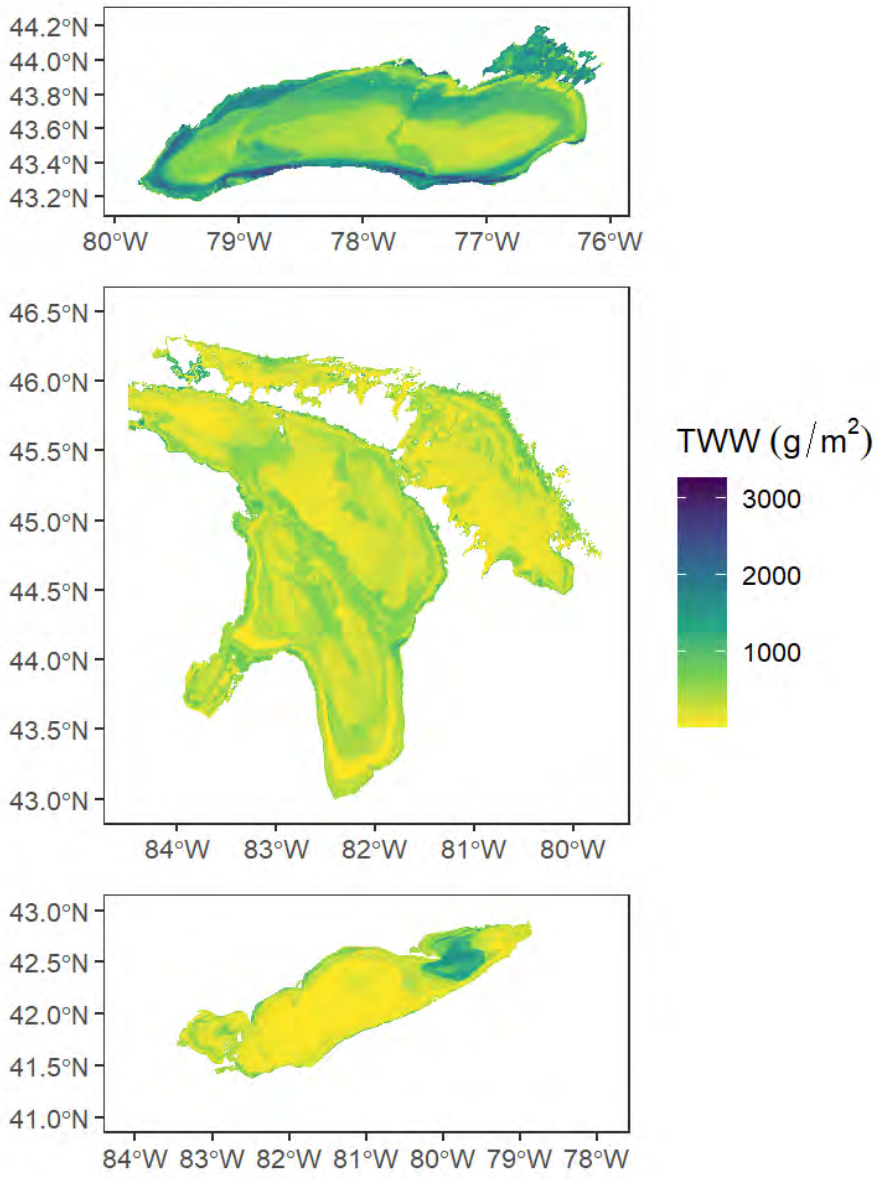
One framework to map them all: A new approach to mapping dreissenid biomass

By Tyler J. Harrow-Lyle

DREISSENID MUSSELS have transformed the nearshore zone of the Great Lakes for more than three decades, yet researchers and managers still lack reliable, lakewide tools to anticipate where dreissenid biomass is highest and how these patterns shift through time. Understanding the distribution of dreissenids is essential given their ability to alter lakewide nutrient dynamics and stimulate nuisance algae growth in the nearshore zone. The challenge of mapping dreissenid biomass is due to the sheer size of the Great Lakes, as well as the extreme heterogeneity and persistent uncertainty of changing environmental conditions.

Recently, my colleagues and I demonstrated that incorporating environmental gradients such as substratum type, wave exposure, and hypoxia duration substantially improve dreissenid predictions within Lake Erie. Building upon this research, our ongoing work has expanded into the creation of a modeling framework that uses machine learning to map dreissenid biomass across the lower Great Lakes (Huron, Ontario, and Erie) with the addition of unique spatial and temporal detail.

A key innovation of this framework is the explicit use of multiple years of observations. Previous Great Lakes dreissenid models aggregate data to a single yearly average; however, this practice removes interannual variability and obscures true variation in populations. By incorporating time as a gradient, the updated modeling framework can learn from year-specific conditions and variability, whilst preserving fine-scale temporal signals. By applying the full temporal record of dreissenid data, the framework also increases the detection of areas outside the model's environmental domain, making uncertainty explicit and informative (i.e., highlighting where additional sampling would most improve future predictions). This is especially valuable for adaptive management, as it consistently identifies nearshore zones as priority areas for expanded monitoring. The same machine learning structure can support benthic monitoring programs in other freshwater and coastal systems, offering a flexible tool for ecosystem managers responding to ongoing environmental change, including climate driven shifts in habitat conditions.



Dreissenid biomass estimates for lakes Ontario, Huron, and Erie produced from the random forest methodology. Dreissenid biomass is reported as total wet weight (g/m²).

Tyler J. Harrow-Lyle, Toronto and Region Conservation Authority and Ontario Tech University. Harrow-Lyle received the JGLR/Elsevier Early Career Award.