Understanding Water Quality Baseline Variability Using the NERR System-Wide Monitoring Program

insights from environmental stoichiometry

Doug Bell, PhD
2018 Sea Grant Knauss Fellow
NOAA Research – Policy, Planning, Evaluation

In Collaboration With:
Dr. Claudia Benitez-Nelson
Dr. Erik Smith

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Nutrient pollution across the Nation’s estuaries

65% moderate-high levels of eutrophication impacts, predominantly from land-based nutrient loads
National Estuarine Research Reserve System

Long-term research, education, training, and coastal stewardship

System-Wide Monitoring Program:
Established in 1995 to monitor long-term changes in water quality, habitat
Original Purpose: Not baseline water quality...

- Study to better understand mechanisms of phosphorus (P) cycling at the molecular level and link it to environmental-scale nutrient cycling (C, N, P)
- Stoichiometry - relative amounts of an element (i.e., N:P) to tease apart the natural variation and behavior.
- Inform on the variation and mechanisms for nutrient retention in a salt marsh or export to the coastal ocean.
Insights from Environmental Stoichiometry….

Post-Hoc: Stoichiometry as a framework and monitoring tool to inform baseline conditions and variability of nutrient behavior

- Policy decisions for reducing nutrient loads historically based upon N (marine) and P (freshwater) limitation...now support for dual nutrient criteria across land-ocean continuum (EPA - 820-S-15-001)

  Concentrations AND relative amounts (i.e. stoichiometry) are important to establish scientific basis for nutrient reduction strategies.

  Stoichiometric proxies useful for comparative, less-intensive assessments and evaluation of nutrient cycling behavior
Nutrient stoichiometry in a salt marsh estuary

North Inlet – Winyah Bay NERR

North Inlet

Oyster Landing
Nutrient stoichiometry in a salt marsh estuary

Dissolved Inorganic Nutrients

Particulate Matter

C:N:P

Chl a

Dissolved Organic Matter

uptake

growth

degradation

regeneration

SWMP

North Inlet

Oyster Landing
Seasonality shapes relative nutrient behavior

- **Winter-Spring**
  - Precipitation events

- **Spring → Summer**
  - P delayed release
  - Rapid cycling

- **Fall → Winter**
  - Consumption / Reset

$\text{PO}_4^{3-}$
Holistic assessment is enlightening

dissolved inorganic

dissolved organic

particulate
Predicting chlorophyll-a responses

In situ "demand"

**DIN – SRP** * PN:PP

**in situ relative supply**

Nutrient Status Index

Informs on limitation without bioassays
Take Home: Stoichiometry as a framework

• Understanding nutrient / water quality baseline conditions and behavior
  
  Effective and relatively inexpensive for practitioners (multiple elemental fractions challenging)

  Ratios important for dual nutrient management (relative changes across land-ocean continuum)

• Assessing and comparing change in estuaries:
  
  Climate Change - Long-term change of ratios (impact of increased/shifting precipitation)

  Anthropogenic – Monitoring impact of reduction / BMPs
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Questions?

Doug Bell – 2018 Sea Grant Knauss Fellow
dwbell5@gmail.com

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