Graham Lakes
Oakland, T04N R11E Sec. 05
Clinton River Watershed, last surveyed in 2014

Cleyo Harris, Fisheries Biologist

Environment

Graham Lakes are located in Bald Mountain State Recreation Area, 2.5 miles east of Lake Orion, Michigan (Figure 1). Within the Lake Erie Management Unit (LEMU), the two in-line lakes are part of the Stony Creek sub-watershed, with West Branch Stony Creek flowing into West Graham Lake and flowing out of East Graham Lake. The Stony Creek sub-watershed is part of the middle segment of the Clinton River Watershed (Francis and Haas 2006). West Branch Stony Creek passes through Shoe Lake then travels about 1/3 miles downstream to West Graham Lake. After passing through a canal and then out of East Graham Lake, West Branch Stony Creek flows about 5 miles, through Clam Lake and Tamarack Lake before reaching Buell Road Dam. The network catchment area for Graham Lakes is 4,962 acres with a surficial geology of glacial outwash and end moraines of coarse-textured till. The land use of the network catchment area for Graham Lakes is 39% forest, 29% urban, 18% wetland, 7% open water, 3% agricultural, 3% barren, and 1% grassland (Fry et al. 2011).

East Graham Lake is 11 acres and has a maximum depth of 34 feet (Figure 2) and West Graham Lake is 22 acres and has a maximum depth of 52 feet (Figure 3). Both lakes have narrow shoal areas and steep drop-offs resulting in about 78% of the lakes being deeper than 5 feet. Much of the shoreline consists of emergent vegetation with a significant wetland buffer around the lakes. The combined perimeter for East Graham and West Graham Lakes is about 2.5 miles.

Bald Mountain State Recreation Area surrounds Graham Lakes, providing natural shoreline with little development. There is one dwelling on East Graham Lake and West Graham Lake is void of dwellings. The other development on the lakes is a public boating access site with a fishing pier located at the west end of East Graham Lake. The gravel-surfaced ramp is suitable for medium-sized and smaller boats with parking for about 18 vehicles with trailers.

Limnological samples, including oxygen, temperature and pH were collected on July 23, 2014 in the deepest portion of EastGraham Lake (Figure 2) and West Graham Lake (Figure 3). East Graham Lake water temperatures ranged from 77°F at the surface to 41°F near the bottom (Figure 4). In West Graham Lake water temperatures ranged from 77°F at the surface to 39°F near the bottom (Figure 5). Lakes become stratified when the water density gradient, caused by warming of the upper waters, is large enough that it prevents wind currents from mixing waters throughout the water column (Wehrly et al. 2015). Both lakes were stratified when the limnology datawere collected. Schneider (2002) identified suitable dissolved oxygen levels to be 3.0 ppm or higher for most fish communities in Michigan. East Graham Lake had suitable conditions down to 16 feet deep before the dissolved oxygen levels dipped below 3.0 ppm. West Graham Lake was similar with suitable dissolved oxygen levels down to 17 feet deep. Secchi disk measurements provide an indication of water clarity. The Secchi disk measurement for West Graham Lake was 10 feet and for East Graham Lake the measurement was 11 feet. These measurements are very similar to the LEMU average of 10 feet (Wehrly et al. 2015).

History

Starting in 1954 there have been six fisheries surveys of Graham Lakes prior to the most recent survey in 2014 (Table 1). Over this 60 year span there have been multiple gear types used and each gear type has certain biases based on habitats in which they can be deployed, along with fish species they effectively capture. Our understanding of the fish community found in Graham Lakes has grown over time through the use of multiple gear types. In the 1950s and 1960s gill nets were used that typically are deployed in open water habitats and are more effective for capturing relatively large species like Northern Pike or larger Yellow Perch. The survey in 1971 was conducted with an electrofishing boat that is effective at capturing species of any size from minnows to Northern Pike but is limited to sampling nearshore habitat. There were multiple gear types (electrofishing, trap net, small-mesh fyke net, and a gill net) used during the fisheries survey in 1990 which allows effective sampling for the fish community in multiple habitats. This fisheries survey was also conducted in August, injecting another difference with seasonal variation. The 1997 fisheries survey was conducted with trap nets and gill nets which each sample different habitats; trap nets effectively sample nearshore habitats. Many of the same species were captured in all of the fisheries surveys conducted on Graham Lakes and the fish community seems to have been stable over time. One consistency for Graham Lakes is the high quality bluegill fishery that remains prevalent for this system. The Bluegill population was evaluated using Schneider's Index (Schneider 1990) that provides a relative measure of the quality of the bluegill fishery based on a scale of 1 to 7. The bluegill population in 1997 received an index of 6, giving it an "excellent" rating.

Graham Lakes have been managed as one system throughout the years. The two lakes were mapped in the winter of 1955 and that provides us with the bathymetric map that is used today. A few stocking events took place in the 1960s starting with what was identified as a maintenance stocking of Northern Pike spring fingerlings (Table 2). After that single stocking of Northern Pike there were three consecutive years of Rainbow Trout Stocking, spanning from 1962 thru 1964 (Table 2). These fish stockings were discontinued after the 1966 evaluation survey resulted in no trout captured. Since that time Graham Lakes has been managed as a self-sustaining system.

Current Status

A fish community survey of Graham Lakes was conducted in May and June of 2014 by Michigan DNR Fisheries. A variety of sampling gear was used including; large-mesh fyke nets, small-mesh fyke nets, experimental gill nets, and electrofishing. Two large-mesh fyke nets were set in each lake along with one small-mesh fyke net and one experimental gill net in each lake. The three net types were set on May 27, 2014 and lifted each day until being removed from the lake on May 29, 2015. Electrofishing efforts were conducted with an electrofishing boat on June 18, 2015, completing two 10-minute transects in West Graham Lake and one 10-minute transect in East Graham Lake. An attempt was made to collect aging structures from 10 individuals per inch group for select sportfish species; Black Crappie, Bluegill, Largemouth Bass, Northern Pike, and Pumpkinseed.

The 2014 fisheries survey resulted in 18 species captured totaling 753 fish that weighed about 165 pounds (Table 3). Panfish like Bluegill, Pumpkinseed, Black Crappie, Rock Bass, and Yellow Perch made up 74% of the catch by number and 45% of the catch by weight. Large predators like Largemouth Bass, Northern Pike, and Brown Bullhead made up 21% of the catch by number and 54% of the catch by weight. Forage species such as Lake Chubsucker, Blackchin Shiner, and Blacknose

Shiner made up 5% of the catch by number and 1% of the catch by weight. Herptofauna observations occurred throughout the week of the netting efforts and included: Snapping Turtle, Painted Turtle, Musk Turtle, and Mudpuppy (Table 7).

The most abundant species captured during the 2014 survey was Bluegill, totaling 453 fish that accounted for 60% of the catch by number and 33% of the catch by weight (Table 3). Bluegill averaged 4.9 inches with a range from 1 to 9 inches. Using 6 inches as the minimum angler acceptable size, 40% of the bluegills captured were larger than the minimum angler acceptable size (Table 4). Bluegill had better than state average growth with a mean growth index of 0.2 inches based on length-at-age data. Ages ranged from 1 to 6 years-old with 88% being 4 years-old or younger (Table 5). Aging structure results showed a range from 1 to 6 years old with 88% being 4 years old or younger. An evaluation using Schneider's Index (Schneider 1990) resulted in an index of 5.3, equating to a "good" rating. The catch per unit effort (CPUE) was 15.6 fish/net lift for large-mesh fyke nets, 23.8 fish/net lift for small-mesh fyke nets, and 7.8 fish/minute for electrofshing. All three CPUEs were lower than the LEMU average for the relative gear type (Table 6).

Pumpkinseed were the second most abundant panfish species, totaling 69 fish that accounted for 9% of the catch by number and 8% of the catch by weight at 12.8 pounds (Table 3). The average size was 5.3 inches with a size range of 1 inch to 7 inches (Table 3), with 49% being larger than the minimum angler acceptable size of 6 inches (Table 4). Growth was exceptional for Pumpkinseed; length-at-age data indicates a mean growth index 1.0 inches larger than the state average. Ages for Pumpkinseed ranged from 1 to 6 years old, though 86% were 4 years old or younger.

Other panfish captured during the survey were fewer in number but important to the fish community. One such species is Black Crappie, captured with a size range from 3 to 10 inches and an average length of 7.8 inches (Table 3). Aging structures from all ten fish revealed multiple year classes ranging from 1 to 6 years old (Table 5). Rock Bass, Yellow Perch, Green Sunfish and Longear Sunfish combined to make up less than 3% of the catch by number (Table 3).

The Largemouth Bass catch totaled 61 fish that made up 8% of the catch by number and 21% of the catch by weight. The length range was from 0 (young-of-year bass) to 16 inches with an average size of 8.3 inches (Table 3). Growth appears to have been slow with a mean growth index of 1.2 inches less than the state average (Table 5). There were three legal size Largemouth Bass captured during the survey that made up 5% of the Largemouth Bass catch. The CPUE for large-mesh fyke net was 2.1 and it was 1.4 for electrofishing, both higher than the LEMU average CPUE for the relative gear type (Table 6).

There were few Northern Pike captured during the survey. Northern Pike totaled four fish that accounted for less than 1% of the catch by number and 7% of the catch by weight (Table 3). With a size range from 12 to 28 inches these fish represented four age-classes (Table 5). Two other large predators captured during the survey are Brown and Black Bullhead. Brown Bullhead were the second most abundant species with a total of 84 fish that made up 11% of the catch by number and 38% of the catch by weight (Table 3).

Forage species captured during the 2014 survey were dominated by Lake Chubsucker that made up 4% of the catch by number and 1.5% of the catch by weight (Table 3). Lake Chubsuckers had a size range

of 1 to 6 inches. Other species considered as forage species include: Blackchin Shiner, Blacknose Shiner, Central Mudminnow, and Iowa Darter. Two additional species captured were Grass Pickerel and Tadpole Madtom.

Analysis and Discussion

Graham Lakes have supported a very diverse fish community. Though surveys over time have not consistently reported this high diversity, likely caused by gear biases and seasonal variation as described previously. Another factor affecting species richness is the open system and ability of fish to immigrate and emigrate through West Branch Stony Creek. The diversity recorded during the 2014 survey is equal to the LEMU average at 18 species and higher than the state average of 13 species (Wehrly et al. 2015).

Graham Lakes continues to produce a quality Bluegill population with good growth rates. The Schneider's Index evaluation resulted in a lower rating for the 2014 fisheries survey (5.3) as compared to the Schneider's Index evaluation from the 1997 fisheries survey (6). The 1997 trap net efforts resulted in a CPUE of 8 fish/net lift for Bluegill with a size range of 6 inches to 8 inches. The 2014 large-mesh fyke net efforts resulted in a CPUE of 15.6 fish/net lift for Bluegill with a size range of 3 inches to 9 inches. It is likely the Bluegill population has not changed over time but that the 2014 fisheries survey characterizes the population more accurately. Given the lack of smaller inch groups in the 1997 catch and the much smaller CPUE it appears as though the 2014 catch is more representative of the Bluegill population and provides a more realistic Schneider's Index for Graham Lakes. Bluegill CPUEs for the 2014 large-mesh fyke and small-mesh fyke nets were below the average for LEMU while the electrofishing CPUE was higher than the 75th percentile when compared statewide (Table 6). This suggests that Graham Lakes continues to support a quality Bluegill population. Bluegill length-at-age data suggests that not many fish get older than 6 years old but have faster than average growth. This allows fish to reach the "angler acceptable size" at a good rate. Based on angler reports and the length-at-age structure observed, this quality fishery is significantly utilized. Schneider (1993) suggests that angler harvest can limit the number of large Bluegill due to the lack of accumulation of older aged fish. Graham Lakes continues to provide a quality Bluegill fishery despite the lack of older fish.

Though lower in number, Pumpkinseeds add to the panfish fishery. In 2014, Pumpkinseed had very high growth though none were aged over 6 years-old, similar to Bluegill. The Pumpkinseed CPUE for large-mesh fyke was high but near the median when compared statewide (Table 6). The CPUEs for small-mesh fyke nets and for electrofishing were near the statewide median as well as the LEMU average (Table 6).

Based on the 2014 survey CPUE's for large-mesh fyke nets and electrofishing there is a good number of Largemouth Bass in Graham Lakes. Both gear types had a CPUE close to the LEMU average and above the statewide median (Table 6). Though they have slow growth, Largemouth Bass are a key component to the predator-prey balance that appears to be intact. There were only two Largemouth Bass captured in 1997 and that is likely due to gear selection for the survey since electrofishing was not used. Electrofishing accounted for 70% of the total Largemouth Bass catch in 2014. The potential for trophy Largemouth Bass exists as indicated by the report of a 22 inch fish submitted to the Master Angler program.

Northern Pike and Bullhead play a role in the predator-prey balance as well. The four Northern Pike captured represent four different year-classes (Table 5) suggesting that natural reproduction is successfully occurring. Brown Bullhead were the second most abundant species of the 2014 survey with a CPUE of 7.3 for large-mesh fyke nets, higher than the LMEU average CPUE of 4.8 (Wehrly et al. 2015). This suggests a significant Brown Bullhead population in Graham Lakes.

Forage species diversity has varied among surveys (Table 1). Similar to the 2014 survey they were typically captured in low numbers. Lake Chubsucker was the most abundant forage species in 2014 (Table 3) and is considered a valuable forage species (Becker 1983).

Graham Lakes are fairly diverse and provide a quality fishery with good access. Angler reports suggest that successful angling efforts targeting panfish occur often throughout all seasons of the year. These reports are backed up by the 2014 survey data showing decent proportions of large panfish and fast growth rates which typically translates into a quality fishery. A good predator-prey balance continues to support a quality self-sustaining system.

Management Direction

Graham Lakes is currently managed as a warmwater fishery open to the public. The fishing pier and boat launch provide a sufficient amount of access without over exposure. Surrounded by state land, these lakes have a natural setting with minimum development that is sustainable.

Statewide regulations appear to be sufficient for maintaining the quality panfish fishery that exists in Graham Lakes and no special regulations are recommended at this time. A fish community survey should be scheduled in 15 to 20 years with the primary objective to evaluate the panfish fishery.

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Table 1. Fish species identified in Graham Lakes during fisheries surveys throughout the years, spanning from 1954 to 2014.

	Fisheries Survey Year						
Species	1954	1961	1966	1971	1990	1997	2014
Black Bullhead							X
Blackchin Shiner							X
Black Crappie				X	X	X	X
Blacknose Dace					X		
Blacknose Shiner							X
Bluegill	X	X	X	X	X	X	X
Bluntnose Minnow					X		
Brown Bullhead		X			X	X	X
Central Mudminnow					X		X
Common Carp					X		
Common Shiner				X	X		
Fathead Minnow					X		
Golden Shiner				X	X		
Grass Pickerel		X		X	X	X	X
Green Sunfish		X			X		X
Iowa Darter							X
Lake Chubsucker	X	X		X	X		X
Largemouth Bass	X	X		X	X	X	X
Longear Sunfish				X	X		X
Northern Pike	X			X	X	X	X
Pumpkinseed		X	X	X	X		X
Rock Bass	X	X		X	X	X	X
Tadpole Madtom							X
White Sucker	X		X			X	
Yellow Bullhead	X		X	X	X		
Yellow Perch		X	X	X	X		X

Table 2. Fish stocking history for Graham Lakes, Oakland County

Year	Species	Amount Stocked	Life Stage
1960	Northern Pike	1,400	Spring fingerling
1962	Rainbow Trout	2,150	Yearling
1963	Rainbow Trout	1,500	Yearling
1964	Rainbow Trout	2,700	Yearling

Table 3. Species composition and relative abundance of fish with all gear combined from the Graham Lakes fisheries survey, May 27 – June 19, 2014.

Species	Number	Percent by number	Weight (lb.)	Percent by weight	Length range (in.)	Average length (in.)	Percent legal size*
Bluegill	453	60.2	53.7	32.5	1-9	4.9	40
Brown Bullhead	84	11.2	37.5	22.7	6-12	9.5	96
Pumpkinseed	69	9.2	12.8	7.7	1-7	5.3	49
Largemouth Bass	61	8.1	34.9	21.1	0-16	8.3	5
Lake Chubsucker	26	3.5	2.4	1.5	1-6	5.3	N/A
Black Crappie	10	1.3	3.7	2.3	3-10	7.8	80
Rock Bass	9	1.2	3.8	2.3	7-8	8.4	100
Yellow Perch	7	0.9	0.3	0.2	2-6	4.5	0
Green Sunfish	2	0.3	0.1	0.1	1-5	3.5	0
Blackchin Shiner	6	0.8	0	0	1-2	2.1	N/A
Black Bullhead	6	0.8	3.3	2	6-12	10.2	83
Northern Pike	4	0.5	11.9	7.2	12-28	24	50
Central Mudminnow	4	0.5	0	0	2-3	3	N/A
Tadpole Madtom	4	0.5	0.1	0	2-3	3	N/A
Longear Sunfish	3	0.4	0.2	0.1	3-5	4.2	0
Grass Pickerel	2	0.3	0.3	0.2	8-10	9.5	N/A
Blacknose Shiner	2	0.3	0	0	2	2.5	N/A
Iowa Darter	1	0.1	0	0	1	1.5	N/A
All species totals	753	100	165.1	100			

*Percent legal or acceptable size for angling

Table 4. Catch summary of select species captured during the Graham Lakes fisheries survey, May 27 – June 19, 2014.

Inch Group*	Black Crappie	Bluegill	Pumpkinseed	Largemouth Bass	Northern Pike
0				1	
1		46	1		
2		48	3		
3	1	42	4		
4		80	3	6	
5		57	24		
6	1	127	22	7	
7	1	45	12	9	
8	1	7		8	
9	5	1		1	
10	1			6	
11				7	
12				8	1
13				5	
14				1	
15				1	
16				1	
17					
18					
19					
20					
21					1
22					
23					
24					
25					
26					1
27					
28					1
Total	10	453	69	61	4

*Inch Group: e.g., “5” = 5.0 to 5.9 inches

Table 5. Weighted mean length and age composition of selected species collected in Graham Lakes, May 27 – June 19, 2014.

Species	Age	No. aged	Length range (in.)	State avg. length (in.)	Weighted mean length (in.)	Mean growth index*
Black Crappie	I	1	3.1	4.2	3.1	--
	II	2	6.3-7.8	6	7.05	
	III	1	8.7	7.5	8.7	
	IV	3	9.0-9.2	8.6	9.1	
	V	1	9.3	9.4	9.3	
	VI	2	9.5-10.4	10.2	10.25	
Bluegill	I	16	1.3-2.7	1.8	1.73	0.2
	II	11	2.7-3.8	3.8	3.39	
	III	15	3.8-6.3	5	4.31	
	IV	26	4.8-8.4	5.9	6.63	
	V	5	5.8-8.4	6.7	8.02	
	VI	4	8.1-9.1	7.3	8.67	
Largemouth Bass	I	7	4.0-6.2	4.2	4.44	-1.2
	II	11	6.2-7.6	7.1	6.89	
	III	9	7.2-10.7	9.4	8.05	
	IV	7	8.2-10.1	11.6	9.2	
	V	15	10.6-13.8	13.2	12.16	
	VI	8	10.3-13.8	14.7	12.09	
	VII	1	12.3	16.3	12.3	
	IX	1	14.2	18.3	14.2	
	X	1	16.2	19.3	16.2	
Northern Pike	I	1	12.2	11.7	12.2	--
	II	1	21.8	17.7	21.8	
	V	1	26.4	25.5	26.4	
	IX	1	28.4		28.4	
Pumpkinseed	I	6	1.9-3.2	1.8	2.37	1
	II	12	3.1-5.4	3.8	4.55	
	III	8	3.1-6.6	4.9	5.86	
	IV	11	6.2-7.8	5.6	7.17	
	V	3	6.2-7.3	6.2	6.95	
	VI	3	6.8-7.7	6.6	7.23	

*Mean growth index is the average deviation from the state average length at age.

Table 6. Comparison of CPUE for selected species in Graham Lakes. The statewide and LEMU CPUE numbers were obtained from Wehrly et al. 2015.

		Statewide CPUE			**Graham Lakes 2014**	LEMU Mean CPUE
Species	Gear	25th percentile	Median	75th percentile		
Bluegill	Large-mesh fyke	2.5	8.5	25.9	**15.6**	23.6
	Small-mesh fyke	1.5	6.3	19.5	**23.8**	39.8
	Electrofishing	1.1	3.5	6.6	**7.8**	10.1
Pumpkinseed	Large-mesh fyke	0.4	1.7	4.7	**6.6**	0.6
	Small-mesh fyke	1.0	1.9	5.6	**1.8**	1.2
	Electrofishing	0.2	0.4	1.0	**0.3**	0.4
Largemouth Bass	Large-mesh fyke	0.4	1.4	2.8	**2.1**	1.9
	Electrofishing	0.4	0.7	1.6	**1.4**	0.8
Black Crappie	Large-mesh fyke	0.7	2.8	5.3	**1.1**	4.7

Table 7. Amphibian observations during the Graham Lakes fisheries survey conducted, May 27 – June 19, 2014.

Species	Number Observed	Length Range* (inches)
Painted Turtle	25	3 – 5
Snapping Turtle	9	9 – 16
Musk Turtle	6	2 – 4
Mudpuppy	1	9

*Length for turtles is obtained by measuring the carapace length.

Figure 1. Regional view of Graham Lakes (indicated by red dot).

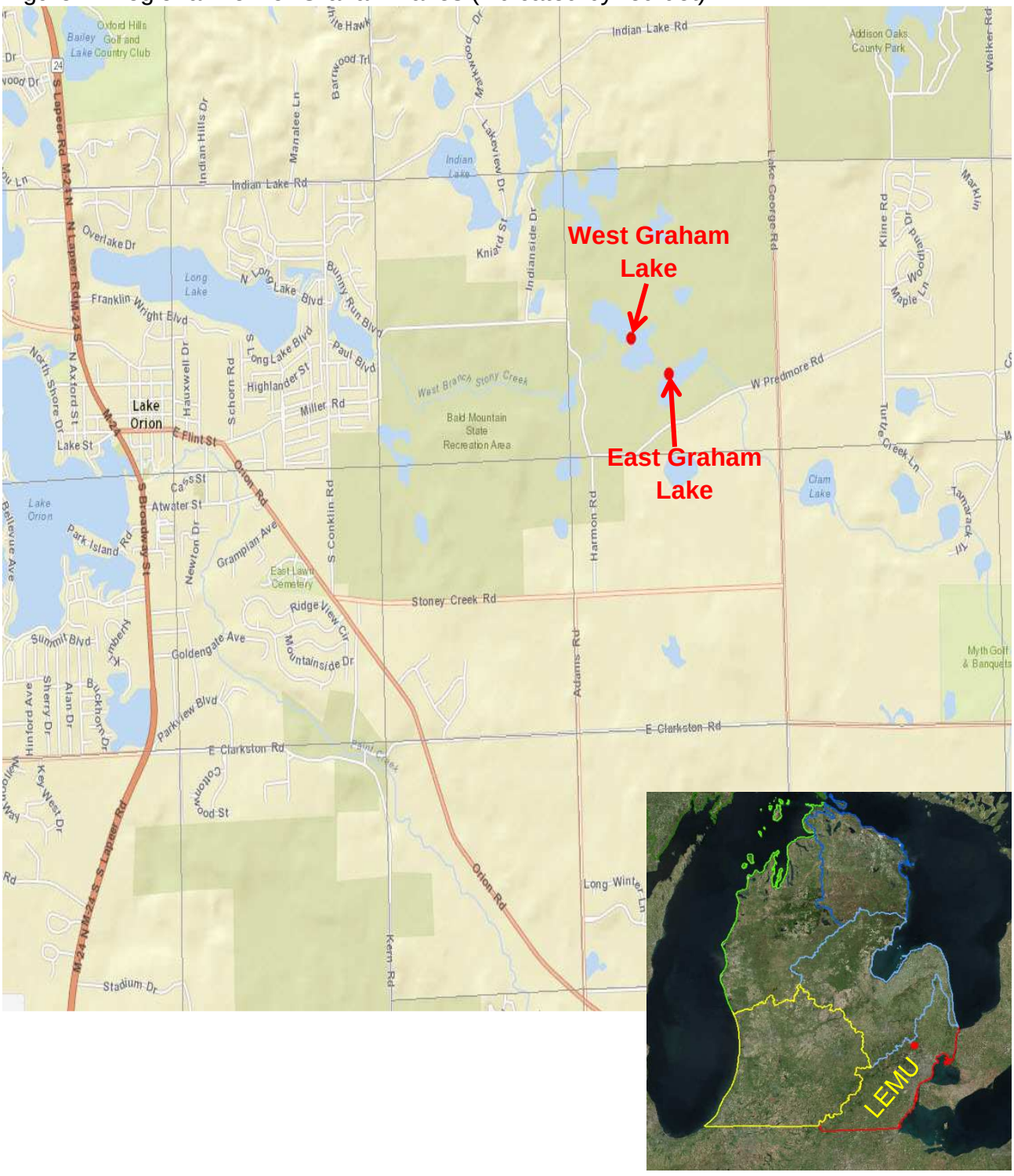
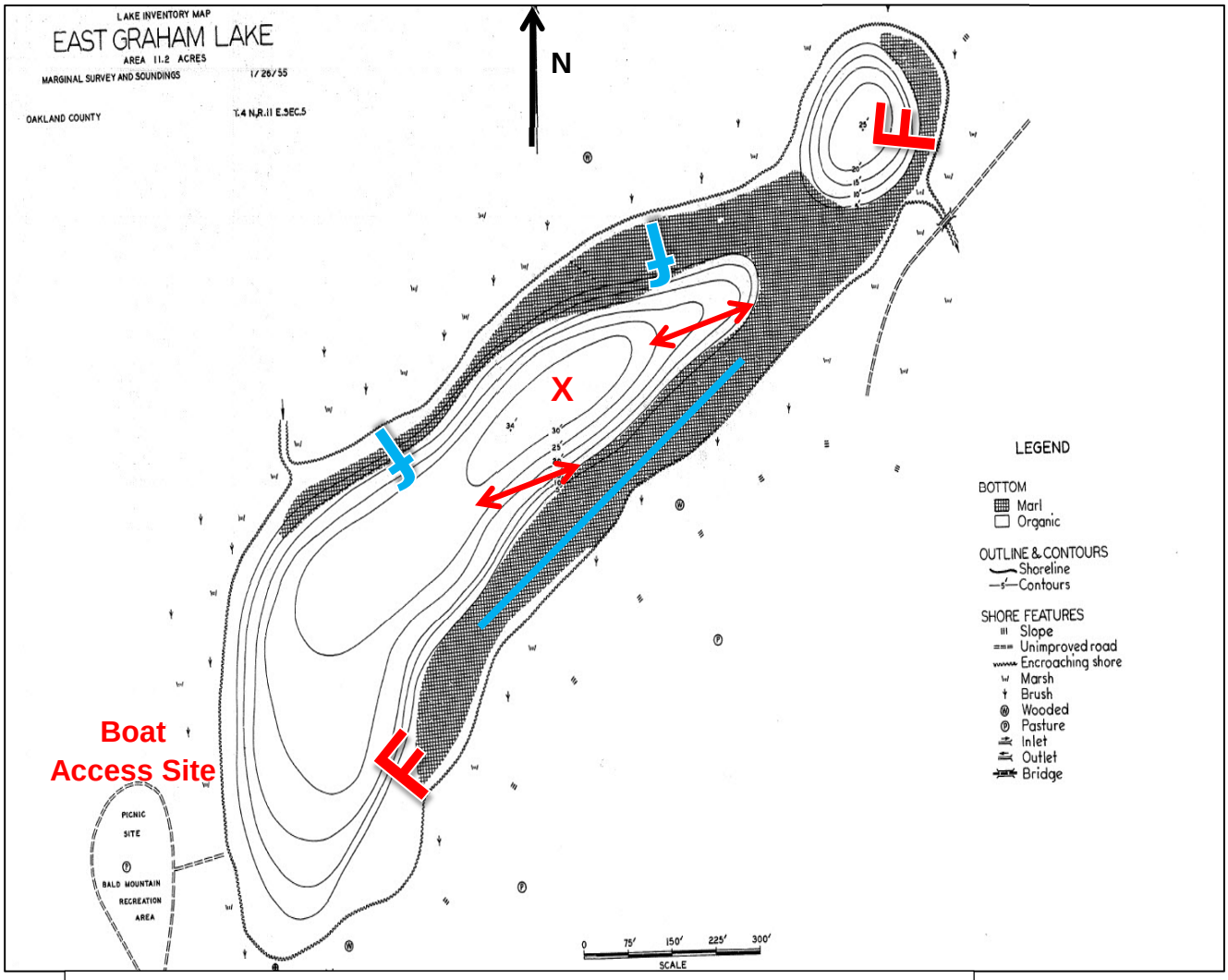


Figure 2. Effort locations in East Graham Lake for the fisheries survey conducted in May and June of 2014. The Contour lines are at 5 feet increments.



Legend

F ..... Large-mesh fyke net

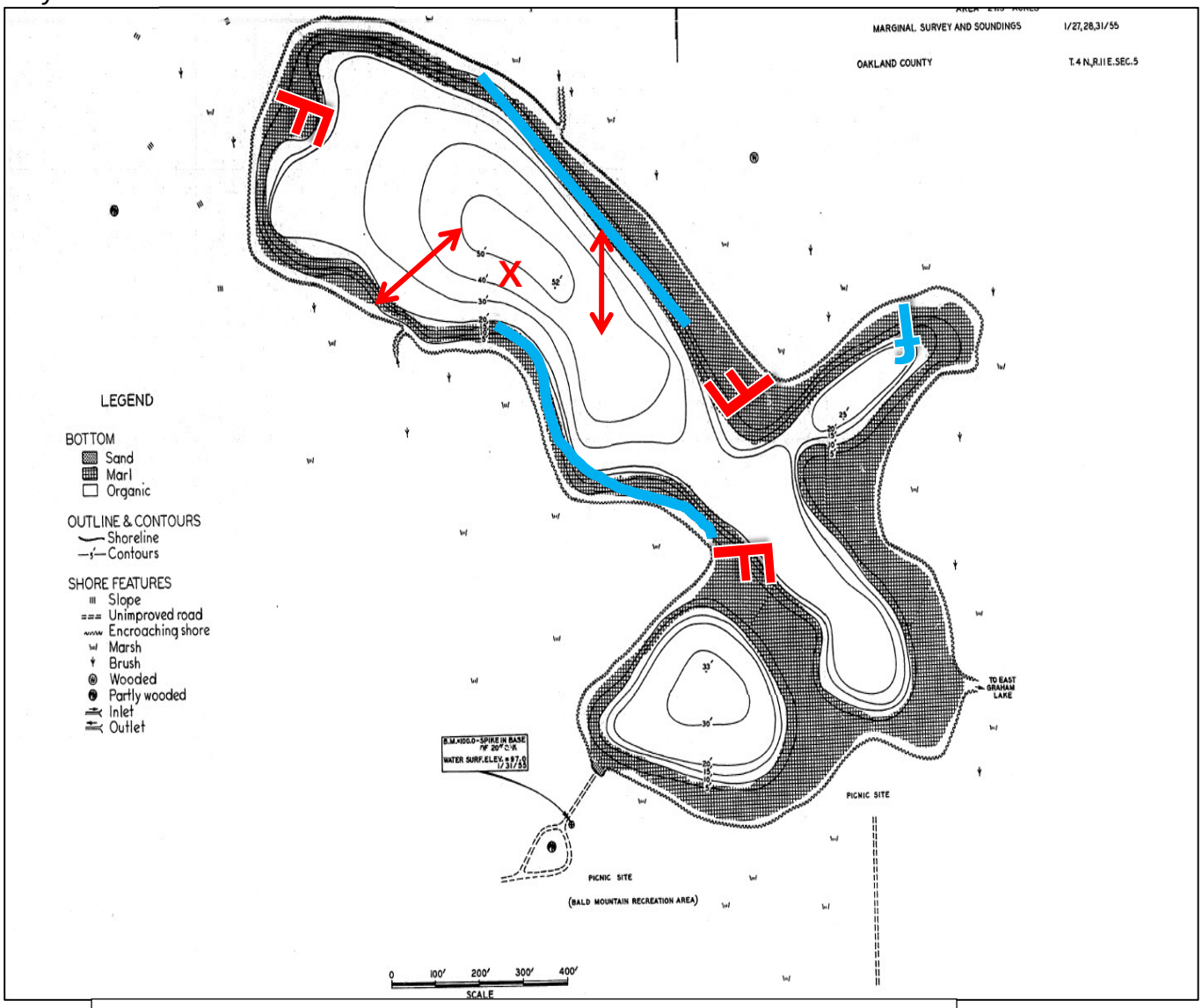
f ..... Small-mesh fyke net

↔ ..... Experimental gill net

— ..... Electrofishing

X ..... Limnology

Figure 3. Effort locations in West Graham Lake for the fisheries survey conducted in May and June of 2014. The Contour lines are at 5 feet increments.



Legend

F ..... Large-mesh fyke net

f ..... Small-mesh fyke net

↔ ..... Experimental gill net

— ..... Electrofishing

X ..... Limnology

Figure 4. Temperature and dissolved oxygen profile for East Graham Lake, collected on July 23, 2014. The red line identifies the depth that dissolved oxygen reaches a minimum level for fish suitability. The black lines identify the upper and lower ends of the metalimnion.

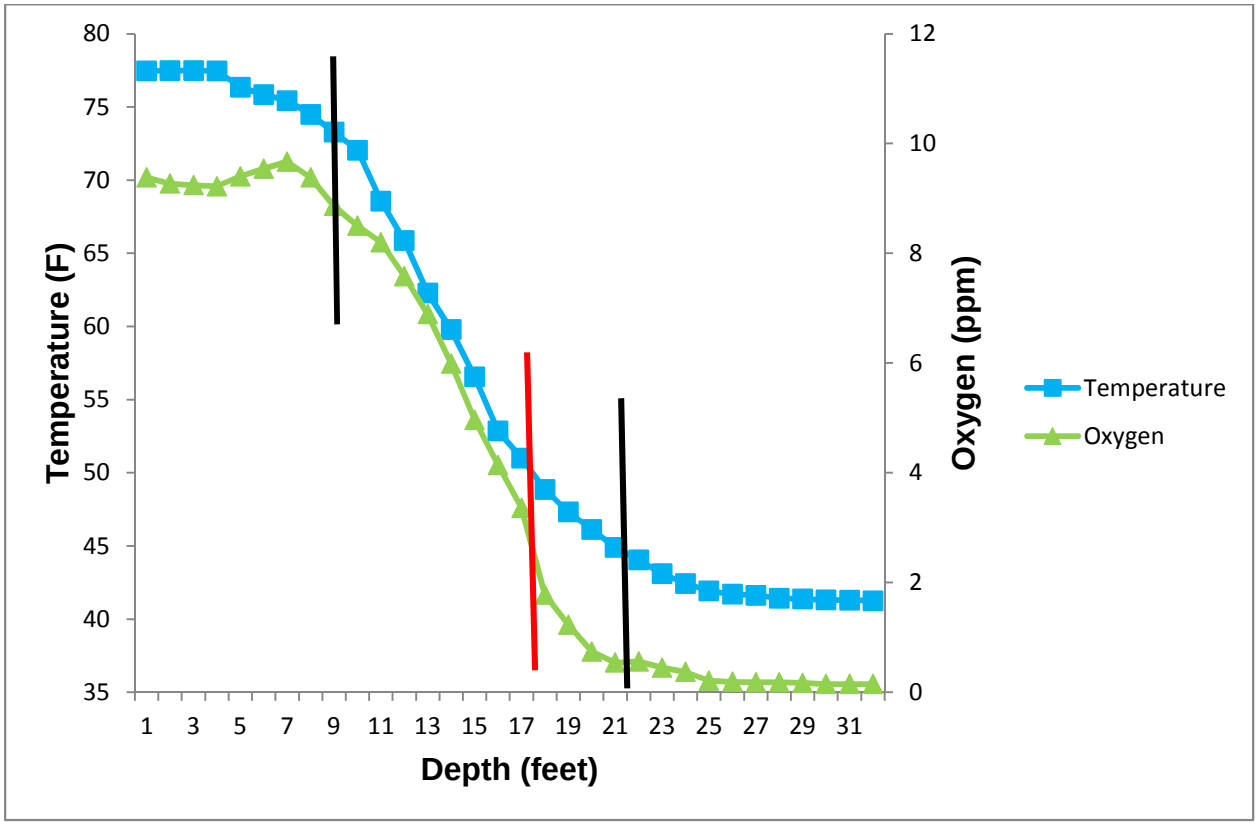


Figure 5. Temperature and dissolved oxygen profile for West Graham Lake, collected on July 23, 2014. The red line identifies the depth that dissolved oxygen reaches a minimum level for fish suitability. The black lines identify the upper and lower ends of the metalimnion.