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

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.