Chesapeake Bay health: What causes positive and negative trajectories?

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STAR lecture
Chesapeake Bay Program
STAR = Scientific Technical Analysis & Reporting

Chesapeake Bay Program

Goal Implementation Teams

Data providers: - monitoring - modeling - GIS - web
STAR Lectures

**Goal:** To provide concise, thought-provoking ideas relating to Chesapeake Bay science & management

**Rules of engagement:** Fifteen minute talks which can be captured on video and posted on Integration & Application Network website

**Videos:** released under a Creative Commons license so they can be freely shared and reposted
Six indicators and thresholds selected to form indices

<table>
<thead>
<tr>
<th>INDICATORS and GUIDELINE VALUES</th>
<th>ASSESS MEASURED VALUE</th>
<th>PRODUCE OVERARCHING INDICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll $a$: $\leq 2.8$ to $\leq 20.9$ $\mu g$ L$^{-1}$</td>
<td>Percentage of region that meets guideline values for each indicator</td>
<td>Water Quality Index</td>
</tr>
<tr>
<td>Dissolved oxygen: $\geq 1.0$ to $\geq 5.0$ $mg$ L$^{-1}$</td>
<td></td>
<td></td>
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<tr>
<td>Water clarity: $\geq 0.65$ to $\geq 2.0$ m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic grass: Acres (acres)</td>
<td>$= $ Area compared to goal</td>
<td>Bay Habitat Health Index</td>
</tr>
<tr>
<td>Bottom dwellers: $\geq 3$ Benthic IBI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phytoplankton: $\geq 3$ Phytoplankton IBI</td>
<td>Percentage of region that meets guideline values for each indicator</td>
<td>Biotic Index</td>
</tr>
</tbody>
</table>

(number) = see backpage for documentation reference
Water quality and biotic indicators combined into indices

Data integrated

Water quality

Biotic

Compared to thresholds

Combined into indices
Bay Health Index (calculated from Water Quality Index and Biotic Index) used for Chesapeake Bay report card
Bay Health Index calculated for 1989-2008

Overall Chesapeake Bay = no significant trend
Bay Health Index trajectories calculated for different regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Correlation Coef. ($r^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James River</td>
<td>+0.68</td>
</tr>
<tr>
<td>Upper Bay</td>
<td>+0.47</td>
</tr>
<tr>
<td>Elizabeth River</td>
<td>+0.38</td>
</tr>
<tr>
<td>All other regions</td>
<td>n.s.</td>
</tr>
<tr>
<td>Mid Bay</td>
<td>-0.20</td>
</tr>
<tr>
<td>Upper Eastern Shore</td>
<td>-0.27</td>
</tr>
<tr>
<td>Lower Western Shore (MD)</td>
<td>-0.43</td>
</tr>
</tbody>
</table>

All correlation coefficients significant at $p < 0.10$
Upper Eastern Shore: Significant degrading trajectory

-0.29

Bay Health Index (-0.29)
Biotic Index (-0.29)
Water Quality Index (-0.27)
Upper Eastern Shore

Land use in the Upper Eastern Shore

Legend
- Small town
- Suburbs
- Residential
- Agriculture (row crops)
- Forest
- Wastewater treatment plant
- Vacation/luxury homes
- Wetlands

Map showing locations such as Elkton, Northeast River, C & D Canal, Sassafras River, Chestertown, Chester River, Eastern Bay, and Centreville.
Upper Western Shore: Significant positive trajectory

- Bay Health Index (n.s)
- Biotic Index (n.s.)
- Water Quality Index (+0.21)
Upper Western Shore

Land use in the Upper Western Shore

Legend
- Small town
- Suburbs
- Residential
- Agriculture (row crops)
- Forest
- Military

Wetlands
Wastewater treatment plant
Governor O'Malley's question: Why are some areas getting better and others getting worse?

Maryland Scientists Explore Tipping Point

On May 11, Governor O'Malley toured the Bush River with State scientists to learn more about recent trends in water quality. According to the 2008 Chesapeake Bay Habitat Health Report Card recently issued by the University of Maryland Center for Environmental Sciences (UMCES), some tributaries adjacent to one another are demonstrating different, diverging trends.

For example, while the Bush River in the Upper Western Bay is seeing signs of improvement, the adjacent Upper Eastern Shore tributaries - such as the Sassafras - are continuing to degrade. Scientists believe this is a likely result of ecological "tipping points."

It has been long known that ecological systems, like Bay tributaries, do not get progressively worse as pollution increases. Instead, they can withstand pollution up to a point, after which they rapidly degrade. The same may be true for restoring a tributary. While initial improvements may not be immediately apparent, the continued strategic targeting of restoration actions in selected tributaries can create a stage at which the natural resiliency of bay grasses, fish and shellfish come into play, accelerating improvements both within the smaller system and in adjacent portions of the Bay. Scientists are still developing more precise information on the actual nutrient loadings that constitute a tipping point for a specific river system, however, they believe it can propel large-scale changes.
Development and evaluation of a spatially-explicit index of Chesapeake Bay health
Michael Williams, Ben Longstaff, Claire Buchanan, Roberto Llansó, William Dennison

www.eco-check.org
Acknowledgements

Integration & Application Network Team

Chesapeake Bay Monitoring team