

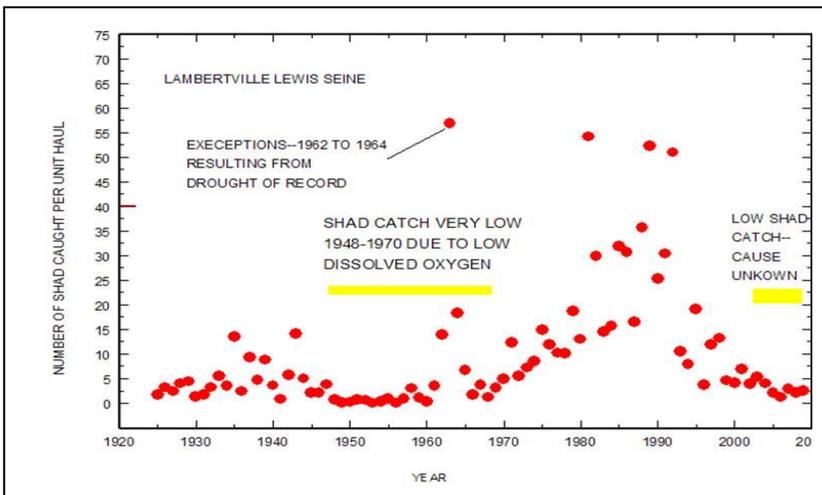
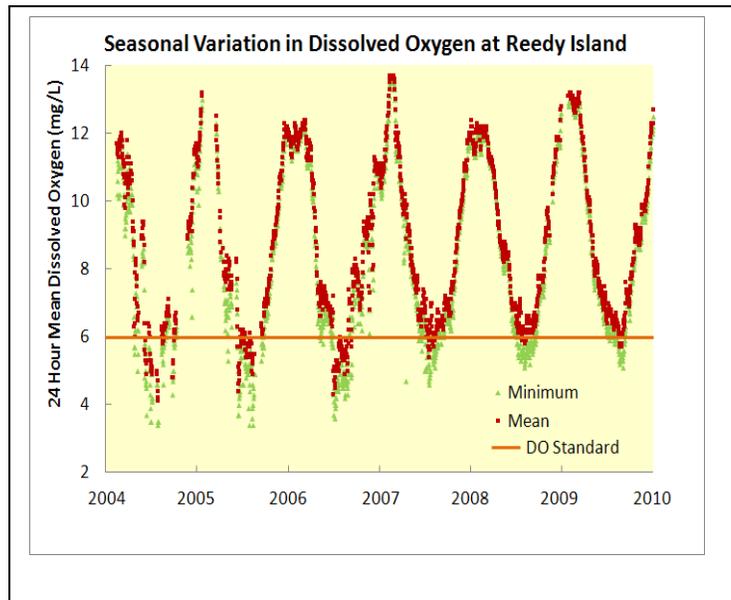
Delaware Estuary—The Delaware Estuary drains more than 13,000 square miles and consists of an 85-mile long tidal freshwater river and a 48 mile long bay. The tidal freshwater river provides drinking water to millions of people, but is susceptible to contamination from urban and agricultural sources. Transported sediments can clog shipping channels, and often carry persistent legacy contaminants, such as polychlorinated biphenyls (PCBs) that can contaminate fish and create disposal problems when dredged.

Nutrient runoff and discharges to the estuary create persistent low dissolved oxygen and the potential for damaging algal blooms. Up until the late 1970s, low dissolved oxygen was prevalent in the estuary, such as in vicinity of Philadelphia, creating anoxic dead zones that affected local aquatic species and migratory fish, such as shad. Over 40 years of monitoring data show improvements in water quality and ecological indicators, including increasing dissolved oxygen, decreasing concentrations of PCBs, and restored fin fish populations. These improvements are attributed to water-quality regulations and bans on contaminants of concern since the 1970s. Improvements over the last 10 to 20 years have been less dramatic and there is concern that conditions may still be harmful to humans and aquatic life.



Hydrologists deploy real-time continuous monitors for turbidity, dissolved oxygen, specific conductance, and other parameters, which help to measure vertical profiles and monitor daily and seasonal variations and trends.

Continuous data for dissolved oxygen on the Delaware River at Reedy Island Jetty in Delaware show levels below the 24-hour mean criteria (orange line) established by the Delaware River Basin Commission. Most regions of the estuary currently meet the established water-quality criteria. However, ongoing real-time monitoring demonstrates that low sags in dissolved oxygen still occur during certain times of the year, such as in the summer. Ammonia may be a lead factor in reducing dissolved oxygen in the estuary. Low dissolved oxygen can be harmful to certain species and research suggests that the established water-quality goals for dissolved oxygen may not protect important species in the estuary, including current and candidate threatened and endangered species, such as the Atlantic sturgeon. Continued management of dissolved oxygen and development of criteria for nutrients are therefore needed to protect living resources in the Delaware Estuary.

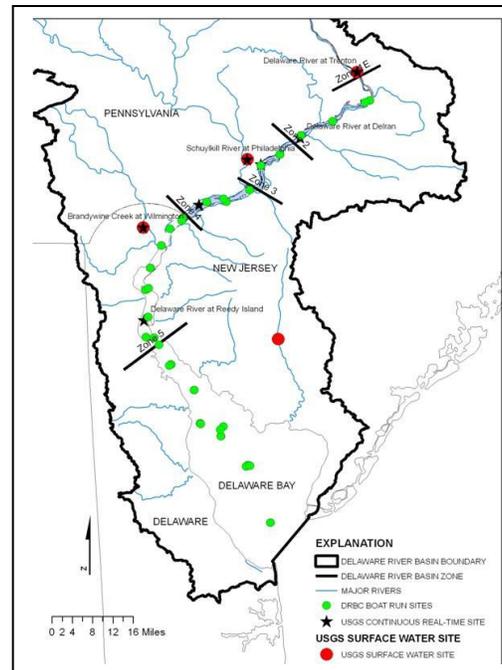


Initial rebound in shad fishery in 1980's and 1990's is attributed to improved levels of dissolved oxygen in the estuary. Reasons for the decline since that time are uncertain.

The Network has served as a catalyst for prioritizing issues and strategies within the basin. Highlights include nutrient monitoring at four head of tide tributaries that contribute over 90 percent of the flow to the Delaware Estuary. Dissolved oxygen, nutrients, and other constituents are monitored eight times each year at over 20 locations from the mouth of Delaware Bay to the head of tide as part of a boat run. The continuous monitoring network, which measures dissolved oxygen, pH, temperature, conductance, and turbidity in real time, has been enhanced in areas of major drinking water intakes in the upper estuary and at existing mid-estuary locations where the role of turbidity in limiting algal growth is uncertain. Data are made available through a public web page linking data and information from a multitude of partners. Real-time data are linked to Delaware River Basin Commission (DRBC) Water Quality Criteria and disseminated to stakeholders using automated software applications and email notification, which allows managers to respond to water issues in real time.

Despite relatively high nutrient loadings to Delaware Estuary, which are comparable to those of the adjacent Chesapeake Bay, algal blooms are not as prevalent in the Delaware Estuary as in Chesapeake Bay. Monitoring and assessments are ongoing to help explain the relatively unique response in the Delaware Estuary, and the importance of factors such as stratification in the bay, high turbidity in the tidal river, and a high flush rate in limiting accumulation of algal biomass.

Future plans involve development of an eutrophication model by the DRBC to help clarify the role of ammonia in reducing oxygen in the estuary. Air and water monitoring and modeling (such as with the USGS SPARROW regression model) will help to improve estimates of nutrient sources and loadings. Flyovers are planned to measure chlorophyll *a*, which will help to identify the timing and location of algal growth. Other planned sampling, monitoring, and modeling will help identify sediment transport and dynamics in the bay from the head of tide to the ocean. Together, information from the discrete samples, continuous monitors, and remotely operated vehicles will help identify locations of elevated ammonia, depleted oxygen, and where turbidity may limit algal growth. Anticipated findings will be useful for managing nutrients in Delaware Bay, as well as in other estuarine and coastal waters across the Nation. In addition, the information will help to forecast future effects of climatic change, such as movement of the salt front towards drinking-water intakes, impacts from sea-level rise on wetlands, and possible increasing temperatures causing decreasing dissolved oxygen and degradation of biological resources in the estuary.



Web Access:

Delaware River Basin Commission: <http://www.state.nj.us/drbc/>

U.S. Geological Survey, New Jersey Water Science Center: <http://nj.usgs.gov/projects/2454BSB/natmonitornet/>

Contacts:

Jeffrey Fischer, fischer@usgs.gov (609) 771-3953,

Eric Vowinkel, vowinkel@usgs.gov (609) 771-3953

Robert Tudor, robert.tudor@drbc.state.nj.us (608) 883-9500, ext. 208

Major partners:

- Delaware River Basin Commission
- Partnership for the Delaware Estuary
- Delaware Department of Natural Resources and Environmental Control
- New Jersey Department of Environmental Protection
- New Jersey Water Monitoring Coordination Council
- University of Delaware, College of Marine and Earth Studies
- Rutgers Institute of Marine and Coastal Sciences
- Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA)
- U.S. Environmental Protection Agency (EPA)
- National Oceanography and Atmospheric Administration (NOAA)
- U.S. Geological Survey (USGS)