.6 mg/l of dissolved oxygen. Temperature remained the same down to 10 ft, with only a slight decline in dissolved oxygen concentration. Bottom temperature (at 18 ft) was 71 (F), with 9.0 mg/l dissolved oxygen. This is a soft water lake, with alkalinity of 24 mg/l CaCO3. Nitrate and nitrite concentrations in August were very low, at 0.0031 mg/l. Likewise, the zooplankton community was very sparse. That combination of parameters indicates that Muskallonge Lake is a relatively unproductive system.

Muskallonge Lake received considerable attention in 1958, when a landowner began digging a canal north toward Lake Superior. The intent of this project is unknown. The landowner was stopped before he reached Lake Superior, which lies about 32 ft below the normal Muskallonge Lake level (Figure 2). Although the project was never finished, the 1,300 ft canal was deep enough to start draining the lake. MDNR File records document that water was flowing into the canal for over two weeks, with a current

strong enough to keep it from freezing in mid-December, 1959. Rather than filling the canal, water entering from Muskallonge Lake was leaking out through the bottom of the canal

Muskallonge Lake is perched on a permeable sand plateau but the sand under the lake generally does not leak water. Arthur E. Slaughter, Michigan Conservation Department geologist at Escanaba (Newberry office files) found that a row of twelve holes dug within a few feet of the lake all remained dry. One hole, right at the water's edge and surrounded on three sides by water, also remained dry despite the sand substrate. In addition, the person dredging the canal claimed that no water infiltrated the dredged area until he breached the shoreline to allow lake water to enter. Slaughter described it as a most unlikely and unusual situation, in which sand at the bottom interface must film over with an impervious material. Slaughter agreed with the local opinion that the dredged canal did not have such an impervious film at the bottom, allowing the lake water to drain through the highly permeable sand substrate. Because the lake level is too low to allow flow into the canal and because the canal still contains water there are no obvious signs of water leaking out of the canal at present. An aerial photograph (Figure 2) taken in 1998 shows the low lake level and standing water in the canal.

History

Muskallonge Lake recorded history extends back to 1936. A comprehensive gillnetting survey was conducted at that time. Survey comments were of few game fish, many suckers, very few bullheads, seven shiner species and two darter species. A local land owner at that time observed that northern pike were not as abundant or as large as they were formerly. An extensive survey in 1942 (Roelofs 1942) described heavy fishing pressure at the lake. Dr. Roelofs classified northern pike and smallmouth bass as common, yellow perch and white sucker as abundant, rock bass as few, and walleye as "reported." Interestingly, he described ten minnow or darter species but made no mention of bullheads. Dr. Roelofs claimed that by 1942, 3,190,000 walleye fry had been stocked into Muskallonge Lake, with little success in establishing a good walleye population. No records of that stocking effort exist in the local file. In fact, there are vague references in the files of other fish stocking efforts as well, but not documented. For example, a 1977 stocking request for bluegills and muskellunge accompanied a request to convert Muskallonge Lake into a muskellunge rearing water. However, no actual stocking record for either species exists in local files. Stocking records became well documented in the 1980's. Dr. Roelofs concluded his report by classifying the lake as a pike lake and recommending against further walleye stocking.

A 1955 netting survey captured 17 northern pike, 17 yellow perch, 9 rock bass, 8 white suckers, and 9 bullheads. Despite their presence in 1936, a local resident claimed that those bullheads were the first evidence of bullheads in the lake. Later, a 1970 survey captured 32 northern pike, 25 yellow perch, 9 rock bass, 3 smallmouth bass, 1 largemouth bass, 5 white suckers, and 325 bullheads.

Many bullhead and white sucker manual removal efforts were conducted since 1979 (Table 1). Bullhead average size increased from 7.2 inches in 1979 to 7.9 inches in 1992, and then to 10.1 inches in both 1998 and 2004. A 1977 survey, included in the table as "a starting point," showed that bullheads comprised 54% of the catch biomass while white suckers comprised 32%. Sucker removals were stopped after 1994. The sucker population since then has never comprised more than 8.4% of the total catch based on biomass. Since northern pike target suckers for forage, the consistently smaller sucker populations might explain, in part, the slow growth rates of pike over this time.

Muskallonge Lake was not stocked from 1980-1990. Walleye fingerlings were stocked from 1991 to 2006, totaling over 230,000 (Table 2). Smallmouth bass fingerlings were stocked in 1998. Despite multiple manual removals and fish stockings, the fish community remained relatively stable from 1985 - 1998 (Table 3). Rock bass average size had been remaining relatively similar over the years until the 1998 survey. That survey, however, was conducted in May rather than in August like the others, and the different sampling season may have contributed to observed size differences in rock bass, smallmouth bass, and northern pike. .The smallmouth bass population, not sampled in 1977, had increased in numbers and average size. The northern pike population increased in average size in the late 1990s, most likely due to the change in minimum legal size from 20 to 24 inches in the mid-1990s. Beginning in 2002, northern pike regulations were set at a 0 in minimum legal size.

A 2002 summer creel census revealed that the lake primarily supports a pike fishery. The estimated harvested of 2,372 pike averaged 21.2 inches, with only 15% larger than 24 inches (Table 4). All harvested pike were legal due to the no minimum size regulation. Yellow perch, with an estimated 1,031 harvested, were the second most caught fish. Only 11% of the harvested perch, however, were larger than 7 inches. Other fish harvested, in descending order of catch rate, were rock bass, walleye, smallmouth bass, and pumpkinseed sunfish. Anglers fished an estimated 21,000 hours, with 9,000 angling trips. Total estimated fish/hour was 1.014. Those numbers and the estimated catch per acre are far higher than those from previous summer creel censuses in eastern Upper Peninsula waters (Table 4). The only census with somewhat comparable estimates is from Thunder Lake, Schoolcraft County, which overlies the much more fertile Niagara limestone escarpment.

Current Status

Northern pike numbers were similar to those in previous surveys, but their average size was considerably larger. At -0.8 inches slower than state average, they were growing much faster than they had since before 1985. The population contained 13% legal in 1985, and 10% legal in 1992, with a 20-inch minimum size. That percentage rose to 18% in 1998, with a 24-inch minimum size. The recent change to a 0-inch minimum size, however, appears to have made a positive change in the population size structure. Fifty-two percent of pike captured in 2004 were greater than or equal to 24 inches (Table 5).

A June 2004 status and trends survey utilizing two types of impoundment nets, gillnets, and shoreline seines was conducted beginning in early June. Several trips to Muskallonge Lake were required to complete the survey, which ended in early August. A total of 3,579 fish were captured, with a total weight of 1,860 lbs (Table 5). Despite previous bullhead removals, brown bullheads totaled 1,309 lbs, comprising 70% of the total catch in terms of biomass. Bullhead average size was very good at 10.1 inches. The white sucker population was 7.3% of the total catch based on biomass, similar to what it has been since 1985.

Growth rates for pumpkinseeds and smallmouth bass were at state average (Table 6). Rock bass were growing 0.6 inch below state average, but not slowly enough to be considered stunted. Despite the fact that Walleyes had been stocked since 1991 (Table 2), their numbers and average size were lower than in the 1992 survey. Perch numbers and average size were also lower than in 1992. Neither species

was captured in enough numbers to provide an estimate of growth rate. Likewise, walleye and yellow perch were not present in large enough numbers to produce more than an occasional angling catch.

Analysis and Discussion

Comparison of the 1998 and 2004 netting surveys indicated that northern pike average size increased from 21.7 in to about 24 in. Also during that period, sucker percent biomass and size remained stable, while rock bass percent biomass increased 400% with a similar average size. Smallmouth bass percent biomass increased over 200% and average size increased 0.5 in. Walleye percent biomass and average size remained roughly unchanged. Yellow perch were scarce and their average length was considerably smaller than in 1998.

Long-term data imply that northern pike, rock bass, and smallmouth bass populations may have benefited somewhat from the periodic bullhead manual removals. Populations remain so small, however, that random capture of only a few more specimens during a survey will statistically show a large change from the previous survey. Northern pike have apparently benefited from the change in minimum legal size, as the differences in average size and percent of the catch biomass between the 1998 and 2004 surveys were striking. Pike are currently regulated in Muskallonge Lake with no minimum size and five fish per day limit. Despite the relaxed harvest regulations, their average size has increased. A relatively large number of pike 24-30 in were observed during the 2004 status and trends survey.

Results from the 2004 extensive survey indicated a drop in bullhead percent biomass, falling from 86% in the 1998 netting survey down to 70% in 2004. Average size remained the same at 10.1 in. A 2006 bullhead manual removal with less netting effort still resulted in removal of 13.4 lbs/a, while the fish averaged about 2 in smaller than they did in 2004. Empirical weight of a 150-fish sample proved to be about 10.8 lbs (34%) lighter than the computer-generated weight for the sample. Previous bullhead populations sampled in the 1990s were comprised of robust individuals. The discrepancy indicated a significant reduction in bullhead physical condition, possibly reflecting an increase in numbers and/or decrease in available forage.

Bullhead removals resulted from an early theory that the huge population of stunted bullheads, averaging about 7 in, were comprising an almost impervious barrier to survival and growth to maturity of all the other fish species. Stunted bullheads compete with all species' fingerlings for food, plus prey on the fingerlings themselves. Each bullhead removal would reduce the population size for at least 1-2 years each time, possibly allowing other species' fingerlings to "slip through" the bullhead barrier into maturity. In addition, the theory predicted that the resulting greater number of mature predators would exert some predation control on the bullhead population.

Removals have increased bullhead size, which in turn probably increased their fecundity. In addition, the removals in effect increased forage base availability for the fewer remaining bullheads, which would allow them to grow faster. The combination of increased size, increased fecundity, and more available forage together probably create a condition where bullhead populations can increase rapidly following each removal. Each removal, then, reduced natural feedback mechanisms for limiting bullhead population size and created an unstable system that promoted larger individuals capable of rapid population growth. Those changes potentially result in long-term instability, which could be

more taxing on resources than if bullheads were undisturbed in the system. Even so, the natural feedback mechanisms did not historically reduce bullhead numbers below about 90% of the total fish community biomass. The history of bullhead removals in Muskallonge Lake is one of trying to alter the natural fish community structure to allow better survival and growth of sports fish.

After all of the removals, the question still remains whether periodic bullhead reductions made any positive changes in the fish community structure. Because relative abundance and species population changes have been so minimal over the years, one has to wonder about the efficacy and cost-benefit ratio of another removal. After 30 years of removals, bullheads still dominate the lake and sport fishes still remain a small fraction of the total biomass. For that reason, it makes sense to discontinue the bullhead removals.

A walleye population estimate was conducted in 1999. Using methodology from the MDNR manual of fish survey methods II (Schneider 1998), results of that study produced an estimate of 380 adults. We had stocked 20,000 SF annually for five years, and then on alternate years for six more years. These results, together with the failed stocking attempts in the 1930s (Roelofs 1942) indicated that walleyes are probably never going to provide a good fishery. Based on data collected throughout the state, walleye do poorly in lakes less than 1000 acres that are shallow (<30ft) and have low nutrients.

Management Direction

Future management should maintain an adequate fish community balance to sustain viable angling populations of northern pike, yellow perch, smallmouth bass, and rock bass. Northern pike and yellow perch should be closely watched to make sure those populations remain viable. The perch population should especially be watched to see if it can rebound from its current low numbers. Since the smallmouth bass population appears to be increasing, it should be watched as well. Rock bass are producing a modest fishery, and since that population has been quite stable over the years, little effort should be needed to maintain it. Current active management of Muskallonge Lake includes bullhead manual removals, walleye stocking, and change in harvest regulations for northern pike. Those management items will be discussed below.

There had been concern about the number of small pike harvested during the last three years, especially the possibility of taking enough small pike to limit recruitment into the larger sizes. The 2004 survey indicated that there was no immediate concern about the future of the pike population. The no minimum size limit should be continued until the next survey, probably in 6 - 10 years.

Walleyes generally target yellow perch as their predominant forage, such that their populations are inter-connected. Because of the concurrent drop in numbers and sizes of both species, it makes sense to cease all walleye stocking. The final year of the current Muskallonge Lake stocking request was 2006. That request should be allowed to lapse for a few years to see if yellow perch populations increase.

All management plans will have to include consideration of the modest productivity in this lake. About 80-85% of the lake is shallower than 15 ft, which generally implies a highly productive system. The Muskallonge Lake aquatic vegetation, however, is dominated by an extensive coarse carpeting of fern pondweed, Potamogeton robbinsii. Because only miniscule amounts of other aquatic plants reach

upward through the water toward the surface, almost all vegetative matter is confined to the near-bottom portion of the lake. Statewide, that ecological niche is generally dominated by northern pike and bullheads, and helps explain why, despite extensive efforts to change the fish community structure, the lake remains dominated by those two species. For the same reason, it seems reasonable to discontinue bullhead manual removals.

References

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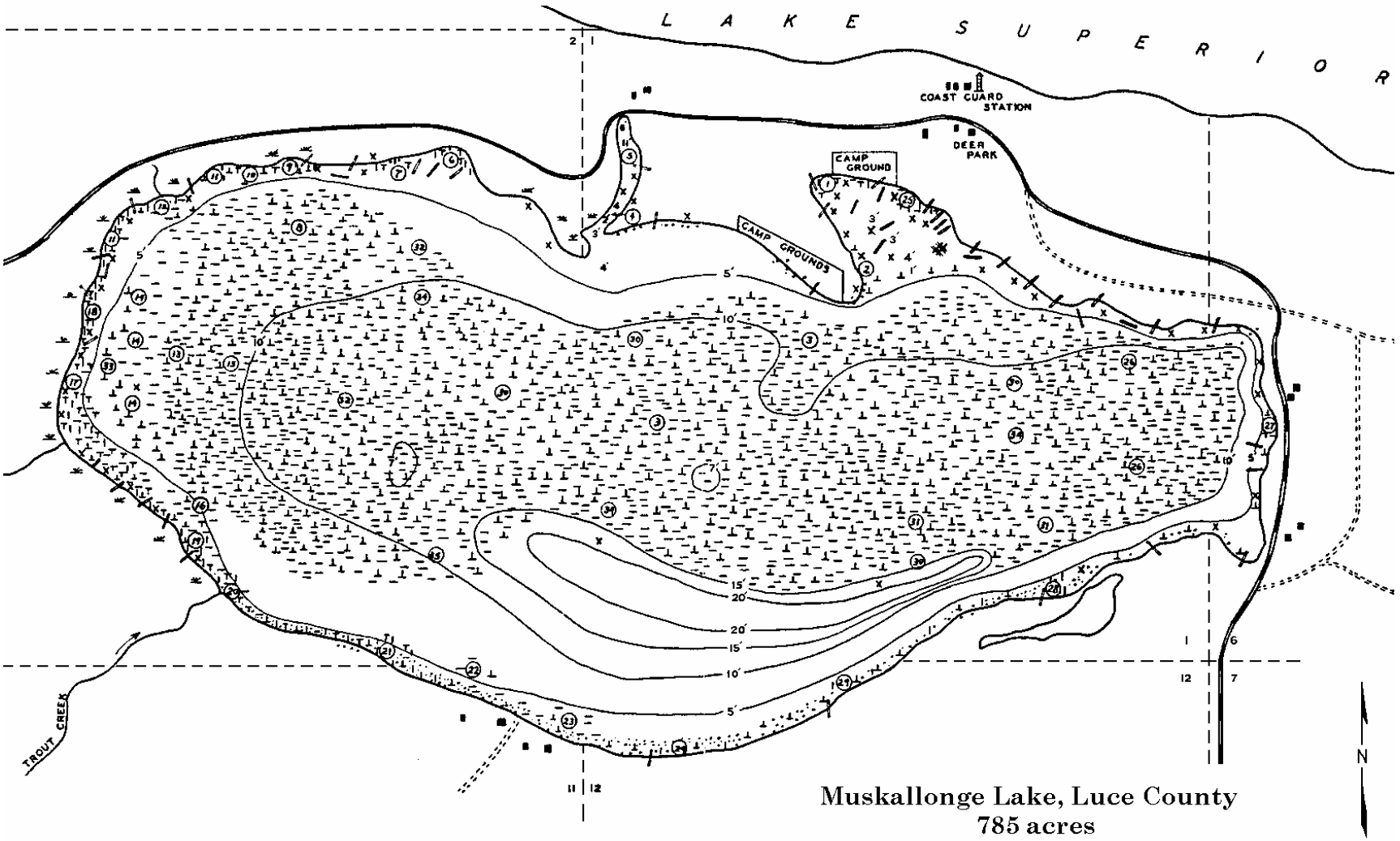

Figure 1 – Muskallonge Lake contour map.

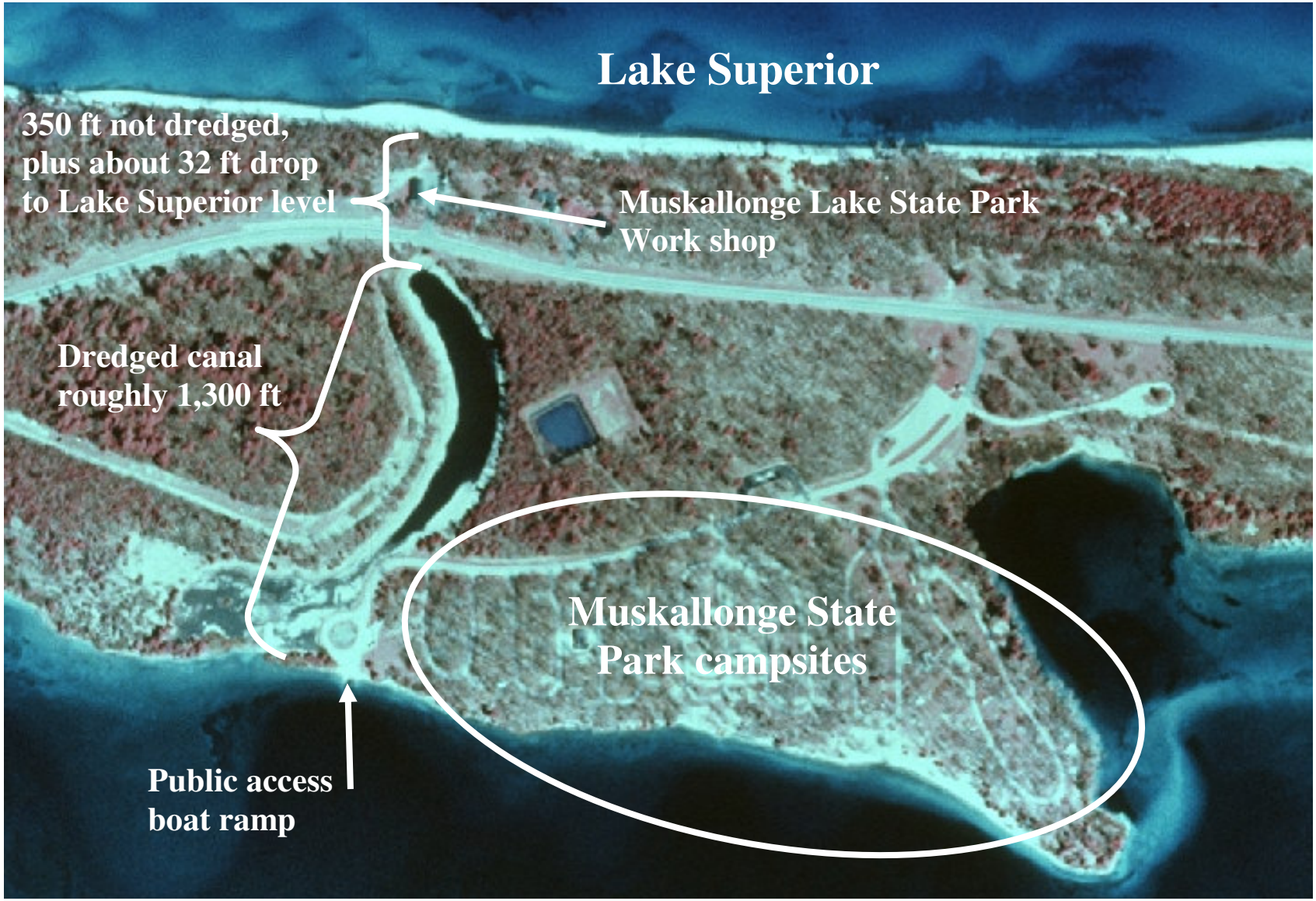

Figure 2 – Detail of canal dredged in 1958.

Table 1 – Muskallonge Lake manual removal efforts, and percent of bullhead and white sucker catch biomass from several netting surveys.

	Bullhead			White sucker		
Date	Removal (lbs)	Pounds per acre	Biomass %	Removal (lbs)	Pounds per acre	Biomass %
1977*	---		54	---		32
1979	6,265	8.0		1,627	2.1	
1980	1,837	2.3		700	0.9	
1981	2,701	3.4		15,028	19.1	
1985*	1,128	1.4	88	115	0.1	6
1987	9,641	12.3		4,686	6.0	
1988	8,684	11.1		14,975	19.1	
1992*	1,370	1.7	79	128	0.2	7
1993	14,413	18.4		9,599	12.2	
1994	2,824	3.6		950	1.2	
1998*	3,554	4.5	86	---		7
1999	14,300	18.2		---		
2001	6,245	8.0		---		
2002	2,344	3.0		---		
2004*	1,309	1.7	70	---		7
2006	10,589	13.5		---		

* Netting surveys. After 1977, captured bullhead and suckers were removed during each survey as indicated in the table.

Table 2 – Fish stocking history for Muskallonge Lake, Luce County, from 1991 – 2006. All fish stocked were spring fingerlings. No fish were stocked from 1980 – 1990.

Year	Species	Strain	Number	Size (in)
1991	Walleye	Bay De Noc	24,165	2.1
1993	Walleye	Bay De Noc	20,572	2.0
1994	Walleye	Bay De Noc	20,000	1.6
1995	Walleye	Bay De Noc	19,968	2.0
1996	Walleye	Bay De Noc	22,230	1.9
1997	Walleye	Bay De Noc	14,491	2.1
1998	Walleye	Bay De Noc	20,140	1.5
1998	Smallmouth bass		2,006	2.6
2000	Walleye	Bay De Noc	10,038	1.9
2002	Walleye	Bay De Noc	8,107	1.9
2004	Walleye	Bay De Noc	11,136	1.4
2006	Walleye	Bay De Noc	10,003	1.4

Table 3 – Survey catch parameters for eight fish species from Muskallonge Lake captured during surveys in August 1977, August 1985, August 1992, and May 1998.

	% of catch biomass				Mean growth index[1]			
Species	1977	1985	1992	1998	1977	1985	1992	1998
Bluegill[2]	0.9	---	---	---	---	---	---	---
Brown bullhead	53.9	83.0	79.0	86.0	---	---	---	---
Northern pike	8.6	4.4	1.7	2.5	---	-3.3	-2.9	-4.8
Rock bass	3.7	2.1	7.1	3.2	---	+0.5	---	---
Smallmouth bass	---	1.1	1.3	0.9	---	---	-1.0	-1.3
Walleye	---	---	2.5	0.3	---	---	+1.9	-0.1
White sucker	32.2	8.4	7.4	6.8	---	---	---	---
Yellow perch	0.8	1.0	0.9	0.1	---	-0.7	-1.1	-0.6

	Average length (in)				% legal/acceptable[3]			
Species	1977	1985	1992	1998	1977	1985	1992	1998
Bluegill[2]	4.4	---	---	---	0	---	---	---
Brown bullhead	8.6	10.1	7.9	10.1	92	58	28	52
Northern pike	17.1	18.4	14.8	21.7	20[4]	13[4]	10[4]	18[4]
Rock bass	6.9	6.5	6.9	8.7	55	61	65	91
Smallmouth bass	---	9.4	8.3	12.4	---	0	10	20
Walleye	---	---	19.7	15.6	---	---	100	44
White sucker	19.2	17.5	15.7	17.7	---	---	---	---
Yellow perch	5.8	8.0	8.5	7.6	11	88	94	40

[1] Mean growth index is the average deviation from the state average length at age in inches.
[2] Bluegill were stocked in 1974.
[3] Percent legal or acceptable size for angling harvest.
[4] Minimum legal size for northern pike from before 1977-1992 was 20 inches. Minimum legal size for pike in 1998 was 24 inches. There was no minimum legal size for pike in 2002. The percentage shown for 2002 was of the normal 24 inch state regulation for comparison purposes.

Table 4 - Creel census comparisons of five lakes in the eastern Upper Peninsula. The Muskallonge Lake census occurred May 28-September 30, 2002 (Su 2006). Petes Lake, Schoolcraft County, was surveyed May 15-September 11, 1993, and Thunder Lake, Schoolcraft County, May 15-September 16, 1995 (Lockwood 2000). Both Beaver and Grand Sable Lakes, Alger County, were surveyed May 15-September 30, 1998 (Lockwood 2000). Muskallonge, Beaver and Grand Sable Lakes lie adjacent to Lake Superior in relatively sterile sand dune country, while Petes and Thunder Lakes overlie the more fertile Niagara limestone escarpment.

	Muskallonge Luce 786 acres		Grand Sable Alger 630 acres		Beaver Alger 765 acres		Petes Schoolcraft 194 acres		Thunder Schoolcraft 340 acres	
Species	C/H	Total	C/H	Total	C/H	Total	C/H	Total	C/H	Total
HARVEST										
SMB	0.008	163	0.007	34			0.023	69	0.013	77
LMB							0.001	17		
WAE	0.010	218			0.100	621	0.072	217		
YEP	0.049	1,031	0.030	154	0.100	640	0.005	15	0.715	4,289
NOP	0.113	2,372	0.002	9	0.005	29			0.064	381
RKB	0.039	817	0.009	44			0.001	4	0.006	36
BLG							0.052	156	0.328	1,969
PSF	0.005	101							0.003	18
LAT			0.031	158						
Total Harvest	0.224	4,703	0.078	399	0.199	1,290	0.155	464	1.128	6,770
Harvest/Acre		6.0		0.6		1.7		2.4		19.9
RELEASED										
SMB	0.025	520	0.072	367	0.009	55				
LMB	0.001	15								
WAE	0.014	292			0.296	1,923				
YEP	0.240	5,025	0.311	1,599	0.087	562				
NOP	0.331	6,955	0.045	233	0.173	1,126				
RKB	0.168	3,529	0.010	50						
BLG	0.003	63			0.005	33				
PSF	0.008	162								
LAT			0.002	12						
Total Released	0.790	16,576	0.440	2,261	0.569	3,699				
Total Catch	1.014	21,279	0.518	2,660	0.768	4,989	0.155	464	1.128	6,770
Catch/Acre		27.1		4.2		6.5		2.4		19.9
Angler Hours		20,985		5,136		6,496		2,996		6,000
Hours/Acre		26.7		8.2		8.5		15.4		17.6
Angler Trips		8,934		1,468		1,847		1,101		2,606

Table 5 – Number, weight, and length by species for Muskallonge Lake, Luce County, from a status and trends survey using fyke, trap, and gillnets, and seines, June 7-11, 2004.

Species	Number	Percent by number	Weight (lbs)	Percent by weight	Length range (inch)	Average length (inch)	Percent legal sized[1]
Blackchin shiner	1	0	0	0	1	1.5	
Brown bullhead	2620	73	1309	70	5 – 12	10.1	93
Logperch	3	0	0	0	2 – 3	3.2	
Northern pike	33	1	101	5	12 – 30	23.1	52
Pumpkinseed	19	1	4	0	4 – 7	6.1	58
Rock bass	764	21	267	14	3 - 11	7.6	90
Smallmouth bass	29	1	36	2	8 – 17	12.9	34
Spottail shiner	50	1	1	0	2 – 3	3.3	
Walleye	5	0	6	0	11 – 19	14.5	40
White sucker	51	1	136	7	6 – 24	18.2	
Yellow perch	4	0	0	0	1 - 7	5.5	25

[1] Percent legal sized is the percent of the population legal or acceptable size for angling harvest.

Table 6 – Weighted mean length at age of six species from Muskallonge Lake, status and trends survey using fyke, trap, gillnet and seine, June 7-11, 2004.

	Ages										Mean growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	X+	index[1]
Northern pike	13.1	17.3	21.4	24.3	25	26.3	26.2	22.7			-0.8
	(3)	(2)	(3)	(5)	(15)	(3)	(1)	(1)			
Pumpkinseed			5.0	6.2		7.0	7.9				0.0
			(11)	(2)		(11)	(1)				
Rock bass		4.3	4.6	5.7	6.6	7.8	8.1	9.0	9.5		-0.6
		(1)	(5)	(3)	(8)	(31)	(30)	(1)	(1)	(2)	
Smallmouth bass		8.8	11.1	12.6	15.3	16.3					0.0
		(2)	(9)	(13)	(6)	(4)					
Walleye		11.0	13.3			19.3					---
		(1)	(2)			(1)					
Yellow perch		6.1	6.6	6.7							---
		(1)	(3)	(5)							

[1] Mean growth index is the average deviation (in.) from the state average length at age.