Update on Progress of the Delaware River Basin Demonstration Project of the National Monitoring Network for Coastal Waters and Their Tributaries

National Water Quality Monitoring Council
National Conference
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Denver, Colorado

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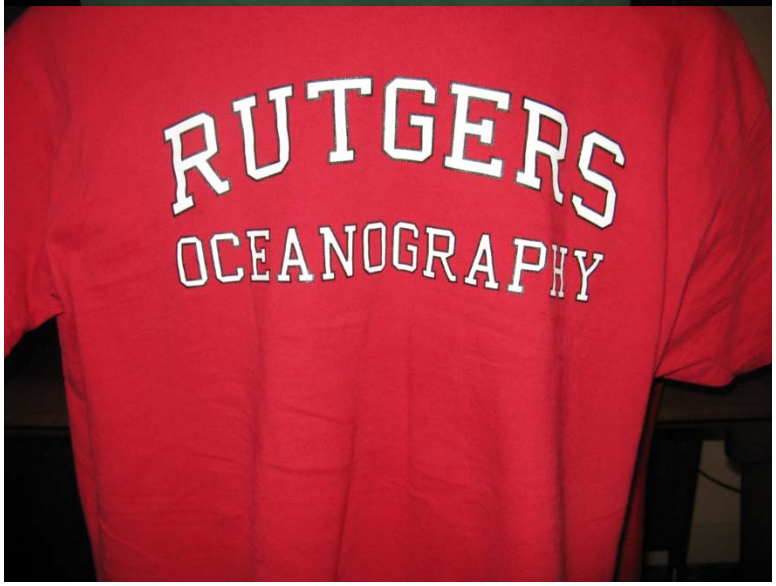
USGS science for a changing world

Delaware River Basin Commission

As part of my job with USGS I wear many “hats/shirts”



Objectives of Presentation

- Brief description of the Delaware Basin and estuary, cooperators, and Delaware Demo webpage
- Provide examples of integrating monitoring data (discrete, probabilistic, continuous, and Lagrangian) from multiple programs to tell the story of water-quality conditions (status and trends) from the watersheds, estuaries, to the ocean:
  - Biological--aquatic species: have shad been affected by poor water quality?
  - Physical—turbidity: What is the turbidity maxima?
  - Physical--dissolved oxygen: are hypoxic conditions present?
  - Chemical-nutrients: are nutrients part of the problem?
- Summary and where do we go from here

Collaborators
Delaware Demo Project
“Network of Networks”

EPA

US Army Corps of Engineers®

U.S. DEPARTMENT OF THE INTERIOR · MARCH 3, 1849

USGS science for a changing world

NOAA · NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION · U.S. DEPARTMENT OF COMMERCE

IOOS INTEGRATED OCEAN OBSERVING SYSTEM

PARTNERSHIP FOR THE DELAWARE ESTUARY INC.

THE ACADEMY OF NATURAL SCIENCES

NWQMC · NATIONAL WATER QUALITY MONITORING COUNCIL · Working Together for Clean Water

MACOORA · Ocean Information for a Changing World

Mid-Atlantic Regional Council on the Ocean · New York New Jersey Delaware Maryland Virginia

Delaware River Basin Commission · DELAWARE · NEW JERSEY · PENNSYLVANIA · NEW YORK · UNITED STATES OF AMERICA

Philadelphia Water Department

New Jersey Water Monitoring Coordinating Council · NJWMCC

pennsylvania · DEPARTMENT OF ENVIRONMENTAL PROTECTION

RUTGERS · JERSEY ROOTS, GLOBAL REACH · COASTAL OCEAN OBSERVATION LAB

UNIVERSITY OF DELAWARE · COLLEGE OF EARTH, OCEAN, AND ENVIRONMENT

Volunteer Monitoring

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DEPARTMENT OF ENVIRONMENTAL CONSERVATION · NEW YORK STATE

New Jersey Water Science Center

Delaware River at Reigelsville, N.J.

NATIONAL WATER QUALITY MONITORING COUNCIL
Working Together for Clean Water
NWQMC

National Monitoring Network

Purpose

The goal of the Network is to provide information about the health of our oceans and coastal ecosystems and inland influences on coastal waters for improved management.

Project proposal summary

National Monitoring Network Pilots and Demonstration Areas

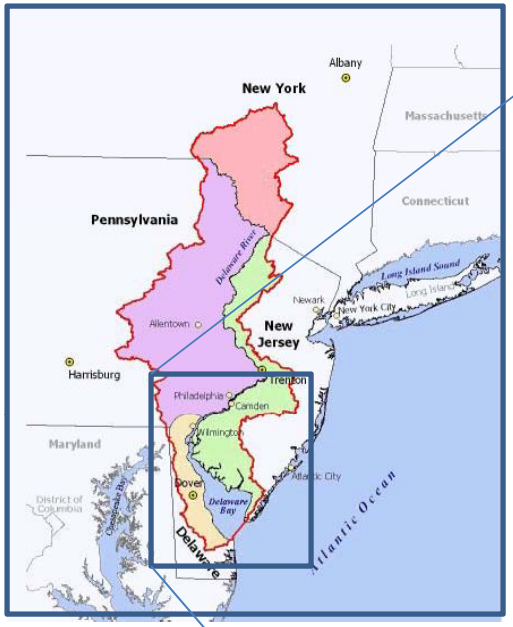
Delaware Bay

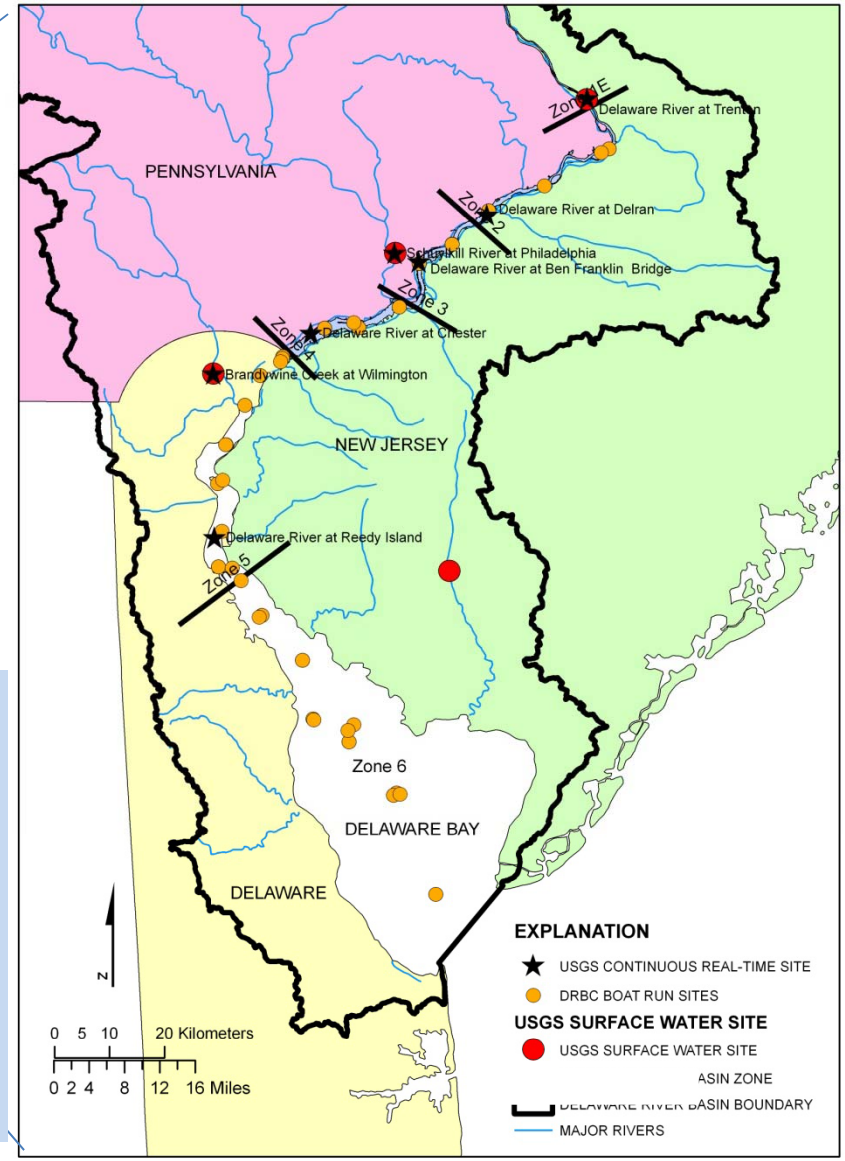
The Delaware Basin encompasses 13,539 square miles (mi) and contains one of the longest un-dammed rivers in the United States, extending 330 miles from the confluence of its East and West branches at Hancock, N.Y. to the mouth of the Delaware Bay. Significant amounts of historical and current water-quality monitoring (physical, chemical, and biological) has been conducted in the watersheds, estuaries, near-shore, and off-shore parts of the basin by Federal, State, local, private, and academic entities. It is the intent of this effort to inventory, compare methods, and enhance data exchange in support of the National Monitoring Network. The watershed is home to more than 200 fish species, and provides habitat for federally protected endangered species such as dwarf wedgemussels, short-nose sturgeon, bald eagles, and bog turtles. Nearly 15 million people (about 5% of the nation's population) rely on the waters of the Basin for drinking water which includes about 7 million people in New York City and northern New Jersey who live outside the Basin.

Partnerships	Reports	Applications and Models	Monitoring	Data Links
Click here to find out more about those involved in monitoring in the Delaware Basin.	Click here to find out more about published reports from various Federal, State, and Local agencies, universities, and volunteers.	Click here to find out more about water quality models and users of the data.	Click here to find out more about what monitoring has or is taking place in the Delaware River, estuary, and coastal areas.	Click here to find out where to find water-quality data or for the Delaware River, estuary, and coastal areas.

http://nj.usgs.gov/projects/2454BSB/natmonitornet/

Monitoring using USGS Coastal Action Funds



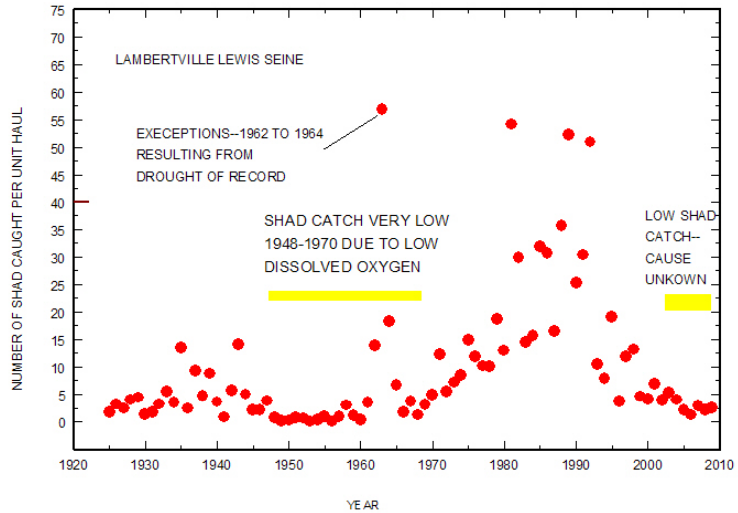


- Trenton is sampled like a NASQAN site
  - http://water.usgs.gov/nasqan/
  - 12-16 times per year
  - Major ions, nutrients, carbon, selected pesticides
- Added continuous real-time site sondes
  - New site in Zone 2 @ Delran (T, pH, SC, DO, turbidity)
  - Added turbidity at Ben Franklin and Reedy Island sites
- Supplemented nutrient analyses at:
  - DRBC Boat Run Sites
  - Trenton, Schuylkill, Brandywine, and Maurice Rivers

Shad as an aquatic species indicator

Source: M. Meserve; written comm. 2010

Source: Newark Star Ledger, 4/21/2010



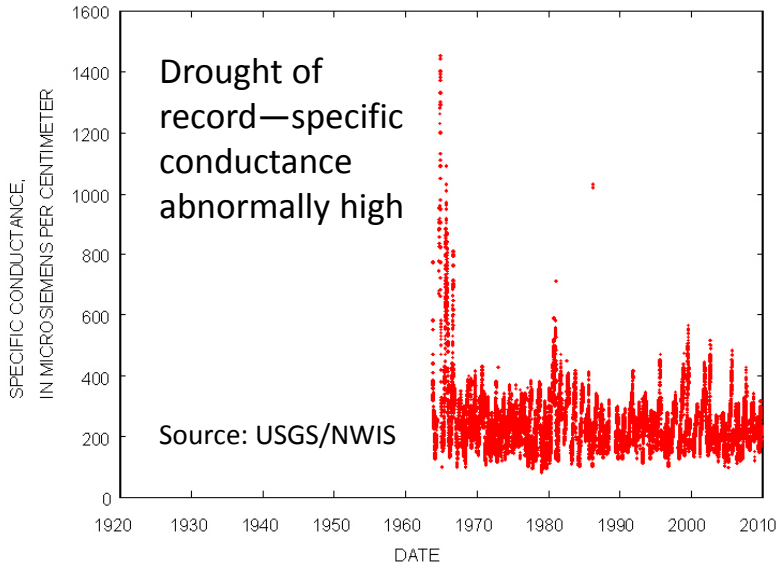
Shad catch per haul at Lewis Seine in Lambertville, NJ

Shad

- Species is anadromous—lives in salt water but spawns in freshwater
- Spawns April to June and returns to saltwater in August
- did not do well from 1940-1970
- some recovery in 1980-1995 followed by decline again—causes not known

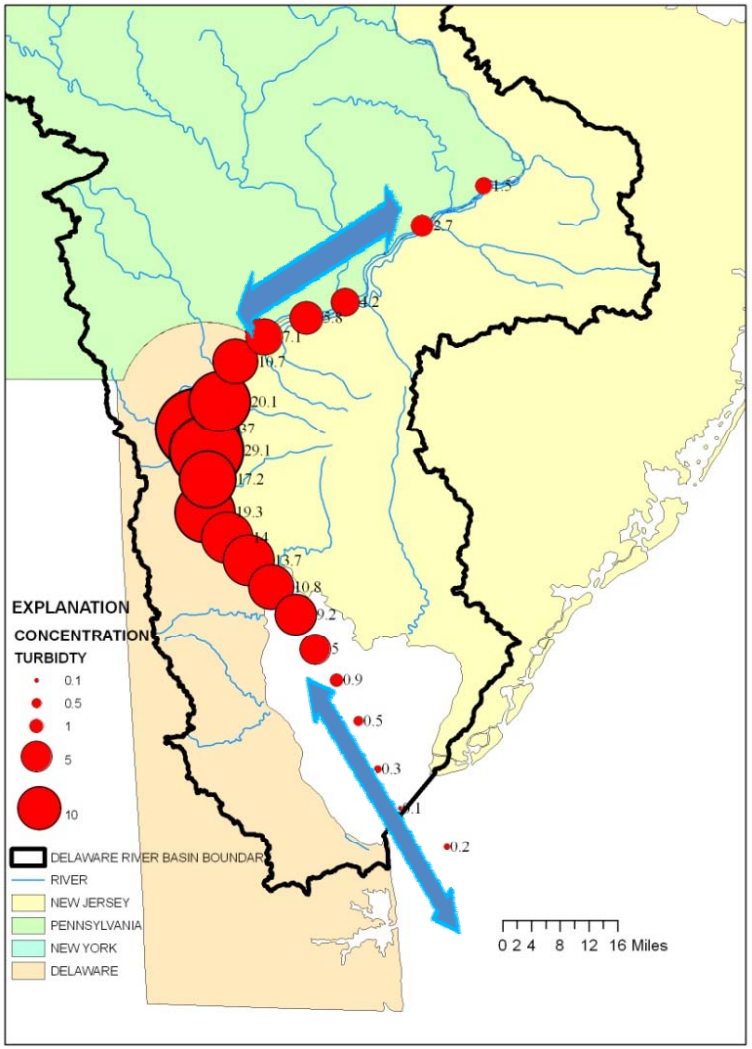
Other organisms of concern

- sturgeon (may be more sensitive than shad)
- shellfish—oysters and clams
- horseshoe crabs and red knot birds



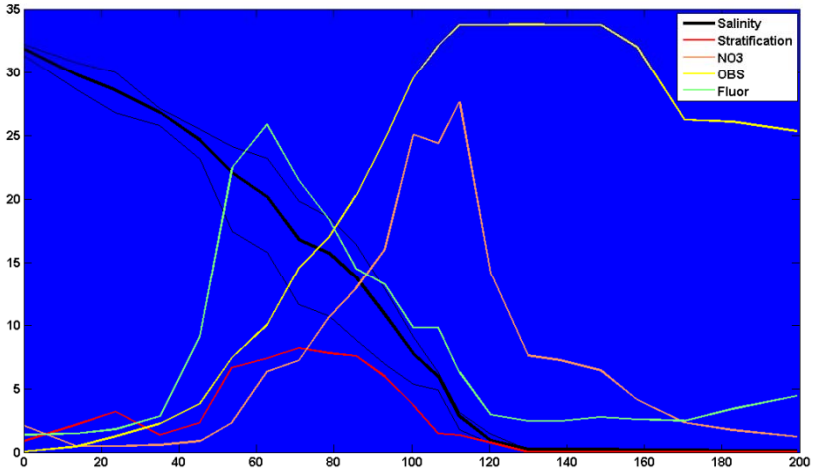
Specific conductance at Delaware River at Trenton, NJ

Turbidity maxima and estuary stratification



Source: Continuous turbidity sensor deployed by USGS 3/12/2010--unpublished data subject to revision

Sensors deployed by Rutgers IMCS on cruise from March 2010. Graph below by R. Chant, IMCS written commun. 2010.



Graph showing relation of various water-quality parameter to turbidity maximum and salinity 3/12/2010--unpublished data subject to revision

The Delaware River—a system in recovery

AN URGENT CALL TO ACTION
REPORT OF THE STATE-EPA
NUTRIENT INNOVATIONS TASK GROUP

NEST Indicator: Hypoxia in U.S. coastal waters

- Dissolved oxygen in water:
  - <2 mg/L (poor--hypoxic)
  - 2-5 mg/L (fair)
  - >5 mg/L (good)
- Oxygen depletion is the most readily recognized symptom of environmental degradation
- Related to fish, bivalve, and crab kills

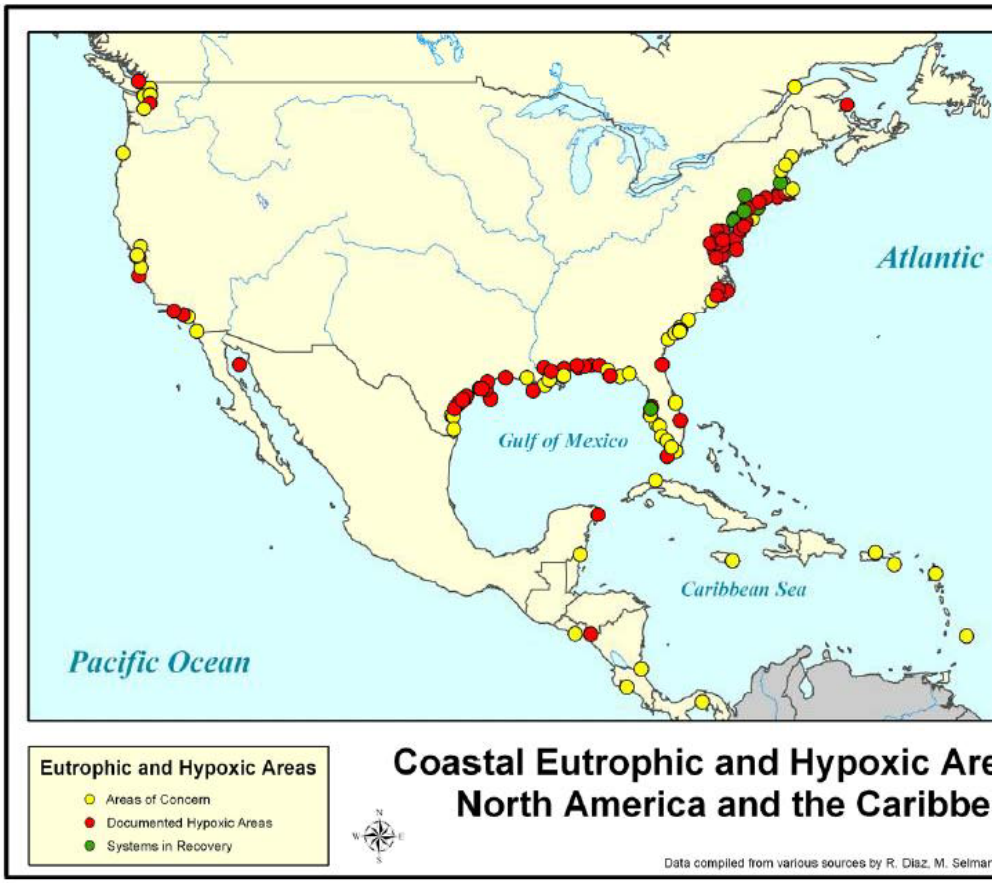
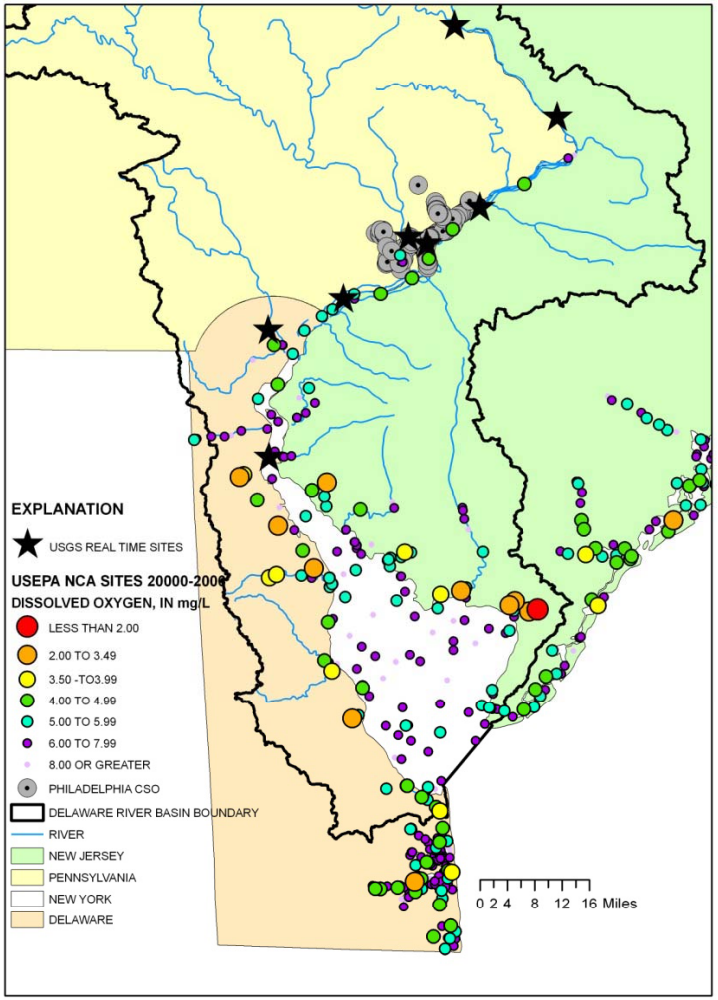


Figure 6. Hypoxic zone locations (Selman et al. 2008).

Coastal monitoring of DO

- EPA Probabilistic design
  - Discrete but random sites each year
  - One measurement per year usually in summer
  - Seven years of record
  - National snapshot
- NJDEP Marine Monitoring data are discrete and recurring sites
- [DO] spatial trends
  - Rarely below 2 mg/L
  - Smaller [DO] near the coastline—more pressure from human activities
  - Center of channel better mixed and [DO] larger

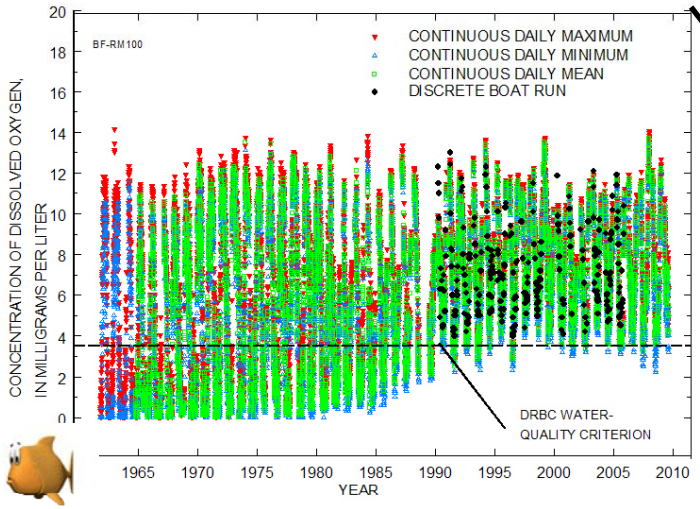


Source: USEPA NCA AND NJDEP Marine data

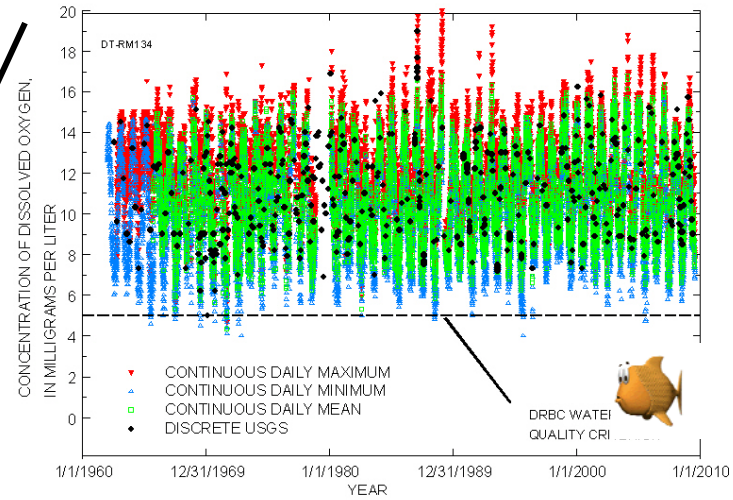
DISSOLVED OXYGEN IN THE DELAWARE BASIN AND ESTUARY

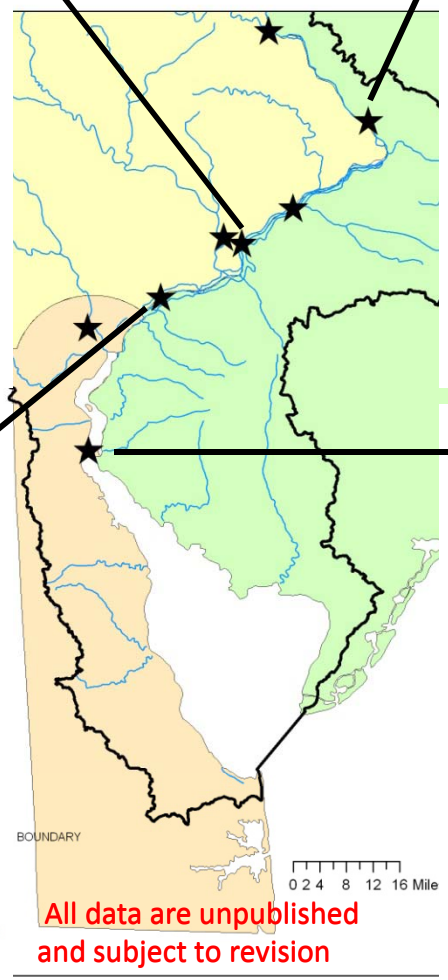
USGS CONTINUOUS-REAL TIME AND DISCRETE DATA from USGS and DRBC Boat Runs
Different [DO] Criteria in different parts of Delaware River
3.5 mg/L [DO] needed for shad to spawn

AT BEN FRANKLIN BRIDGE



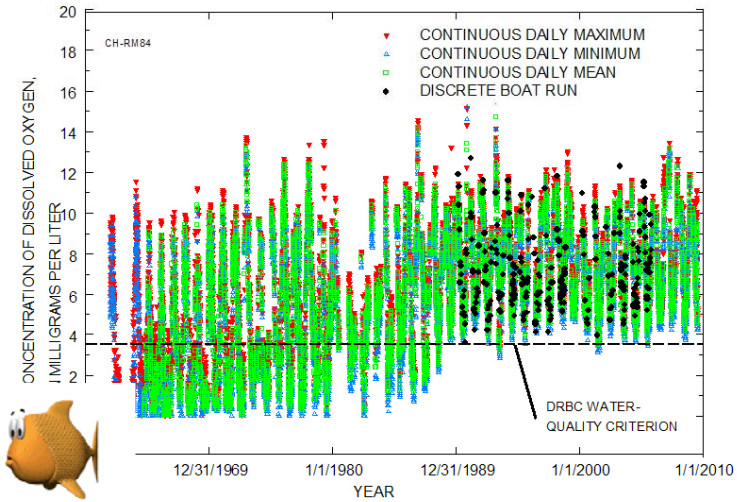
AT TRENTON



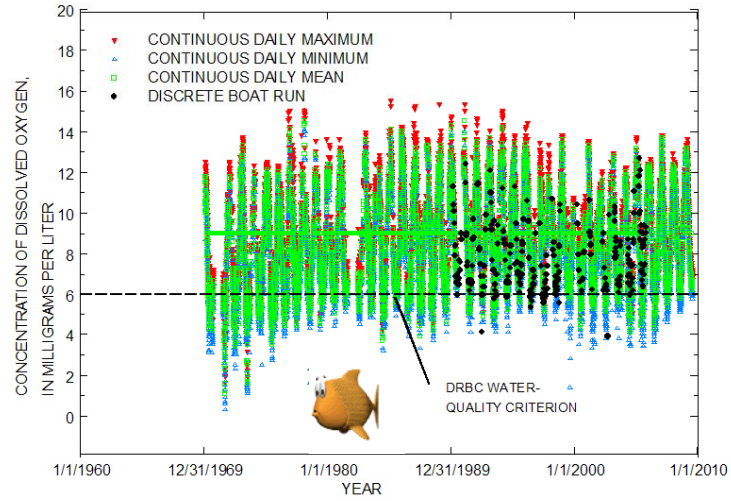


All data are unpublished and subject to revision

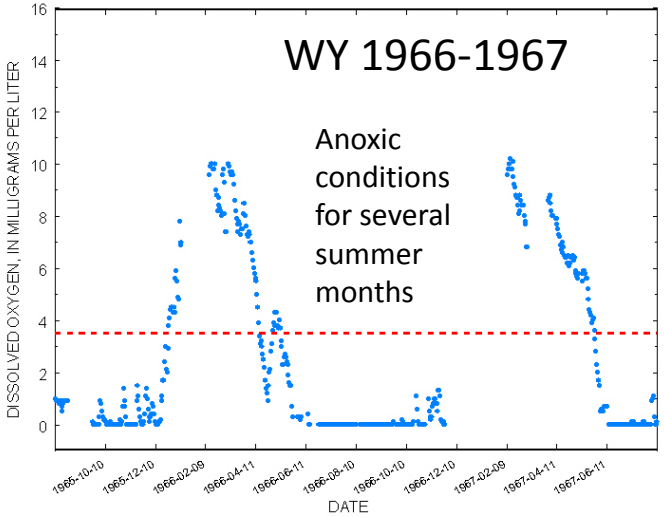
AT CHESTER

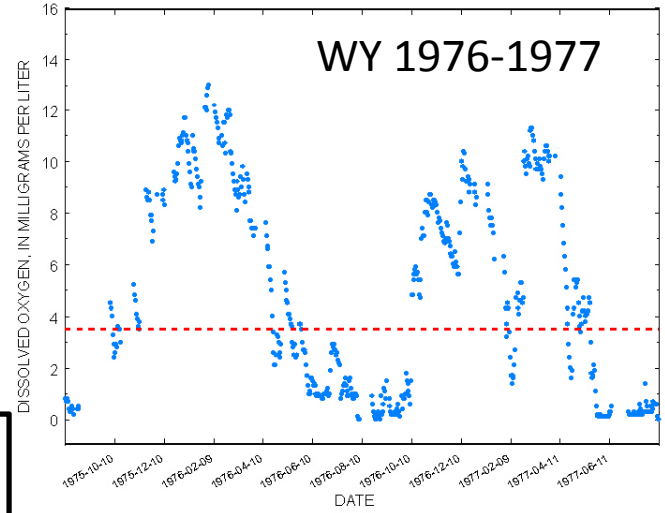


AT REEDY ISLAND

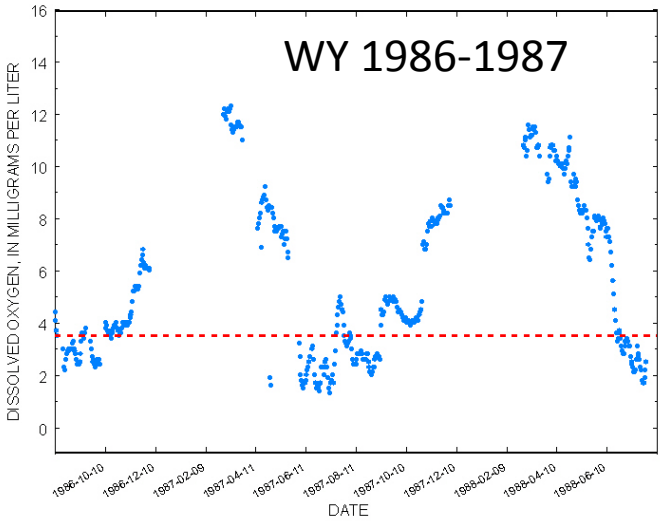


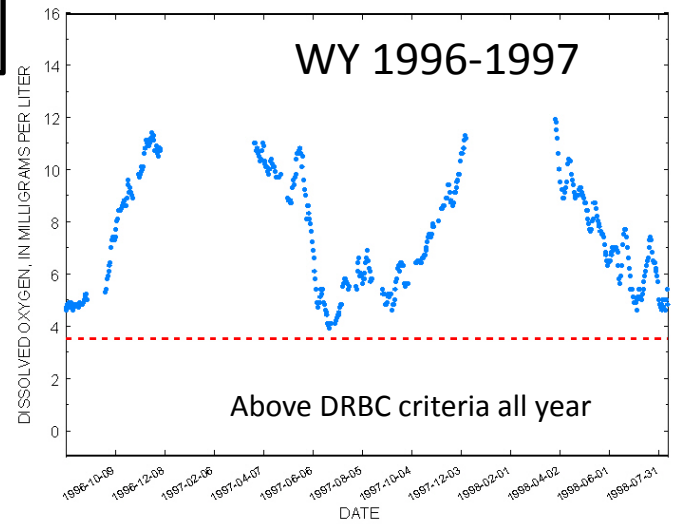
Continuous estuary monitoring of minimum dissolved oxygen at the Ben Franklin Bridge





DRBC Water Quality Criteria set at 3.5 mg/L





Selected water quality data in the Delaware Estuary by kilometer by decade and season

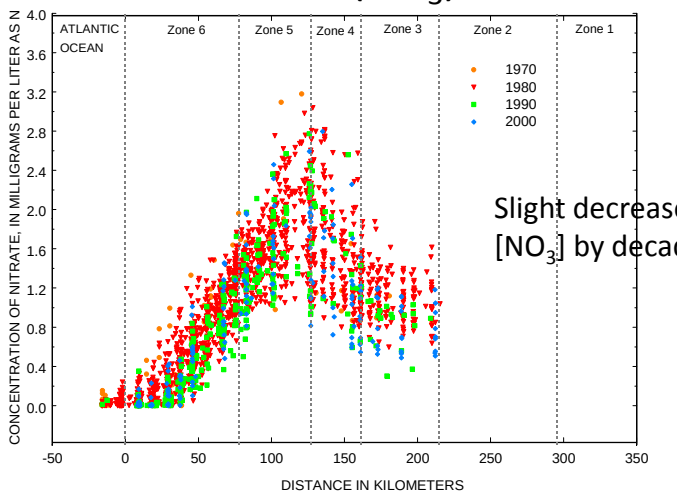
Estuaries and Coasts (2009) 32:1023–1043
DOI 10.1007/s12237-009-9210-8

REVIEW PAPER

A Biogeochemical View of Estuarine Eutrophication: Seasonal and Spatial Trends and Correlations in the Delaware Estuary

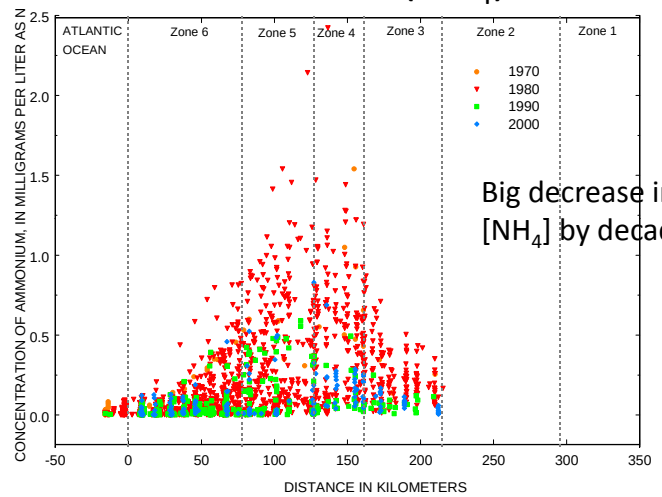
Jonathan H. Sharp · Kohei Yoshiyama · Alexander E. Parker · Matthew C. Schwartz · Susan E. Curless · Allison Y. Beauregard · Justin E. Ossolinski · Allen R. Davis

Nitrate (NO_3)



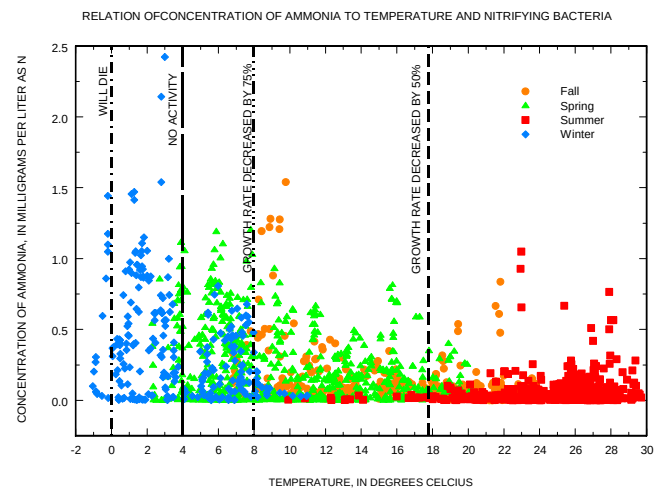
Slight decrease in [NO_3] by decade

Ammonium (NH_4)



Big decrease in [NH_4] by decade

- [NO_3] are largest in Zones 4-5 due to STP discharges
- Harmful algal blooms are rare in the estuary & bay
- [NH_4] were greatest in Zones 4-5 in the 1980's but have declined due to less input from STPs
- Ammonia is very toxic to fish http://www.epa.gov/waterscience/criteria/ammonia/
- [NH_4] very high during the winter and spring when shad are running in the estuary to spawn
- Toxicity increases with higher pH which is greatest in spring due to increased phytoplankton activity.

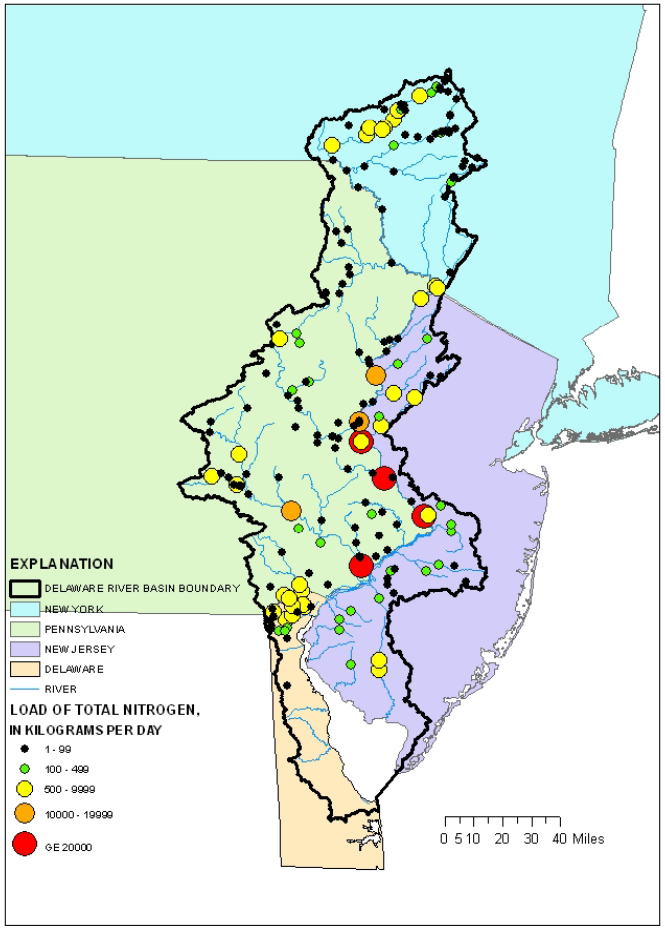


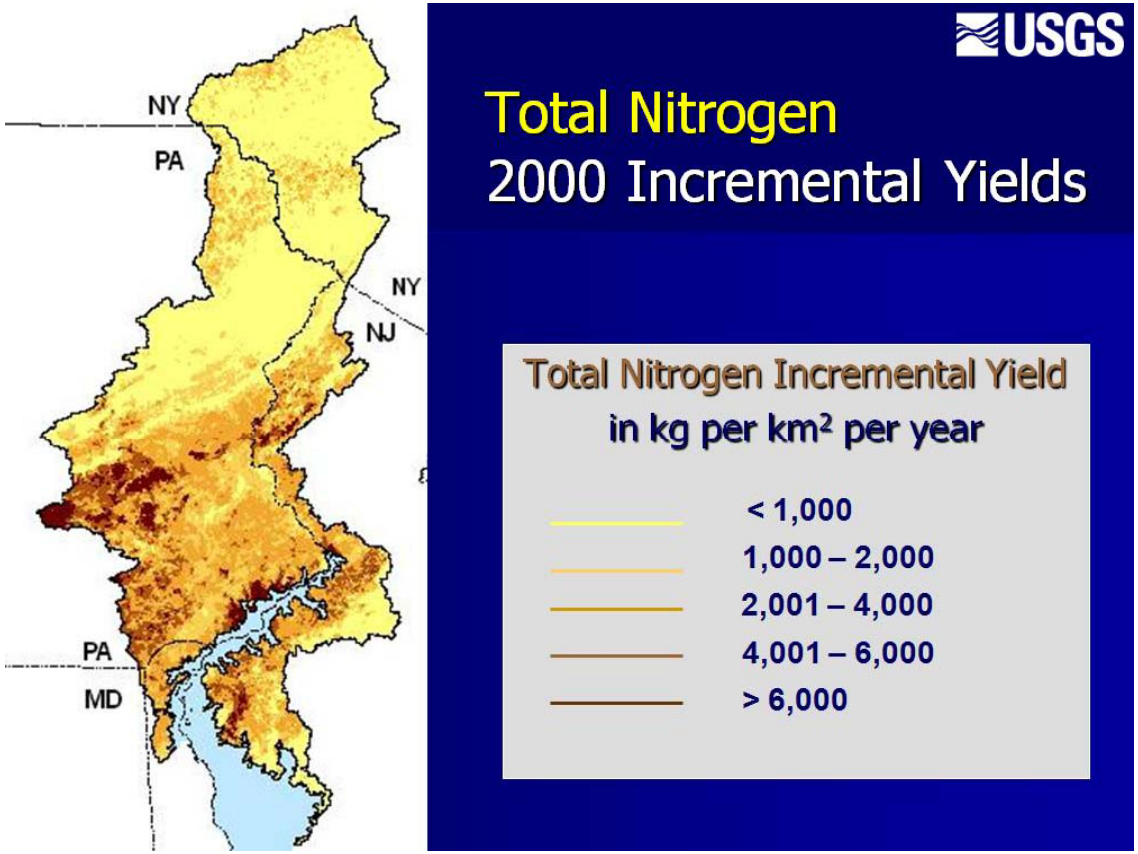
Watersheds surface-water monitoring and modeling above the head of tide

Total Nitrogen Loads in the Delaware Basin --2001

USGS SPARROW MODEL FOR DELAWARE BASIN

Source: Mary Chepiga, USGS NJWSC unpublished data subject to revision





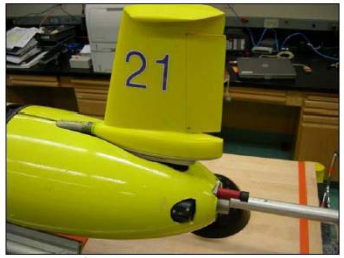
Ocean and near shore monitoring

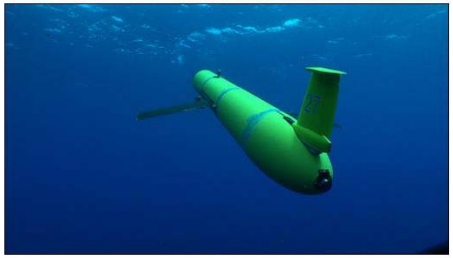
(Source: Josh Kohut of Rutgers IMCS and Robert Connell, NJDEP)

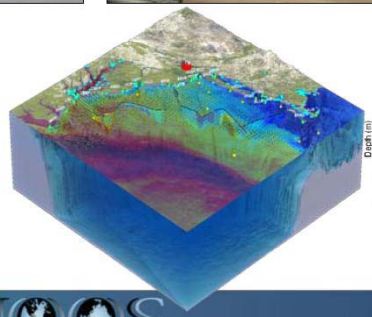
Autonomous Platforms: Dissolved Oxygen

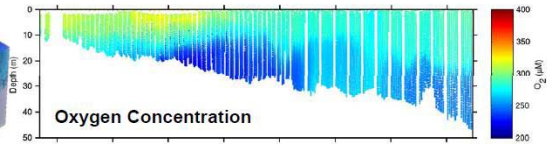
Aanderra Optode

NJDEP
EPA
Rutgers
MACOORA





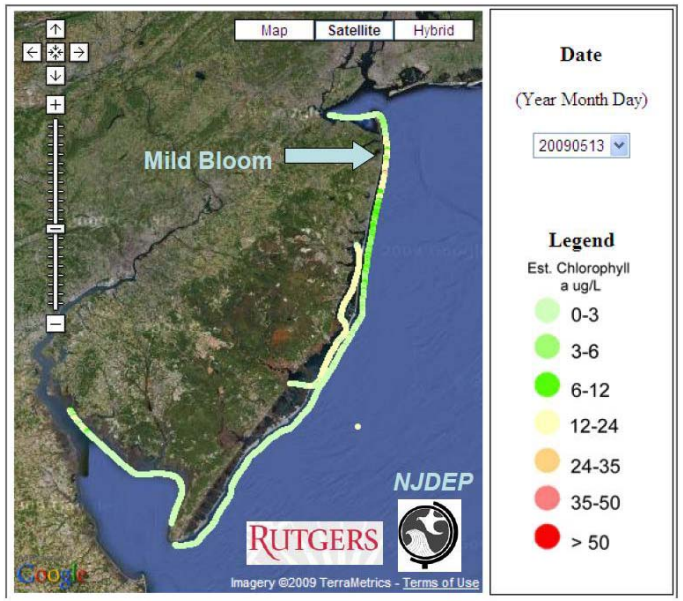




IOOS

Phytoplankton Monitoring in the Age of IOOS

- Aircraft Remote Sensing
- Thousands of measurements each day
- Near-daily flights by piggybacking on coastal surveillance flights
- State-wide coverage in one day
- ID's bloom locations to target vessel sampling & algal species ID by microscopy.



Summary

- Extremely good cooperation among agencies in Delaware Basin due to presence of DRBC
- Delaware Basin is rich in data for biological, physical, and chemical monitoring and modeling
- Data management and sharing of data is becoming easier
- Able to mix different types of water-quality data (discrete, probabilistic, continuous, and Lagrangian) from different sources to tell stories of status and trends in water quality in the Delaware Basin
- Program development is happening at many agencies and universities as direct relation to Demonstration Phase in Delaware Basin
- Use of continuous monitoring and new technologies have been significant
- Data indicate that there has been significant improvement in [DO] in the estuary which was anoxic or hypoxic for several decades.
- Through improvements to point-source discharges during the 1970's and 1980's the basin was engineered to improve [DO] (reduction of ammonium) so that shad and other aquatic species could survive and spawn
- The effects of non-point source contamination controls on water-quality are not as evident

Where do we go from here?

- Continue good cooperation among agencies in Delaware Basin to connect watersheds to the estuaries to the coasts
- Work with MACOORA, MARCO and others to keep water-quality monitoring/modeling in the forefront of issues facing the region
- Need a dedicated group of scientists from USGS (water quality, sediment, and biologist) to work with Federal, State, and local agencies to better understand the dynamics of the ecosystem and link watersheds, to estuaries to coasts
- Increase continuous real-time monitoring in the study area and expand to new sensors that are well tested in the lab and field
- Need to integrate data and modeling more effectively
- Work with DRBC, universities, and other agencies to better understand sediment, carbon, nutrient, salinity, and other water-quality constituents on ecosystem
- Work with U.S. EPA on understanding nutrient criteria and ecological services for nutrients and other chemicals of concern
- Develop eutrophication and other relevant models to better understand the effects of human activities on the evolving dynamics of the basin and estuary