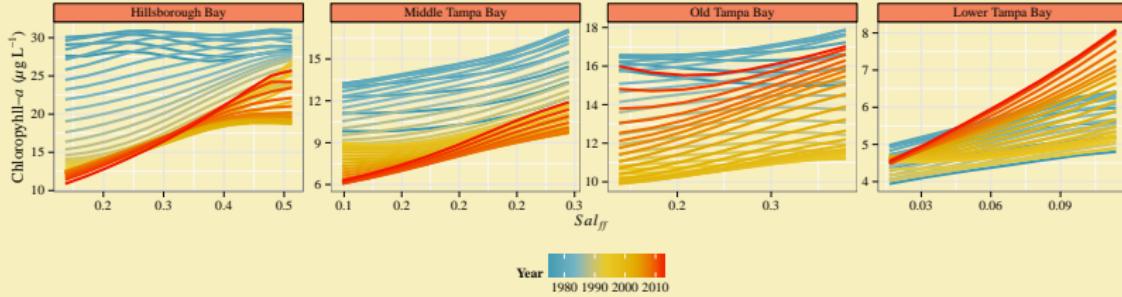


The search for truth in numbers: Quantitative approaches for evaluating trends in water quality data

Marcus W. Beck

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Oct. 24, 2014



The eutrophication paradigm

Research and management in coastal waters

Eutrophication (noun) - an increase in the rate of supply of organic matter to an ecosystem

– [Nixon, 1995]

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Nutrient Loading

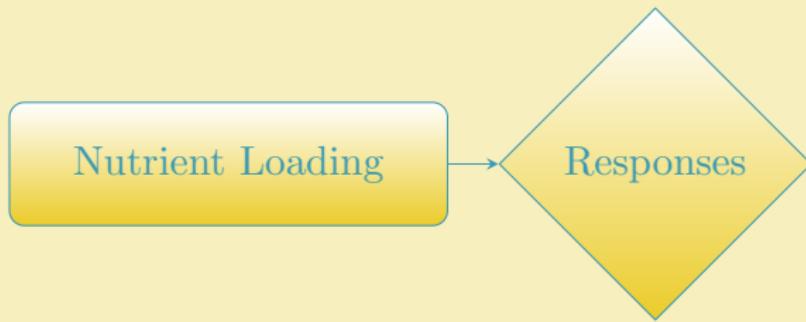
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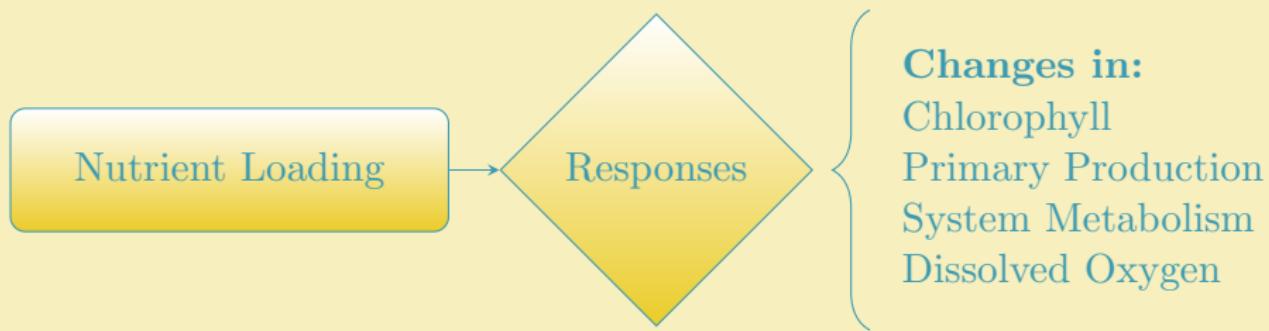
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Human inputs can greatly accelerate eutrophication... particularly for bays and estuaries

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- Depletion of bottom water dissolved oxygen
[Diaz and Rosenberg, 2008]

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- Propogated effects to upper trophic levels [Powers et al., 2005]

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Red tide off northwest Florida may hit economy

Jason Dearen, Associated Press

2:40 p.m. CDT September 18, 2014



(Photo: Bruce Graner)

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CLEARWATER –

It's like Florida's version of The Blob. Slow moving glops of toxic algae in the northeast Gulf of Mexico are killing sea turtles, sharks and fish, and threatening the waters and beaches that fuel the

region's economy.

Known as "red tide," this particular strain called Karenia brevis is present almost every year off Florida, but large blooms can be particularly devastating. Right now, the algae is collecting in an area about 60 miles wide and 100 miles long, about 5 to 15 miles off St. Petersburg in the south and stretching north to Florida's Big Bend, where the peninsula ends and the Panhandle begins.

MORE STORIES



Forum faces economic realities

Oct. 14, 2014, 8:40 p.m.



Businessman buys block in downtown Pensacola

Oct. 14, 2014, 8:27 p.m.

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Water Quality Act Amendments of 1972

- Federal mandates to protect and restore the chemical, physical, and biological integrity of surface waters
- Protection and restoration requires criteria

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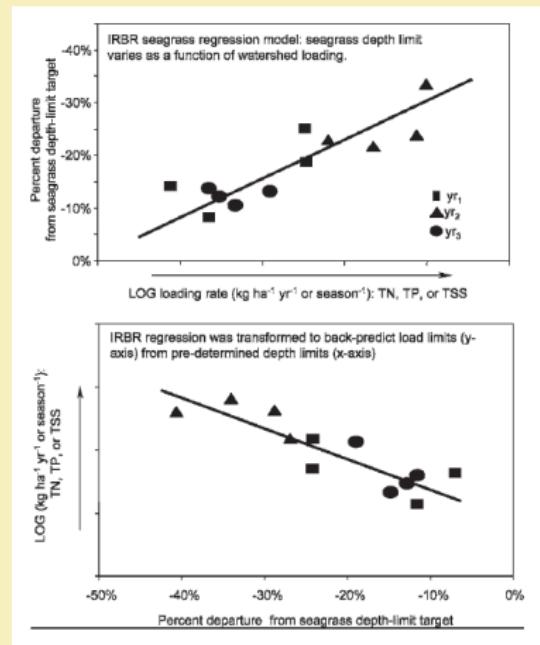
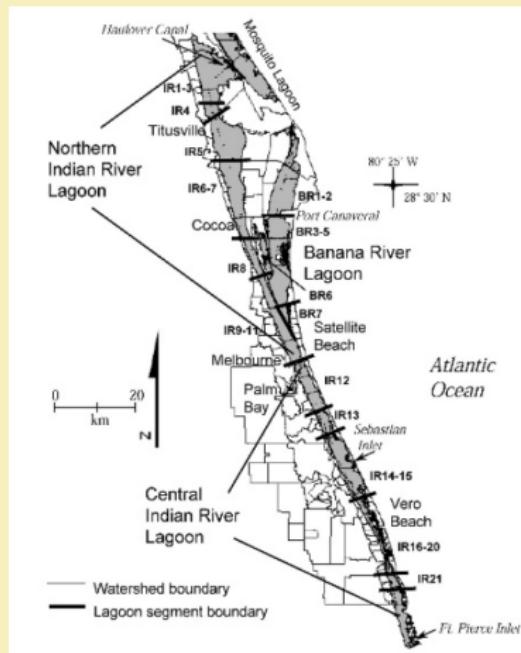
Numeric nutrient criteria

- The amounts of contaminants or pollutants that may be present without impairing aquatic life or human health
- E.g., nutrients limits for seagrass in Indian River Lagoon...

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Nutrient limits using seagrass depth-limit targets [Steward and Green, 2007]



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USEPA national strategy for the development of regional nutrient criteria

- Aid states' ability to control and reduce nutrient enrichments
- Responsibility of EPA to develop criteria guidance

[USEPA (US Environmental Protection Agency), 1998]

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USEPA Gulf Ecology Division - guidance to Florida DEP and others
on criteria development for estuaries



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Challenges for criteria development

There are challenges to providing guidance...

Challenge 1: We don't fully understand eutrophication processes

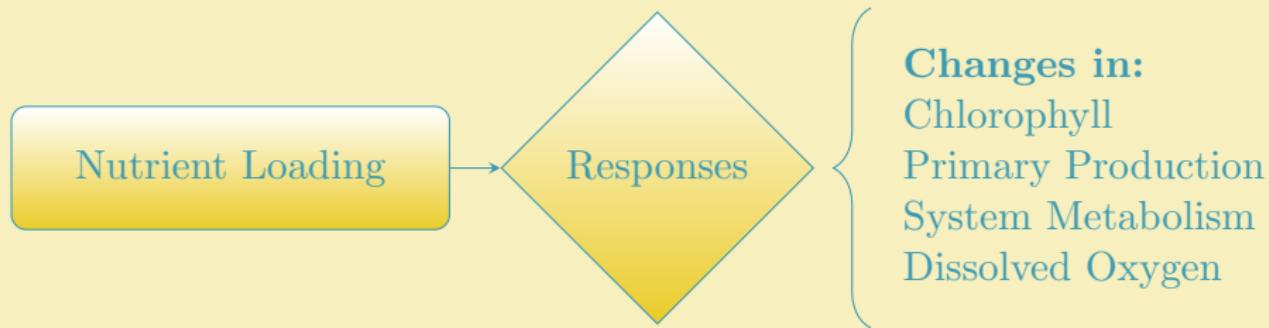
There are good reasons to believe that eutrophication will, in the near future, become a hazard in marine coastal areas in many parts of the world.

– [Rosenberg, 1985]

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Challenges for criteria development

Our conceptual model for understanding the effects of nutrient pollution is adopted from freshwater sciences.



Adapted from [Cloern, 2001]

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Challenges for criteria development

Spatial and temporal variation in estuaries is significant - multiple drivers of system change

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Challenges for criteria development

Challenge 2: Change over time is apparent – we have the data but often lack tools to unambiguously and quantitatively characterize

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Challenges for criteria development

Challenge 2: Change over time is apparent – we have the data but often lack tools to unambiguously and quantitatively characterize

Data without models are chaos, but models without data are fantasy.

– NWQMC 2014 plenary, R. Hirsch via [Nisbet et al., 2014]

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Challenges for criteria development

Challenge 2:

References

- Cloern JE. 2001.
Our evolving conceptual model of the coastal eutrophication problem.
Marine Ecology Progress Series, 210:223–253.
- Diaz RJ, Rosenberg R. 2008.
Spreading dead zones and consequences for marine ecosystems.
Science, 321:926–929.
- Glibert PM, Hinkle DC, Sturgis B, Jesien RV. 2013.
Eutrophication of a Maryland/Virginia coastal lagoon: A tipping point, ecosystem changes, and potential causes.
Estuaries and Coasts.
- Nisbet EG, Dlugokencky EJ, Bousquet P. 2014.
Methane on the rise – again.
Science, 343(6170):493–495.
- Nixon SW. 1995.
Coastal marine eutrophication: A definition, social causes, and future concerns.
Ophelia, 41:199–219.
- Powers SP, Peterson CH, Christian RR, Sullivan E, Powers MJ, Bishop MJ, Buzzelli CP. 2005.
Effects of eutrophication on bottom habitat and prey resources of demersal fishes.
Marine Ecology Progress Series, 302:233–243.
- Rosenberg R. 1985.
Eutrophication – the future marine coastal nuisance?
Marine Pollution Bulletin, 16(6):227–231.
- Steward JS, Green WC. 2007.
Setting load limits for nutrients and suspended solids based upon seagrass depth-limit targets.
Estuaries and Coasts, 30(4):657–670.
- Tomasko DA, Corbett CA, Greening HS, Raulerson GE. 2005.
Spatial and temporal variation in seagrass coverage in Southwest Florida:
Assessing the relative effects of anthropogenic nutrient load reductions and rainfall in four contiguous estuaries.
Marine Pollution Bulletin, 50(8):797–805.
- USEPA (US Environmental Protection Agency). 1998.
National strategy for the development of regional nutrient criteria.
Technical Report EPA-822-R-98-002, Office of Water, Office of Research and Development, US Environmental Protection Agency, Washington, DC.