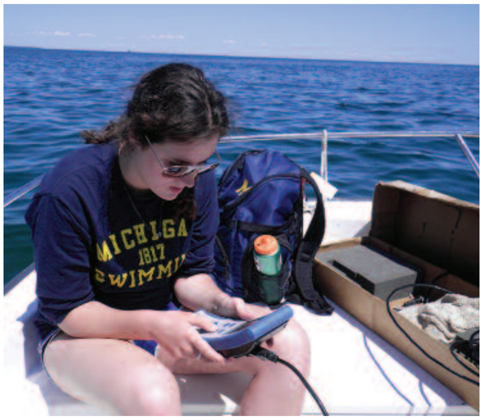
Volunteer Water Quality Monitoring Programs

2014 REPORT

COMPREHENSIVE MONITORING



LAKE MONITORING

STREAM MONITORING

Comprehensive Coverage for Valuable Water Resources

The ice finally melted off of Douglas Lake on April 29th, 2013, one of the latest "ice-out" dates in University of Michigan Biological Station (UMBS) records, which stretch back to 1931. Thus, monitoring for the Watershed Council's Comprehensive Water Quality Monitoring Program (CWQM) began in earnest at the end of April. Watershed Council staff worked long days and weekends to monitor 63 sites on 56 different lakes and streams, including four locations on the Great Lakes. On May 24th, when the Secchi disc was pulled into the boat on Lake Marion, we completed the ninth round of comprehensive monitoring.

Since 1987, the Watershed Council has been taking the pulse of lakes and streams throughout the Northern Lower Peninsula every three to five years. A variety of physical parameters are measured at every site including dissolved oxygen, pH, and conductivity levels. In addition, staff collect water samples that are later analyzed for nutrient and chloride concentrations. In rivers, discharge (flow) is measured when conditions allow.

The CWQM database now includes over 8,000 water quality measurements or analyses! These data are used regularly by the Watershed Council to assess lake and stream health, develop watershed management plans, evaluate the success of restoration projects, and much more. And it is not only a resource for us, but the data are also utilized by numerous other organizations, agencies, local governments, and researchers in their efforts to protect the lakes and streams we cherish in Northern Michigan. The following sections describe a typical day in the field, parameters monitored, and findings from the CWQM program.

Monitoring the chemical water world

The typical work day during the CWQM season starts early and entails calibrating equipment, loading supplies, driving to several lakes, launching the boat, and conducting the monitoring. Using bathymetry (depth contour) maps, we navigate to the deepest part of each lake and drop the anchor to remain stationary throughout the course of monitoring. River and stream monitoring differs in that we simply wade into the stream or lower equipment from a bridge.

Now if you're wondering why we monitor in the early spring, it's because most Northern Michigan lakes experience a "spring turnover." The turnover occurs when changes in water density from warming temperatures, coupled with wind and wave action from spring storms, cause a lake to mix from top to bottom. This mixing results in relatively homogenous conditions throughout the water column, meaning that concentrations of dissolved oxygen, nutrients, and the other parameters are approximately the same from the surface to the bottom.

The first thing we do at each site is collect water samples. Two to three samples are collected throughout the water column in lakes while only one sample is collected in streams. A Kemmerer sampler is used to collect water samples in the lakes. The Kemmerer is rinsed with lake water before being lowered into the lake to collect the first water sample just below the water's surface. A weight is then dropped down the line triggering a mechanism that causes the sampler to close on both ends. The Kemmerer is then pulled out of the water and used to fill the sample bottles. The Kemmerer sampler is lowered through the water two more times to grab samples from mid-depth and the bottom (lakes less than 30' deep are not sampled at mid-depth). Streams are sampled by wading into the water and directly filling the sample bottle.

Water samples sent to the lab are analyzed for nutrient concentrations, but why? Nutrients are needed to maintain healthy, vibrant aquatic ecosystems because they are required by organisms to live, grow, and reproduce. However, excess nutrients from sources such as fertilizers, faulty septic systems, and stormwater runoff, can have negative impacts on our surface waters.

In Northern Michigan, phosphorus is usually the most important nutrient in terms of impacts on aquatic ecosystems. Phosphorus is the limiting nutrient for algae and plant growth, essentially controlling biological productivity in most of our lakes and streams. Reductions in phosphorus would lead to less algae growth, which would in turn diminish the numbers and size of everything throughout the food pyramid up to the top predator fish. On the other hand, phosphorus has a high potential for nutrient pollution. Excessive phosphorus inputs can cause problematic algae blooms and nuisance aquatic plant growth, which has led to legislation banning it in soaps, detergents, and fertilizers.

Michigan does not yet have water quality standards for nutrients, but the United States Environmental Protection Agency (USEPA) recommends 10 micrograms per liter or less (µg/L) of total phosphorus for lakes and 12 µg/L or less for streams in Northern Michigan. Lakes monitored in the CWQM program have met this recommendation in over 80% of lake samples analyzed and nearly 95% of stream samples. In several of the larger lakes, such as Charlevoix, Mullett, and Burt, total phosphorus concentrations have decreased markedly over time (Figure 1). These decreases are likely caused by invasive zebra and quagga mussels, which filter algae and therefore, phosphorus from the water column.

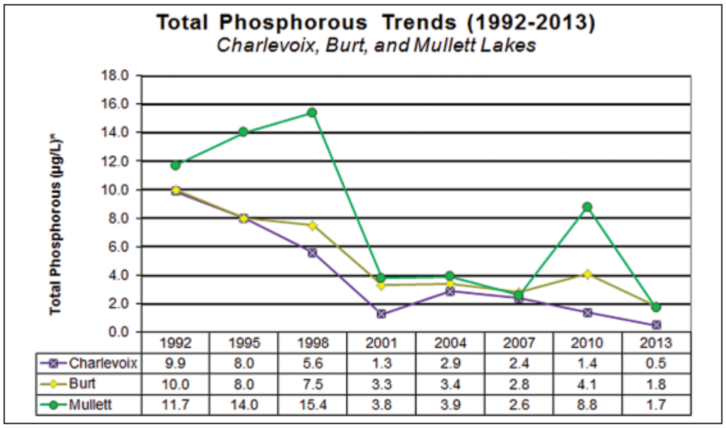


Figure 1. Phosphorus trends in Charlevoix, Burt, and Mullett Lakes.

Nitrogen is an abundant element throughout the earth's surface and is a major component of all plant and animal matter. It is also generally abundant in our lakes and streams. Some of the highest total nitrogen concentrations have been found in the Jordan River, Spring Lake, and Mud Lake. Agricultural operations in the Mancelona Plains are suspected to be the source of nitrogen in the Jordan River, whereas urbanization is thought to contribute to the high concentrations in Spring and Mud Lakes.

Beyond nutrients, the water samples are also analyzed for chloride concentrations. Chloride, a component of salt, is naturally present at low levels, typically < 5 milligrams per liter (mg/L), in Northern Michigan surface waters. Chloride is a reliable indicator of human activity in a watershed because many products associated with people contain chloride (e.g., de-icing salts, water softener salts, fertilizers, and bleach). Furthermore, chloride is not removed by chemical or biological processes in soil or water and therefore, persists over time.

Chloride concentrations have increased over time in many of the water bodies monitored in the CWQM program, including Black, Crooked, and Elk Lakes (Figure 2). Michigan has not set limits for chloride in surface waters. The USEPA recommends that the chronic toxicity level for freshwater organisms continually exposed to chloride be set at 230 mg/L and acute toxicity at 860 mg/L. Current chloride concentrations in Northern Michigan lakes and streams are far below these levels. Nevertheless, this trend indicates that levels of other pollutants associated with chloride are also increasing in our surface waters (e.g., leaking automotive fluids, etc.).

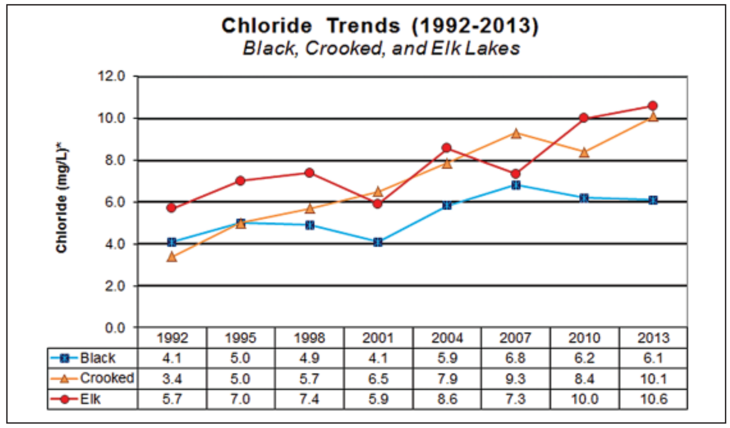


Figure 2. Chloride Trends in Black, Crooked, and Elk Lakes.

Monitoring the physical water world

After the water samples are stored securely in the cooler, we prepare our Hydrolab MiniSonde multi-parameter probe for deployment. The MiniSonde is connected to the Surveyor, a handheld computer used for viewing and storing data, via a 300' cable on a reel. The probe is lowered into the water to collect the first readings just below the surface. Although there are many options today in terms of probes, ours has the basic suite of sensors that continuously monitor dissolved oxygen, pH, conductivity, water temperature, and water depth.

Dissolved oxygen is perhaps the best barometer of water quality. Most aquatic life, whether fish, insects, plants, or bacteria, needs oxygen to survive. Dissolved oxygen levels are usually quite high in the early spring. In fact, there is not a single instance of low dissolved oxygen concentrations near the water surface in the decades of CWQM monitoring data. However, low dissolved oxygen levels have been found in the deep waters of small lakes, even in early spring.

Atmospheric oxygen is an abundant source that diffuses into surface waters, particularly when there is turbulence from wind and waves, but can only reach deeper waters through mixing. Algae and aquatic plants also produce oxygen as a byproduct of photosynthesis, though only in the upper water column where there is enough sunlight. Small lakes surrounded by hills often have less turbulence at the surface, a lesser degree of spring mixing, and therefore, less replenishment of dissolved oxygen stores in the deeper waters. Oxygen becomes depleted in deeper waters due to consumption by aquatic organisms, particularly by aerobic bacteria involved in the decomposition of organic matter that sinks to the lake bottom.

The Michigan Department of Environmental Quality (MDEQ) Water Quality Standards minimum dissolved oxygen concentration for sustaining a cold-water fishery is 7 mg/L. Throughout the duration of the CWQM program, dissolved oxygen levels of less than 7 mg/L have been documented in 16 lakes, in most cases at the very bottom. The low levels are probably due to factors described above, but can also be a sign of water quality impairment.

Comprehensive Water Quality Monitoring data from the surface of all water bodies monitored in 2013.

Water Body	Date	Temperature (˚C)	Dissolved Oxygen (mg/L)*	Specific Conductivity (µS)*	pH (units)*	Nitrate-Nitrogen (µg/L)*	Total Nitrogen (µg/L)*	Total Phosphorus (µg/L)*	Chloride (mg/L)*
Bass Lake	4/30/13	7.55	11.2	343.8	8.36	37	693	6.9	27.6
Bear River	4/28/13	22.36	14.97	270.9	8.57	180	405	4.3	14.4
Bellaire Lake	4/28/13	4.35	12.3	311.6	8.21	339	535	2.5	9.2
Ben-way Lake	5/3/13	5.60	10.85	304.5	8.19	232	456	2.0	8.4
Birch Lake	4/30/13	5.63	12.9	290.3	8.45	1.3	278	4.1	10.4
Black Lake	5/6/13	9.28	11.98	284.4	8.23	38	322	6.1	6.1
Black River	5/6/13	1.28	8.90	293.4	8.13	8	340	5.1	9.0
Boyne River	4/9/13	6.89	13.14	346.3	8.25	349	496	1.1	12.0
Burt Lake	5/5/13	12.84	12.76	304.9	8.35	84	275	6	11.9
Charlevoix, Main Basin	5/3/13	5.53	13.3	314.7	8.46	301	538	<1.0	9.9
Charlevoix, South Arm	5/3/13	10.18	12.45	303.8	8.41	579	652	<1.0	9.7
Cheboygan River	5/17/13	1.46	11.29	305.1	8.34	38.0	233	1.4	6.9
Clam Lake	4/28/13	6.61	12.08	313.9	8.32	277	500	2.5	7.8
Crooked Lake	4/27/13	10.31	11.77	283.8	8.15	255	393	17.0	10.3
Crooked River	4/10/13	6.83	12.84	309	8.26	280.0	476	4.2	10.4
Deer Lake	5/3/13	11.40	11.52	287.6	8.31	1	386	3.4	15.6
Douglas Lake	5/2/13	8.36	11.27	208.7	8.15	34	358	6.4	7.7
Elk Lake	4/28/13	2.49	12.49	269.6	8.53	205	323	<1.0	10.6
Elk River	4/28/13	3.95	13.06	269.1	8.39	201	336	10.7	11.0
Ellsworth Lake	4/30/13	4.88	10.81	281.4	8.01	179	365	7.3	8.0
Hanley Lake	4/28/13	7.92	10.98	303.3	8.12	292	493	3.6	7.7
Huffman Lake	5/4/13	11.86	9.94	297.03	8.04	68	249	2.0	4.0
Huron, Duncan Bay	5/17/13	10.34	11.99	240.9	8.65	102	307	1.2	7.9
Indian River	4/10/13	12.62	13.41	326.2	8.31	142	355	3.1	11.9
Intermediate Lake	4/28/13	5.23	10.96	333.6	8.13	372	547	3.6	9.2
Jordan River	4/9/13	7.56	12.41	279.2	8.13	485	745	5.3	13.4
Lancaster Lake	5/2/13	7.26	9.71	174.1	7.9	7.5	410	8.2	7.0
Larks Lake	5/9/13	14.11	10.78	196.1	8.8	47	393	3.3	4.4
Little Sturgeon River	4/10/13	10.60	12.71	301.9	8.14	103	242	3.5	11.4
Long Lake	5/5/13	11.37	11.39	216.2	8.21	45	353	3.5	8.9
Maple River	5/9/13	4.21	9.3	270.1	8.12	171	466	6.3	7.1
Marion Lake	5/24/13		11.33	291.4	8.54	3	349	4.0	21.9
Michigan, Bay Harbor	5/9/13	14.52	12.22	295.63	8.38	279.9	423	4.1	18.4
Michigan, Grand Traverse Bay	4/28/13	1.68	13.52	251.1	8.48	402	357	4.7	12.5
Michigan, Little Traverse Bay	4/27/13	6.00	13.98	248.5	8.41	270	360	3.6	13.0
Mud Lake (Emmet County)	4/29/13		13.6	618.73	8.23	649	1288	6.5	77.3
Mullett Lake	5/5/13	11.35	12.87	310.1	8.22	77.0	244	4.3	11.7
Munro Lake	5/2/13	11.34	11.24	213.2	8.21	65	498	4.5	4.5
Nowland Lake	4/29/13	17.33	10.51	216.1	8.09	19	470	5.6	2.6
Paradise Lake	5/2/13	9.33	9.7	198.2	8.01	40	416	3.6	9.9
Pickerel Lake	5/7/13	11.78	10.52	284.1	8.44	212	405	3.0	6.6
Pigeon River	4/10/13	13.86	13.19	293.37	8.27	104.4	277	2.3	6.4
Pine River, Charlevoix	4/9/13	2.43	14.2	249.9	8.33	256	382	0.5	11.3
Round Lake (Emmet Cty)	4/29/13	12.96	12.99	318	8.45	88	425	4.4	26.1
Six Mile Lake	4/30/13	10.95	9.92	272.8	7.90	144	323	6.3	6.7
Skegemog Lake	4/28/13	5.40	12.38	260.9	8.42	336	347	2.4	5.9
Spring Lake	4/29/13	13.89	12.77	816.1	8.23	1005	1192	3.9	137.9
St. Clair Lake	4/30/13	6.24	10.58	259.33	7.98	213.0	328	1.1	6.2
Sturgeon River	4/10/13	3.15	12.43	343.63	8.32	267.9	538	3.3	12.9
Susan Lake	4/29/13	13.29	11.37	302.9	8.19	24	367	3.6	6.9
Tannery Creek	4/8/13		14.93	464.3	8.36	540.1	752	4.6	30.6
Thayer Lake	4/30/13		11.47	69.37	8.05	47.9	570	5.6	8.4
Thumb Lake	5/4/13	8.37	11.4	198.9	7.97	55	298	2.4	4.7
Torch Lake	4/28/13	2.11	13.54	264.1	8.4	271	389	0.0	9.4
Twin Lakes	5/5/13	12.11	11.25	275.8	8.33	43	291	4.7	2.3
Walloon, Foot	5/8/13	10.62	11.35	286.4	8.33	118	355	3.7	13.7
Walloon, Mud Basin	5/8/13	16.81	11.31	319.2	8.45	88.0	372	7.2	15.9
Walloon, North Arm	5/8/13	13.42	10.59	318.3	8.27	295	328	4.7	16.6
Walloon, West Arm	5/8/13	11.85	12.06	278.5	8.31	144	530	1.4	12.7
Walloon, Wildwood Basin	5/8/13	10.67	11.48	276.77	8.34	80	345	2.9	13.1
Wildwood Lake	5/6/13	14.56	11.38	289.1	8.38	0.1	416	8.9	15.1
Wilson Lake	5/3/13	5.70	10.68	291.37	8.16	200	215	2.8	8.0

*Unit descriptions: mg/L = milligrams/liter (parts per million), µg/L = micrograms/liter (parts per billion), µS = microSiemens per centimeter

We continue to spin the reel and the MiniSonde drops through the water until reaching mid-depth where the next readings are recorded. As the probe descends into deeper waters, we often notice that pH levels decrease. The decrease in pH, which is a measure of the alkalinity or acidity of water, is caused by the release of carbon dioxide during decomposition of organic matter that sinks to the bottom. When pH drops too far and water becomes acidic, or conversely rises and becomes too alkaline, most aquatic organisms become stressed and populations of some species can become depressed or disappear entirely. Fortunately, all pH levels recorded in the CWQM program have been in the range of 6.5 to 9.0 required by MDEQ standards.

We then lower the MiniSonde to the very bottom of the lake, as deep as 300' in the case of Torch Lake. Even through 300' of water, conductivity, which is a measure of the ability of water to conduct an electric current, tends to stay the same. We are concerned about conductivity because, similar to chloride, it is a reliable indicator of pollution. Conductivity levels usually increase as the human population and landscape development in a watershed increase. Conductivity levels in most water bodies monitored in the CWQM program fall below 400 microsiemens per square centimeter (µS/cm2). There are a few lakes that we are keeping our eyes on because of abnormally high conductivity, including Spring and Mud Lakes with levels as high as 825 µS/cm2 and 624 µS/cm2 respectively. These lakes are located in the midst of major roads, commercial zones, and residential areas, which all likely contribute nonpoint source pollution that caused conductivity levels to rise.

Local Volunteers Monitor and Protect Our Lakes

Volunteer Monitoring Introduction

During the last 30 years, the Watershed Council has worked with local residents to keep a watchful eye on Northern Michigan's waters. Hundreds of volunteers have graciously devoted time and energy to our volunteer lake and stream monitoring programs, gathering data at 97 sites on 56 different lakes and streams. This priceless information is used by the Watershed Council and others to evaluate the health of our lakes and streams, identify trends, develop watershed management plans, and much, much more. We are continually impressed and thankful for the outpouring of community support and interest in our water quality monitoring programs.

The Tip of the Mitt Volunteer Lake Monitoring Program is our longest standing water quality monitoring program, with data on some lakes spanning nearly three decades. The Watershed Council provides training, equipment, and technical support to volunteers. In return, volunteers provide a wealth of data to the Watershed Council, which we use to assess the water quality and biological productivity of our lakes. Trainings are held each spring prior to sending volunteers into the field. Data are collected from early June through late August. Each week, volunteers venture onto the lake in their personal watercraft to record water transparency and surface temperature. Every other week, they collect water samples for chlorophyll-a analysis. In addition, volunteers on a handful of lakes monitor dissolved oxygen.

The Tip of the Mitt Volunteer Stream Monitoring Program was started in 2004 with just a handful of volunteers, but has grown considerably with well over 100 people now involved. Volunteers are trained and equipped by Watershed Council staff each spring and fall. A week later, teams of three to six volunteers monitor two stream sites where they collect aquatic insects and other macroinvertebrates. Volunteers gather together a few weeks later to sort and identify the specimens that they collected in the field. Our program identifies most invertebrates to the family level, which provides a fairly clear picture of water quality and stream ecosystem health.

Together, these volunteer water quality monitoring programs generate more data on an annual basis than all other Watershed Council programs and projects. These programs also serve an even greater purpose: they connect people with water. Through a combination of aquatic ecosystem education and immersion, i.e., simply getting their feet and hands wet in these ecosystems on a regular basis, these programs build a connection that instills a strong sense of stewardship. As they become better informed and in touch with our lakes and streams, volunteer monitors often transform into ambassadors, devoted to and sharing their passion for protecting Northern Michigan's waters.

Volunteer Lake Monitoring

The Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM) since 1986. During the summer of 2013, 58 volunteers helped monitor water quality at 32 stations on 24 lakes. All data collected by volunteers are available at www.watershedcouncil.org/protect. The following section summarizes monitoring parameters and program results.

Secchi Disc

The Secchi disc is a weighted black and white disc used to measure water clarity by lowering it into the water and recording the depth at which it disappears. Water clarity, which is principally determined by the concentration of algae and/or sediment in the water, is a simple and valuable way to assess water quality. Lakes and rivers that are very clear usually contain lower levels of nutrients and sediments and, in most cases, boast high quality waters. Throughout the summer, different algae types bloom at different times, causing clarity to vary greatly. Secchi disc depths range from just a few feet in small inland lakes to over 80 feet in the Great Lakes!

Chlorophyll-a

Chlorophyll-a is a pigment found in all green plants, including algae. Water samples collected by volunteers are analyzed for chlorophyll-a to estimate the amount of phytoplankton (minute free-floating algae) in the water column. Higher chlorophyll concentrations indicate greater phytoplankton densities, which reduce water clarity. The chlorophyll-a data provides support for Secchi disc depth data used to determine a lake's biological productivity, but it also helps differentiate between turbidity caused by algal blooms versus other factors such as sediments or calcite.

Trophic Status Index

Trophic Status Index (TSI) is a tool developed to rank the biological productivity of a lake. TSI values range from 0 to 100. Lower values (0-38) indicate an oligotrophic or low productive system, medium values (39-49) indicate a mesotrophic or moderately productive system, and higher values (50+) indicate a eutrophic or highly productive system. Lakes with greater water clarity and lower phytoplankton densities score on the low end of the scale, while lakes with greater turbidity and more phytoplankton score on the high end.

Oligotrophic lakes are characteristically deep, clear, nutrient poor, and have abundant oxygen. Eutrophic lakes are generally shallow and nutrient rich, which, depending upon variables such as age, depth, and soils, can be a natural state of a lake. However, nutrient and sediment pollution caused by humans can lead to the premature eutrophication of a lake, referred to as "cultural eutrophication." Cultural eutrophication can lead to nuisance plant growth, problematic algal blooms, water quality degradation, and fish and invertebrate mortality.

Results from 2013 and Historical Trends

Water transparency data for some lakes go back to 1986, providing a long-term view of water quality conditions and trends. Data from Lake Charlevoix are among the best for showing water transparency trends, with Secchi disc depths more than doubling between 1987 and 2013 (Figure 3). Increasing water transparency is also fairly well pronounced in Black, Burt, Douglas, Elk, Mullett, Michigan, Pickerel, Skegemog, and Walloon Lakes. What do all these lakes have in common that might be causing such changes? Invasive zebra mussels (and quagga mussels in Lake Charlevoix).

These invasive mussels have turned up in all of the region's largest lakes, as well as many of the smaller lakes, during the last twenty years, causing far-reaching changes in the ecosystem. Zebra and quagga mussels are filter-feeders that consume algae and, essentially, clear the water column, which increases water transparency. Unfortunately, the invasive mussels are not cleaning the water, but rather removing the base of the food chain. This loss of primary productivity (i.e., algae) alters the entire food web, ultimately leading to a reduction in top predator fish populations, such as trout or walleye.

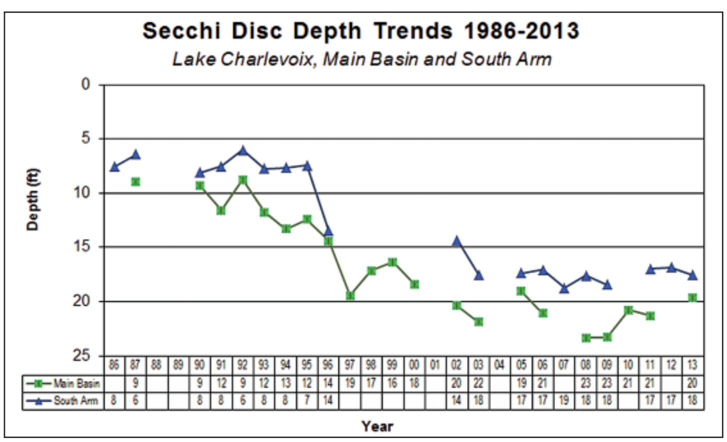


Figure 3. Secchi disc trends in Lake Charlevoix.

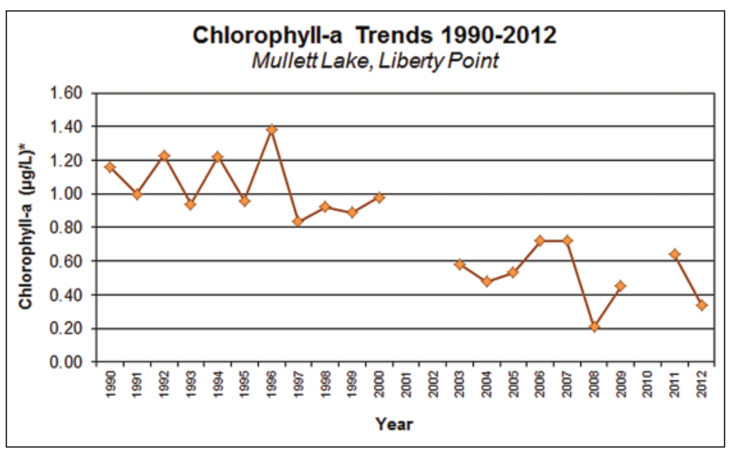


Figure 4. Chlorophyll trends in Mullett Lake.

The loss of primary productivity caused by invasive mussels should also be evident in the chlorophyll-a data, since it essentially provides a measure of planktonic algae in the water column. Fortunately, we have a few years of data for some lakes prior to zebra mussel invasion. Mullett Lake provides a clear example of chlorophyll-a reductions following the zebra mussel invasion (Figure 4). Other lakes displaying this trend include: Charlevoix, Black, Burt, Michigan, and Paradise. In some lakes where the invasive mussels have been present for a long time (generally over 10 years), trends have reversed with water clarity decreasing and chlorophyll increasing, which may indicate that invasive mussel impacts are subsiding and that the lake ecosystem is approaching a new equilibrium. It should be noted that data from some lakes with invasive mussels do not show clear trends, though for reasons unknown.

We calculate trophic status index scores based on Secchi disc depths and therefore, see the same trends. Lakes with invasive mussels have experienced declining TSI scores, becoming less biologically productive over time. We present TSI scores, as well as averaged Secchi depths and chlorophyll-a concentrations, below so that you can see the biological productivity of your favorite lake(s) and make comparisons with others (Table 1).

Table 1. 2013 Volunteer Lake Monitoring Data.

Lake/Station	TSI Score 2013*	Secchi Depth 2013 (feet)*	Chlorophyll-a 2013 (ug/l)*	Lake/Station	TSI Score 2013*	Secchi Depth 2013 (feet)*	Chlorophyll-a 2013 (ug/l)*
Bass Lake	46	9	1.43	Larks Lake	22	*i*	0.34
Black Lake	40	13	1.83	Long Lake, Cheboygan	32	23	0.63
Burt Lake, Central	35	19	1.23	Mullett Lake, Central	36	17	0.94
Burt Lake, North	35	19	*i*	Mullett Lake, North	37	17	0.13
Burt Lake, South	33	21	0.91	Mullett Lake, South	37	16	1.30
Douglas Lake, Cheboygan	40	13	1.84	Munro Lake	39	14	1.39
Douglas Lake, Otsego	39	14	2.43	Pickerel Lake	41	13	1.54
Elk Lake	35	18	0.63	Six Mile Lake	45	10	2.83
Intermediate Lake	36	19	1.19	Thayer Lake	46	9	2.23
Lake Charlevoix, Main	35	20	0.32	Thumb Lake	34	20	0.88
Lake Charlevoix, S. Arm	36	18	0.82	Twin Lakes	40	13	1.62
Lake Charlevoix, West	33	23	0.39	Walloon Lake, Foot	37	17	0.78
Lake Marion	40	13	2.91	Walloon Lake, North	39	14	1.75
Lake Michigan, LT Bay	23	43	0.32	Walloon Lake, West	35	19	0.33
Lake Skegemog	38	15	1.18				

**all scores are seasonal averages, i=insufficient data, ug/l=micrograms per liter or parts per billion.*

Volunteer Stream Monitors of all ages enjoy the indoor identification day at North Central Michigan College.

Volunteer Stream Monitoring Program Results

Streams are the freshwater circulation system of Northern Michigan, carrying rainwater, snowmelt, and groundwater into and out of the region's lakes. Our streams provide recreational opportunities to anglers, paddlers, and others, as well as habitat to a wide variety of wildlife. Fortunately, many Northern Michigan residents recognize the value of these streams. In 2013, 141 volunteers helped monitor 37 sites on 15 different rivers and creeks!

Volunteer stream monitors perform biological monitoring, collecting aquatic insects and other macroinvertebrates that are used to assess stream ecosystem health. Community diversity and species sensitivity are key factors in determining water quality; a variety of pollution-sensitive stoneflies, mayflies, and caddisflies characterize a healthy ecosystem and high water quality, while a sample with only pollution-tolerant aquatic worms and midges reveals a stream ecosystem that is likely suffering. We usually find excellent water quality in Northern Michigan streams because of limited agricultural and urban land cover in the watersheds. However, there are a few sites in or near urban areas where diversity is low.

Stream Reports

The ecological health of streams is assessed using three different measurements of diversity: 1) Total Taxa = total number of macroinvertebrate families found at a site; 2) EPT taxa = number of families in the three pollution-sensitive insect orders (mayflies, stoneflies, and caddisflies); and 3) Sensitive Taxa = number of the most sensitive macroinvertebrate families. Scores for each stream are averaged using data from all monitoring events and presented in Table 2. Each stream receives a water quality grade based on a system developed by Watershed Council staff that utilizes all three index scores.

Stream Name	Total Taxa Average	EPT Taxa Average	Sensitive Taxa Average
Bear River	17.5	7.3	2.7
Boyne River	16.3	9.1	5.0
Carp River	19.0	6.8	3.5
Eastport Creek	20.8	7.2	3.0
Horton Creek	17.5	8.0	3.6
Jordan River	21.8	12.0	7.0
Kimberly Creek	21.1	7.8	3.9
Maple River	22.9	10.1	3.7
Milligan Creek	20.1	9.6	6.3
Mullett Creek	21.2	8.3	3.7
Pigeon River	18.7	9.4	5.7
Stover Creek	16.1	4.5	1.8
Sturgeon River	20.9	10.8	6.8
Tannery Creek	14.1	5.3	1.7
ALL STREAMS	19.1	8.3	4.2

Table 2. Averaged diversity scores for rivers and creeks.

Boyne River Volunteer Stream Monitoring Team

Water Quality Grading System*

A = Excellent
B = Good
C = Moderate
D = Poor
E = Very Poor

**Grades based on system that utilizes all three index scores.*

Bear River: Grade = B

Currently, five sites are monitored on the Bear River and its tributaries. Overall, this river system appears to be healthy, though urban and agricultural runoff appear to be affecting diversity in the lower section near Petoskey.

Boyne River: Grade = A

The Friends of the Boyne River help monitor fours sites on the Boyne from the headwaters to the mouth. Stressors to the Boyne River ecosystem include sediments from roads and eroding streambanks, elevated water temperatures from dams, and urban stormwater runoff. Although total diversity scores rarely surpass 20, consistently high EPT and sensitive family diversity at all sites show that the Boyne remains a healthy stream.

Carp River: Grade = TBD

Due to water quality concerns in Emmet County, two sites on the Carp River (to the southwest of Mackinaw City) were added to the program in 2013. Stream ecosystem health will not be rated until at least three years of data are available, but preliminary index scores suggest that the Carp River is doing well.

Eastport Creek: Grade = B
Eastport Creek, which drains into the north end of Torch Lake, has been monitored at two sites since 2005. Biological data from the upper reaches show a diverse and healthy macroinvertebrate community, whereas the lower section is not as diverse and may be impacted by adjacent residential areas.

Horton Creek: Grade = B+
Horton Creek flows south from its headwaters near Little Traverse Bay into Lake Charlevoix at Horton Bay. Natural circumstances at Church Road, including slow flow, mucky substrate and warm water temperatures, contribute to the relatively low diversity scores. Diversity is much greater downstream at Boyne City Road where flow is faster and habitat diversity greater.

Jordan River: Grade = A
The Friends of the Jordan River help coordinate volunteer monitoring at four sample sites from Pinney Bridge to Fair Road. Pristine conditions throughout most of the Jordan River watershed and limited development along the river's edge result in a very healthy stream ecosystem, which is evident in our biological assessment.

Kimberly Creek: Grade = A
Kimberly Creek flows through the small community of Afton on M68 before converging with the Pigeon River. Two sites monitored since 2005 show healthy diversity in spite of impacts from residential development, agriculture, and mining.

Maple River: Grade = A
The Maple River drains a large area to the northwest of Burt Lake, including the Pleasantview Swamp, Larks Lake, Douglas Lake, and Lake Kathleen. Three monitoring sites in the lower section of the river boast exceptional diversity. The upstream site at Pleasantview Road has less diversity, which may naturally be the result of slow flow and warmer water temperatures, but other factors could be involved.

Milligan Creek: Grade = A
Milligan Creek is a tributary of the Black River near the village of Tower on M68 with a unique section downstream of Waveland Road where the stream bottom is composed nearly entirely of solid rock. EPT and sensitive families are generally found in abundance at two sites monitored, indicating a healthy stream ecosystem.

Mullett Creek: Grade = A
Mullett Creek flows from its headwaters near Riggsville Road and the University of Michigan Biological Station into the northwest side of Mullett Lake. Fast flow, cool water temperatures, high dissolved oxygen levels, and greater habitat variability contribute to the high sensitive species diversity found at the upper sites. In the lower reaches of Mullett Creek, slopes decrease considerably and the channel is more exposed to the sun, resulting in sluggish flow, warmer water temperatures, lower dissolved oxygen levels, and therefore, lower sensitive species diversity.

Pigeon River: Grade = A
The Pigeon River begins just northeast of Gaylord, flows through the heart of Pigeon River Country, and eventually makes its way to Mullett Lake. Sites were added on the Pigeon River following the accidental release of large volumes of water and sediment from the impoundment at Song of the Morning Ranch in 2008. Strong EPT and sensitive family diversity indicate that the Pigeon has weathered the storm.

Stover Creek: Grade = C
Stover Creek, located just south of the City of Charlevoix, holds the distinction of being the first stream to be included in our program. Macroinvertebrate diversity at the mouth is the lowest of any site in the program. Intermittent flow upstream during dry summers and stormwater pollution are among the problems that the Watershed Council is investigating as we develop a Restoration and Management Plan for the Stover Creek Watershed. Plan development is funded by the Charlevoix County Community Foundation and is scheduled to be completed by the end of 2014.

Sturgeon River: Grade = A
The precipitous Sturgeon River flows from headwaters in Gaylord and Huffman Lake (West Branch) through Wolverine and Indian River until emptying into Burt Lake. Due to the pristine status of the upper watershed, index scores show that the Sturgeon River is in great shape. Encroaching residential development threatens the lower Sturgeon, which will be assessed and addressed during development of the Burt Lake-Sturgeon River Watershed Management Plan in the next two years.

Tannery Creek: Grade = C
Tannery Creek flows into Little Traverse Bay to the southwest of Petoskey State Park. Low diversity near the mouth show the negative impacts associated with urban development. Last year, a watershed plan was completed by University of Michigan students to help improve and protect the creek. In addition, a Great Lakes Restoration Initiative grant funded stream restoration efforts in the lower section of the creek, including replacement of a culvert with an open-span bridge and invasive species control.

THANK YOU Volunteers

We cannot thank our volunteers enough for the critical role they play in helping protect the lakes of Northern Michigan, but we try: thank you, thank you, THANK YOU! If you would like to get involved or would like additional information, please contact program coordinators, Kevin Cronk and Dan Myers at (231) 347-1181 or email info@watershedcouncil.org.

Watch for our **Avian Botulism Monitoring Report** in the summer edition of *Current Refletions*