February 1992

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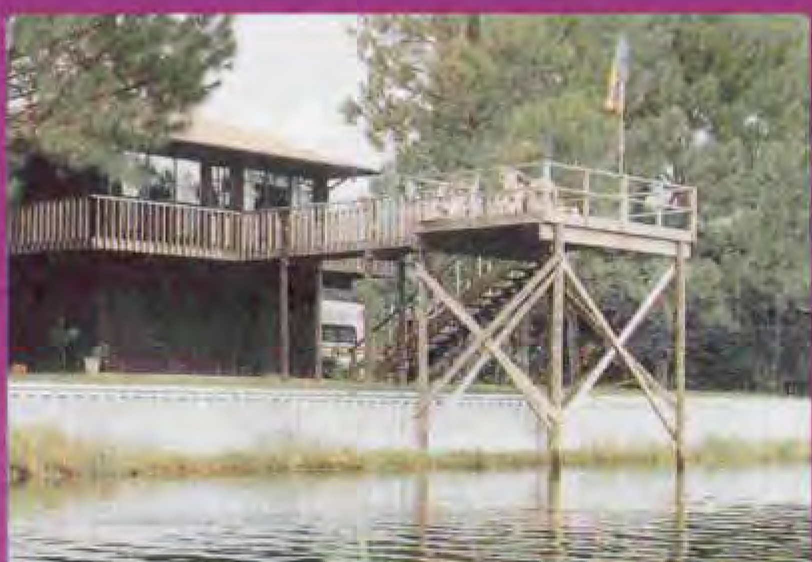

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► Zebra mussels look like small clams with a yellowish and/or brownish "D"-shaped shell, usually with alternating dark and light bands of color (thus the name "zebra").

► They can grow up to two inches long, but most are under an inch long. Zebra mussels usually grow in clusters containing numerous individuals (see photo), and are generally found in shallow (6 to 30 feet deep), algae-rich water.

► Zebra mussels are the ONLY freshwater mollusk that firmly attaches itself to solid objects, including rocks, boat hulls, etc.

What to Do

► Note the date and precise location where the mussel or its shell(s) were found;

► Take the mussel with you (several, if possible) and store in rubbing alcohol (in any case, DON'T throw it back in the water), and

► IMMEDIATELY call the Michigan Sea Grant Extension office (517/353-9568) or the Sea Grant agents in western Michigan (616/846-8250), Upper Peninsula (906/228-4830) or eastern Michigan (313/469-6085).

Letter To The Editor

Dear Sirs:

It has been in my mind for some time to write to you about my concerns about the articles and the type of print in the *Riparian*.

I find the *Riparian* very hard to read for two reasons, it seems to me. First, there is little white space around the type. It looks to me like too much information being compressed in too little space. Second, the articles have become so technical in nature that I find most of them very hard to read. I just don't have the background to make good use of them.

I really have to wonder how many others are finding the same to be true for them. I think consideration should be given to the understanding of the subscribers and to readability. The *Riparian* can provide wonderful information to lake property owners, but I have to wonder if it is doing that in its present format and content.

Thank you for your consideration of my comments.

Sincerely,

Marilyn J. Waumans

Marilyn is a resident and member of Painter, Juno and Christian Lakes Association, Edwardsburg, Michigan, Cass County.

THE MICHIGAN
RIPARIAN

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The Michigan RIPARIAN is the only magazine devoted exclusively to protection, preservation and improvement of Michigan waters and to the rights of riparian owners to enjoy their waterfront property.

The Michigan RIPARIAN is published quarterly and is mailed to subscribers during February, May, August and November.

In This Issue:

EDITORIAL

Donald Winne

Each Acre of Wetlands Destroyed Brings Us Closer to the Day of Judgement

We are continuing to destroy wetlands in Michigan at a rapid pace. The pace 150 years ago was minimal when it was done by a man with a shovel and a team of horses with a scoop. With today's mechanical giants with all manner of hydraulic power lifts, we can make short rift of a wetland in hours and minutes.

We have destroyed at least one-half of Michigan's wetlands, and 1991 saw us attacking wetlands in Michigan at the rate of about four (4) every day. We will pay the price for this foolishness. Some costs to the people of Michigan and to tourism in the State are immediately apparent. Those costs include:

1. Greater and more frequent floods along rivers and streams.
2. Diminished fish populations in lakes and streams.
3. Diminished duck populations through loss of nesting and nursery habitat.
4. Degraded water quality of lakes and streams from more rapid runoff and erosion.
5. Decreasing the opportunity for people to enjoy and appreciate the natural environment.
6. Disturbing and disrupting the natural hydrologic cycle.

If we want to promote the survival of man on this planet, then we must bring a halt to our destruction of wetlands.

(Please see editor's related article on page 23.)

Donald E. Winne

PUBLICATION DEADLINES: At least the 10th day of the preceeding month.

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A Limnological Survey of Blue Lake, Mecosta Lake And Round Lake, Mecosta County, Michigan, August 1990

Survey conducted by: Niles R. Kevern, Robert F. Elliott, Glenn Barner, Holly Jennings and David Zafft
Department of Fish and Wildlife, Michigan State University, East Lansing, Michigan 48824

In order to give better coverage of the study of Blue, Mecosta and Round Lakes, it will be divided into three parts. Part I, Concepts and Terminology *appeared in the November, 1991, issue of* The Michigan Riparian. *Part II, presented in this issue, will cover the* Physical and Chemical Parameters. *Part III, which will appear in the May, 1992, issue, will present the* Biological Parameters *and the* Recommendations *for management of the three lakes.*

Part II — Physical & Chemical Parameters

A. Physical Parameters
1. General Description & Morphometry
2. Transparency or Visibility
3. Parameter Depth Profile
4. Temperature

B. Chemical Parameters
1. Dissolved Oxygen
2. Conductivity
3. pH
4. Alkalinity
5. Hardness
6. Chlorides
7. Nutrients

The following results reflect the status and condition of the Tri Lakes (Blue, Mecosta and Round) on August 14, 15, and 16, 1990, when the lakes were surveyed and samples collected.

General Description and Morphometry

The Tri-Lakes are located in Michigan in Mecosta County, all T.14 N., R.8 W, with Blue Lake in Sections 8 and 9, Mecosta in Sections 8 and 17 and Round Lake in Section 7. Hydrographic maps are shown in Figures 2, 3 and 4 for Blue, Mecosta and Round Lake respectively. The three lakes are clustered together and connected by channels. It is possible that in prehistoric time the three lakes may have been one large lake. It appears that Round Lake is upper-most in the watershed with one major inlet, Cole Creek, at the north end of the lake and a minor inlet, Burden Creek, on the northwest corner. Round Lake connects to Mecosta Lake by a channel at the southeast corner of Round Lake and enters Mecosta Lake at its northwest corner. Water flows from Round to Mecosta. Inlets to Mecosta Lake are primarily the channel from Round Lake and large spring or drainage areas on the west side and southwest corner. The outlet from Mecosta Lake to Blue Lake is from Mecosta Lake's northeast corner. Since Mecosta Lake has an elongated shape and the inlet and outlet channels are both located at the extreme north end, it would seem that there would be relatively little mixing of inlet water from Round Lake with the middle or southern part of Mecosta Lake. Some mixing could possibly occur during spring or fall mixing periods; however, during periods of stratification (90% of the time) inlet water would probably flow over the surface toward the outlet. Exceptions would occur with strong north winds.

The channel from Mecosta Lake connects to the southwest corner of Blue Lake and adjacent to the main outlet of the system to the west branch of the Muskegon River. Another main inlet to the system is Gilbert Creek which is the outlet of Horsehead Lake to the north. Gilbert Creek enters the channel between Mecosta and Blue Lakes and thus encounters the outlet before entering Blue Lake. It seems that relatively little of the flow from Mecosta Lake or Gilbert Creek enters Blue Lake and thus would probably have little influence on its water quality. The lower end of Gilbert Creek is a low marsh area that may have some overflow into Blue Lake north of Shepherd's Island during high water periods; e.g.

(Continued on Page 10)

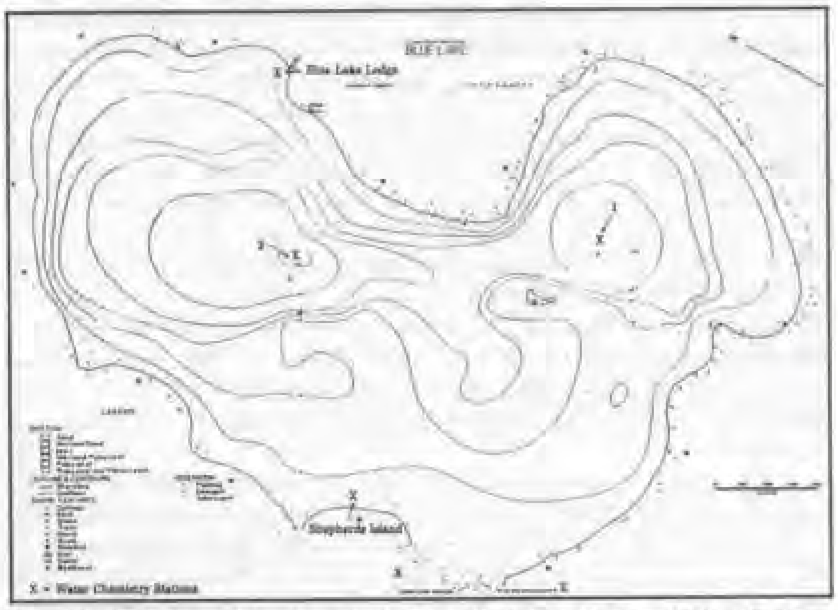

Fig. 2) Hydrographic Map and Sampling locations of Blue Lake.

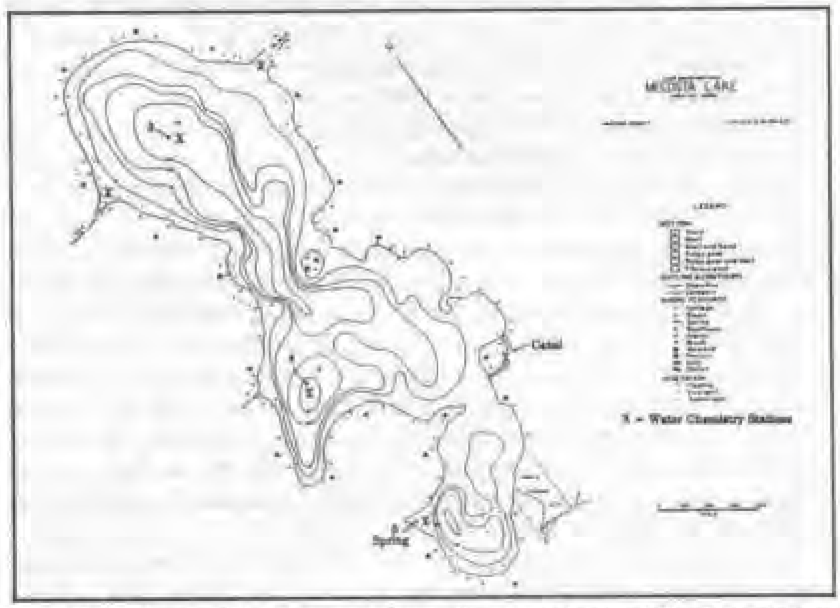

Fig. 3) Hydrographic Map and Sampling locations of Mecosta Lake.

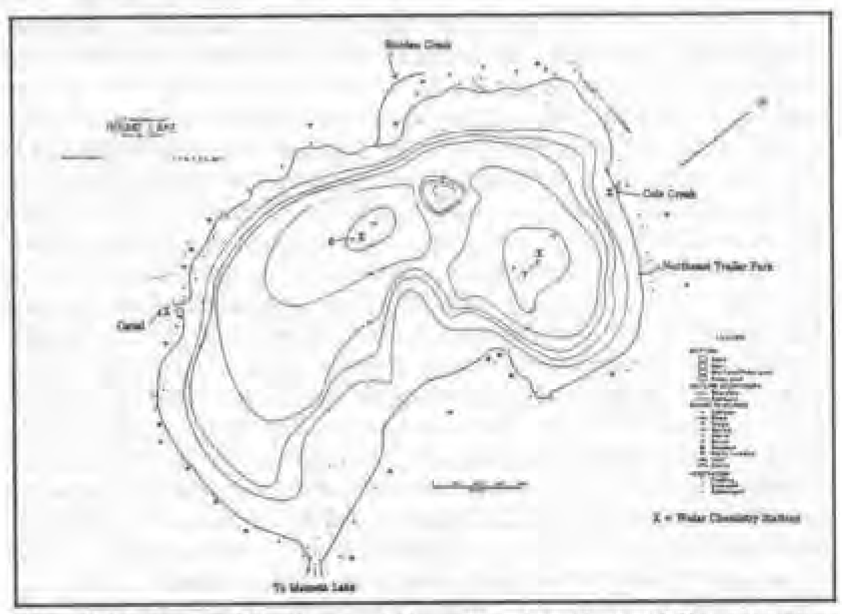

Fig. 4) Hydrographic Map and Sampling locations of Round Lake.

A Limnological Survey of Mecosta County Lakes

(Continued from Page 9)

during spring runoff. There is a small inlet to Blue Lake on the east side which appears to be minor in terms of flow.

The lakes are all modest in size, but all have good depth relative to their surface area, depth sufficient to allow summer stratification. Round Lake, the smallest of the three, has a surface area of 62.6 hectares (155 acres), a maximum length of 1,183 meters (3,883 ft. or 0.74 miles) a maximum depth of 13.7 meters (45 feet), a shoreline length of 3,565 meters (11,695 feet or 2.2 miles) and a shore development (Sd) of 1.27. Mecosta Lake is the largest of the three with a surface area of 120 hectares (297 acres), a maximum length of 2,300 meters (7,546 feet or 1.43 miles), a maximum depth of 11.9 meters (39 feet), a shoreline length of 8,016 meters (26,301 feet or 4.98 miles) and a shore development of 2.06. Blue Lake has a surface area of 95 hectares (235 acres), a maximum length of 1,561 meters (5,120 feet or 0.97 miles), a maximum depth of 15.2 meters (50 feet), shoreline length of 4,600 meters (15,090 feet or 2.86 miles) and a shore development of 1.33.

All three lakes have multiple basins that are oriented in a general north-south direction. Round Lake has a north basin 45 feet deep and a second basin 36 feet deep somewhat to the southwest of the first. Mecosta Lake has its deepest basin, 39 feet, at the north end, a basin 33 feet deep to the south along the west side and a 20 foot basin at the south end. The Blue Lake basins are 50 feet in the north central part and 36 feet in the south central part. These basins are numbered on the maps in Figures 2, 3 and 4 and are the locations where depth profiles for temperature, oxygen and conductivity were measured and where samples for water chemistry were collected. Depth profiles are plotted in Figures 5, 6 and 7 along the major axes of the lakes thus depicting the relative bottom contours, the deep areas and the stratification. *(Figures 5, 6 & 7 are omitted but are available upon request.)*

Round Lake and Blue Lake have somewhat round shapes and relatively regular shorelines. Mecosta Lake is elongated and has a more irregular, dissected shoreline. The shore development (Sd) reflects the shape of the lake with the Sd of Mecosta Lake (2.06) being higher than that of Round (1.27) or Blue Lake (1.33). Lakes with higher shore development values are often more productive because they have more shallow littoral area relative to the overall surface area. This provides more area where the sunlight penetrates to the bottom causing more growth of aquatic macrophytes (weeds) if nutrients are available. Probably of more significance is that a high Sd means there is more shoreline relative to the surface area of the lake thus allowing for more dwellings to be located on such lakes. This in turn allows for greater human use per unit of surface area and thus greater potential impact from congestion on the lake, and nutrient inputs from faulty septic systems or lawn fertilization. However, public access to lakes is often more significant in terms of recreational carrying capacity than is the number of lake homeowners. Of course, proper attention to setbacks, green belts, septic system location and minimum lawn fertilization can minimize the impact of lake-side dwellings.

Many lakes in Michigan were mapped in the early 1940's by the Fisheries Division of the Michigan Department of Natural Resources (MDNR — then the Department of Conservation). The Tri Lakes were thus mapped in 1940. The time elapsed since then is 50 years, a significant time for us humans, but rather insignificant for a reasonable size lake. As is the usual case, we found no changes in the depths of the deep basins of the three lakes from that on the 1940 maps. Sedimentation of organic matter, while no doubt occurring, has not been a problem. The general process of sedimentation is for aquatic weeds produced in the shallow areas (usually 12 feet or less) and the plankton produced in the open water areas to settle downward along the basin slopes toward the deep areas. Wave action and seasonal mixing assist in this process. Some of the organic matter that settles is broken down and recycled by bottom dwelling animals and bacteria. Having deep areas and significant volume of deep water in lakes is generally good and your lakes have these deep areas as shown on the maps and the depth profiles.

Transparency or Visibility

Secchi disk data from many Michigan lakes that participate in the MDNR Inland Lake Self-Help Program are presented in their Annual Reports. Our secchi disk readings for the Tri Lakes are given in Table 2. and are compared there with other data for the Tri Lakes. Our readings are similar to those from other sources taken in other years. While Secchi disk readings vary seasonally with the presence or absence of plankton blooms, the readings for your lakes have a small range, usually from 2.7 to 3.5 meters, the exception being Mecosta Lake in August of 1975 (Table 2), and average slightly over 3 meters for all three lakes. Your lakes are near the reported average for the Self-Help Lakes. Interpretation can be that your lakes are moderately productive and reasonably clear.

	Round		Mecosta		Blue	
Date	Meters	Feet	Meters	Feet	Meters	Feet
Aug. 1990	3.2	10.5	3.0-3.3	9.9-10.8	3.0-3.3	9.9-10.8
1989 ($\bar{x}$)[1]	2.93	9.6	3.0	9.9	3.4	11.2
1977, '81-85 ($\bar{x}$)[1]	2.7	8.9	3.0	9.9	3.0	9.9
Summer '83[2]	3.2-3.5	10.5-11.5				
Aug. '75[3]			1.5-2.1	4.9-6.9		
Apr. '78[3]	3.0	10.0	3.6-4.3	11.8-14.1		

[1]MDNR, Self-Help Program [2]Ferris State College Report [3]Aquatic Consulting Services

Table 2. Secchi Disk readings (meters/feet) for Round, Mecosta and Blue Lake.

Parameter Depth Profiles

Temperature, dissolved oxygen and conductivity measurements were taken at one meter intervals from top to bottom over the deep holes of each basin in all three lakes. The data for each basin are presented in Appendix 1 and profiles for the basins by lake are graphed in Figures 8, 9 and 10. It will be helpful to refer to these graphs while reading the discussion on temperature, oxygen and conductivity.

Temperature

All basins of all three lakes were thermally stratified (layered) in mid August, 1990. This was expected as a normal condition and was the reason for doing the study in August. The lakes were probably stratified since the spring overturn in May. Temperatures ranged from 22-23°C (71.6-73.4°F) at the surface of the lakes to lows near the lake bottoms of 9.1°C (48.4°F) for Blue Lake, 10.0°C (50.0°F) for Mecosta Lake and 7.6°C (45.6°F) for Round Lake. Lakes in the temperate zones of the world usually stratify in the summer if they are deep enough. The middle layer or metalimnion is distinguished by a rapid drop in temperature with increasing depth. The metalimnion was between 7 and 11 meters at Station 1 and between 6 and 11 meters at Station 2 in Blue Lake; below 4 meters at Station 3 and below 5 meters at Station 4 in Mecosta Lake and between 4 meters and 8 meters at Station 6 and between 3 meters and 8 meters at Station 7 in Round Lake (Figs. 8, 9 and 10). These temperature profiles are typical of normal temperate zone lakes and lakes normally managed for warm — and cool — water fish (e.g. bass, pike, sunfishes, and walleye).

Dissolved Oxygen

Dissolved oxygen (DO) concentrations measured indicated well-oxygenated water in all three lakes in their epilimnions (top layer) and into the upper part of the metalimnions (middle layer). DO was at 5.0 mg/L or higher as deep as 4.5 meters (14.8 feet) in Round Lake, as deep as 5.4 meters (17.7 feet) in Mecosta Lake and the best in Blue Lake where the 5.0 mg/L or better went as deep as 6.5 meters (21.3 feet). DO at 5.0 mg/L would be sufficent for the species of fish living in the Tri Lakes. While fish can survive at concentrations below 5.0 mg/L for considerable time periods, it is possible that stress will occur after extended periods. Concentrations below 2.0 mg/L probably result in discomfort in most fish species and few fish would be found in such locations for any length of time. Anglers would be wise to note the depths of adequate DO on the figures as they relate to mid and late summer locations of fish.

After the spring and fall periods of mixing the lakes are usually uniformly oxygenated to or close to the bottom. Once stratification occurs, the oxygen in the deep areas near the bottom begins to be consumed by the respiration of bacteria as they decompose organic matter that has settled out. Further, plankton that settle toward the bottom also reach depths where sunlight is low and their respiration dominates the photosynthesis/respiration relation, thus contributing to the depletion of DO in the deeper areas. Generally, the richer (more nutrients) and more productive the lake, the greater will be the oxygen depletion. This reflects the organic food base for bacteria and the respiration of plankton populations.

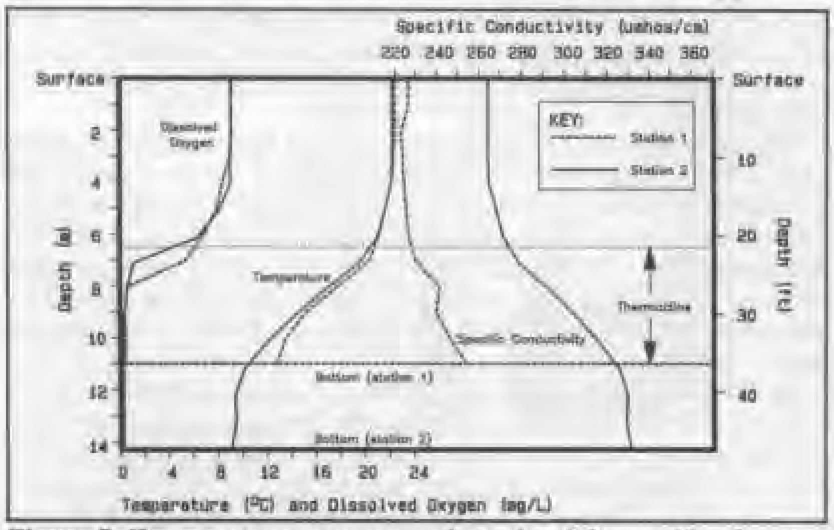

Figure 8. Temperature, oxygen and conductivity profiles for stations 1 and 2, Blue Lake on August 14, 1990.

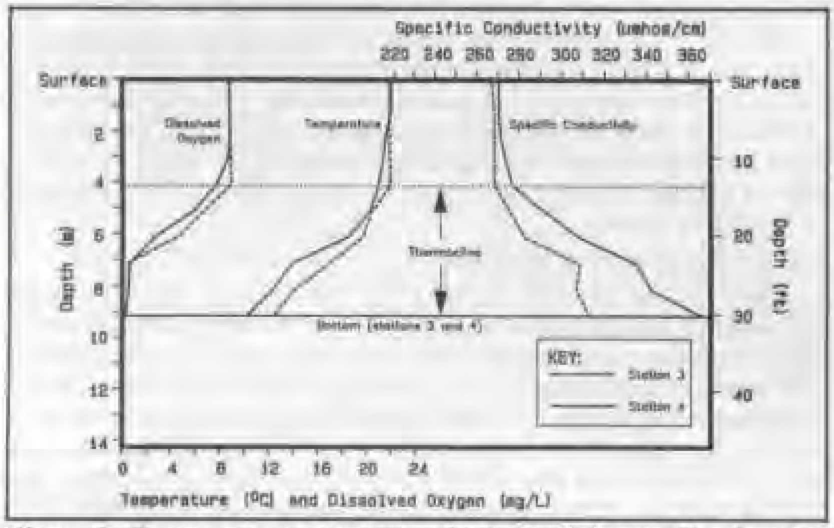

Figure 9. Temperature, oxygen and conductivity profiles for stations 3 and 4, Mecosta Lake on August 14, 1990.

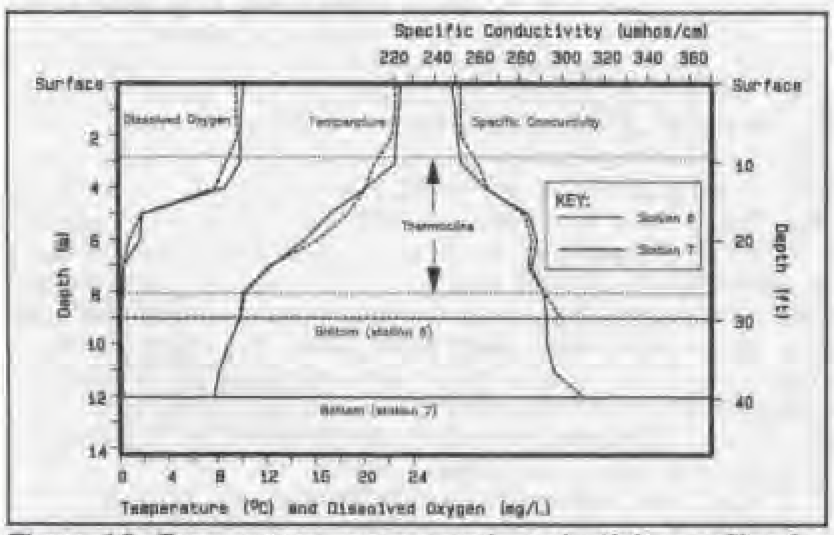

Figure 10. Temperature, oxygen and conductivity profiles for stations 6 and 7, Round Lake on August 14, 1990.

This depletion of oxygen in the bottom layers of a lake is common in the summer and winter stratification periods, being usually more pronounced in the summer. Since the extent of the oxygen depletion is a reflection of productivity it also is an indication of a lake's trophic state and is important in determining the species of fish that can live in the lake. Fish such as trout that must have cold water therefore would have to have oxygen in the lower layer of the lake where the cold water exists in the summers.

While consumption of oxygen also occurs in the upper layer of a lake, it is continually replenished from atmospheric aeration and by the photosynthesis of plants. Reoxygenation is usually greatest at or near the surface while oxygen-consuming organisms settle out and accumulate in the denser layers of water near the top of or in the metalimnion. Here, oxygen is usually depleted faster than it can be replenished, resulting in a decrease in DO that continues and expands with depth.

Based on oxygen depletion, the Tri lakes rank from Round Lake as the most productive to Blue Lake as the least productive. Fish growth might be slightly better in Round Lake relative to Blue Lake; however, many other factors are involved in fish growth. This situation in other terms would place Blue Lake as the best with Round Lake as the third ranking of your three lakes.

Conductivity

Specific conductance ranged from about 226 micromhos/cm at the surface of Station 1 on Blue Lake to a high of about 365 micromhos/cm at the bottom of Station 4 on Mecosta Lake (Figs. 8, 9 and 10). Generally surface water values were similar as were the profiles and deep water values. The profiles of the Round Lake Stations were nearly identical, the two Mecosta Lake profiles were close and the two Blue Lake profiles were similar in shape but about 40 micromhos/cm apart. This probably only serves to reveal that the two basins are quite separate in terms of water exchange with the shallower Station 1 perhaps receiving more spring water in the deep area. This assumes the spring water to have a slightly lower specific conductance. Spring water would likewise have a more moderate temperature and this appears in Figure 8 as a slightly warmer water at 11 meters for Station 1 and for Station 2. A similar situation appears in Mecosta Lake at the lower depths.

These specific conductance levels are within the range expected for unpolluted hard water lakes. Conductance values typically increase with depth due to the gradual settling of precipitated particles and their dissolving near the bottom and the release of ions from decaying organic sediments at or near the bottom. We look for high values at other sampling locations relative to the open lake values to indicate possible input of chemicals (nutrients or contaminants).

Conductivity was measured at several sites around the lakes (Table 3). *Higher values, over 300 micromhos/cm, were measured at Station 5 (the spring) on Mecosta Lake and in the canal on the south end of Round Lake (this may be the area known as Pine Shores?). These specific conductance values would indicate an input of some ionized chemicals, possibly nutrients.* Conductivity slightly higher than the open lake values were measured *at the Cole Creek inlet (290 micromhos/cm)* and Gilbert Creek inlet (296 micromhos/cm). *These inlets* have discharges higher than the above sites, thus their values, even though only slightly higher than the open lake, *could represent significant inputs.* Gilbert Creek flow exits to the outlet of the Tri lakes. *Cole Creek, however, enters directly to Round Lake in the area of dense macrophyte (plant) growth and would appear to be contributing to that situation* (problem). A slightly higher value at the south end of Mecosta Lake probably reflects the inflow from the spring at Station 5. Other measurements were similar to the open lake measurements.

(Continued on Page 24)

The Gull Lake Story

Alan J. Tessier and George H. Lauff
W.K. Kellogg Biological Station, Michigan State University, Hickory Corners, Michigan 49060

Gull Lake is a large (2044 acres surface area, 110 feet maximum and 41 feet mean depth) and recreationally important lake in southwestern Michigan (northern Kalamazoo and southern Barry counties - Figure 1). Gull Lake is also the location of one of the premier ecological research and teaching programs in the United States — the W.K. Kellogg Biological Station of Michigan State University (KBS). The presence of a field station on the shores of Gull Lake has resulted in this lake having one of the best historic records of water quality in the state of Michigan. The story of Gull Lake is one typical of many natural lakes — cultural eutrophication, but unlike other lakes this story has a happy ending.

Figure 1. Location map of Gull Lake.

Lake Background

As with most lakes in Michigan, Gull Lake was created by glacial activity. It is most likely a compound "kettle" lake, formed by several large ice blocks that broke off a retreating glacier and eventually melted, leaving several, joined depressions in the surrounding landscape of what was once a preglacial valley. The land that now drains into the lake is 8 times the size of the lake itself. A water budget for the lake indicates that 35% of the total water entering the lake comes by way of the four small streams, 25% comes from precipitation, and 40% is ground water inflow. The average time that a drop of water spends in the lake is relatively short: 4.3 years.

In many ways Gull Lake is typical, albeit larger, than most lakes in the lower peninsula of Michigan. The lake is dimictic; in spring and fall there is a long period of complete vertical mixing. The lake is usually thermally stratified from May to early November with the average depth of the thermocline at 30 feet. Ice cover varies, but is generally complete from January through February. The waters of Gull Lake are very hard (high in concentrations of calcium and magnesium salts) giving the lake a deep bluish-green color. During summer when the upper waters of the lake become warm, some of these salts precipitate out of solution and settle to the bottom of the lake, carrying with them nutrients such as phosphorus.

Cultural History

In 1833, a man by the name of Tillotson Barnes established a dam on the only stream outlet of Gull Lake and created a water-powered sawmill. By 1855, a small town of Yorkville had developed around that sawmill, with lumbering and agriculture as the major occupations. Twenty years later, all the land around the lake had been claimed, but there were few people and little development outside the south end of the lake (Yorkville). The forests were gone, most of the land was in agriculture, and the sawmill gave way to a grist mill for grinding grain. With the turn of the century the lake became important for something other than water power at the outlet: summer resorts and cottages sprang up around the lake. Interurban electric trains allowed easy access from the major cities, and recreation became an important part of the local economy. Still, year round residences and density of people living on the lake remained low until after World War II.

The earliest limnological study of Gull Lake was conducted by the Michigan Department of Conservation in 1942; they found a pristine lake with excellent water clarity and a diverse fish community dominated by smallmouth and largemouth bass. The lake also possessed a native cold-water fisheries (Cisco - lake herring), which was later expanded with stockings of trout and smelt. The 1950's and 1960's, however, brought a major increase in year-round homes on Gull Lake and a large increase in population density. A comparison of land use in 1938 with that in 1964 shows that urban and developed lands increased from only 8% to over 20% of the immediate watershed. In addition to this increased density of lake residents, the output of nutrients from each household was greatly increased by the introduction of phosphorus based detergents.

The rate of growth (production) of algae and aquatic plants in Gull Lake (as in most midwestern lakes) is controlled by the availability of phosphorus in the water. The higher the rate at which phosphorus enters a lake (referred to as the phosphorus "loading") the greater the rate of algae growth. When phosphorus inputs are increased due to human sources (primarily sewage and fertilizers) the resulting increased lake production is referred to as cultural eutrophication.

In 1965 researchers at the Kellogg Biological Station (KBS) noticed an important warning sign that the lake algal production was increasing; i.e. there was increased depletion of oxygen from the deep waters during summer (see below). By 1970 the handwriting was on the wall, Gull Lake was experiencing rapid cultural eutrophication. During 1970-76, the KBS conducted detailed studies to document the process of cultural eutrophication, identify the causes, and educate the lake residents as to corrective measures. Funding for this research came from local sources (Kalamazoo Nature Center, Kalamazoo Foundation) and from national sources (National Science Foundation). Several papers and graduate student theses were completed during this period, the most notably being publications by George Lauff, Brian Moss and Robert Wetzel. Anyone interested in details can review this work at the KBS library.

The Symptoms of a Problem

What the limnological record shows for 1965 to 1975 is a large increase in the density of algae in the open water of Gull Lake. There was also a change in the type of algae, from small forms of diatoms to nuisance blooms of bluegrass algae. Further, beds of shoreline vegetation and filamentous algae began to increase around the lake. The increased numbers of aquatic plants and algae resulted in an increased production of organic matter (by photosynthesis). As the organic matter settled into the deep waters during summer, it decomposed. The process of decomposition uses up oxygen from the bottom waters — the more organic matter produced in the surface waters, the more decomposition in the bottom waters. In 1964 and 1965 there was oxygen at the bottom of Gull Lake all summer long. Within a few years, however, the depletion of oxygen in the bottom waters during late-summer was becoming severe; by the early-1970's the typical late-summer condition was for Gull Lake to have no oxygen in the bottom half (50 feet) of the lake (Figure 2). Anoxia in the bottom waters probably contributed to the local extinction of the native cold-water fisheries.

In 1974, a student at KBS named David Tague conducted a study of the phosphorus budget of Gull Lake. It was clear from other work that the major culprit of the eutrophication of Gull Lake was increased concentrations of phosphorus in the lake water. Tague's goal was to determine where the phosphorus was coming from. The study was fairly intensive and involved year-round monitoring of phosphorus entering the lake from all inlet streams, precipitation and ground-water.

The summary result of Tague's work is shown in Table 1. The total annual loading of phosphorus to the lake was estimated at 0.27 grams per square meter of lake surface area. This level of loading is considere excessive and if continued would eventually create a highly eutrophic lake. For a lake having a mean depth similar to Gull Lake, a permissible rate of phosphorus loading would be around 0.10 grams per square meter and a dangerous level is anything greater than about 0.20 grams per square meter. What was clear from Tague's work (Table 1) was that more than 0.20 grams (75%) of the total phosphorus loading to Gull Lake was estimated to come from septic tanks (0.18 grams) and lawn fertilization practices (0.02 grams). If these two human sources could be eliminated, the lake loading of phosphorus would be decreased to well under the 0.10 permissible level.

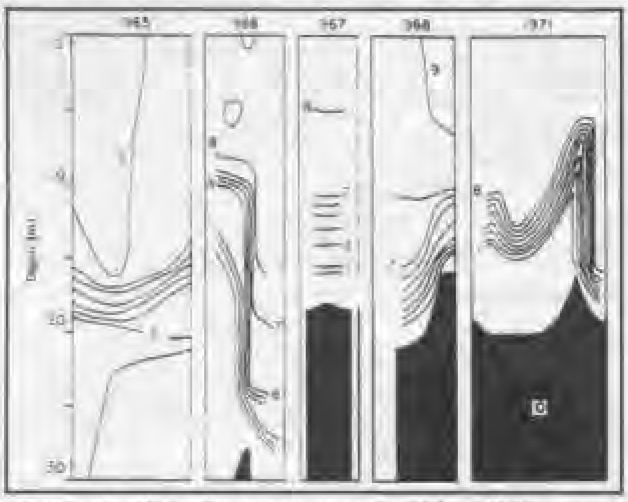

Figure 2. Concentration of oxygen expressed in milligrams per liter at different depths in Gull Lake for 5 years during the month of October. Each line indicates a level of equal oxygen concentration. The dark area indicates a complete lack of oxygen.

	Loading	Percent
Natural Sources		
Total from Tributaries	0.027	10
Precipitation	0.033	12
Ground Water	0.008	3
Artificial Sources		
Septic Systems	0.183	67
Lawn Fertilization	0.022	8
Total	0.273	100%

Table 1. Summary of the total phosphorus budget for Gull Lake for 1974. The contribution of phosphorus entering the lake from each source is expressed both as the loading, (grams of phosphorus per square meter of lake surface per year), and as the percentage of the total annual phosphorus input. From D. Tague, MS thesis.

The Cure

Although planning for a sewage treatment facility had been proposed as early as 1965, there was no action until the 1970's. During the late 1960's and early 1970's many of the lake residents began to notice the decline of water quality and formed a lake organization (now called the Gull Lake Quality Organization — GLQO). Armed with information provided by the researchers at KBS, the GLQO began an educational program. An immediate goal was to convince all lake residents to reduce phosphorus use. Soil testing around the lake indicated that the soils were already saturated with phosphorus, hence, further additions of phosphorus in lawn and garden fertilizers were unnecessary. Local garden centers were encouraged to carry phosphorus free fertilizers for the lake residents to use. However, as Tague's thesis showed, the major cause of the lake eutrophication was clearly inputs of phosphorus from septic tanks.

The GLQO and township officials also pushed ahead with plans to develop a sewer line around Gull Lake. In 1972 an application was filed for state and federal funding. By 1977 there was final approval by all four townships involved to begin the final design stage. Although some were opposed to the idea of a sewer system on the grounds that it would increase local development and pressure for more public access, the vast majority of resident supported the sewer line. the possible disadvantage of sharing the lake with more people was a better prospect to most than eventually not being able to enjoy the lake at all. In 1980, federal money was finally awarded to begin construction of the sewer project that would involve 21 miles of pipe, serve over 1100 homes and eventually cost 12 million dollars. The system became fully operational in early 1984; nearly twenty years from the first observation of lake eutrophication and the first call for action.

Recovery

Gull Lake had three things working in favor of rapid recovery from eutrophication once the major source of phosphorus had been eliminated: 1) it was deep, 2) its water was high in concentrations of calcium and magnesium salts, and 3) the average residence time for water was short (4 years). The harder the water (more salts) the greater the rate at which phosphorus is captured and carried to the bottom sediments of the lake. The deeper the lake, the harder it is for that phosphorus to become resuspended once it settles out to the bottom. Finally, with a short residence time, rapid flushing of water through the lake would be expected to dilute the phosphorus concentration.

Within a few years after the sewer system installation, there were indications that the lake eutrophication process was reversing. The clearest evidence of reversal (oligotrophication) was not collected until the KBS re-initiated lake monitoring in 1988. Results of three indices of lake trophic status; water clarity, total phosphorus concentration, and oxygen depletion in the bottom waters are shown in Figures 3, 4 and 5 respectively. The results have been dramatic; water clarity has more than doubled in summer, phosporus concentration has dropped below levels of detection and rates of oxygen depletion in the hypolimnion have greatly decreased. Summer blooms of bluegreen algae have vanished; the lake is now

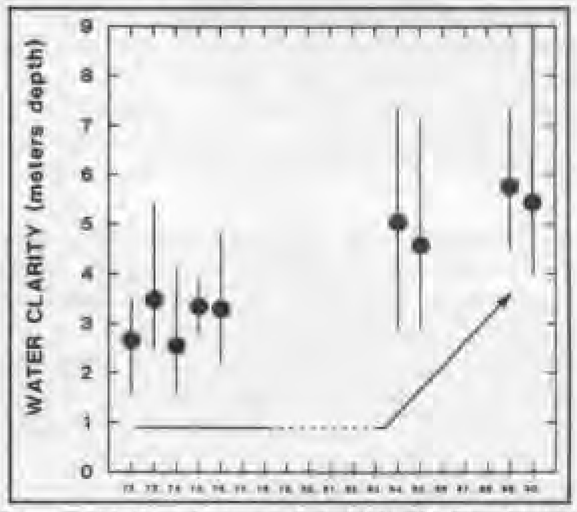

Figure 3. Average (dot) and range of variation in Secchi depth for Gull Lake during summers (June-August). Arrow indicates increasing water clarity starting shortly after 1983, when the sewer system was installed.

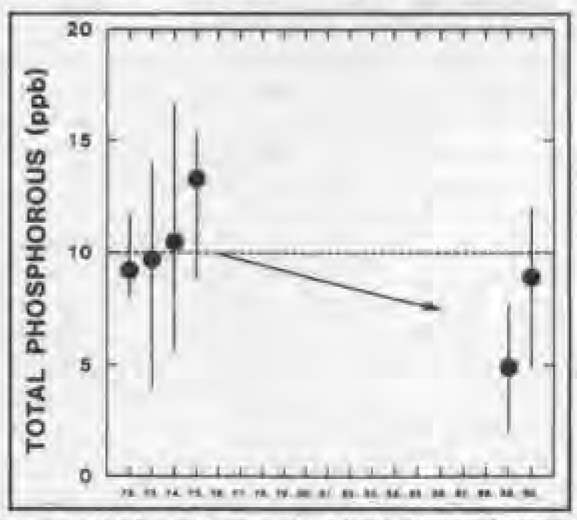

Figure 4. Average (dot) and range of variation in total phosphorus concentration of the top 30 feet (epilimnion) of Gull Lake during summers.

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The Gull Lake Story

(Continued from Page 13)

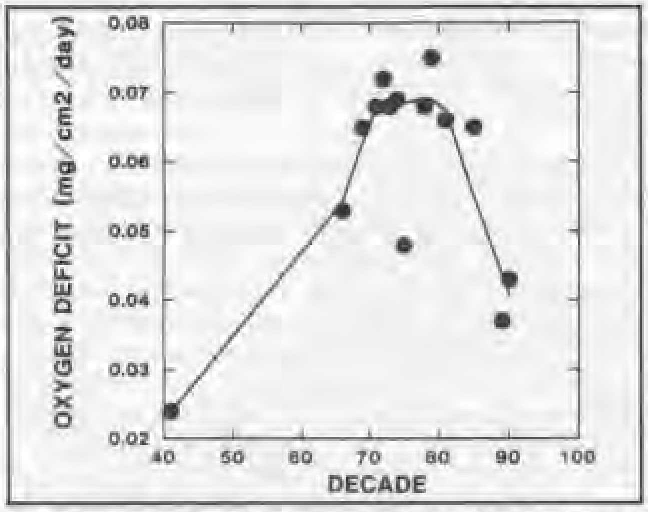

Figure 5. Estimated rate of oxygen depletion in the bottom waters (hypolimnion) of Gull Lake during the summers. The low value for 1975 represents a year of unusually cold conditions. High rates indicate high lake productivity, low rates indicate low lake productivity. Line indicates a statistical smoothing procedure to indicate typical values across years.

characterized by a diversity of small forms of algae that support a productive zooplankton community and fisheries.

A recent fisheries report on Gull Lake was released by the Michigan DNR earlier this year. The MDNR considers the 55 species of fish reported for Gull Lake to represent one of the most diverse fish communities found in Michigan. Their studies also indicate that game species of fish in Gull Lake are all growing at better than the state average by 0.2 to 2.7 inches. The lake supports an excellent fisheries for both warmwater species (e.g. largemouth bass and bluegills) and coldwater species (e.g. rainbow trout and landlocked Atlantic salmon).

Reflections

Along with a sewer system and improved water quality has come the expected increase in desirability of living on Gull Lake. Land values have risen and accompanying that increase has been a fair turnover of the lake residents. Many that now live on Gull Lake were not around during the 1960's and 1970's; some take for granted the now excellent water quality and recreational opportunities of Gull Lake. But the lake is not immune to future problems. Fisheries manipulations, water safety, ground water contamination, and zoning regulations all demand attention. In the past several years there has even been a tendency to again apply phosphorus to lawns and gardens. Phosphorus-free fertilizers are not readily available in the stores and many residents simply use commercial lawn care companies, which apply both phosphorus and other chemicals harmful to the lake (herbicides and pesticides) in heavy doses. After a period of rest, the GLQO has re-organized and is addressing these issues of the 1990's and beyond — recognizing that the real key to preserving lake quality is education and organization of all lake users. These must be continuous activities.

Two future changes to Gull Lake, however, may be unavoidable and could result in fundamental modifications to the physical, chemical and biological limnology. The first and most immediate threat is invasion of an invertebrate species that lives in the open water of lakes: *Bythotrephes cederstromii* (BC) (Figure 6). This species recently invaded the Great Lakes from northern Europe and has drastically affected the food web of Lake Michigan. When BC invades a lake it quickly reproduces in vast numbers, feeding on the algae-eating zooplankton such as *Daphnia.* In Gull Lake (and Lake Michigan) the *Daphnia* are important for two reasons: 1) they eat the algae and keep the water clear, and 2) they are eaten by the young-of-year fish and hence support the lake fisheries. Predation by BC on the *Daphnia* is expected to decimate the *Daphnia* populations, leading to an increase in algae, decrease in water clarity and a reduction in growth of several game fish species. The invasion of BC is probably inevitable but fisheries management might alleviate the consequences.

The second environmental change that Gull Lake is apt to experience is due to global climate change: the greenhouse effect. In the past decade there has alredy been a slight increase in global temperature, and while debate continues over how high an increase we will witness in the next few decades, it is likely that any change will have profound effects on our lakes. Gull Lake is unique in having a nearly 70 year record of freezing and thawing dates of winter ice. Although there has been tremendous variation among years in how long the lake was covered in ice (twice in the 1930's it never froze), the average ice cover was 77 days each winter from 1920's to 1960's (Figure 7). In the past couple of decades, however, there is trend toward decreased length of ice cover, suggesting warmer winters. In the past decade the typical ice cover was less than 60 days — a loss of more than two weeks compared to the first 5 decades of record! If this continued for the next 50 years, ice cover on Gull Lake could become a rare event. Climate change of this magnitude would cause major change in species in the lakes.

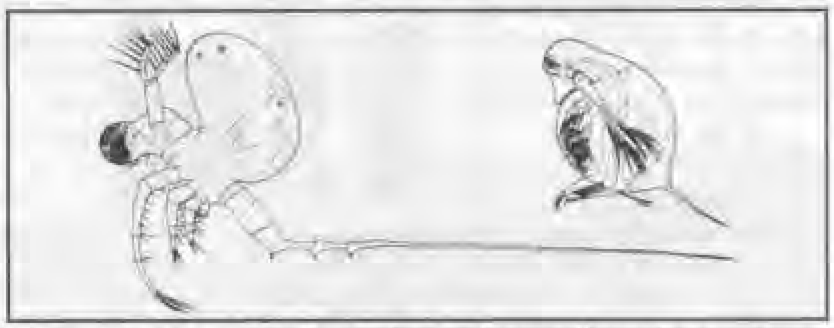

Figure 6. Drawing of *Bythotrephes cederstromii* (predator — larger drawing having a long tail spine) and *Daphnia pulicaria* (prey). Drawings accurately portray relative sizes of the two animals with the *Daphnia* being about 2 mm in total body length.

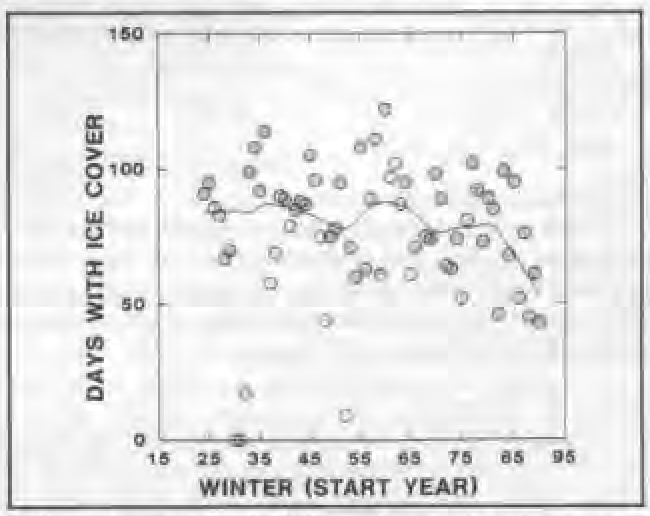

Figure 7. Long-term record of days of complete ice cover for Gull Lake. Winter (start year) indicates the year based on December as the start of winter. Line indicates a statistical smoothing procedure to indicate typical values across years.

Although there are several important lessons from the Gull Lake story, the most relevant to other watershed organizations is the need for long-term monitoring of lake conditions, and education of lake residents. Routine baseline measurements of water quality can be done cheaply by the lake residents themselves. The longer the record of monitoring the easier it is to assess whether the condition of a lake is changing. In the near future the KBS will begin a program to train lake residents on the most important types of measurements to make and how to make them. The collection of information alone, however, achieves little if the local residents are not aware of how their activities within a watershed determine water quality. Successful lake stewardship is ultimately dependent upon the local residents being educated in the basics of watershed management.

ML&SA NEWS

MICHIGAN LAKE & STREAM ASSOCIATIONS, INC.
Business Office: P.O. Box 249, Three Rivers, Michigan 49093
Office Address: 124½ N. Main St. Phone: (616) 273-8200
Donald E. Winne, Executive Director Fax: (616) 273-2919

NEW ML&SA MEMBERS

Crystal Lake Association, Montcalm County
Joseph Herald, President - 217 members

Gun Lake Protective Association, Allegan & Barry Counties
Von Tucker, President - 1,000 members

Arbutus Lake Association, Grand Traverse County
Grace MacDonald, President - 85 Members

New ML&SA Contributing Members

When the *Riparian* individual subscription renewal notices were mailed, we asked that the subscribers give consideration to becoming a contributing member of Michigan Lake & Stream Associations. The membership categories were Individual, $25.00; Sustaining Donor, $50.00; Benefactor, $100.00; Lifetime, $500.00; and Endowment Contributor $1,000.00.

We are happy to report that 40 individuals and/or families have become members of the ML&SA. Individual membership includes a subscription to the Michigan Riparian (4 issues). The individual members are listed below:

Karl F. Barnett	Bloomfield Hills, MI
Jack W. Boss	Ada, MI
Carl R. Brannock	Bloomfield Hills, MI
Douglas Brown	Brighton, MI (Benefactor)
James & Patricia Collins	Coloma, MI
John Collis	Marcellus, MI
Jerry & Christine Crosser	Lansing, MI
Dr. Charles Cubbage	Milford, MI
William & Karen Ensminger	Ann Arbor, MI
Rob Fair	Waterford, MI
Tim Feist	Ann Arbor, MI
William & Connie Frey	Grosse Pointe Farms, MI
Mark Geis	Highland, MI
George & Mabel Gilbert	Schoolcraft, MI
Michael Grant	Indian River, MI
Tim Green	Holly, MI
Helen Hitchcock	Allegan, MI
Mel Hurlbut	Niles, MI
Robert & Nancy James	Glennie, MI
Thomas & Cheryl Kastelz	Allendale, MI
Lawrence Kelly	Wyoming, MI
Hans & Edna Lammert	Fenton, MI
Everett Lienhart	Elkhart, IN
Richard Luecht	Rapid City, MI
David Mark	Waterford, MI
Jerry McCoy	Delton, MI
Paul McEwen	Fenton, MI
James & Janet Montgomery	Detroit, MI
Dr. Robert Radtke	Birmingham, MI
Dr. John Richter	East Jordan, MI
Walter & Helen Rinehart	Elkhart, IN
Roy and Mary Roush	Downer's Grove, IL
Howard & Rosemary Rush	Elkhart, IN
Robert & Diane Saxton	Linden, MI
P.F. Seaser	Brighton, MI
Richard Thompson	Wyckoff, NJ
Village of Wolverine Lake	Wolverine Lake, MI
Jack Waite	Rockford, MI
John Weh	Farmington Hills, MI
Melbourne Worfel	Stanton, MI

Regional Seminars Scheduled For Spring Meeting Dates In 1992

One of the goals of Michigan Lake and Stream Associations in 1992 is to increase the effectiveness of all member associations in their efforts to achieve established goals. We hope to do that by working closely with the officers of each member association. We need to know what your goals are so that the Vice Presidents and Regional Directors can take an active role in those efforts.

The regional Vice Presidents have scheduled spring "Seminars" to help each lake association to get off to a good start for their summer plans.

The schedule of meetings is given in the table below. The meeting dates have been arranged under the direction of Pearl Bonnell who was given the title of "Director of Operations" of ML&SA by the Board of Directors at its meeting on November 16, 1991.

If you cannot attend the meeting scheduled for your region, you may attend any of those scheduled.

All "Seminars" ***are open to the public.*** We hope that you will invite people you know who live on other lakes in the counties of your region to attend your regional seminar.

Region	Counties in Region	Vice President	VP Phone No.	Date of Meeting	Place of Meeting
1	Monroe, Washtenaw, Wayne	Floyd Phillips	313-231-2368	April 25, Saturday	Jackson Community College
2	Branch, Calhoun, Hillsdale, Jackson, Lenawee	Marion Schnell	517-547-6606	April 25, Saturday	Jackson Community College
3	Berrien, Cass, Kalamazoo, St. Joseph, Van Buren	Kathy Shirk	219-259-3978	April 4, Saturday	Kalamazoo Valley Community College
4	Allegan, Barry, Eaton, Ionia, Kent, Montcalm, Ottawa	Earl Kraai	616-874-8313	March 28, Saturday	Holiday Inn (North) Grand Rapids
5	Clinton, Genesee, Gratiot, Ingham, Livingston, Saginaw, Shiawassee	Dick Brown	313-629-5964	April 12, Sunday	Holiday Inn Gateway Flint
6	Huron, Lapeer, Macomb, Oakland, Sanilac, St. Clair, Tuscola	Don Hoes	313-623-0750	April 26, Sunday	To Be Announced
7	Arenac, Bay, Clare, Gladwin, Iosco, Isabella, Midland, Ogemaw, Roscommon	Dennis Zimmerman	517-588-9343	May 2, Saturday	Beaverton Bowl Beaverton
8	Lake, Mason, Mecosta, Newaygo, Oceana, Osceola, Muskegon	John Stone	616-894-2141	May 3, Sunday	Ferris State University Big Rapids
9	Antrim, Benzie, Grand Traverse, Kalkaska, Leelanau, Manistee, Wexford	Terry Ely	616-256-7392	May 30, Saturday	Northwest Michigan Council of Government, Traverse City, MI
10	Alcona, Alpena, Crawford, Montmorency, Oscoda, Otsego	Geri Rorabacher	313-477-8492	June 6, Saturday	To Be Announced
11	Charlevoix, Cheboygan, Emmet, Presque Isle	Dick Walker	616-525-8531	June 7, Sunday	To Be Announced

Michigan Lake & Stream Associations Sets New Record Of 201 Member Associations In 1991

The total number of individual members in the 181 local associations numbers approximately 65,000. Many lake associations include a subscription to *The Michigan Riparian* magazine for all of their members and is paid for out of the association's annual dues. There are over 600 individual subscribers to *The Riparian* who own property on a lake or stream or are interested in supporting the objectives of the magazine and ML&SA. We believe that there are many lake associations in Michigan that have not heard about Michigan Lake & Stream Associations, Inc., and have not seen or read *The Michigan Riparian* magazine. We do appreciate you telling your friends who are not members of an ML&SA member association about Michigan Lake & Stream Associations. If you do not keep your copy of *The Riparian* magazine, would you consider sharing it with your friends who own property on other lakes in Michigan?

The dues schedule and an application blank for local association membership follows.

Dues Schedule

Adopted November 1990

(Based upon the number of family members in local association.)

No. Members	Dues
1-50	$ 45.00
51-75	55.00
76-100	65.00
101-125	75.00
126-150	85.00
151-175	95.00
176-200	110.00
201-300	125.00
301-400	150.00
401-600	175.00
600 plus	225.00

Individual Memberships

The minimum annual dues for individual membership in Michigan Lake & Stream Associations is $25.00.

Individual Memberships are as follows:

Individual Membership	$ 25.00
Sustaining Donor	50.00
Benefactor	100.00
Project Sponsor	500.00
Lifetime Membership	500.00
Endowment	1000.00

Secchi Disk available to ML&SA Member Associations. If your Association has not received their Secchi Disk from ML&SA, call or write to Pearl Bonnell, P.O. Box 303, Long Lake, MI 48743, (517) 257-3583.

APPLICATION FOR MEMBERSHIP

Name (Individual or Lake Association) ________________ Date ________

Street ________ City ________ State ____ Zip ______

Lake or Stream on which your property is located ________________

County ________________ Township ________________

Name of Lake or Stream Association if established ________________

Upon acceptance of this application and payment of one years dues, you as a member, will be granted all the rights and privileges of membership in accordance with the by-laws of MICHIGAN LAKE & STREAM ASSOCIATIONS, INC.

____

(signature of applicant or officer)

All contributions and dues payments should be sent to the treasurer; Pearl Bonnell, P.O. Box 303, Long Lake, MI 48743. Her phone number is 517-257-3583.

Natural Resources Commission — State Of Michigan

1992 Meeting Schedule

Month	Wed.	Thu.	Meeting Location
February	12	13	Ralph A. MacMullan Conference Center 104 Conservation Drive, Roscommon
		27	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
March	11	12	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
		26	Kellogg Center, MSU Agriculture/ Natural Resources Week
April	8	9	Ramada Heritage Center (Pres. Inn) 17201 Northline Road, Southgate
		23	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
May	13	14	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
		28	Ralph A. MacMullan Conference Center 104 Conservation Drive, Roscommon
June	10	11	State Office Building 305 Ludington, Escanaba
		25	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
July	8	9	Ralph A. MacMullan Conference Center 104 Conservation Drive, Roscommon
		23	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
August	12	13	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
September	1	(Tue)	Governor's Luncheon — State Fair
	9	10	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
		24	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
October	7	8	Holiday Inn West 2747 S. Eleventh Street, Kalamazoo
		22	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing
November	4	5	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
		19	Ralph A. MacMullan Conference Center 104 Conservation Drive, Roscommon
December	2	3	Holiday Inn South, Lansing (Clarion)/ Law Building Auditorium 525 W. Ottawa, Lansing
		17	Mason Building, 7th Floor Conf. Room 530 W. Allegan, Lansing

The Wednesday evening Lansing meetings are held at the Holiday Inn South/Convention Center, 6820 S. Cedar Street, Lansing, Michigan. During the out-of-town meetings, the Wednesday evening meetings are held at the same location as the Thursday meetings. The Wednesday evening meetings begin at 7:30 p.m.; the Thursday *regular monthly* meetings begin at 9:00 a.m.; and the one-day Thursday meetings begin at 9:30 a.m.

Natural Resources Commission, Box 30028, Lansing, MI 48909; 517-373-2352.

Natural Resources Commission

Name & Address	Phone	Term Expires
Lary DeVuyst 3813 E. Pierce Ithaca, MI 48847	517-875-2561	12-31-94
Paul Eisele 21001 Van Born Taylor, MI 48180	313-697-2493 (h) 313-374-6031 (w)	12-31-94
Gordon E. Guyer 862 Whitman East Lansing, MI 48823	517-332-6227 (h) 517-355-5060 (w)	12-31-93
James P. Hill 205 Smith Hall Central Michigan University Mount Pleasant, MI 48859	517-773-6903 (h) 517-774-7415 (w)	12-31-95
David Holli 2002 Prairie Ishpeming, MI 49849	906-486-8626 (h) 906-485-6351 (w)	12-31-92
O. Stewart Myers 12063 N. Lake Street Bitely, MI 49309	616-745-4889 (h)	12-31-92
Joey M. Spano 3325 Middlebelt West Bloomfield, MI 48323	313-646-1362 (h) 313-334-5660 (w)	12-31-95

Department of Natural Resources
Executive Division
Attention: Dennis Conway
P.O. Box 30028
Lansing, MI 48909
517-373-2352

ML&SA Member News

BLACK LAKE ASSOCIATION —
Cheboygan & Presque Isle Counties
Peggy Lukitch, President

Walleye Stocking

We planted 11,000 walleye fingerlings in October, 1991. The extra 1,000 fingerlings were donated by Harry Moran of Onaway. The Walleye Garage Sale and Raffle were a huge success. Thanks to all who helped and donated. Carter's and Glen's Markets are to be applauded for their generous donations through their Community Cash Programs. 1991 has been a productive year for walleye fishing. In late August and September many walleye were caught. We would like to urge *everyone* who catches a walleye in Black Lake to check the front fins. If one of the fins is clipped, please report the catch to the Black Lake Association at 211 Outpost - Black River Marina - Sunset Bluffs - or call (616) 625-2680.

DERBY LAKE COTTAGE OWNERS ASSOCIATION —
Montcalm County
Harry Morris, President

4th of July Weekend

Participation in the Boat Parade was up from last year. We had many good themes. Make plans for a bigger and better Boat Parade in 1992. Many thanks to the judges, Dick and Glenna Wenzel; and to all those who took part. And at 1:30 p.m. of this day, the faithful West End Gang were ready at the Public Landing for a great picnic lunch. Approximately 325 people went through the line and enjoyed a fine lunch. There is a lot of hard work involved in hauling chairs, tables, etc., and preparing a lunch of this size. We want to thank all of those responsible for this great effort.

DEWEY LAKE ASSOCIATION — Cass County
LaVerne Carnegie, President

Water Quality/Lake Management Committee

Chuck Moden, Chairman; Greg Longpre, Bruce Nevins, Jim Wardlaw and John Wolph.

"We are in agreement that a short- and long-term plan should be developed to protect and enhance the quality of the Dewey Lake ecosystem. Although considerable data has been gathered in the past, the Committee feels that our first chore is to update and enhance that data to determine current conditions of our water and marine plant life.

We will be testing to determine the clarity, pH, bacteriological, biological oxygen demand, nutrient (nitrogen and phosphorus), and dissolved oxygen status of Dewey Lake at various locations and depths.

We also intend to plot the type and location of the various marine growths common to Michigan inland lakes. With that information, we hope to develop specific treatments for defined problem areas.

In the meantime, the Committee agrees that the indiscriminate "shotgun" approach to herbicide application, although aesthetically pleasing, might be doing more harm than good! For that reason, we do not plan herbicide application in 1992 except for milfoil. Milfoil growth is an immediate threat to Dewey Lake.

LAKE FENTON PROPERTY OWNERS ASSOCIATION —
Genesee County
Richard Brown, President

President's Comments

Our lake has several areas around it that serve many vital functions. They provide breeding and rearing areas for waterfowl, mammals and fish; filter heavy metals and silt laden run off water. Solids are removed while the settling waters are recharging underground springs that feed our lake.

The Michigan Senate is considering bills that pose a severe threat to these wetlands. State and Federal agencies will make more local land use decisions if Senate Bill #522 and Senate Bill #593 were to pass.

Do you want State or Federal government to exclusively make critical land use decisions in many of our shoreline and wetland areas? Your Lake Association feels that local control of land use serves the community better than special interest lobbies in Lansing, that have no interest in local concerns.

FISHER LAKE ASSOCIATION — St. Joseph County
Blaine Rabbers, President

November Meeting

Just before Thanksgiving, Progressive was out taking their last water samples before the water turns to ice. At the November 14 general meeting, Mr. Tony Groves of Progressive updated the members present on the progress of the water quality study. Tony also passed out a handout covering the physical characteristics of the lake, a watershed and wetland map, deep basin water quality data, surface water quality data, bacteriological data, and eutrophic threshold standards.

HAMLIN LAKE ASSOCIATION — Mason County
Dave Kalina, President

Membership Drive

Jim Hukill, Membership Committee chairman, spearheads a membership drive which began last spring and which is ongoing. During the summer, he and his committee members visited cottages all around the lake and left packets of information about the association, including a brochure describing association activities, a copy of the Spring, 1991, *Hamlin Currents*, and a membership form. He reports that our membership has increased from 205 at the beginning of this year to 282 at the present time. Dues are $15 per year and include a subscription to *Hamlin Currents*. If you know someone who is interested in joining the association, dues can be sent to: The Hamlin Lake Association, P.O. Box 918, Ludington, MI 49431. Please include summer and winter addresses and phone numbers.

INDIANA LAKE ASSOCIATION —
(75 Acres) Cass County, Michigan and
(38 Acres) Elkhart County, Indiana
Larry Lehman President

Water clarity of Indiana Lake has been measured for the last 4 years (1988-91) by Larry Lehman and is reported as follows:

Lake Clarity in Feet

	1988	1989	1990	1991
Average	13.0	10.3	13.8	13.7
Minimum	6.0	5.0	8.0	8.0
Maximum	21.0	17.0	20.0	24.5
Standard Deviation	3.9	2.8	2.7	4.0
Number of Samples	105	133	94	106

MACEDAY-LOTUS LAKES ASSOCATION — Oakland County
Helen Hoes, President

The Waterford Hills Landfill has received a high rating for its degree of toxicity to the area. Because of the 307 designation there will be public hearings for both the process of clean-up and also for the decision which process will be chosen. We are going to have to participate and be knowledgeable so that we can choose the best for ourselves or else we are going to get what the polluters are willing to pay for, regardless of its effectiveness.

We have to stop the storm water pollution that's been dumped into our lake for years. We have to continue our vigilance on development and the protection of our wetlands.

LAKE ORION LAKE ASSOCIATION — Oakland County
Richard Hennessy, President

General Membership Meeting

This fall's general membership meeting was a success and had a larger turnout than normal. Many thanks to all of you who came. The primary activities were a discussion of keyhole access and the election of new officers.

Keyhole Access

Much of the discussion centered on explaining and clarifying the keyhole access ordinance that the LOLA board proposes the township and village adopt. The ordinance would be similar to the Bloomfield Township ordinance which was upheld by the Michigan Supreme Court earlier this year. The proposed ordinance would limit the number of boats that could be docked, moored, or anchored adjacent to any one lot.

THREE LAKES ASSOCIATION — (Bellaire, Clam & Torch Lakes)
Antrim & Kalkaska Counties
William Weiss, Jr., Executive Director

Skegemog Swamp Purchase A Reality

The October 1991 issue of the *Michigan Conservancy* officially announced the purchase of the infamous "trailer site" in the center of the wildlife area. This brings the total acreage of the preserve to 2,700. The Trailer is slated to be moved, sold, and the property returned to its natural condition.

Water Quality Notes From Summer 1991

Phosphorus levels continue to be stable as monitored by tests now done by Battelle Labs in Traverse City. However, homeowners continue to complain of more grass and algae growing along the lakeshore. Probably Mother Nature is smarter than we are — maybe she's letting more plants utilize that phosphorus so it won't be around later to cause noxious blue-green algae blooms. But it does suggest that more nutrients are being collected.

Marble-Coldwater Lake Chain Improvement Project Update

By Tony Groves and Pam Tyning, Lake Management Department, Progressive Architecture Engineering Planning

Introduction

The scope of a comprehensive project to preserve and protect the water quality of the Marble-Coldwater Lake Chain was originally presented in the May, 1989, issue of *The Michigan Riparian*. Since that time, funds to fully implement the project have been acquired through the Environmental Protection Agency (EPA), the Michigan Department of Natural Resources (MDNR), and the Michigan Department of Agriculture (MDA). Many of the management alternatives discussed herein are applicable to other lakes experiencing similar problems. The purpose of this article is to provide an update on the status and organizational aspects of the project.

Lake and Watershed Physical Characteristics

The Marble-Coldwater Lake Chain is located in Branch County, Michigan, immediately south of the village of Quincy and approximately five miles east of the city of Coldwater. The chain is composed of six interconnected lakes, with a combined surface area of about 2600 acres. Marble Lake, a 755-acre lake with a maximum depth of 60 feet, is at the north end of the chain; Coldwater Lake, a 1563-acre lake with a maximum depth of 92 feet, is at the south end of the chain. The intermediate lakes from north to south are Archer Lake, Bartholemew Lake, Mud Lake, and Long Lake (Figure 1). The lake chain has a shoreline length of just under

	SURFACE AREA (acres)	MAXIMUM DEPTH (feet)	MEAN DEPTH (feet)	VOLUME (acre-feet)
MARBLE LAKE	755	60	25	18,875
ARCHER LAKE	68	36	16	1088
BARTHOLOMEW LAKE	80	56	29	2320
MUD LAKE	48	25	13	624
LONG LAKE	109	45	19	2071
COLDWATER LAKE	1563	92	21	32,823
TOTAL	2623			57,801

Figure 1

40 miles, and navigation between all six lakes is possible via the connecting channels. At present, there are approximately 1460 seasonal cottages and year-round homes that directly abut the lakes. The lake chain watershed covers an area of approximately 80 square miles (Figure 2). The two major tributaries to the chain, Tallahassee Creek and Fisher Creek, drain areas of 18.6 and 19.2 square miles, respectively. Water is discharged from the lake chain from two outlets. The Sauk River flows in a westward direction from Marble Lake, and the Coldwater River flows in a northwest direction from Coldwater Lake to their point of confluence near the city of Coldwater. Ultimately, water flowing from the lake chain is transported to Lake Michigan via the St. Joseph River.

Soil mapping of the area indicates the predominant soil types in the Marble-Coldwater watershed are sandy loams. The predominant land use in the watershed is agricultural. The topography of the watershed area is relatively flat. The approximate grade differential between the headwaters of Tallahassee and Fisher Creeks and the lakes, a distance of over 10 miles, is less than 90 feet (USGS datum).

In past years, high water levels related to unusually heavy precipitation caused periodic flooding of some lakeside homes. The fluctuating water level problem was most pronounced during early spring subsequent to the winter snow melt. In addition, residents were concerned about conditions which could impair recreational usage and aesthetic enjoyment of the lakes. In order to remedy this situation, the Marble-Coldwater Lake Board was established pursuant to provisions of Act 345 of 1966, the Inland Lake Improvement Act. In 1985 the lake board retained Progressive Architecture Engineering Planning to conduct an engineering study to evaluate the feasibility and cost of lake level control alternatives and methods which could be utilized to protect and enhance the water quality of the lakes over the long-term.

In 1986, the engineering feasibility study was complete, and the following recommendations were made:

- Construct new outlet dams to alleviate flooding;
- Construct large sedimentation basins on major tributary inflows to trap nutrients and sediment; and
- Develop and implement a watershed eutrophication abatement program to reduce nonpoint source pollution loading to the lake chain.

An overview of the current status of key components of the project, along with a discussion of the project's financing and organizational structure, is as follows:

Lake Level Control

The lake level control problems were addressed by constructing supplemental dam structures adjacent to the existing dams on the two outlets of the lake chain. The dams became operative in 1989. When operated in conjunction with the old dams, the water level of the lake chain can be lowered in the fall to the desired legal lake level. In spring, sufficient freeboard capacity exists in the lakes to accommodate the increase in lake level generally experienced during the period of the spring melt without flooding lakeside properties.

Sedimentation Basin Construction

Theoretical nutrient loading estimates and field monitoring of

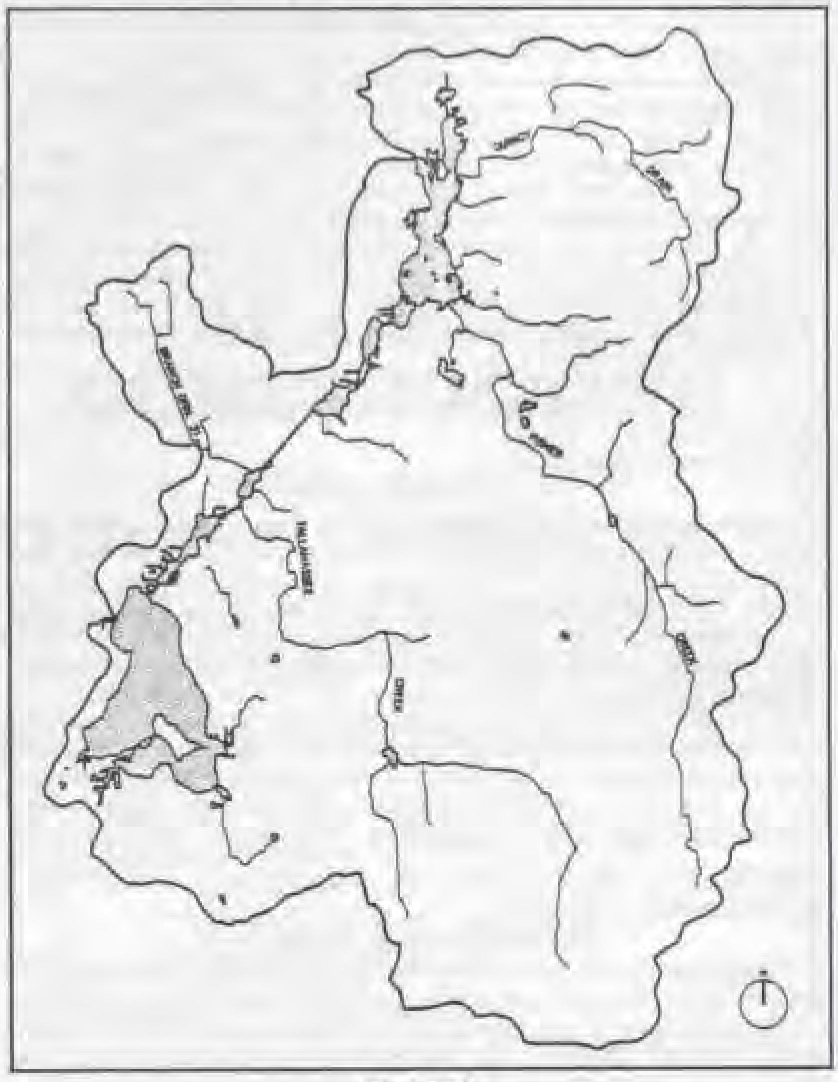

Figure 2

tributary inflows to the lake chain indicated Fisher Creek and Tallahassee Creek were major sources of pollution input to the lakes. Based on these findings, the construction of large-scale sedimentation basins was recommended for both creeks. The sedimentation basin for Fish Creek became fully operative during 1990, while construction of the basin on Tallahassee Creek will be completed by the summer of 1992. The Fisher Creek basin is 700 feet long, 120 feet wide, and has a maximum depth of approximately 3.5 feet. Utilizing the HEC-1 computer model to estimate storm flows, the basins have been designed to achieve a settling velocity sufficient to remove all but the finest soil particles. When filled to design capacity, each basin will capture approximately 10,000 tons of sediment. Roadways have been positioned adjacent to the basins to facilitate access and periodic cleanout. The Tallahassee Creek sedimentation basin incorporates a constructed wetland to promote additional removal of fine-grained sediment and phosphorus.

Monitoring of the Fisher Creek basin performed to date indicates the basin has removed approximately 25 percent of the incoming phosphorus load. Performance monitoring of both basins will be conducted in upcoming months to evaluate the efficiency of the basins at removing sediment and phosphorus pollutants. It should be noted that sedimentation basins are not a panacea, nor are they effective in all circumstances. In some instances, topographic constraints or soil conditions may diminish basin efficiency. Information on topography, soils, and drainage must be examined in detail when evaluating the desirability, feasibility, and effectiveness of basin construction.

Eutrophication Abatement Program

The eutrophication abatement program has been designed to reduce nonpoint sources of pollution loading to the lake chain. This project element includes the following components.

- Water quality monitoring;
- Implementation of agricultural best management practices (BMPs) in the lake chain watershed;
- Local wetland protection;
- The promotion of proper lakeside landscaping; and
- Septic system maintenance.

Water Quality Monitoring

Water quality monitoring of the lake chain is being conducted to determine the limnological character of each lake of the chain and to evaluate the impact of major tributary inflows. Volume-weighted total phosphorus concentrations, chlorophyll-a concentrations, and Secchi transparency data for each of the lakes is shown in Figure 4. When compared to the other lakes, Coldwater Lake maintains relatively low total phosphorus and chlorophyll-a concentrations and high Secchi transparency measurements. Mud and Long Lakes often exhibit elevated phosphorus, chlorophyll-a levels, and reduced transparencies characteristic of highly eutrophic lakes, while Bartholomew, Archer, and Marble Lakes range from mesotrophic to moderately eutrophic. All the lakes exhibit hypolimnetic (i.e., bottom water) oxygen depletion during summer stratification, though Coldwater Lake does not exhibit a corresponding increase in hypolimnetic phosphorus levels.

The disparity in water quality observed when comparing Coldwater Lake with Mud and Long Lakes appears to be related to tributary inflows. Tallahassee Creek, the largest tributary to the lake chain, flows into the canal between Mud and Long Lakes. In addition, Mud Lake receives direct drainage from Branch Drain 31. On the other hand, Coldwater Lake, the largest lake of the chain in terms of surface area and volume, receives no inputs from major tributaries and maintains low nutrient levels. However, lake chain hydrology is complicated by the fact that the interconnecting channels between the lakes permit water to flow in either direction throughout the lake chain, depending on climatic conditions in the watershed. This phenomenon can, in turn, impact water quality. At times, Secchi transparency in Coldwater Lake is reduced when water from Long Lake flows into Coldwater Lake.

Monitoring of the lake chain is being continued to better define baseline water quality conditions and the impact of ongoing improvement efforts.

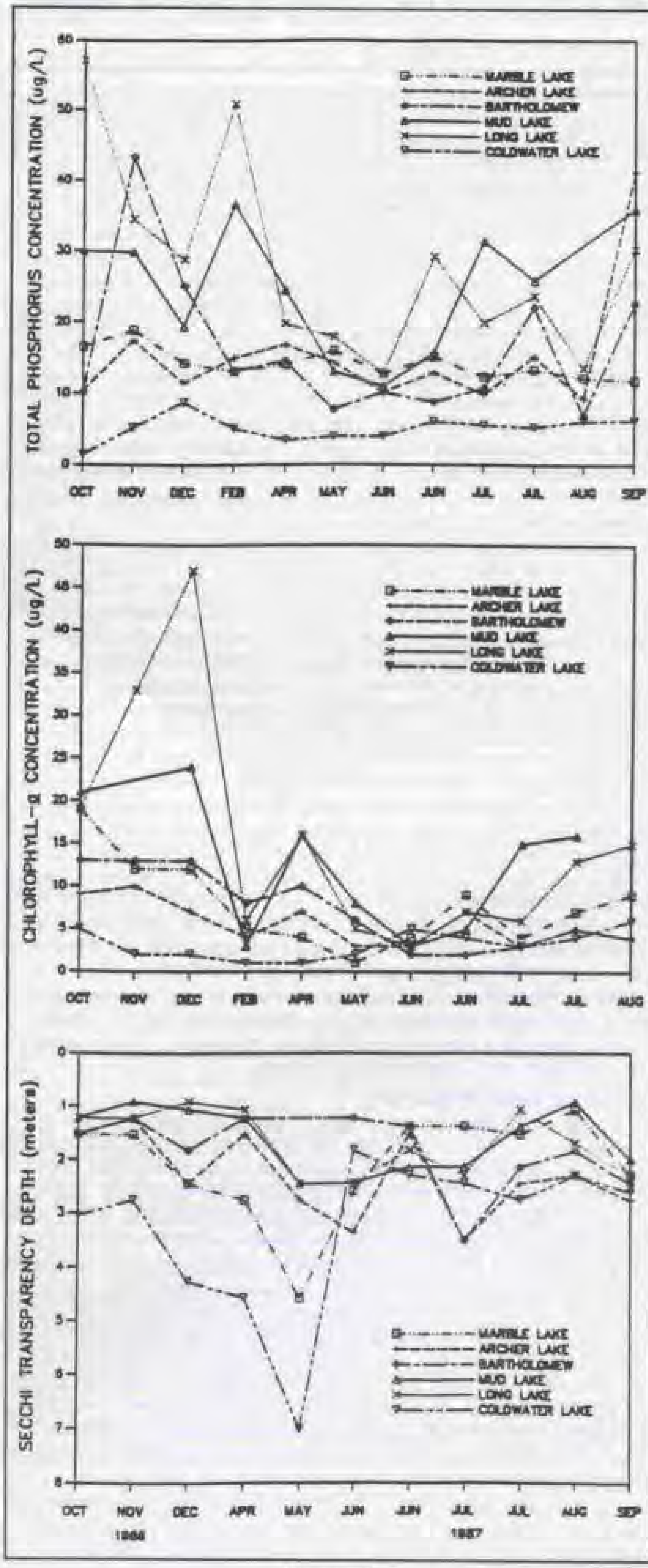

Figure 4

Agricultural Best Management Practices

The implementation of agricultural best management practices (BMPs) on individual farms in the watershed is an essential com-

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Marble-Coldwater Lake Chain

(Continued from Page 21)

ponent of the eutrophication abatement program. However, considering the size of the lake chain study area, priority problem areas within the watershed had to be delineated before agricultural BMPs could be defined. Since the majority of the agricultural nonpoint source load is transported to the lakes via tributary inflows, first priority for conservation plans was given to land within 1000 feet of the four major tributaries to the lake chain. During the course of the preliminary study, field surveys were undertaken to locate problem areas within and adjacent to the tributaries. Streambank areas with insufficient vegetative cover were identified throughout the length of the tributaries. Row-cropped fields often had less than ten feet of permanent vegetative cover (such as grasses, legumes, and/or trees) along the streambanks, thus allowing minimal absorption of soil, fertilizer, and pesticides before runoff entered the stream channels. Along portions of streambanks, active erosion and sloughing of side slopes was apparent. In some instances, stream channels were utilized to water livestock, and vegetative cover along the stream was stripped as livestock traversed the streambanks.

The information acquired during the preliminary investigation of priority problem areas was conveyed to the Branch County Soil Conservation District (SCD). SCD staff, along with the USDA Soil Conservation Service (SCS), the USDA Agricultural Stabilization and Conservation Service (ASCS), and Michigan State University's Cooperative Extension Service (CES), have extensive experience assisting in the design and implementation of individual conservation plans. In some instances, cost shares of up to 70 percent can be secured for eligible BMPs through these agencies. In light of these considerations, it was concluded that the rate of participation in the implementation of BMPs would be increased if a conservation planner were retained to work solely with farmers in the Marble-Coldwater watershed. To this end, a portion of project funds was directed to the Branch County Soil Conservation District to define specific BMPs for farms within the priority areas and to assist individual farmers, both technically and financially, to implement such practices. Since October of 1990, a conservation planner has been working in the watershed, and at a minimum, this work will continue until October of 1993.

As of December 1991, 68 landowners in the watershed have become directly involved with the implementation of agricultural BMPs and soil conservation measures have been implemented on farmland comprising over 3260 acres.

Local Wetlands Protection

Local wetlands protection has become a primary focus of the program. In order to evaluate the extent of wetland degradation in the project area, aerial photographs of the lake chain were examined to delineate historical shoreline development patterns. Prior to 1955, shoreline areas of the intermediate lakes of the chain were largely undeveloped. Photographic records show that between 1955 and 1967, extensive development occurred in wetlands contiguous to the shorelines of Archer, Bartholomew, and Long Lakes and at the extreme southern end of Coldwater Lake. Often, canals were cut perpendicular to the shoreline, and fill soils were placed to accommodate building sites. Many of the canals traversed wetlands and were designed to provide lake access privileges to nonriparian (i.e., back lot) properties. This encroachment into low-lying areas set the stage for subsequent flooding problems in that the loss of existing wetlands destroyed their ability to mitigate storm flows and surges in lake level.

To facilitate local wetland protection efforts, a preliminary inventory of all wetlands within the lake chain watershed was conducted utilizing recent aerial photographs (MDNR 1988) and USDA soil maps that depict hydric (i.e., muck) soil types. By integrating information on soils, surface drainage, and vegetative groundcover, wetlands were delineated and mapped. To focus attention on the magnitude of wetland impacts in the vicinity of the lake chain, the preliminary map also depicted areas in which wetlands had been filled or converted to other uses. The extent of wetland losses was alarming. To stem this trend, three of the four townships adjacent to the lake chain adopted wetland protection ordinances pursuant to provisions of the Goemaere-Anderson Wetland Protection Act (P.A. 203 of 1979). Recently acquired wetland inventory maps prepared by the U.S. Fish and Wildlife Service are being used to administer the ordinances.

The local ordinances regulate all activities that may adversely impact wetlands contiguous to the lake chain and its tributaries. In addition, a provision to prohibit canal and channel construction along the lakeshore was also included in the wetland ordinances. In Michigan, canal and channel construction is most often regulated under provisions of the Inland Lakes and Streams Act (P.A. 346 of 1972). Under provisions of this act, a permit must be acquired from the MDNR prior to the initiation of canal or channel construction. The act also provides a mechanism by which interested parties (in this case, the lake board) can receive notification of pending permit applications. While P.A. 346 does not categorically prohibit canal or channel construction, the MDNR will typically deny permits for the construction of canals or channels in wetlands or environmentally sensitive lake shorelands. However, the statutory notification procedure provides the lake board with an opportunity to review and comment on all construction applications submitted, and if deemed appropriate, a public hearing can be requested if an activity is likely to adversely impact water quality.

Lakeside Landscaping and Septic System Maintenance

In order to reduce nonpoint source loadings from residential shoreland area, lakeside landscaping plans that detail vegetative buffer strip and lakefront lawncare methods are being distributed to all lake chain riparians. Nonphosphorus lawn fertilizers are being warehoused locally for lakewide distribution at wholesale rates. Revenue generated from fertilizer sales will be used to restock supplies. Many of the lakeside vegetative plantings will be purchased directly through the Branch County Soil Conservation District and local nurseries and will be made available to lake residents at discounted rates. To further promote broad-scale implementation of proper lakeside landscaping techniques, educational workshops and field demonstrations of planting and lawn maintenance methods will be conducted to provide "hands-on" assistance to lake residents.

In conjunction with the promotion of proper lakeside landscaping techniques, a septic system management program is being developed, and septic system operation and maintenance procedures are being defined. Septic system management procedures, along with lakeside landscaping guidelines, will be outlined and distributed annually in future lake board publications.

Project Financing and Organization

Pursuant to provisions of Michigan's Inland Lake Improvement Act (P.A. 345 of 1966), the Marble-Coldwater Lake Board was established to oversee and administer the project. The lake board is comprised of a representative of each of the four townships that abut the lake chain; a county commissioner; the Branch County Drain Commissioner, a representative of the Michigan Department of Natural Resources; and a lake chain resident. Local funds for the project were derived via assessment of properties within the Marble-Coldwater Lake Chain special assessment district.

In 1986, a $435,000 special assessment was levied to finance initial stages of the project, and a perpetual assessment of $5,000 per year is being levied for operation and maintenance of the sedimentation basins. When spread throughout the district, the special assessments for residential lakefront and backlot properties were $200 and $50, respectively. Revenue generated through special assessments was utilized to match EPA Clean Lakes Program grant funds, which, to date, have totaled $190,000. In addition, the Michigan Department of Natural Resources awarded a grant in the amount of $25,000 through its Recreational Improvement Fund Program, and the Michigan Department of Agriculture contributed $26,000 to the project. The key for the ongoing success of this project is the willingness of local, state, and federal agencies to work in concert toward a common goal, the protection of the water quality of the lake chain. The Marble-Coldwater Lake Board, with its broad base of representation from local

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Sentence Given For Filling Wetlands

Kalamazoo Gazette, Wednesday, December 11, 1991

Dumping dirt in your own back yard shouldn't be a crime as Ronald Angelocci sees it.

The federal government disagrees. A judge has sentenced the financial consultant to two months in a halfway house for violating federal wetlands law.

Angelocci was denied permission in 1987 to fill in wetlands behind his house on the Detroit River. He said his former wife and her son suffered from allergies to plants there.

But he also wanted to build a sea wall and boat dock. "What good is a house on the water if you don't have access to the water?" Angelocci said Tuesday.

In 1988, he dumped 30 truckloads of dirt, about 6,000 square feet, to dry up the area of his back yard leading to the water's edge.

"If you buy a house, you buy the property it sits on and the boundary lines," he said. "I believe the Constitution of the United States allows us to own property, protect it and conserve it."

Officials said that when it comes to wetlands, that is only partly true. They said Angelocci ignored several orders to restore the wetlands before he was prosecuted.

Wetlands are protected by the federal government because they are breeding grounds for fish, birds and other wildlife, including some endangered species. They also act as a filter for pesticides and fertilizer and help offset erosion.

In addition to the two-month halfway house sentence, Angelocci was fined $3,000 and placed on two years' probation for violating the federal Clean Water Act. He cannot leave the state.

"It's very rare for the U.S. Attorney's Office to seek criminal charges in a case like this," said Terry Heatlie, a U.S. Army Corps of Engineers biologist. "It's usually a civil case. But it had to do with the flagrant nature of the violation and the lack of cooperation."

Angelocci said he left the area for about 16 months, a period during which the Corps sent him several warnings to restore the wetlands. When he returned, he said he offered to establish wetlands elsewhere.

By then it was too late. Angelocci said he didn't think he would be prosecuted, but when authorities threatened a felony charge, he backed off, fearing he could lose his right to sell securities if he was convicted.

"We're talking about Mideast-type tactics here," he said. "Steal a loaf of bread and get your hand cut off."

Michigan Wetlands Under Siege

By Don Winne, Editor, The Michigan Riparian

Applications to the DNR to dredge, fill, dig ponds, construct roads, construct buildings and various other activities in wetlands in Michigan had reached a total of 1,137 by November 4, 1991. This is at the rate of nearly 4 a day since January 1, 1991. While some of these applications may have been denied, many of them were approved as presented.

The greatest number of applications were to fill wetlands — about 33%. Other activities in wetlands include the following:

Construction of buildings in wetlands	21%
Fish ponds in wetlands	15%
Dredging wetlands	13%
Construction of roads in wetlands	10%
Other applications in wetlands	8%

The Michigan Wetland Protection Act, Act #203, which requires a permit for activities in a wetland, was passed by the Michigan legislature in 1979, and was scheduled to become effective in October, 1980. Attempts to pass a wetland protection bill through the legislature beginning in 1970 were thwarted for nine years (1970-79) by failure of the Senate Environmental Affairs Committee to report it out of committee. Only after the majority party in the Senate replaced the chairman of the Environmental Affairs Committee was it possible to report a wetlands bill out of committee.

During the House and Senate hearings on wetland protection bills in the spring of 1979, strong opposition against the bills were brought to bear by lobbyists representing the housing and real estate businesses. Battles occurred over the definition of wetlands, the date on which the law would take effect, the counties in which the act would become effective, the size of wetlands to be covered, etc. The success of the opposition is evidenced by the fact that the law would not become effective until October 1, 1980, and then only in those counties with 100,000 or more population. It would not become effective in the other 67 counties until all wetlands of each county had been inventoried. This inventory was to be done by the DNR, but was never completed.

We now see some of those same interests which fought the bills in the 70's now trying to repeal or amend parts of the wetlands protection act to make it less effective than it is now. They would take away all power of municipalities to adopt wetland protection ordinances. They would also deny municipalities the power to zone wetlands under their zoning authority.

What is the solution to Michigan's continuing loss of wetlands? Probably the first step in the solution would be to put into execution a statewide program to educate all citizens on the value of wetlands. Another step would be to revise Act #203 to set minimum standards for wetland protection, to prohibit development of wetlands essential to the reproductive capacity of fish and wildlife, and provide that those minimum standards be enforced under penalty of law. A third step would be to enact legislation that would exempt a wetland owner from paying property tax on each acre of wetland declared to be wetland under definition of law. A fourth step would be to guarantee that the enforcement of the minimum standards of wetland protection be an obligation of local government. Whenever local government fails to carry out its responsibility to protect wetlands, the state should retain the power to intercede.

We will continue to see the rapid loss of wetlands in Michigan until the wetland owner, the state legislature and local government officials believe strongly in the value of wetland protection.

A Limnological Survey

(Continued from Page 11)

Conductivity was measured in 1975 on the north and south basins of Mecosta Lake by Aquatic Consulting Services. Their measurements were very similar to ours. Conductivity reported for spring runoff by Engineering Design, Inc. indicated high values for Pine Shores, Lake Mecosta Bay (our Station 5) and Baar Creek (an area near the canal on Round Lake). We assume the values reported by others were standardized to 25°C.

Alkalinity, Hardness, pH, and Chloride

Water samples for the determination of these parameters were collected from the surface, mid-depth and bottom over the deep basins (Stations 1, 2, 3, 4, 6 and 7). These parameters were measured also at the Cole Creek inlet on Round Lake and at Station 5 on Mecosta Lake. These results are given in Table 3. *(Table 3 is omitted, but may be requested from* The Michigan Riparian*).*

pH

The pH values ranged from a low of 7.53 to a high of 8.8. This is a narrow range around neutrality and is *normal and expected for Michigan hardwater lakes.* pH values near the bottom of deep basins are usually lower than those at the surface due to differences in the amount of free carbon dioxide. Photosynthesis uses up carbon dioxide and results in an increase in the pH. Thus we find higher values, such as 8.8 at the surface of Station 1. Respiration, the predominate process in the deep water near the bottom, releases carbon dioxide and results in a decrease in the pH. We see this as a value of 7.53 near the bottom of Station 6 on Round Lake.

Alkalinity

Alkalinity in the surface waters of the three lakes was quite similar varying only from 124 to 137 mg $CaCO_3$/l. These lakes are thus moderately hardwater lakes and would be expected to be moderately productive. This alkalinity provides good buffer capacity and protects the lakes from damage from acid deposition ("acid rain"). Alkalinity is typically higher near the bottom of the deep basins of a lake than at the surface. This again, is due to differences in carbon dioxide resulting from photosynthesis at the surface and respiration near the bottom. Uptake of carbon dioxide by phytoplankton (algae) and macrophytes (aquatic weeds) often results in the formation of small particles of calcium carbonate when the pH exceeds 8.3. These particles are called marl. Marl formed at the surface sinks to the bottom where it redissolves in a pH below 8.3. This causes higher alkalinity values near the bottom especially in the summer. Marl also appears as a whitish crust on the leaves of aquatic plants in the summer. This process also is normal and expected in hardwater lakes.

The alkalinity of Cole Creek was somewhat higher than the surface water of Round Lake, but lower than the deep water values, a situation of no importance.

Hardness

Hardness values were only slightly higher than the alkalinity. These two parameters are similar in character and tend to confirm the other when similar in concentration. Changes in hardness from top to bottom are usually linked to the changes in alkalinity. Hardness in excess of alkalinity is common and usually indicates the presence of chlorides, sulfates, nitrates and organic acids, all of which may contribute to hardness but not to alkalinity. The hardness values of the three lakes are normal.

Chlorides

Chlorides are a component of human and other animal wastes and are very soluble in water. While chlorides are not harmful to aquatic life, because of their soluble nature and association, they are a good indicator of leaking septic systems and possible runoff from farm feed-lots.

Values ranged from a low of 2.5 mg/l in Mecosta Lake to a high of 13.5 mg/l in Blue Lake. Concentrations less than 20 mg/l generally indicate no problem. The most common values on the three lakes were between 4.5 and 7.5 mg/l. Values for Horsehead Lake in 1988 were between 2 and 4 mg/l indicating little contribution from that lake to Gilbert Creek. Several areas in the Tri Lakes were higher than the "background" concentrations and should be noted. These areas are Station 5 (the spring) on Mecosta Lake, the canal on Round Lake and surprisingly, the mid-depth sample at Station 2 on Blue Lake; these were 9.0, 10.0, and 13.5 mg/l respectively. These sites will be further discussed in the conclusions and recommendations of this report.

Nutrients

Nutrients considered are phosphorus and nitrogen. Because of the changing nature of phosphorus, we only analyze and report total phosphorus. While nitrogen has a similar nature, we do analyze for nitrite/nitrate and Kjeldahl (organic) nitrogen with these combined as total nitrogen. Concentrations of phosphorus and nitrogen by lake and sampling site are given in Table 4. *(Table 4 is omitted but is available by request from* The Michigan Riparian.*)*

Phosphorus concentrations were low and normal for mesotrophic lakes. We sampled water on each lake over the deep basins and combined, for each lake, the two samples from the surface, mid-depth and near the bottom. Since plankton and marl drift downward toward the lake bottom, it is common in August to find concentrations of nutrients higher at the mid-depth and highest near the bottom. This was true for phosphorus in Mecosta and Round Lake, but not so for Blue Lake. The average total phosphorus for Mecosta, Blue and Round Lakes was 0.013, 0.018 and 0.023 mg/liter respectively. Many lakes have values around 0.025 mg/liter (Horsehead Lake in 1989 averaged 0.023 mg/liter). Total phosphorus reported by Aquatic Consulting Services for Mecosta Lake in August of 1975 averaged 0.014 mg/liter. Storet data, retrieved and reported by MDNR, gives average total phosphorus concentrations for early September, 1985, for Blue Lake as 0.013 mg/liter; for Round Lake as 0.02 mg/liter. Our values are very close to these other reports. Aquatic Consulting Services reported total phosphorus values for the Canadian Lakes from 1984 to 1989; these values ranged from highs of 0.08 in 1985 and 0.10 in 1988 to lows of 0.02 in 1984 and 1989 (all in mg/liter). Engineering Design, Inc. reported spring run-off values for the Tri Lakes in 1990; however, their data are only for orthophosphate and thus cannot be compared to total phosphorus values.

Phosphorus concentrations on Blue Lake at the small inlet near the lodge, and at Shepherd's Island were both lower than the average for Blue Lake open water (Table 4). On Round Lake, phosphorus concentrations at the mouth of Cole Creek, off the weed beds at the north end and in the canal at the southwest were all lower than the open water values (Table 4).

A sample taken from the spring area at the southwest end of Mecosta Lake was higher than its open water phosphorus (Table 4).

Based on our phosphorus concentrations reported here, *we would say that the Tri Lakes in 1990 do not have a phosphorus problem.* Only the southwest spring of Mecosta Lake appears to be contributing phosphorus at a concentration over the average lake values. We are unable to explain the universe concentrations of phosphorus in the deep basins of Blue Lake.

Our nitrogen concentrations for the Tri Lakes are given in Table 4. Nitrite (NO_2) and nitrate (NO_3) concentrations ranged from 0.014 to 0.020 mg/liter on the three lakes and are essentially the same. Nitrate is the available form of nitrogen that is taken up by plants. Concentrations at all extra sampling sites on the three lakes were about the same (or less) as the open water concentration except for the Cole Creek inlet. The nitrate concentration at Cole Creek was 0.066 mg/liter or over four times as high as the open lake concentration of Round Lake. *Cole Creek appears to be a site of concern here. It is possible that in this location nitrate may be limiting aquatic macrophyte growth. A high input of nitrate from Cole Creek could then partly explain the dense weed growth at the north end of Round Lake.*

The Kjeldahl (organic) nitrogen and thus the total nitrogen concentrations given in Table 4 are quite normal for mid-Michigan lakes. Concentrations of total nitrogen given by Aquatic Consulting Services for 1975 for Mecosta Lake are slightly lower than ours. Nitrate concentrations reported by Engineering Design, Inc. for the 1990 spring run-off were seven to ten times higher than our values. These may reflect a strong watershed contribution of nitrate to the lakes. Storet data for 1985 reported by MDNR for Blue Lake gave spring nitrate concentrations higher than ours, but September values were lower than ours with the same being true for Round Lake. The storet data for total Kjeldahl nitrogen for 1985 was nearly identical to ours for Blue and Round Lakes. *Nitrogen concentrations do not appear to be a problem in the Tri Lakes.*

Townships Have Power To "Eradicate Or Control Aquatic Weeds And Plants"

Township Boards in Michigan have power to make improvements under Act #180, Public Acts of 1986. Act #180 amends Act #188, Public Acts of 1954. *Sections 1 & 2 of Act #180 follow:*

41.721 Public improvements by township board; bonds; special assessments to defray costs. [M.S.A. 5.2770(51)]

Sec. 1. The township board has the power to make an improvement named in this act, to provide for the payment of an improvement by the issuance of bonds as provided in section 15, and to determine that the whole or any part of the cost of an improvement shall be defrayed by special assessments against the property especially benefited by the improvement. The cost of engineering services and all expenses incident to the proceedings for the making and financing of the improvement shall be deemed to be a part of the cost of the improvement.

41.722 Types of improvements authorized; approval; conditions. [M.S.A. 5.2770(52)]

Sec. 2. (1) The following improvements may be made under this act:

a) The construction, improvement, and maintenance of storm or sanitary sewers or combined storm and sanitary sewer systems.

b) The construction, improvement, and maintenance of water systems.

c) The construction, improvement, and maintenance of public roads.

d) The acquisition, improvement, and maintenance of public parks.

e) The construction, improvement, and maintenance of elevated structures for foot travel over roads in the township.

f) The collection and disposal of garbage and rubbish.

g) The construction, maintenance, and improvement of bicycle paths.

h) The construction, maintenance, repair, or improvement of erosion control structures or dikes.

i) The planting, maintenance, and removal of trees.

j) The installation, improvement, and maintenance of lighting systems.

k) The construction, improvement, and maintenance of sidewalks.

l) The eradication or control of aquatic weeds and plants.

m) The construction, improvement, and maintenance of private roads.

Boater's Advisory — Zebra Mussels In Michigan

WARNING:

1. Mussel larvae and adults can infest engines, cooling systems and attach to boat hulls if left in water.
2. Mussels can cause navigation markers to sink.

HOW TO *PREVENT* THE SPREAD TO INLAND WATERS:

1. Always inspect your boat, motor, trim tabs and trailer.
2. Adult zebra mussels can be easily spotted and removed by thoroughly scraping.
3. In earlier stages mussels may not be as noticeable. Pass your hand over the bottom of the boat. If it feels *grainy* you may have larval zebra mussels. Clean them off.
4. Always drain bilge water, live wells and engine compartments.
5. Disinfect all wells, anchors, bait buckets, etc. with chlorine and water (1:10).
6. Flush engines with tap water and disinfect.
7. Leaving your boat out of the water during hot weather for 10 days will kill zebra mussels.

Wisconsin Moves To Establish Water Quality Standards For Wetlands

The following information is from Patricia Ann Trochlell, Environmental Specialist, Surface Water Standards & Monitoring Section, Bureau of Water Resources Management, Department of Natural Resources, State of Wisconsin, Madison, Wisconsin. The information below is a summary of Administrative Rule NR 103 approved by the Wisconsin Legislature in July and became effective on August 1, 1991. Pat has reported to the editor of The Michigan Riparian *that fewer applications to destroy wetlands have been received since August 1, 1991.*

Purposes. The purposes of adopting NR 103 were to:

1. Protect public rights and interest.
2. Protect public health and welfare.
3. Protect the present and prospective uses of all waters of the state for public and private water supplies.
4. Protect the propagation of fish and other aquatic life and wild and domestic animals.
5. Preservation of natural flora and fauna.
6. Protect domestic and recreational uses.
7. Protect agricultural, commercial, industrial and other uses.

"In all cases where the potential uses are in conflict, these water quality standards for wetlands shall be **administered to protect the general public interest.**" (The bold type is that of the editor.)

Functions and Values of Wetlands as Identified in NR 103:

1. Sediment and pollution attenuation.
2. Storm and flood water retention.
3. Hydrologic cycle maintenance.
4. Shoreline protection against erosion.
5. Biological diversity and production.
6. Human uses such as recreation.

Wetlands Defined:

"Wetlands means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions."

Prohibited Activities in Wetlands:

1. Activities which may interfere with public rights or interest and may cause significant adverse impacts to wetlands.
2. Activities which have significant adverse impacts on the hydrological conditions necessary to support the biological and physical characteristics naturally present in wetlands.
3. Activities in wetlands which disturb or disrupt existing habitat and populations of wetland animals and vegetation. Existing habitat will be maintained by:
   1. "Protecting food supplies for fish and wildlife.
   2. Protecting reproductive and nursery areas, and
   3. Preventing conditions conducive to the establishment or proliferation of nuisance organisms."

Appeals Court Upholds Riparian Rights Along Sturgeon River In Machga Anstalt v. MDNR

Planning & Zoning News, November, 1991

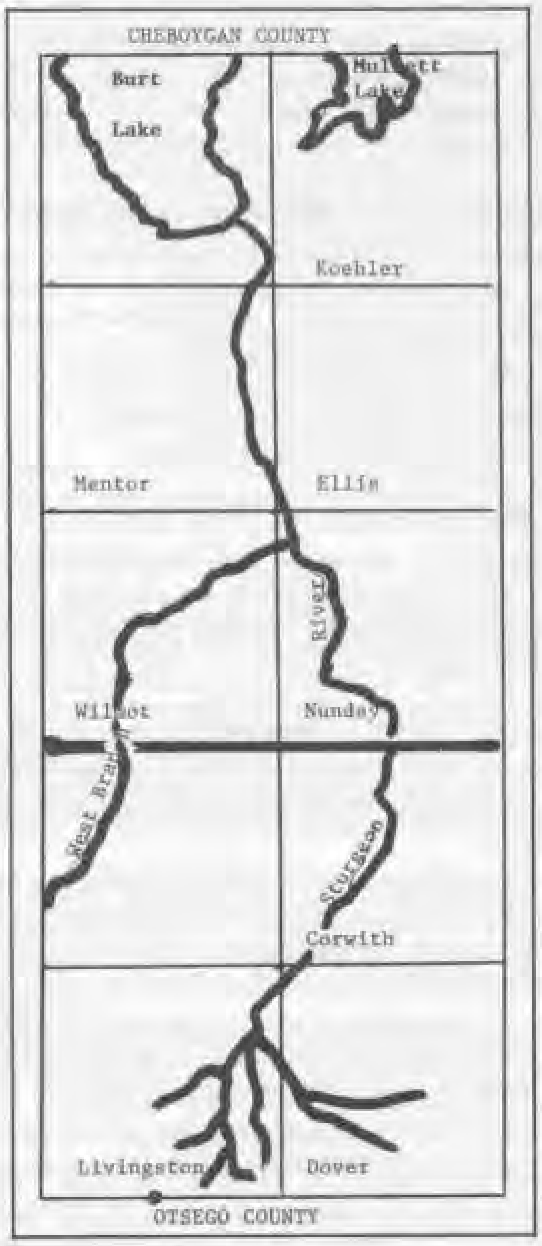
A stretch of the Sturgeon River was deemed to be nonnavigable because it had no commercial value for log flotage due to its hydrological characteristics, the natural objects in the river, and the sharp bending and winding of the river, and was thus closed to the public. **Machga Anstalt v. Michigan Department of Natural Resources,** Case No. 124804, September 9, 1991, unpublished.

The defendants appealed from a circuit court order which determined that a section of the Sturgeon River was nonnavigable and enjoined public use of that stretch of the river that ran through plaintiff's property.

"The title of a riparian owner includes the bed of a ... navigable" inland stream or lake to the midpoint of the water, subject to a servitude for the commercial navigation of ships, the commercial flotation of logs, and for fishing ... If a waterway is "navigable," the public has a right to utilize the navigational servitude for the navigation of vessels, flotation of logs, and, as an incident to the servitude, fishing."

A waterway is navigable if it may be used for the commercial flotation of logs. The circuit court found that the stretch was not navigable because it had *"no commercial value for log flotage due to its hydrological characteristics, the natural objects in the river, and the sharp bending and winding of the river."*

The court affirmed.



Appeals Court Upholds Ban On Farming Of Wetlands Area In Schoolcraft

Kalamazoo Gazette, Sunday, September 8, 1991

A 600-acre marsh in southwestern Kalamazoo County is protected wetland and cannot be used for farming, a state appeals court has ruled.

The Kramer Marsh, north of TU Avenue in Texas and Prairie Ronde townships, can't be tampered with because it qualifies as a lake under Michigan's Inland Lakes and Streams Act, the Michigan Court of Appeals said in a ruling issued Thursday. The ruling reverses a 1982 Kalamazoo County Circuit Court decision allowing Balkema Inc. to drain 170 acres in the marsh to grow corn on.

The state sued in 1979 to stop Balkema farming plans, but former circuit Judge Robert Borsos ruled the parcel was not protected and dismissed the suit. The land was partially dredged before the lawsuit was filed, but has not been developed into farmland.

"This decision protects just the kind of fragile natural area that is quickly disappearing not only in Michigan but in many other states, and it preserves an inland lake and marsh that many species of wildlife need to survive," said Attorney General Frank Kelly in a news release.

Michigan Department of Natural Resources Director Delbert Rector was equally pleased.

"The value of areas such as Kramer Marsh is immeasurable," the DNR chief said. "This judgement not only ensures protection for this environmentally sensitive marsh, it also preserves a critical component of Michigan's ecosystem and the state's natural heritage."

Kramer Marsh is a nesting area for the endangered sandhill crane and is one of the region's more productive wetlands, according to the DNR.

The *Kalamazoo Gazette* was unable to reach Balkema attorney Richard Morris for comment. He told the *Gazette* in a November 25, 1990, report, "The Balkemas feel that a balance needs to be struck between farming and wildlife habitat aspects of such land use."

Balkema could ask the Michigan Supreme Court to review the Appeals Court decision.

Marble-Coldwater Lake Chain

(Continued from Page 22)

governmental units, is the primary facilitator of the project. The project consultant acts to provide technical assistance and to coordinate implementation activities.

Conclusions

The Marble-Coldwater Lake Chain Improvement Project represents a multifaceted approach to control nonpoint source pollution. The framework under which the implementation of the plan is proceeding promotes interagency cooperation and avoids the duplication of effort and manpower. With the Marble-Coldwater Lake Board as the primary facilitator of the project, representatives of local units of government, the farm community, and lake chain residents have become actively involved in both the planning and implementation phases of the project. This approach greatly facilitates the dissemination of information on a watershed-wide basis and concurrently promotes the successful implementation of the program. Due to the inherent complexity and magnitude of nonpoint source loadings in the lake chain watershed, complete implementation of the plan will take several years, as will anticipated water quality benefits. The collective resolve of all parties involved is required to ensure the plan is fully implemented, and continued monitoring will be required to discern water quality impacts.

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