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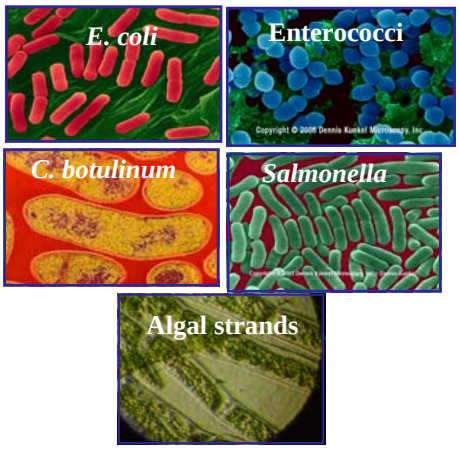
Algal (*Cladophora*) Mats Harbor High Concentrations of Indicator Bacteria and Pathogens

Indicator bacteria and human enteric pathogens have been recovered from *Cladophora* mats and may influence recreational water quality.

Researchers at the Lake Michigan Ecological Research Station (LMERS), USGS Great Lakes Science Center have studied the enteric bacteria in *Cladophora* mats found along the Lake Michigan shoreline. LMERS scientists and their collaborators have found that *Cladophora* is a potential environmental reservoir of enteric bacteria, including some pathogens of public health concern:

- *E. coli*
- Enterococci
- *Campylobacter*
- Shiga toxin-producing *E. coli*
- *Shigella*
- *Salmonella*
- *Clostridium botulinum*
- *Clostridium perfringens*




Cladophora mats. Photo by Ken Hyde, Sleeping Bear Dunes National Lakeshore

Cladophora

Cladophora, a green alga commonly found in the Great Lakes, grows on hard substrates and the lake bottom and becomes detached throughout the summer. In recent years, there has been a resurgence of *Cladophora* within the Great Lakes. Algal accumulations along shorelines, often in great masses, affect recreational activities, potentially influence water quality, and may pose economic concerns. For five years, LMERS scientists have studied the *Cladophora*-enteric bacteria association, using traditional microbiological and DNA-based techniques. *E. coli* and enterococci were commonly found in *Cladophora*, with densities often exceeding 100,000 colonies/g. Using cutting-edge DNA fingerprinting technology, we found that the *E. coli* population in *Cladophora* was different from that of human and animal *E. coli* population. These results indicate that *E. coli* has a unique, strong association with *Cladophora*. *Cladophora* provides a suitable habitat for indicator bacteria and potentially pathogens to persist and grow, which may in turn impact recreational beach water quality. Also, *Clostridium botulinum* was detected in *Cladophora* samples collected from two locations in an area along the upper eastern Lake Michigan shore, suggesting a possible link between *Cladophora* and bird botulism. The source of these enteric bacteria in *Cladophora* is unclear, but they likely originate from shore bird waste and human contaminants (e.g., sewage, run-off, agricultural operations). Our investigations show that the relationship between *Cladophora* and enteric bacteria is casual because the bacterial population varied between location and time; also, there was a high degree of genetic diversity within the bacterial population. This suggests that the bacteria are not derived from the *Cladophora* itself, but rather unique bacterial source inputs at different locations, which requires new source inputs seasonally. The *Cladophora* bacterial relationship appears to be an opportunistic one for indicator bacteria and pathogens: once colonization occurs, these bacteria quickly adapt to *Cladophora* as a habitat.

Cladophora mats along shorelines are an environmental source of indicator bacteria to near-shore water, potentially affecting beach water quality. Also, *Cladophora* harboring pathogenic bacteria increases the health risk to wildlife (e.g., shorebirds) and the public. These impacts from *Cladophora* accumulations at recreational areas may have public health and economic consequences.

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