

A less green but more blue, Narragansett Bay

DATE: Wednesday, November 15, 2023

TIME: 3:00 P.M.

PLACE: Quahog Commission, Senate Lounge-State House



Candace Oviatt

Director Marine Ecosystem Research Lab
Professor of Oceanography
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI 02882

Managed Nutrient Reduction

Implemented in 2005 and Ongoing

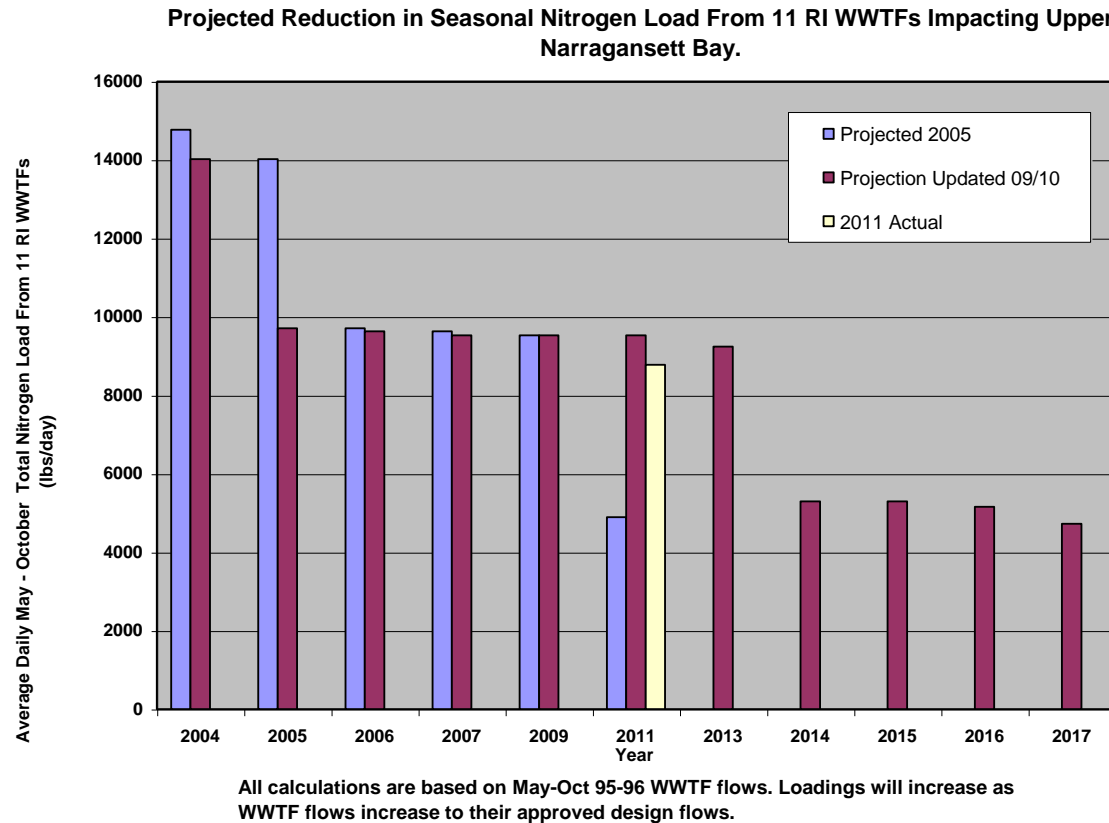
Nitrogen Reduction was a Huge Success In Improving Water Quality
in Narragansett Bay!

The Nutrient Reduction Plan: Reduce Nitrogen by 50%

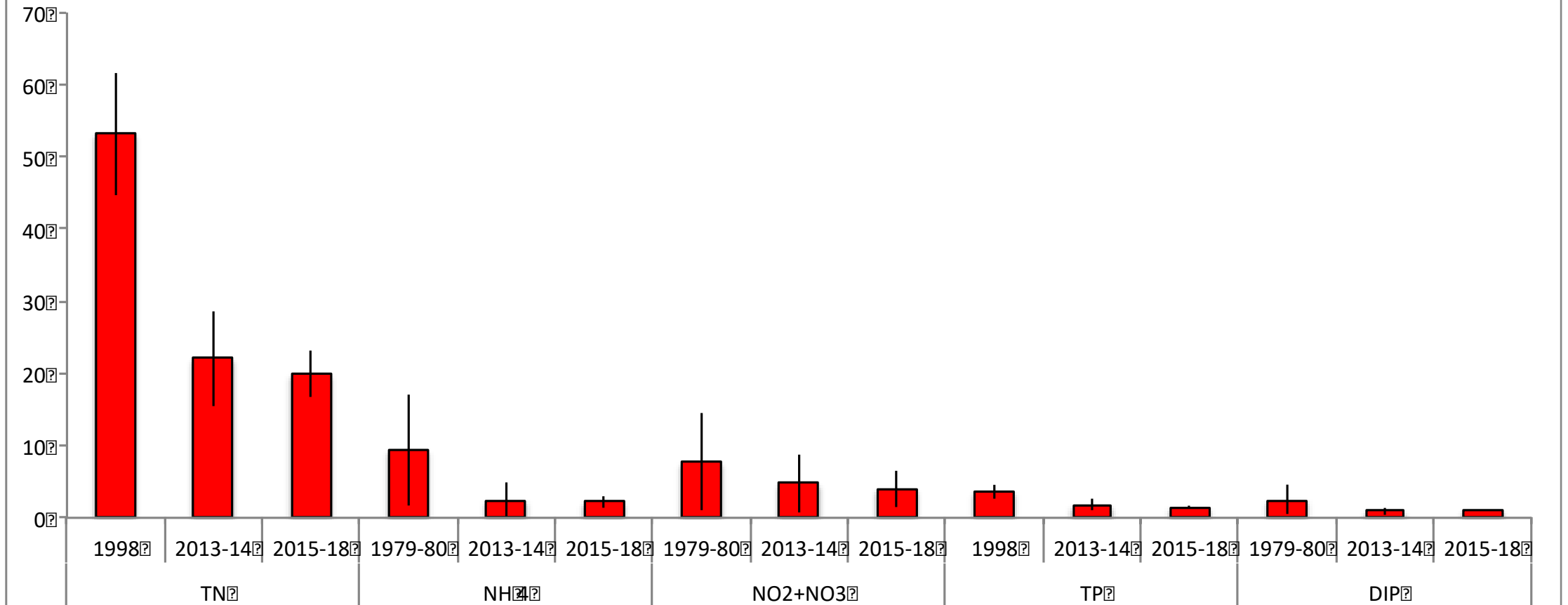
RI WWTF Nitrogen Reductions

From Angelo Liberti, Chief Surface Water Protection, Office of Water, RI DEM (2012)

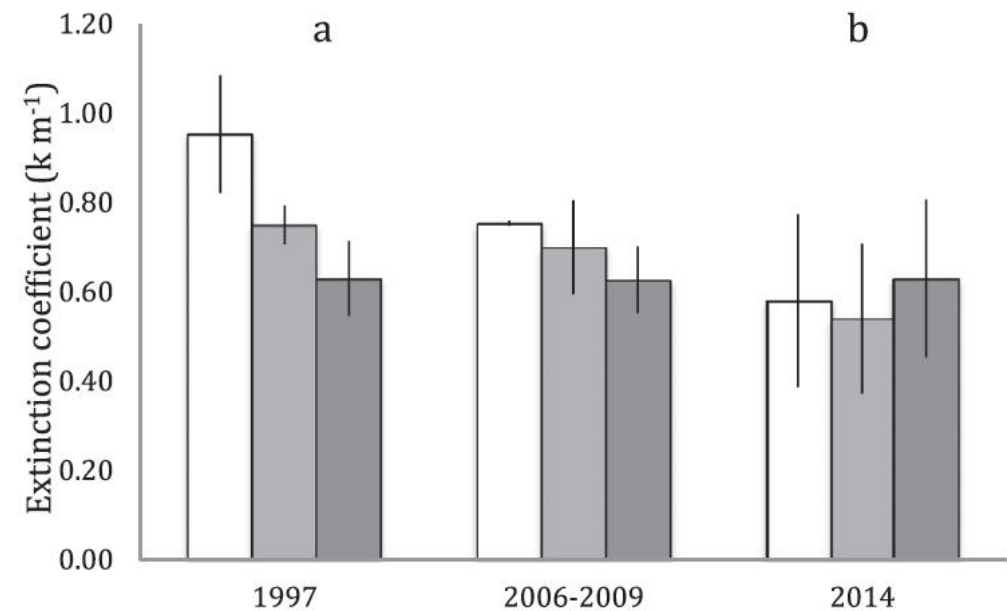
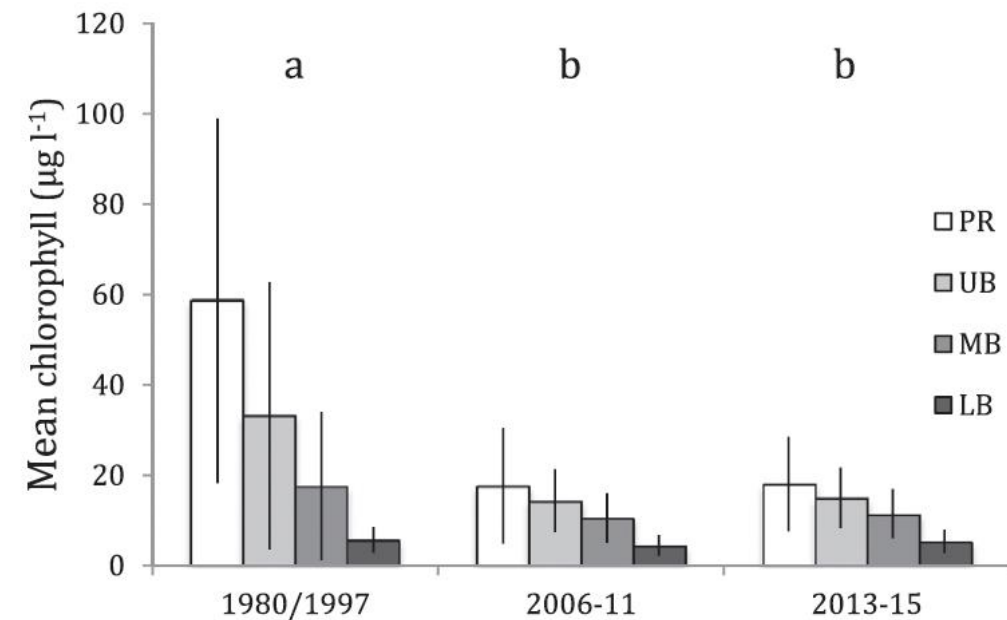
Nitrogen removal at 11 RI WWTFs - reduces their summer season nitrogen loading by 65%, dropping to 48% as WWTF flows reach approved design flows.



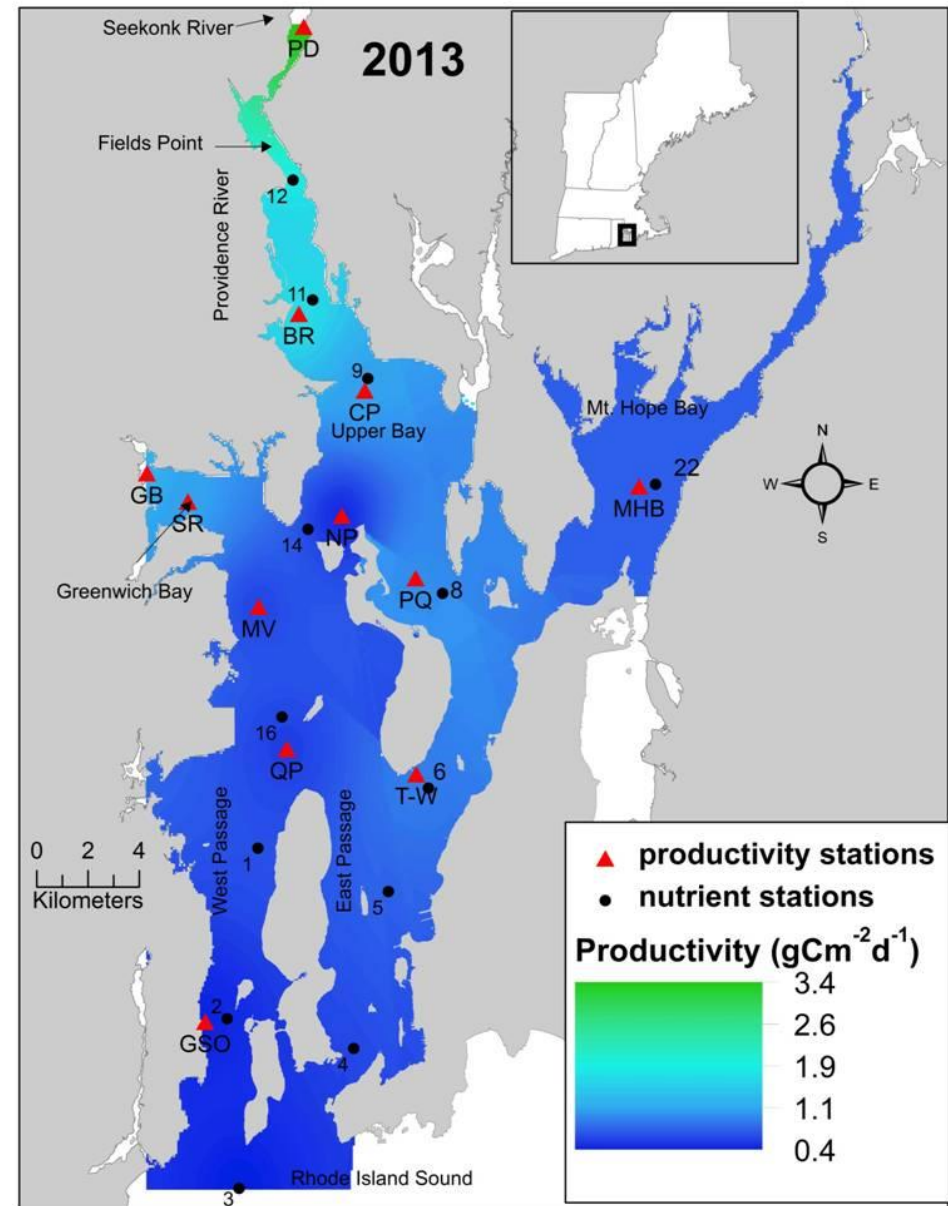
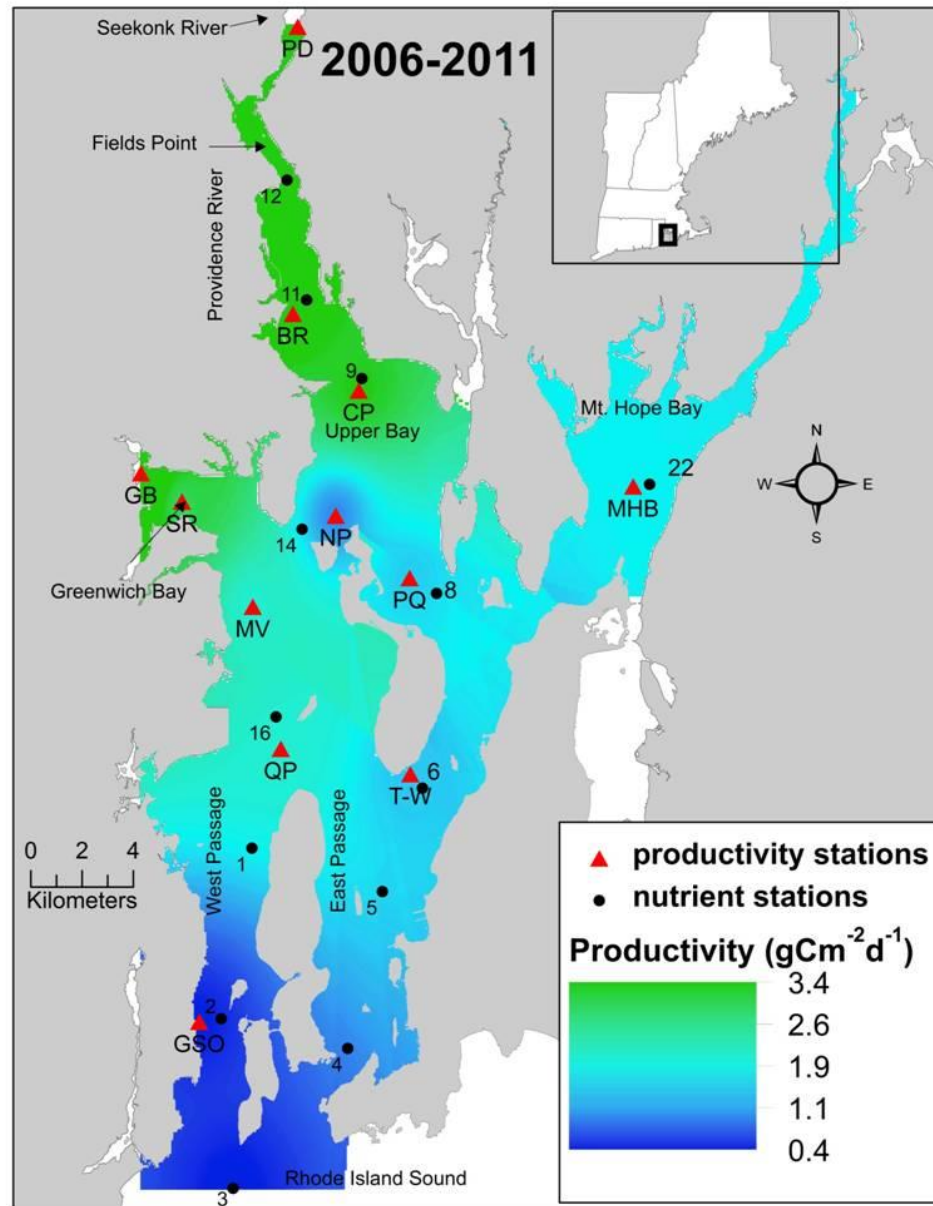
Mean Narragansett Bay Nutrient Decrease (μM)



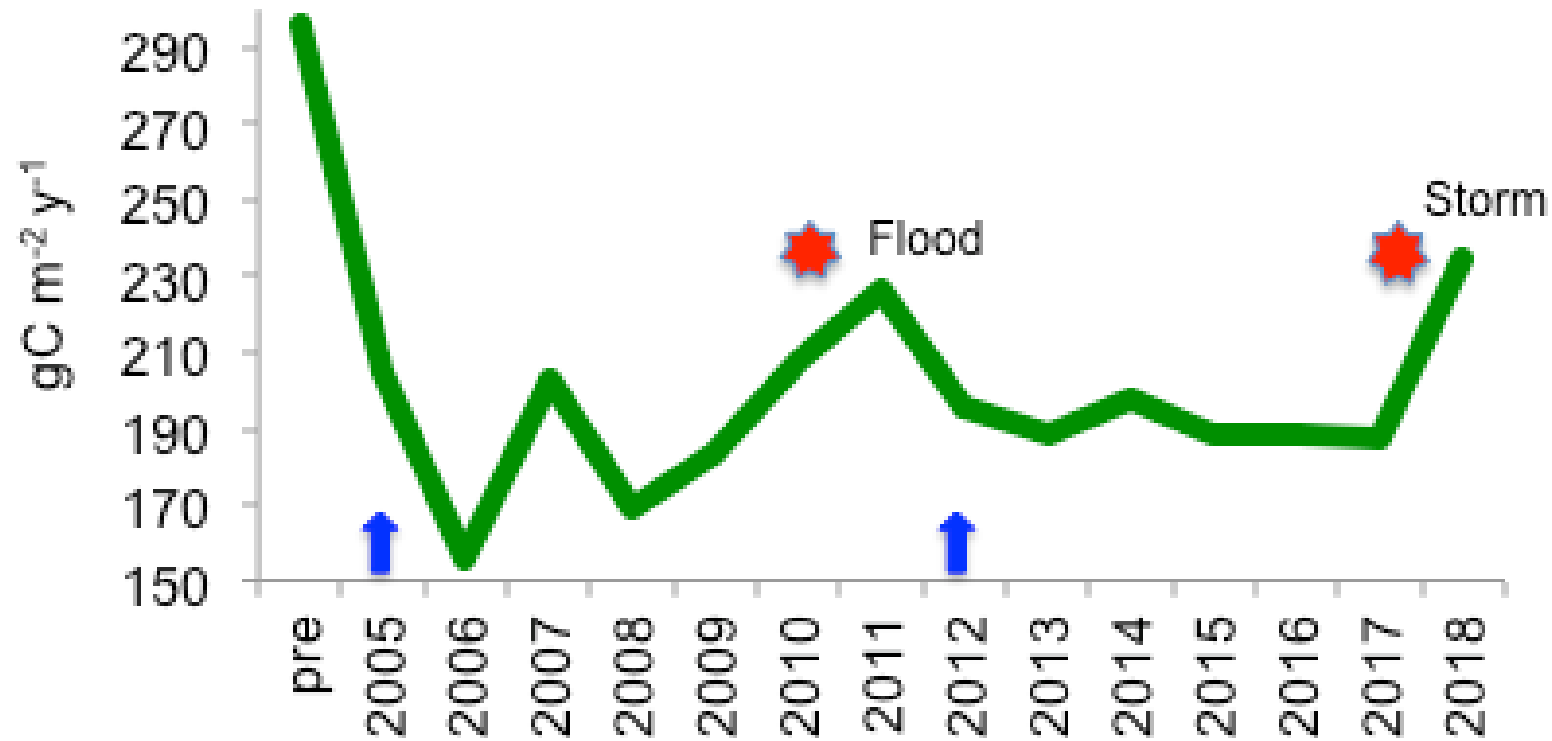
Decrease in Phytoplankton Biomass and Water Clarity Increase after the 30% and 50% Nutrient Reductions



Change in Primary Production: 300 to 200 $\text{gC m}^{-2} \text{y}^{-1}$



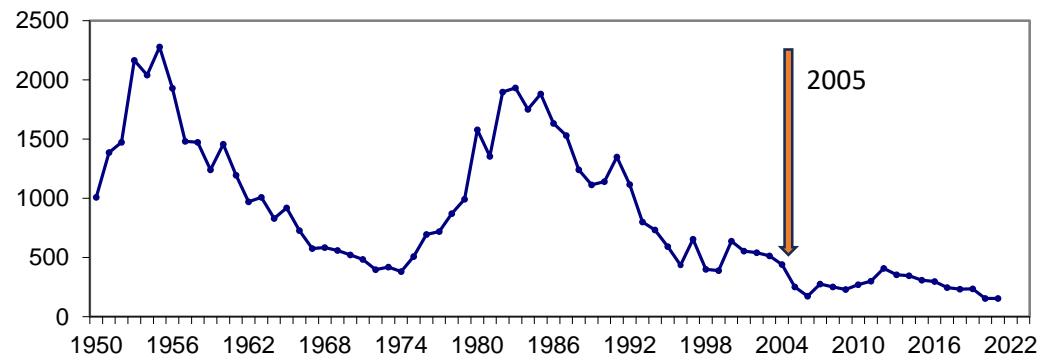
Annual primary production dropped by a third after managed nutrient reduction by 2012 and increased after flood year 2010 and storm year 2018 nutrient enhancements.



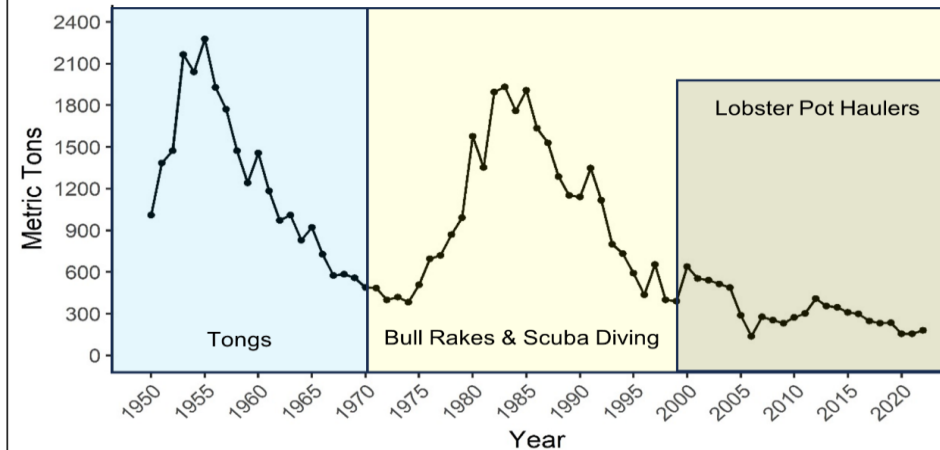
Were quahogs reduced by the nutrient reduction?

- 1) Landings evidence not clear:
Reduction in landings started earlier than decrease in nutrients.
- 2) Clam condition in the Upper Bay declined after nutrient reduction.
- 3) Clam condition after spawning does Increase sooner with nutrient enrichment.
- 4) An option to Increase nutrients in Bay areas without causing hypoxia.

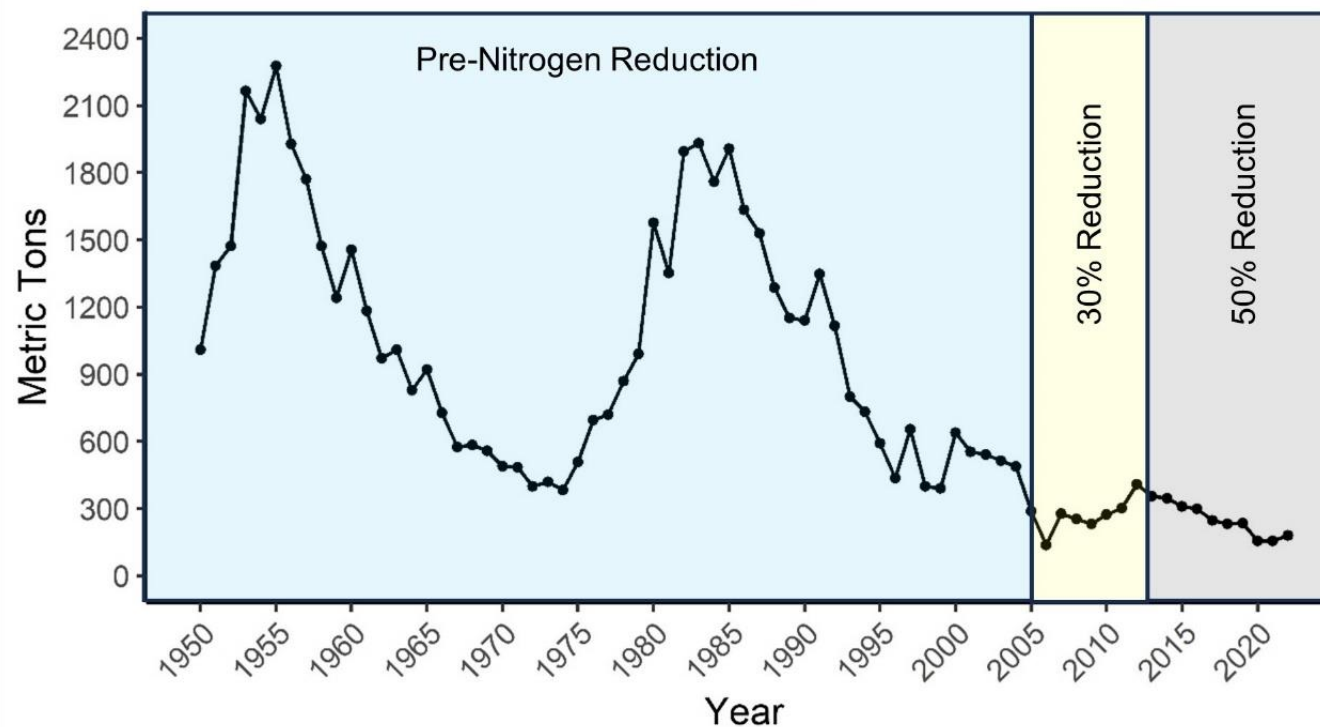
RI Landings Quahog, MT ww



Rhode Island Hard Clam Landings



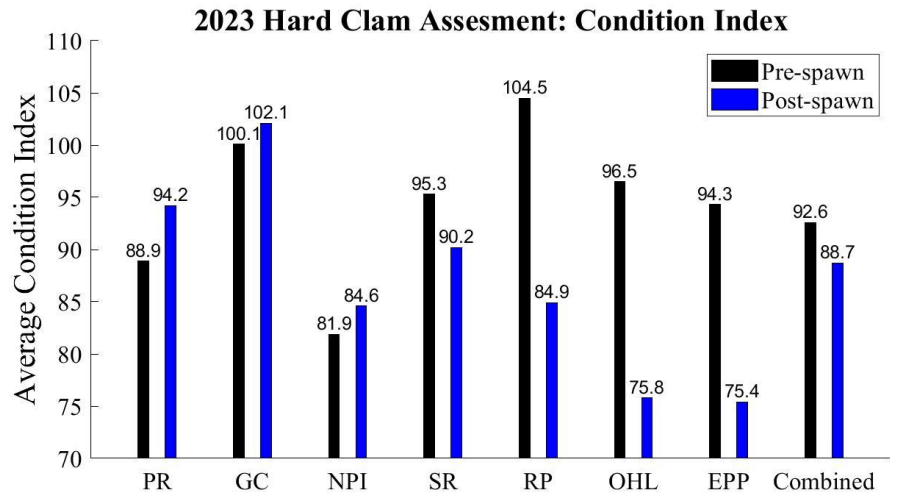
Rhode Island Hard Clam Landings



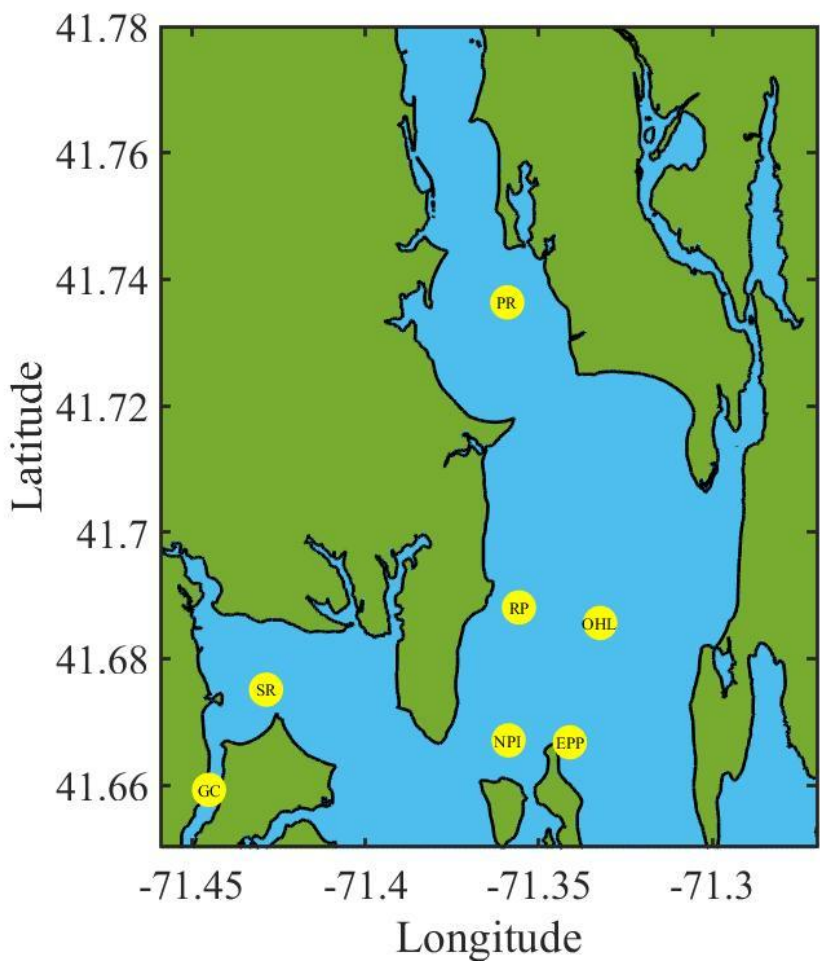
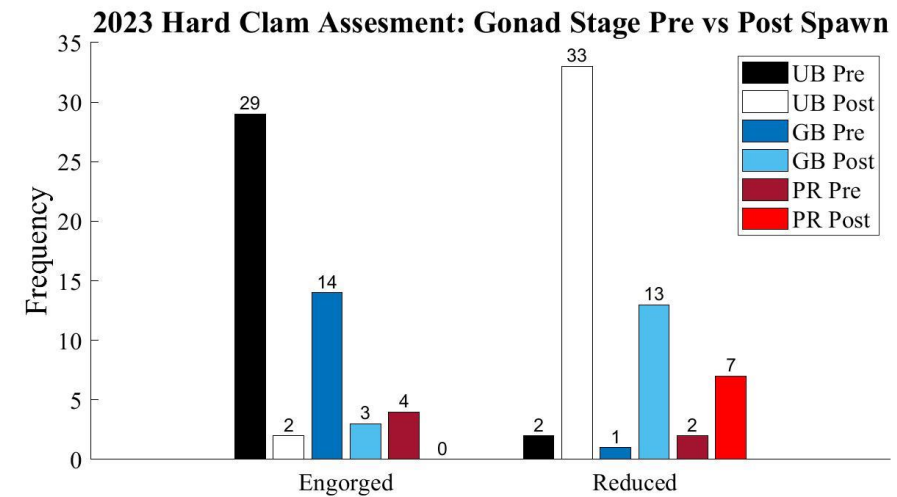
Evidence for the Impact of Nutrient Reduction on Clams:

After the 50% nutrient reduction, quahog fishermen have reported fewer animals, some in poor condition and dying, in the upper Bay Ohio Ledge area. Hard clam condition at Ohio Ledge, as measured by shell weight to meat volume of 6 kg L⁻¹ in 2008 to 9 kg L⁻¹ in 2019, suggested the animals may have starved. By contrast in Greenwich Bay, where nutrients remain high, they were reported in good condition (Johnson, Mark, Rhode Island Quahogger, personal communication).

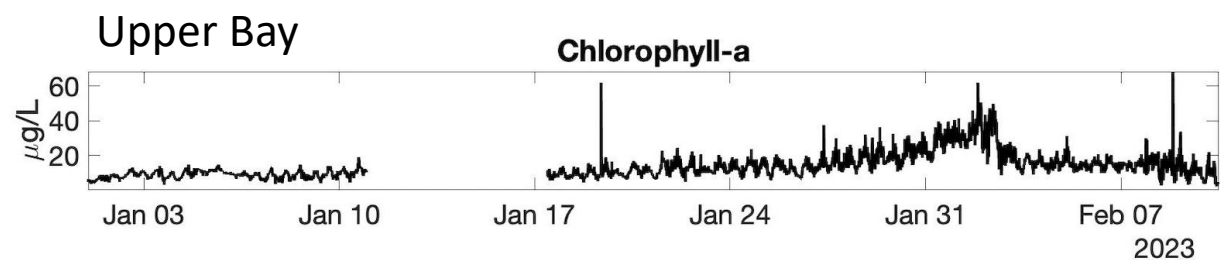
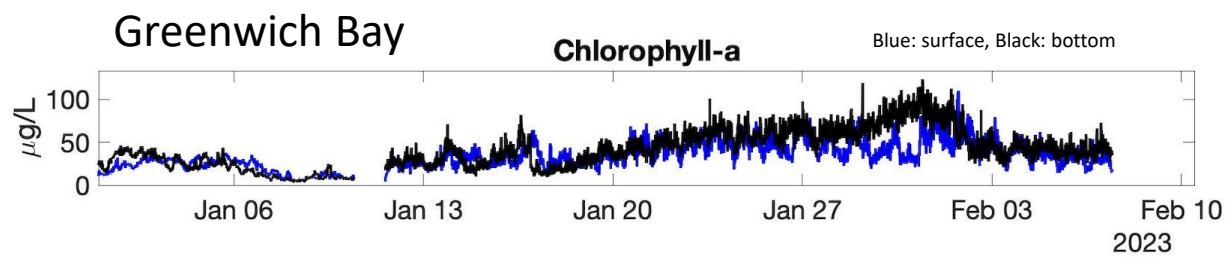
Clam in good Condition in Providence River, Upper Bay and Greenwich Bay In 2023



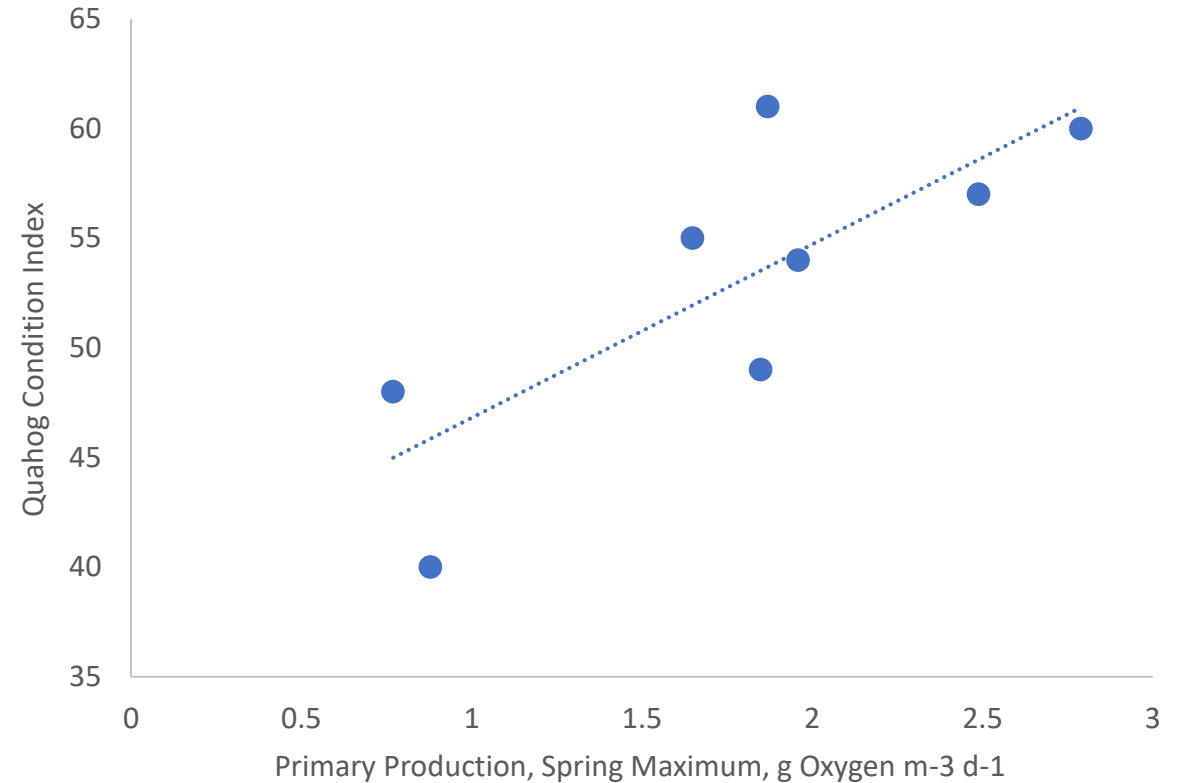
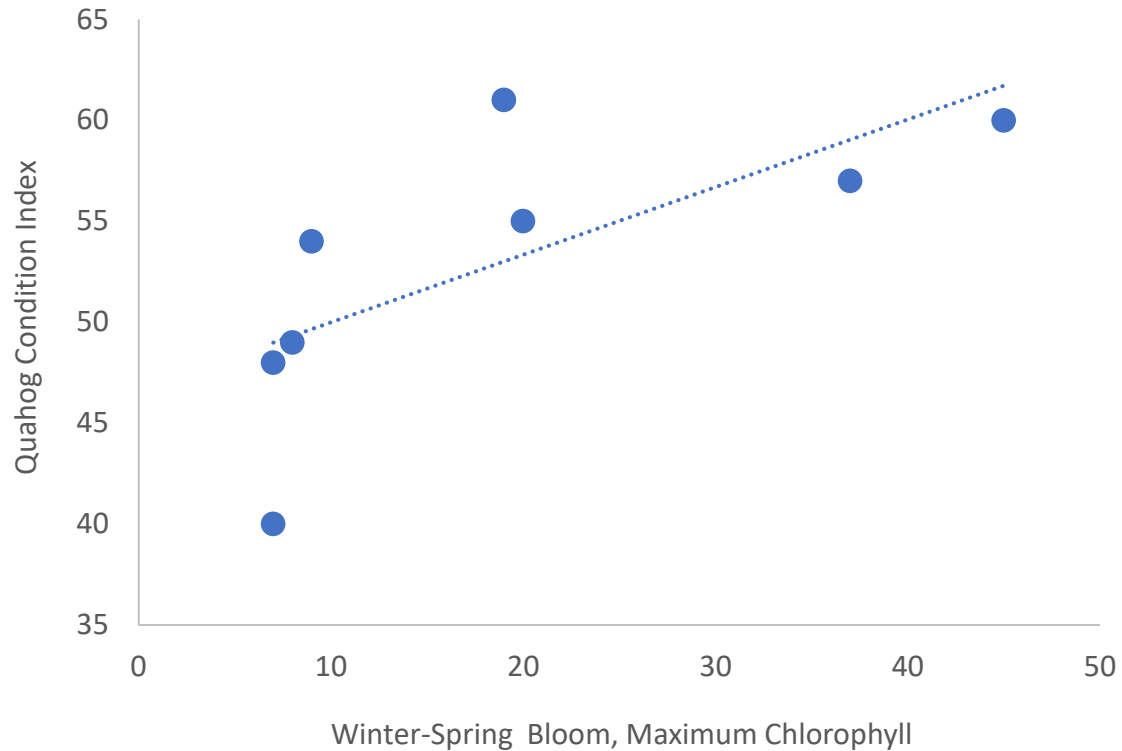
Samples courtesy of Mark Johnson
And Data from Michael Potter



Winter-Spring Bloom



Quahog Condition as a function of the Strength of the Winter-Spring Bloom



2021 Experiment from Michael Potter

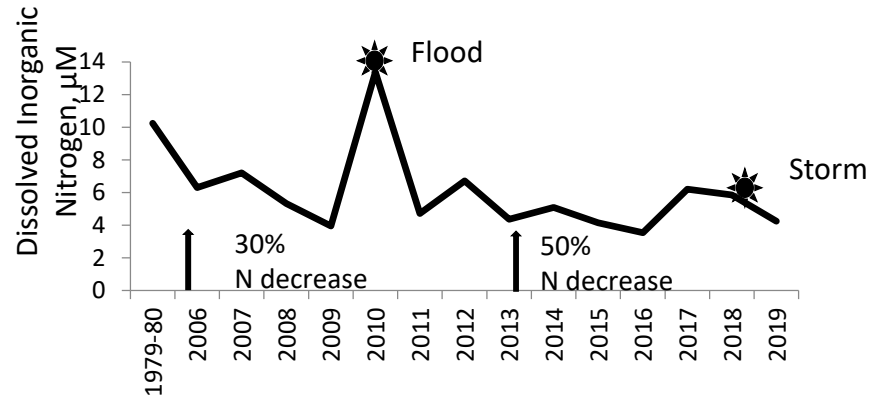
A Rationale for Winter Nutrient Release to Upper Narragansett Bay

A step toward increasing clam reproduction in the upper Bay quahogs may be winter release of nutrients. Recent literature indicates that most quahog growth occurs in the spring and in the fall after diatom blooms in the northeast US.

URI Sea Grant mesocosm experiments further suggest that the winter-spring diatom bloom enhances the reproductive potential of hard clams.

A management option to consider is the release of nutrients from the Narragansett Bay Commission's three big WWTFs on the Providence River to support a winter-spring bloom in the upper Bay. Our data indicate that summer hypoxia will not be a problem.

Standing stock of dissolved inorganic nitrogen during managed nitrogen reduction and storms.



Flood 2010

Providence, RI

16.34" of rain in March 2010
(up to 19" at some stations)

Storms 2017-2018

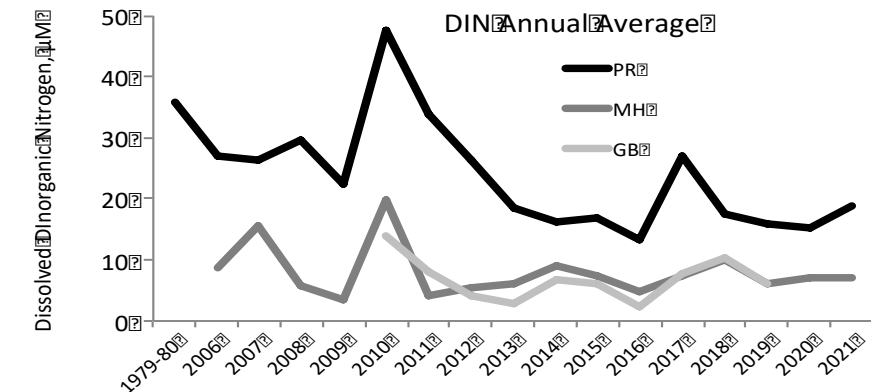
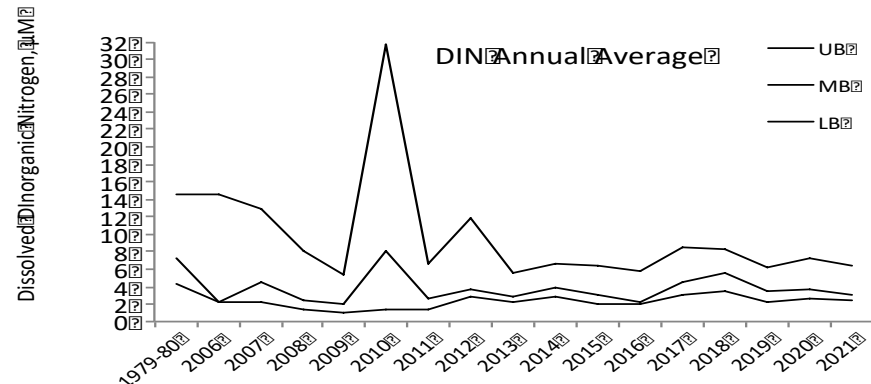
Kingston, RI

7.9" of rain October 2017

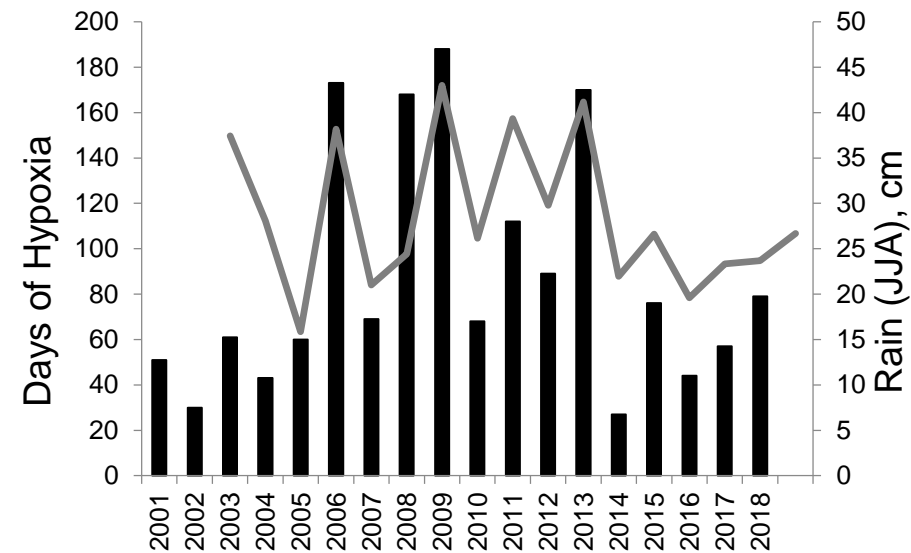
Providence, RI

5.44" of rain October 2017

14.8" of rain Fall (SOND) total
(up to 17" at some stations)



Days of summer hypoxia have tended lower since the managed nutrient reduction. Storm nutrients in colder months in 2010 and 2018 did not cause greater hypoxia than other non-rainy summers.



Nutrient release in winter does not
cause summer hypoxia!

Summary

Nutrient reduction has decreased primary production in the Bay by a third.

No evidence in quahog landings data that quahogs have decreased because of the nutrient reduction.

Fishermen have supplied evidence of quahogs in poor condition in the upper Bay after the nutrient reduction.

Field data indicate 1) quahogs in the upper Bay now in good condition and 2) quahogs recover from spawning faster in enriched environments such as Greenwich Bay and the Providence River compared to the upper Bay.

Experimental evidence suggests that quahog summer condition is improved by bigger winter-spring phytoplankton blooms.

An option for quahog improved condition is to release more sewage nutrients during the winter period when the nutrients will result in intense winter-spring phytoplankton blooms but not cause summer hypoxia.