PONDerings®...

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AERIAL DRONE TECHNOLOGIES

TO SUPPORT LAKE AND POND MANAGEMENT

Andrew W. Howell, PhD Aquatic Weed Science, North Carolina State University

The Impact of Drone Technology

Unoccupied aerial systems (UAS), commonly known as drones, have the potential to modernize and improve current aquatic plant/algae monitoring and control strategies. Over the past decade, we have increasingly seen UAS popularized to support military, infrastructure, and agricultural operations. Aquatic resource managers have also recognized the utility of UAS platforms and are beginning to adopt the technology into daily tasks. Let's face it, actively managing water resources is challenging due to the inherent nature of aquatic environments. Recent advances in commercially available UAS show potential to both improve and complement current lake and pond management tactics. These systems offer accurate, near real-time plant evaluations with the benefit of never leaving the shoreline. Coupling these technologies with geographic information systems (GIS) can further improve management strategies by producing mapping elements, viewable by clients or stakeholders not directly involved in the UAS survey activity. In addition to providing a platform for rapid remote sensing, some UAS, sometimes called spray drones, also have the capability to remotely deliver herbicide applications.

(Continued on page 2)

Drones in Lake Management *(continued from page 1)*

Monitoring and Mapping
It is well accepted that timely monitoring and efficient mapping strategies are critical in developing an aquatic plant/algae control program. One of the primary benefits of UAS is that in many situations there is no need to launch a watercraft or be on the water. Not only does this save time, but also improves the safety of survey personnel. While several sensor options are available for UAS platforms, true-color cameras (RGB), which come standard, generally provide managers with appropriate image resolutions and desired data. Following a well-developed aerial image capture process can allow managers to perform accurate plant/algae monitoring to inform management direction.

Examples of how UAS can be used for monitoring and mapping activities in aquatics:

- Inspecting stormwater and HOA retention ponds
- Estimate waterbody size and plant cover
- Monitor plant spread and distribution over time
- Mapping native and invasive plant community composition
- Evaluating aquatic plant revegetation efforts
- Collecting water samples

Using computer analytics and image software, we can perform more advanced mapping to calculate percent area cover before and after management, estimate emergent plant heights, and use image classification tools to help differentiate certain plants.

Remote Weed Control
Over the past decade, UAS sprayers have shown potential to increase applicator safety while precisely delivering herbicide treatments where treatment sites limit ground-based spray equipment. Some aerial spray units even allow navigation through complex treatment zones to apply herbicide to individual patches of weeds. However, there are currently two major limitations to this technology: payload size and application volume. Watercraft utilized for herbicide applications are commonly fitted with 10-to-250-gallon spray tanks to apply products, versus UAS sprayers that typically have tank capacities of around 2.5 gallons due to Federal Aviation Administration (FAA) regulatory constraints. Besides payload, additional constraints include Environmental Protection Agency (EPA) aquatic site aerial application label requirements. For many products currently available, the label generally requires a minimum spray volume greater than 5 gallons per acre, which is more than most UAS spray tank capacities (typically less than 5 gallons). Thus, requiring applicators to conduct multiple tank fills per treated acre, which can limit efficiency and potential efficacy.

Even though UAS sprayer applications in aquatics are in their infancy, many managers do anticipate positive results can be achieved by integrating these units into current spray programs. These systems are already expanding in popularity within agricultural markets for site-specific weed management. Although current UAS sprayer regulations and aquatic herbicide labels do have limitations for wide-scale use, future integration of UAS sprayers in aquatic weed control programs are likely. It is important to recognize that these systems will not likely be a direct replacement for many of our tried-and-true management tactics; rather, UAS should be viewed as another available tool in the toolbox.

The Future of Oxygen Management: The New Natural FLO$_2$®

Patrick Goodwin MS, CLM, Water Resource Scientist, Natural Lake Biosciences

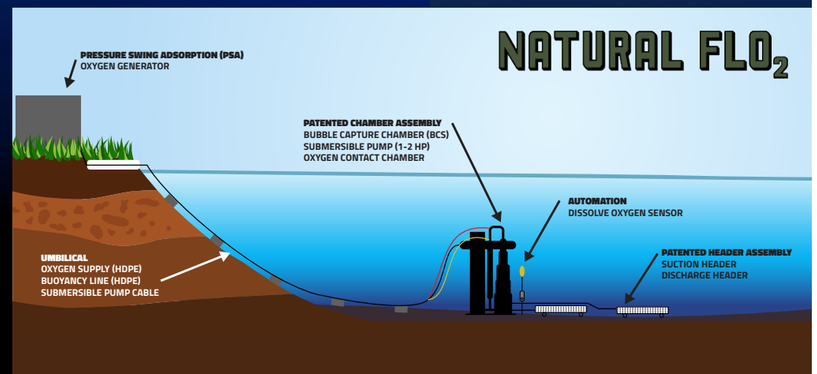
The Significance of Natural FLO$_2$
Natural FLO$_2$ represents the most technically effective approach for managing oxygen in shallow bodies of water (greater than 60 ft deep), where the oxygen transfer efficiency (OTE) of traditional aeration or oxygenation systems are limited. Natural FLO$_2$ operates on our Oxygen Saturation Technology (OST®) platform, which our engineers have been working with for over a decade. Many improvements have been made since the first-ever OST® installation in 2014, and now patented, we are excited to announce that Natural FLO$_2$ is available to the commercial lake and pond management market.

Natural FLO$_2$ can be adapted to suit site-specific needs and is designed to preserve thermal stratification. This facilitates higher oxygen concentrations to develop over and into the sediments. Such an oxygen capping approach offers significant water quality enhancements over conventional mixing strategies. Comparing the results of oxygenation and circulation projects, traditional aeration systems reached their desired goals 56% of the time, whereas saturation technology boasted a success rate of 90%. This stark difference stems from the fact that non destratifying oxygenation eliminates the risks associated with mixing surface sediments and ensures high oxygen levels are achieved. The bottom line: the higher the oxygen levels above and within the sediment, the better the water quality.

Benefits of Oxygen Saturation
Oxygen management is one of the most common water quality restoration techniques worldwide. When dissolved oxygen (DO) levels drop below 2 mg/L over the sediments, chemical reactions accelerate, causing iron and phosphorus in surficial sediments to mobilize to the overlying water column and accumulate in the deep-water. Sediment ammonification (the release of ammonia, which is preferred by cyanobacteria) is also promoted when DO drops below 5 mg/L. The released phosphorus and ammonia can then be accessed by cyanobacteria, often triggering harmful algal blooms (HABs). Moreover, the absence of oxygen in deep waters is ecologically undesirable, as it limits habitat for fish and other aquatic life. A level of 5 mg/L DO is the national US EPA's minimum DO criteria for aquatic life, though values greater than 8 mg/L are desired. Restoring deep-water oxygen is a valid approach to solving these multiple lake and pond issues. Natural FLO$_2$ allows you to set desirable deep-water oxygen levels in your lake or pond, just like you would set the thermostat of your house.

Key Features:

- No bubbles, no mixing, and no sediment re-suspension while maintaining the natural aquatic ecosystem; preserving thermal stratification and ice formation.
- Fully automated to monitor and maintain pre-programable dissolved oxygen levels. Oxygen capping is achieved at values greater than 8 mg/L DO, and any DO level can be programed for fisheries or other habitat improvement.
- Scientifically proven technology to improve water quality, eliminate ammonia and sediment phosphorus release, degrade organic muck, enhance fisheries, and stimulate desirable shifts in algal community.



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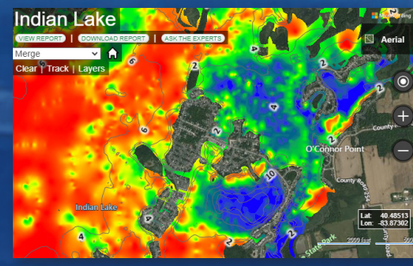
Hydroacoustic Mapping: A Modern Tool for Comprehensive Aquatic Plant Management

Edward Kwietniewski MS, CLM, Aquatic Biologist, AQUA DOC Inc.



Density map of Eurasian watermilfoil generated with Biobase®

As issues regarding nuisance aquatic plant and algae growth continue to grow in scale, the need for modern technology to address these issues has become more important than ever. At AQUA DOC Lake & Pond Management, we are committed to utilizing the latest tools to create the best possible management plan for each individual waterbody we work on. Our working relationship with Biobase® of Navico is just one way in which we adhere to this commitment. Biobase® is a cloud-based mapping software that allows for automated processing and storage of hydroacoustic mapping data. To put it more simply, the program can be used to create and analyze highly accurate maps for a wide variety of tasks, including mapping and quantifying submersed aquatic plant beds, calculating an accurate water volume or storage capacity, creating depth charts or fishing maps, aeration design, regulatory compliance, and pre- and post-dredge assessments. This information can be invaluable when comprehensive management is necessary to accomplish stakeholder goals like identifying critical management zones or providing large-scale information regarding the current condition of a waterbody. The ability to do this can save a significant amount of money for the client while allowing for a sustainable approach to lake management.

To provide an example of how this technology can be utilized to help provide comprehensive lake management, let's look at a recent success story involving a large lake experiencing submersed aquatic plant issues. Indian Lake is located in Logan County, Ohio and is just over 5,100 acres in scale. In 2022, the lake experienced an incredible surge in submersed aquatic plant growth primarily consisting of coontail and Eurasian watermilfoil that impaired the lake's use as a recreational reservoir. AQUA DOC was able to implement Biobase® mapping technology in conjunction with rake toss sampling methods to generate heat maps that showcased individual species distribution and density. These maps were paramount to identifying a successful management direction for the lake as they showcased defined areas where different plant management techniques would be most effective for remediation. AQUA DOC and regional partners were able to use this data to successfully implement an aquatic plant management plan and restore the lake's recreational functionality.

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