Amber M. White

Student Corner

Lakeside Lessons: Insight from three years of aquatic herbicide treatments

I spent the summers from 2019 to 2022 traversing the state of Wisconsin to study aquatic herbicide treatments as part of my graduate studies at the University of Wisconsin-Madison. All treatments were targeting the invasive Eurasian watermilfoil, one of the most managed aquatic plants in Wisconsin, due to aggressive growth patterns that make it nearly impossible to paddle, fish, or swim. As a scientist, I am interested in how chemicals move through aquatic environments and how laboratory experiments compare to what happens in the environment. Aquatic herbicide treatments are ideal to study this question because of the intentional and controlled application of the chemical to a lake.

Are herbicide treatments good or bad?

Throughout my studies, I learned a lot about the chemical treatments themselves as well as the lake users. Intrigued by my abundance of coolers but lack of fishing equipment, everyone was curious why I was on the lake, and most importantly, whether herbicide treatments are good or bad. While I can't broadly say whether a treatment is good or bad, I can share some insight on the process and chemistry to help resource managers make decisions for their lakes. First, liquid herbicide products will drift away from the treatment area and likely mix completely throughout the lake. While herbicides can be very effective, knowing baseline lake characteristics support successful treatment design. However, preventing the introduction of any invasive species is critical to maintaining long-term ecosystem health.

Logistics of herbicide treatments

When an herbicide is applied to a lake, it is usually applied over a target area with a high plant density. This process can take several hours as applicators crisscross the target areas on the lake and requires ideal weather conditions, such as low wind and no rain, to limit the drifting away from the treatment area. Drift away from the treatment area can either help or hinder the success of the application.

While the initial application is intended to inundate the invasive plants with high concentrations, some herbicides like those containing 2,4-dichlorophenoxyacetic acid (2,4-D) or fluridone, work best when applied as low dose, whole-lake treatments. This means the herbicide is present in the lake at a low concentration for an extended period of time – at least two weeks for 2,4-D and several months for fluridone (Nault et al. 2017). This is not the case for florpyrauxifen-benzyl (FPB). This herbicide touts an exposure time of less than a day at concentrations significantly lower than 2,4-D. However, rapid drift away of FPB from treatment area can influence the effectiveness of the treatment.

In my studies, I observed these herbicides mix completely and achieve lake wide concentration (i.e., the entire waterbody is the same concentration) within 24 hours of treatment and initial detection of the herbicide outside of the treatment area just hours after treatment (White et al. 2022). Thus, knowing rapid (within hours) chemical drift will occur with liquid products is critical to remember when designing a chemical treatment and it requires consideration of specific waterbody features, such as treatment area size versus lake size and plant distribution/density within the lake, to achieve required concentration and exposure time.

Know the waterbody

There are important lake characteristics that can be monitored prior to treatment as part of regular lake monitoring programs. Knowing lake stratification timing and depth is important to scheduling the initial herbicide application and applying the correct amount of herbicide. We also observed that discharge through streams could account for 20-30 percent of chemical loss in a lake, which is important when choosing a longer exposure herbicide like 2,4-D or fluridone products (White et al. 2022).

For herbicides that can stick to sediments, like FPB, or that can be degraded by sediment bacteria, like 2,4-D, knowing the sediment characteristics can be useful. Collecting bathymetry data and measuring organic matter content of the sediment can inform treatment design to reduce chemical loss to sediments.

Water chemistry parameters, such as pH, can change the rate at which an herbicide breaks down. For example, FPB can break down more quickly in high pH systems (pH 8+) compared to more acidic or neutral systems (pH 6-8) (SePRO 2017).

Last, knowing whether your targeted plant population has developed a tolerance to a certain herbicide is important to promoting successful treatments in the present and future. For Eurasian watermilfoil specifically, knowing whether the targeted plant population is mostly invasive or mostly hybrid watermilfoil is important for selecting an herbicide that will be effective on both strains (Nault et al. 2017). Conversely, documenting the population of native plants and knowing their sensitivity to individual herbicides can support treatment of nuisance plants while limiting impacts to the native plant population (Mikulyuk et al. 2020). The collection of baseline water quality and ecological data is instrumental to designing effective and efficient treatments that optimize costs and minimize negative outcomes.

Finally, efforts to reduce new introductions of previously treated/eradicated or novel invasive species can reduce or prevent the costs of treatment. This can include prevention and early detection activities. Our lakes are a valuable resource that provide numerous social and ecological functions for our communities. Invasive species management practices can be costly and disruptive whether it is chemical or not. Proper cleaning and disinfection of boats and equipment when moving between waterbodies might be annoying at the end of a successful day of boating, but a little prevention can go a long way for protecting our precious aquatic resources.

Author's note:

This article is written by Dr. Amber White, but the research was carried out by a team at the University of Wisconsin-Madison including Sydney Van Frost, Josie Jauquet, Angela Magness, Dr. Trina McMahon, and Dr. Christy Remucal, as well as Michelle Nault at the Wisconsin DNR.

References

Mikulyuk, A., E.R. Kujawa, M.E. Nault, K.I. Wagner, M. Barton, J. Hauxwell and J. Vander Zanden. 2020. Is the cure worse than the disease? Comparing the ecological effects of an invasive aquatic plant and the herbicide treatments used to control it. FACETS 5(1):353-366. DOI: 10.1139/facets-2020-0002.

Nault, M.E., M. Barton, J. Hauxwell, E. Heath, T. Hoyman, A. Mikulyuk, M.D. Netherland, S. Provost, J. Skogerboe, and S. Van Egeren. 2017. Evaluation of large-scale low-concentration 2,4-D treatments for Eurasian and hybrid watermilfoil control across multiple Wisconsin lakes. *Lake and Reservoir Management* 34(2):1-15. DOI: 10.1080/10402381.2017.1390019

SePRO. 2017. ProcellaCOR-EC Safety Data Sheet. https://sepro.com/Documents/ProcellaCOR_EC--SDS.pdf. Accessed: 2023-03-25

White, A.M., M.e. Nault, K.D. McMahon, C.K. Remucal. 2022. Synthesizing Laboratory and Field Experiments to Quantify Dominant Transformation Mechanisms of 2,4-Dichlorophenoxyacetic Acid (2,4-D) in Aquatic Environments. *Environmental Science and Technology* 56 (15). DOI: 10.1021/acs.est.2c03132

Amber White recently graduated with her PhD in environmental chemistry from UW-Madison and is now working as a chemist with a biodegradation focus at 3M Company in Minnesota. She specializes in conducting studies to characterize chemical fate and transport in the environment and is passionate about bridging the gap between laboratory studies and true environmental fate. Amber also holds a master's degree in water resources from the University of Minnesota-Duluth and bachelor's degree in biology and environmental science from Loyola University Chicago. Amber can be reached at ambermwhite16@gmail.com.

UPCOMING IN *LAKELINE*

SUMMER 2023: Harmful Algal Blooms – Every other summer we like to focus on Harmful Algal Blooms (HABs), and include a range of articles highlighting new data, activities, monitoring techniques, and reporting strategies, among other topics. If you are working on something now related to HABs, consider writing up your work for the summer 2023 issue of *LakeLine*.
Articles for summer 2023 are due June 15, 2023, for publication in July 2023.

FALL 2023: Shoreline Stabilization – The fall issue will focus on topics related to shoreline stabilization. Topics related to impacts of shoreline erosion on water quality and aquatic life, methods for shoreline restoration and stabilization, case studies on restoration projects, and other topics related to shoreline stabilization are welcome.
Articles for fall 2023 are due by September 15, 2023. The issue will be published in October 2023.

Please contact Amy Smagula, LakeLine Editor, with any questions, or to propose an article for one of the above-listed themes. Do you have a topic that doesn't match a theme? That's okay, we can include the article in any of these issues, or use it to build a themed issue. Amy can be reached at lakeline@nalms.org.