An Examination of Nitrogen and Phosphorus Values and Ratios during Twenty-Five Years of Monitoring Water Quality along the Estuarine Gradient of the Pettaquamscutt Estuary (RI)

Veronica M. Berounsky,(1,2), Annette DeSilva (1,2), Eric Peterson (2), and Linda Green (3),
(1) Graduate School of Oceanography, University of Rhode Island, Narragansett, RI;
(2) Narrow River Preservation Association, Saunderstown, RI;
(3) Watershed Watch Program, University of Rhode Island, Kingston, RI

Estuary Research Workshop
Narragansett, RI
September 13, 2017
In southern Rhode Island, Pettaquamscutt Estuary (Narrow River) parallels Narragansett Bay.

Pettaquamscutt Cove

To RI Sound
1944 - 1980 – as housing increased, nitrogen load increased
Since 1980 – most houses on municipal sewer system
Since 1980 – some decrease in nitrogen load, but load remains high since

Includes the calculated nitrogen load (SAIC 1994) from three sources: from rain that falls on the watershed and is not taken up by vegetation; from lawn fertilizer; and from septic systems
Monitoring Locations, most since 1992

- NR1 - Gilbert Stuart Stream
- NR2 - Upper Pond
- NR3 - Lower Pond A
- NR4 - Lower Pond B
- NR5 - Lacey Bridge
- NR6 - Mettatuxet Beach
- NR7 - End of the Narrows
- NR8 - Middlebridge
- NR9 - Pettaquamscutt Cove
- NR10 - Sprague Bridge
- NR11 – FW Mettatuxet Brook (1996)
- NR12 – FW Mumford Brook (2000)
What is monitored?

- Monitoring Season: May – Oct

- Biweekly:
  - Temperature
  - Salinity
  - Dissolved Oxygen
  - Chlorophyll

- Monthly
  - Bacteria
  - Nutrients- TN, NH4, NO3+2, TP, DIP
  - Analyzed by the URI Watershed Watch Program

Photo by A. DeSilva
URI Watershed Watch & Narrow River Watch Goals:

- To promote active citizen participation in water quality protection.
- To educate the public about water quality issues.
- To obtain multi-year surface water quality information in order to ascertain current conditions and to detect trends.
- To encourage sound management programs based upon water quality information.
• A 501(c)(3) non-profit organization founded in 1970. This was 2 years before the Clean Water Act was passed.

• Is the state-designated watershed council for the Narrow River and is a member of the RI Rivers Council

• **Mission:** The NRPA works to preserve, protect, and restore the natural environment and the quality of life of all communities within the Narrow (Pettaquamscutt) River Estuary and its Watershed

• Has funded (through the RI Rivers Council) analysis of the data

• Check out our webpage: www.narrowriver.org and “like” us on Facebook!

• Now for the data…..
Salinity at Saltwater Sites
Averages from 1992 to 2003 and from 2004 to 2016
Total Nitrogen at Saltwater Sites
Averages from 1992 to 2003 and from 2004 to 2016

- Upper Pond
- Lower Pond A
- Lower Pond B
- Lacey Bridge
- Metatuxet Beach
- Narrow River 7
- Middlebridge
- Sprague Bridge
- Pettaquamscutt Cove

Total Phosphorous at Saltwater Sites

Averages from 1992 to 2003 and 2004 to 2016

Total Phosphorous (micromoles per liter)
Dissolved Oxygen at Saltwater Sites
Averages from 1992 to 2003 and from 2004 to 2016
Chlorophyll at Saltwater Sites
Averages from 1992 to 2003 and from 2004 to 2016
Ammonia at Saltwater Sites
Averages from 2006-2011 and from 2012 to 2016
Nitrate+Nitrite at Saltwater Sites
Averages from 2006-2011 and from 2012 to 2016
Dissolved Phosphorous at Saltwater Sites

Averages from 2006-2011 and from 2012 to 2016

Dissolved phosphorous (micromoles per liter)
General trends:

- Decreasing TN as increasing salinity
- Higher average TN since 2004
- TP similar over time and with changes in salinity but higher in Pettaquamscutt Cove
- TP averages slightly higher before 2003
- Oxygen levels are never hypoxic
- More chlorophyll since 2004
- Decreasing chlorophyll with increasing salinity
- Higher averages of NH4, NO2+3, and PO4 between 2006 and 2011 then afterwards
TN to TP at Gilbert Stuart Stream (Narrow River 1)
TN:TP at Upper Pond (Narrow River 2)

Total Nitrogen : Total Phosphorus (molar)

-0.5 m 3 m
TN : TP at Lakeside Drive Dock (Narrow River 13)
TN : TP at Mettatuxet Beach (Narrow River 6)
TN : TP at End of the Narrows (Narrow River 7)
TN : TP at Middlebridge (Narrow River 8)
TN : TP at Pettaquamscutt Cove (Narrow River 9)
TN:TP at FW Lakeside Drive Outfall
(Narrow River 14)
TN : TP at FW Mumford Brook (Narrow River 12)
General TN:TP trends

- Higher TN:TP ratios in less saline water
- Highest TN:TP ratios in freshwater streams and stormwater outfall
- Slight increase in TN:TP ratios over time
- Slightly lowered TN:TP ratios in deeper waters (3m waters as supposed to 0.5m waters)
- What does this mean for production?
What’s ahead?
Thank you

• To the 200 volunteer monitors who took thousands of samples and measurements over these 25 years.

• To the URI Watershed Watch Lab for running the samples

• To the URI Graduate School of Oceanography for providing a supportive environment for data analysis and interpretation.