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Official Newsletter | Issue 28
of AQUA DOC®

The Science of Lake Management

DeShawn Johnson, Ph.D. Ecology, Kent State University

Lake managers, like many other applied scientists, prefer to solve complex issues by implementing science and data collection into their management decisions. This process makes it is easier to identify and address complex issues, allowing us to make informed and objective decisions based on concrete data often with predictable outcomes. In the business world, data-driven decision making is commonly implemented to help decrease expenses, optimize business operations, enhance consistency, and improve accountability, all of which boosts consumer confidence – the management of your lake or pond is much the same. Data-driven decision making can aid in countless lake management decisions including, aquatic plant and algae control, nutrient reduction strategies, fishery improvement, aeration design and implementation, and dredge planning, to name a few.

Once the objectives of your project are clearly defined, we can begin to analyze your particular waterbody and start the data collection process. Depending on the project we can use different strategies, such as water quality testing, depth and sediment studies, bathymetric mapping, watershed mapping, aquatic plant surveys, and/or fisheries surveys.

(continued on page 2)

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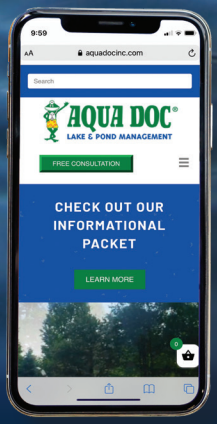
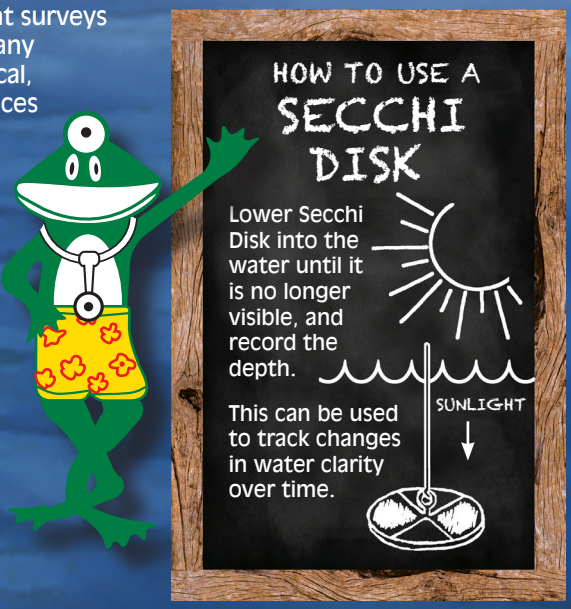


The Science of Lake Management *(continued from page 1)*

Water quality testing provides a baseline for the overall condition of a waterbody by measuring physical, chemical, and biological parameters of water, such as temperature, dissolved oxygen, pH, alkalinity, total phosphorus, and algae identification. Depth and sediment studies determine average water depth and amount of sediment accumulation within a waterbody. Bathymetric mapping allows us to measure the depth of a waterbody and map its various forms and features. Watershed mapping characterizes and evaluates various factors beyond the waterbody that may be directly or indirectly influencing the overall health and quality of that waterbody. Aquatic plant surveys determine population dynamics such as number of species, density, and presence of any invasive plants. Nutrient budgeting takes large sets of data including biological, physical, chemical and social parameters and transforms them into simple, yet informative indices that represent overall ecosystem health, identifing possible sources of impairment, and extrapolating these trends over time. Fisheries surveys determine population dynamics such as number of species, catch rates, and predator/prey ratios.

These data sets can be used to set goals and thresholds that are specific, reasonable, and measurable. For instance, targeted goals or thresholds may include increasing the diversity of the native plant community by reducing non-native and invasive plants, setting phosphorus concentrations below a specified threshold to restore water quality, introducing feeder or predatory fish to improve the overall health of a fishery, facilitating dredging considerations by providing estimated sediment accumulations, and/or improving dissolved oxygen concentrations to support desirable wildlife. Freshwater is one of Earth's most precious commodities and is crucial for the survival of all living organisms. Specific goals and thresholds, backed by science, allow us to create and implement management programs tailormade for the desires of our customers.



Grass Carp in Lake Erie

Dr. Patrick Kocovsky, Ecologist, USGS Great Lakes Science Center

Grass carp are a type of plant-eating fish native to Asia, originally brought to the US to control plant growth in aquaculture ponds. Soon after their arrival, several Grass Carp escaped into the Mississippi River basin during flooding and have since spread throughout the US. Grass Carp are sold through fish farms, sometimes under the name white amur, for vegetation control in private ponds. Most of the Grass Carp sold are treated to be sterile and incapable of reproducing, especially in states that surround the Great Lakes. However, some states in the Mississippi River basin allow the sale of fertile Grass Carp. When Grass Carp escape captivity into the broader environment, their feeding habits can damage wetlands and submerged vegetation beds, which provide important ecosystem services and habitat to many native animals.

Although Grass Carp have been occasionally captured in the Great Lakes since 1975, it was assumed that most were sterile and hence incapable of spawning. Grass Carp spawn in rivers because their eggs need to stay suspended in the current to develop and hatch. USGS research determined that some tributaries to Lake Erie are highly suitable for reproduction of Grass Carp. In 2012, spawning was suspected when several juvenile grass carp were captured in the Sandusky River, a Lake Erie tributary in Ohio. Spawning surveys of the Sandusky River began in 2014 but yielded no evidence of Grass Carp reproduction. However, spawning was documented in 2015 with the collection of eight fertilized eggs in the Sandusky River. This was the first documentation of reproduction by Grass Carp or any of the four major Chinese Carp species in the Great Lakes. Spawning was documented again in 2017, 2018, and 2019, all correlated with high flow events.

In 2017, spawning surveys were expanded to a second Lake Erie tributary, the Maumee River, and spawning was again documented that year and during 2018 and 2019, with early-stage larvae collected in 2018. Other Lake Erie tributaries in Ohio were added to surveys in following years, including the Portage River (2018), Huron River (2018, 2020), and Cuyahoga River (2019, 2020), but no evidence of spawning has yet been detected.

Evidence of Grass Carp reproduction has increased interest in population control and the need to identify spawning grounds. The State of Ohio's response strategy aims to "prevent Grass Carp expansion beyond western Lake Erie, the Maumee and Sandusky rivers." Part of that strategy includes closing knowledge gaps and gaining a better understanding of the Grass Carp's life history. Potential spawning locations in the Sandusky River were identified with an egg drift simulator. The actual spawning location was confirmed by field observations of spawning behavior and the presence of early stage eggs immediately downstream of the estimated spawning location in 2018. Efforts to identify the spawning location in the Maumee River are underway.

This research, which is led by USGS in collaboration with the University of Toledo, the Ohio Department of Natural Resources, and other universities and state, federal, and provincial agencies, has informed management actions to reduce Grass Carp numbers in Lake Erie. Strike teams have removed hundreds of adult Grass Carp from the Sandusky and Maumee rivers. Removing adults reduces reproduction and the risk that Grass Carp will establish a large population in western Lake Erie or spread to other Great Lakes.

Nichole King (USGS) holding an invasive Grass Carp captured during a Lake Erie survey.

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Understanding Phragmites

Carter Bailey, Aquatic Biologist, AQUA DOC Inc.

Phragmites australis, has undergone a population explosion in North America over the past 150 years. This plant species, also known as common reed, is an aggressive variety of wetland grass. Phragmites is easy to identify, and once you become familiar with it you will see it almost everywhere as it commonly grows along roadside edges in right-of-ways and ditches. This plant is primarily characterized by large leaf blades, stalk-like stem structure, and large seed head that develops later on in the growing season. Largely, Phragmites is considered an invasive species; however, the history and distribution of the plant is a bit more complicated than that.

It is true that the more common variety of the plant is invasive, and that the large increase in population is due to this invasive variety, but native varieties still do exist in the wild. These stands are typically found in undisrupted natural habitats where they grow in mixed wetland plant communities at lower densities than their invasive counterparts. Researchers have also discovered that both varieties do have distinct genetic markers and unique vegetative characteristics. The vast majority of what we see on a daily basis at AQUA DOC and across our service territory is the invasive variety. In good growing conditions these plants can reach up to 20 ft tall forming dense monoculture stands.

An attack of highly successful reproduction strategies, including stolons (above ground runners), rhizomes (below ground rootstalks), and seeds (typically +2,000 seeds per plant), has given rise to the dramatic expansion of invasive Phragmites and native wetland habitat loss that we see today. Habitat loss has had negative impacts on many types of wildlife including fish and several marsh-nesting bird species, including most notably the red-winged blackbird. Scientists agree that Phragmites management is a crucial part of wetland habitat restoration across North America. Federal, state, and local environmental agencies along with many non-for-profits are actively engaged in restoration efforts across the United States to help improve wildlife habitat.

Homeowners and homeowner groups should also consider the conservation value of their water resources as well. Oftentimes, if addressed early on in the infestation period, costly restoration projects can be avoided down the line. At AQUA DOC we recommend a three-step method for small scale habitat restoration, this includes spray, cut, and removal. Once under control an effective long-term management strategy can be implemented. Understanding Phragmites is the crucial first step in the management of this invasive species, take a look at low-lying or wetland areas near where you live and see if you can identify any stands of this invasive plant species.

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