

Where People Meet the Muck:

An Integrated Assessment of Beach Muck and Public Perception at the Bay City State Recreation Area, Saginaw Bay, Lake Huron

Final report to Michigan Sea Grant submitted by:

Donna Kashian¹, Avik Basu², Alisha Davidson¹, Joseph DePinto³, Jason Duvall³, Ray Fahlsing⁴, Darrin Hunt¹, Frank Lupi⁵, Bretton Joldersma⁶

Executive Summary

Organic debris referred to as “muck or wrack” has been an issue in the Saginaw Bay region since the 1960s. Muck has environmental, human health, economic and social impacts and as such requires an interdisciplinary, stakeholder engagement process for management. This project used the Integrated Assessment (IA) approach to understand the muck issue and identify possible solutions for the Bay City State Recreation Area (BCSRA). This IA process engaged a variety of stakeholders including federal, state, and local agencies; universities; Multiple Stressors technical experts; and, the Friends of the BCSRA. Community engagement occurred through the process. The first community collaboration event occurred to better understand public perception of muck and used a series of interviews and surveys including both public and agency representatives. The second event included workshops that focused on management solutions. The workshops included a session for a broad group of stakeholders to engage in the project and a more selective, invitation-only session with key stakeholders possessing some knowledge and/or expertise on the muck-related subjects.

Key outcomes of this project are grouped into four themes:

Environmental Modeling and Human Health Impacts – The environmental modeling component demonstrated that even drastic reductions in external phosphorus loads will not result in complete elimination of *Cladophora* growth in the inner bay, although the peak growth at the mouth of the Saginaw River is reduced significantly. The model also showed that increased water levels can play a role in the amount of *Cladophora* growth. Deeper waters limit the area

that light can penetrate down to the sediments, and therefore remove some viable substrate area for benthic algae growth. Finally, the model was used to assess the relative contribution of the main tributaries to each model grid cell. This analysis demonstrated that while the Saginaw River provides approximately 82% of the total phosphorus load to the bay and dominates the overall nutrient balance (Figure 1), there are areas within the inner bay that are significantly influenced by other smaller tributaries.

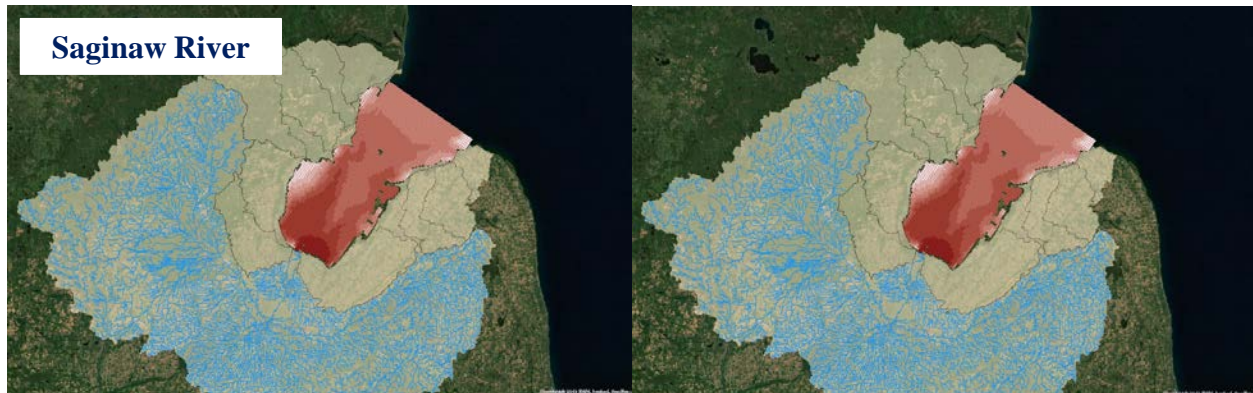


Figure 1. Relative contribution of Saginaw River to each 1km model grid cell. (left: cell contribution with only Saginaw River inflow; right: cell contribution with all tributary inflows.)

In the human health impact review, several regional studies implicated muck as a nonpoint source of fecal indicator bacteria (FIB). *E. coli* and enterococci were highest in algal mats and sediment. Elevated bacteria in shallow waters were related to concentrations of bacteria in the sediment and algal mats. This presence may not be due to recent influx of fecal materials, but may be legacy contamination that persists in sediments and algal mats. Higher concentrations of *E. coli* were found in wetter shoreline wrack, and high concentrations of *E. coli* were released during rinsing experiments, suggesting that loosely attached *E. coli* were abundant. This may contribute to the often-seen spike in FIB following rainfall events. A study in California demonstrated that beach grooming of wrack associated with FIB saw either no change or increase in FIB concentrations, with additional impacts of beach grooming including surf zone turbidity and silicate, phosphate, and dissolved inorganic nitrogen concentrations. The findings suggest that beach grooming for wrack removal is not justified as a microbial pollution remediation strategy.

Economic Impacts – The economic analysis found that spending by all Michigan beachgoers living in the Lower Peninsula had a total economic impact of direct sales within a region that

ranged from \$425.87 million to \$1.72 billion per season in 2014 dollars. Michigan Central region received the largest amount of total direct sales at \$1.72 billion, in contrast to Huron South region (which contains Saginaw Bay) with the lowest total sales at \$425.87 million. If half of Great Lakes beaches' water quality in a region are increased by one level (e.g., medium to high quality), compared to the direct sales at status quo, the direct sales increases by 33.52% for Mid-East region (Huron South). Improving water quality leads to more utility increase for beaches with initially higher algae levels than for beaches with initially lower algae levels in Huron North and Lake Michigan. When water quality is degraded by one level, the LP Mid-East region loses \$138.76 million total sales.

Public Perception – To develop a better understanding of stakeholder perception of the muck (and associated FIB) and state agencies credibility to address the issue, this study interviewed citizens and agency representatives. Citizens indicated that they felt moderately knowledgeable about the muck issue, with a mean score slightly higher than mid-range (see Table 1). The mean knowledge rating of agency representatives was nearly half a point higher than that of citizens. Agencies significantly underestimated the knowledge that citizens felt they had regarding beach muck by more than a full rating point. Although this suggests that the public may be more educated than agencies realize, it is important to remember that citizen knowledge is likely to be quite varied, with some citizens knowing very little and others knowing a good deal more. This situation can create challenges for resource management agencies. Attempts to educate citizens about the basics of beach muck may be appropriate for some audiences, but citizens who feel more knowledgeable may not be interested or receptive to these kinds of efforts—wanting instead to discuss what they feel are more pressing issues, such as management actions.

Table 1. Mean ratings for Knowledge of Beach Muck

	CITIZENS	AGENCIES	AGENCY VIEW OF CITIZENS
KNOWLEDGE OF MUCK	3.49*	3.97*	2.43*

*all differences significant at p<.001 level using t-test

In order to assess management options, agency representatives and citizens were asked to rate 10 strategies (not at all to extremely). Citizens evaluated all management options as being at least somewhat effective and practical. That said the use of a *Muck Filtering Machine* and *Physical*

Removal of muck from the beach were deemed as the two most effective management options by citizens. Citizens seemed to make less significant distinctions about whether certain management options were more practical than others. Agency representatives were much more critical of the effectiveness and practicality of all the proposed management strategies; with only one strategy, *Physical Removal*, receiving a high mean rating for both effectiveness and practicality.

Management Solutions – Most beaches across the Great Lakes manage shoreline deposition on an as needed basis using manual removal, hand and landscape rakes. In extreme conditions, some beaches employ the usage of heavy machinery such as tractors, Cherrington and Barber beach cleaners, and tow away services. To offset costs, most beaches employing extreme measures have partnered with volunteer organizations, share heavy equipment with other state parks, or some combination of the two.

In reviewing beach maintenance practices implemented by the BCSRA as compared to other Great Lakes beaches there are few differences. The BCSRA has taken an active role in maintaining shoreline deposition. This has included manual removal of macrophytes as they wash ashore, hand and landscape raking. This has resulted in improved beach aesthetic which will likely be reflected in beach tourism and attendance. Some beaches have gone beyond this by using beach cleaning machines, beach curtains and sand fences, but it has required significant investment. Unfortunately, most of these strategies are palliative, and therefore only work for a short period, in that they address only the symptoms without controlling the many sources of nuisance muck problems in Saginaw Bay. Ultimately, beach maintenance has improved at the BCSRA in recent times.