Nuisance Algae on Lake Michigan Shores

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During the past five summers, heaps of rotting algae have piled up on some beaches of Lake Michigan, creating a powerful stench. The offending plant is known as *Cladophora*. It is a filamentous green alga common in the Great Lakes and many other fresh waters. Growing on submerged rocks, it looks like long, green hair waving in the water.

Decaying *Cladophora* may lower property values and has been linked to taste and odor problems in drinking water. In addition, it provides an environment that may sustain or exacerbate levels of *E. coli* and enterococci bacteria in beach sand and possibly swimming waters, raising questions about beach safety.

E. coli bacteria is an indicator of fecal contamination and thus the potential presence of other human pathogens (bacteria, viruses and protozoa). High *E. coli* numbers prompt managers to close beaches. Recent research shows *Cladophora* mats may nourish the growth of bacteria that come from gull droppings, sewage overflows or runoff from urban and agricultural areas.

Problems with *Cladophora* date back to the mid-1950s, when nutrient levels, particularly phosphorus, were higher throughout the Great Lakes. Following the 1972 Amendments to the Clean Water Act, wastewater discharges of phosphorus were limited. Phosphorus levels in the lakes declined and nuisance algae blooms in Lake Michigan largely subsided.

Possible Reasons for Excessive Growth

The causes of the *Cladophora* resurgence in the Great Lakes are not known for certain, but experts increasingly agree they probably include changes involving dreissenid (zebra and quagga) mussels and possibly rising phosphorus inputs.

- **Zebra and quagga mussels –** During the past decade, water clarity in parts of the Great Lakes has increased substantially because dreissenid mussels filter suspended particles from the water as they feed. Light now penetrates to much greater depths, expanding the areas of well-lit, hard substrates where *Cladophora* can grow.

  The vast beds of exotic mussels now found in the Great Lakes also provide *Cladophora* with new substrate to grow on. *Cladophora* can grow directly on the hard shells of the mussels and may draw upon the rich nutrients the mussels deposit. As the mussels feed, they filter algae and other phosphorus-containing particles out of the water. They are glutinous feeders, taking in more organic matter than they can digest. The mussels egest the excess food in a mucous-covered packet called **pseudofeces,** which settles on the bottom and fertilizes *Cladophora*.
- **Possible increased phosphorus –** Most of the phosphorus in Lake Michigan water comes from the internal recycling of nutrients from the lake bottom during spring and fall circulation, called **turnover.** Phosphorus concentrations in the offshore waters of Lake Michigan do not show signs of increase. However, it has been suggested that dreissenid mus-

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Conditions Favoring Cladophora's Growth

- **Substrate – *Cladophora* generally grows attached to rocky substrates or other hard surfaces like piers, breakwalls or woody debris. *Cladophora* requires high levels of calcium and thus grows well on the dolomite (limestone) bedrocks of the west shore of Lake Michigan.**
- **Temperature – Optimal water temperature for *Cladophora* is 15-25°C (59-77°F). It does not grow well in the cold waters of Lake Superior, but is commonly found in the other Great Lakes. Abundance generally peaks in the spring and again in the fall. Die-offs occur in mid-summer, possibly due to higher water temperatures. Then, filaments break free from their substrate, and waves and currents carry the dead algae ashore.**
- **Light – *Cladophora* thrives in shallow and clear waters where light easily penetrates to the lake bottom.**
- **Nutrients – In freshwater ecosystems, phosphorus is usually the essential plant nutrient in shortest supply. Therefore, additions of phosphorus will usually stimulate *Cladophora* growth.**

sels effectively capture and retain nearshore phosphorus inputs, redirecting nutrients away from offshore waters and to the nearshore benthic community where *Cladophora* grows.

Limited evidence suggests that phosphorus inputs may have increased in recent years from some streams that flow into Lake Michigan. Runoff is known to be the largest source of new phosphorus to Lake Michigan, and it is possible that levels in the nearshore waters may be higher due to inputs from fertilizers, livestock manure, soil erosion or urban storm water. More monitoring is needed to assess nutrient inputs.

What about the Smell?

Many people are offended by the stench of decaying algae along the shoreline, but some researchers have noticed the odor may have more to do with what is in the rotting beds of algae than with the algae itself.

Cladophora that washes up on beaches often contains dead zebra mussels, crustaceans and fish. The smell of these decaying animals, combined with droppings from gulls and other animals that come to feed off of the algae beds, may be the true source of the stench that keeps people off the beaches. Additional evidence comes from researchers studying *Cladophora* in streams without zebra mussels who have noticed little or no smell as the algae beds decay.

Why Are Certain Shorelines More Affected?

Offshore areas with cobble or bedrock substrates will produce more *Cladophora* than sandy areas. However, once *Cladophora* detaches from its hard substrate it may be carried for considerable distance 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 production.

What Can Be Done?

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* is capable of accumulating small amounts of heavy metals from the lake water.

For most homeowners, hand raking is feasible, albeit a tedious task. Managers of some large Great Lakes beaches have used mechanical removal (front-end loaders, backhoes and beach grooming equipment). 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.

The key to successful clean-up is vigilance in removing the algal mats as soon as they wash ashore.

Cladophora at Newport State Park

Victoria A. Harris

After only a few days in the warm sun, the algae begins to decay into an organic soup which is virtually impossible to remove.

Long-term management is also difficult. Unfortunately, zebra and quagga mussels are here to stay and their presence has forever altered the Great Lakes ecosystem. If ongoing research concludes that the mussels are primarily responsible for the expansion of nuisance *Cladophora* growths, there may be little that can be done. The many negative impacts of foreign mussels punctuate the importance of preventing new exotic plants and animals from entering our Great Lakes.

Reducing the amount of phosphorus entering the lakes is clearly the best means available of controlling the growth of *Cladophora* and other algae. New regulations are helping curb runoff pollution in Wisconsin. Smart Growth guidelines promote low-impact development that minimizes urban pollution. Farms near streams and lakes must meet new agricultural performance standards, and urban storm water management programs are required for larger communities. Some municipalities also prohibit the sale of phosphorus-containing lawn fertilizers.

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