Spatial and temporal trends in dissolved oxygen concentrations and dissolved oxygen depletion (hypoxia)

in the Delaware River Basin Demonstration Area of the National Monitoring Network for Coastal Waters and Their Tributaries

Water Quality Workshop

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Eric Vowinkel, USGS/NJWSC

vowinkel@usgs.gov

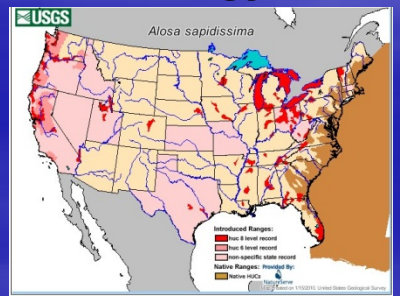
Bob Tudor, DRBC

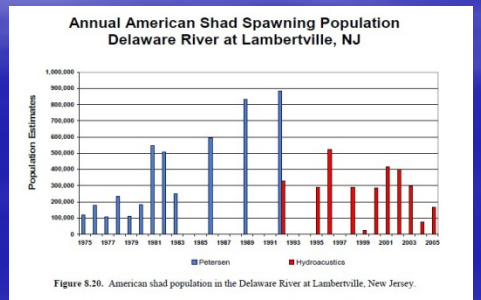
Robert.Tudor@drbc.state.nj.us

Water Quality Issues

For the Delaware River Basin for dissolved oxygen (DO):

- **Evaluate of the spatial (horizontal and vertical) and temporal distributions (status, trends, and current) [DO] and DO depletion in the Delaware River Basin from the head of tide to the Atlantic Ocean.**
- **Determine the aquatic health (Clean Water Act) of the water in rivers above the head of tide, estuaries, wetlands, coastal areas, and ocean areas of the Delaware Basin as per criteria set by the Delaware River Basin Commission (DRBC) and the individual states in the Basin.**
- **Evaluate of the use of continuous/real time, discrete, and probabilistic observations of [DO] by agencies including DRBC, USGS, USEPA, NOAA, and States, and water utilities and universities. (*All observations have value but some are more valuable than others*)**
- **Evaluate the effects of nutrients and other water-quality constituents on DO concentrations in water**
- **Relate of DO depletion to the biology of the Delaware Basin such as the shad population**





New Jersey Water Science Center

Delaware River at Reiglesville, 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.

User Community:
Who cares and benefits from these products?

- Federal (NOAA, USEPA, USGS, USACOE), Interstate (DRBC), State (NY, PA, NJ, DE), and local water-quality managers and scientists
- water and wastewater utilites
- commerce as the Delaware Estuary is one of Nation's largest ports
- fishermen
- the public

Process:

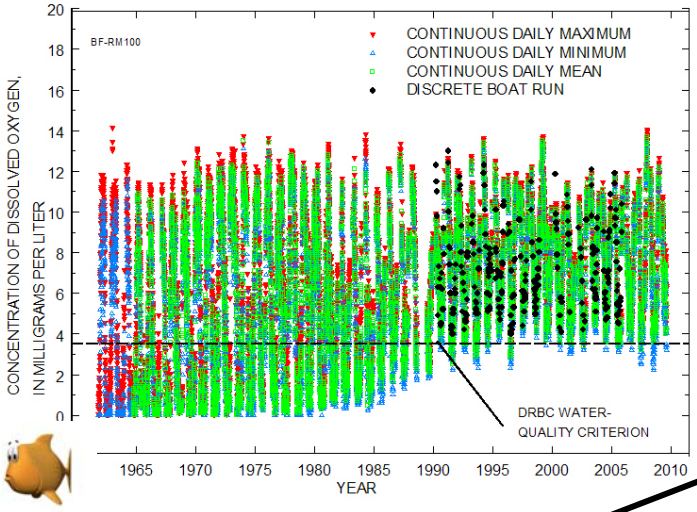
(coupling monitoring, models and other tools for enhanced assessment that benefits management decisions from the watersheds to nearshore to coasts)

- **Networks: Integration across multiple programs and networks** Data Links
  - NOAA: NEERS , PORTS, MW -- States
  - USEPA: NCA -- Universities
  - USGS: NAWQA, NASQAN -- Partnership Del Est (PDE)
  - DRBC: Boat Run -- National Monitoring Network
- **Linking continuous monitoring stations, discrete, and probabilistic data to DRBC / State Water Quality Criteria by DRBC Zone**
- **Integration of models and other assessment tools with monitoring**

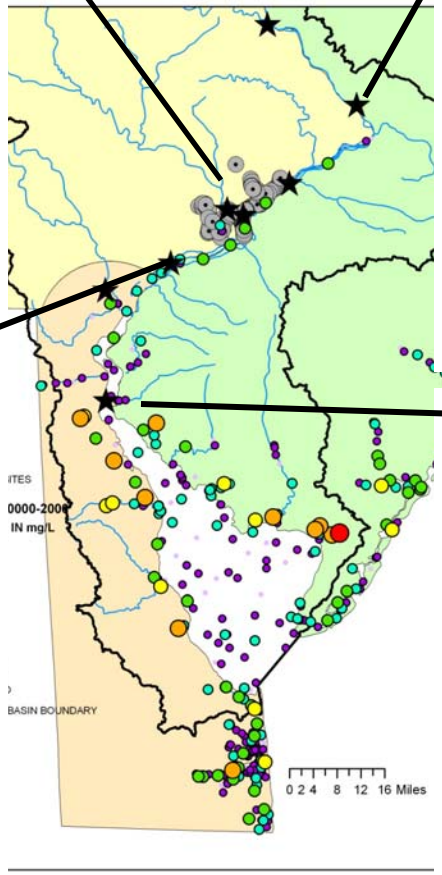
DISSOLVED OXYGEN IN THE DELAWARE BASIN AND ESTUARY

USGS CONTINUOUS-REAL TIME AND DISCRETE DATA AND DRBC and UDEL BOAT RUN DATA

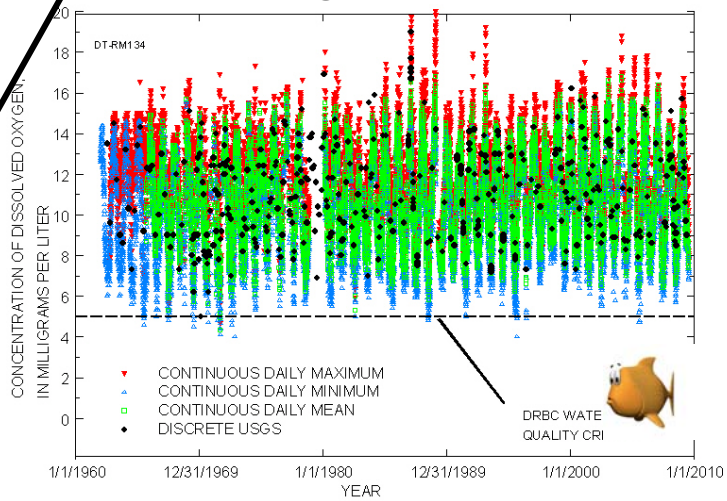
AT BEN FRANKLIN BRIDGE



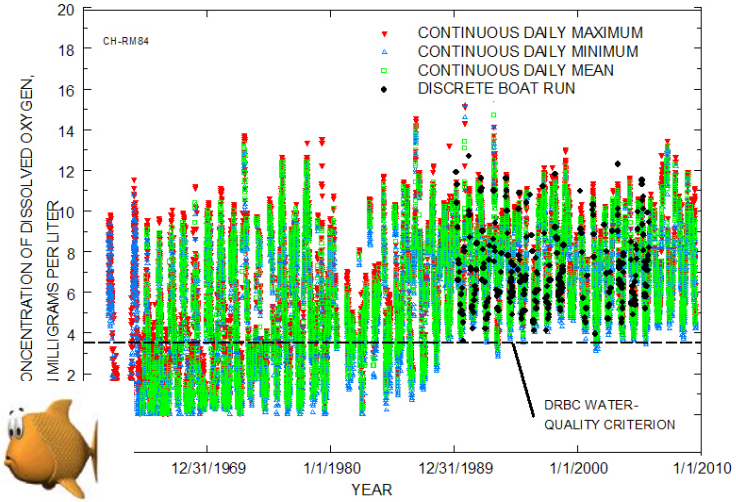
USEPA NCA Data 2001-2007



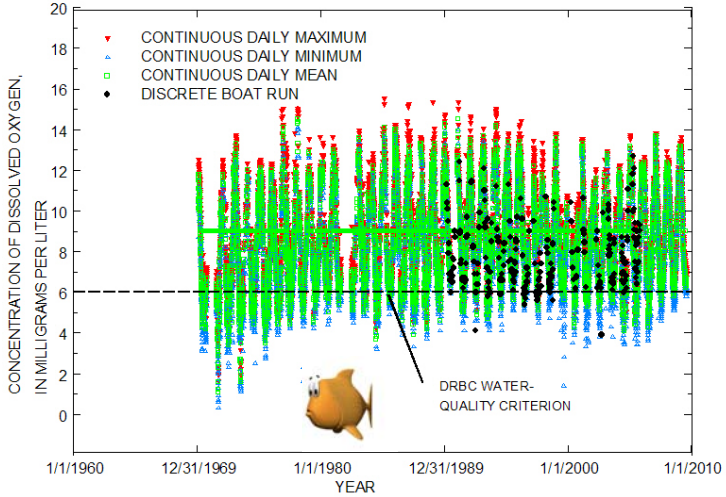
AT TRENTON



AT CHESTER



AT REEDY ISLAND



All data are unpublished and subject to revision

Selected water quality 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

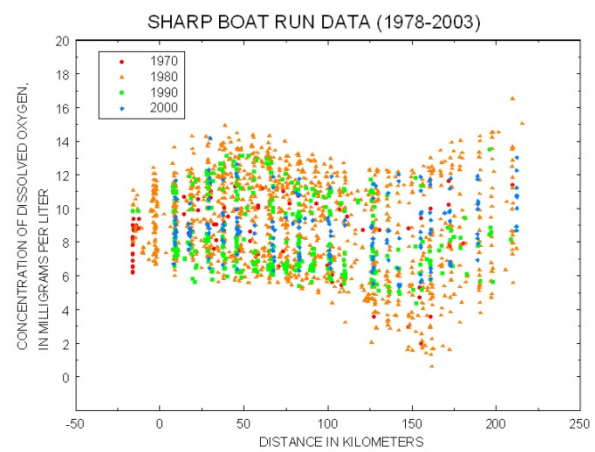
A Biogeochemical View of Estuarine Eutrophication: Seasonal and Spatial Trends and Correlations in the Delaware Estuary

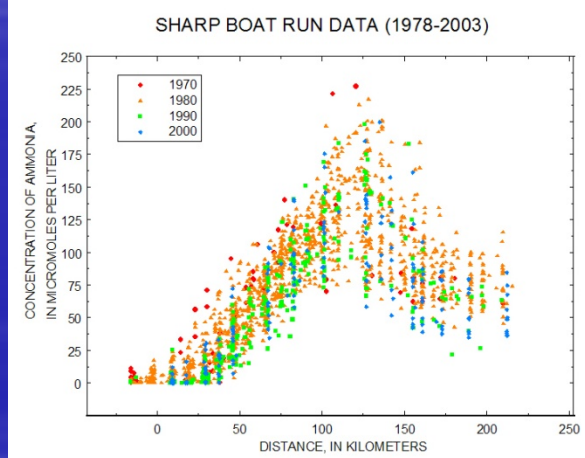
Jonathan H. Sharp · Kohei Yoshiyama · Alexander E. Parker · Matthew C. Schwartz · Susan E. Curless · Allison Y. Beauregard · Justin E. Ossolinski · Allen R. Davis

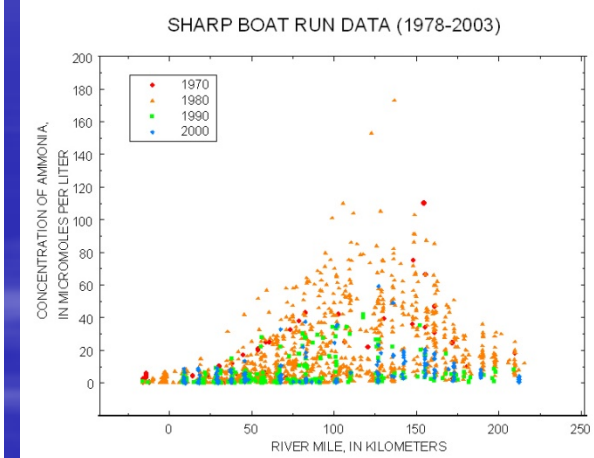
Dissolved oxygen (DO)

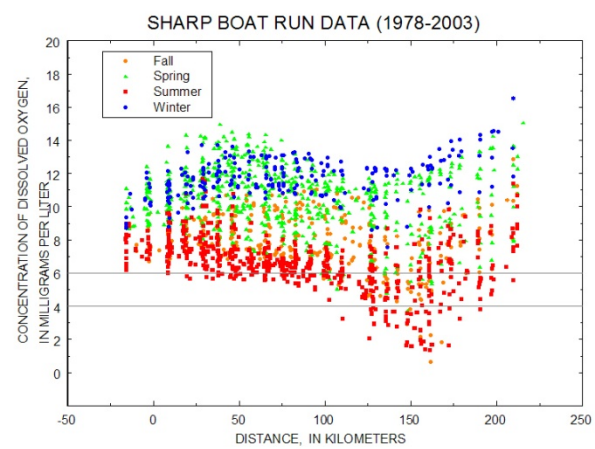
Nitrate (NO_3)

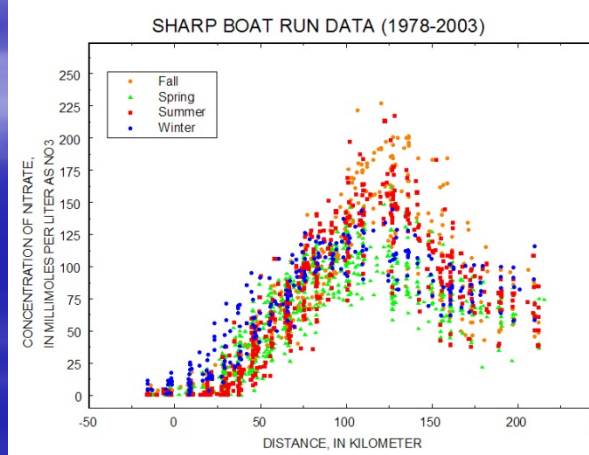
Ammonia (NH_4)

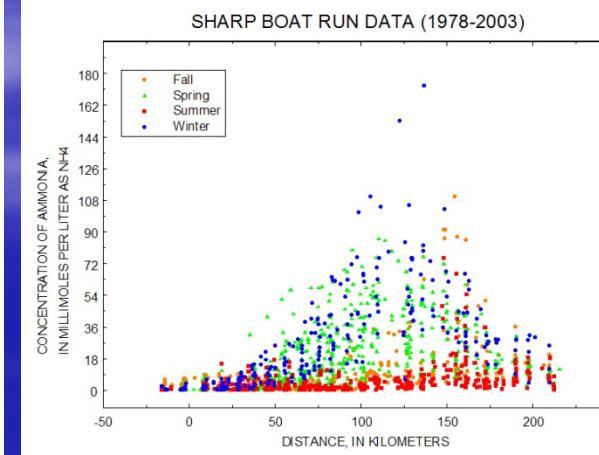












Models or Applications

- PHILLY RIVERCAST A Daily Forecast of Schuylkill River Water Quality in Philadelphia
- **Delaware River Real Time Monitoring for Real Time Management by Yagecic of DRBC**
- **Nowcasting to Protect Public Water Supply: Using Real Time Data in an Emergency Flow and Transport Model by Suk and Yagecic of DRBC**
- Watershed Information Center
  Philadelphia Water Department - Office of Watersheds
  Delaware Valley Early Warning System (EWS)
- USGS science for a changing world SPARROW Surface Water-Quality Modeling
  - **National -- Regional -- Local (Delaware Basin)**
- **Probability contamination of ground water and surface water in NJ (by Baker and Vowinkel of USGS/NJWSC (in review)**

Outcomes:

Management outcomes/decisions that results from the assessment and (or)development of dynamic management tools: Applications to support or inform decision-making (preferably in real-time and in predictive mode)

- Coordination with Federal, Interstate, State and local water-quality managers to plan for short term and long term remediation of water quality
- Improvements to wastewater treatment and nonpoint source controls (ie Philly Water)
- Green City Clean Waters

  The City of Philadelphia's Program for Combined Sewer Overflow Control
  A Long Term Control Plan Update
  Summary Report

  Submitted by the Philadelphia Water Department
  September 1, 2009
- More refined assessment and coordination among water-quality-data users
- Adaptive monitoring in cases where DO exceeds a water-quality criterion in an zone

Metrics for tracking success and measuring performance

- Need to conduct a cost/benefit analysis for different observation methods
- Better integrated assessments over time by using “all” the data
- Monitoring at a more valuable frequency

Value added from advances in technology (i.e. sensors), assessment tools, or process

- Directly feeding the data from sensor into frameworks that use the data
- React to problems in real time
- Better able to determine diurnal, seasonal, and monthly variability of DO and other water-quality in different compartments of the system.

Gaps and needs from improved outcomes

- Need better coverage of real time DO in shallow waters in estuary near streams
- Need better continuous coverage at the boundary of the system by using the Cape May Ferry
- Need sensors that correspond to assessment such as nitrate, ammonia, phosphorus, chlorophyll, PARs, etc.
- Opportunities to look at combined parameters for resource-specific assessments.

Summary

- Observations indicate that there has been significant improvement in [DO] in the estuary
- All observations have value but some are more valuable than others
- The shad are running again after a long time of not being able to get past Chester and Philadelphia to spawn in the freshwater of the Schuylkill River and the mainstem of the Delaware above Trenton
- Hopefully more improvements in water quality will happen with time