Paradise Lake

2009 Report

What attracts people to Northern Michigan? In general, people come north to enjoy the natural beauty of the area's pristine ecosystems, but if asked for one specific landscape feature, most would undoubtedly say our "lakes". Lakes define the landscape of Northern Michigan and sustain local economies, providing stunning views, abundant fisheries, and tremendous recreational opportunities.

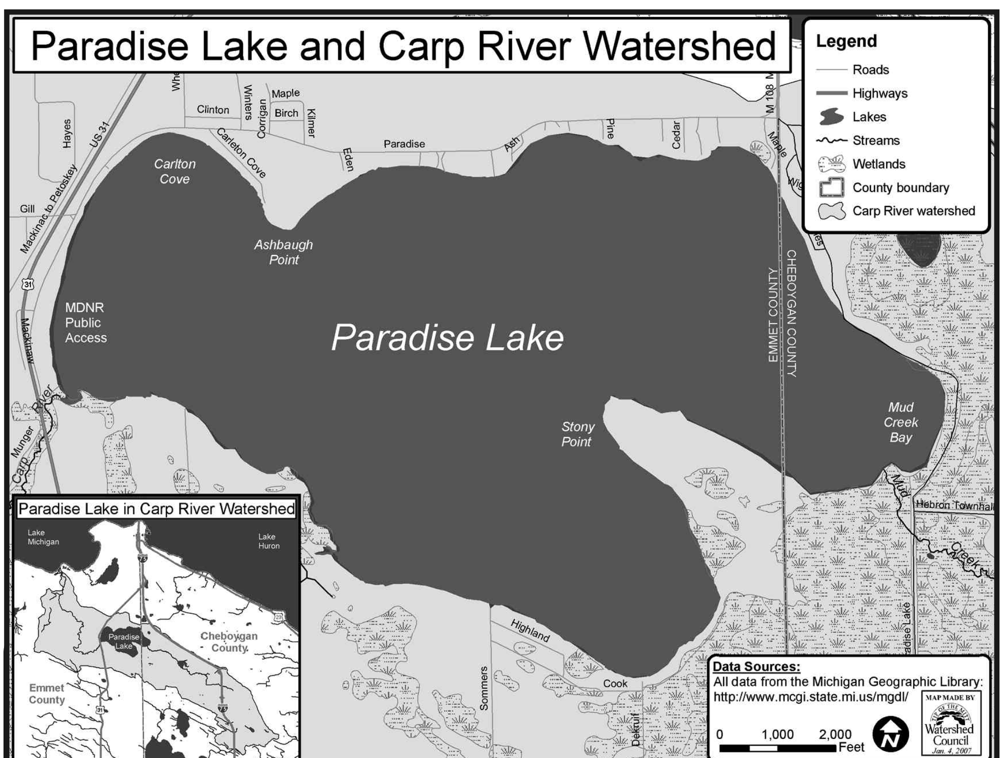
In the Tip of the Mitt Watershed Council service area there are nearly 60 lakes greater than 100 acres in size, and 14 of these are among the State's largest with over 1,000 acres of lake-surface area. The region also boasts some of the State's deepest lakes with five lakes having maximum depths of 100 feet or more. Paradise Lake, in northern Emmet and Cheboygan Counties, stands among these lake "giants" with over 1,900 acres of surface area, though only 18 feet of depth at its maximum.

The waters of Paradise Lake are dark, obscured by tannins, yet exceptionally clean and pure. Within its mysterious waters you will find an enchanting and vibrant ecosystem; from the large predatory pike inhabiting its depths to the resplendent pond-lilies emerging from its surface. Over the last few decades, the Watershed Council has put forth great effort to preserve Paradise Lake and ensure it remains a high quality resource for the enjoyment of future generations. Water quality of the region's lakes, both large and small, has been monitored by staff and volunteers alike, providing valuable data on the overall health of our waters. Our cornerstone water quality monitoring programs include Comprehensive Water Quality Monitoring and Volunteer Lake Monitoring.

The Comprehensive Water Quality Monitoring program is run by Watershed Council staff who have monitored water quality of Northern Michigan's lakes and streams for over 20 years. The Volunteer Lake Monitoring program was started in 1984 and has relied on hundreds of dedicated volunteers who monitor water clarity, algae abundance, phosphorus levels and more.

In addition to monitoring, the Watershed Council has worked with lake shoreline owners and lake organizations on a variety of projects to protect the lakes scattered throughout Northern Michigan. Projects carried out on these lakes have ranged from comprehensive aquatic plant surveys to shoreline restoration projects. Details about recent monitoring activities and lake projects on Paradise Lake are included in this report.

We hope you find this report both informative and helpful. If you have any questions, comments, or concerns, please contact Tip of the Mitt Watershed Council at (231) 347-1181 or visit our website at www.watershedcouncil.org.



Over the last few decades, Tip of the Mitt Watershed Council has put forth great effort to preserve Paradise Lake and ensure it remains a high quality resource for the enjoyment of future generations.

Comprehensive Water Quality Monitoring

Water Quality Trends: 20 years of data

In 2007, Tip of the Mitt Watershed Council completed its 20th year of comprehensive monitoring. Starting on just 10 lakes in 1987, the Watershed Council's Comprehensive Water Quality Monitoring Program has expanded to include over 50 lakes and rivers throughout Northern Michigan. An incredible amount of data has been generated from this program and utilized by the Watershed Council, lake and stream associations, local governments and regulatory agencies in an effort to protect and improve the water resources that are so important to the region.

Every three years, Watershed Council staff head into the field as soon as ice is out to monitor lakes and rivers spread across the tip of the mitt. Over 60% of the region's lakes greater than 100 acres in size, and all major rivers are included in the program. In each of these water bodies, the Watershed Council collects a variety of data, including parameters such as dissolved oxygen, pH, chloride, phosphorus and nitrogen.

Information gathered in the Comprehensive Water Quality Monitoring Program has proven to be very useful. The data are used by the Watershed Council and others to characterize water bodies, identify specific problems and examine trends over time. One obvious trend found by analyzing data from this program is that chloride (a component of salt) levels have increased significantly in many water bodies during the last 22 years. Why? We need not look any farther than ourselves to find the answer as we use salt in everything from de-icing to cooking.

The following pages contain descriptions of the types of data collected in the program as well as select data from Paradise Lake. We have also included charts to provide a graphic display of trends occurring in the lake. For |additional information about the Comprehensive Water Quality Monitoring Program please visit our web site at www. watershedcouncil.org/protect

Parameters and Results

pH

pH values provide a measurement of the acidity or alkalinity of water. Measurements above 7 are alkaline, 7 is considered neutral, and levels below 7 are acidic. When pH is outside the range of 5.5 to 8.5, most aquatic organisms become stressed and populations of some species can become depressed or disappear entirely. State law requires that pH be maintained within a range of 6.5 to 9.0 in all waters of the state. Data collected from Paradise Lake show that pH levels consistently fall within this range, with a minimum of 7.38 (1992) and maximum of 8.60 (1987).

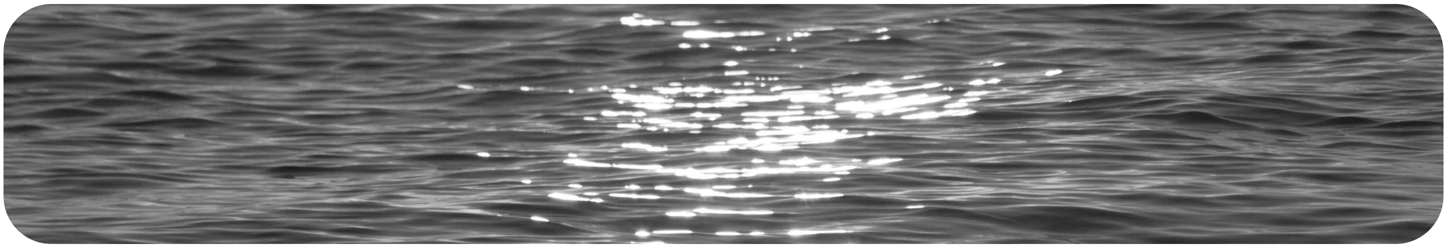
Dissolved Oxygen

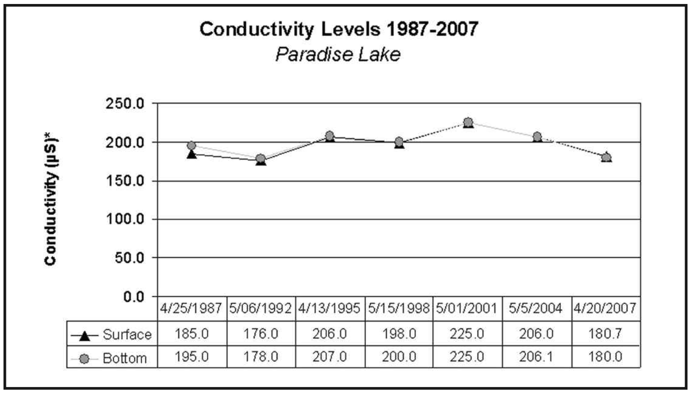
Oxygen is required by almost all organisms, including those that live in the water. Oxygen dissolves into the water from the atmosphere (especially when there is turbulence) and through photosynthesis of aquatic plants and algae. State law requires that a minimum of 5 to 7 parts per million (PPM) be maintained depending on the lake type. Dissolved oxygen levels recorded in Paradise Lake have consistently exceeded State minimums, ranging from 8.3 PPM (1998) to 12.9 PPM (1995).

Conductivity

Conductivity is a measure of the ability of water to conduct an electric current, which is dependent upon the concentration of charged particles (ions) dissolved in the water. Readings on lakes monitored by the Watershed Council have ranged from 175 to 656 microSiemens (µS), and in Paradise Lake, ranging from a low of 176 µS (1992) to a high of 225 µS (2001). Conductivity levels rose gradually in Paradise Lake from 1987 to 2001 and have since decreased. A steady increase in conductivity levels generally occurs due to greater human activity in the watershed and may indicate that water pollution is occurring.

Kevin Cronk, our Monitoring and Research Coordinator, measures the water clarity on Paradise Lake with a secchi disc. This is just one of the many tests done to thoroughly check the health of the lake.

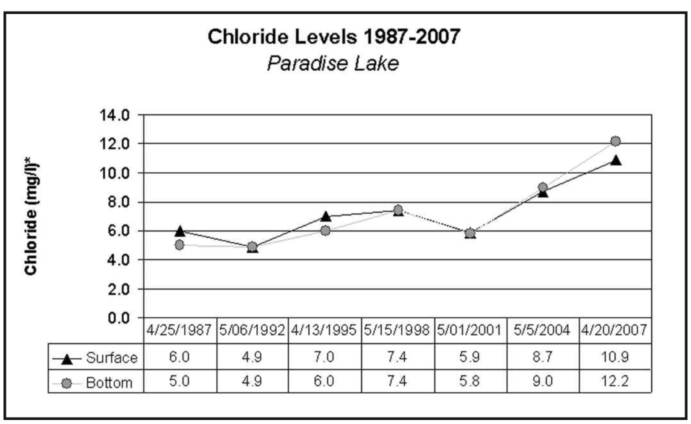




	4/25/1987	5/06/1992	4/13/1995	5/15/1998	5/01/2001	5/5/2004	4/20/2007
Surface	185.0	176.0	206.0	198.0	225.0	206.0	180.7
Bottom	195.0	178.0	207.0	200.0	225.0	206.1	180.0

Chloride

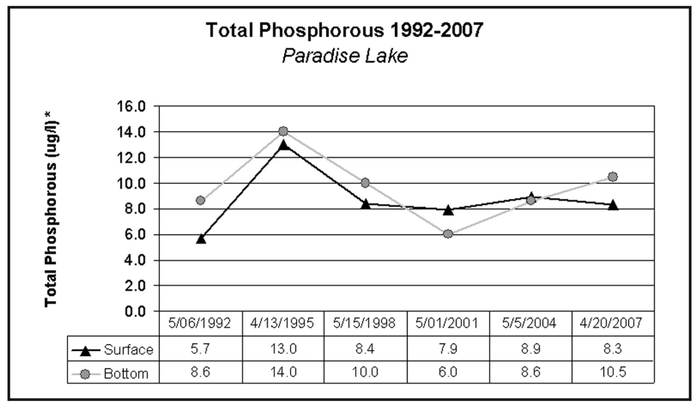
Chloride, a component of salt, is present naturally at low levels in Northern Michigan surface waters due to the marine origin of bedrock (typically < 5 PPM). Chloride is a "mobile ion," meaning it is not removed by chemical or biological processes in soil or water. Many products associated with human activities contain chloride (e.g., de-icing salts, water softener salts, and bleach). Although most aquatic organisms are not affected until chloride concentrations exceed 1,000 PPM, increasing chloride concentrations are indicative of other pollutants associated with human activity (such as automotive fluids from roads or nutrients/bacteria from septic systems) reaching our waterways. Chloride concentrations have more than doubled in Paradise Lake, from a low of 4.9 PPM in 1992 to a high of 12.2 PPM in 2007.



	4/25/1987	5/06/1992	4/13/1995	5/15/1998	5/01/2001	5/5/2004	4/20/2007
Surface	6.0	4.9	7.0	7.4	5.9	8.7	10.9
Bottom	5.0	4.9	6.0	7.4	5.8	9.0	12.2

Total Phosphorus

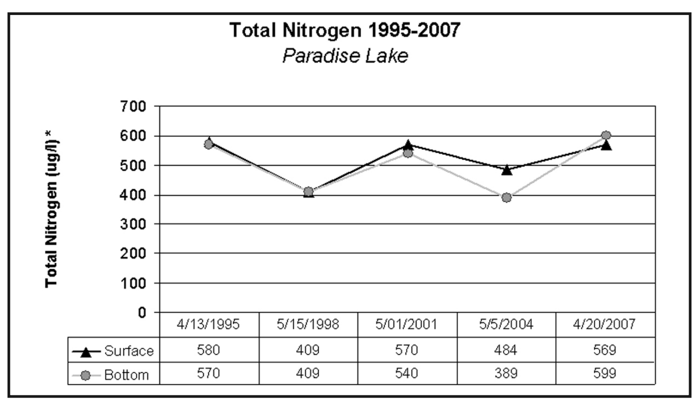
Phosphorus is the most important nutrient for plant productivity in surface waters because it is usually in shortest supply relative to nitrogen and carbon. A water body is considered phosphorus limited if the ratio of nitrogen to phosphorus is greater than 15:1. In fact, most lakes monitored by the Watershed Council are found to be phosphorus limited. Although water quality standards have not been set for lakes, the U.S. EPA recommends that total phosphorus concentrations in streams discharging into lakes not exceed 50 parts per billion (PPB). Phosphorus is normally found at concentrations of less than 10 PPB in high quality surface waters. In Paradise Lake, total phosphorus concentrations have changed little during the last two decades, ranging from a low of 5.7 PPB in 1992 to a high of 14.0 PPB in 1995.



	5/06/1992	4/13/1995	5/15/1998	5/01/2001	5/5/2004	4/20/2007
Surface	5.7	13.0	8.4	7.9	8.9	8.3
Bottom	8.6	14.0	10.0	6.0	8.6	10.5

Total Nitrogen

Nitrogen is another essential nutrient for plant growth. It is a very abundant element throughout the earth's surface and is a major component of all plant and animal matter. Although nutrients occur naturally, nutrient pollution is usually the result of human activities (e.g. fertilizers, faulty septic systems, and storm water runoff). In general, the lowest nutrient levels were found in Lake Michigan and large deep inland lakes, while the highest nutrient levels were found in small shallow lakes. Total nitrogen levels in Paradise Lake have ranged from 373 PPB in 2004 to 599 PPB in 2007. No clear trend is present within the total nitrogen data.



	4/13/1995	5/15/1998	5/01/2001	5/5/2004	4/20/2007
Surface	580	409	570	484	569
Bottom	570	409	540	389	599

*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

Comprehensive Water Quality Monitoring Program 2007 Data

Water Body	Date	Dissolved Oxygen (mg/l)	pH (units)	Specific Conductivity (µS)	Chloride (mg/l)	Nitrate-Nitrogen (µg/l)	Total Nitrogen (µg/l)	Total Phosphorus (µg/l)
Bass Lake	4/19/2007	12.33	8.41	309.6	38.1	17.0	504.0	7.9
Bear River	5/24/2007	8.78	8.26	338.0	12.3	103.5	305.0	8.6
Bellaire Lake	4/19/2007	12.43	8.36	294.9	8.5	428.1	469.0	4.6
Benway Lake	4/16/2007	11.37	8.08	311.7	8.5	419.4	556.0	1.6
Birch Lake	4/19/2007	12.48	8.30	257.0	15.6	42.5	279.0	3.7
Black Lake	5/4/2007	11.74	8.16	262.5	6.0	54.5	269.0	3.5
Black River	4/9/2007	13.14	8.17	260.7	2.9	62.4	250.0	3.1
Boyne River	4/2/2007	10.29	8.32	366.4	6.1	368.2	475.0	3.2
Burt Lake	5/8/2007	11.19	8.29	273.6	10.4	120.3	254.0	3.0
Charlevoix, Main Basin	5/2/2007	13.00	8.19	271.9	10.2	300.0	498.0	2.2
Charlevoix, South Arm	5/2/2007	12.28	8.30	285.3	9.1	570.6	508.0	2.4
Cheboygan River	4/9/2007	14.18	8.34	282.9	6.1	68.4	338.0	4.8
Clam Lake	4/17/2007	12.10	8.24	300.5	8.8	421.4	471.0	2.6
Crooked Lake	4/25/2007	11.62	8.31	275.1	7.8	267.9	404.0	2.8
Crooked River	3/28/2007	11.97	8.36	290.3	8.9	224.8	373.0	4.9
Deer Lake	4/24/2007	11.41	8.32	239.9	6.7	49.1	308.0	2.6
Douglas Lake	4/20/2007	12.24	8.22	194.9	6.8	46.9	455.0	9.4
Elk Lake	4/17/2007	13.24	8.31	249.4	9.3	262.3	338.0	2.9
Elk River	4/2/2007	11.64	8.47	267.1	8.0	245.0	305.0	1.0
Ellsworth Lake	4/16/2007	11.90	8.12	310.3	9.6	349.3	409.0	3.5
Hanley Lake	4/19/2007	11.79	8.26	316.5	9.4	443.7	547.0	3.3
Huffman Lake	4/30/2007	10.43	8.41	277.2	4.7	38.0	179.0	6.9
Huron, Duncan Bay	5/8/2007	12.11	8.27	215.5	8.2	170.5	311.0	3.9
Indian River	5/22/2007	10.13	8.25	284.7	10.4	105.2	316.5	3.9
Intermediate Lake	4/19/2007	12.11	8.33	315.9	11.3	442.6	608.0	3.4
Jordan River	4/2/2007	10.04	8.30	322.0	6.0	981.5	1021.0	5.6
Lancaster Lake	4/20/2007	10.08	8.25	201.1	7.9	53.8	444.0	13.5
Larks Lake	5/3/2007	10.88	8.50	189.6	4.2	66.0	453.0	7.6
Little Sturgeon River	5/21/2007	9.82	8.30	293.3	13.2	57.5	202.0	8.1
Long Lake	5/4/2007	11.40	8.21	191.3	8.9	45.3	346.0	4.4
Maple River	4/9/2007	14.41	8.17	222.3	3.3	270.3	472.0	3.0
Michigan, Bay Harbor	5/30/2007	10.87	8.13	262.2	13.4	279.0	391.0	2.5
Michigan, Grand Traverse Bay	4/17/2007	13.34	8.29	232.6	6.3	257.3	331.0	2.0
Michigan, Little Traverse Bay	5/17/2007	13.40	8.29	228.0	11.6	259.0	397.0	2.5
Mullett Lake	5/8/2007	11.54	8.28	276.2	12.9	73.0	211.0	3.1
Munro Lake	5/8/2007	11.88	8.35	187.8	4.0	79.6	948.0	9.5
Nowland Lake	5/10/2007	10.40	8.49	184.2	6.5	10.2	567.0	8.1
Paradise Lake	4/20/2007	12.58	8.29	180.7	10.9	35.5	569.0	8.3
Pickerel Lake	4/25/2007	11.07	8.31	267.5	6.3	209.1	361.0	2.7
Pigeon River	5/21/2007	9.75	8.37	316.0	6.8	28.0	247.0	7.8
Pine River	4/2/2007	13.54	8.47	277.7	7.7	322.2	418.0	4.6
Rainy River	4/9/2007	13.14	8.09	248.8	4.5	32.7	411.0	8.3
Round Lake (Emmet Cty)	5/1/2007	10.44	8.54	262.9	26.9	16.7	350.0	6.3
Silver Lake (Wolverine)	4/30/2007	11.15	8.30	190.0	4.2	35.2	1203.0	2.8
Six-mile Lake	4/24/2007	11.38	8.21	260.6	6.9	224.9	433.0	4.2
Skegemog Lake	4/17/2007	12.75	8.36	257.7	8.3	300.0	311.0	1.8
Spring Lake	5/1/2007	11.07	8.25	571.5	88.2	857.7	1292.0	7.3
St. Clair Lake	4/16/2007	11.97	8.13	293.6	6.1	283.8	385.0	3.2
Sturgeon River	4/9/2007	14.41	8.26	340.5	12.2	280.5	280.0	2.3
Susan Lake	4/24/2007	10.83	8.28	251.4	9.5	29.1	333.0	3.6
Tannery Creek	3/28/2007	12.22	8.22	428.1	37.1	705.2	902.0	5.7
Thumb Lake	4/30/2007	11.66	8.33	177.8	4.4	37.0	293.0	2.8
Torch Lake	4/17/2007	13.07	8.34	245.9	6.2	364.6	377.0	2.2
Twin Lakes	5/1/2007	11.27	8.40	239.5	2.3	10.3	275.0	7.7
Walloon, Foot	5/7/2007	11.77	8.18	243.6	12.4	91.2	279.0	1.9
Walloon, Mud Basin	5/9/2007	10.92	8.32	277.7	15.2	9.6	424.0	10.2
Walloon, North Arm	5/7/2007	10.91	8.24	267.1	14.2	268.5	458.0	4.1
Walloon, West Arm	5/9/2007	12.27	8.27	238.4	9.3	157.7	385.0	3.0
Walloon, Wildwood Basin	5/7/2007	11.79	8.24	238.8	12.5	82.9	255.0	2.7
Wildwood Lake	4/30/2007	10.13	8.42	247.0	13.2	>1	379.0	6.2
Wilson Lake	4/16/2007	11.75	8.11	317.6	9.7	405.2	595.0	1.9

*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

PARADISE LAKE
Invaded on Multiple Fronts

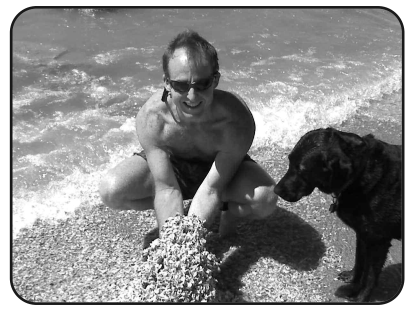
Dr. Ed Voss from the University of Michigan, foremost expert on Michigan's plants and long-time resident of Mackinaw City, first saw invasive Eurasian watermilfoil in Paradise Lake in 1991. In just five years, the plant expanded and became a major recreational nuisance throughout the lake. Following a survey by Tip of the Mitt Watershed Council staff in 1996 that documented large beds of Eurasian watermilfoil, native aquatic weevils were released in Paradise Lake in an innovative approach to control the nuisance plant growth. Although brought in check for a period of time with biological control, the invasive watermilfoil resurged in 2007, bringing the spotlight on invasive species in Paradise Lake back to front and center.

The entire Great Lakes region is under threat of invasion, biological invasion by animals and plants, from other parts of the world that find their way here more readily each year as global trade and travel increase. To date, nearly 200 non-native aquatic species have been documented in the Great Lakes. Most of these have probably been transported through the ballast water of ocean-going ships, but they spread through other means as well, such as the aquarium trade and recreational fishing and boating. All of these non-native, alien, or exotic species (depending upon which term you want to use) have some impact on the native ecosystems, but those that really cause problems are labeled "invasive".

"An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" is among the many definitions for invasive species. Based on this definition, does Eurasian watermilfoil in Paradise Lake qualify as an invasive species? Undoubtedly. As a recreational nuisance, it causes economic harm by reducing the number of lake-users (vacationers, anglers, skiers, etc.) that might otherwise contribute to the local economy, and it can even reduce property values. In terms of environmental damage, Eurasian watermilfoil crowds out the native plants, thereby affecting other native organisms adapted to depend upon those plants. Furthermore, excessive growth can even have impacts on the fisheries and water quality.

Eurasian Watermilfoil Photo: Michigan Sea Grant

More recently, zebra mussels have invaded Paradise Lake and are now commonplace. The invasive zebra mussel may pose less of a recreational nuisance than Eurasian watermilfoil, though they certainly pose a human health hazard – particularly cuts on hands and feet from sharp shells, but they may have an even more pronounced impact on the lake ecosystem. Zebra mussels are filter feeders, feeding upon and thus, depleting the water of phytoplanktonic (free-floating, unicellular) algae that are the base of the food chain. Many interpret the clearer waters following the introduction of zebra mussels as cleaner water, but it is in essence more sterile water that is less biologically productive. This alteration in the food web, the loss of algae that would have otherwise been utilized by other organisms, affects the entire food chain, eventually reducing the number or size of top predator fish.



Zebra Mussels Photo: Tip of the Mitt Watershed Council

Which invasive species will appear next in Paradise Lake? Although impossible to predict and perhaps difficult to avoid, we can all make a difference and potentially save Paradise Lake from further invasion by unwanted creatures. Many such species hitch a ride on boats and moreover, on trailers that are moved from one lake to another. One of the most important things to do when launching or loading boats is to remove the aquatic plants from the trailer and boat because the plant may be invasive and things attached to the plant (like zebra mussels) may also be invasive. Observing and respecting all signs at boat launches and other water access points that warn against potential invasive species threats and how to prevent their spread is also helpful. In some areas, volunteer watch groups are monitoring high-traffic boat launches to educate lake-users and ensure that invasive species are not being spread. On the policy front, we can all voice our opinions to our congressional representatives, encouraging them to support legislation that helps control the spread of invasive species, such as legislation that focuses on ballast water. The affects of these various measures and efforts are cumulative. If we all work together, we can make a difference and reduce the risk of further biological invasion in Paradise.

Volunteer Lake Monitoring

Local Volunteers Monitor & Protect Our Lakes

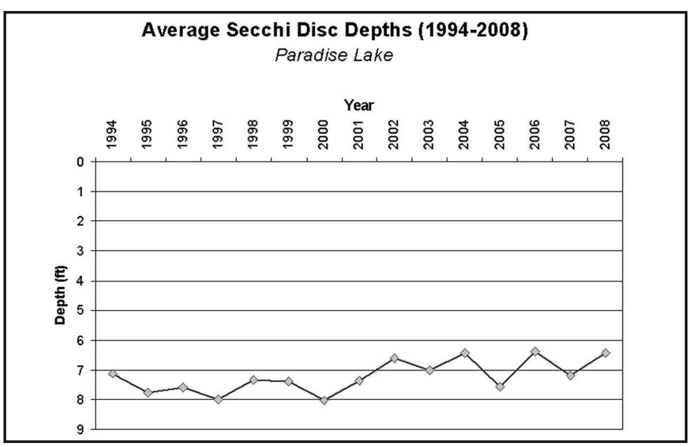
Since 1984, Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM), relying upon hundreds of volunteers to monitor the water quality of dozens of lakes in the northern Lower Peninsula of Michigan. During the summer of 2008, 40 volunteers monitored water quality at 33 stations on 25 lakes.

A tremendous amount of data has been generated by the VLM program and is available to the public via our web site (www.watershedcouncil.org/protect). This data is essential for discerning short-term changes and long-term trends in the lakes of Northern Michigan. Ultimately, the dedicated effort of volunteers and staff will help improve lake management and protect and enhance the quality of Northern Michigan's waters.

Volunteers measure water clarity on a weekly basis using a Secchi disc. Every other week volunteers collect water samples to be analyzed for chlorophyll-a. Staff at the Watershed Council process the data and determine Trophic Status Index (TSI) scores to classify the lakes and make comparisons. On Paradise Lake, volunteers have monitored water quality since 1987 near the deepest part of the lake. The following section summarizes the results.

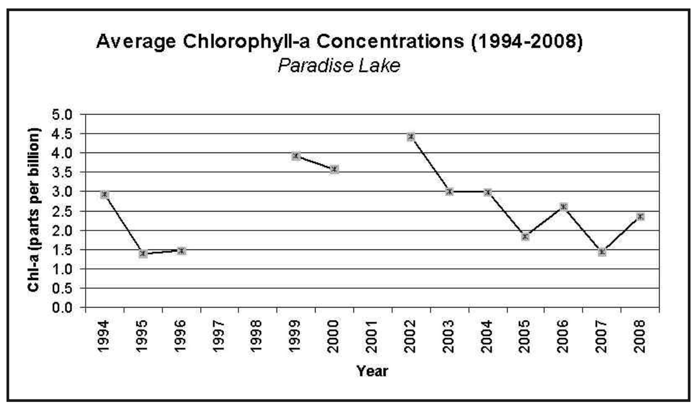
Secchi Disc

The Secchi disc is a weighted disc (eight inches in diameter, painted black and white in alternating quarters) that is used to measure water clarity. The disc is dropped down through the water column and the depth at which it disappears is noted. Using Secchi disc measurements, we are able to determine the relative clarity of water, which is principally determined by the concentration of algae and/or sediment in the water. The clarity of 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 bloom at different times, causing clarity to vary greatly. Secchi disc depths have ranged from just a few feet in small inland lakes to 40-50+ feet in large inland lakes and Great Lakes' bays.



Chlorophyll-a

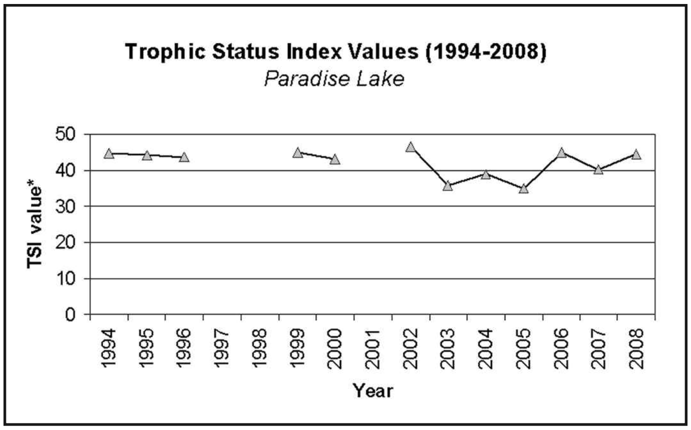
Chlorophyll-a is a pigment found in all green plants, including algae. Water samples collected by volunteers are analyzed for chlorophyll-a to determine the amount of phytoplankton (minute free-floating algae) in the water column. There is a strong relationship between chlorophyll-a concentrations and Secchi disc depth. Greater amounts of chlorophyll-a indicate greater phytoplankton densities, which reduce water clarity and, thus, the Secchi disc depth as well. So why collect chlorophyll-a data? The chlorophyll-a data provides support for Secchi disc depth data used to determine the productivity of the lake, but it can also help differentiate between turbidity caused by algal blooms versus turbidity caused by other factors such as sedimentation or calcite



Trophic Status Index

Trophic Status Index (TSI) is a tool developed by Bob Carlson, Ph.D. from Kent State University, to determine the biological productivity of a lake. Formulas developed to calculate the TSI value utilize Secchi disc depth and chlorophyll-a measurements collected by our volunteers. TSI values range from 0 to 100. Lower values (0-38) indicate an oligotrophic or low productive system, medium values (39-49) indicate a

*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter



Results from Paradise Lake

Volunteer monitors have collected water quality on Paradise Lake for over 20 years! Since 1988, the lake has been monitored near its deepest point in the northern half of the lake. The long-term Secchi disc and chlorophyll-a data from this site allow Watershed Council staff to assess water quality and examine changes over time.

Data from the last few decades show a gradual decrease in average Secchi disc depths in Paradise Lake. Average chlorophyll-a concentrations have bounced around, but have showed a marked decreased since 2002. Just a few years ago zebra mussels began to appear in large numbers in Paradise Lake and may be the cause of changes that we are seeing. Zebra mussels are voracious filter-feeders that feed upon algae and essentially clear the water column. Unfortunately, zebra mussels are not cleaning the water, but rather removing the algae that are the base of the food chain and ultimately, causing ecosystem disruptions. Their feeding habits are likely responsible for the decrease in chlorophyll-a concentrations, though it is not reflected in the secchi depth data. Water clarity in Paradise Lake is affected by the tannins in the water, which might explain why secchi data does not support the chlorophyll-a data.

Paradise Lake appears to be wavering between mesotrophy (moderately productive) and oligotrophy (low productivity). Trophic status index scores were consistently above 40 until 2003 when they dipped into the upper 30s. Although scores have since rebounded, the introduction of zebra mussels or other factors may be moving Paradise Lake into the oligotrophic category: clearer with fewer nutrients in the open water, but maintaining high dissolved oxygen levels.

Overall, data show that Paradise Lake has exceptionally high quality waters. Without dedicated volunteers, we would have less data, so we would like to send out a big "thank you" to all those that have helped with the program. We would also like to encourage others to become involved with our volunteer program to help us monitor and protect the aquatic treasures of Northern Michigan.

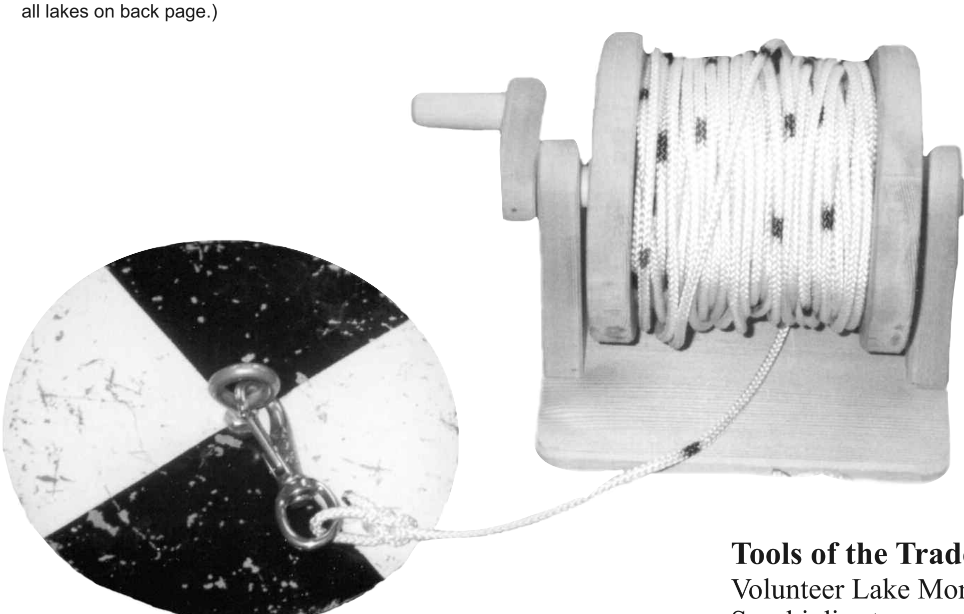
If you would like to get involved, please contact the program coordinator, Kevin Cronk, at (231) 347-1181 ext. 109 or by e-mailing kevin@watershedcouncil.org.

mesotrophic or moderately productive system, and higher values (50+) indicate a eutrophic or highly productive system. Lakes with greater water clarity and smaller phytoplankton populations would score on the low end of the scale, while lakes with greater turbidity and more phytoplankton would be on the high end.

TSI values do not measure water quality, but simply place the lake on a scale of biological productivity. Oligotrophic lakes are characteristically deep, clear, nutrient poor, and with abundant oxygen. On the other end of the spectrum, eutrophic lakes are shallow, nutrient rich and full of productivity, which when excessive can lead to oxygen depletion. Mesotropic lakes lie somewhere in between and are moderately productive.

Lakes may be placed in the eutrophic category as a result of algal blooms, which are often a public concern and can be indicative of water pollution problems. On the other hand, low productivity of oligotrophic lakes may result in a lackluster fishery when compared to highly productive eutrophic lakes.

(2008 TSI Values for
all lakes on back page.)



Tools of the Trade...
Volunteer Lake Monitors use a Secchi disc to measure water clarity.

* 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.

Trophic Status Index* (TSI) Values for Lakes Monitored in 2008

Lake	TSI	Lake	TSI	Lake	TSI
Bass Lake	44	Lake Charlevoix, South Arm	32	Pickerel Lake	38
Black Lake	28	Huffman Lake	31	Six Mile Lake	44
Burt Lake, Central Basin	34	Lake Marion	23	Thayer Lake	43
Burt Lake, North	34	Lake Michigan, Bay Harbor	14	Thumb Lake	32
Burt Lake, South	36	Lake Michigan, Little Traverse Bay	27	Twin Lake	38
Crooked Lake	38	Long Lake, Cheboygan County	31	Walloon Lake, Foot Basin	34
Douglas Lake - Cheboygan	39	Mullett Lake, Center	25	Walloon Lake, North	37
Douglas Lake - Otsego	42	Mullett Lake, Pigeon Bay	32	Walloon Lake, West Arm	33
Elk Lake	38	Munro Lake	39	Walloon Lake, Wildwood	33
Lake Charlevoix, Main	24	Paradise Lake	45		

* 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.

Special Thanks to Our Paradise Lake Volunteers
We couldn't do it without you.