Synthesis of Water Quality Studies in Baffin Bay With a View Towards Solutions

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The Situation in 2012: Visual Evidence of Environmental Change in Baffin Bay

1. Brown tide blooms (1990’s-present)
2. Episodic low oxygen & fish kills
3. Emaciated drum, dead clams
Should we be concerned about the health of the Baffin Bay ecosystem?
Year-to-Year & Long-Term Trends: Chlorophyll $a$

= algal biomass; indicator of nutrient enrichment

• 2-fold increase since mid-1970’s (Montagna & Palmer 2012)
  – Brown tide the primary culprit

• Year-to-year variability tied to rainfall patterns
  – Volunteer data important for fully understanding drivers of brown tide

What is driving long-term increase in chlorophyll & dense, prolonged brown tide blooms?
Potential Cause(s) of Long-term Increase in Algal Biomass

Baffin Bay is poorly flushed... Retains/recycles nutrients & sensitive to external inputs

Factors affecting algal growth:
- Salinity- high salinity favors brown tide; salinity has decreased dramatically since ICW opening
- Benthic filter feeders- unknown change in population over time; die-off’s in other systems have led to algal blooms
- Water temperature- enhances algal growth; increase since 1960’s along much of Texas coast
- **Nutrients (N and/or P)**- increases in several parameters since 1970’s
Nitrogen in Baffin Bay

- Inorganic nitrogen generally low in surface waters
- *Dissolved organic nitrogen conc. very high in Baffin Bay*
Brown Tide & Organic Nitrogen in Baffin Bay

- TKN and DON 3-fold higher in BB than in other Texas bays
- High DON & brown tide linked in other systems
- TKN increased from mid-1970’s to early 1990’s, stabilized since (Montagna & Palmer 2012)
External Sources of Nitrogen to Baffin Bay

1. Fertilizer ≈ Atmospheric deposition
2. Manure
3. Wastewater ≈ Urban

- Likely varies depending on rainfall conditions
External Sources of Nitrogen to Baffin Bay

Organic nitrogen = urea-based fertilizers, animal waste & plant matter, wastewater, etc.

- USGS study – most of N from Petronilla Creek as particulate organic N; attributed to crop residue

- TCEQ data – very high algae levels in Petronilla Creek, increasing over time; algal debris flushed into bay?
Should We Be Concerned About the Health of the Baffin Bay Ecosystem?

- Very high (AND increasing) chlorophyll & nitrogen levels in Baffin Bay
- Increasing temperature enhances algal growth, increases bacterial respiration & reduces dissolved oxygen levels

*Yes, multiple indicators suggest that Baffin Bay water quality has deteriorated.*

*Given sensitivity of system to nutrient inputs, solutions are needed to reduce loadings to the system.*
What Are The Solutions?

• Water temperature increase driven by larger climate system, beyond local capacity to resolve

• Increase flushing?
  • No major rivers or freshwater inputs
  • Previous opening of Yarborough Pass in 1940’s only decreased salinity by few %
  • Chlorophyll continues to increase despite ICW opening and lower salinities than in past

• Reduce nutrient inputs?
  • Has been accomplished elsewhere
  • Public-private stakeholder partnership ideal, e.g., Tampa Bay restoration
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