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Nuisance Algae on Lake Michigan Shores

Over the last decade, washed-up heaps of rotting algae have become a reoccurring nuisance on some Lake Michigan beaches. The offender is Cladophora, a stringy green alga common in the Great Lakes and many other fresh waters. Cladophora grows underwater at the bottom of the lake on rocks and looks like long, green hair waving in the water. Once dislodged, algal mats wash up on shore and begin to decay, creating a powerful stench and compromising beach safety.

Recent research shows Cladophora mats may encourage the growth and persistence of bacteria such as *E. coli* and Enterococci, which come from gull droppings, sewage overflows or runoff from urban and agricultural areas. *E. coli* bacteria indicate possible fecal contamination and the presence of other human pathogens (bacteria, viruses and protozoa). High *E. coli* numbers in sand and swimming waters prompt managers to close beaches.

Decaying Cladophora mats have also been linked to avian botulism outbreaks and bird kills. The oxygen-poor conditions produced by decomposing algae create an environment for growth of the bacteria that produces the botulism toxin. Shorebirds and other waterbirds (loons, cormorants, etc.) unknowingly ingest the neurotoxin when they eat the mussels, fish and other small animals carried to shore in the mats of Cladophora or infected fish in offshore waters.

Problems with Cladophora date back to the mid-1950s. That's when nutrient levels, particularly phosphorus, were higher throughout the Great Lakes due to industrial wastewater pollution, farm runoff (manure, fertilizer) and household laundry detergents and cleaners. Following the 1972 amendments to the Clean Water Act, phosphorus discharge was limited and nuisance algae blooms in Lake Michigan subsided temporarily.

Possible Reasons for Excessive Growth

The causes of the Cladophora resurgence in the Great Lakes are not completely understood, but experts agree that major influencing factors include the success of the invasive quagga and zebra mussels over the last three decades and phosphorus coming from scattered pollution sources (e.g., agriculture and urban stormwater).

Quagga and zebra mussels: Since their introduction in the 1980s and '90s, water clarity in parts of the Great Lakes has increased because the mussels filter water as they feed. Light penetrates to greater depths, expanding the areas where Cladophora can grow. In addition to more sunlight, Cladophora can benefit from drawing upon rich nutrients mussels

deposit on the lake bottom or from dissolved phosphorus they excrete.

Possible increased phosphorus: Rain and snowmelt runoff from urban streets and farm fields carry fertilizers, manure, soil and other pollutants down the streams and rivers that flow into Lake Michigan. Runoff is the largest source of new phosphorus to Lake Michigan. Evidence suggests that dissolved, inorganic phosphorus, the type that Cladophora needs to grow, has increased in some rivers and streams in the last decade, possibly increasing its availability in nearshore waters.

What About the Smell?

The stench of decaying Cladophora can lower property values and has been linked to taste and odor problems in drinking water. The foul smell is due to decomposition of the large algal mats. As the algae decays, bacteria thrive and convert sulfur to hydrogen sulfides, more commonly recognized as a "rotten-egg" smell.

In addition, Cladophora that washes up on the shoreline often contains dead mussels, fish and crustaceans. The smell of these rotting animals, combined with droppings from gulls and other animals, contributes to the stench that keeps people off beaches.

Why Are Certain Shorelines More Affected?

Offshore areas with cobble or bedrock will produce more Cladophora than sandy areas. However, once Cladophora detaches from the lake bottom, it may be carried by water currents and waves before finally collecting along calmer shores, often in bays and on beaches. Repeated algae build-up on some shores may have more to do with shoreline shape and currents than with local sources of phosphorus and algae.

What Can Be Done?

The key to successful cleanup is removal of algal mats as soon as they wash ashore, before they begin to decay. Removing Cladophora from beaches and composting it is a short-term solution. The compost is probably best suited for landscaping rather than vegetable gardens, since Cladophora can accumulate small amounts of heavy metals from lake water.

For most homeowners, hand raking is feasible. Managers of some large Great Lakes beaches have used mechanical removal (front-end loaders, backhoes and beach-grooming equipment). Permits from the Department of Natural Resources may be required for this in some cases. However, monitoring has shown that heavy mechanical equipment may grind the decaying algae down into the moist sand, creating conditions that promote higher counts of *E. coli* bacteria.

Long-term management is more complex. Since control of quagga and zebra mussels is difficult, reducing the amount of phosphorus entering lakes is probably the best means to limit the growth of Cladophora. New regulations are helping curb rain and snowmelt pollution in Wisconsin. Phosphorus discharge and runoff limits have been set for large urban areas, municipal wastewater districts, industrial dischargers and agricultural producers.

In 2010, Wisconsin, along with 16 other states, passed a law banning phosphorus-containing dish detergents, and some municipalities have even prohibited the sale of phosphorus-containing lawn fertilizers. Municipalities are also trying to minimize stormwater pollution by using low-impact development techniques and green infrastructure.

Farmers are developing nutrient management plans and integrating conservation techniques such as cover crops and streamside buffer strips. Industrial and wastewater dischargers are complying with the lower phosphorus effluent limits with technology upgrades and by working with upstream farmers to reduce agricultural runoff.

Nuisance Cladophora blooms indicate an ecosystem under stress. They demonstrate the vulnerability of the Great Lakes to disturbances from urban and agricultural runoff, introductions of invasive species, and changes in weather and climate.

For more information, watch a Wisconsin Sea Grant video on nuisance algae at **bit.ly/1g89Vby** and **bit.ly/1czLfYQ**.

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