Technological Advances in Lake Mapping

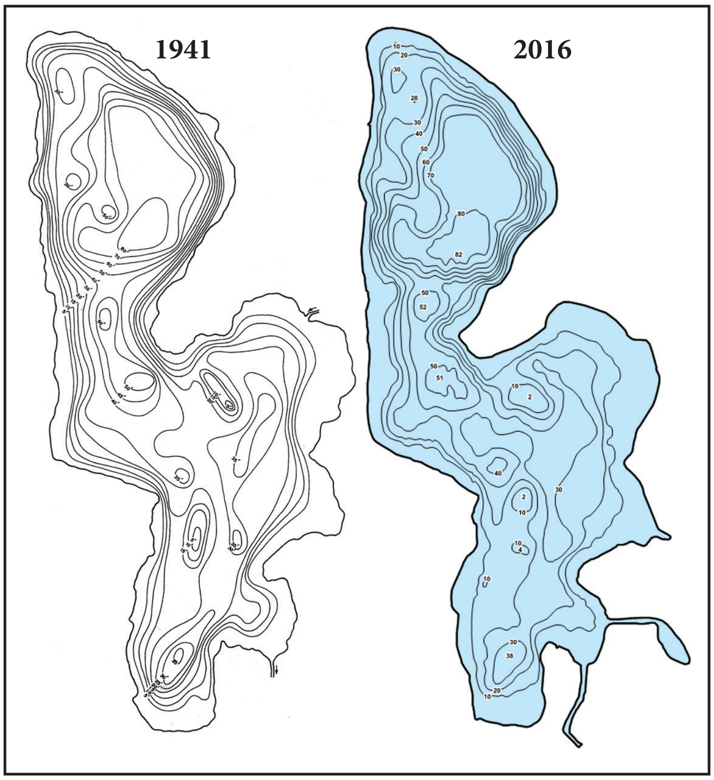
By: Tony Groves, Pam Tyning, and Tory Meyers
Water Resources Group, Progressive AE

Advances in technology have helped make lake mapping much easier. In the not too distant past, lake mapping was done by hand. Holes were drilled through the ice and weighted drop lines were used to measure depths and collect bottom samples. This was a laborious process that often took many days to complete. Much of this mapping was conducted by the Michigan Conservation Department Institute of Fisheries Research in the 1940 to 1970 timeframe.

Computer software is now available that allows hydro-acoustic soundings collected with a depth finder to be used to create highly accurate depth contour maps. In addition to water depths, measurements of plant bio-volume (i.e., the height of plants in the water column) and bottom hardness are also possible. Navico BioBase is one of the companies that helps users convert their hydro-acoustic (SONAR) data into digital maps. Below are some examples of maps created with this technology and some interesting side notes.

LAKE DEPTHS

There is a common perception that lakes quickly fill-in with sediment and become shallower. However, most lakes appear to be filling in at a very slow, almost imperceptible rate. Often, lake depths shown on historical maps from many years ago are nearly identical to present day lake depth measurements. An exception to this general observation might be an impoundment receiving a substantial sediment load or the portion of a lake at the mouth of a tributary where sediment accumulates.



On Ryerson Lake, Newaygo County, the water depths in 1941 were almost identical to the depth measured in 2016, some 75 years later. In the 1941 map, the maximum depth shown is 80 feet. In the 2016 map, the maximum recorded depth is 82 feet.

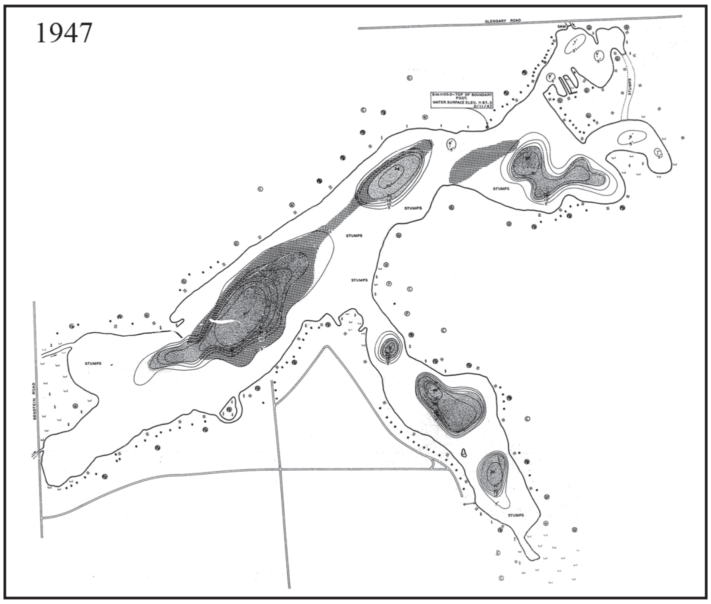
(Continued on page 10)

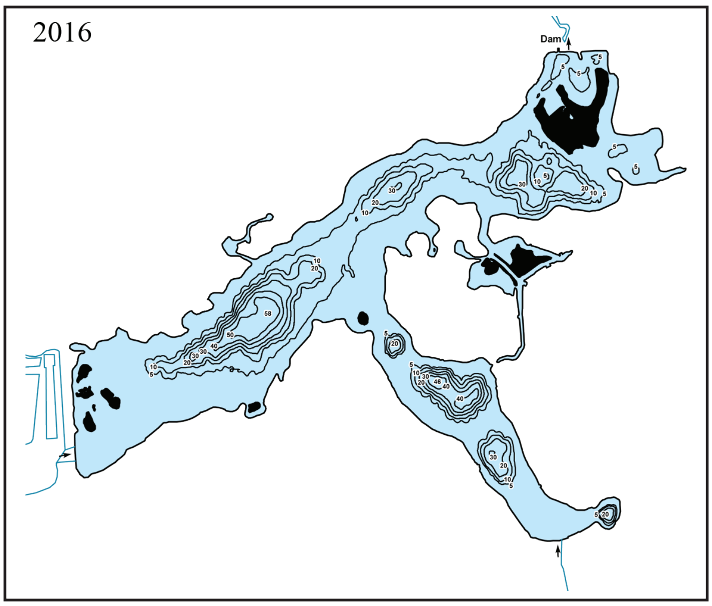
Technological Advances in Lake Mapping

(Continued from page 9)

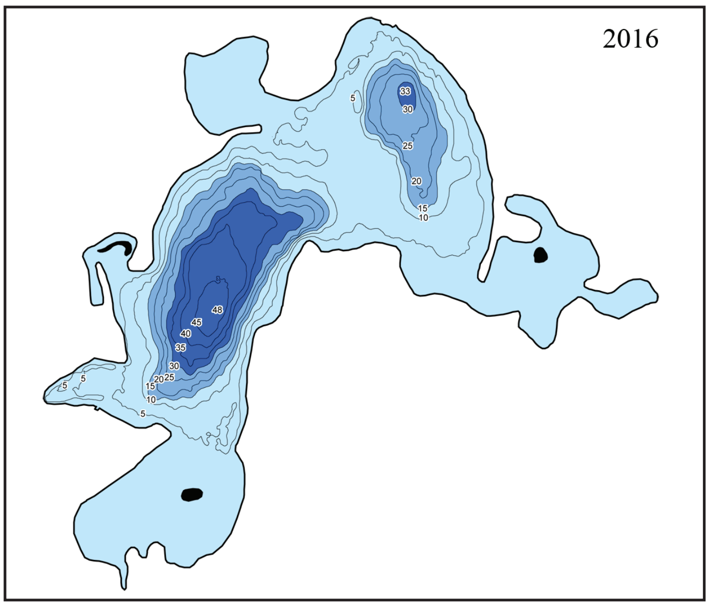
However, when comparing present-day maps with historical maps, changes in shoreline configuration are often observed. These changes are often the result of channelization and other shoreline alternations that occurred primarily in the 1950s and 1960s as development pressure on lakes increased. Most dredging and filling activities around lakes ceased with the enactment of Michigan's Inland Lakes and Streams Act and the Wetland Protection Act in the 1970s.

Natural fluctuations in water levels can also affect shoreline configuration. In lakes prone to considerable fluctuations in water level, shoreline configurations can change as lake levels rise and fall. In some lakes, fluctuations in water level can be so great that the lakes can be substantially larger during periods of high water than during periods of lower water levels. When mapping lakes, the lake level should be noted at the time of the survey.





In Wolverine Lake, Oakland County, the depths measured in the deep holes in the lake in 2016 were nearly identical to the measurements conducted in 1947. However, the shoreline configuration in the 2016 map is dramatically different than the 1947 map, especially at the east end of the lake.



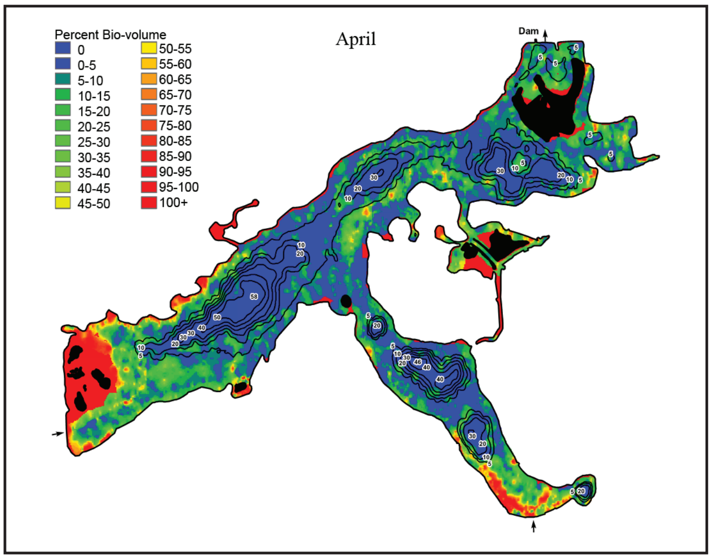
Bankson Lake, Van Buren County, was mapped in 1963 and again in 2016. The 1963 mapping was conducted at a time when water levels on Lake Michigan were near historic lows, while the 2016 mapping occurred during a prolonged period of above-average Lake Michigan water levels. Water level fluctuations in Bankson Lake appear to mimic water level fluctuations in Lake Michigan. When comparing the 1963 and 2016 maps, Bankson Lake appears dramatically different, both in shoreline configuration and size.

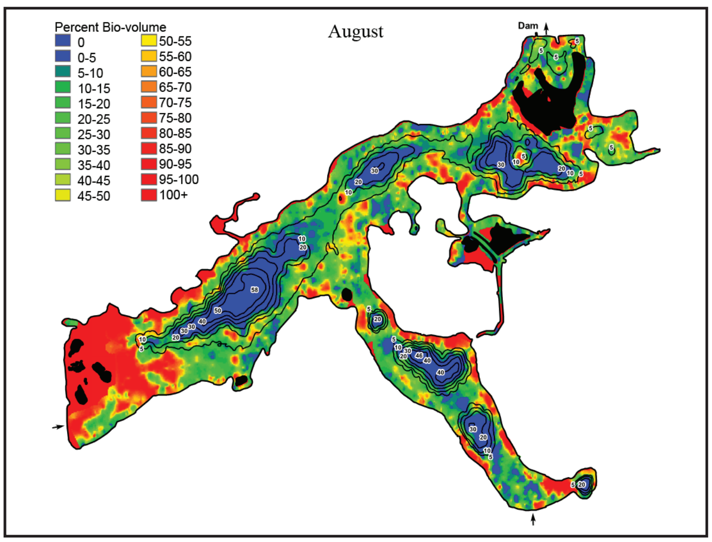
PLANT BIO-VOLUME

Bio-volume is a measure of the height of plants in a lake. In shallow lakes, plants can grow over much of the bottom while, in deeper lakes, plants are generally restricted to portions of the lake less than about 15 feet. Changes in bio-volume can be expected both seasonally and year-to-year. Generally, plant growth is sparser in the spring and, as summer progresses, plants are found over a greater portion of the lake and growing higher in the water column. Year-to-year changes can be evident due to variability in weather, variations in water level, or other factors. Greater bio-volume would be expected after a mild winter or a warm summer, while less bio-volume would be expected after a harsh winter or cooler summer. Similarly, plant bio-volume during periods of prolonged high water levels would be expected to be less than during periods of low water levels. When evaluating plant bio-volume over time, climatological and lake level fluctuations should also be considered.

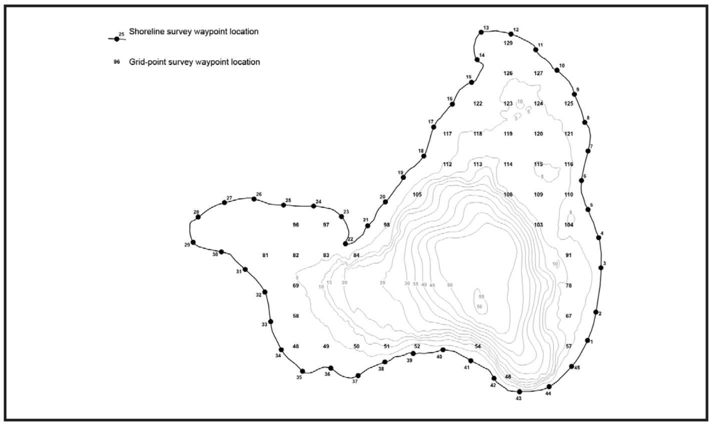
From a lake management perspective, another important use of bio-volume measurements is to evaluate the impact of exotic plant invasions. Infestations of exotic species such as Eurasian milfoil or starry stonewort can increase bio-volume as these plants tend to grow higher in the water column than many native plants. These plants may also colonize areas of the lake that were formerly free of plants. While bio-volume does not reveal which plants are in a given lake, bio-volume measurements can be supplemented with plant identification surveys to evaluate plant types.

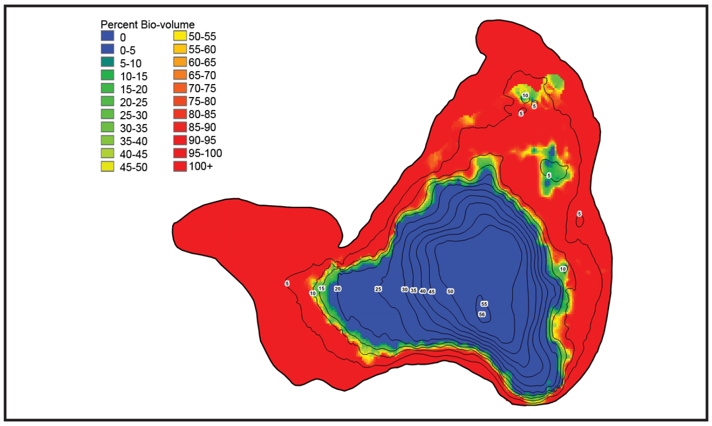
(Continued on page 20)

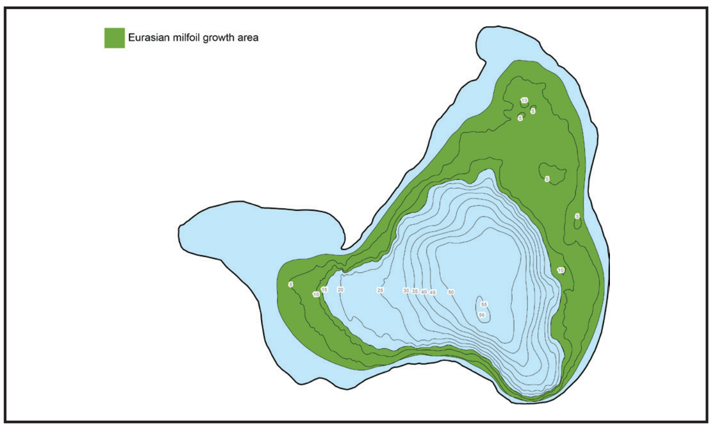




In Wolverine Lake, Oakland County, seasonal variability in bio-volume is apparent with much more vegetation measured in August compared to April.





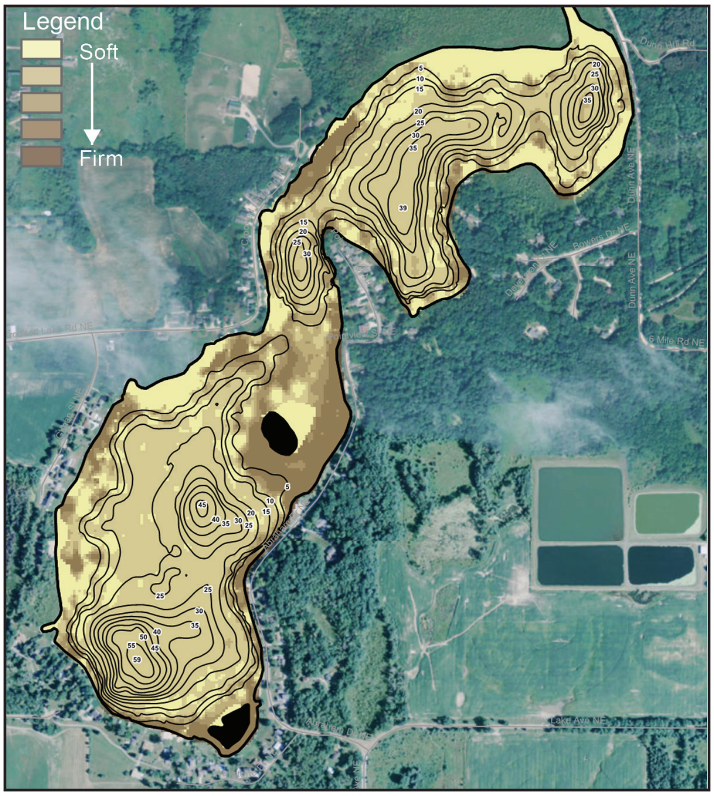


On Stone Lake, Cass County, a point-intercept plant survey was conducted to determine what plants were present in the lake. At each reference point, plant samples were collected and plant type determined. Most of the off-shore areas with plant growth to the surface (shown in red on the bio-volume map) were dominated by the exotic plant Eurasian milfoil.

Technological Advances in Lake Mapping (Continued from page 11)

SEDIMENT CHARACTERISTICS

Hydro-acoustic soundings can also provide a generalized view of hard versus soft sediment in a lake. Most often, near-shore areas or wind-swept portions of lakes have firmer sediments while deeper areas or isolated coves have softer bottom sediments. In some lakes, changes in bottom hardness appear to be related to seasonal influences with softer sediments measured in shallow areas after ice-off and firmer sediments measured later in the season. This difference may be due to wind and wave action during ice-free periods and scouring of soft sediments from near-shore areas as a result of summer boating activity.



In Big Crooked Lake, Kent County, firmer sediments are generally more common in near-shore areas while softer sediments are found in off-shore and deeper water areas. The soft sediments near the shore at the north end of Big Crooked Lake are adjacent to a large contiguous wetland area.

CONCLUSIONS

Advances in lake mapping technology are having a significant impact on lake research and management projects. These advances are making data collection and monitoring efforts less time consuming and more cost-effective. If you do not have a map of your lake or want to update an existing map, there is now a relatively easy way to do it.

COOPERATIVE LAKES MONITORING PROGRAM Winners!

Since 2008, the Cooperative Lakes Monitoring Program (CLMP) has held an annual drawing for the volunteers who enter their lake data into the online MiCorps Data Exchange. The lakes are selected randomly for each CLMP monitoring parameter to receive a waiver for FREE enrollment in that parameter for 2017.

This year the winning lakes are:

- Bear Lake (Manistee County) for Chlorophyll monitoring
- Horsehead Lake in Mecosta County for the Spring Total Phosphorus monitoring
- Earl Lake in Livingston County for Dissolved Oxygen/Temperature monitoring
- Middle Straits in Oakland County for Summer Total Phosphorus
- Lake Angelus in Oakland County for Secchi Transparency.

On behalf of the CLMP Steering Committee, we thank all the volunteers for participating in the CLMP. We appreciate that you take time from your busy schedules to collect important water quality data on a Michigan lake. We are especially grateful for the dedication of our volunteer monitors who cooperate in data entry. The online MiCorps Data Exchange allows volunteers to view and download a complete history of monitoring data from their lake, and facilitates statewide lake management and research efforts. Thanks again for all you do. ~ CLMP Steering Committee