Human health: Current understanding and protective measures surrounding ‘MUCK’

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Muck in Saginaw Bay

- Muck: Decaying detritus composed of algae, sediment, and organic matter
- Perceived increase in distribution compared to past years
- Degrades aesthetics and usage of beaches
- Reported throughout the Great Lakes
- The Muck Song

Muck and microorganisms

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIB are harmless bacteria found in the gut of humans and animals</td>
<td>FIB have been linked to human health illness and risk</td>
</tr>
<tr>
<td>Detection indicates likely presence of pathogens</td>
<td>E. coli is the most common FIB used in Great Lakes</td>
</tr>
<tr>
<td>Indicate pollution and risk</td>
<td>Regrows in environment</td>
</tr>
<tr>
<td>Cheap</td>
<td>24 hours for results</td>
</tr>
<tr>
<td>Easy to test</td>
<td>Not source specific</td>
</tr>
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ADVANTAGES
- Species specific markers
- Quick and quantitative
- Automated

DISADVANTAGES
- More expensive than FIB
- Specialized laboratory
- Detections include non-infectious organisms

Molecular Source Tracking: Identify sources of fecal contamination in water (e.g. human, cattle, or bird)

Determine presence and level of host-specific molecular targets in fecal pollution

**Muck and microorganisms**

- MST uses Polymerase Chain Reaction (PCR)
- Enzymatic reaction that makes many copies of DNA from single molecule
- $2^n$ copies of DNA from single molecule
  - $n =$ No. of cycles
  - 35 cycles of PCR would yield $2^{35}$ copies of DNA

**Muck and human health**

**Human health concerns**

- Ideal environment for bacteria accumulation and regrowth
- Can become anaerobic, provide habitat for toxin producing bacteria (Clostridium)

**Microorganisms detected in muck**

<table>
<thead>
<tr>
<th>Fecal indicator bacteria</th>
<th>Pathogens</th>
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<tbody>
<tr>
<td><em>E. coli</em></td>
<td><em>Salmonella</em></td>
</tr>
<tr>
<td>Enterococci</td>
<td><em>Campylobacter</em></td>
</tr>
<tr>
<td>Total coliforms</td>
<td><em>Shigella</em></td>
</tr>
<tr>
<td><em>C. perfringens</em></td>
<td><em>Shiga Toxin Producing</em></td>
</tr>
<tr>
<td>Coliphage</td>
<td><em>E. coli</em> (e.g. O157:H7)</td>
</tr>
</tbody>
</table>

**Muck and human health**

- Fecal indicator bacteria in all samples
- Human and bovine feces in muck
- Muck and shallow water interact
  - Wind speed/direction decreases *E. coli* in muck
  - Wave height increases *E. coli* in shallow water

Wind action cause a release of bacteria from the muck and wave action resuspends *E. coli* into the water column
Muck and human health

- Can muck cause illness?
  - YES but risk assessment has not been performed

- How to reduce risk from muck?
  - Avoid contact
  - Wash hands
  - Do not submerge head

Mucky options

- Hand rake
- Barber Surf Rake at Bay City Recreation Area
- Excavators and dozers used on larger sites
  - Raking scatters microorganisms into water column
  Verhougstraete et al. 2010; Whitman et al. 2003

- Best Management Practices for muck removal
  - Remove early in morning
  - Allow time for sunlight inactivation of bacteria
  - Routine beach grooming

- On-site disposal in gardens, burial, garbage bags, and compost piles
  - Drying not overly successful (>5mm)
  - Burying prolongs bacterial survival
  Verhougstraete et al. 2010; Whitman et al. 2003
**Mucky options**

- Aquicide pellets
  - [http://www.killlakeweeds.com](http://www.killlakeweeds.com)
- Air Diffusion Systems
  - [http://www.airdiffusion.com](http://www.airdiffusion.com)
- Aqua Blaster
  - [http://www.muckblaster.net/](http://www.muckblaster.net/)
- Truxor Amphibian Machine
- Gunderboom
  - [http://www.gunderboom.com](http://www.gunderboom.com)

**Long term solutions and needs**

- Routine maintenance and inspection of on-site septic systems
- Sewage system upgrades
- Don’t feed gulls and other wildlife
- Removal of beaches from AOC list requires an understanding of bacterial processes across the beachscape

**Thank you**

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