Gourdneck Lake
Kalamazoo County (T4S, R11W, Sec.3)
Surveyed May-August 2005

Kregg Smith

Environment

Gourdneck Lake is a 218-acre lake located in Schoolcraft Township, Kalamazoo County (T4S, R11W, Sec 3). Public access is available at a state-owned site from Hogsett Lake along U Avenue. Gourdneck Lake lies within the Portage Creek subwatershed of Portage River which drains 38,968 acres. Gourdneck Creek is the main inlet and outlet of the lake with the inlet entering along the west side and the outlet flowing to Portage Creek from the south-east side. Hogsett Lake also drains to the lake along the south-west side. Gourdneck State Game Area is located along the western shoreline of the lake with most of the north and east shoreline developed by the surrounding city of Portage. Maximum depth of the lake is 51 feet and average depth is 22.3 feet. The estimated volume of water is 4,860 acre-feet. Approximately 28.8 % of the lake area is less than 10 feet deep while 50 % of the lake area is less than 25 feet (Figure 1). The bottom of the lake is marl and organic matter with sand and marl along the shoreline.

Important components of water quality include phosphorous, nitrogen (ammonia, nitrate, and nitrite), water temperature, oxygen, carbon dioxide, pH, and a number of metals and salts. Water temperature and dissolved oxygen are critical habitat components for aquatic organisms. Water temperature influences internal structure, chemistry, biological metabolism, and the types of aquatic organisms that live in lakes. Water temperatures in Michigan lakes vary from the southern portion of the state to the northern portion, a function of regional air temperatures. Internal lake water temperatures also vary. The warmest water temperatures are found near the surface of the lake (epilimnion) during summer months and near the bottom of the lake (hypolimnion) during winter months. This condition is called stratification. Stratification is most pronounced during summer months when temperature changes are the greatest. A zone of rapid temperature change occurs in the metalimnion (also called thermocline) and this often forms a physical barrier that prevents interchange of water, gases, organic material, and nutrients between the epilimnion and the hypolimnion. Temperature profiles were obtained from two locations in Gourdneck Lake during mid-August 2005. These temperature profiles illustrate that summer stratification occurred in the lake with the metalimnion demarcated by a depth from 15 to 26 feet (Figure 2).

Dissolved oxygen is important for sustaining aquatic life. The solubility of oxygen and other gases depend on water temperature. Colder water can contain more dissolved gases. Oxygen enters the water from the atmosphere and is also produced by aquatic plants during photosynthesis. Oxygen is used by all animals and microorganisms in lakes and it is removed by plants during respiration when sunlight is not available. Oxygen depletion can occur in lakes with high plant and animal oxygen demand, especially in areas of lakes where waters do not mix freely or come in contact with the atmosphere. Water quality standards (related to discharges) in Michigan require maintenance of 7 mg/l dissolved oxygen for all Great Lakes and connecting waters, designated trout streams, and coldwater inland lakes. The water quality standard for other water bodies is 5 mg/l. Minimum dissolved oxygen levels for suitable summer habitat are approximately 3.0 mg/l for coldwater and coolwater fish and 2.5 mg/l for warmwater fish

(Schneider 2002). The influence of water temperature stratification, dissolved oxygen, and trophic status determine the types of aquatic organisms that live in a lake. Dissolved oxygen profiles in Gourdneck Lake showed a clinograde curve where the oxygen content depleted rapidly by oxidative processes (Figure 3). Dissolved oxygen concentrations were below the warmwater fish levels of 2.5 mg/l at a depth of 18 feet with anaerobic conditions in the hypolimnion. Critical depth is defined as the point at which dissolved oxygen concentrations are less than 0.5 mg/l and refers to conditions below which microorganisms like zooplankton will not occur below this depth. The critical depth in Gourdneck Lake occurred around 25 feet. This means that approximately 50% of the lake would not have any or very low dissolved oxygen during summer stratification.

The trophic state of a lake refers to the rate of organic matter supply and is a measure of its productivity. Oligotrophic lakes are low in productivity and eutrophic lakes are high in productivity. Mesotrophic lakes have intermediate levels of productivity. Rates of productivity are regulated by natural and human-induced levels of carbon and inorganic nutrient inputs into the lake. Mesotrophic lakes have Secchi disc transparencies usually between 6 to 15 feet. Nutrient levels are moderately high, with phosphorous concentrations between 0.01 to 0.03 mg/l. Aquatic macrophytes may be abundant in shallow waters. Chlorophyll-a concentrations are usually between 0.002 to 0.010 mg/l. Organic matter deposition in the hypolimnion can result in oxygen depletion for a portion of the year. Anaerobic conditions promote nutrient recycling from the hypolimnion and lower rates of organic matter deposition. Secchi depth readings in Gourdneck Lake were between 11.5 to 16.5 feet with concentrations of total phosphorous (0.02 mg/l), total Nitrogen (0.54 mg/l) suggesting that the trophic status of the lake is somewhat mesotrophic. Alkalinity is a measurement of the buffering capacity of the carbonate system in water. The term hardness is used as a classification of the content of water supplies. Samples collected in Gourdneck Lake were greater than 160 mg/l suggesting the water is classified as hard with a good buffering capacity.

History

The first biological survey of Gourdneck Lake was conducted by the Institute for Fisheries Research at the University of Michigan in the summer of 1953. Water chemistry tests indicated that the water of Gourdneck Lake was hard and dissolved oxygen was adequate for fish to a depth of 21 feet, with a note that trout were not suited for the lake because of a lack of adequate supply of oxygen in the cold-water regions during the critical summer period. Ten night sets of gill nets were used in this early survey (each net 125 feet long and 6 feet deep) capturing yellow perch, largemouth bass, brown bullhead, and spotted gar. A 30-foot bag seine was also used to collect fish such as yellow perch, largemouth bass, bluegill, pumpkinseed, green sunfish, rock bass, white sucker, longnose gar, mimic and sand shiners, bluntnose minnow, logperch, Iowa and Johnny darters, and brook silverside. This report also noted a scarcity of natural cover for fish in the lake. Beginning in the late 1930's the Institute for fisheries Research evaluated the improvement of lakes for fishing (Hubbs and Eschmeyer 1938). This bulletin discussed the addition of brush shelters for improvement of habitat. This research prompted biologists to install brush shelters in Gourdneck Lake during the fall of 1954 when 55 shelters in 12 groups of 1, 4, or 5 shelters were installed.

The only other surveys of Gourdneck Lake were conducted June 1971 and August 1970. These two surveys caught similar species of fish utilizing boat electrofishing for 1.5 and 2 hours, respectively. These surveys documented a fish community composition of 20 fish species typically found in warmwater lakes.

Current Status

Aquatic vegetation survey procedures were followed according to Michigan Department of Environmental Quality protocol. Aquatic vegetation sampling was conducted by sampling 56 individual aquatic vegetation assessment sites (AVAS) spaced approximately 300 feet in length throughout the lakes littoral zone. See attached map of Gourdneck Lake for transect (AVAS) locations. Each AVAS was sampled by using visual observations from weighted rake tows to identify separate plant species, species composition, and relative density. A total of 22 aquatic plants and muskgrass (Chara sp., a macro-algae) were identified during the survey. Muskgrass was the most observed species with a cumulative cover percentage of 52.2. There was four pondweed species observed with Illinois pondweed the most common. Eurasian watermilfoil in general does not appear to be a "nuisance" in Gourdneck Lake. Cumulative cover percentage for Eurasion watermilfoil was only 0.4. Most all of it is confined in deeper water down along the drop-off. Overall, when considering "nuisance" vegetation, there appeared to be little to no problem areas in Gourdneck Lake.

Sampling effort for fish was based on statewide status and trends protocol with standardized sampling gear by lake size (Hayes et al. 2003). We used two trap nets for three net nights, two large-mesh fyke nets for three net nights, two small-mesh fyke nets for two net nights, two gill nets for three net nights, two seine hauls, and three 10-minute boat electrofishing transects.

We recorded mean catch per unit effort (CPUE) in trap nets and large mesh fyke nets as an indicator of relative abundance, utilizing the number of fish per net night (including recaptures) for all net lifts that were determined to have fished effectively. As one possible index of fish community composition, the percent by number of fish we collected in each of three feeding guilds was calculated for, 1) species that are primarily piscivores; 2) species that are primarily pelagic planktivores and/or insectivores; and 3) species that are primarily benthivores. Of the species collected, we classified northern pike, largemouth bass, bowfin, longnose and spotted gar as fish predators; bluegill, rock bass, yellow perch (planktivore with highly variable percent contribution of benthic prey), black crappie, sand shiner, spottail shiner, blacknose shiner, brook silverside, golden shiner, and warmouth as pelagic planktivores-insectivores; and brown and yellow bullheads, pumpkinseed (may be highly reliant on benthic resources), common carp, bluntnose minnow, lake chubsucker, central mudminnow, and logperch as benthivores.

We collected a total of 1,089 fish of 23 species and four turtles during this survey. The turtle species include snapping turtle, common musk turtle, painted turtle and common map turtle. The fish species collected were typical of warmwater fish communities with common carp the only non-indigenous species collected. Large-mesh fyke netting captured 145 fish representing 13 species. Nearly 50% of all black crappie and warmouth were captured in fyke nets (Table 1). Trap nets captured 407 fish representing 14 species and boat electrofishing captured 356 fish representing 15 species. Small-mesh fyke netting capture 57 fish representing 9 species. Minnow seine hauls captured only two species, bluntnose minnow and sand shiner, which accounted for 83 % and 95% of the combined catch for each fish, respectively. Gill nets were the only gear used that did not sample the littoral area of the lake. Gill nets captured 81 fish representing 9 species that were also collected by other gear, but accounted for 79% of the northern pike and 51 % of the yellow perch catch.

Bluegill comprised 38.7% of the total catch by number (Table 1). Rock bass were also abundant with 17.7 % of the catch by number. Other panfish including pumpkinseed, warmouth, yellow perch, and

black crappie were present but in low numbers. Largemouth bass were the most abundant predator with 8.4 % of the catch by number. Northern pike were also present but at low numbers in the catch (2.2%). The overall fish community composition in Gourdneck Lake was 18.4% fish predators, 78% pelagic planktivores-insectivores, and 3.6% benthivores. This represents a very high percentage of fish that are pelagic and is one result of the low oxygen concentrations found in the hypolimnion of the lake that is not suitable for benthivores and most predators.

Bluegill and rockbass were the most abundant species captured in impoundment gear. Bluegill catch per unit effort (CPUE) was 26.0 and 6.33 fish/ net night in trap nets and large mesh fyke nets, respectively. Rockbass CPUE was 18.83 and 6.17 fish/ net night in trap nets and large mesh fyke nets, respectively. Yellow perch were the most representative species captured in gill nets with a CPUE of 6.17 fish/net night. Northern pike CPUE was the second highest in gill nets at 3.17 fish/ net night. Largemouth bass CPUE were low in both trap and fyke nets (1.83 and 0.17 fish/net lift), but catch rates were reasonable by using boat electrofishing (2.4 fish/min.).

Weighted mean lengths at age were calculated for bluegill and largemouth bass because a sub-sample of age structures was collected. Mean growth index for bluegill was +1.1 in 2005. Thus, bluegills are growing at or slightly above bluegill populations across Michigan. State averages across Michigan are calculated from scale aging and can be considered comparable to this study that also used scales to determine mean lengths at age. Age classes from 1 to 6 were collected in the study. A "size score" was calculated to determine that bluegill growth is acceptable (Schneider 1990). Largemouth bass mean growth index was calculated at -0.8 in 2005. Largemouth bass appear to be growing at state averages (less than an inch difference). This difference is likely the result of differences in aging structures used to determine mean lengths at age. Spines were used as the aging structure in this survey in contrast to scales used to develop state averages. Estimated mean lengths at age of scale-aged fish have been found to be larger than spine-aged fish. Sample sizes for largemouth bass from a single gear type were low and prevented accurate measurements of mortality.

Northern pike age structure included 9 year classes with a single individual measured at 38 inches. Few northern pike were captured, but growth appears to be acceptable. Rock bass age structure included 8 year classes with a mean growth index of +1.9. Rock bass are growing above state average growth and are surprisingly common in Gourdneck Lake because this species is more abundant in northern Michigan lakes. Yellow perch were not well represented in the catch other than in gill nets. Catch of yellow perch in 2005 found that 6 year classes were present with a strong 2001 year class (age 4).

Analysis and Discussion

In 1982, the Michigan Department of Natural Resources surveyed 656 inland lakes and found 12% to be oligotrophic, 62% mesotrophic, and 26% eutrophic (Michigan State University 1987). The majority of Michigan's eutrophic lakes were located in the southern part of the Lower Peninsula where agriculture, urban development, and lakeshore development were prevalent. An evaluation of 91 lakes in 2002 indicated the productivity of 25% were low, 62% moderate, 12% high, and 1% excessive (Harrison 2003). Gourdneck Lake is a typical mesotrophic, warmwater, inland lake, based on data collected from this survey. In comparison to data collected in past surveys of the lake (as early as 1950), conditions of water quality and productivity have not changed over time. Likewise the fish community composition has remained similar to the records noted from previous surveys during the 1970's.

Management Direction

Additional fisheries management is not necessary on Gourdneck Lake. The fish community appears to be in satisfactory condition with some very good recreational fishing opportunities for bluegill, rock bass and largemouth bass. Northern pike, pumpkinseed and yellow perch offer additional angling opportunities but they exist in fewer numbers.

References

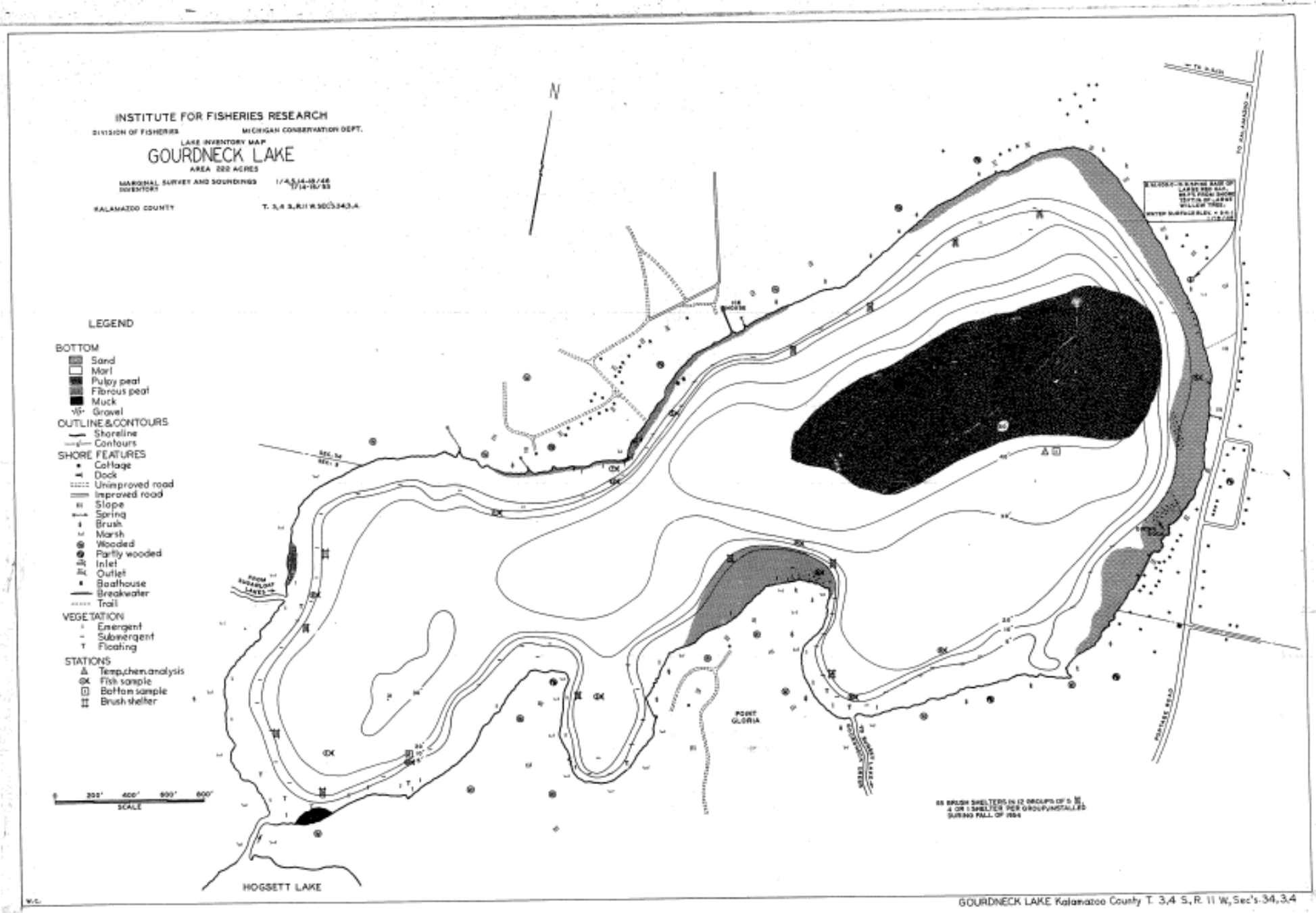
Harrison, K. G. editor. 2003. State of Michigan's Environment 2003. Michigan Department of Environmental Quality, Second Biennial Report. Special Projects. Lansing, MI.

Hayes, D., E. Baker, R. Bednarz, D. Borgeson Jr., J Braunscheidel, J. Breck, M. Bremigan, A. Harrington, R. Hay, R. Lockwood, A. Nuhfer, J. Schneider, P. Seelbach, J. Waybrant, and T. Zorn. 2003. Developing a standardized sampling program: The Michigan Experience. Fisheries. Vol. 28 No. 7 pgs. 18-25.

Hubbs, C. L. and R. W. Eschmeyer. 1938. The improvement of lakes for fishing. Michigan Department of Conservation, Institute for Fisheries Research Bulletin 2, Ann Arbor, MI.

Schneider, J. C. 1990. Classifying bluegill populations from lake survey data. Michigan Department of Natural Resources, Fisheries Technical Report 90-10, Ann Arbor.

Schneider, J. C. 2002. Fish as indicators of lake habitat quality and a proposed application. Michigan Department of Natural Resources, Fisheries Research Report 2061, Ann Arbor.



GOURDNECK LAKE Kalamazoo County T. 3,4 S., R. 11 W., Sec's. 34, 3,4

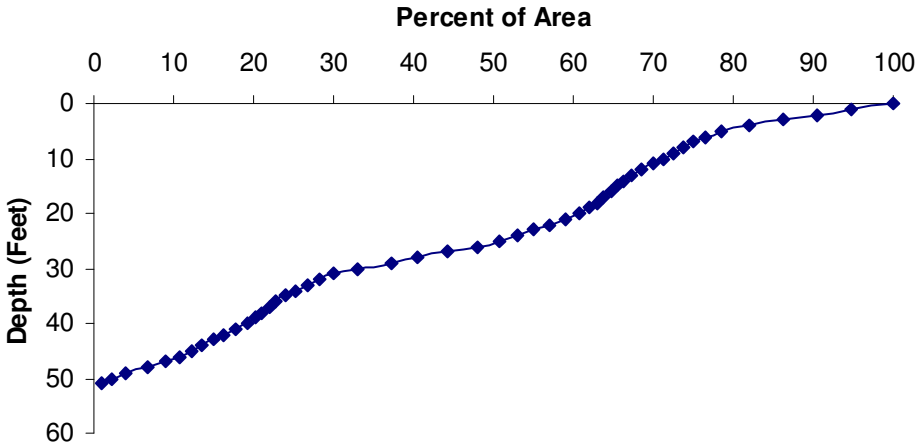


Figure 1. Hypsographic curve (depth-area) of Gourdneck Lake, Kalamazoo County. Data obtained from MDNR Digital Water Atlas.

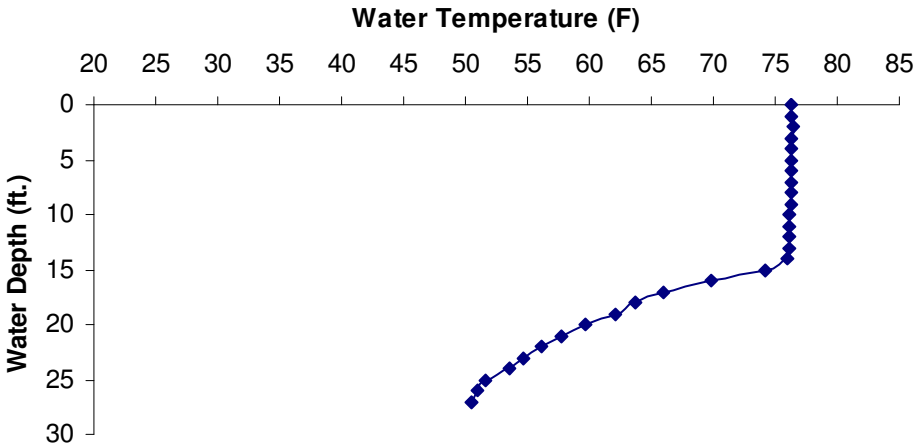


Figure 2. Water Temperature profile of Gourdneck Lake during summer stratification.

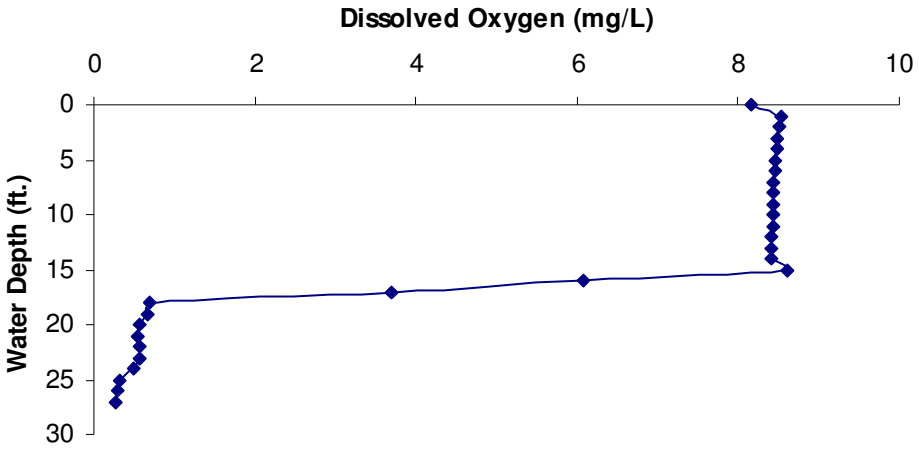
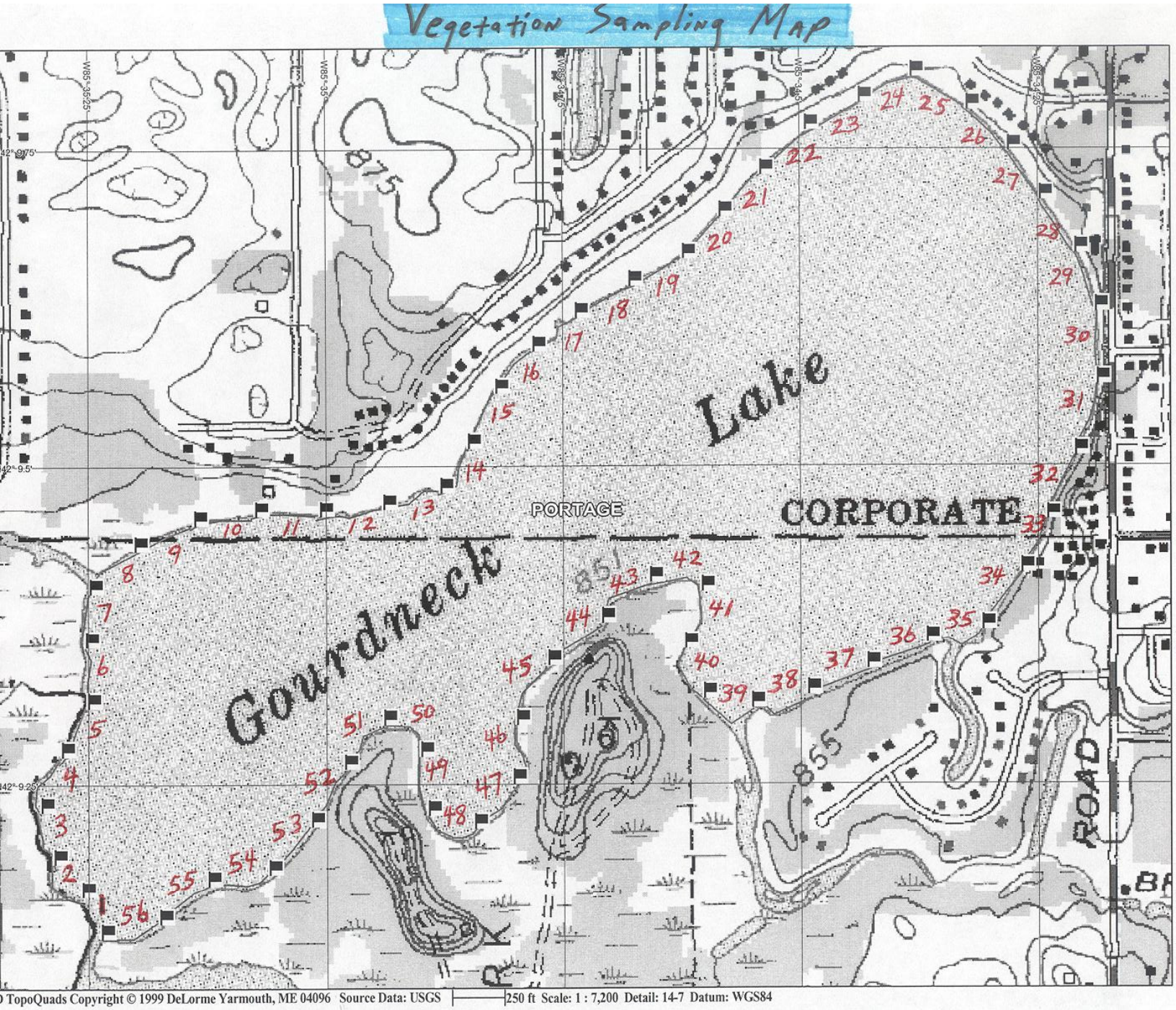


Figure 3. Dissolved oxygen concentrations during summer stratification in Gourdneck Lake.

Table 1. Catch of fish by gear type in Gourdneck Lake, Kalamazoo County

Species	Total Catch	SM Fyke Netting RA (%)	#O	Boat Electrofishing RA (%)	#O	Trap Netting RA (%)	#O	LM Fyke Netting RA (%)	#O	Gill Net RA (%)	#O	Minnow Seine RA (%)	#O	Combined RA (%)
Black Crappie	35	0.0		0.0		42.9	15	48.6	17	8.6	3	0.0		3.2
Bluegill	421	5.7	24	46.8	197	37.1	156	9.0	38	1.4	6	0.0		38.7
Bluntnose Minnow	6	16.7	1	0.0		0.0		0.0		0.0		83.3	5	0.6
Blacknose shiner	1	0.0		100.0	1	0.0		0.0		0.0		0.0		0.1
Bowfin	20	5.0	1	10.0	2	70.0	14	5.0	1	10.0	2	0.0		1.8
Brown Bullhead	6	0.0		0.0		100.0	6	0.0		0.0		0.0		0.6
Brook Silverside	1	100.0	1	0.0		0.0		0.0		0.0		0.0		0.1
Common Carp	1	0.0		100.0	1	0.0		0.0		0.0		0.0		0.1
Golden Shiner	1	0.0		0.0		100.0	1	0.0		0.0		0.0		0.1
Lake chubsucker	1	0.0		0.0		0.0		100.0	1	0.0		0.0		0.1
Largemouth bass	91	0.0		79.1	72	12.1	11	1.1	1	7.7	7	0.0		8.4
Longnose Gar	47	2.1	1	4.3	2	76.6	36	17.0	8	0.0		0.0		4.3
Logperch	1	0.0		100.0	1	0.0		0.0		0.0		0.0		0.1
Central mudminnow	1	0.0		100.0	1	0.0		0.0		0.0		0.0		0.1
Northern pike	24	0.0		0.0		12.5	3	8.3	2	79.2	19	0.0		2.2
Pumpkinseed	45	8.9	4	20.0	9	40.0	18	31.1	14	0.0		0.0		4.1
Rock bass	193	8.8	17	13.0	25	58.5	113	19.2	37	0.5	1	0.0		17.7
Sand shiner	40	0.0		5.0	2	0.0		0.0		0.0		95.0	38	3.7
Spotted Gar	19	36.8	7	0.0		42.1	8	21.1	4	0.0		0.0		1.7
Spottail shiner	2	0.0		100.0	2	0.0		0.0		0.0		0.0		0.2
Warmouth	35	2.9	1	8.6	3	25.7	9	54.3	19	8.6	3	0.0		3.2
Yellow Perch	73	0.0		45.2	33	2.7	2	1.4	1	50.7	37	0.0		6.7
Yellow Bullhead	25	0.0		20.0	5	60	15	8.0	2	12.0	3	0.0		2.3
	1089		57		356		407		145		81		43	

Vegetation Sampling Map



 250 ft Scale: 1 : 7,200 Detail: 14-7 Datum: WGS84