Bass Lake

Luce County, T47N, R11W, Sec. 17, 18, 19, 20
Tahquamenon River Watershed, Last Surveyed 2008

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Environment

This lake of approximately 145 acres is located on County Road 455, approximately 9.2 miles northwest of McMillan. Forest vegetation around the lake are mixed hardwood stands, mostly of maple and beech, with some stands of white pine and hemlock along the shoreline. Surrounding soil is glacial till of mixed rock, gravel, and sand. A sand beach encircles the lake, extending in most areas out to about the 30 ft contour. The sole sunken island, about 30 feet down from the surface, is also sand. Fibrous peat is found in the few small bays, while organic material is found in the deeper areas. Water connections exist to Little Buckeye Lake on the west and Goose and Murray Lakes to the east during high water. However, current low lake levels do not provide the water connection to Little Buckeye Lake. The intermittent stream out of Bass Lake flows northeasterly into Goose Lake through a culvert under County Road 455. Although the surrounding property is privately owned, the State of Michigan owns the cement plank launch site. However, anglers and campers were using the site for many years before the state bought it. Because of the low water level, people must back beyond the cement planks onto relatively soft sand and gravel to launch boats from a trailer. One cabin exists on the lakeshore. It is located along the northeast shoreline of the northwest bay on a 20 ft, steeply-sloped, wooded shelf. There is also a state forest campground across County Road 455 from the launch site.

Much of the shoreline consists of a narrow, shallow beach with a relatively steep drop-off to about 30 ft (Figure 1). For that reason, the littoral zone, 0-15 ft, comprises only about 10-15% of the surface area. The 30 ft contour flattens into a broad shelf along the southwest portion of the lake. A transect line extending from northwest to southeast will intersect four deep areas of 50+, 74, 55, and 68 ft. The shoreline perimeter contains numerous downed and partially floating logs and deadheads, some extending out over the steep drop-off. Shallow submerged aquatic plants are relatively scarce, although some Potamogeton colonies exist within the 10-25 ft contours. Yellow pond lilies, Nymphaea, are found in the small, shallow bays with organic substrate. Eleven fish structures were placed just off the drop-off around the lake in 1957.

Dissolved oxygen concentrations in September 1952 ranged from 9.8 mg/l at the surface to 9.5 at 20 ft and 5.5 at 40 ft. In August 2008, it ranged from 9.2 mg/l at the surface to 8.6 at 25 ft, 6.0 at 28 ft, and 1.1 at 33 ft. The increased volume of anoxic water is probably not anthropogenic because there is no significant urban development on the lake. The pH in 2008 was 8.0 at the surface, falling to 6.7 at 25 ft, 6.1 at 28 ft, and 5.9 at 33 ft. Conductivity was 17 umhos through the epilimnion, and alkalinity was 6 mg/l CaCO3.

History

Anecdotal history for this lake dates back to 1919, via file narratives by Lee Anderson, previous Fisheries supervisor. Newberry and McMillan residents described to him how people used to come to the lake with horse and wagon, and take home "wagon loads" of both largemouth and smallmouth bass. A 1957 file report by Lee Anderson described Bass Lake as "one of the Little Mendotas in the middle west. Lake Mendota is that fabulous perch producing lake located within the city limits of Madison, Wisconsin." Even so, stocking records showed that bass and bluegill were stocked from 1937 to 1941. Rainbow trout were stocked annually from 1953 to 1966. Although 2,000 legal rainbow trout were stocked annually from 1953, the protocol was changed to 10,000 fall fingerlings in 1965 and 3,000 fall fingerlings in 1966. Rainbow trout survival and growth declined precipitously after 1965, and fall fingerling splake were stocked beginning in 1966. Correspondence in 1969 between Lee Anderson and Merle Galbraith, Fisheries Research Biologist, discussed the the association of poor survival and growth of trout with an apparent decline in zooplankton, particularly numbers of large Daphnia. At that time, Galbraith noticed an inverse relationship between yellow perch and rainbow trout abundance, and suggested discontinuing all trout stocking. He also suggested that if trout were the more desirable species, the lake perimeter should be treated with antimycin in 1970 to remove large numbers of small perch. The antimycin treatment was conducted as suggested and either rainbow trout, splake, or lake trout were stocked annually until 1985. Trout stockings were discontinued after 1985 because they continued to exhibit low survival. Beginning in 1987, after yellow perch populations were thinned by a manual removal, walleye were stocked every year until 1992, then on alternate years until 2004.

A 1996 netting survey found that perch growth rates had declined since 1991. Faster growth rates of perch in 1991 may have been in response to the 1987 manual removal, which most likely caused a short term increase in growth. Walleye growth, as expected, had declined considerably compared to the first couple of years that they were stocked. Northern pike still were growing well, although few in number, and no golden shiners were captured, compared to many in 1981. Perch numbers in 1996 were down, concurrently with their growth rates. Since splake and perch compete for many of the same food resources it was hypothesized that they had depressed the benthic community. Even ten years after splake plants were discontinued, a stunted perch population could potentially have been keeping the benthic organisms cropped off, thereby limiting their own numbers and growth rates.

The walleye stocking program that began in 1987 was evaluated through recruitment surveys (Serns index) and through fyke netting surveys. A netting survey conducted in 2001 confirmed the existence of successful natural reproduction of walleye that was first detected in the 2000 walleye recruitment survey. Walleye growth rates were well above state average. Naturally reproduced walleye from the 1999 year class captured in 2000 as yearlings had a growth index of +2.2", and 2-year-old walleyes from the same year class captured in 2001 also exhibited excellent growth (growth index of +3.0"). Although the walleye growth rate in 2001 remained excellent, it appeared unlikely that it would remain good because the forage base appeared small relative to the number of predators. Northern pike were still growing well at -0.3 inches, compared to State Average, although what they were foraging on was unknown. Walleyes, other pike, and a few larger perch were apparently the only suitable-sized forage for them. Yellow perch growth rates had improved in 2001 compared to the 1996 survey, but their average size and the average number caught per net (CPE) were both down. Although all growth rates were acceptable, the observed forage base appeared incapable of sustaining the high proportion of predators.

The biggest concern for Bass Lake in 2001 was the lack of balance between predator and prey species. In 1996, predators (walleye, splake, northern pike, and smallmouth bass) comprised 91.7% of the total biomass by weight. Even without including the two large splake captured in 1996, the biomass of predators during that survey was still 69.5% by weight of the total catch. No splake were captured in this 2001 survey. Since splake stocking was eliminated in 1990, it is likely that all those fish were out of the system in 2001. Nevertheless, predators in 2001 comprised 74% of the biomass by weight. This was a dangerous situation, with great potential for collapse of the whole fish community structure due to excess predation.

Management recommendations stemming from the 2001 survey were to stop all walleye stocking before this fishery totally collapsed. Natural reproduction of walleyes was already occurring and that may have been enough to maintain a decent fishery in this lake. For example, walleyes were stocked in 1994, 1996, 1998 and 2000, while growth analyses showed that walleyes captured during the 2001 survey were spawned in 1995, 1996, 1997 and 1999. Thus, 3 of 4 year classes of walleye captured in 2001 were naturally reproduced, which suggests that naturally reproduced walleye were sustaining the population and that stocked walleye were making only a minor contribution. Transplanting some suckers into the lake to help alleviate the perceived forage problem was considered but never carried out. In 2003, Fisheries Division transferred two gallons of minnows into the lake to increase food available to perch. Because minnows tend to eat more from the periphyton community, it was hoped that perch concentrating on them would take some pressure off the benthic community, perhaps allowing it to recover. Despite the minnow stocking, however, perch growth rates fell slightly by 2008.

Current Status

An extensive netting survey totaling 34 net-nights was conducted at Bass Lake during late June, 2008. Net locations are shown in Figure 2. Species caught were bluntnose minnow, brown bullhead, fathead minnow, Johnny darter, northern pike, pumpkinseed sunfish, rock bass, smallmouth bass, walleye, and yellow perch (Table 1). Northern pike comprised 41% of the catch by weight, down from 51% in 2001, with 17% =24 in. Walleye comprised 15%, down from 23% in 2001, with 100% =15 in. Yellow perch comprised only 5%, down from 9% in 2001, with 10% =7 in, while rock bass comprised 19% of the catch, up from 16%, with 19% =6 in. Pumpkinseed sunfish catch increased from 0% to 4%, while brown bullheads increased from 9% to 14%. Smallmouth bass, however, comprised only 1%, with none larger than 11 in. The most obvious difference between the two surveys was the presence in 2008 of many brown bullheads, not seen since 1991. It was surprising that they comprised 14% of the catch, only seven years after the last survey in which they were not found at all. In addition, 97% were mature adults at =7 in. A total of 995 fish were captured, with combined weight of 214 lbs.

Pumpkinseed sunfish and yellow perch were growing just under an inch slower than their state average. All other analyzed species were growing at roughly state-average rates (Table 2). Since 2001, however, yellow perch growth had slowed by 0.5 inch, while walleye growth slowed by just over 3 in. Four species had enough age diversity to allow mortality estimates using the Robson Chapman (1961) methodology. The northern pike estimate was 45%, rock bass was 42%, walleye was 39%, and yellow perch was 81%.

One vertical limnological profile was produced on August 26, 2008 (Table 3). Dissolved oxygen concentrations were 9.2 mg/l at the surface, and 8.6 at the 25 ft thermocline. The concentration fell to 0.5 mg/l below the thermocline at 34 ft. The hypolimnion at depths below 34 feet generally contained less than 0.5 mg/l of oxygen Lack of oxygen in the hypolimnion would be expected to severely limit benthic communities in the lake basin. Temperature fell from 70 F at the surface to 64 F at 25 ft and 51 F at 34 ft. The pH fell from 8.0 at the surface to 6.7 at 25 ft, and 5.9 at 34 ft. Conductivity was relatively uniform at 17 µmhos, falling to 16 at 34 ft. A composite alkalinity sample was 6 mg/l CaCO3.

Analysis and Discussion

The continuing lack of balance between predator and prey species observed again in the 2008 netting survey remained a major concern. The fish community structure, however, had changed since 2001. Predators in 2001 comprised 74% of the catch biomass by weight, compared with 58% in 2008. Proportions of northern pike, smallmouth bass and walleye remained generally similar to 2001. Despite the lower percentage of predators, however, the forage base did not appear to increase equivalently. A brown bullhead population, last seen in this lake in 1991, comprised almost all of the percent difference between 2001 and 2008 predator components.

Growth rate of walleyes had fallen, dropping from a growth index of +3 in during 2001 down to the state average rate in 2008. The change had been tentatively predicted in 2001, due to the apparently small forage base. Northern pike were still growing well at -0.1 in, compared to state average, although what they were foraging on was still unknown. Walleyes, small pike, sunfish, and a few larger perch were still apparently the only suitable forage for them. Yellow perch growth rates had fallen slightly, while their average size increased slightly and their average number per net (CPE) remained similar to the 2001 survey. Although all growth rates were acceptable, the observed fish forage base still appeared low relative to the number of predators. Alternative prey such as zooplankton and benthos may be sustaining growth rates of fish species such as yellow perch and sunfish.

There were two major fish community differences observed between 2001 and 2008. The pumpkinseed sunfish catch increased from 4 (CPE = 0.13) to 285 (CPE = 8.38). Pumpkinseeds potentially contributed to slower perch growth due to competition for the same invertebrate forage base. Brown bullheads averaged 9.3 in with 97% =7 in, and comprised almost 14% of the catch biomass. The size and maturity of the bullhead population was a surprise considering the mere seven year time lapse between surveys. Even so, their numbers were still too low to be considered a management problem.

Older walleyes were aged as being from non-stocked years as well as stocked. Although an occasional fish may have been incorrectly aged, too many of them were determined to be from non-stocking years for the results to be sampling error. Thus, age composition data from past surveys indicated that some walleye natural reproduction had been occurring. However, no walleye captured in the 2008 survey was younger than age 7 (2001 year class), despite the lake being stocked in 2002 and 2004 (Table 4). For that reason, the lack of specimens from recent years implied a more serious situation than stocking failure. Non-representation in the survey may not have been a simple sampling anomaly, because the walleye growth index concurrently showed a full 3 in decrease in only seven years. It appeared to be

time to "listen to the lake," and stop stocking walleyes, at least for the next few years. If the next survey indicates a better balance between predator and prey species and acceptable growth rates for predators, we can at that time consider resuming the walleye stocking program.

Office file data from the 1950s described Bass Lake as a fertile water, with excellent yellow perch and good smallmouth bass fisheries. Another file document described a rich zooplankton community with good numbers of large Daphnia. By 1970, however, there was concern about the lack of larger zooplankters. By 2008, this lake appeared to support very little zooplankton and a small fish community. Discontinuing the stocking of trout species known to compete with perch and panfish for food did not produce a larger population of perch. In fact, their numbers have continued to decline.

Canadian science reports in The Ottawa Riverkeeper (2008) and the Environmental Research Web (2008), described a study by Dr. John Smol (Smol, 2009) concerning calcium in lakes. The study documented how 1980s acid rain onto terrestrial soils depleted calcium to the extent that currently no new calcium is leaching from certain types of riparian soils into lakes and streams. Even if the water is non-acidic, there may not be enough calcium to support an invertebrate community, including zooplankton. Smol referred to the phenomenon as "lake osteoporosis", and The Ottawa Riverkeeper article described the critical concentration as 1.5 mg/l calcium. The concept may have relevance in Bass Lake. Considering the pH in this lake, in conjunction with an alkalinity concentration of only 6 mg/l, the concept of lake osteoporosis may very possibly explain the observed paucity of the lake biota at the base of the food chain. Calcium comprises 25% of the CaCO3 molecule, so 6 mg/l CaCO3 provides only 1.5 mg/l of actual calcium. If lake osteoporosis is actually limiting production in this lake, the economic cost of fishery rehabilitation will be very high.

Management Direction

The long management history of Bass Lake began in the 1930s, a time when the lake provided excellent yellow perch fishing and good smallmouth bass fishing. Through the years, largemouth bass, bluegills, rainbow trout, splake, lake trout, and walleye have been stocked. In addition, managers treated the shoreline with antimycin and conducted a manual removal, both to remove small, stunted yellow perch. Since the early 1990s, though, walleye stocking has been the only management protocol. Strong declines in walleye growth rates since 2001 indicate that food available for these predators has also declined. Catches of northern pike (both numbers and pounds) in 2008 were about twice as high as those in 2001. This further indicates that additional fish predators are not needed in the lake, particularly since forage abundance appears to be low.

Although the lake had suffered an apparent yellow perch population decline of over 90% since 1991, their growth rate had not improved by 2008. Concurrently, visual analysis of the zooplankton community appeared to document a decline as well. If the new concept of lake osteoporosis, described in the analysis section, is operating in this lake, then remediation will be very expensive. Given the high cost of lime applications and our limited budget, there will be little opportunity to increase the calcium concentration and thus, overall lake productivity and game fish stocks in Bass Lake. The single management option available is to cease stocking walleye fingerlings to allow the lakes perch and panfish a chance to recover from such a strong predator. For that reason, termination of the walleye stocking program is recommended.

References

Robson, D.S. and D.G. Chapman. 1961. Catch curves and mortality rates. Transactions of the American Fisheries Society 90: 181-189.

Ottawa Riverkeeper. 2008. Lake osteoporosis.
11/28/2008,
http://ottawariverkeeper.ca/news/canadian_lakes_suffering_from_aquatic_version_of_osteoporosis/

Environmental Research Web (ERL). 2008. Lake osteoporosis.
12/10/2008, http://environmentalresearchweb.org/cws/article/research/37018

Smol, John. 2009. Queens University biology professor, holder of the Canada Research Chair in Environmental Change. 02/04/2009,: http://biology.queensu.ca/faculty/smol.html

Historical files are kept at the Newberry Operations Service Center, 5100 S. M-123, Newberry, MI 49868

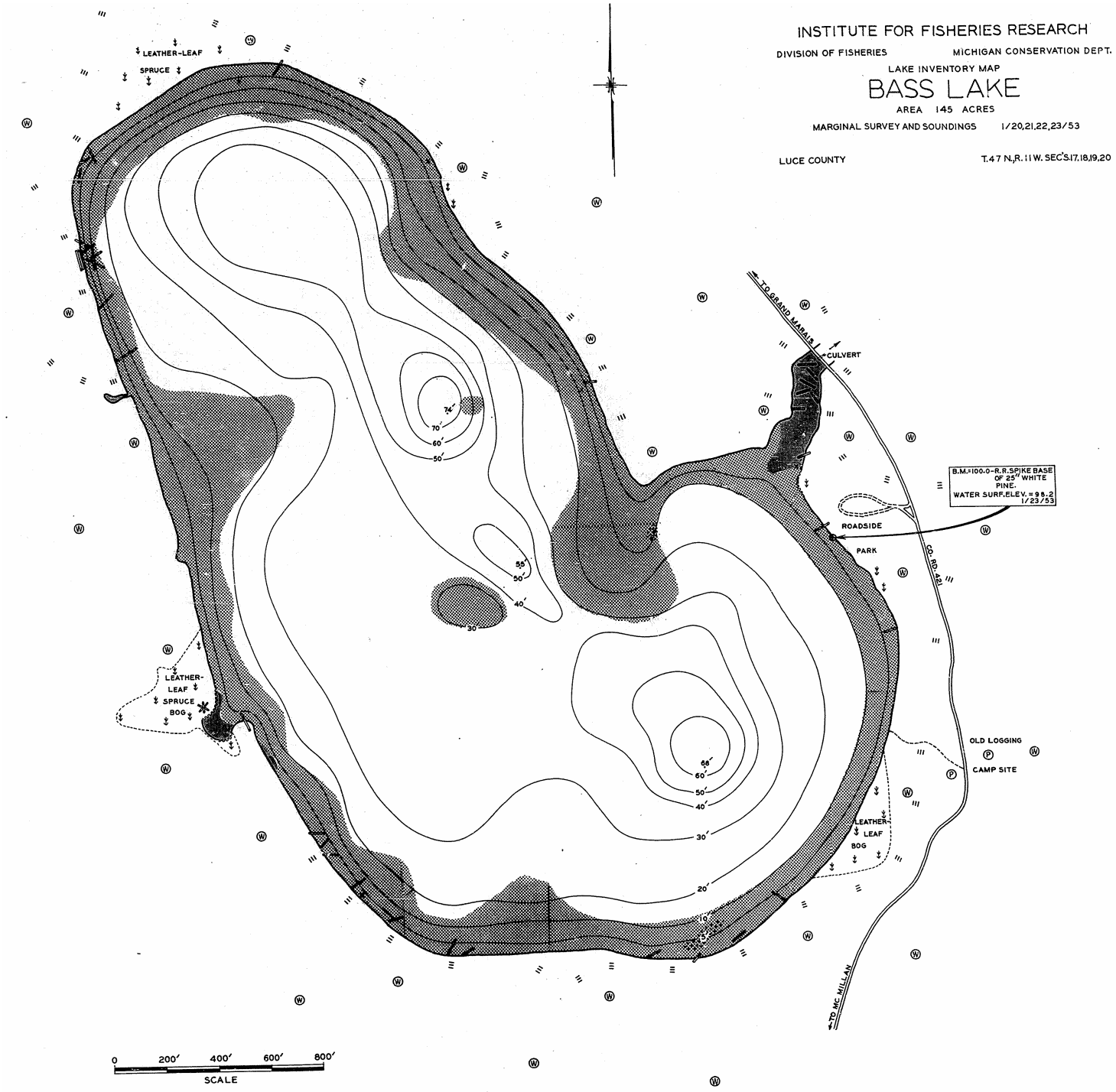

Figure 1. Contour map of Bass Lake, Luce County.

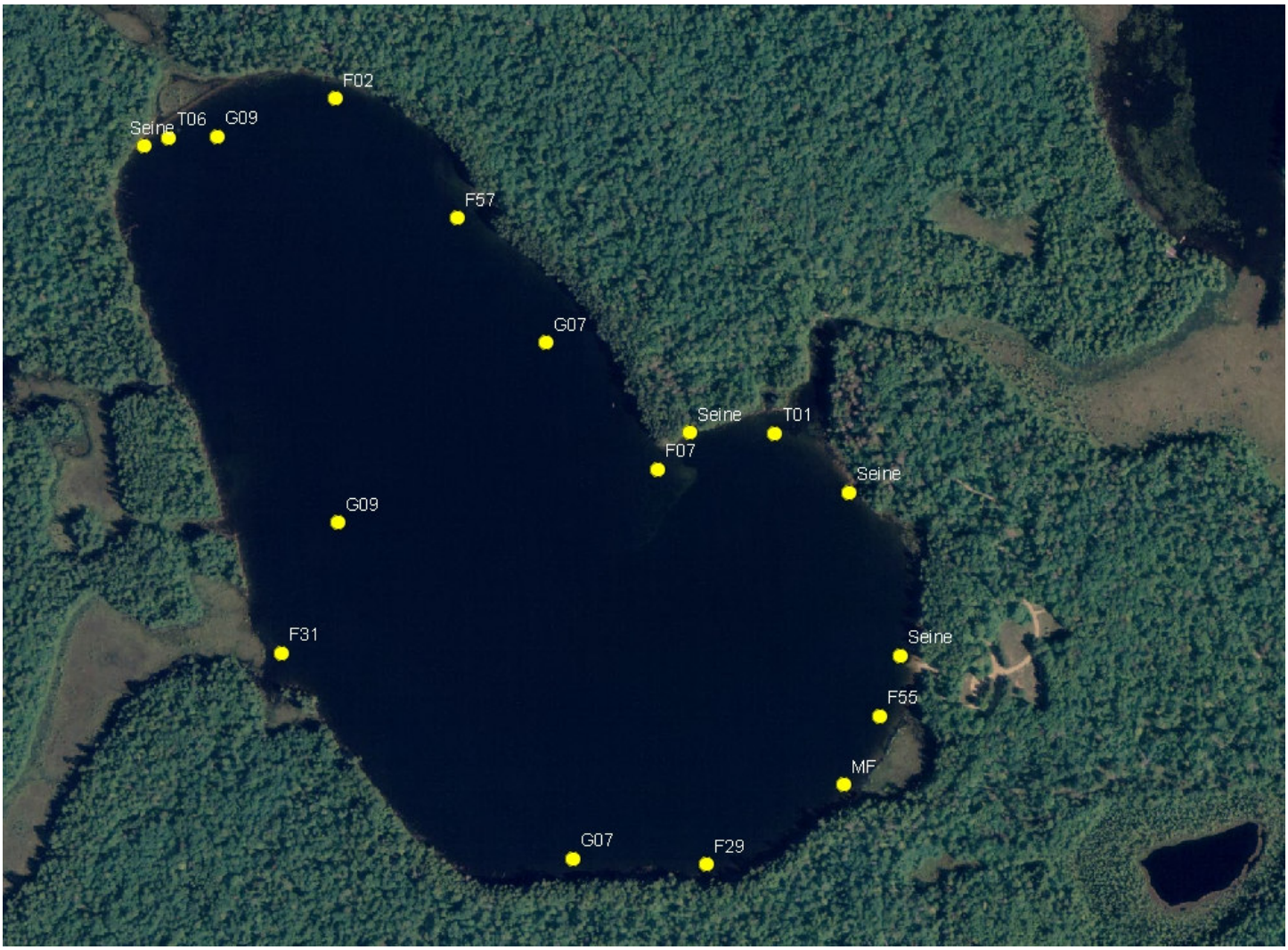

Figure 2. Aerial photograph of Bass Lake, Luce County, showing netting locations during 2008 survey.

Table 1. Number, weight, and length by species for Bass Lake, Luce County, from a 2008 status and trends survey on June 23-26, 2008, using fyke, mini-fyke, trap, and gill nets, and seines.

Species	Number	Percent by number	Weight (lb.)	Percent by weight	Length range in.)[1]	Average length (in.)	Percent legal size2
Bluntnose minnow	116	11.7	0.8	0.4	2 - 3	2.6	100
Brown bullhead	72	7.2	29.2	13.7	6 - 11	9.3	97
Fathead minnow	1	0.1	0.0	0.0	2 - 2	2.5	100
Johnny darter	1	0.1	0.0	0.0	2 - 2	2.5	100
Northern pike	36	3.6	88.5	41.4	18 - 28	22.1	17
Pumpkinseed sunfish	285	28.6	9.3	4.4	1 - 8	3.3	0
Rock bass	359	36.1	40.9	19.2	2 - 9	4.8	19
Smallmouth bass	6	0.6	2.1	1.0	5 - 11	8.3	0
Walleye	10	1.0	31.9	14.9	19 - 23	21.3	100
Yellow perch	102	10.3	10.8	5.0	3 - 8	6.3	10

[1] Some fish may be measured to 0.1 in, others to inch group: e.g., “5” = 5.0 to 5.9 in; “12” = 12.0 to 12.9 in; etc.
[2] Percent legal size is the minimum legal size for size-regulated fish or else the size generally considered to be a keeper for non-regulated fish.

Table 2. Weighted mean length and age for six fish species from Bass Lake, Luce County, from a 2008 status and trends survey on June 23-26, 2008, using fyke, mini-fyke, trap, and gill nets, and seines. Mortality rates for four species were estimated using Robson Chapman formulae.

	Age											Mean growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	X1	index (in.)[1]
Northern pike		20.1	21.8	23.0	25.3	25.7	28.9					-0.1
		(14)	(9)	(5)	(3)	(2)	(1)		estimated mortality			45%
Pumpkinseed			4.3	8.5								-0.9
			(13)	(1)								
Rock bass			5.2	6.0	6.9	8.3	8.5		9.5			-0.2
			(19)	(9)	(15)	(9)	(7)		(1)	est. mortality		42%
Smallmouth bass		6.7	9.3	11.1								---
		(3)	(2)	(1)								
Walleye							20.4	21.6	20.5	21.2	23.7	-0.1
							(2)	(5)	(1)	(1)	(1)	
									estimated mortality			39%
Yellow perch		5.1	6.2	6.6	8.1							-0.8
		(6)	(15)	(5)	(4)				estimated mortality			81%

[1] Mean growth index is the deviation from state average length in inches.

Table 3. Limnological vertical profile for Bass Lake, Luce County, on August 26, 2008.

Depth (ft)	Temperature (F)	Dissolved oxygen (mg/l)	Percent Dissolved oxygen	pH	Conductivity µmhos	Alkalinity composite (mg/l $CaCo_3$)
0	70.4	9.2	104	8.0	17	6
5	70.5	9.2	104	7.8	17	
10	70.5	9.2	104	7.7	17	
15	70.3	9.1	103	7.5	17	
20	70.3	9.1	103	7.4	17	
23	69.9	8.9	100	7.3	17	
24	68.9	8.9	98	7.2	17	
25	63.9	8.6	91	6.7	16	
26	60.0	7.8	79	6.5	16	
27	57.5	7.0	68	6.3	15	
28	56.3	6.0	58	6.1	15	
33	51.1	1.1	10	5.9	15	
34	50.6	0.5	4	5.9	16	

Table 4. Walleye stocking records for Bass Lake, Luce County, from 1996 to 2008, compared with ages of walleyes captured during the June 23-26, 2008 status and trends survey, using fyke, mini-fyke, trap, and gill nets, and seines.

Year	Number stocked	Average length (cm)	Captured in survey
1996	5,980	4.8	0
1997	0		1
1998	4,500	4.2	1
1999	0		1
2000	3,000	4.8	5
2001	0		2
2002	3,500	4.7	0
2003	0		0
2004	2,446	3.5	0
2005	0		0
2006	0		0
2007	0		0
2008	0		0