A review of Saginaw Bay Water Quality and Harmful Algal Bloom Monitoring



Saginaw Bay true color image derived from the OLCI sensor on Copernicus Sentinel-3a obtained from EUMETSAT.

Cyanobacteria Index (Clcyano) for Saginaw Bay. Algal bloom covers about 290 square miles. Winds above 4.0 mph may mix the bloom and clouds may obscure it, leading to an underestimate of the area. Moderate and low concentrations may not be obvious to the eye. Winds from NOAA NDBC station SBLM4.

Tom Johengen CIGLR-University of Michigan

Water Quality History - context

1974 Report - many problems, minimal data

1978 Great Lakes Water Quality Agreement 440 metric ton/year Total Phosphorus target 15 μg/L total phosphorus 3.6 μg/L chlorophyll a 3.9 m secchi depth mesotrophic state

early phosphorus reduction efforts – targeted point sources mid-1980s success "declared" - emphasis shifted to toxic contaminants

2012 Great Lakes Water Quality Agreement

charge to review/update existing targets (3 years for Lake Erie) 440 metric ton/year Total Phosphorus interim until updated 15 μg/L total phosphorus spring mean - western Lake Erie 5 μg/L total phosphorus spring mean - Lake Huron

Estimated TP Load vs. Time (Saginaw River only)



Cha, Y., C.A. Stow, K.H. Reckhow, C. DeMarchi, and T. Johengen. 2010. Phosphorus load estimation in the Saginaw River, MI using a Bayesian hierarchical/multilevel model. *Water Research*, 44: 3270-3282.

Total Phosphorus and Chlorophyll



History of Water Quality Monitoring Led by NOAA-GLERL and CIGLR

- ✤ Zebra Mussel Impacts Study: 1991 1996
 - NOAA Technical Memorandum ERL GLERL-91 (May 1996)
 - NOAA Technical Memorandum GLERL-115 (Jan 2000)

- ✤ Saginaw Bay Multiple Stressors Project: 2008 2013
 - 5 yr NOAA SCOR project: HABs/Muck/Invasive/Fisheries
 - NOAA Technical Memorandum GLERL-160 (Sept 2013)



- Discrete monitoring
- Remote Sensing
- Modeling















Microcystin vs Chlorophyll a

Saginaw Bay - Lake Erie



Courtesy of Dr. Freya Rowland



Courtesy of Michigan Tech Research Institute





Courtesy of Michigan Tech Research Institute

Summertime Oxygen Depletion





2012 – New GLWQA

effective February 2013

10 Annexes

<u>Annex 4 - Nutrients</u>

Six Lake Ecosystem Objectives

- 1) minimize hypoxic zones
- 2) algal biomass below nuisance levels (Cladophora)
- 3) algal species consistent with healthy ecosystems nearshore
- 4) cyanobacteria at levels that do not pose toxin risk
- 5) oligotrophic state in open waters
- 6) mesotrophic conditions western, central Erie

Update Phosphorus Load Targets (Do this for Lake Erie within 3 years - February 2016)

Summary

- TP load target not met as of 2011 current status unclear need data (all tributaries)
- Original TP, chlorophyll a, secchi objectives not met
- Microcystin present
 - moderate concentrations
- Evidence for periodic, short-term hypoxia important...?
- HABS concentrated around perimeter declining extent?
- Decisions pursuant to Annex 4 2012 GLWQA pending