

The State of the Delaware River Basin and Estuary:

***“400 years from
Henry Hudson to JFK”***

Technical Summary

State of the Delaware River Basin Report

*A Report on the Health of the 13,539-square-mile Delaware River Basin
in Delaware, New Jersey, New York, and Pennsylvania*



July 4, 2008



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Delaware River Basin Partners



Cornell University



RUTGERS

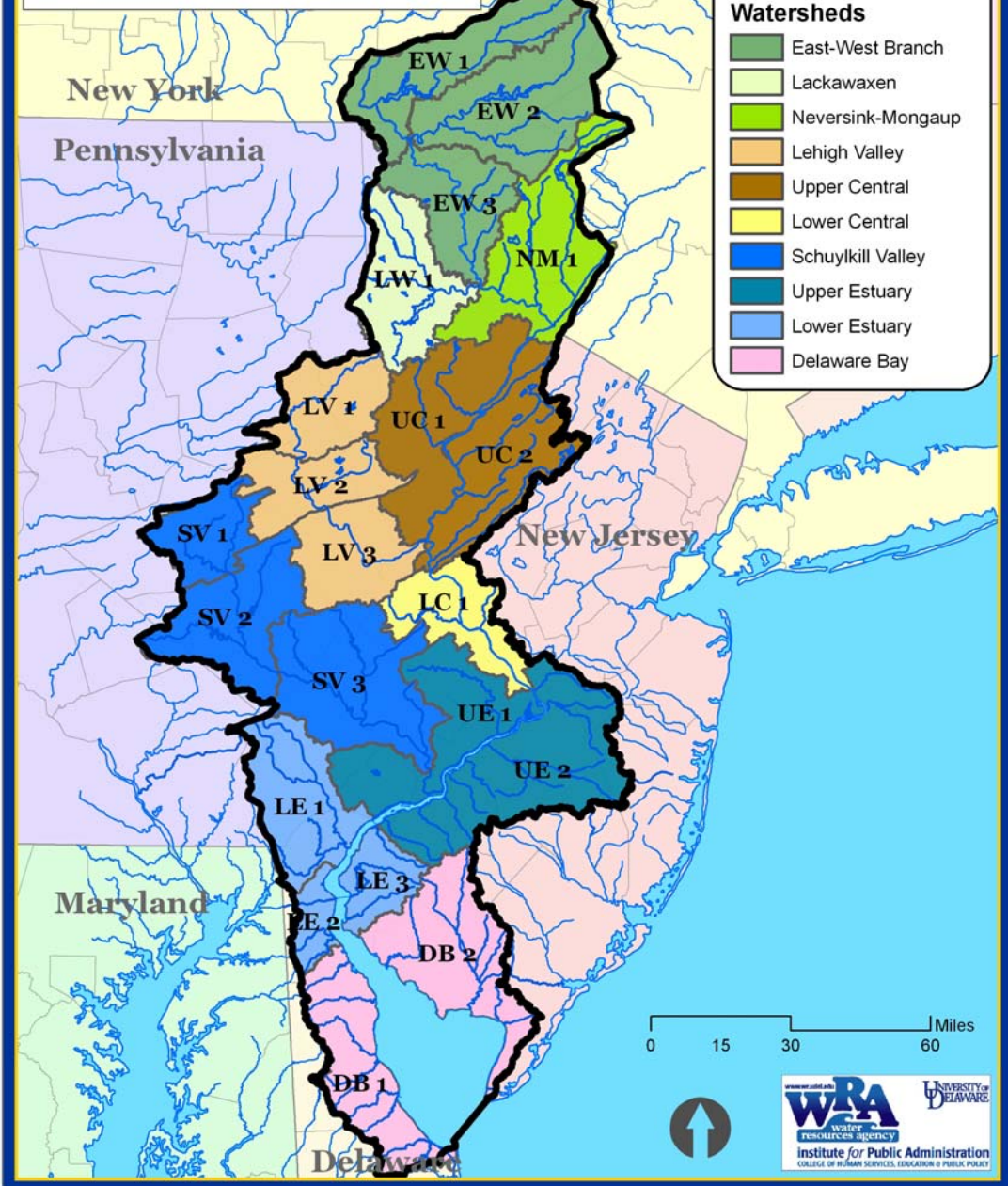
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Watersheds of the Delaware River Basin



0 15 30 60 Miles

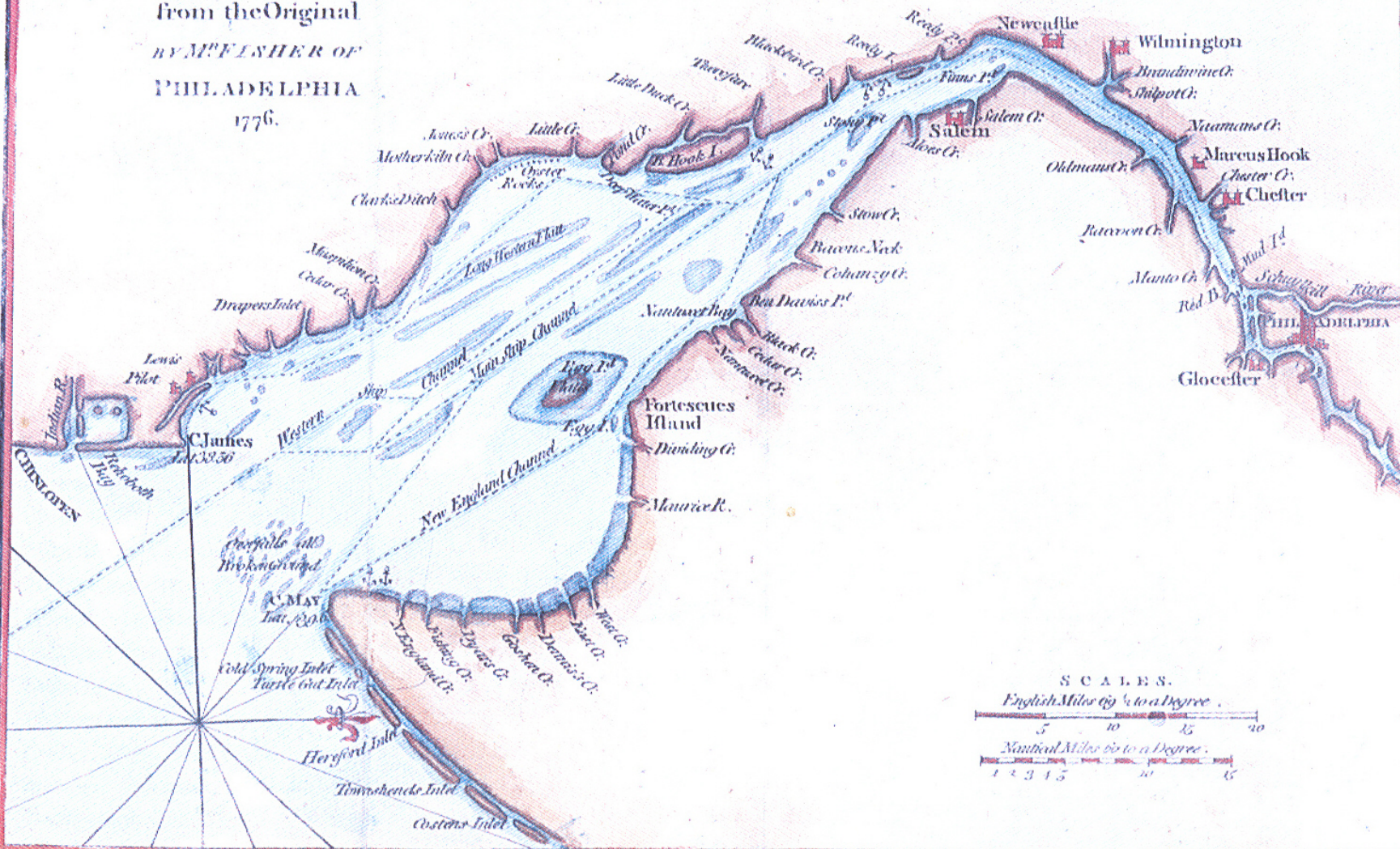


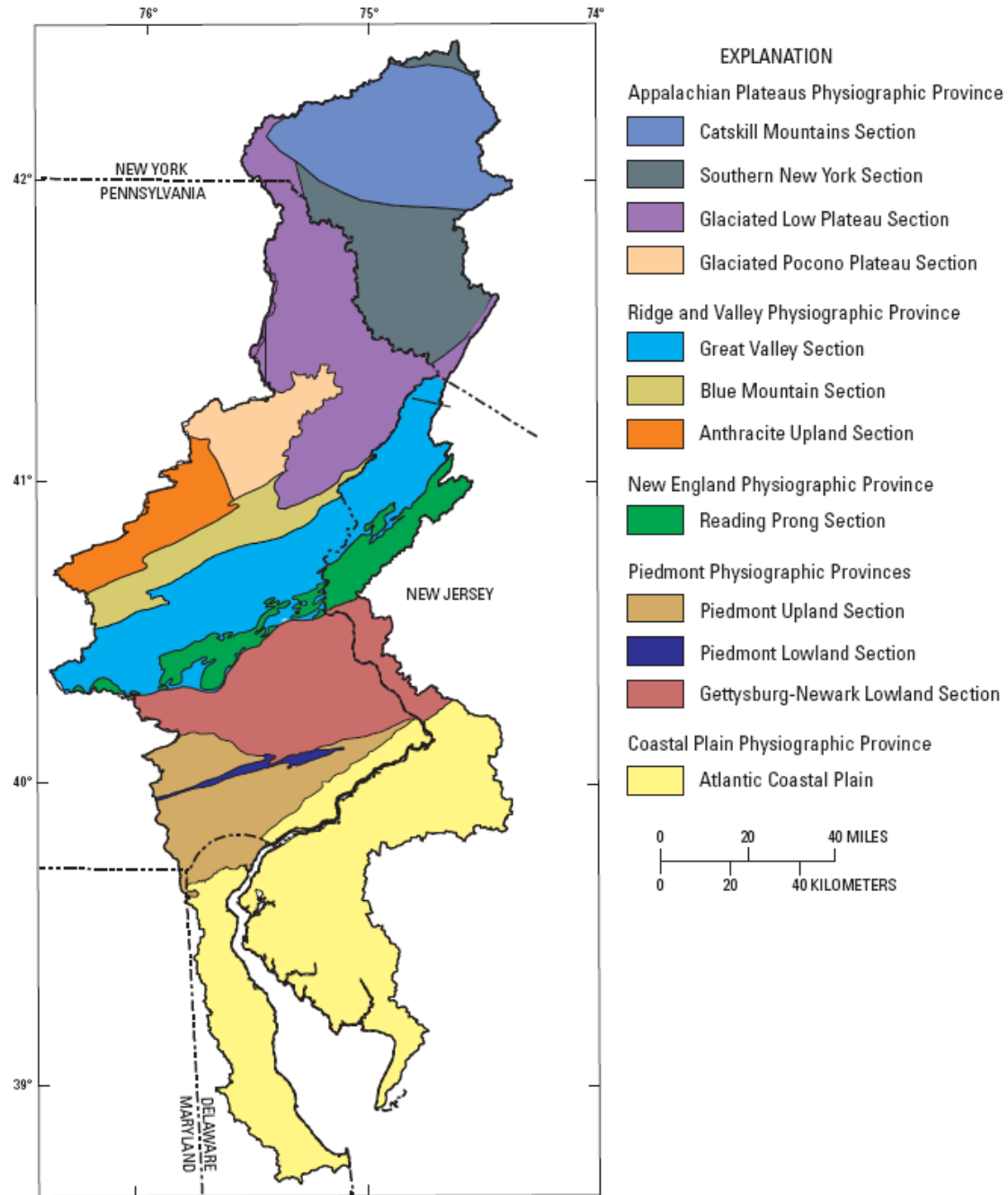
www.wra.state.de.us
WRA
 water resources agency
 Institute for Public Administration
 COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY



A CHART OF
DELAWARE BAY
AND RIVER,

from the Original
BY M^r FISHER OF
PHILADELPHIA
1776.





Base from U.S. Geological Survey digital data, 1972, 1:2,000,000 Albers Equal-Area Conic Projection. Standard parallels 29°30'N, central meridian 75°00'W. Physiographic provinces from Sevon (2000), Pristas (2002), and Fenneman and Johnson (1946)

600 A.D.- Lenni Lenape fish in pristine waters.

1609 – Henry Hudson sails to Capes.

1638 – Swedes sail to Christinakill.

1682 – William Penn founder of Philadelphia.

1776 – Declaration of Independence signed.

1802 – DuPont found mills along Brandywine.

1880 – Drinking water causes cholera.

1887 – 22 million lb oysters harvested from bay.

1896 – 14 million lb of shad caught in river.

1900 – Oyster, shad, sturgeon fishery begin to collapse.

WWI – Industries dump raw sewage in Clyde of America.

1931 – Supreme Court OKs NYC diversion of 400 mgd.

1936 – DE, NJ, NY, and PA create INCODEL. Trenton only city with sewage treatment.

1940 – Delaware River one of most grossly polluted in world.

WWII – Pilots comment on rotten egg smell. Navy ships turn to color of rainbow.

1952 - Delaware River *“outstanding example of destruction of bass habitat by industrial and domestic pollution”*.

1959 – 236 towns have wastewater plants.

1955, Hurricanes Connie and Diane hammered the Delaware Basin causing killer floods and leaving an *“oily film of silt... and a terrible stench – an aroma of feces and rotting flesh.”*

1960 – Only 100,000 bushels of oysters harvested due to MSX disease.

1961 – JFK signs Delaware River Basin Compact.

1968 – DRBC issues waste load allocations.

1970 – Earth Day. Richard Nixon creates USEPA.

1971 - *“gross pollution of tidal freshwater had extirpated the striped bass from its historical chief spawning and nursery areas in the Delaware River”*

1972 – Richard Nixon signs Clean Water Act.

1973 – USEPA official says Delaware River/Bay will never meet fishable standards.

1973 – NY bans phosphate detergent.

1974 - Water quality in the tidal Delaware River improving but still poor, *“extirpation of the remnant (shad) runs is distinct possibility”*.

1985 – Over \$1.5 billion spent on wastewater treatment.

1988 – Delaware River and Bay observed best water quality in 50 years.

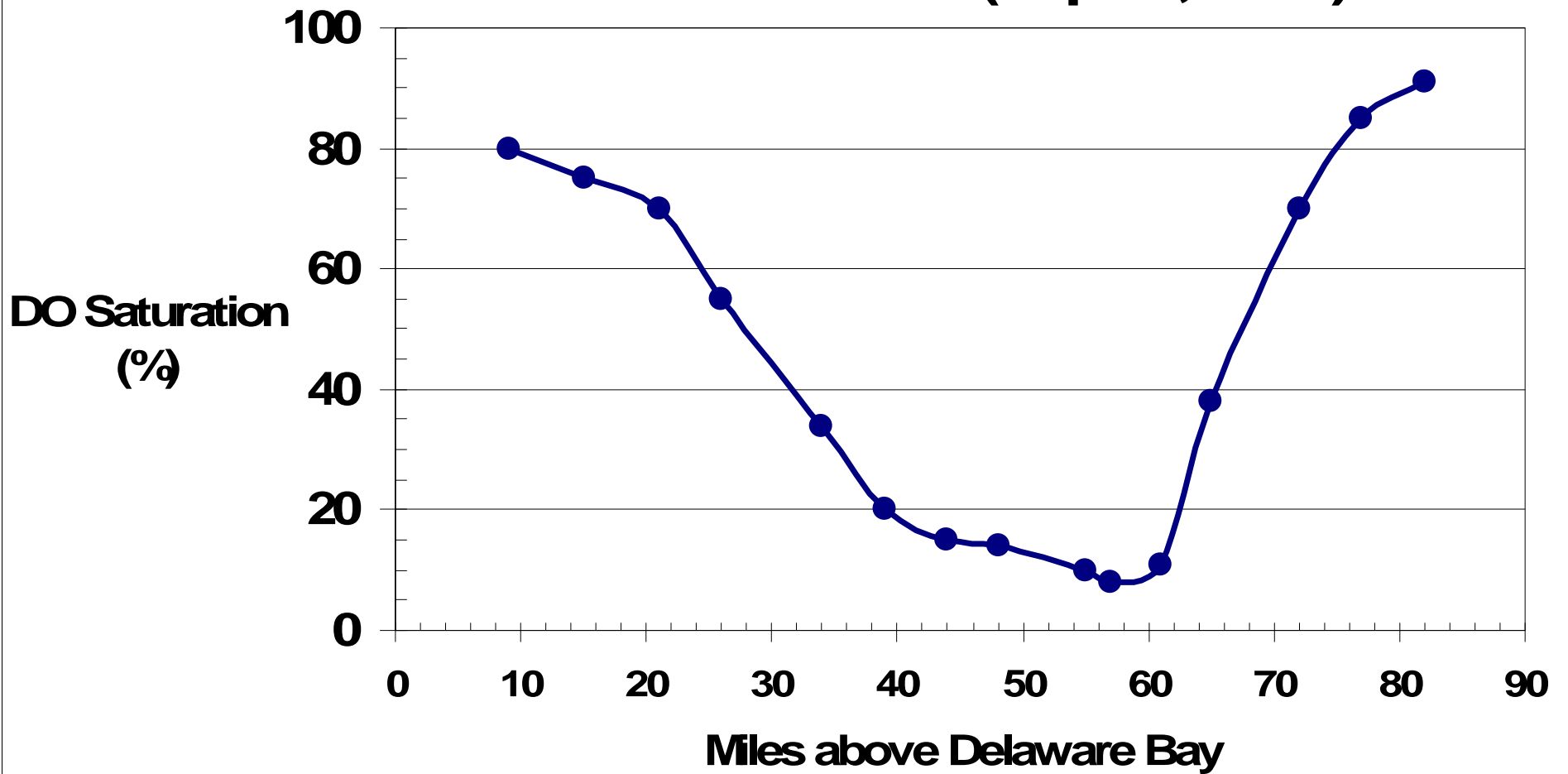
1993 - Increased shad, striped bass, and white perch coincide with improved water quality.

1996 – States form Delaware Estuary Program. Over 90% of Delaware Estuary meet fishable and swimmable goals.

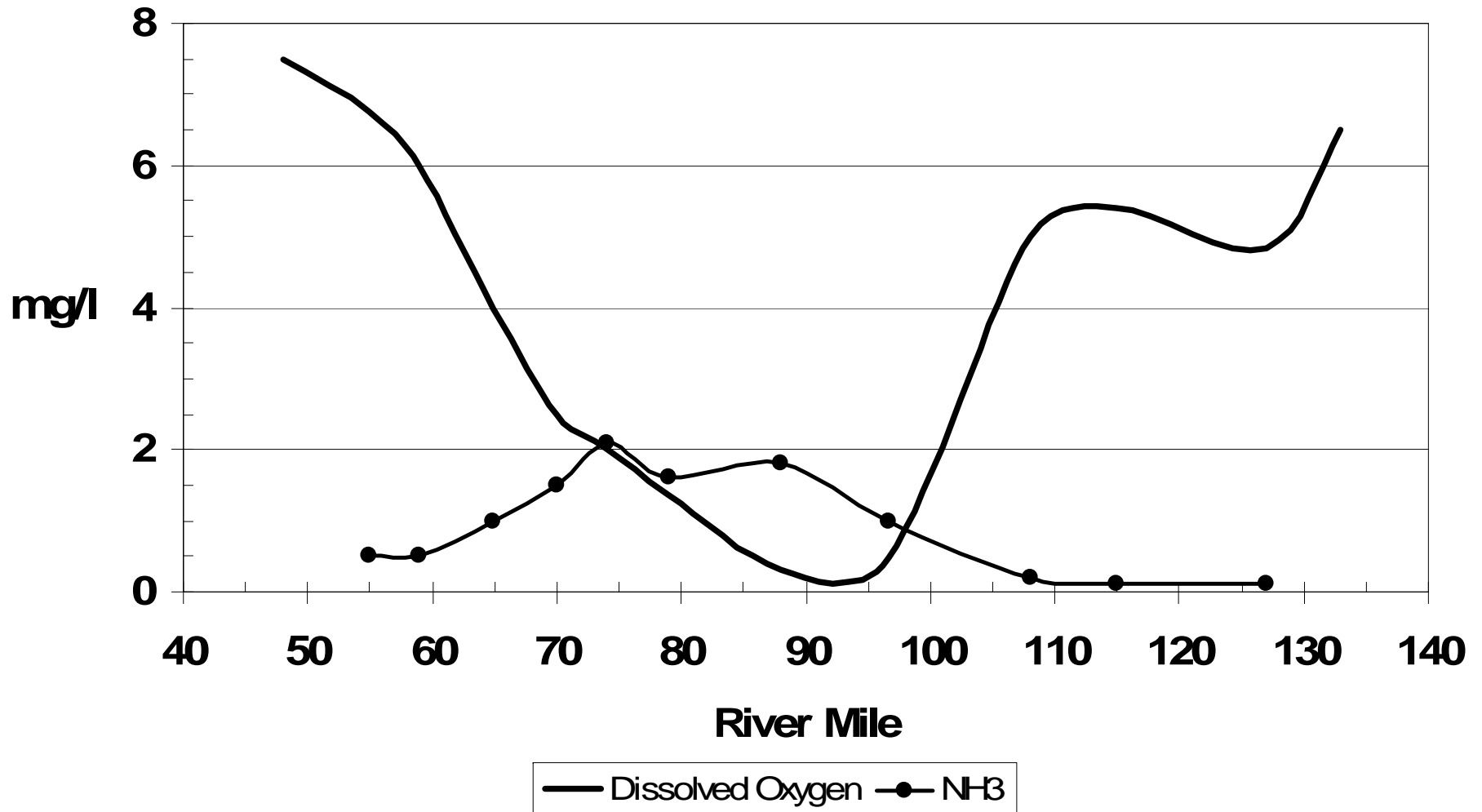
2000 – American shad/striped bass return to river/bay.

2005 – DO at Ben Franklin Bridge exceeds 4 ppm.

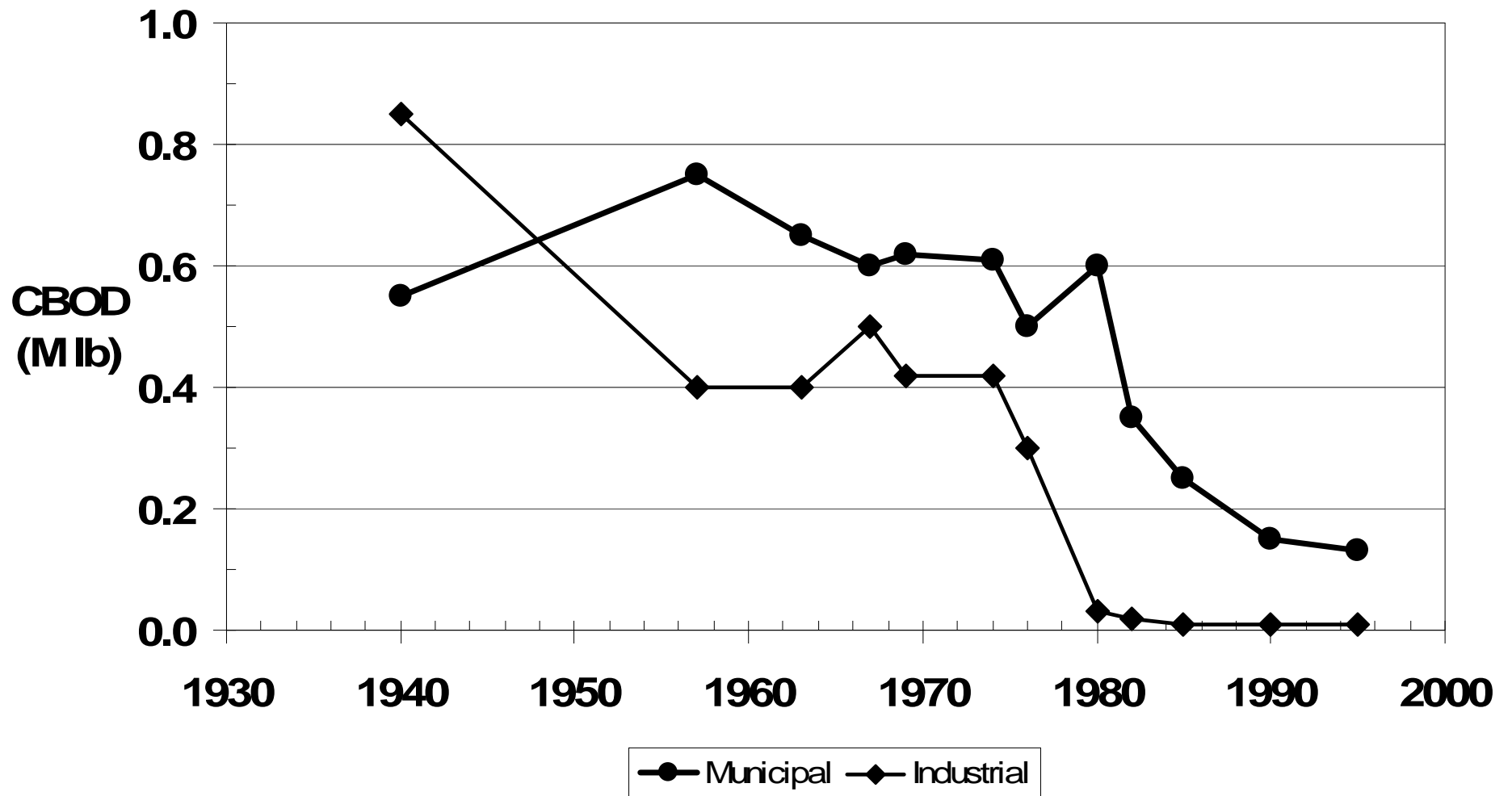
Dissolved Oxygen during High Water Slack Delaware River (Sep 15, 1958)



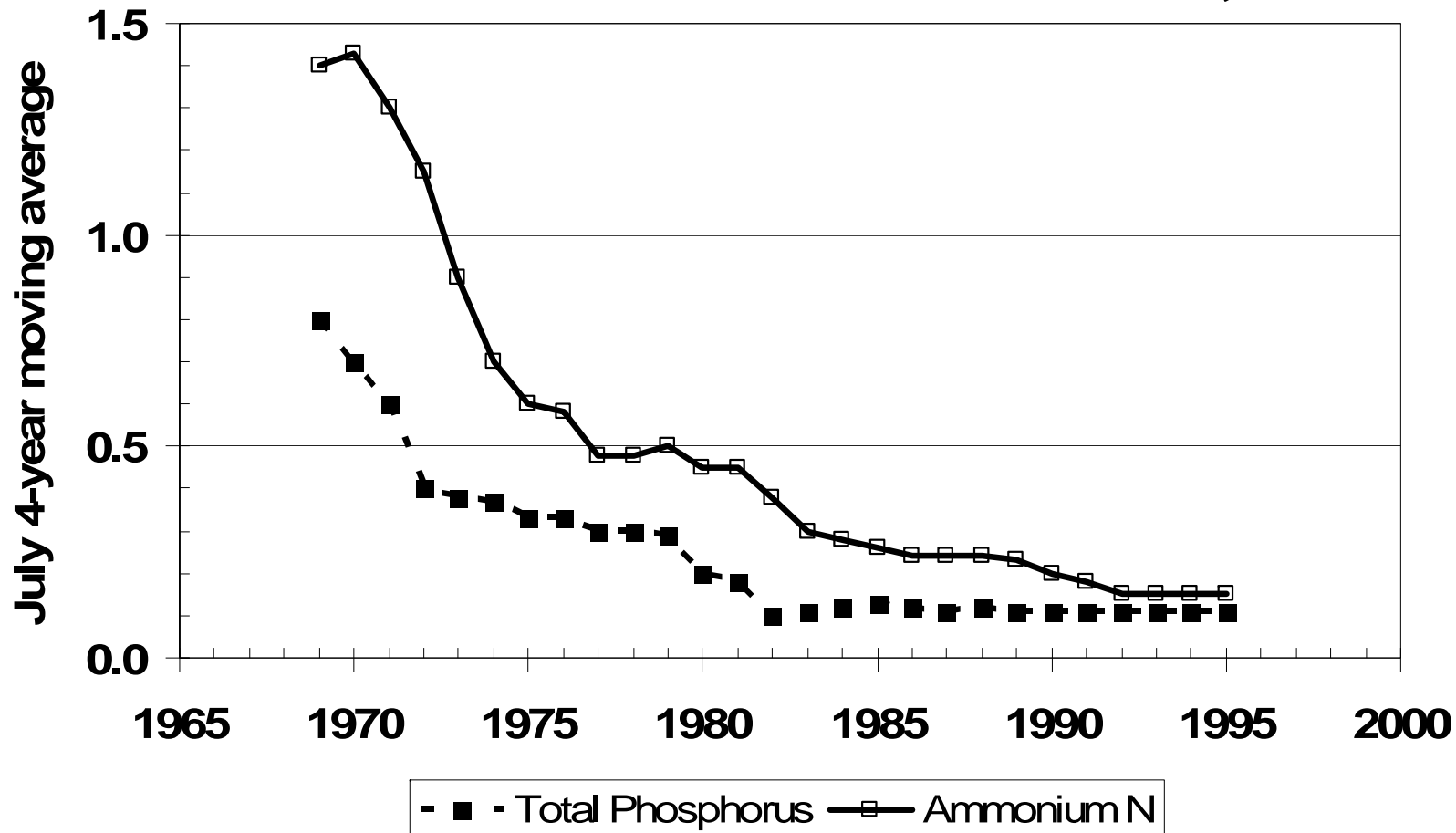
DO and NH3 Profile Delaware River and Bay (July 1967)



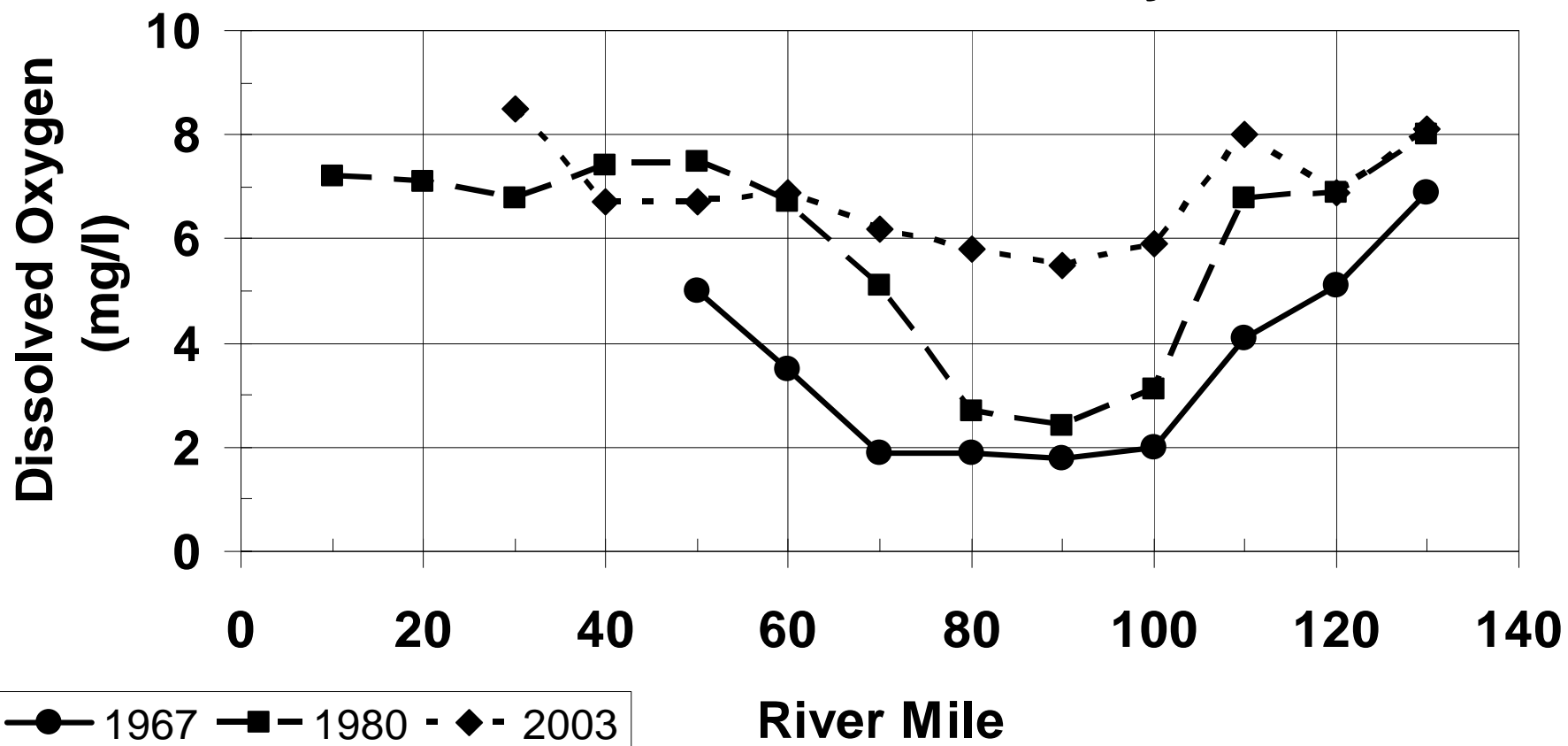
CBOD Loading along the Delaware Estuary



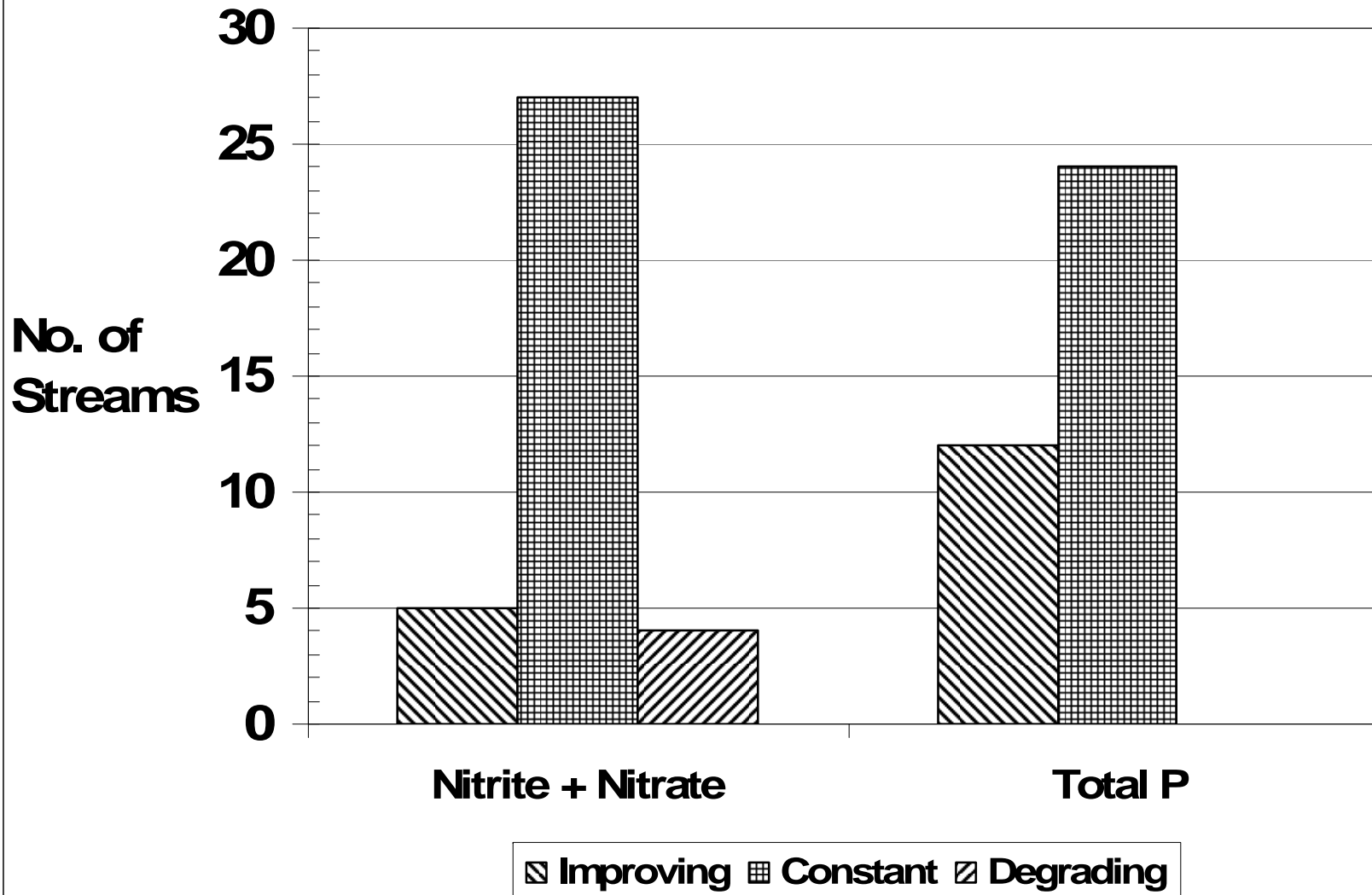
Summer Ammonium N and Total Phosphorus Delaware River at Marcus Hook, PA



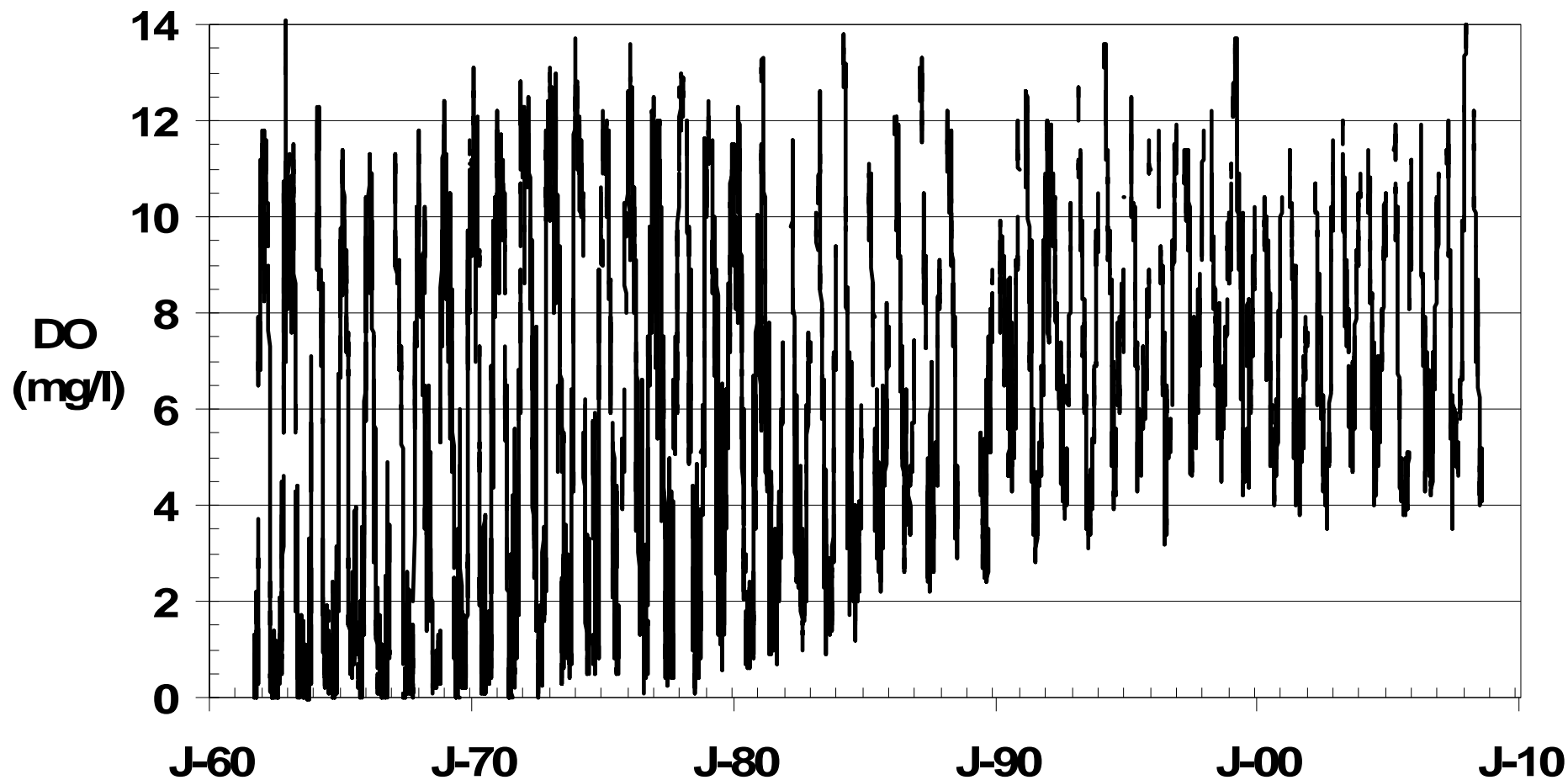
Mean Annual Dissolved Oxygen Delaware River and Bay



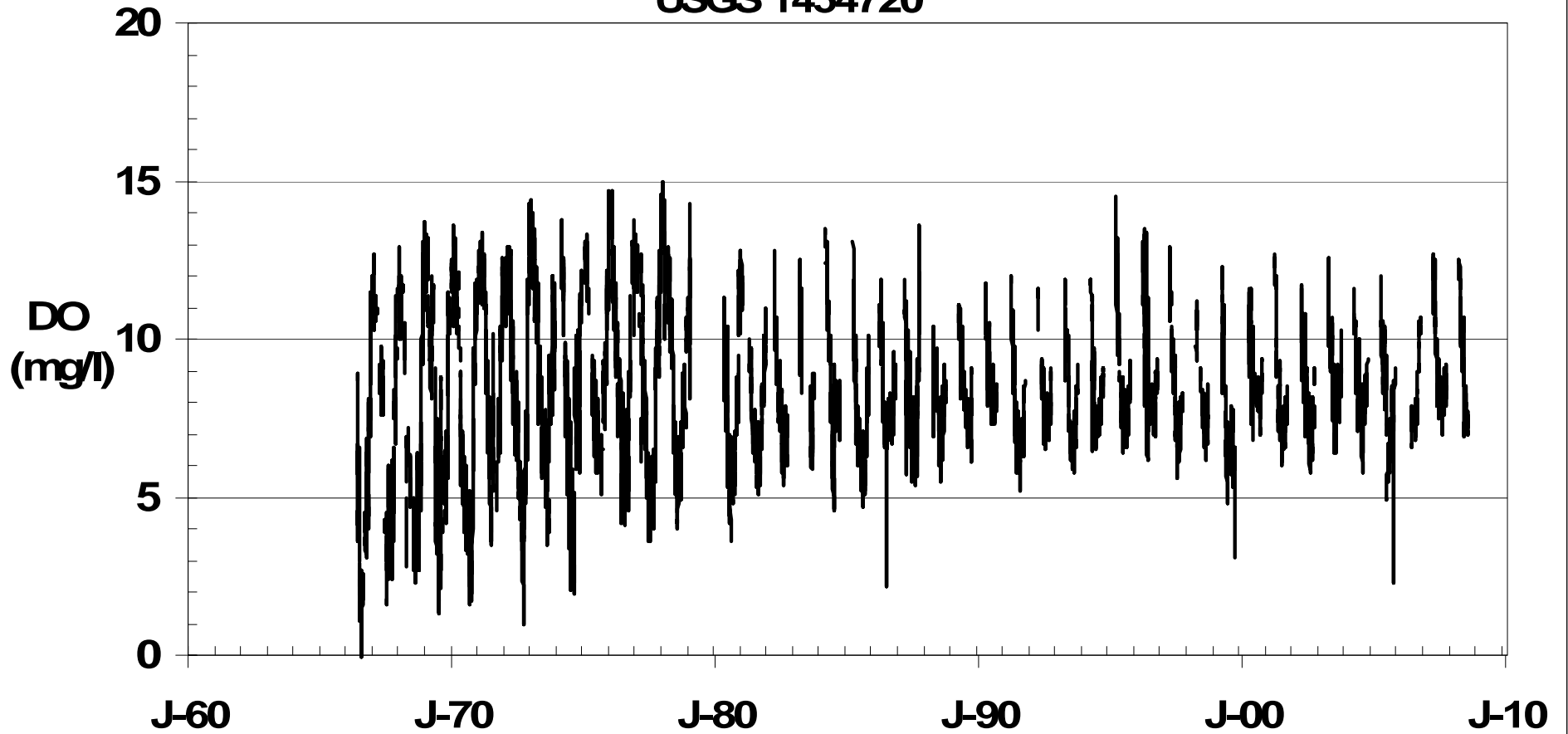
Water Quality Trends along Penna. Streams in the Delaware River Basin



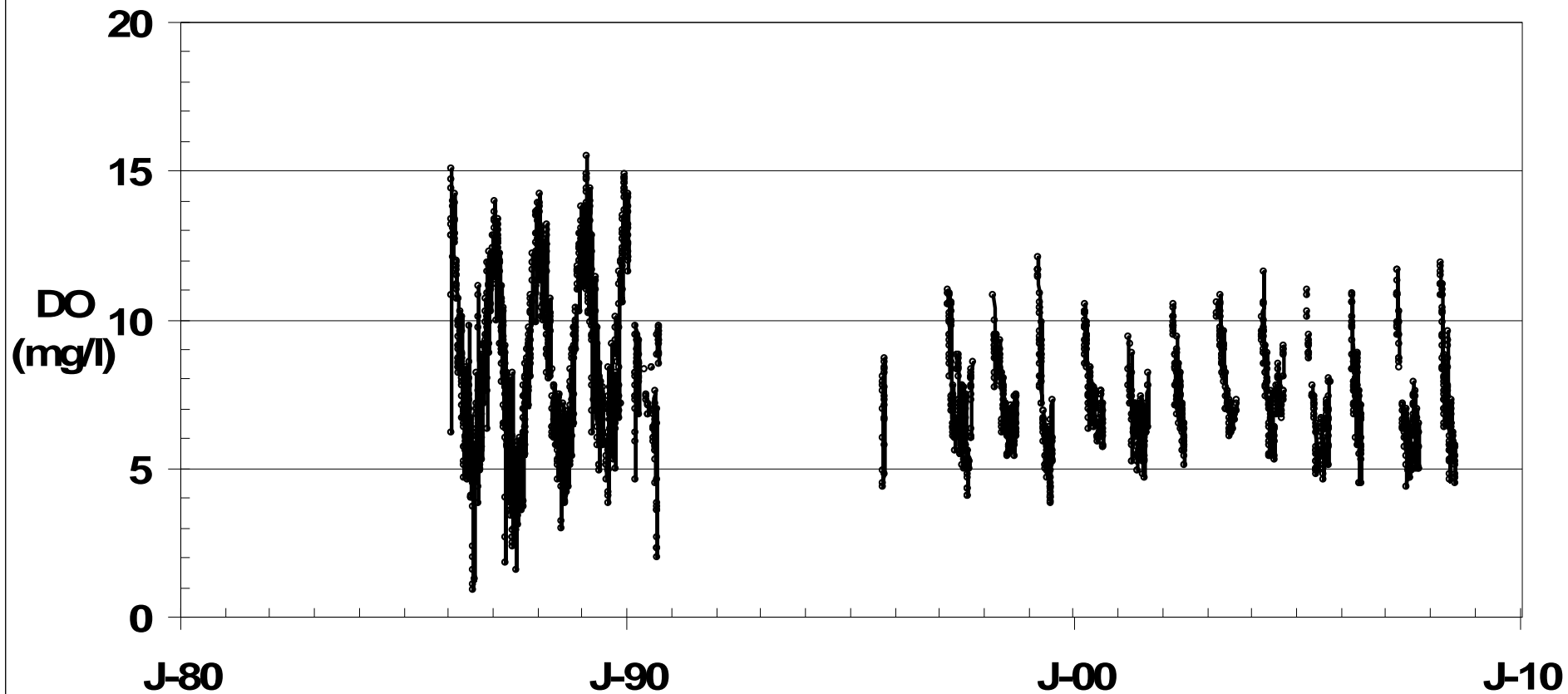
Dissolved Oxygen
Delaware River at Ben Franklin Bridge, Philadelphia
USGS 01467200



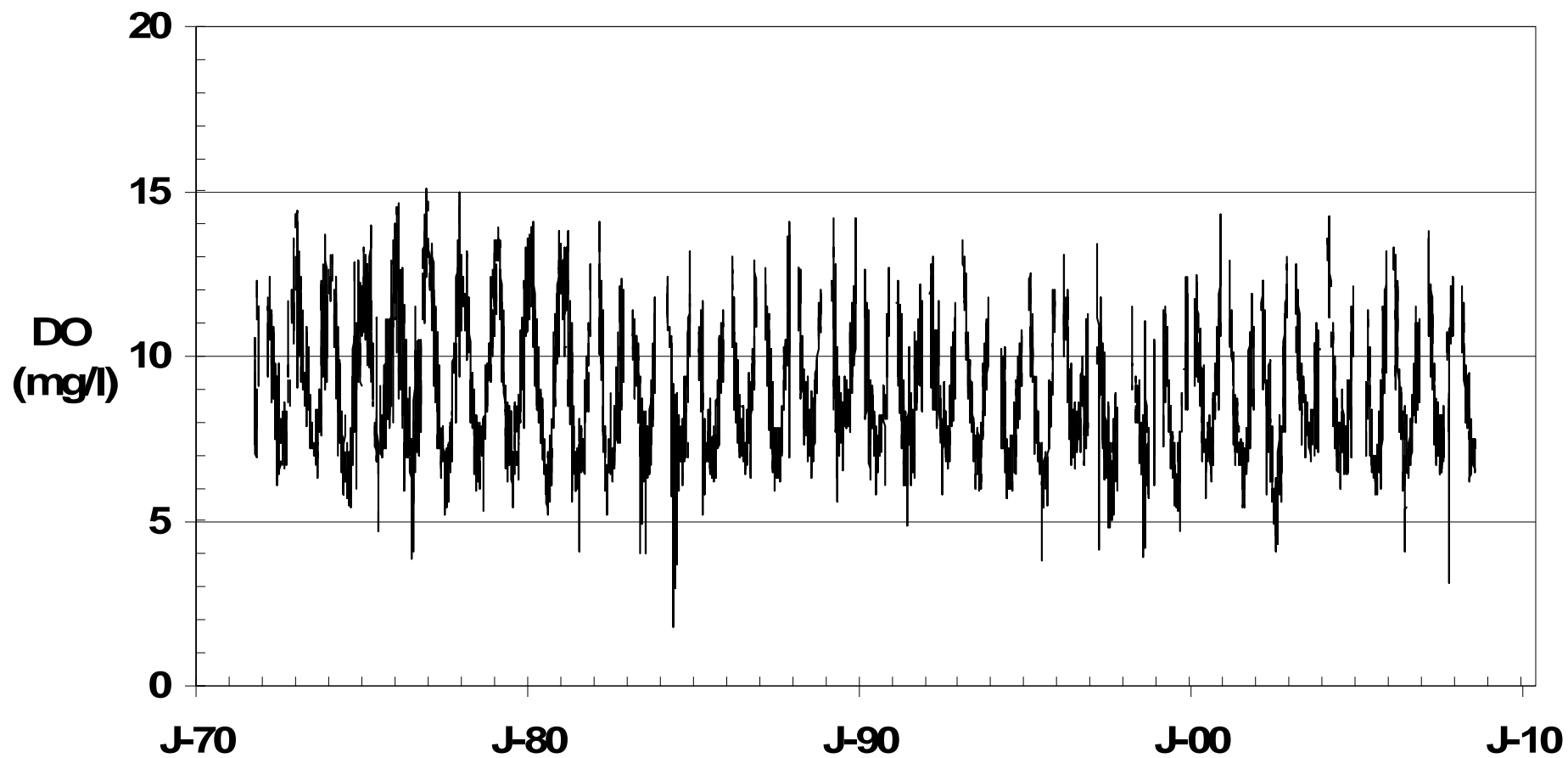
**Dissolved Oxygen
Lehigh River at Easton, PA
USGS 1454720**



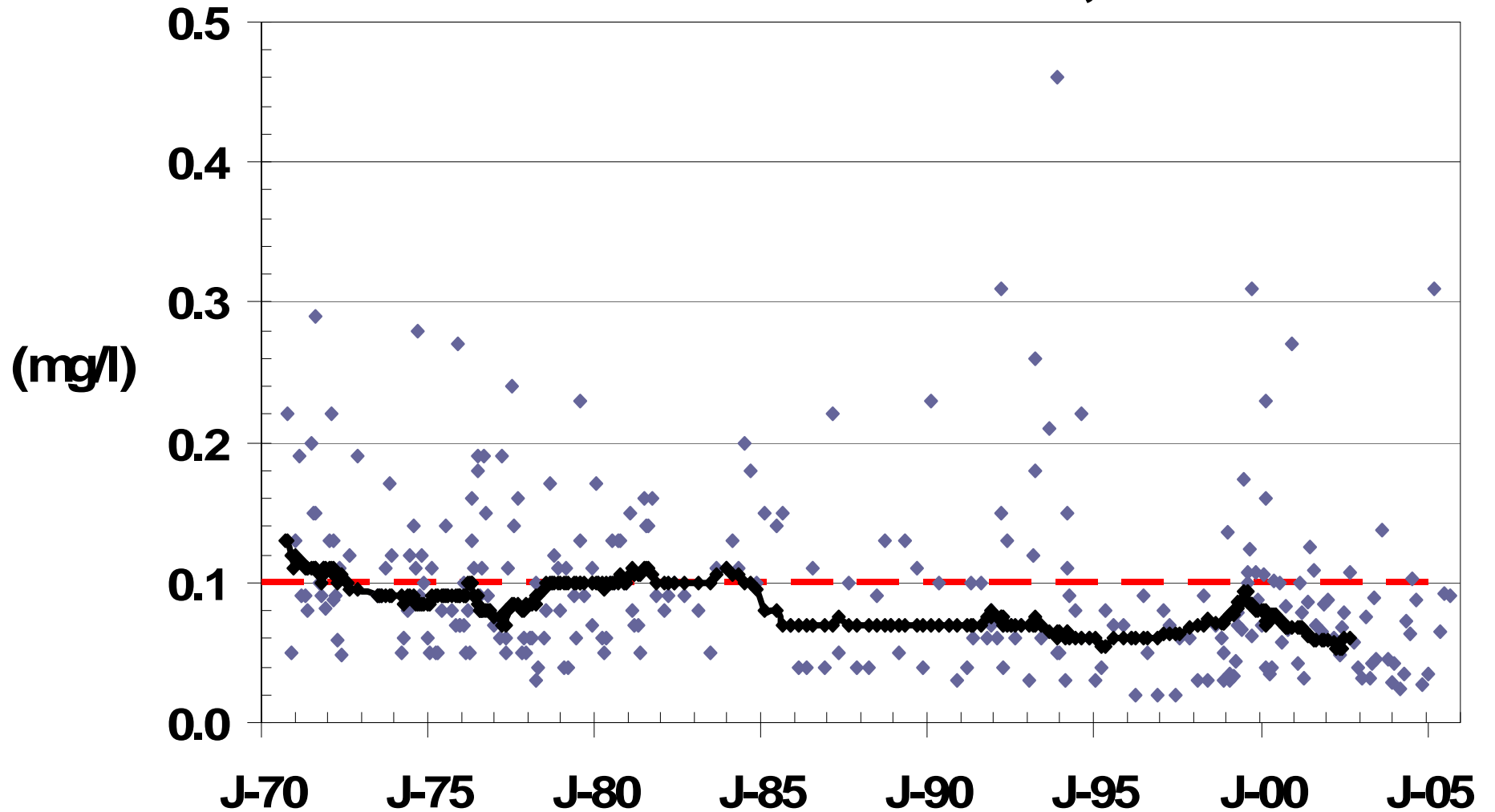
**Dissolved Oxygen
Schuylkill River at Linwood, PA
USGS 1472104**



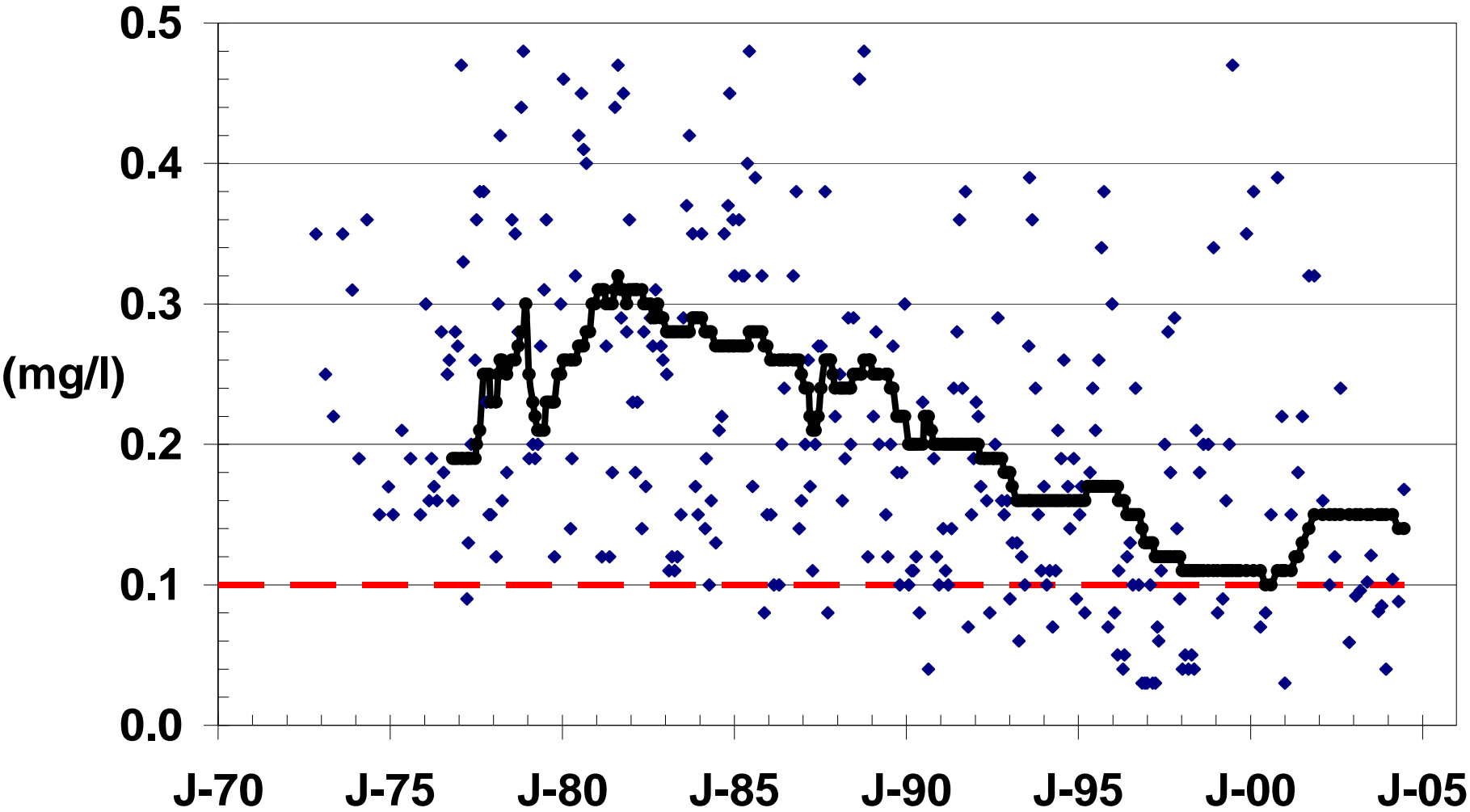
**Dissolved Oxygen
Brandywine Creek at Chadds Ford, PA
USGS 1481000**



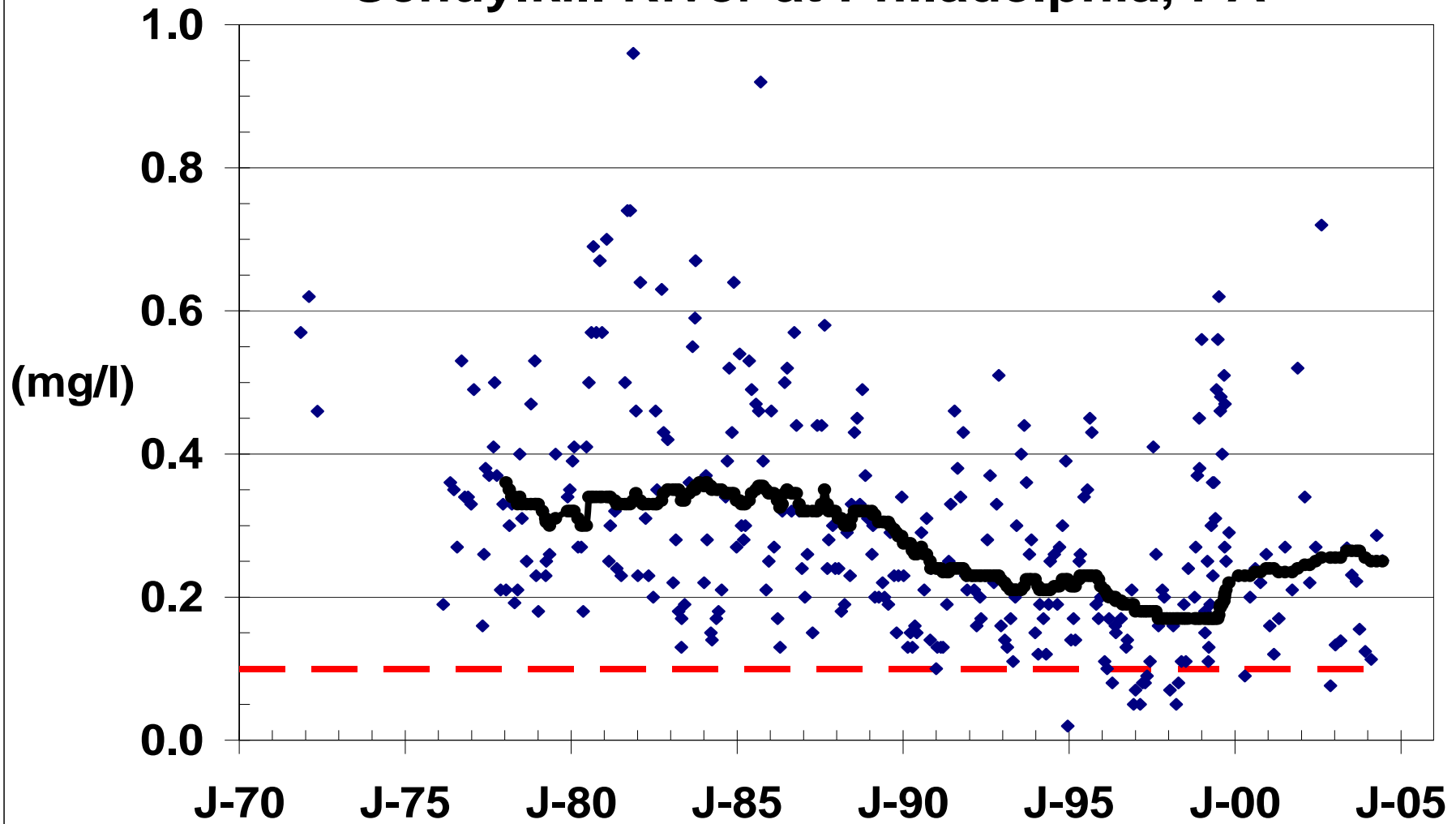
Total Phosphorus Delaware River at Trenton, N. J.



Total Phosphorus Lehigh River at Glendon, PA

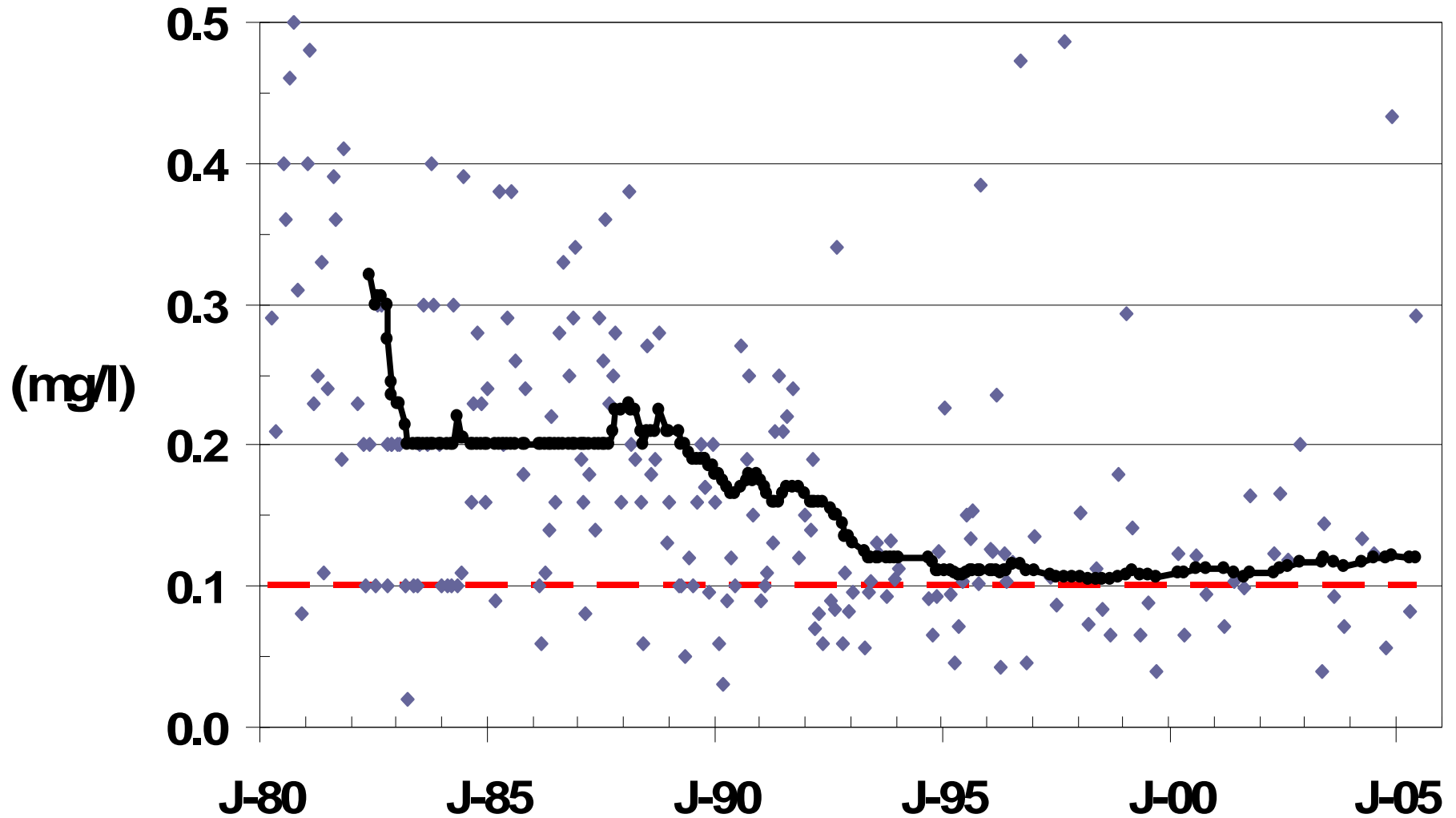


Total Phosphorus Schuylkill River at Philadelphia, PA

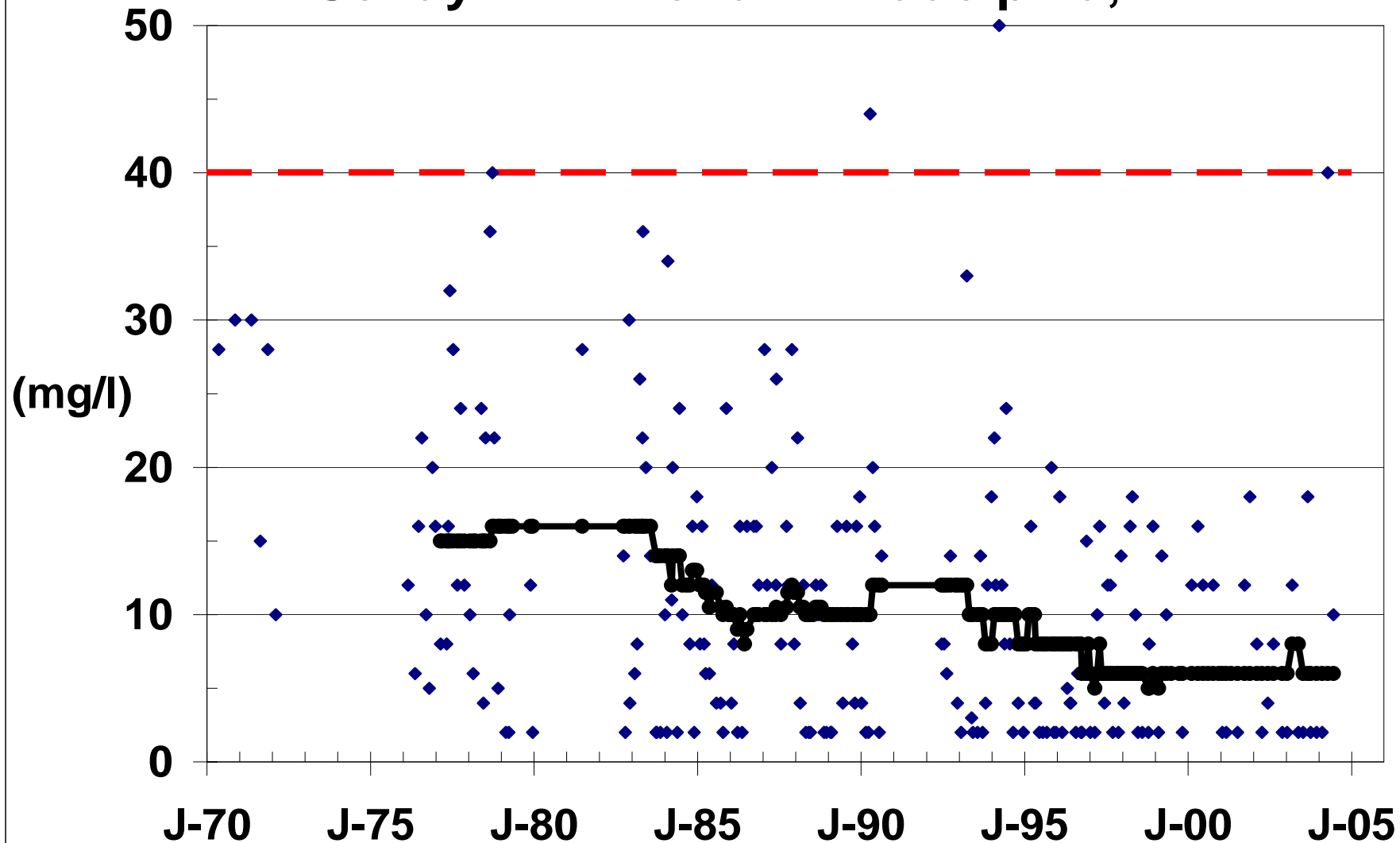


Total Phosphorus

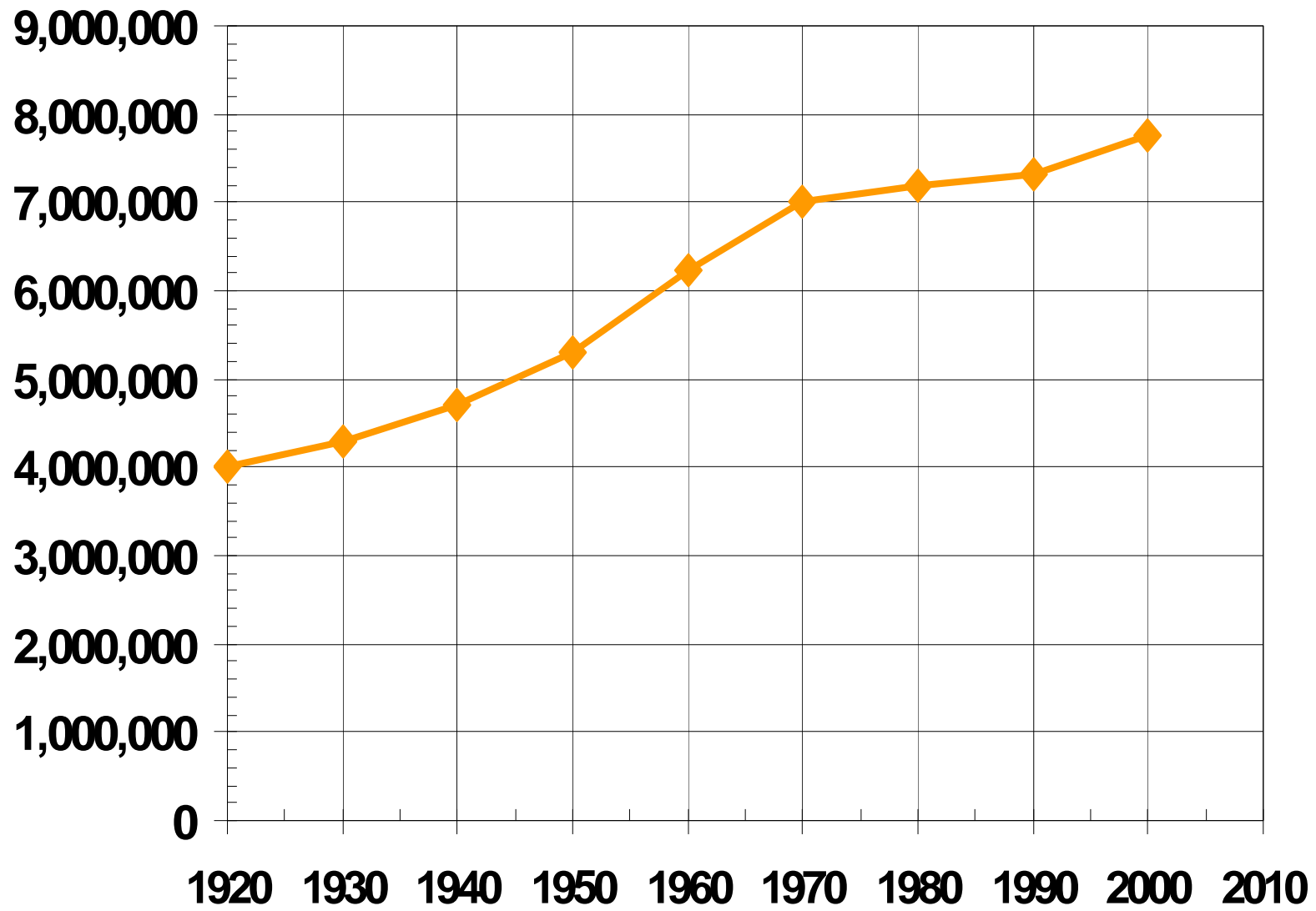
Brandywine River above Wilmington, DE

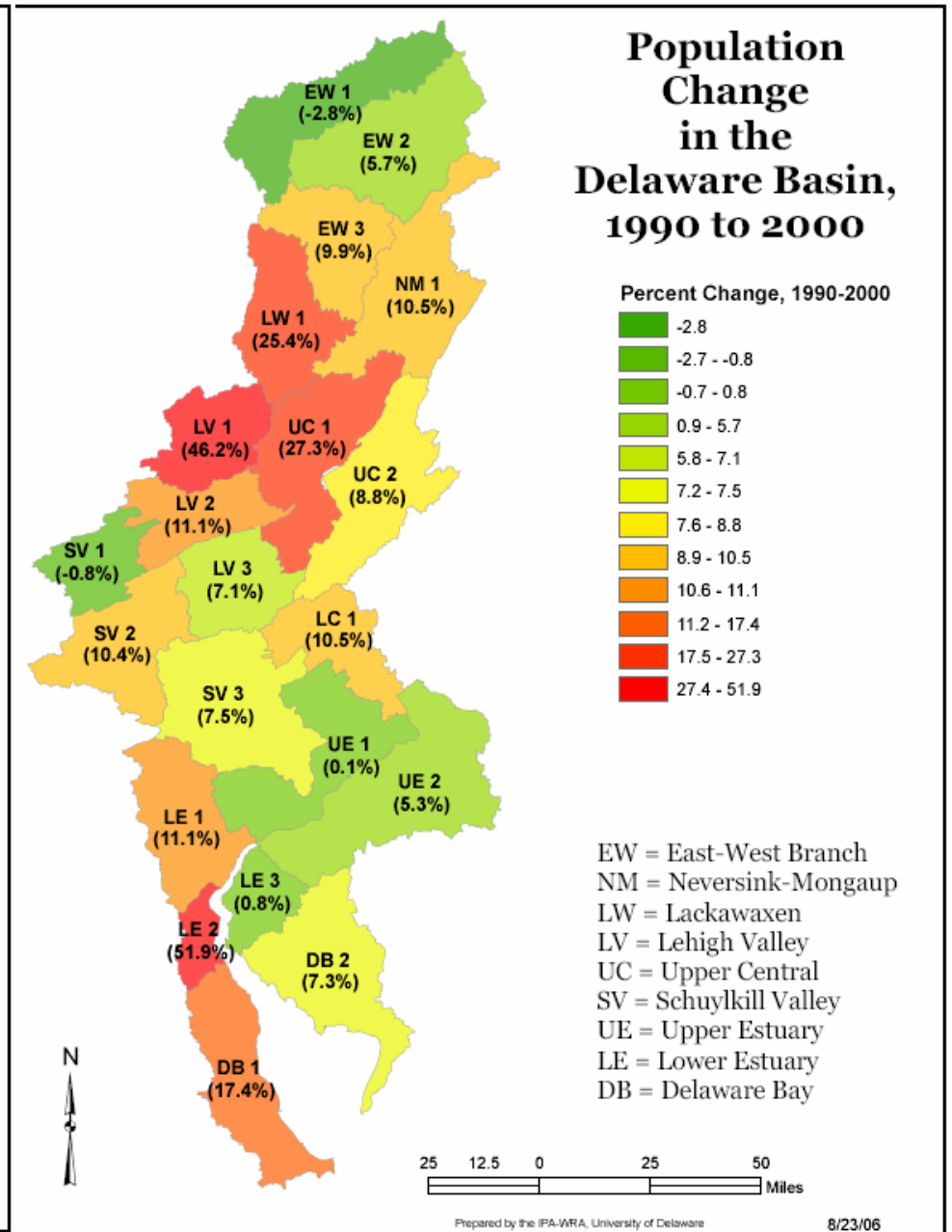
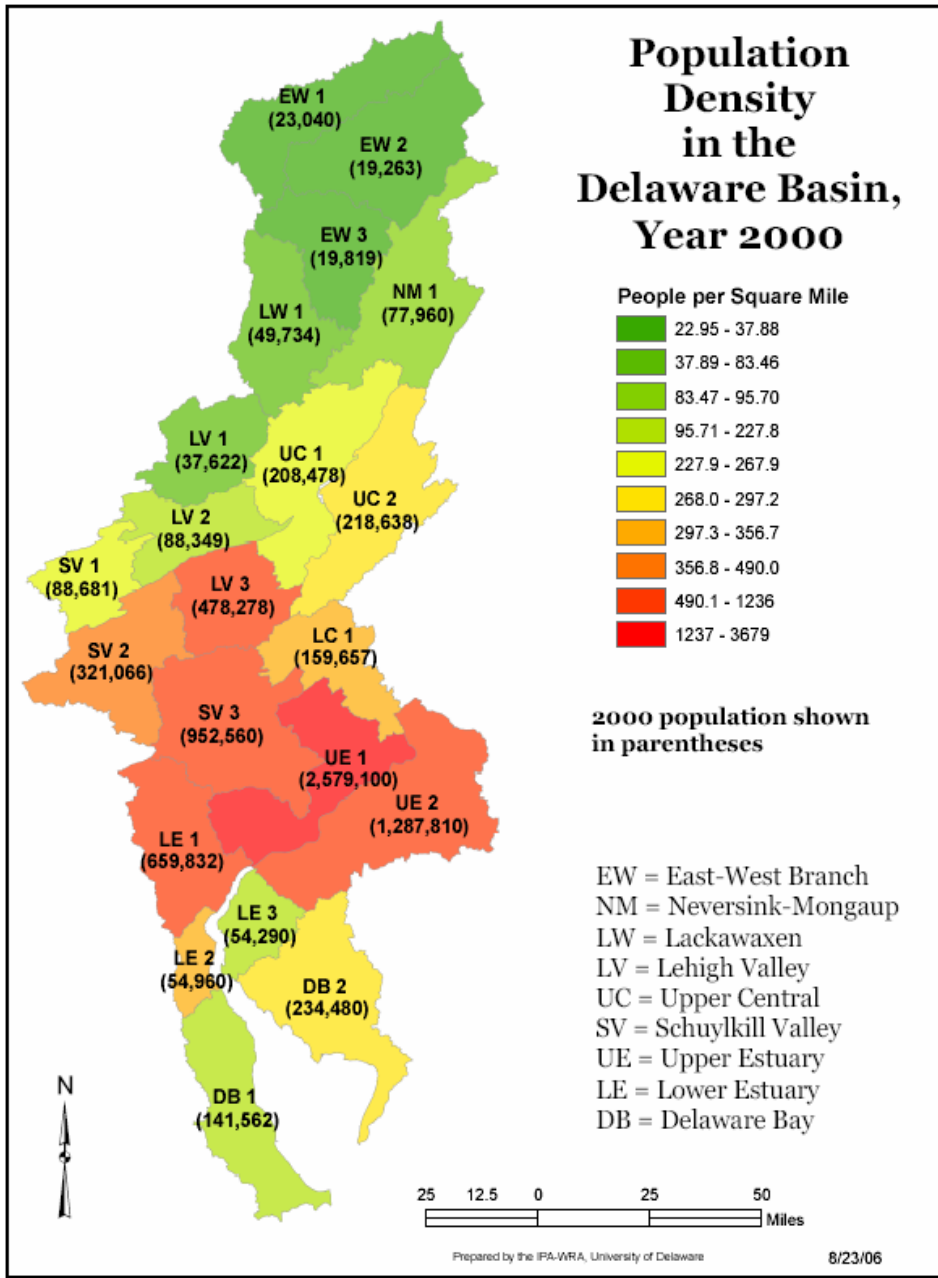


Total Suspended Sediment Schuylkill River at Philadelphia, PA

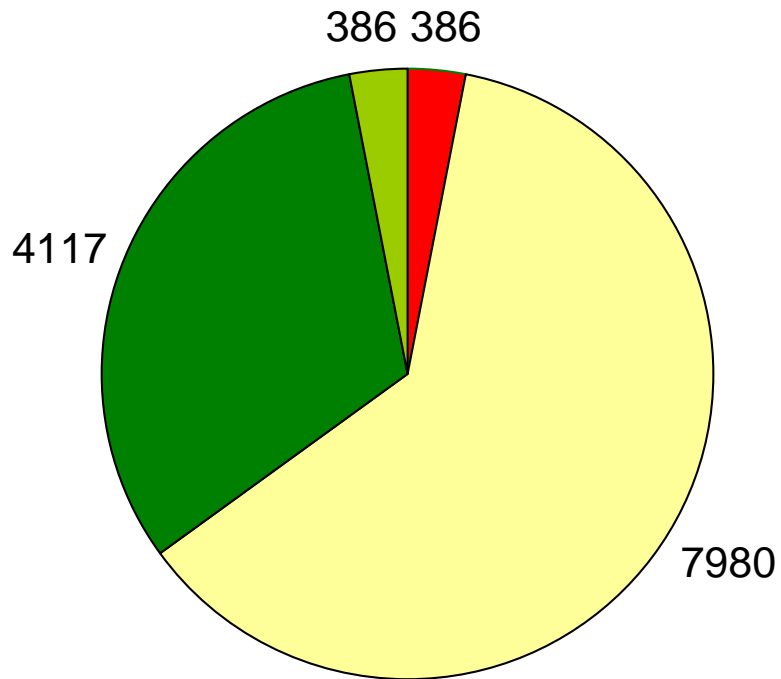


Population Delaware River Basin



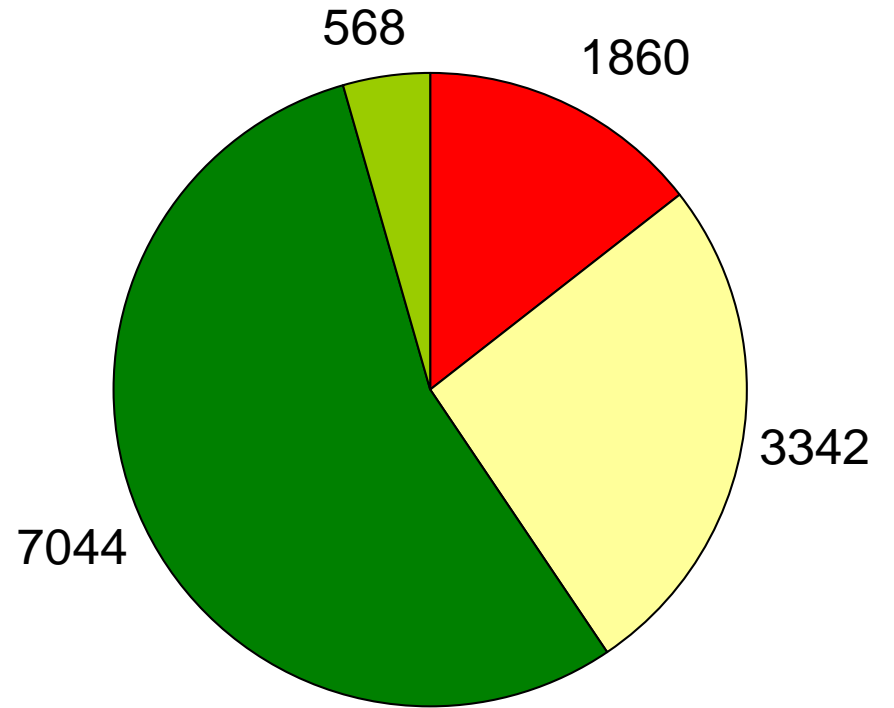


**1930 Land Use
Delaware River Basin**



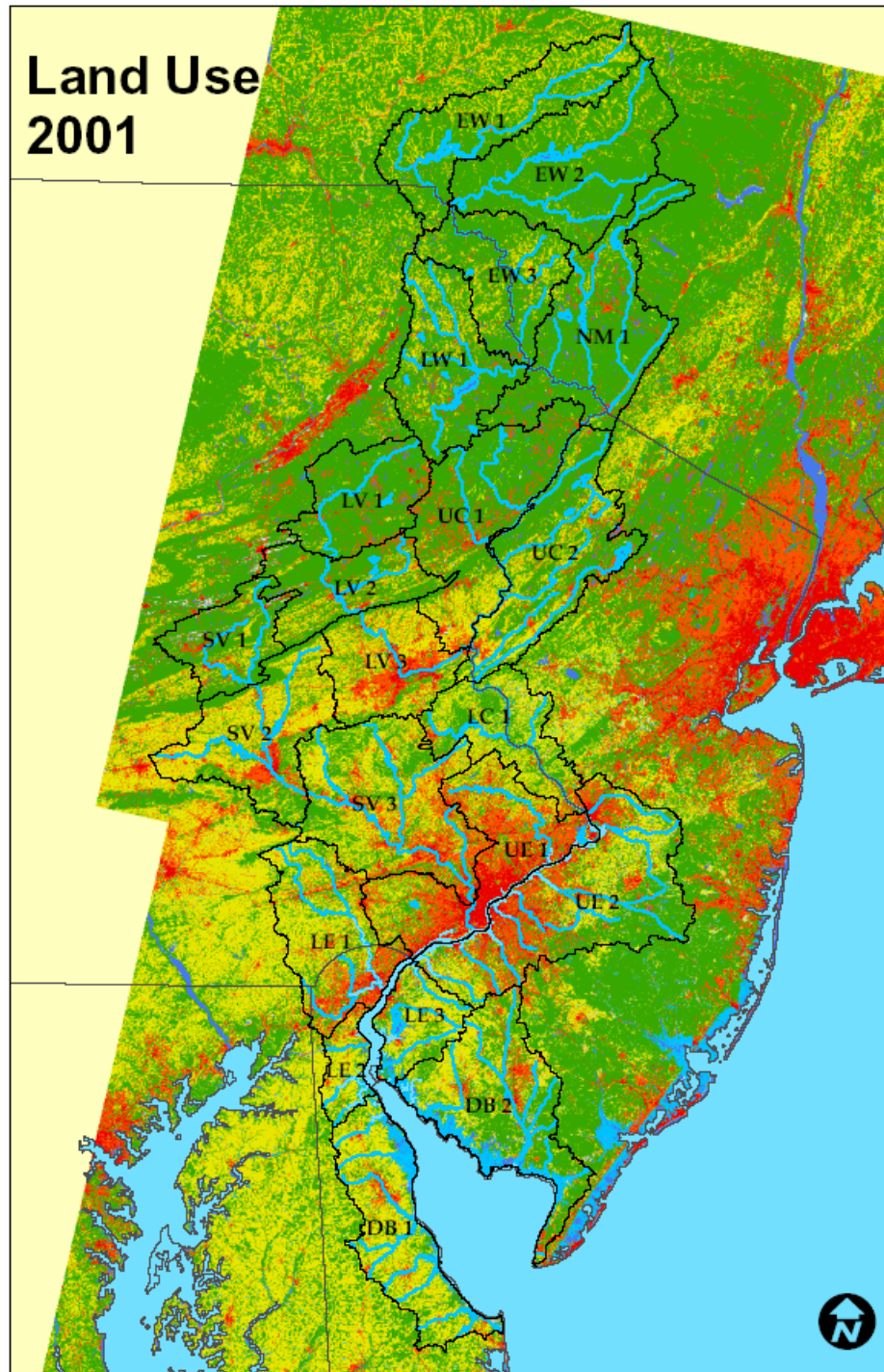
■ Developed ■ Agriculture ■ Forest ■ Water/Wetlands

**2001 Land Use
Delaware River Basin**

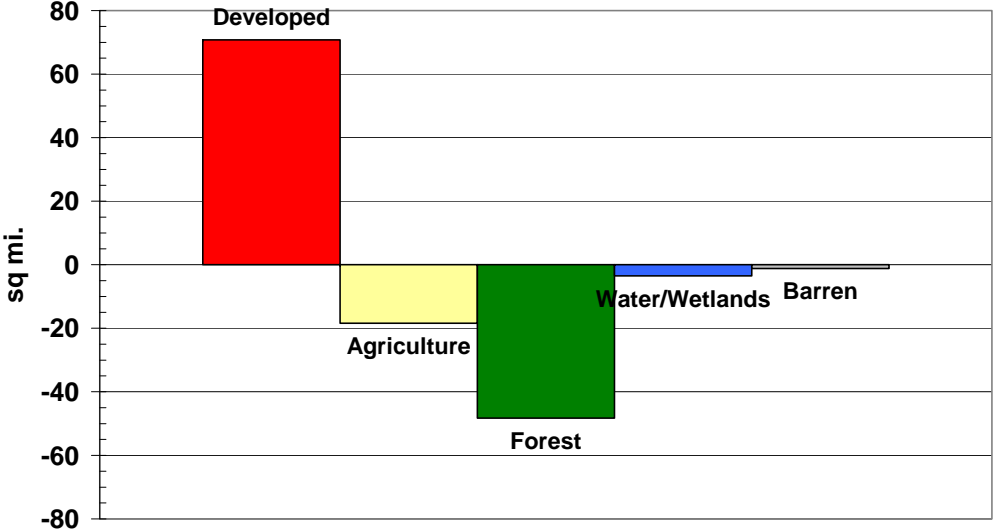


■ Developed ■ Agriculture ■ Forest ■ Water/Wetlands

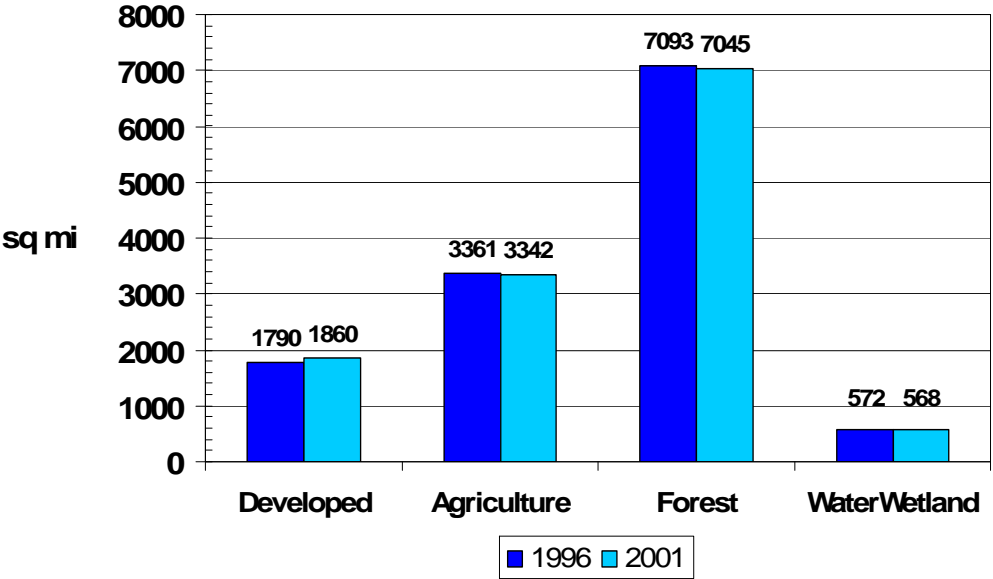
Land Use 2001



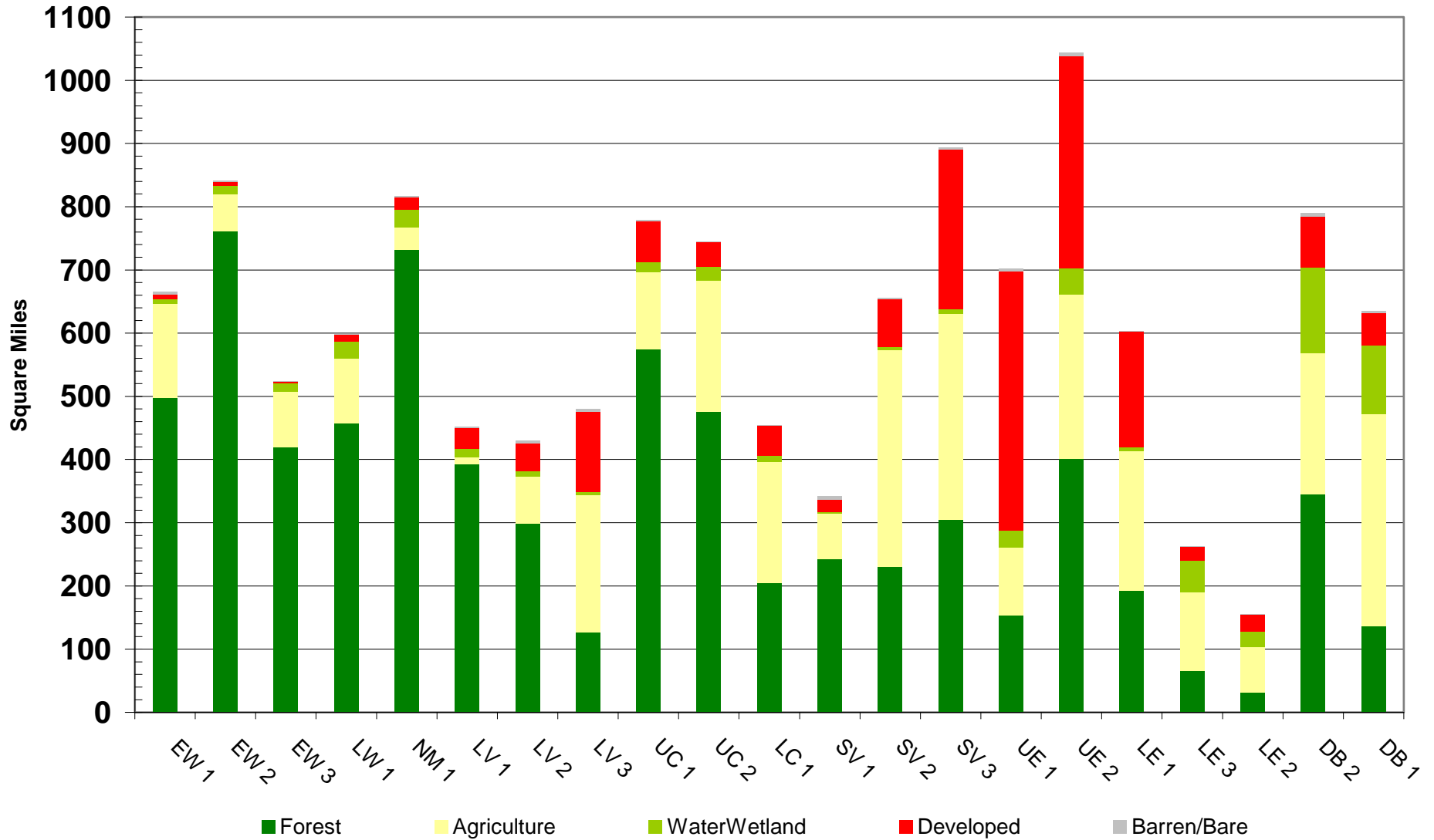
Land Use Change in the Delaware River Basin 1996 - 2001



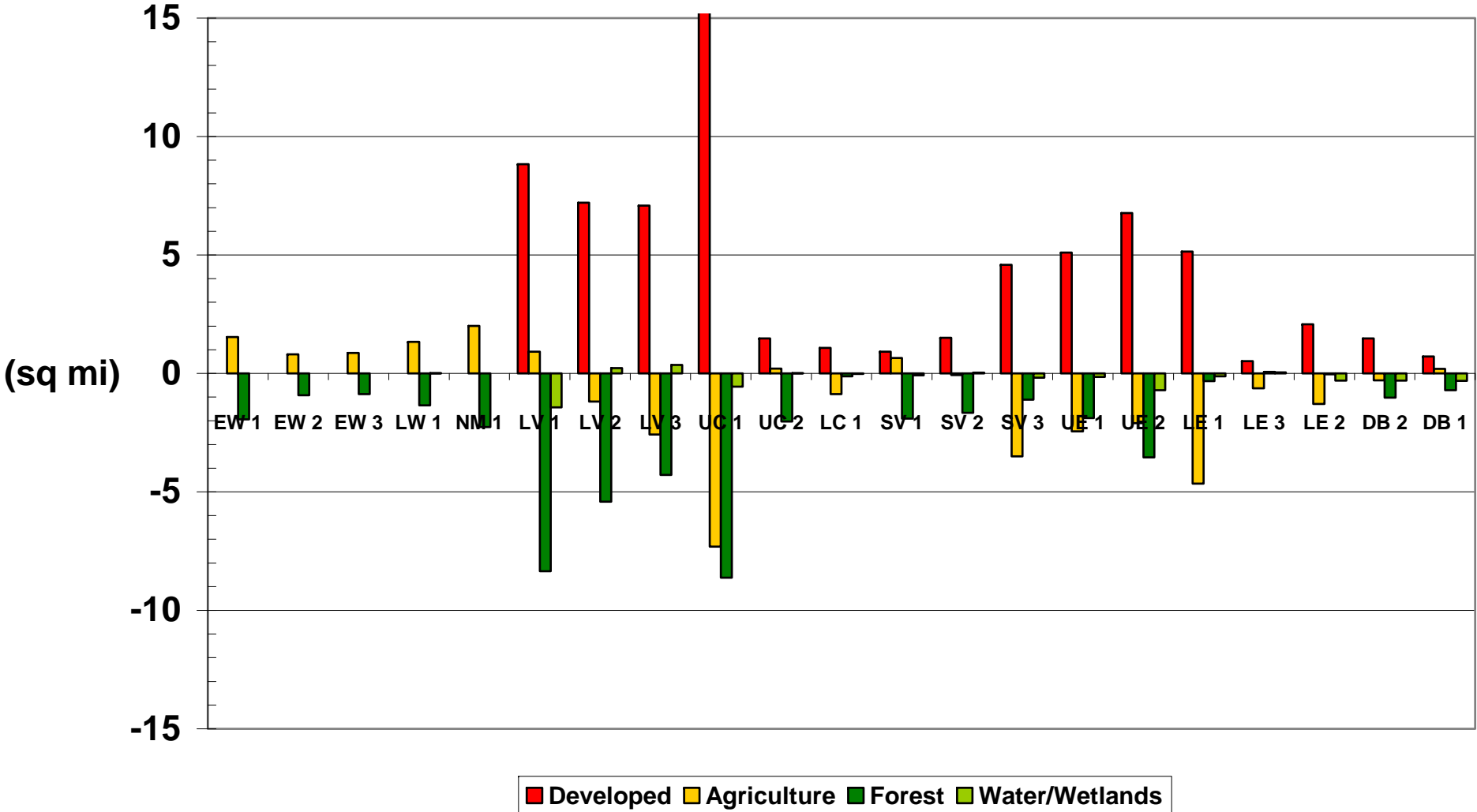
Land Use Transition in the Delaware River Basin 1996 - 2001

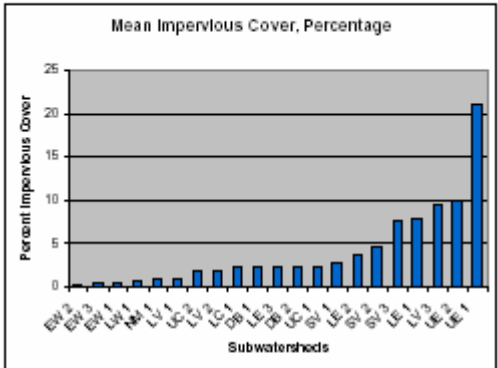


Land Use, 2001 Delaware River Basin

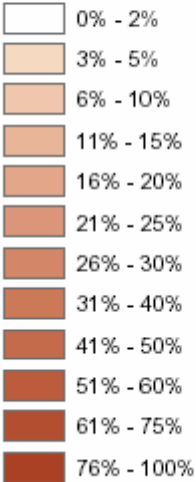


Change in Land Use Area in the Delaware River Basin 1996 - 2001

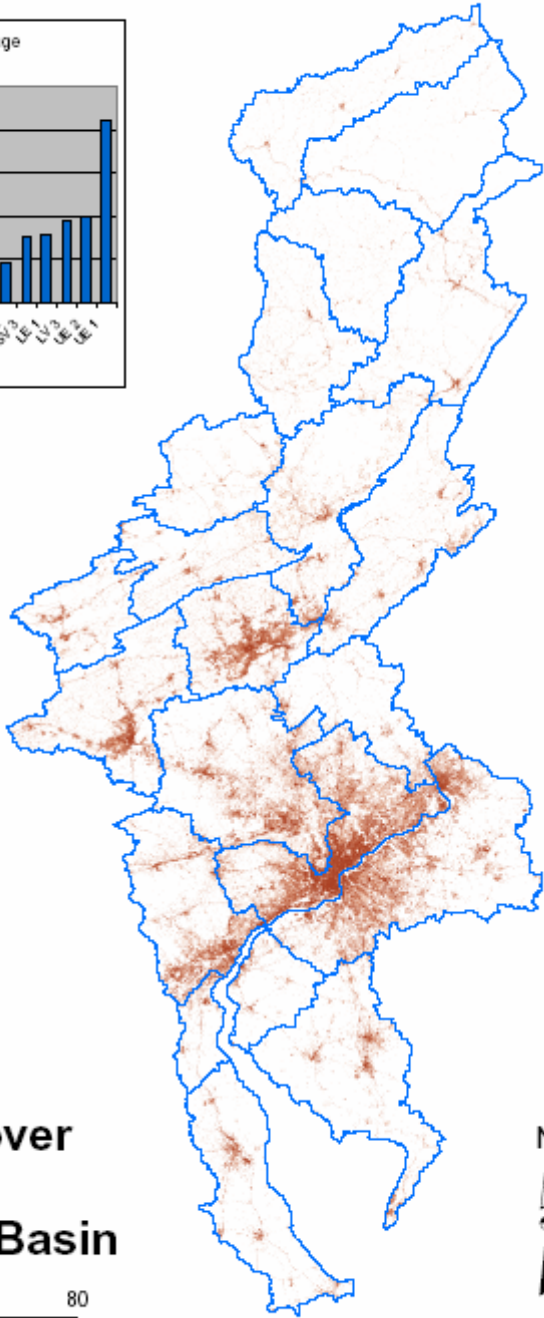
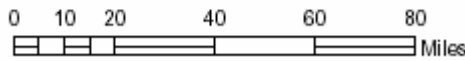




Percent Impervious Cover

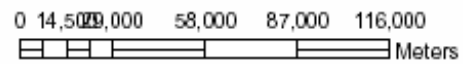
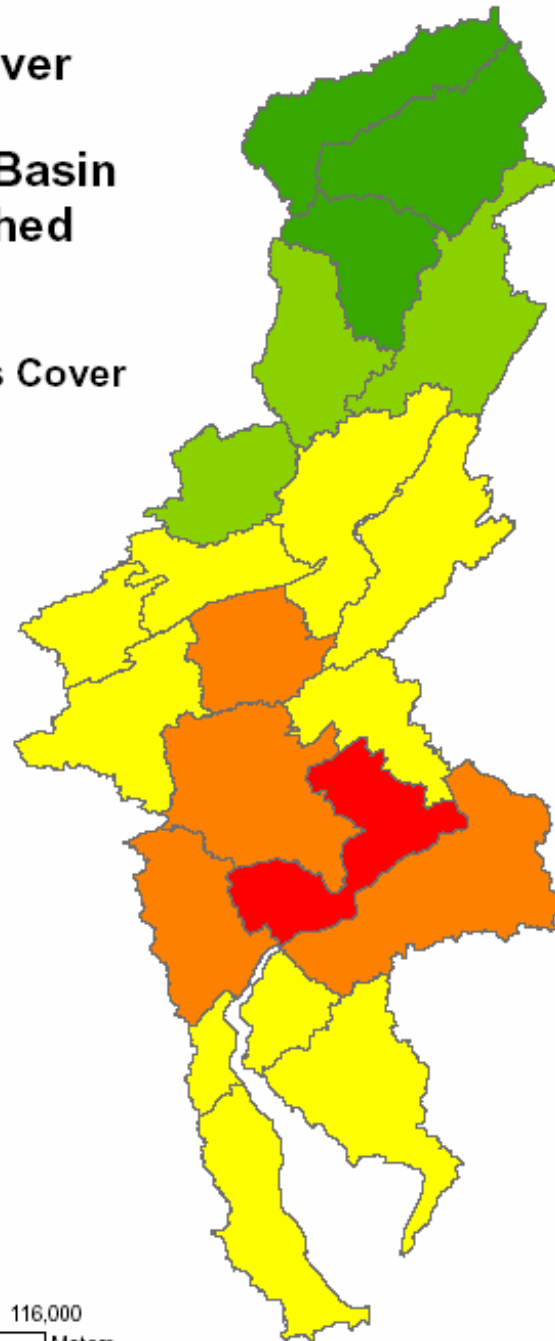
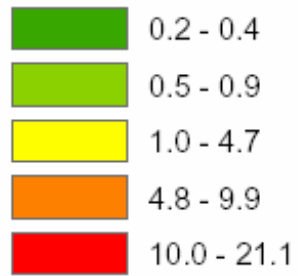


**Impervious Cover
in the
Delaware River Basin**



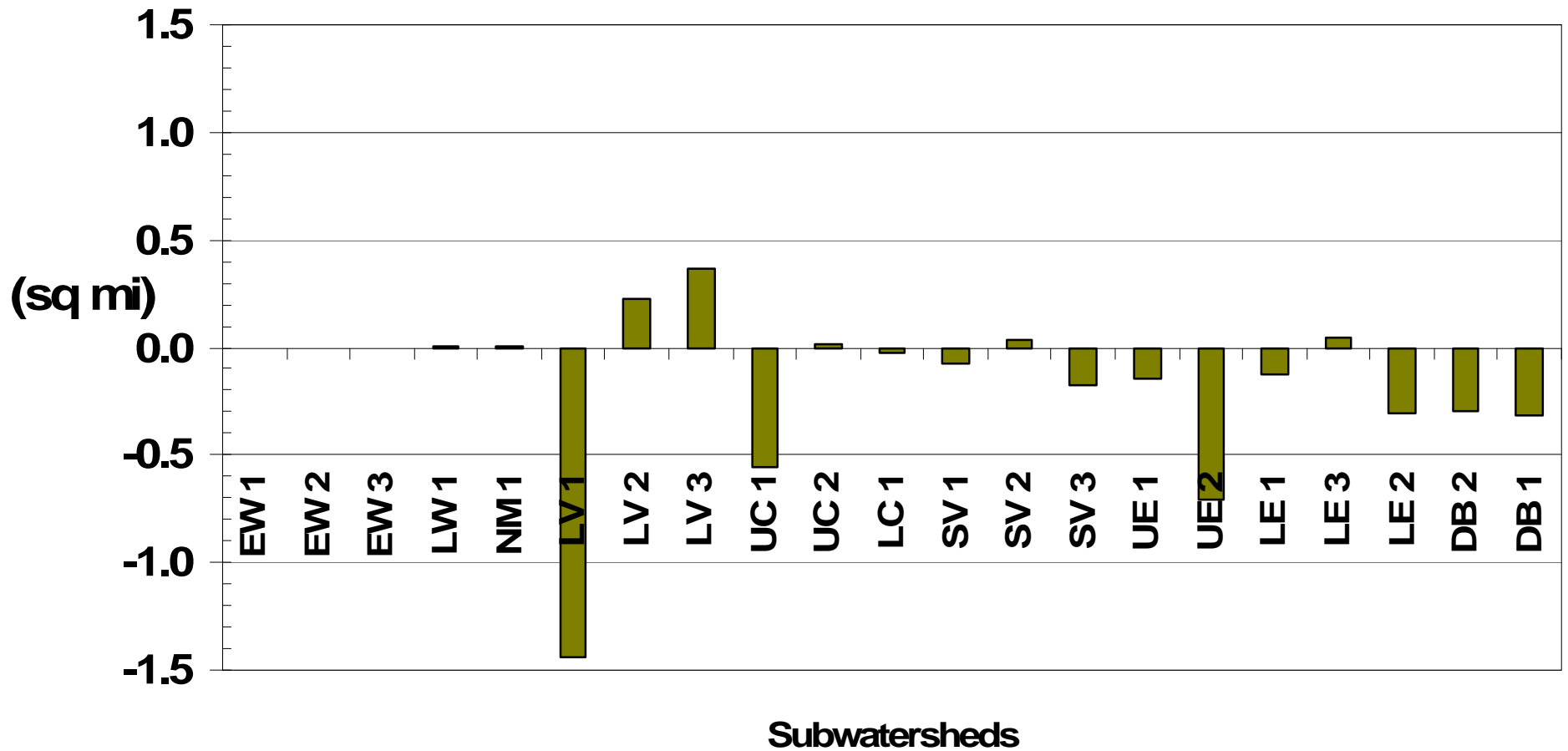
Impervious Cover in the Delaware River Basin by Subwatershed

Percent Impervious Cover

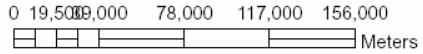
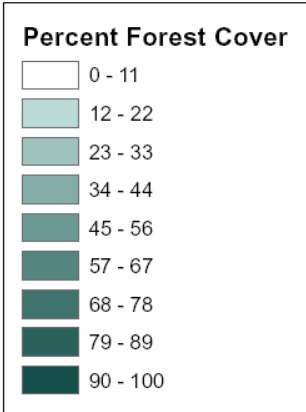
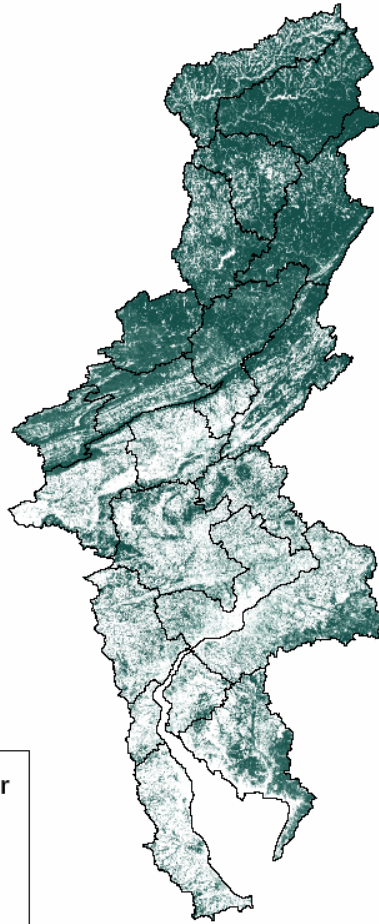


Change in Water plus Wetlands, 1996 - 2001

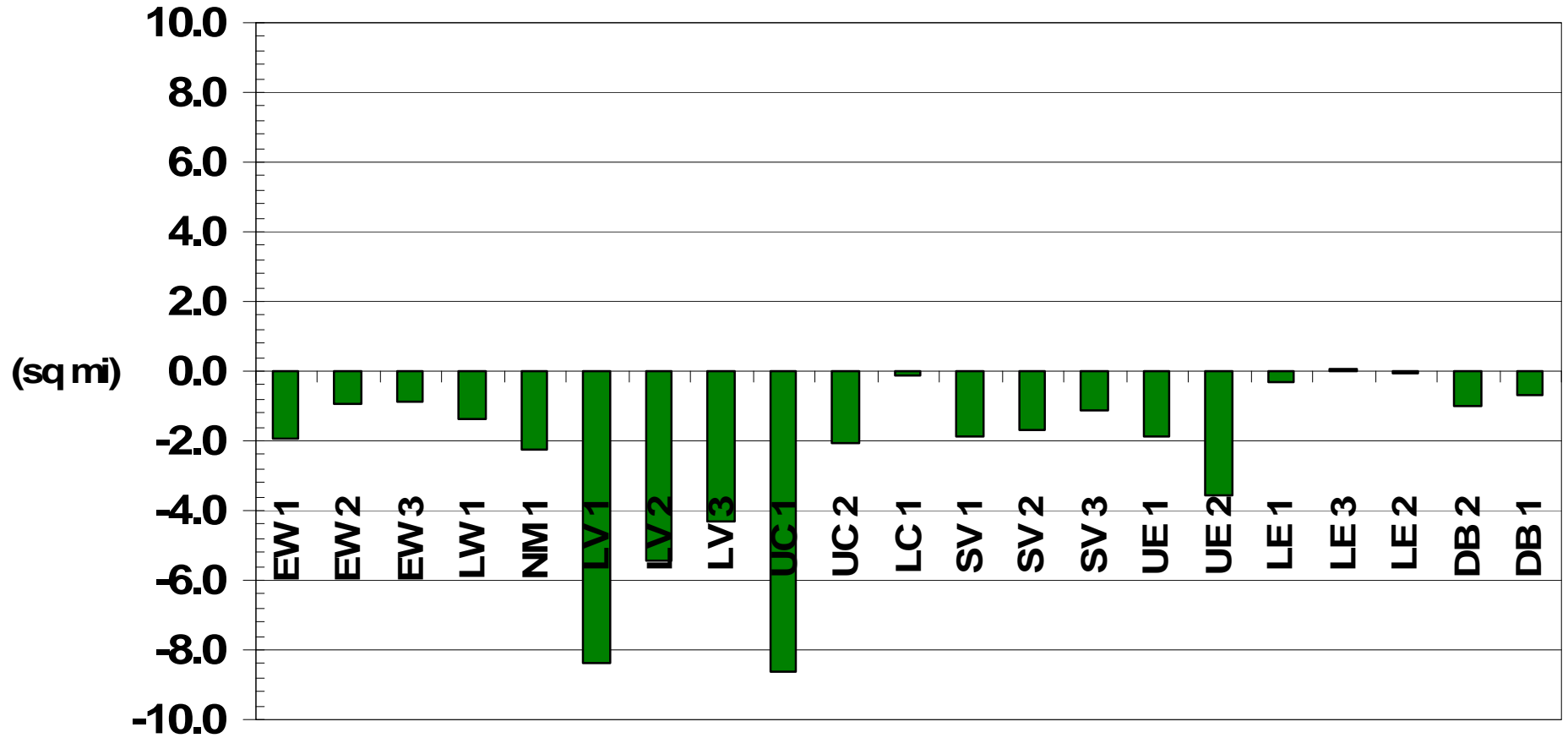
Delaware River Basin



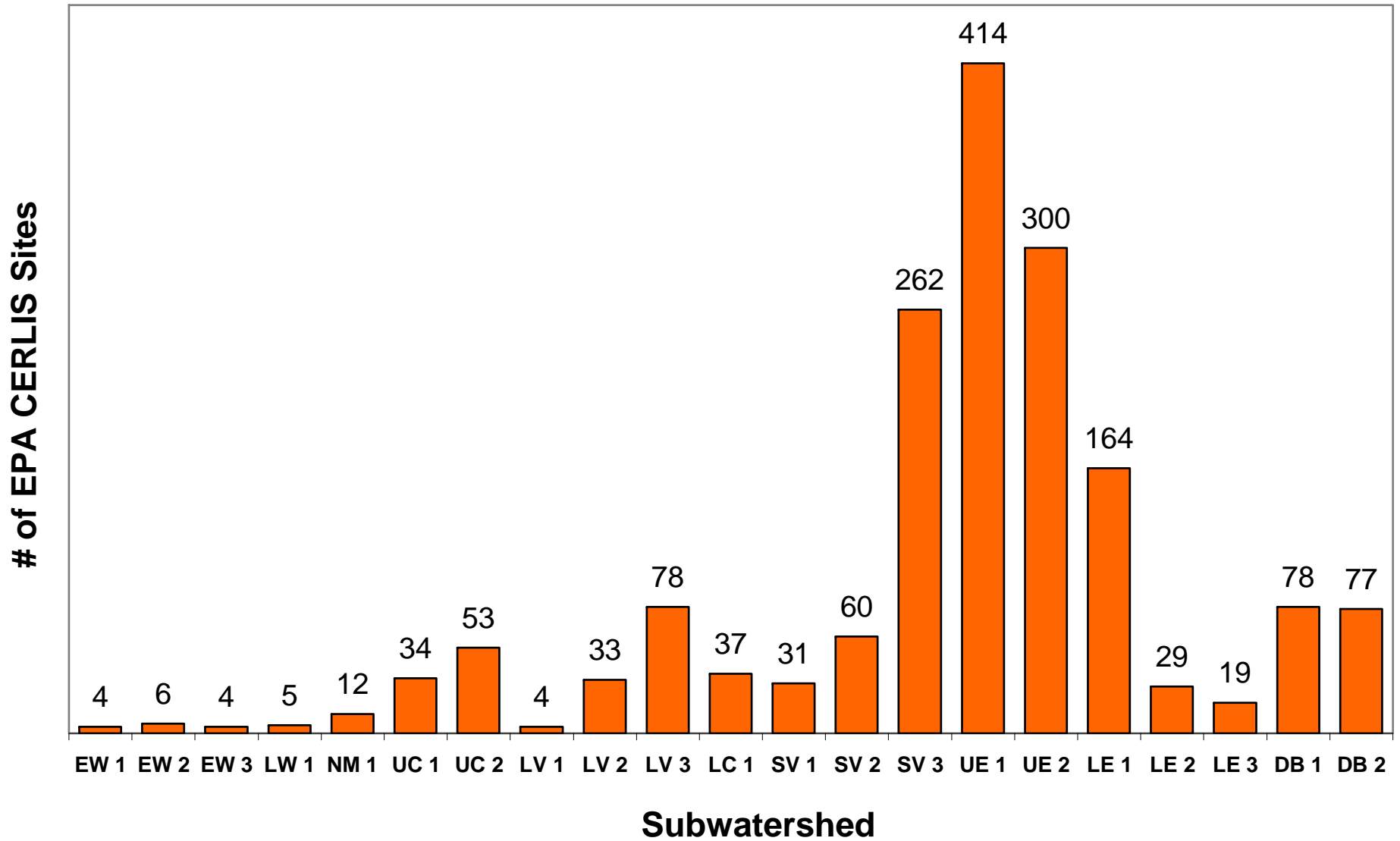
Forest Cover in the Delaware River Basin



Forest Change in the Delaware River Basin, 1996 - 2001

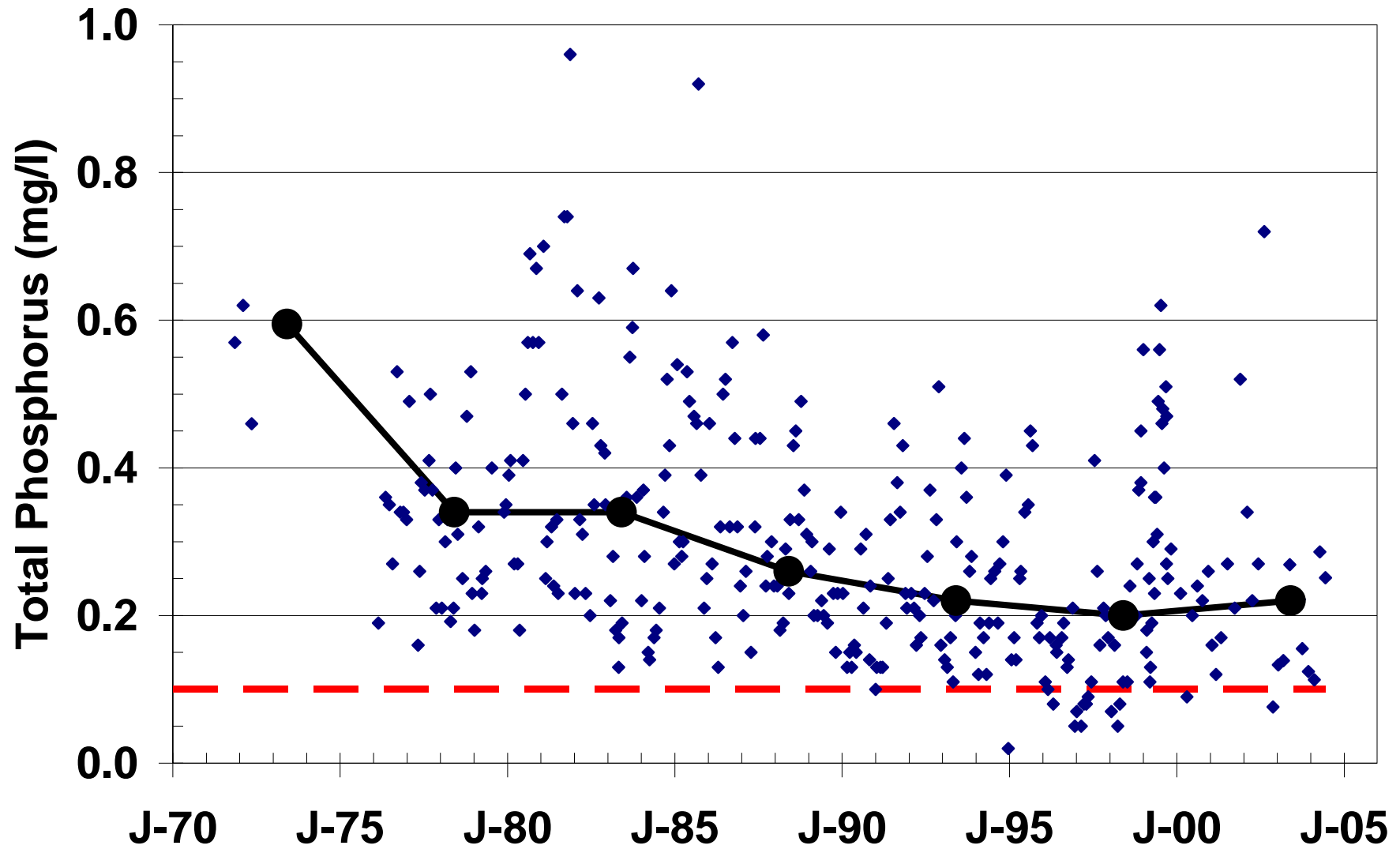


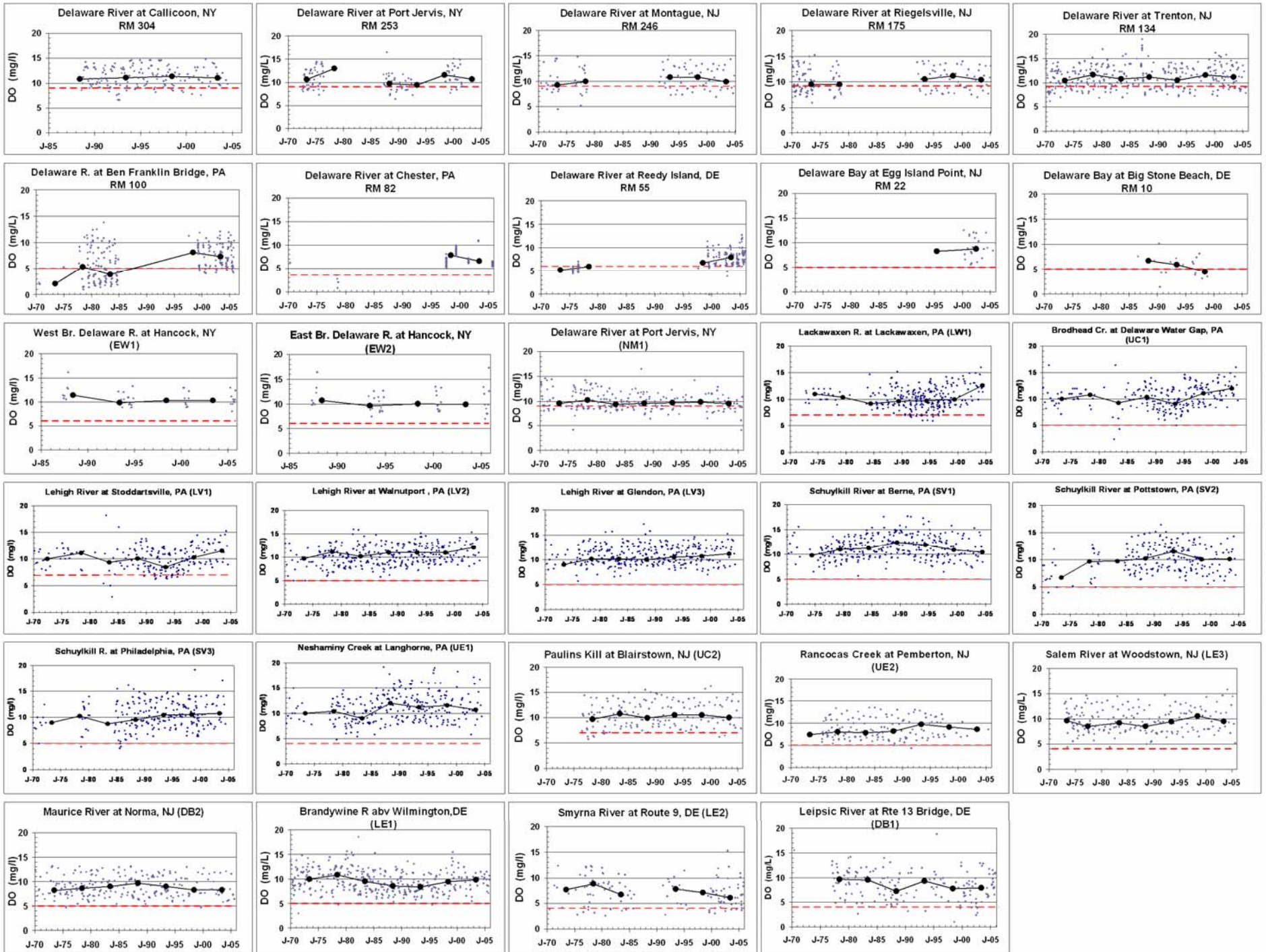
Superfund Sites by DRBC Subwatershed

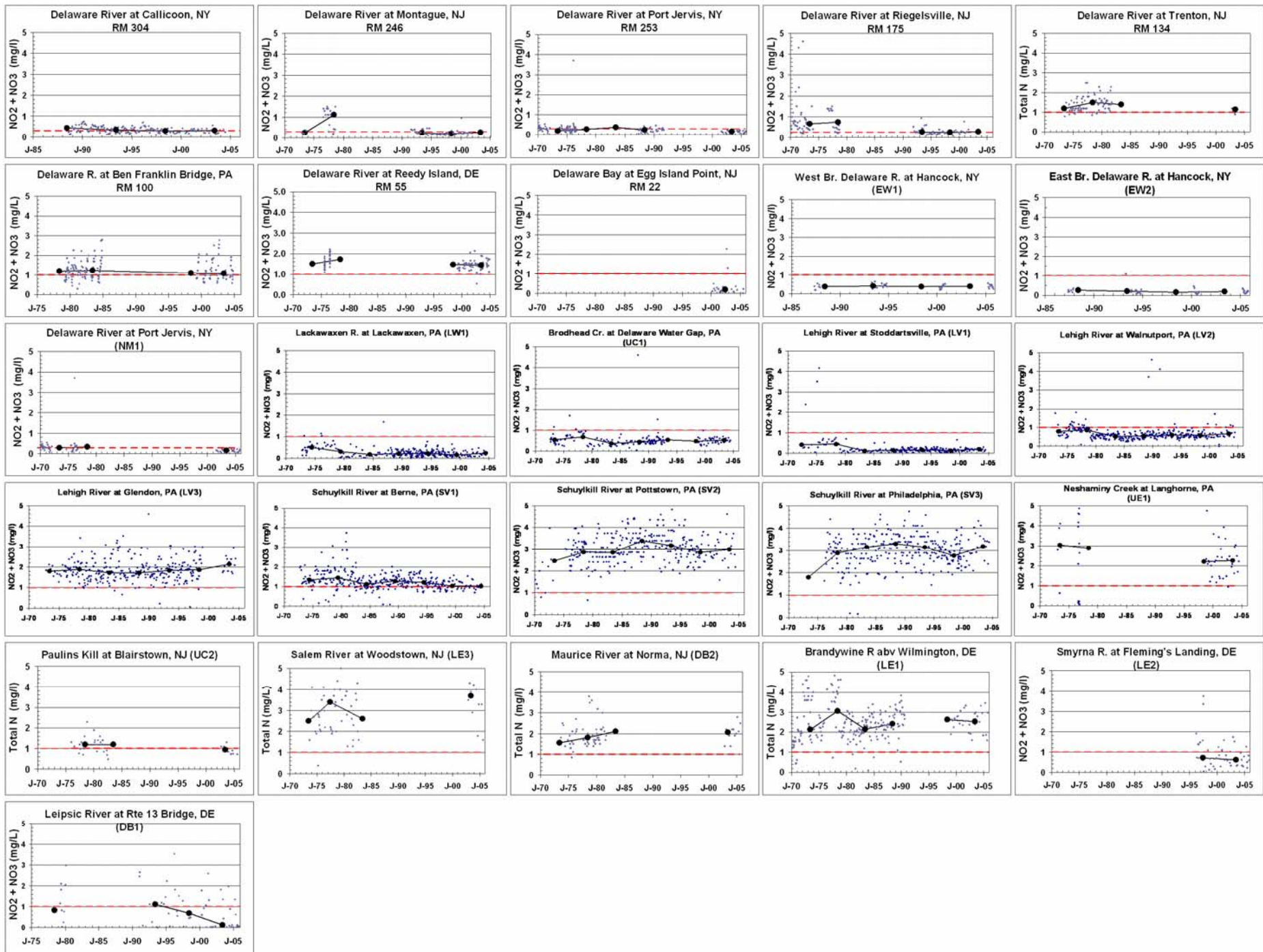


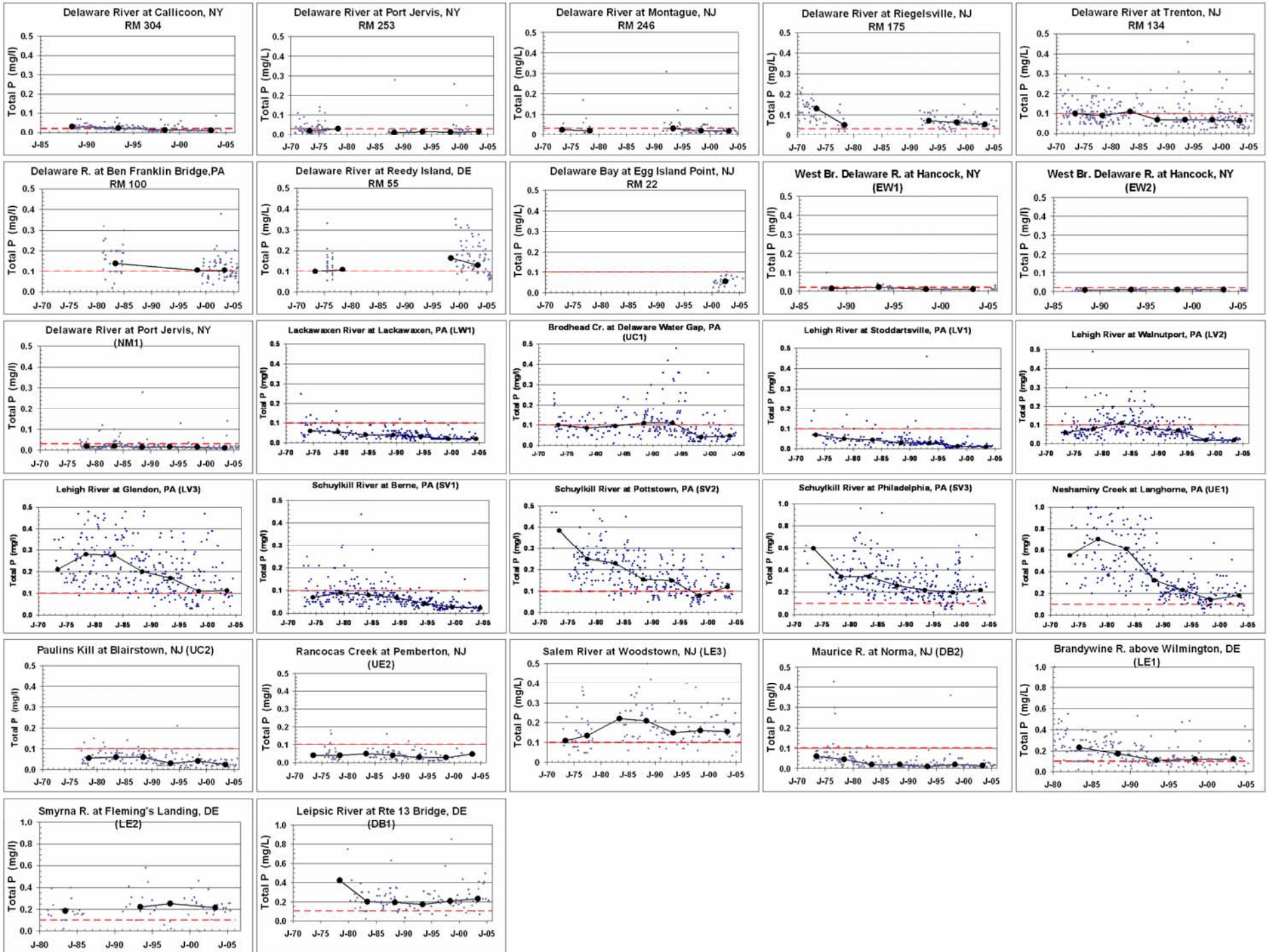


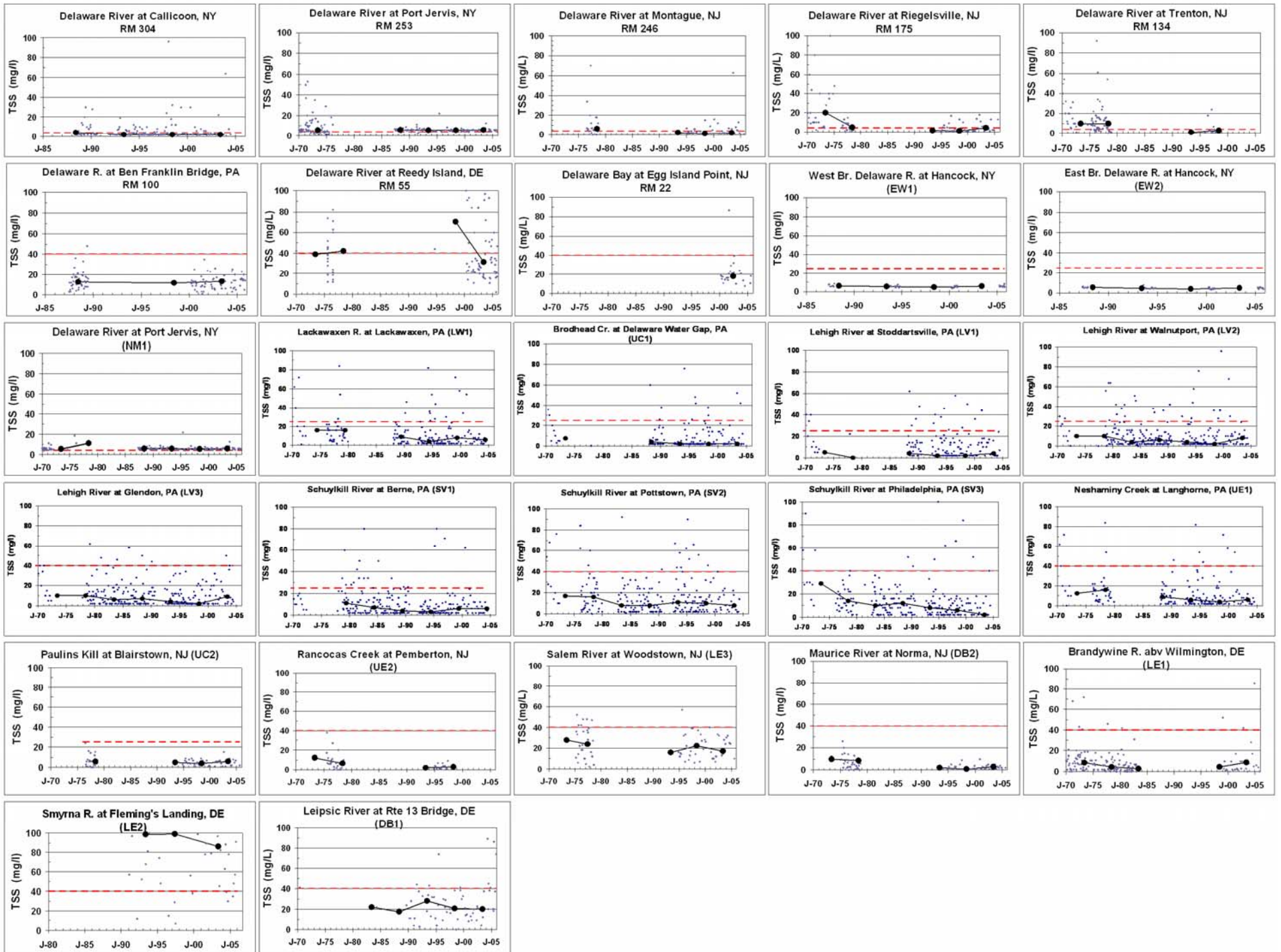
Schuylkill River at Philadelphia, PA (SV3)





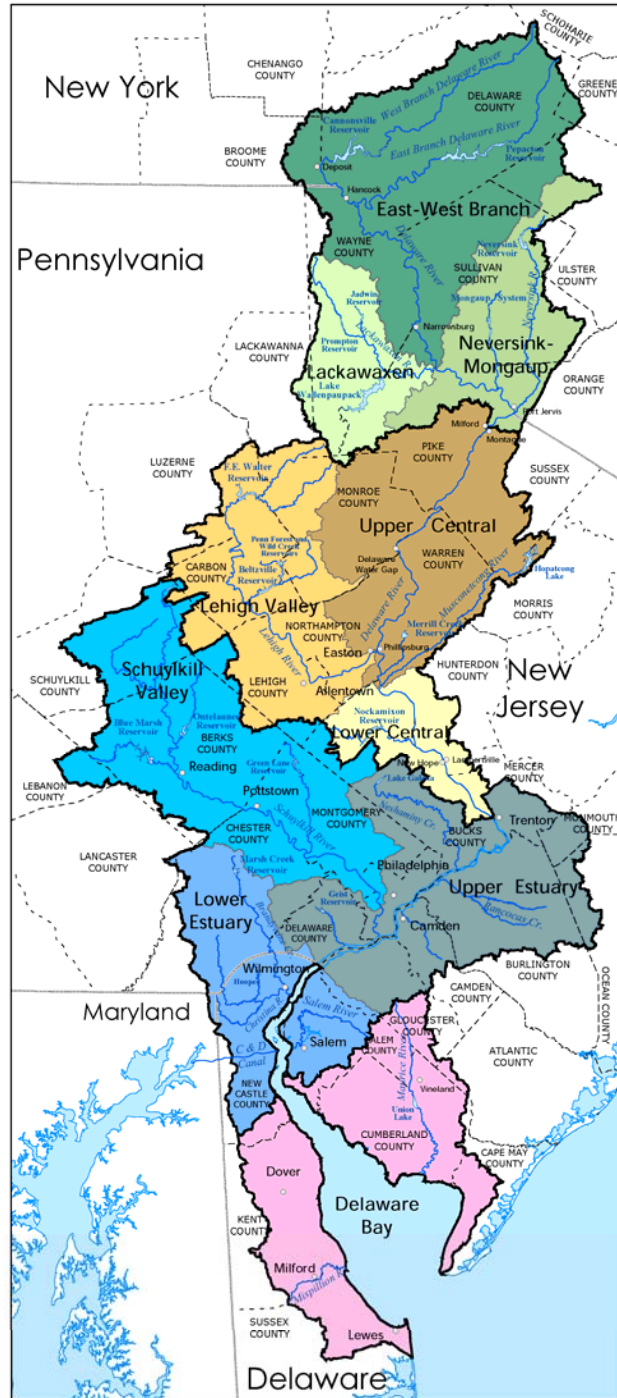




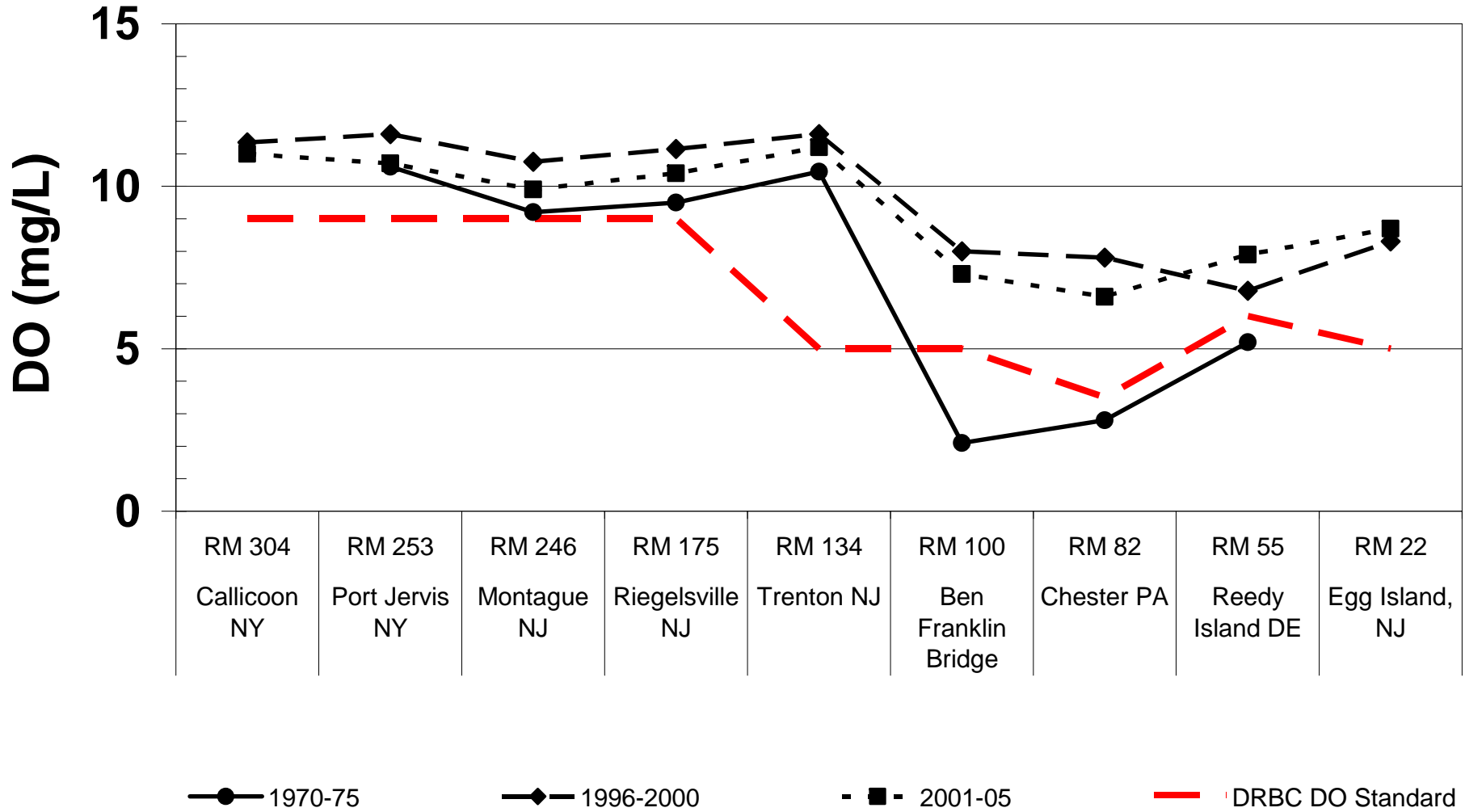


Watersheds of the Delaware River Basin

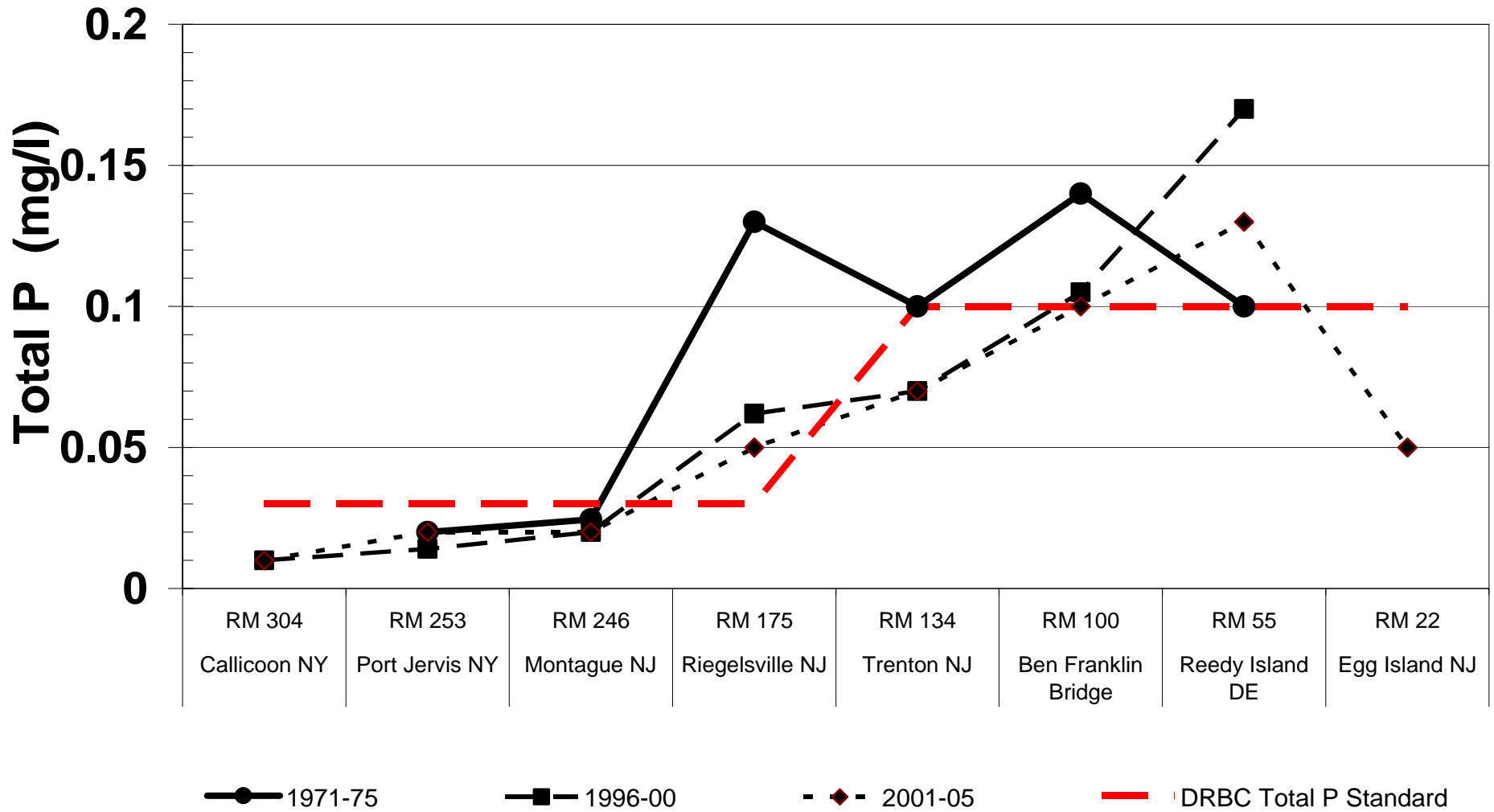
- East-West Branch Watersheds
- Lackawaxen Watersheds
- Neversink-Mongaup Watersheds
- Upper Central Watersheds
- Lower Central Watersheds
- Lehigh Valley
- Schuylkill Valley
- Upper Estuary Watersheds
- Lower Estuary Watersheds
- Delaware Bay Watersheds



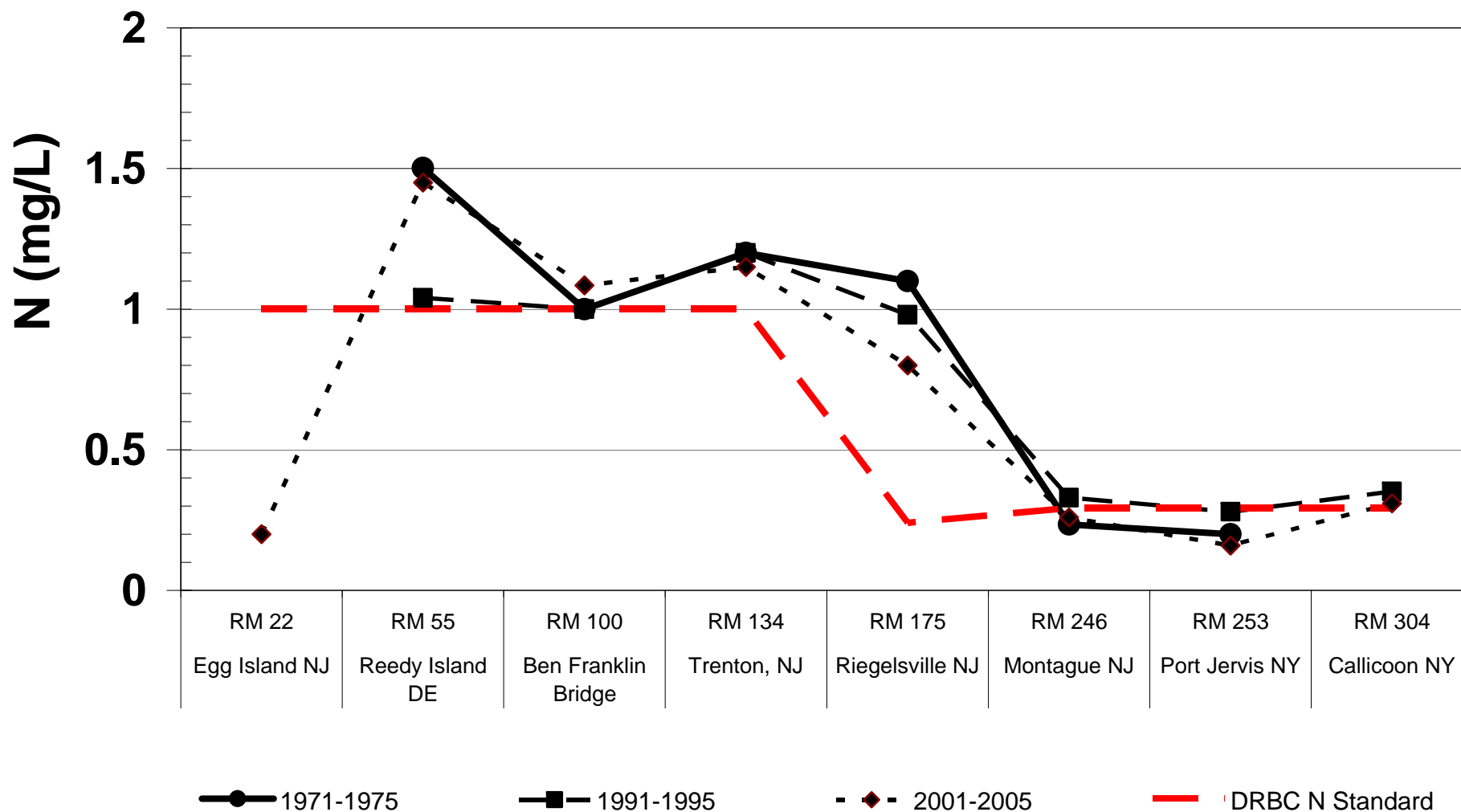
Dissolved Oxygen (5-yr Median) Delaware River and Bay



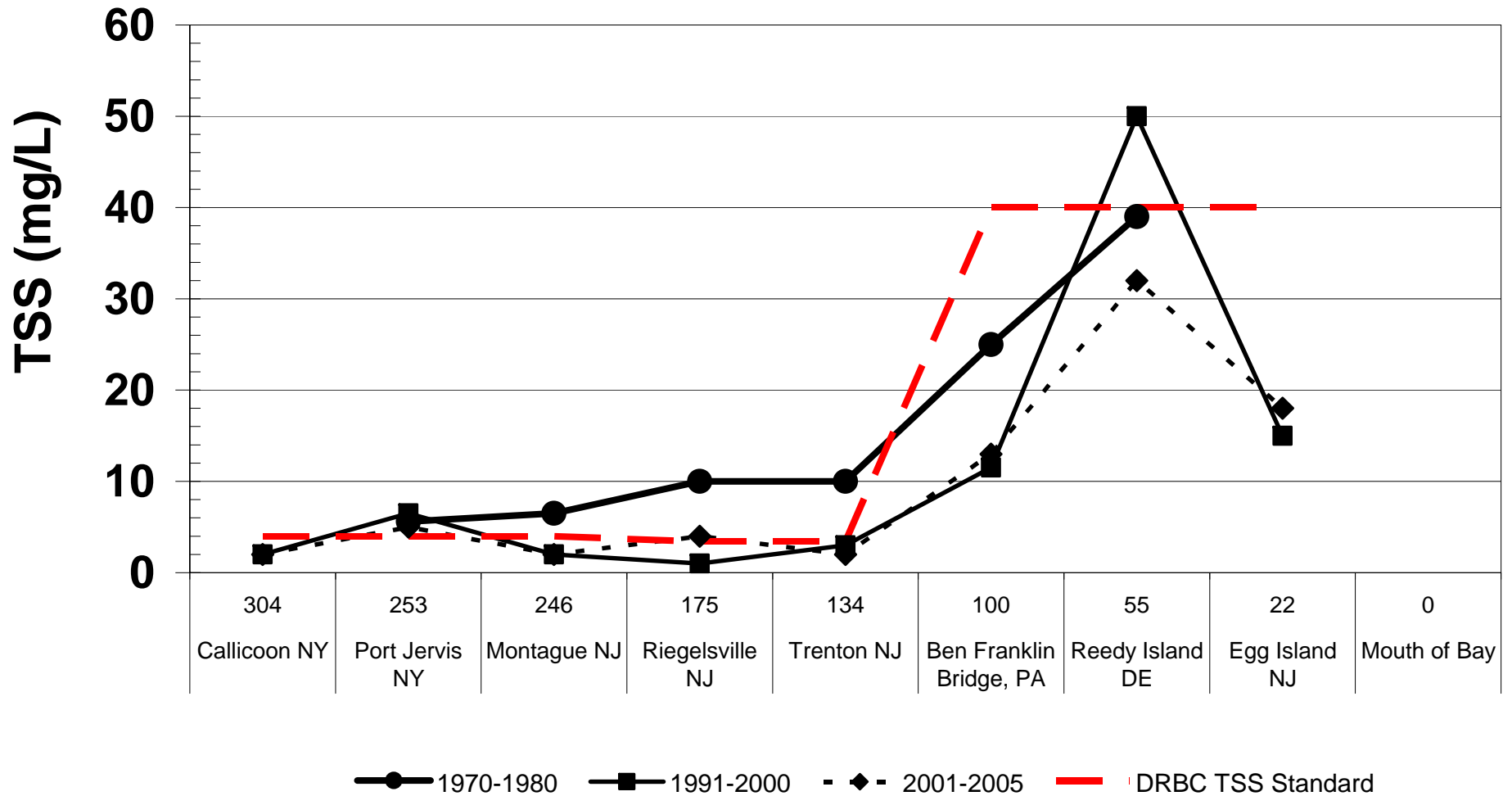
Total Phosphorus (5-yr Median) Delaware River and Bay



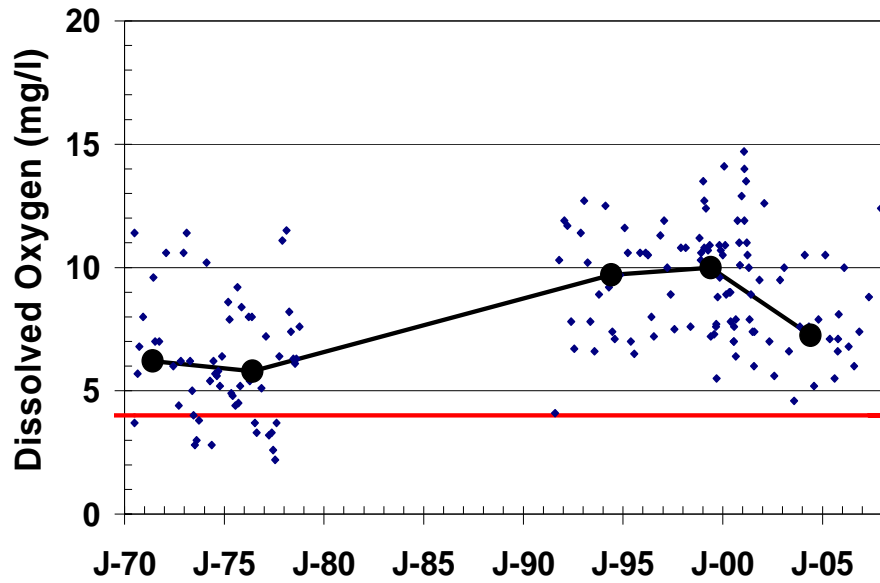
Nitrate + Nitrite N (5-yr Median) Delaware River and Bay



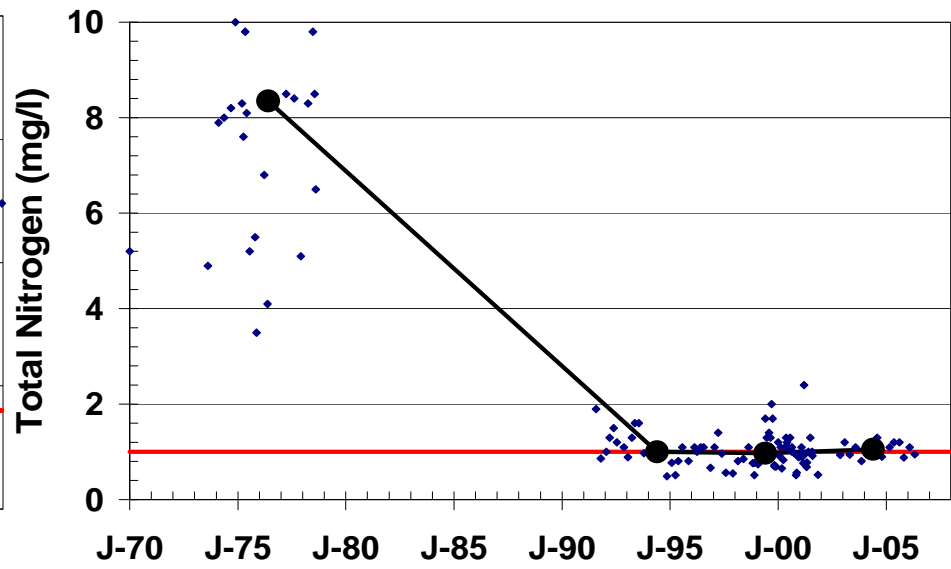
Total Susp. Sediment, (10-Yr Median) Delaware River and Bay



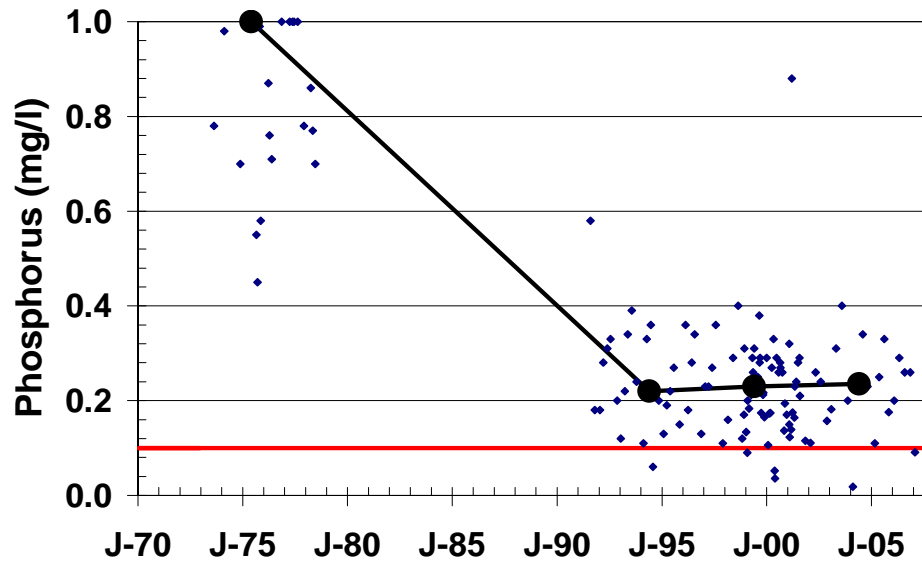
Cooper River at Haddonfield, NJ



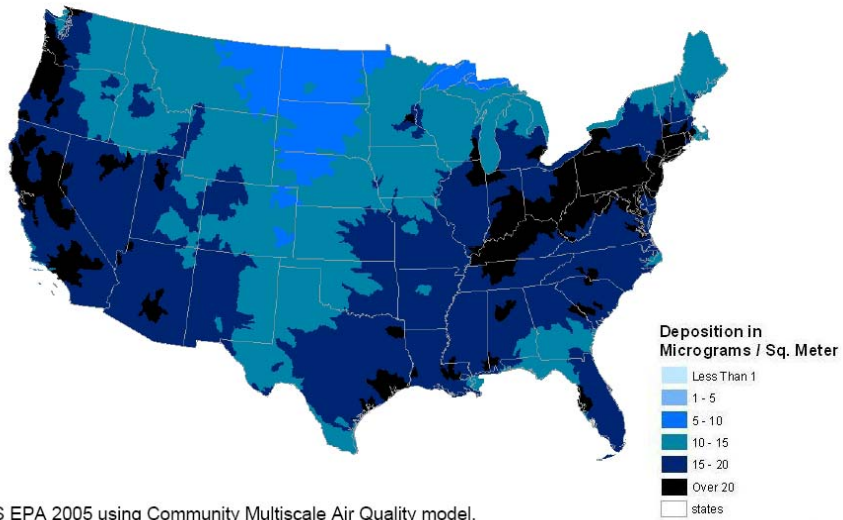
Cooper River at Haddonfield, NJ



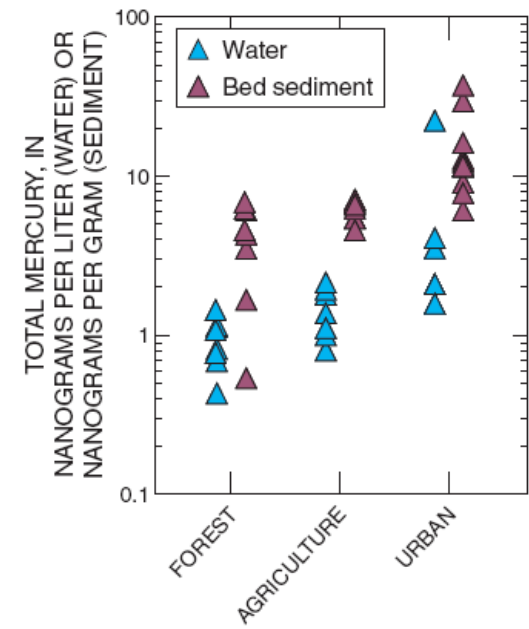
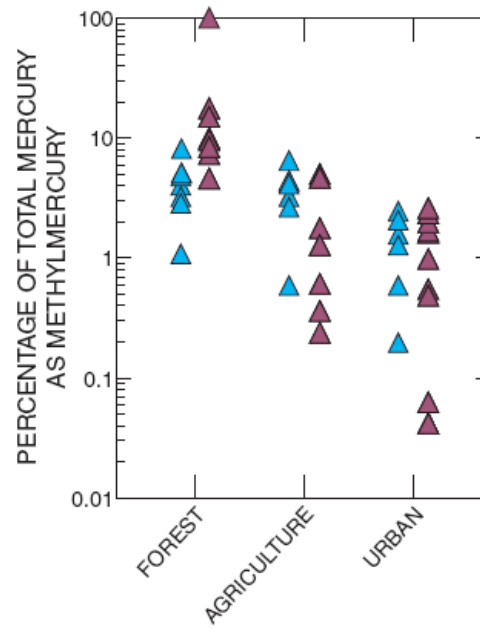
Cooper River at Haddonfield, NJ



Mercury Deposition From All Sources in 2001

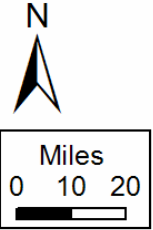
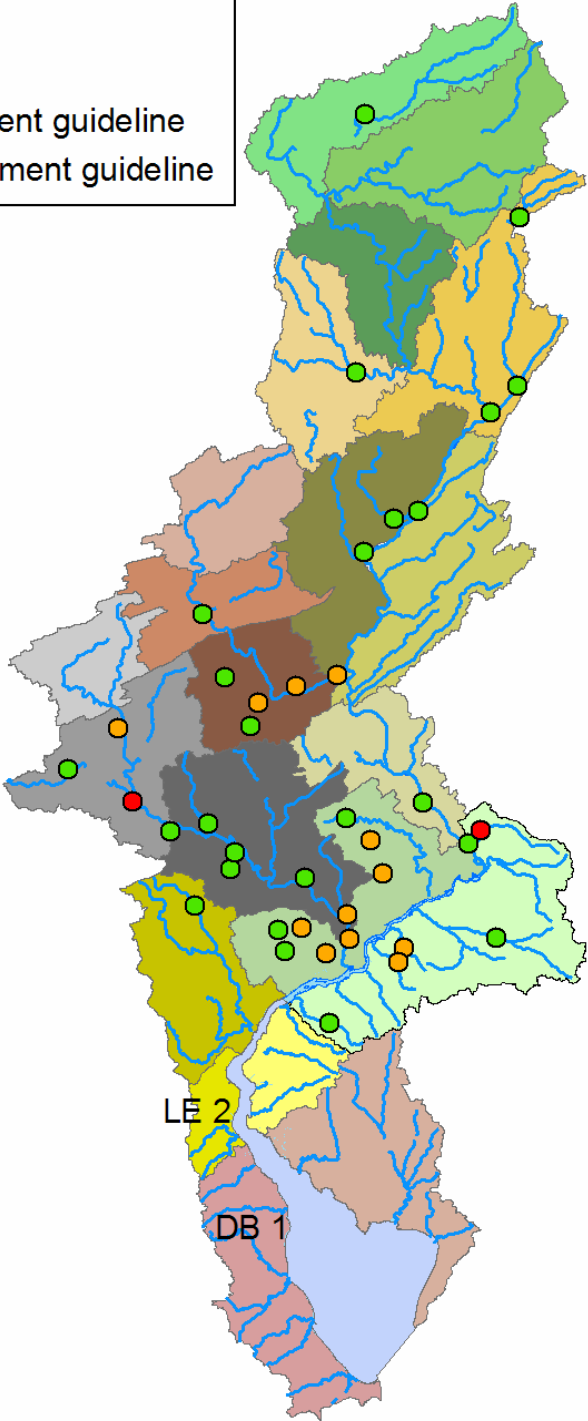


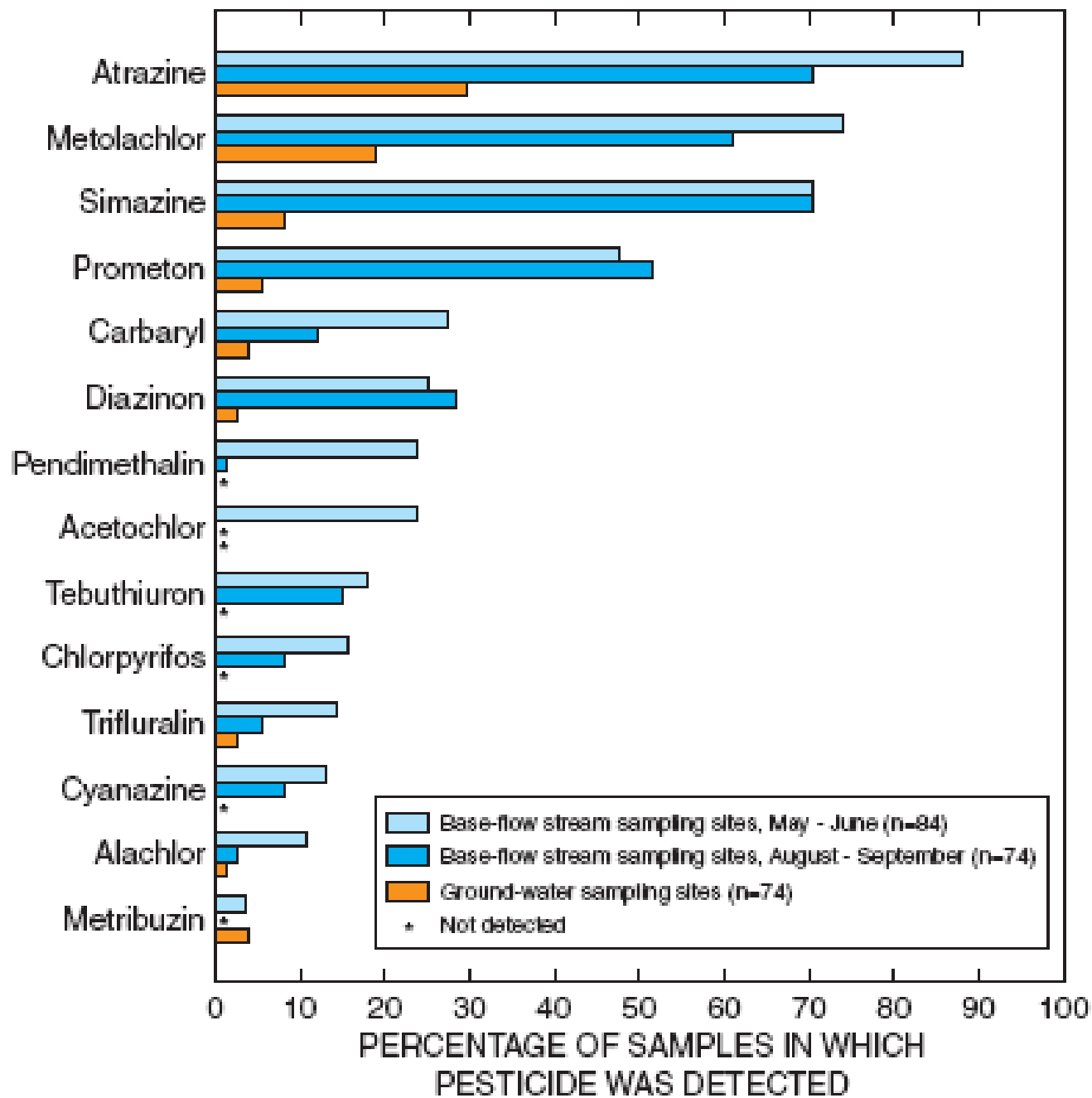
Source: US EPA 2005 using Community Multiscale Air Quality model.



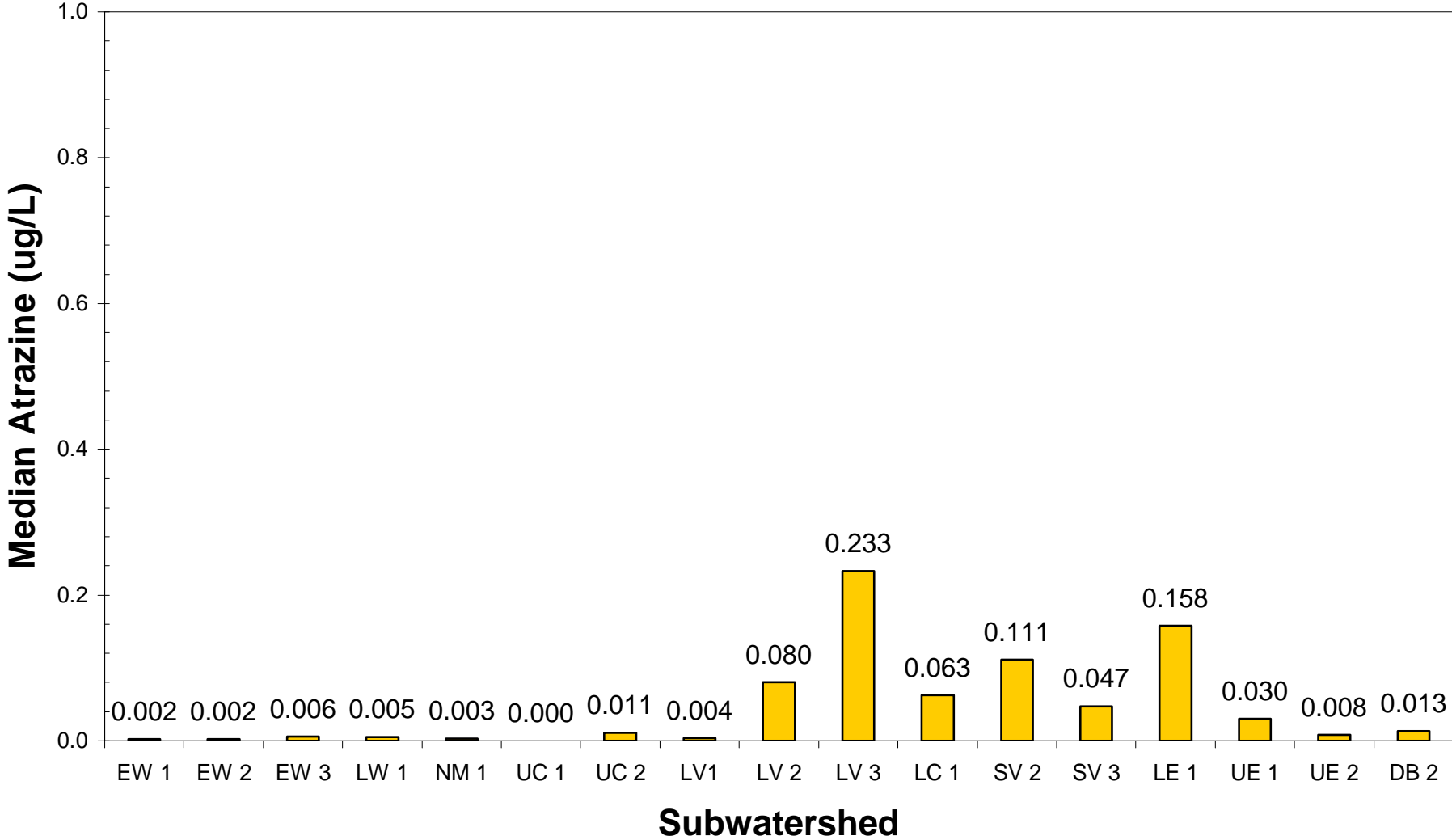
PCBs in Bed Sediment

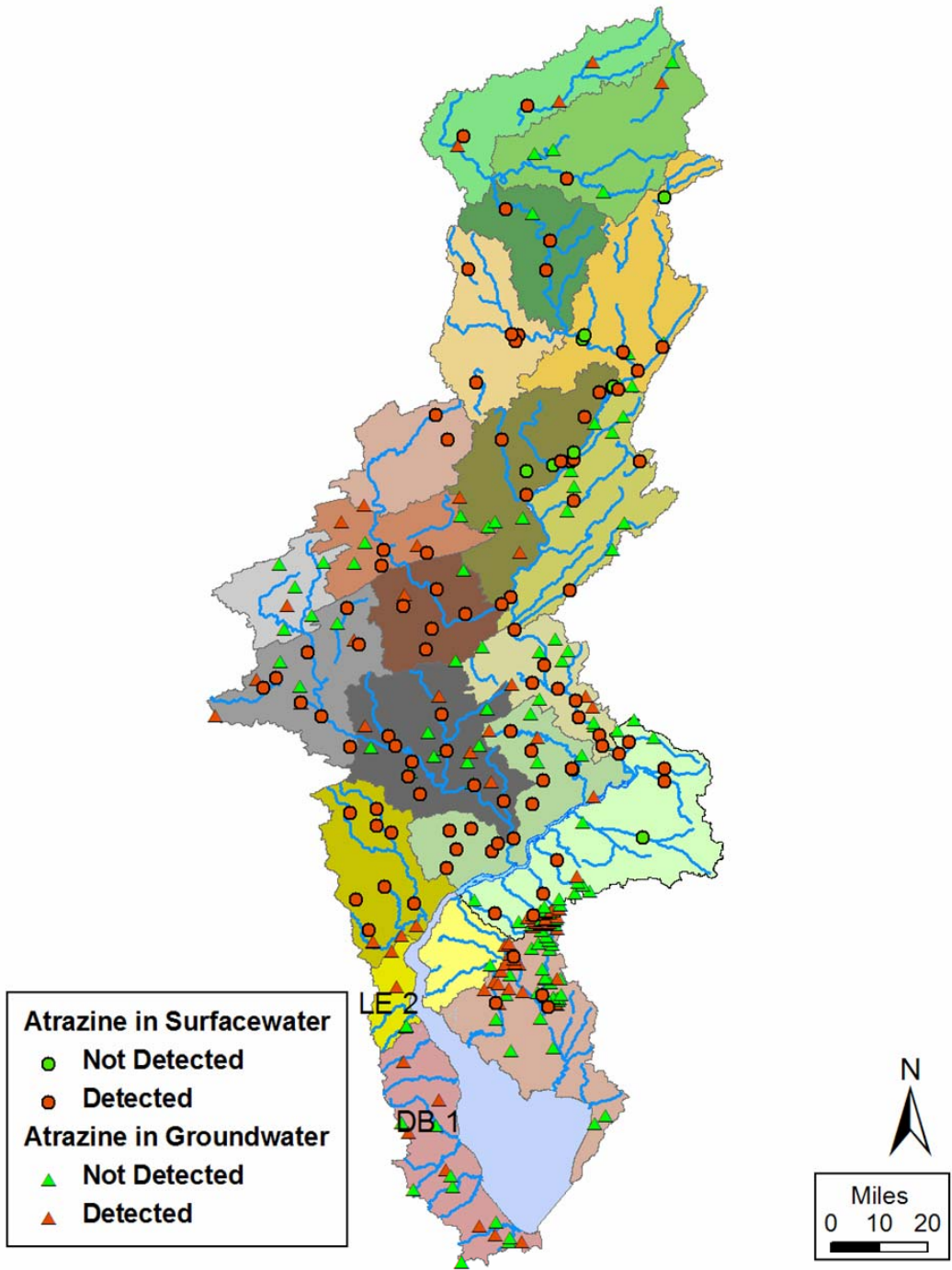
- Not Detected
- > 23 ppb NOAA ERL sediment guideline
- > 180 ppb NOAA ERM sediment guideline



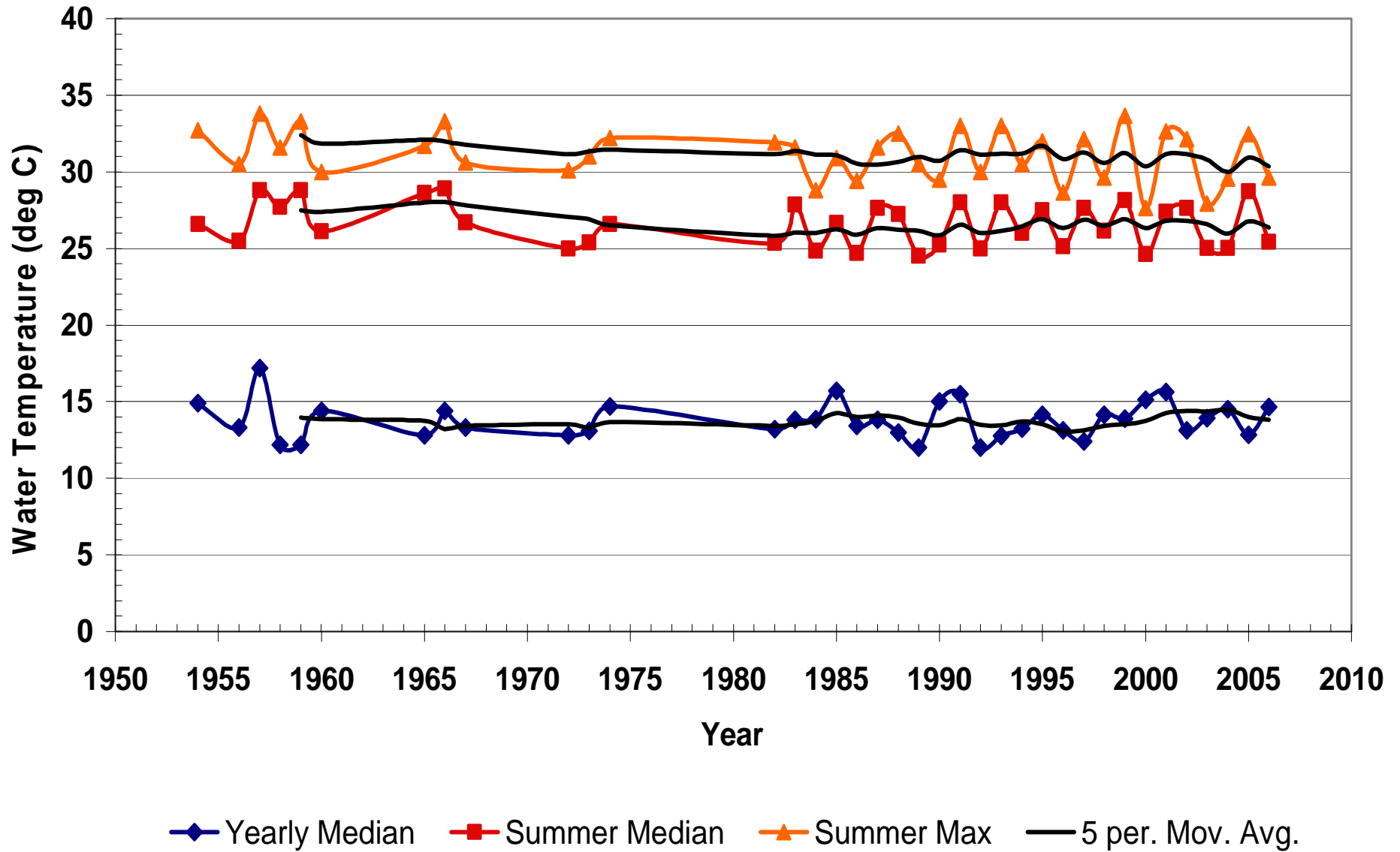


Median Atrazine Concentrations Surface Water in the Delaware River Basin

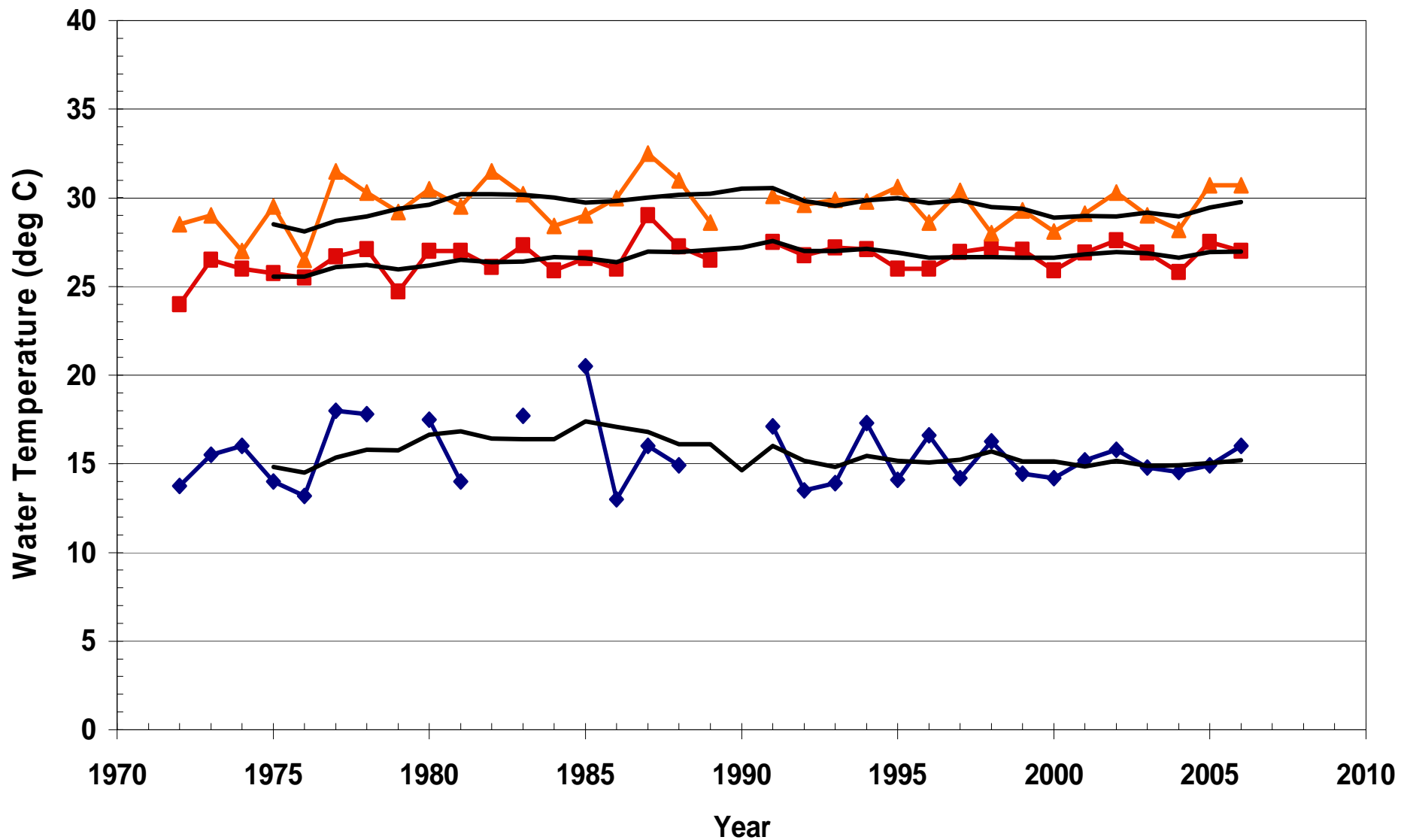




Water Temperature Delaware River at Trenton, NJ

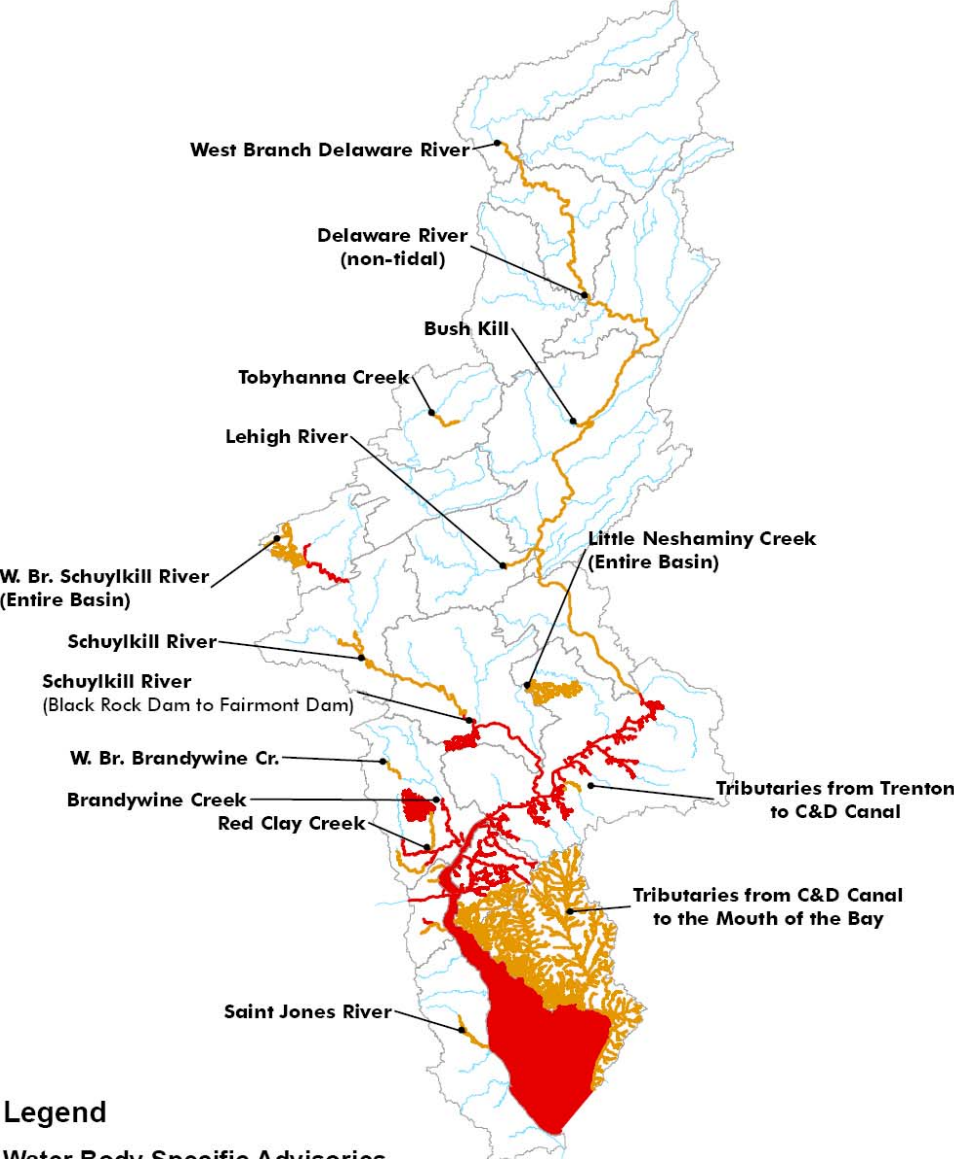


Water Temperature Delaware River at Reedy Island, DE

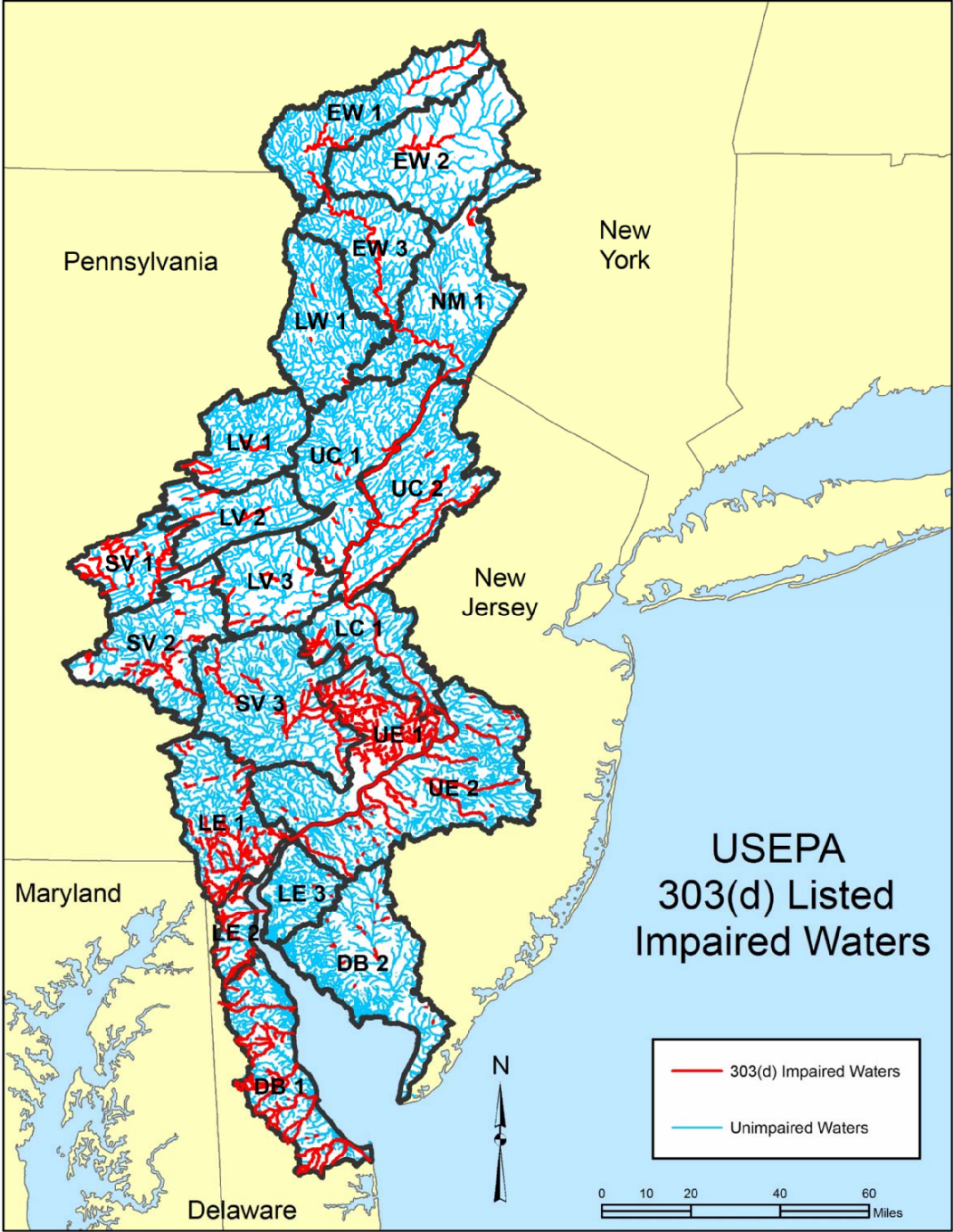


◆ Yearly Median ■ Summer Median ▲ Max Temp — 5 per. Mov. Avg.

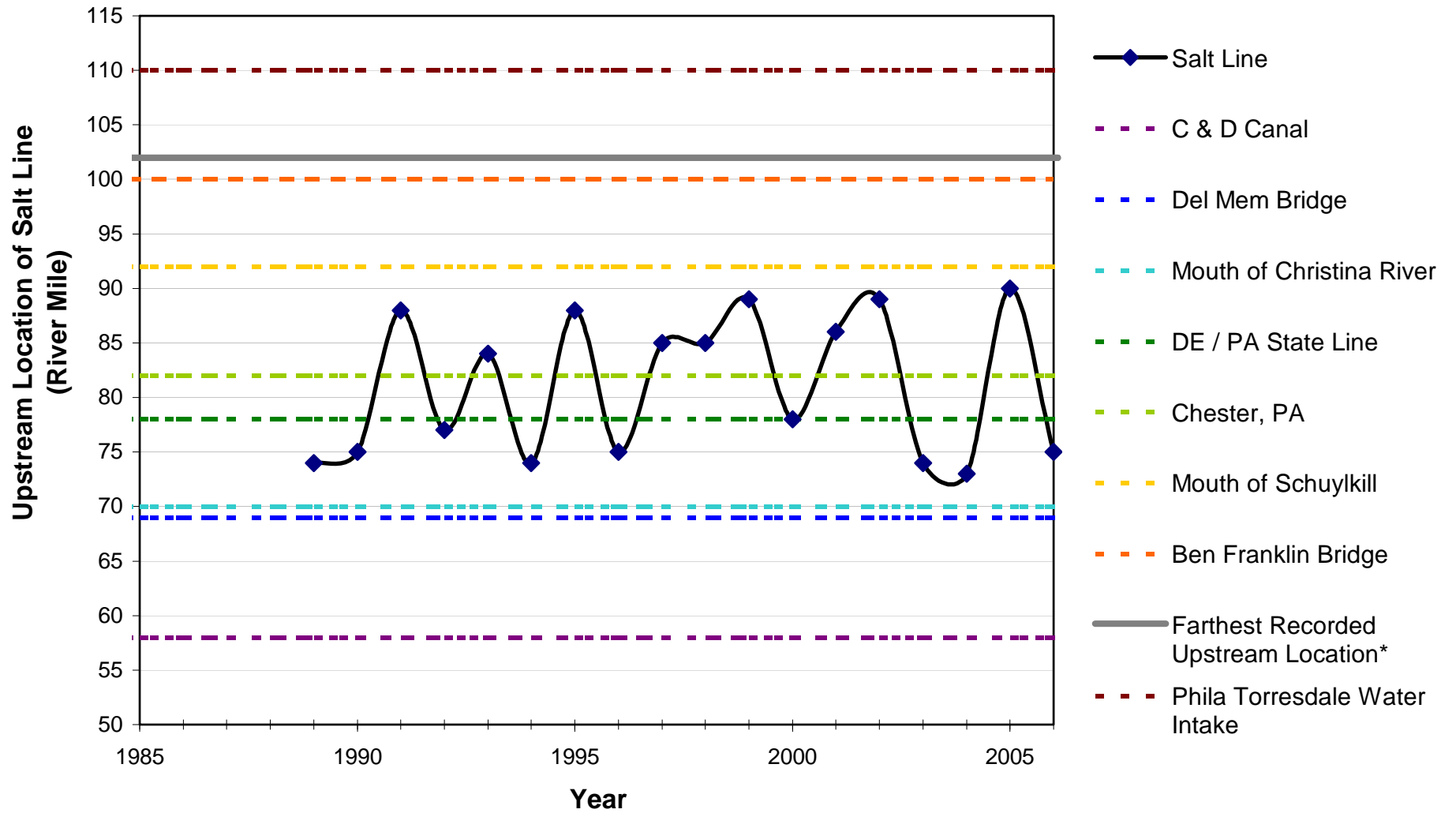
Fish Consumption Advisories



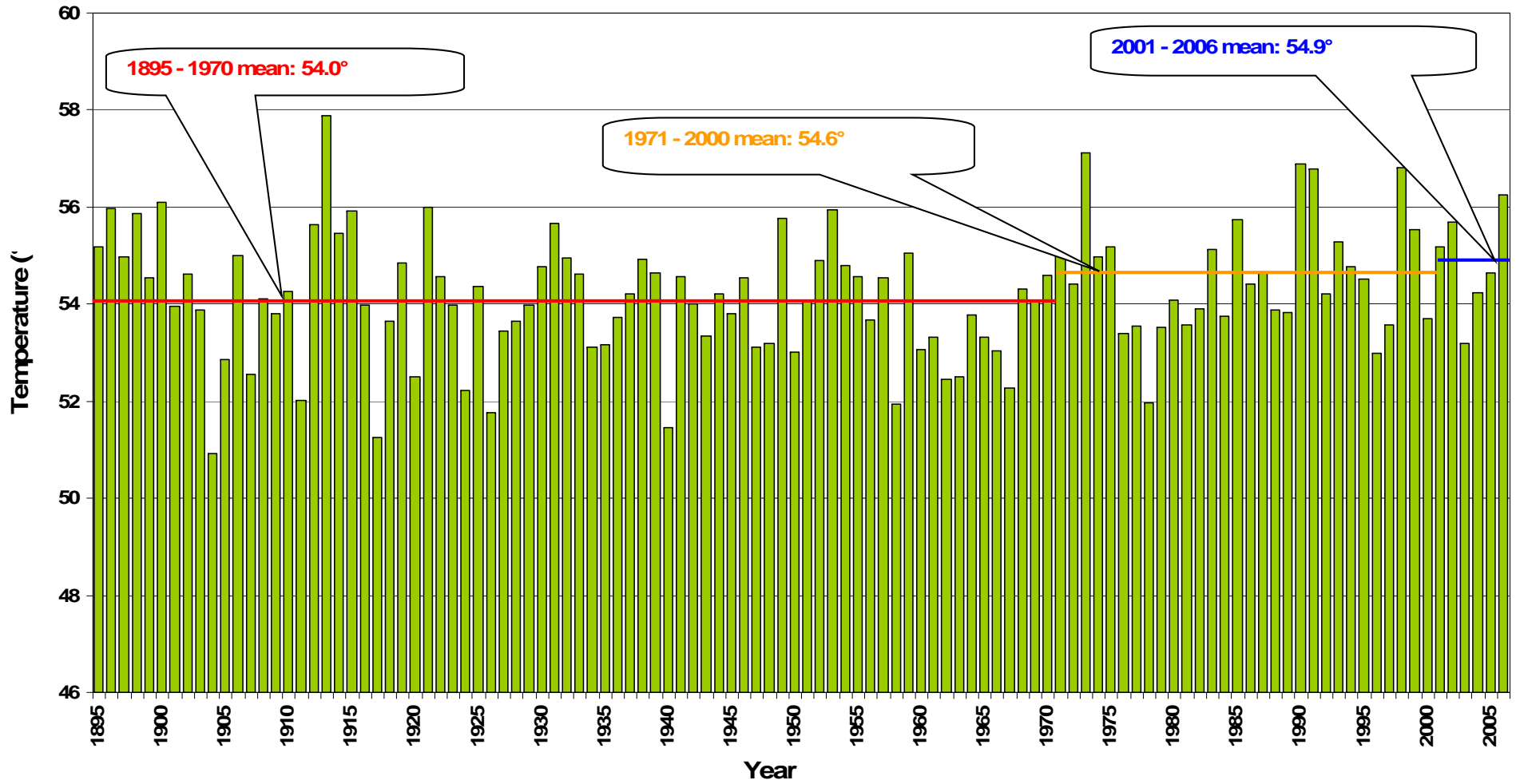
- Legend**
- Water Body Specific Advisories**
- Do Not Eat
 - Partial Consumption
 - Rivers



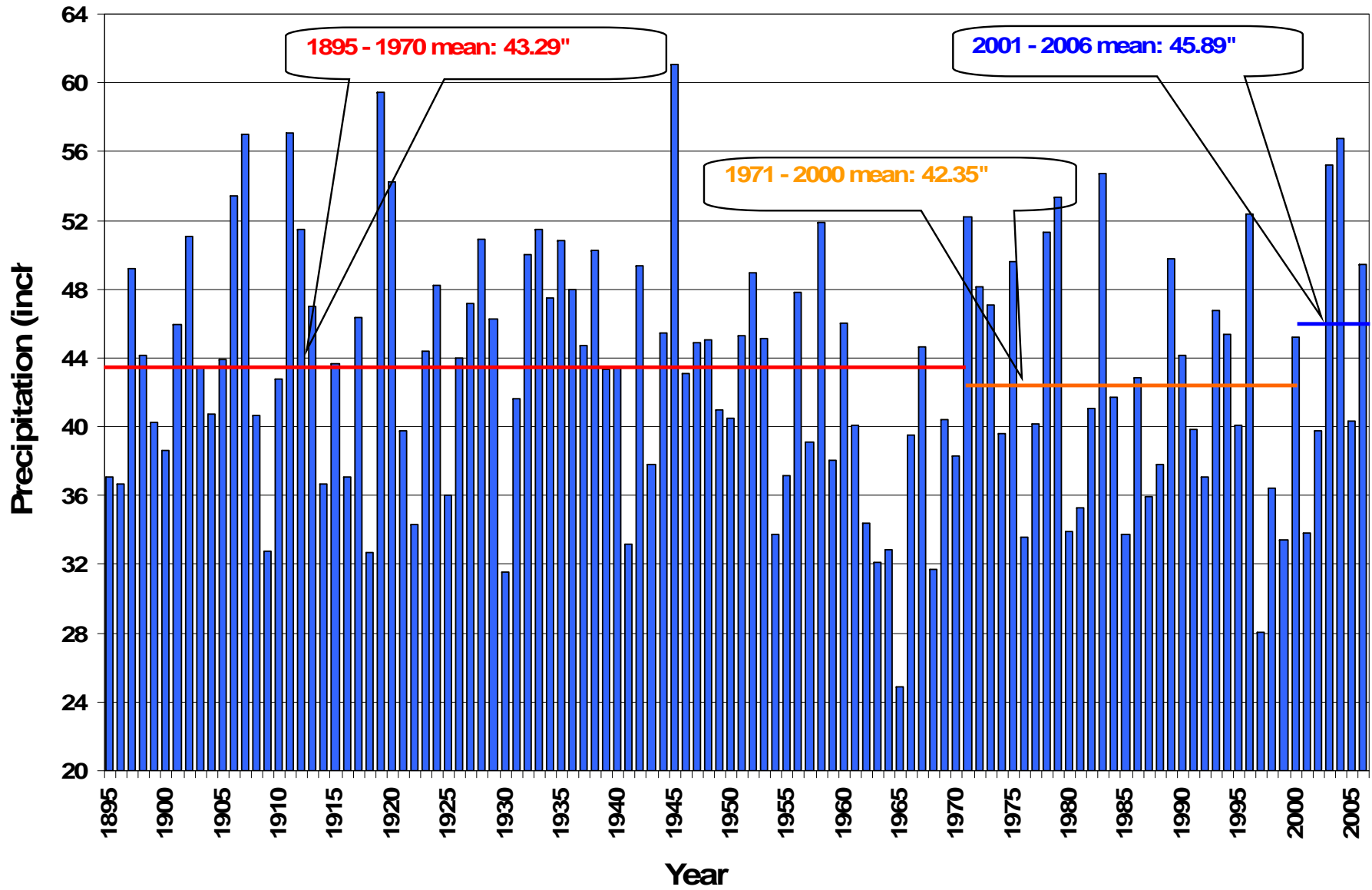
Delaware River and Bay Salt Line



Mean Annual Temperature at Wilmington Airport, DE (1895-2006)

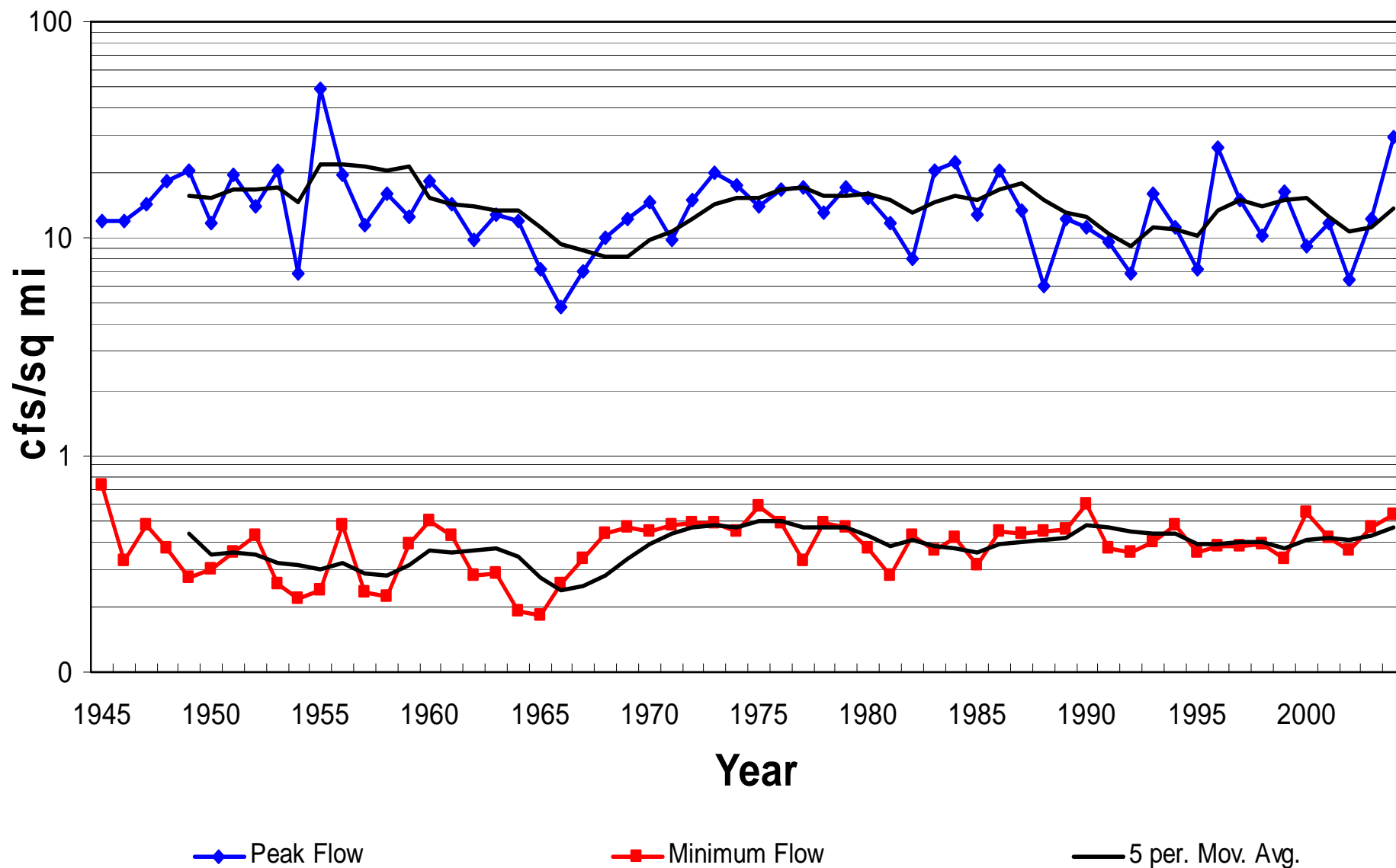


Precipitation at Wilmington Airport, DE (1895-2006)

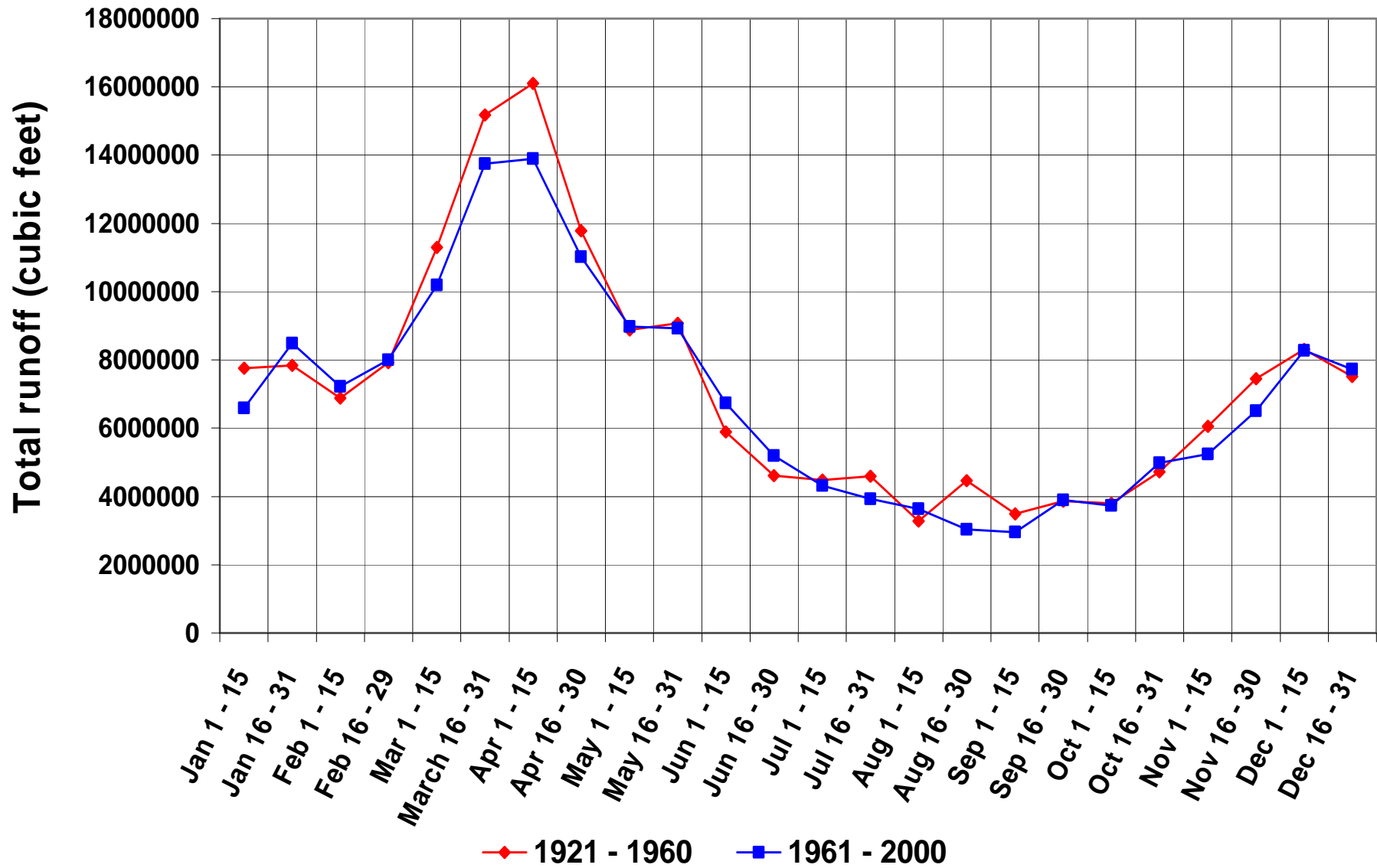


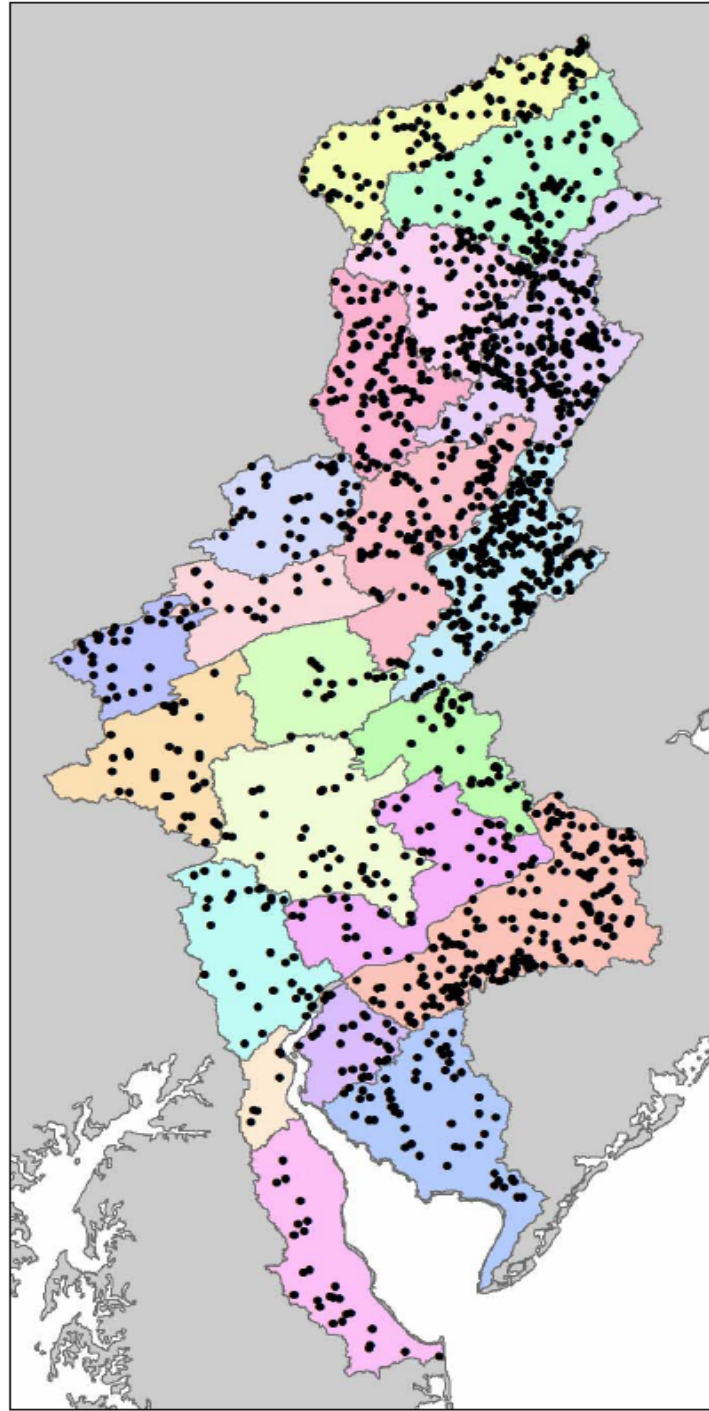
Maximum Peak and Minimum Daily Flow

Delaware River at Trenton, NJ, USGS Gage 1463500



Total Runoff Delaware River at Trenton





MacroInvertebrates

NY - Assessment

- Moderately impacted
- Slightly impacted
- Non-impacted

PA - Beck's Biotic Index

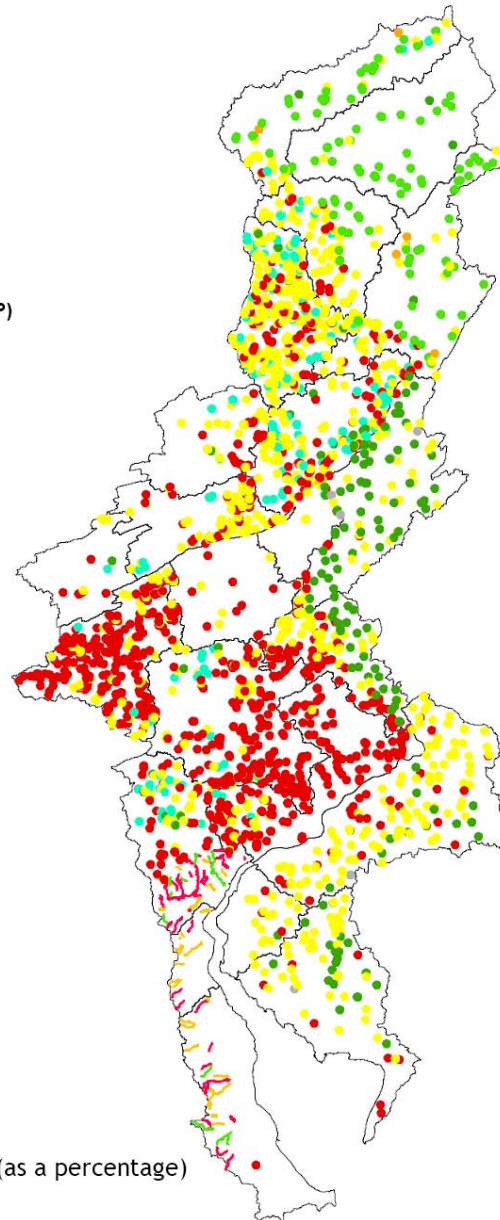
- 0 - 10 Poor
- 11 - 20 Fair
- 21 - 29 Limited (PA Only)
- 30 - 49 Good

NJ - Biological Impairments (NJDEP)

- SEVER, Poor
- MODERATE, Fair
- NONE, Good
- NOSAMPLE

DE - BCI, Percentage

- 0% - 33% Poor
- 34% - 67% Fair
- 68% - 100% Good



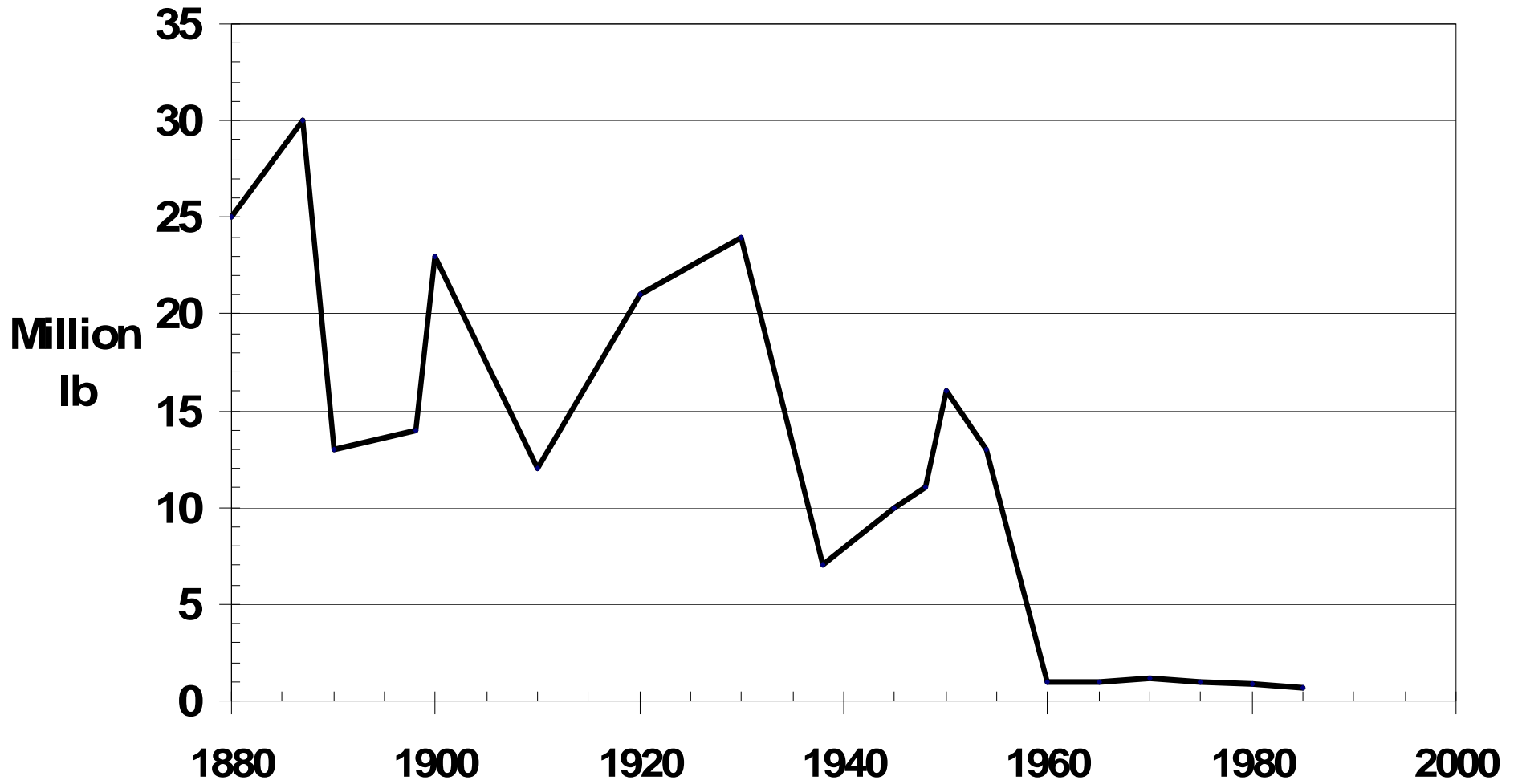
DE: Biological Classification (as a percentage)

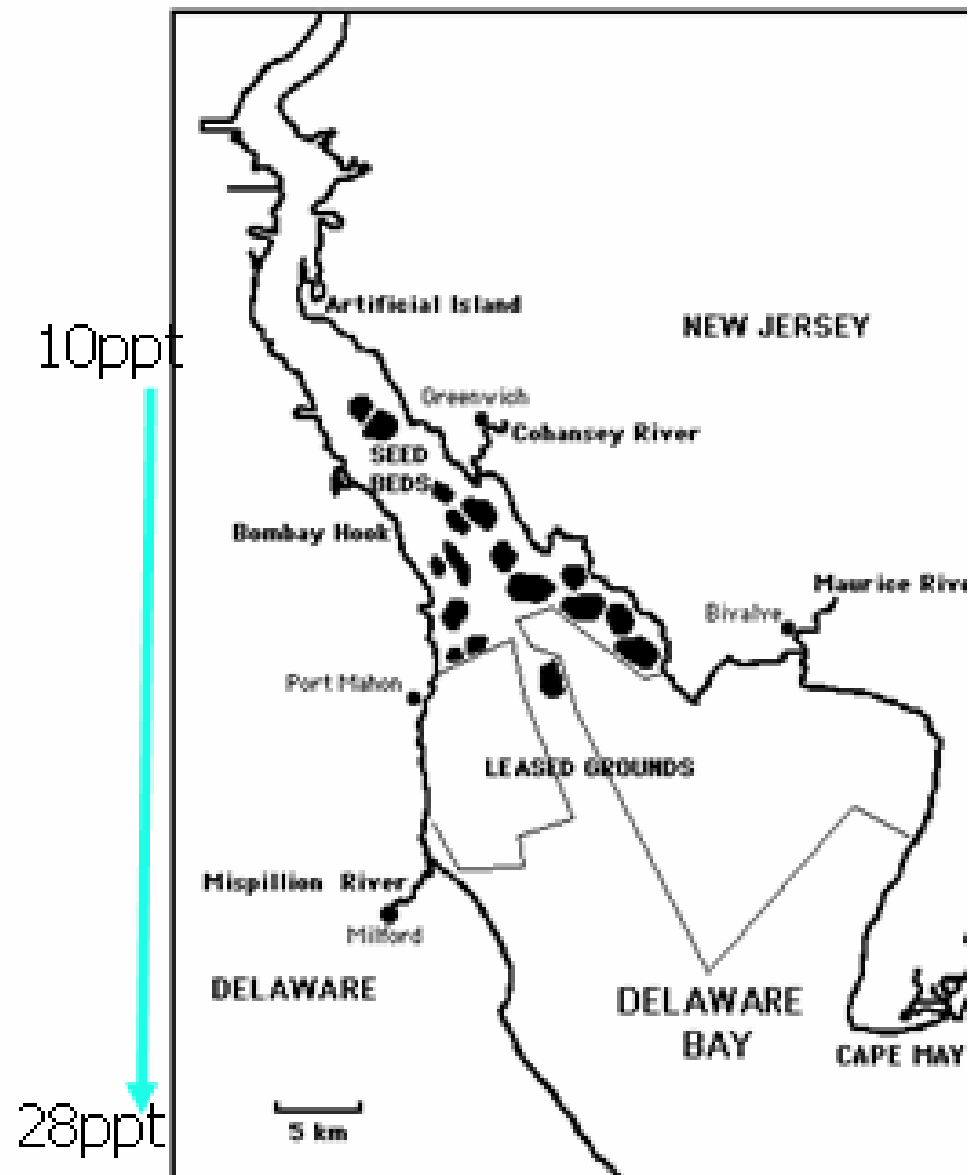
NJ: Biological Impairments

NY: Biomass Data

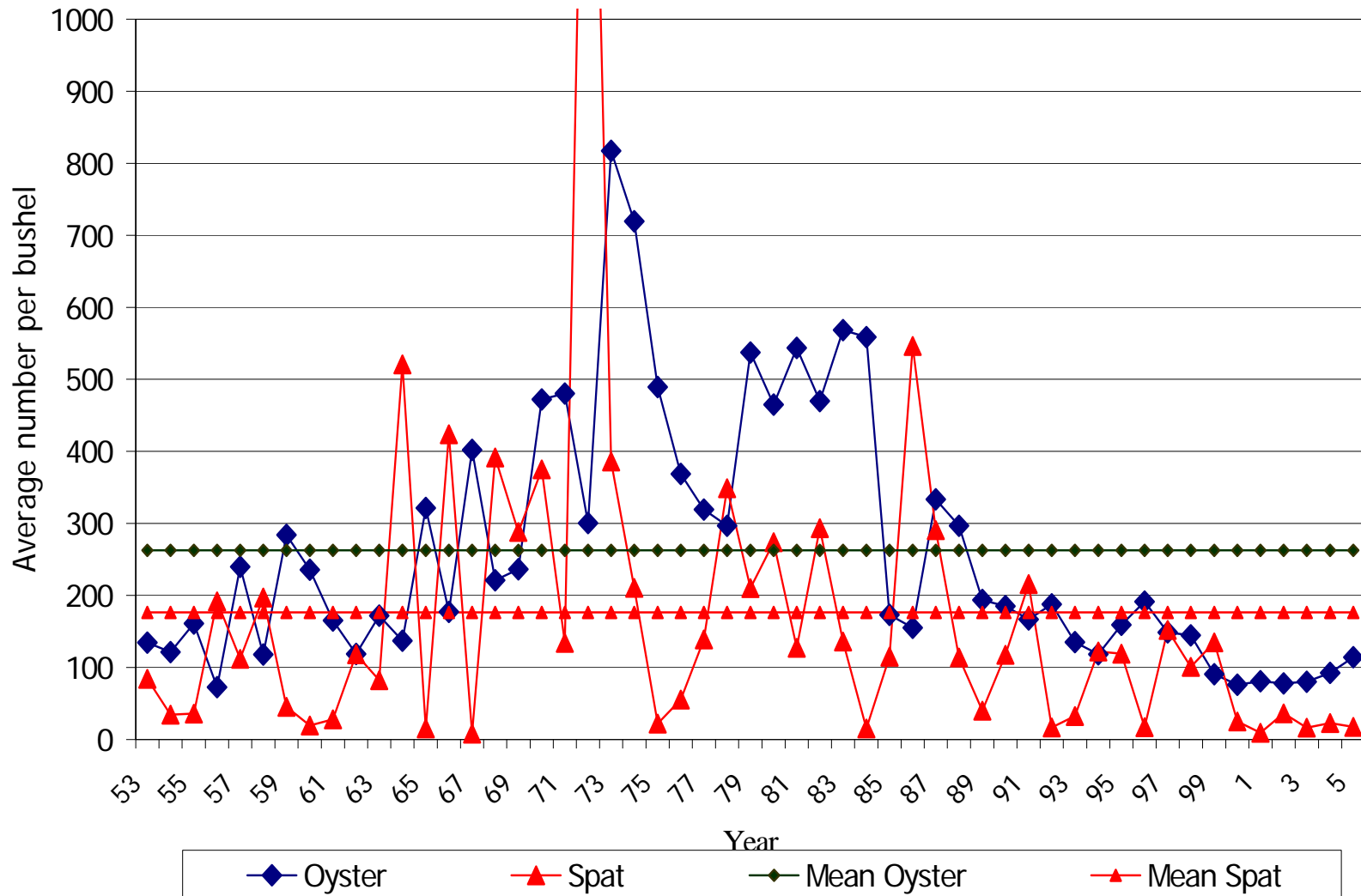
PA: Beck's Biotic Index

Oyster Landings in the Delaware Estuary

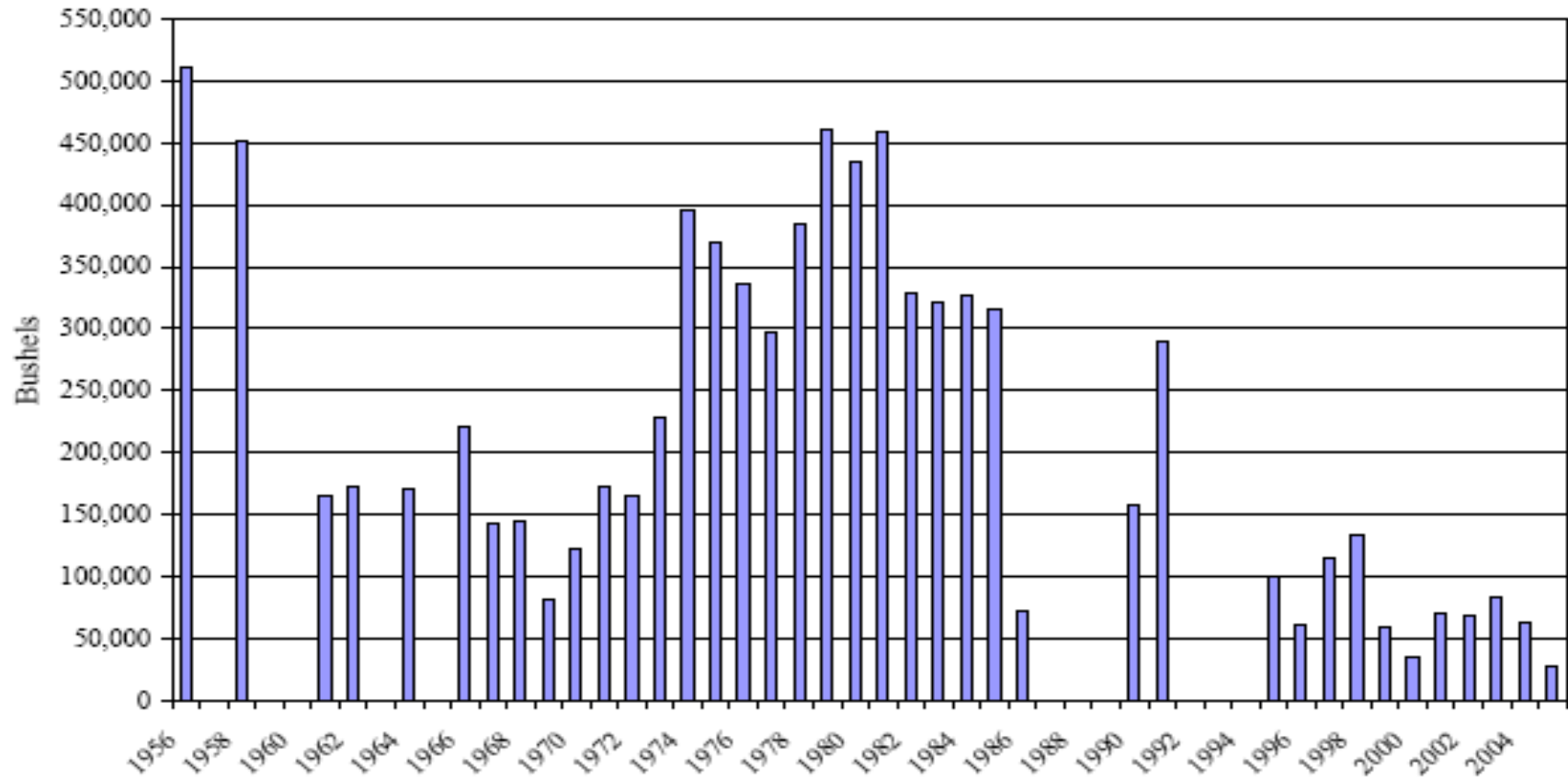


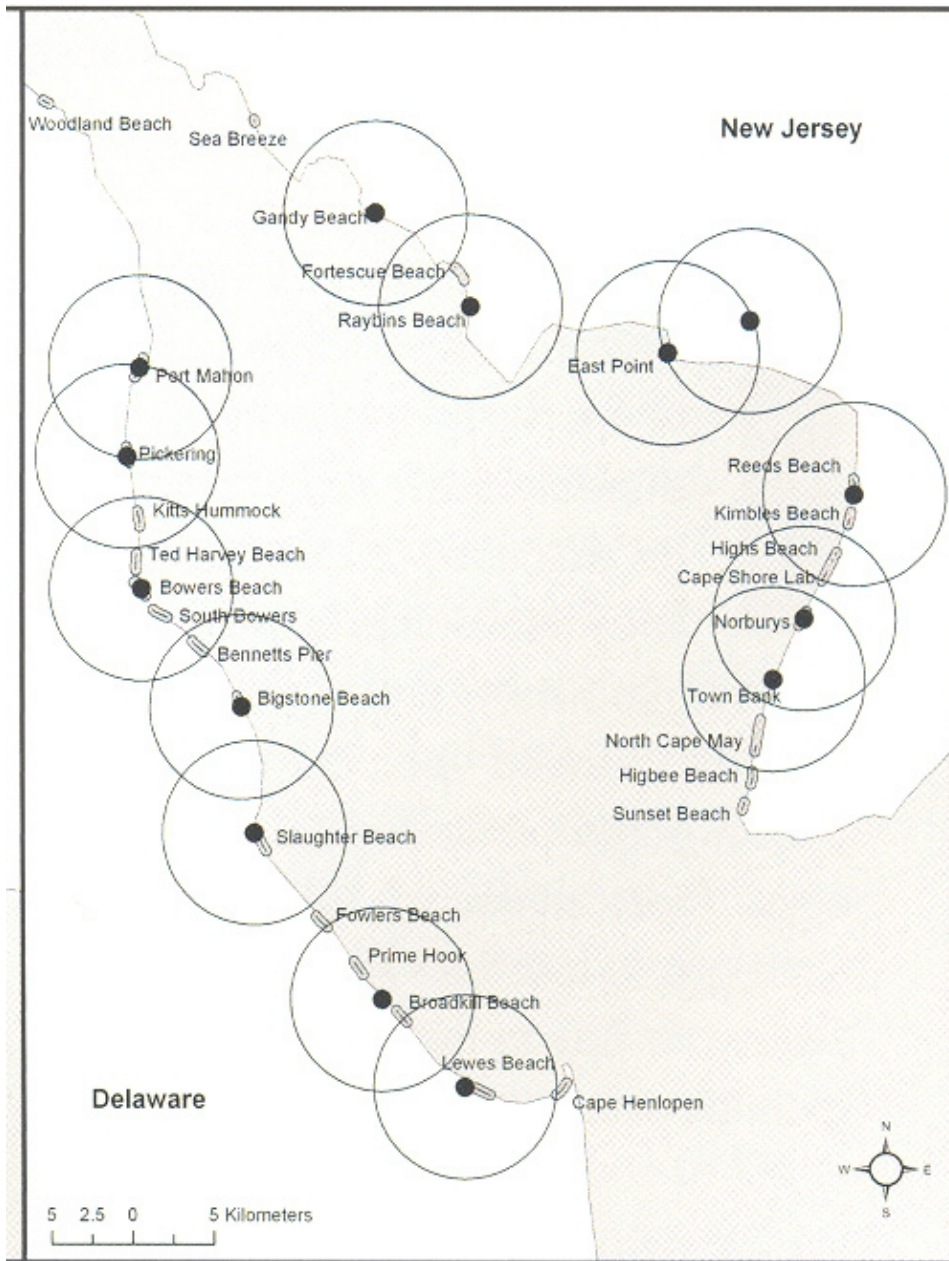


Delaware Bay Oyster Seed Beds

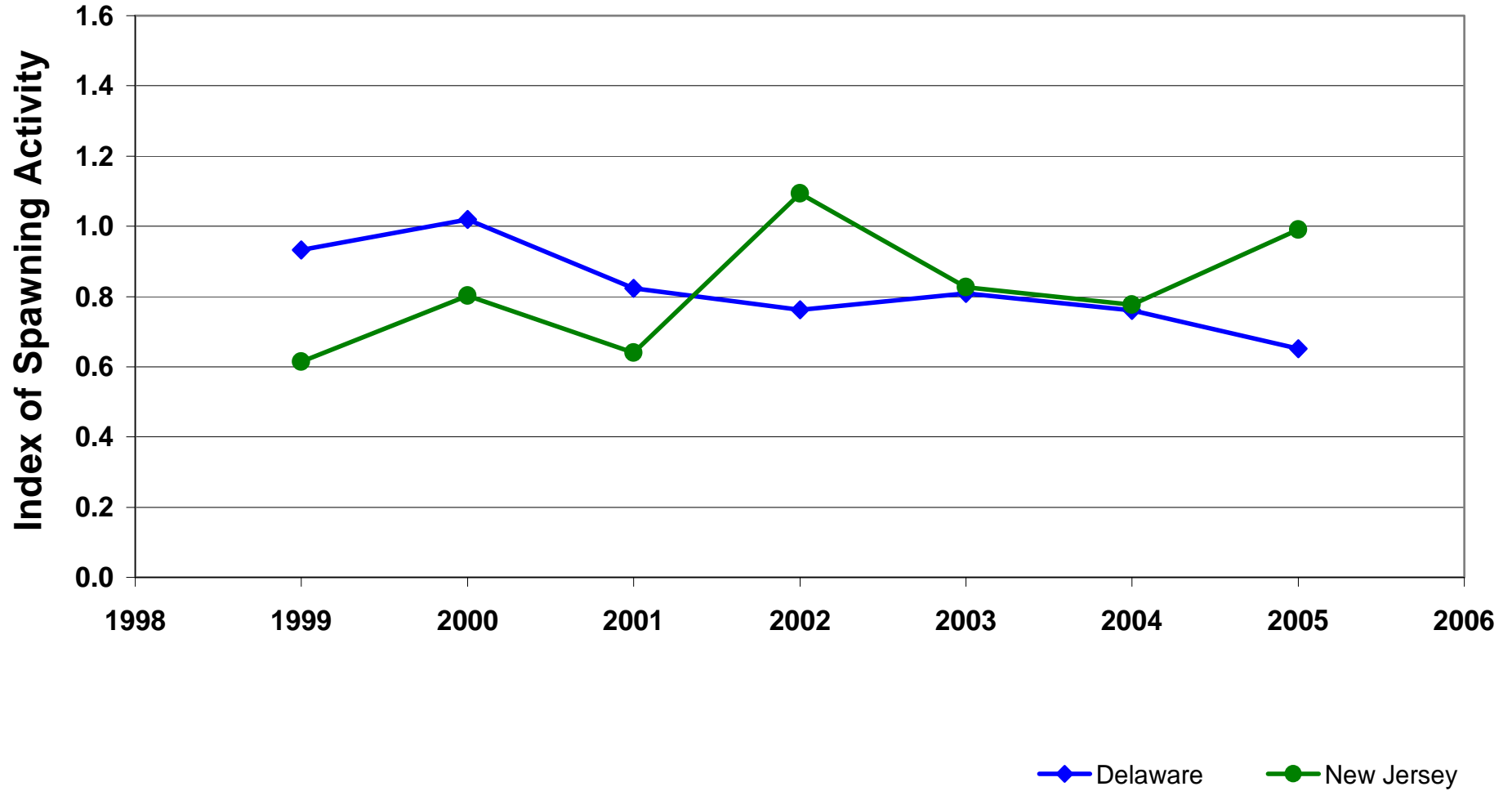


Seed Bed Harvest

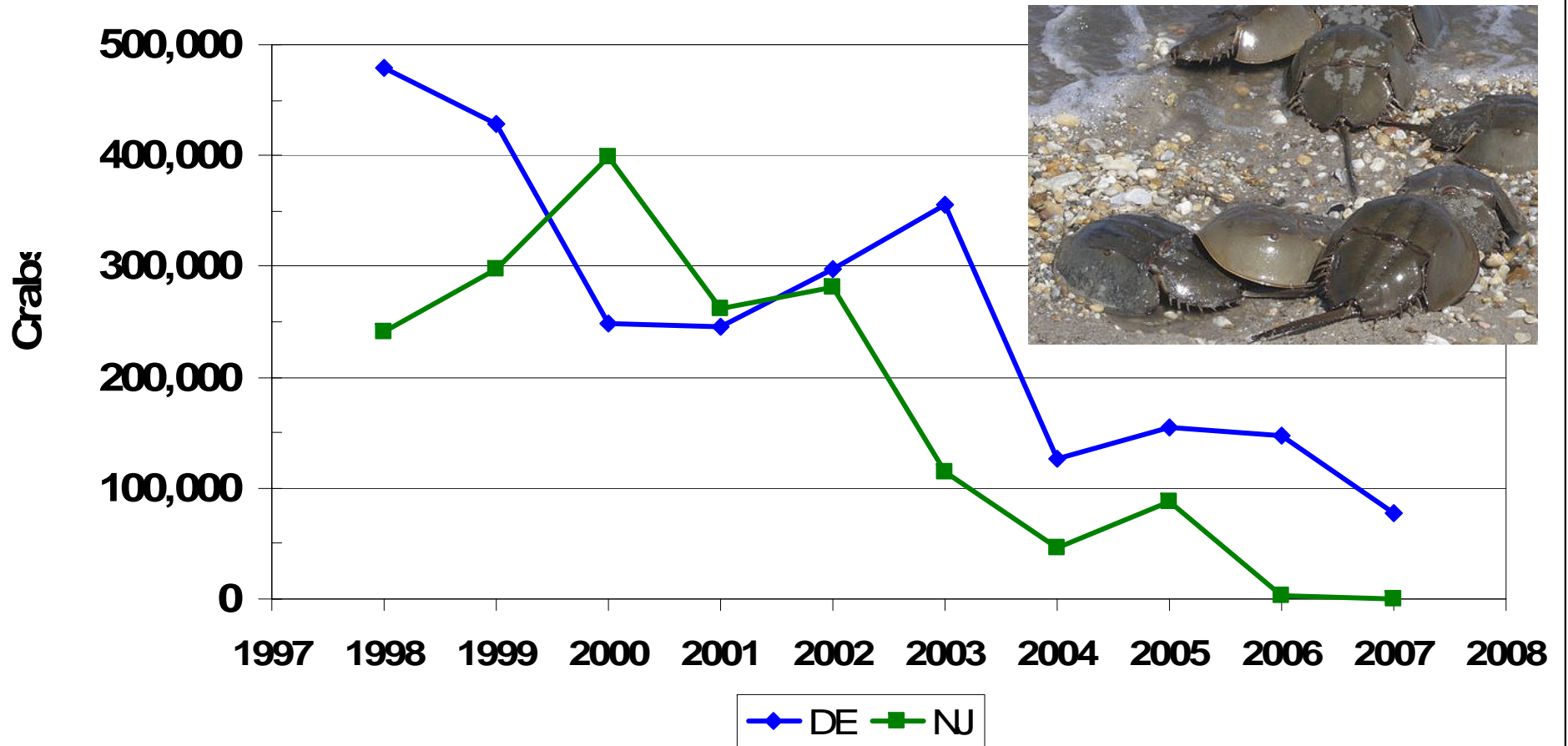




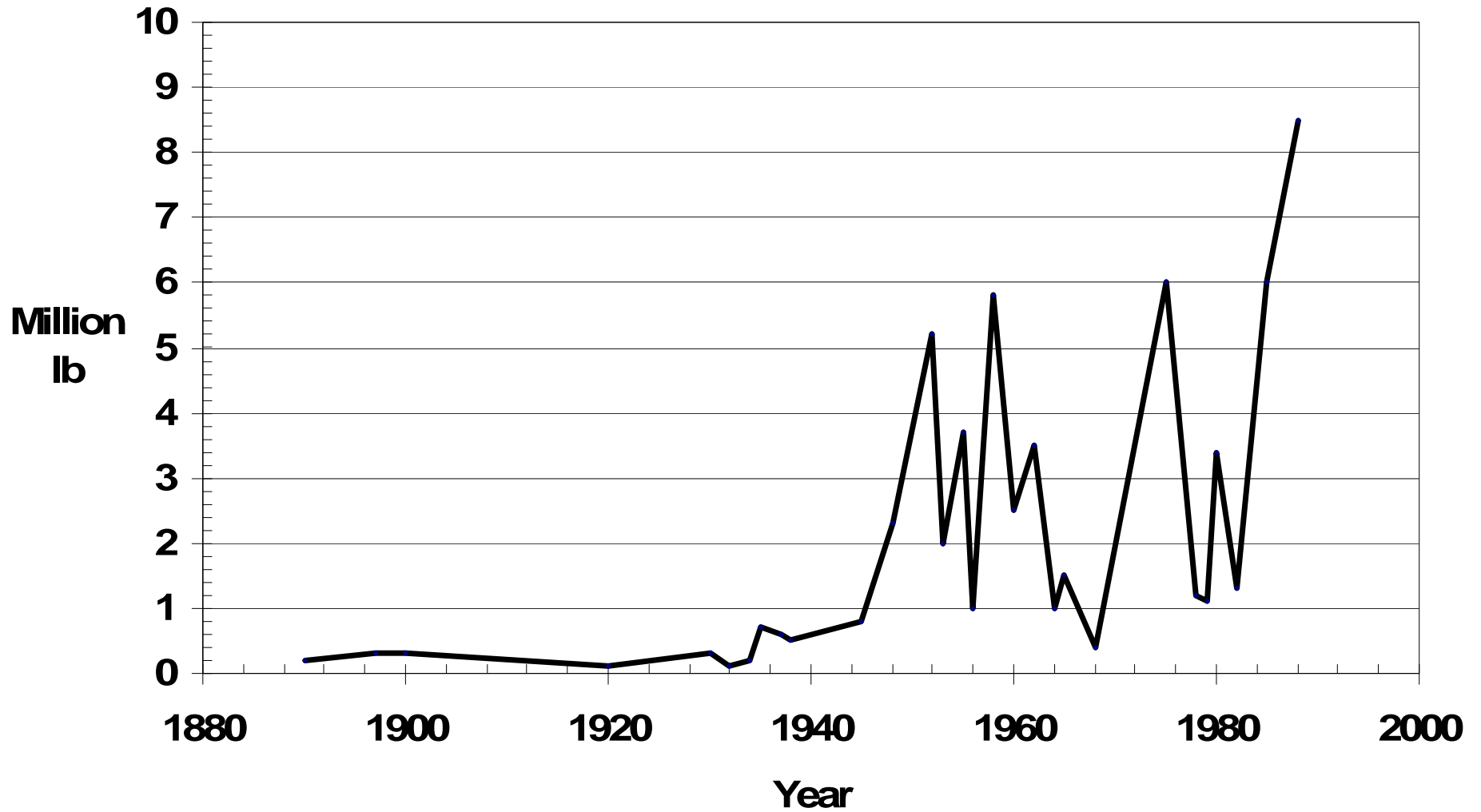
Horseshoe Crab Spawning Activity Delaware and New Jersey



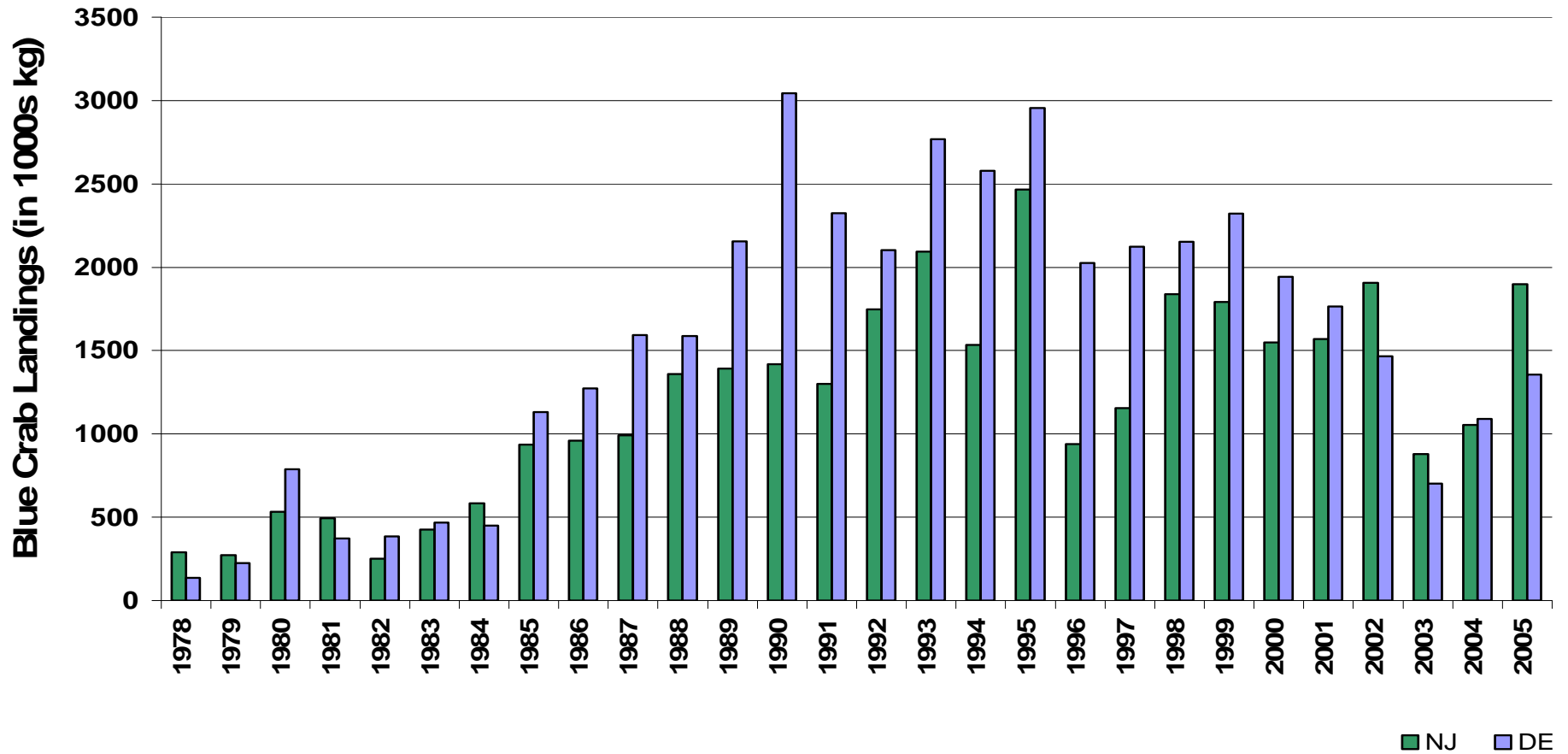
Commercial Horseshoe Crab Landings in the Delaware Bay

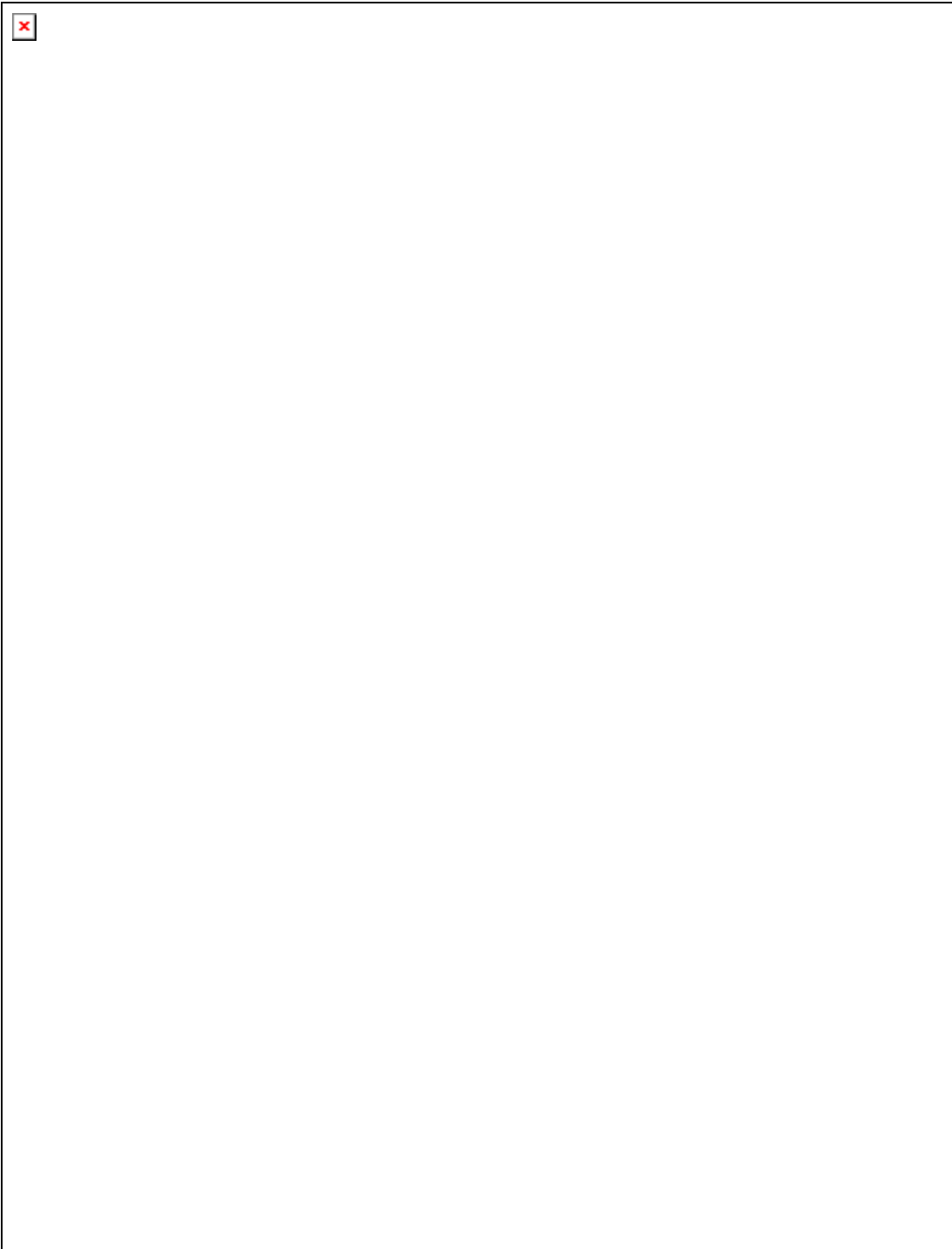


Synthesized Blue Crab Harvest in the Delaware Estuary



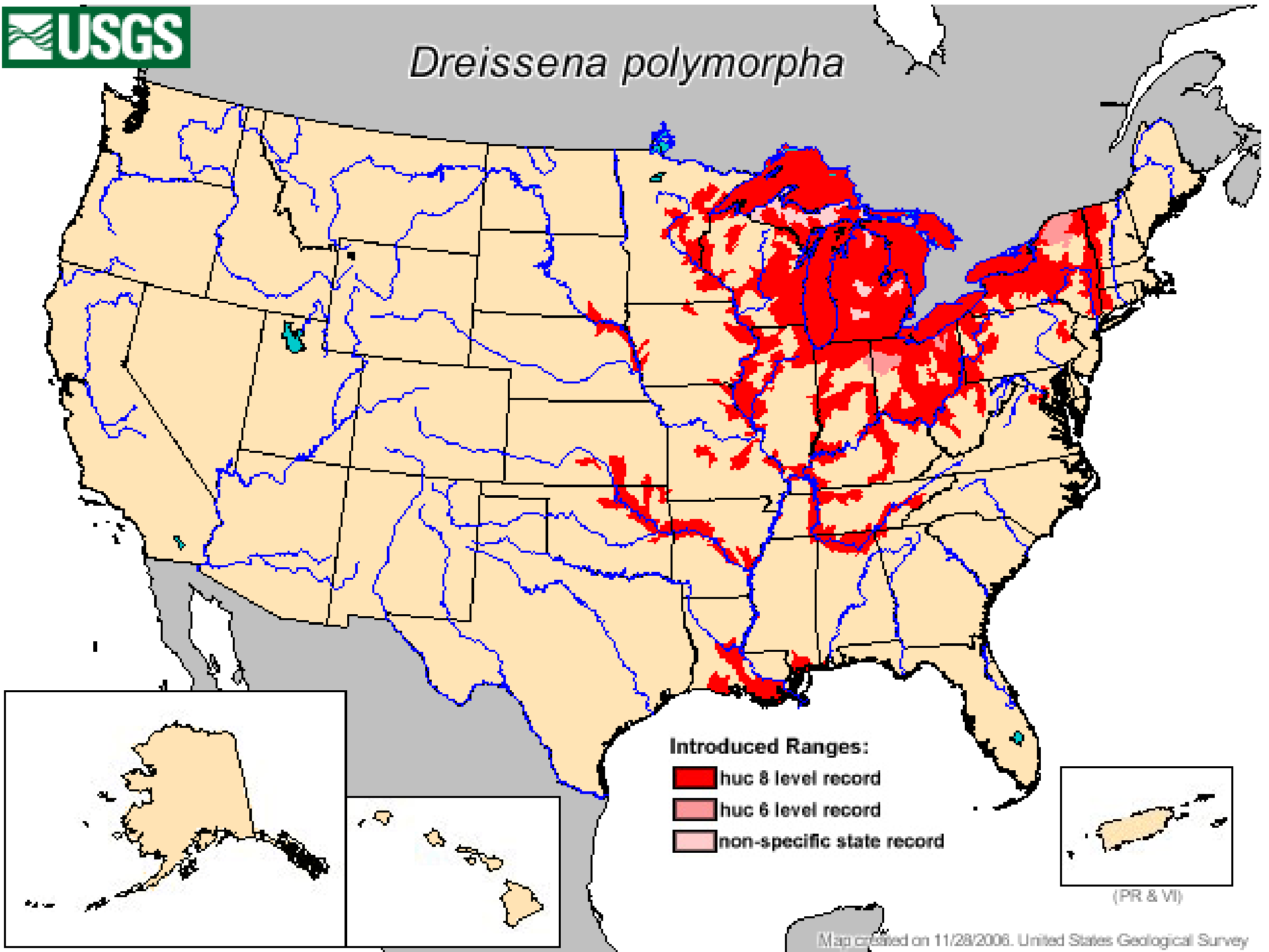
Blue Crab Landings 1978-2005 Delaware Estuary



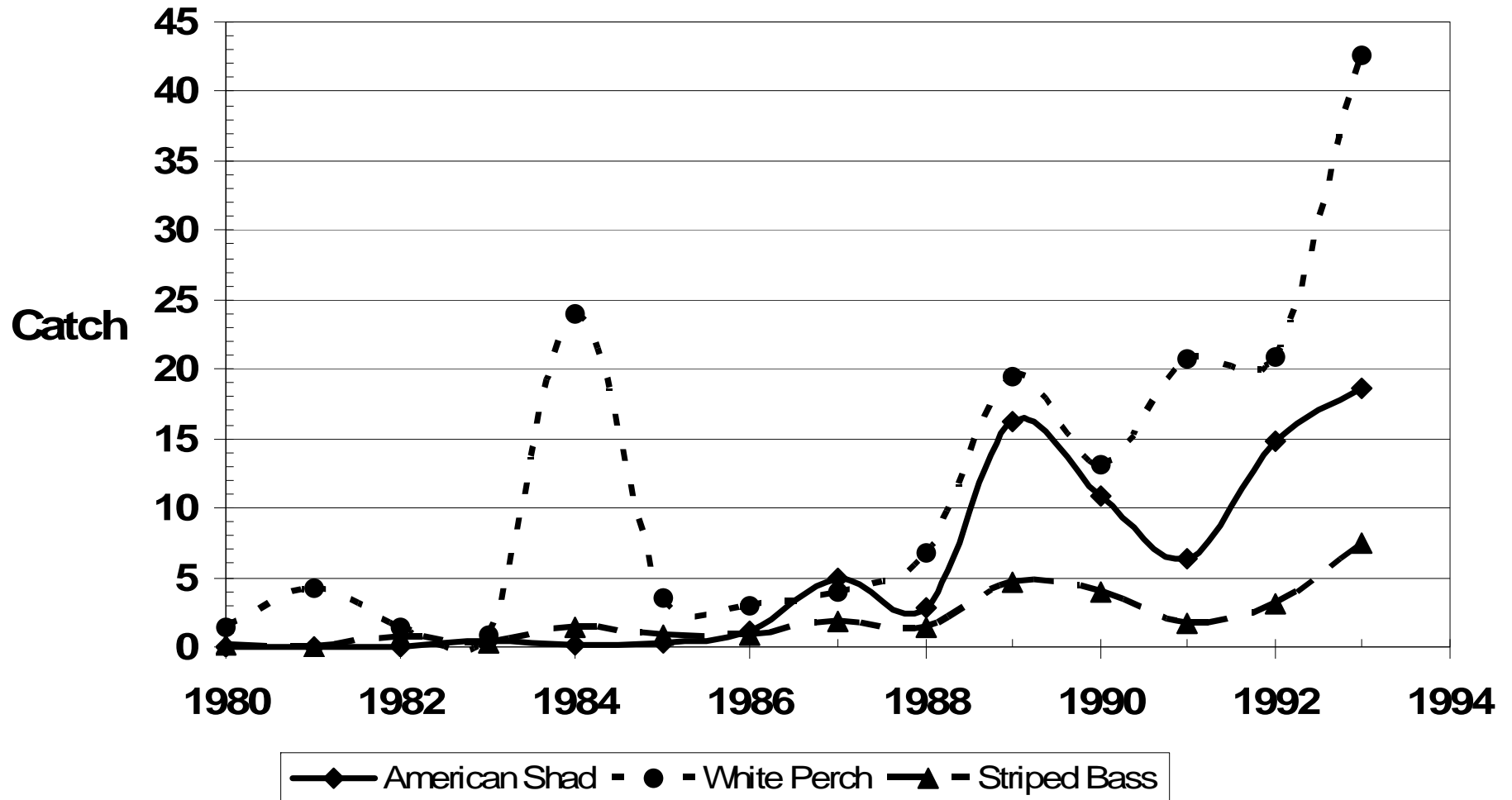




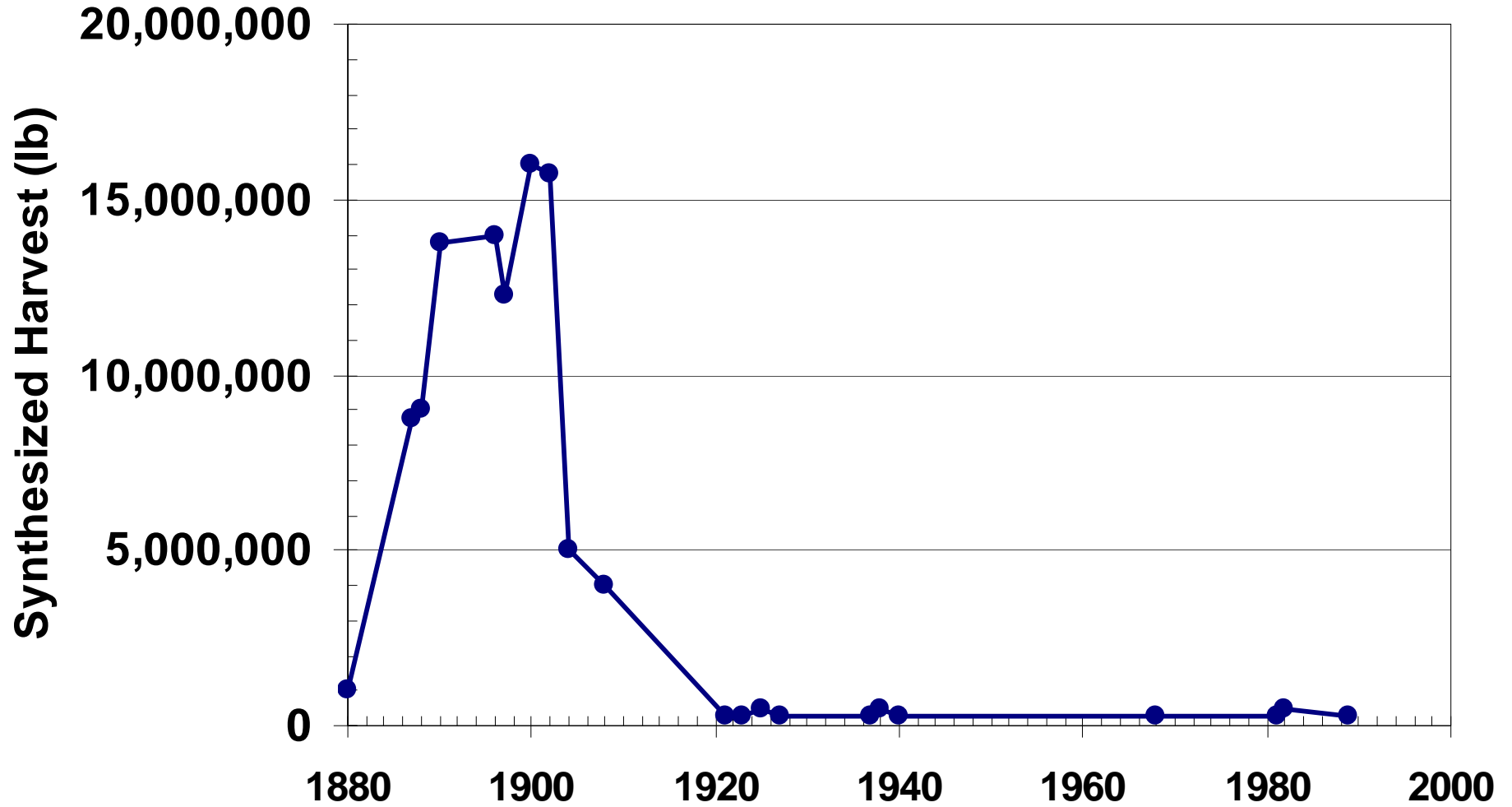
Dreissena polymorpha



Catch per Haul (95% C. I.) Delaware River from C & D Canal to Trenton



American Shad Harvest Delaware River Estuary



American Shad Spawning Population Delaware River at Lambertville, NJ

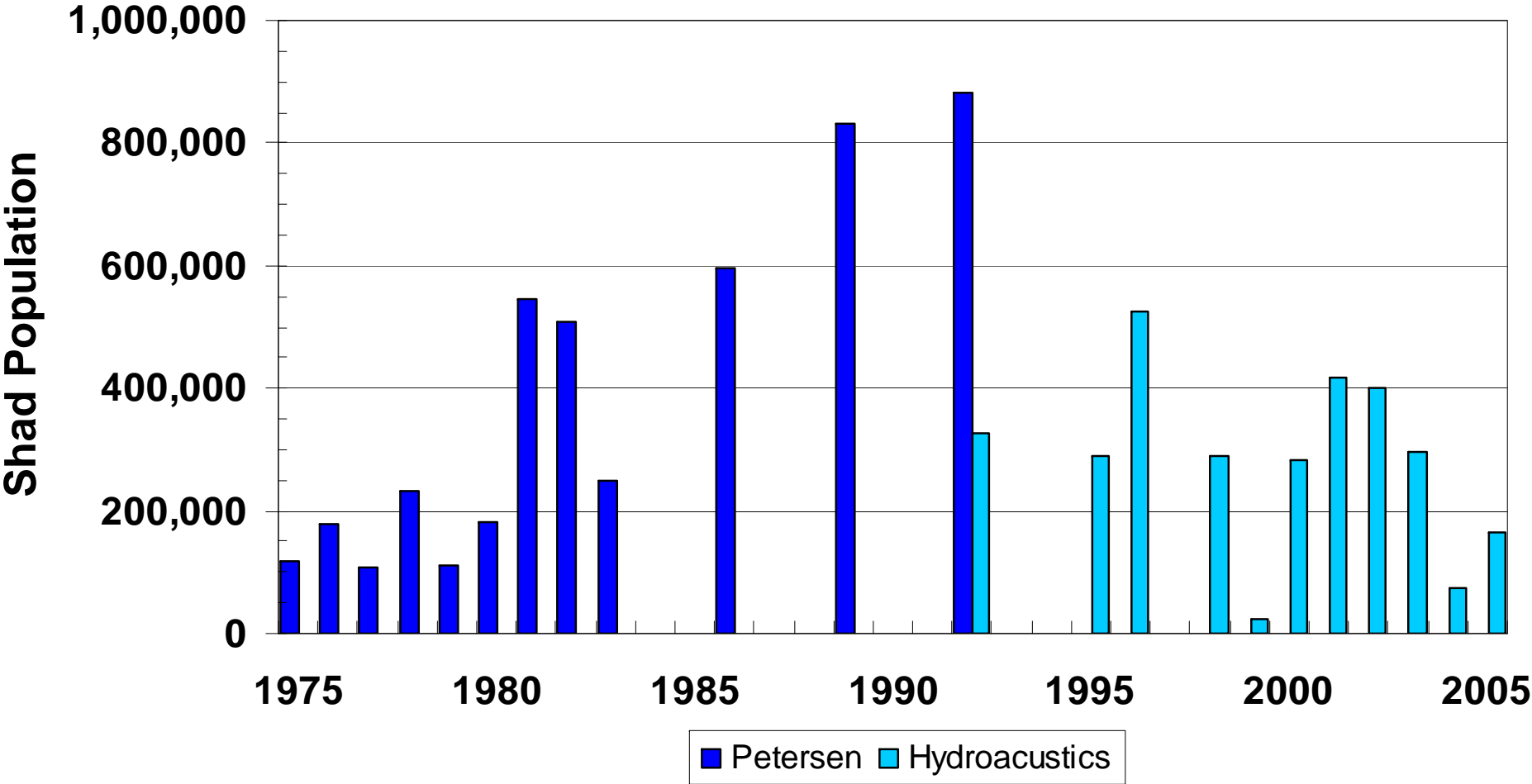
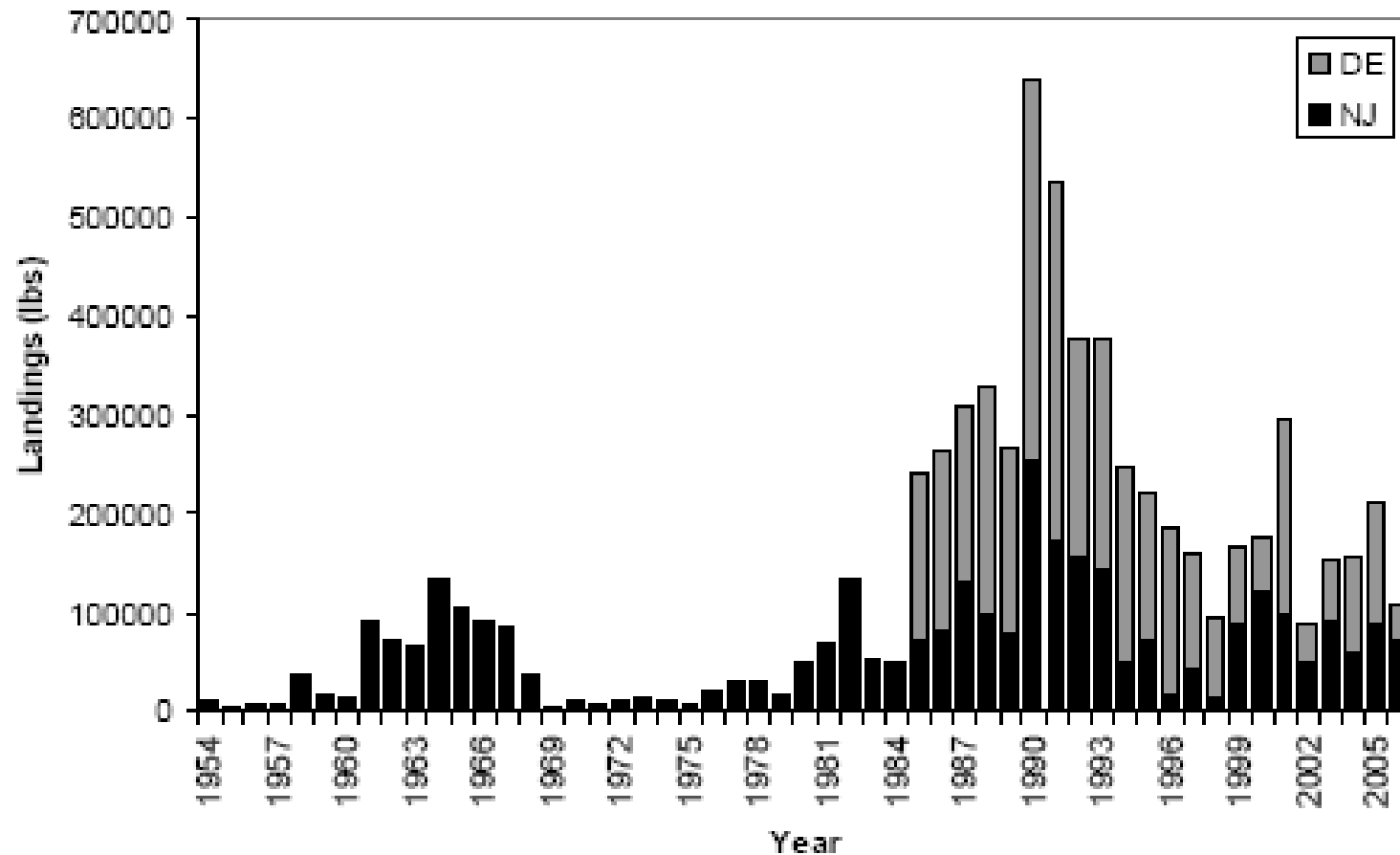
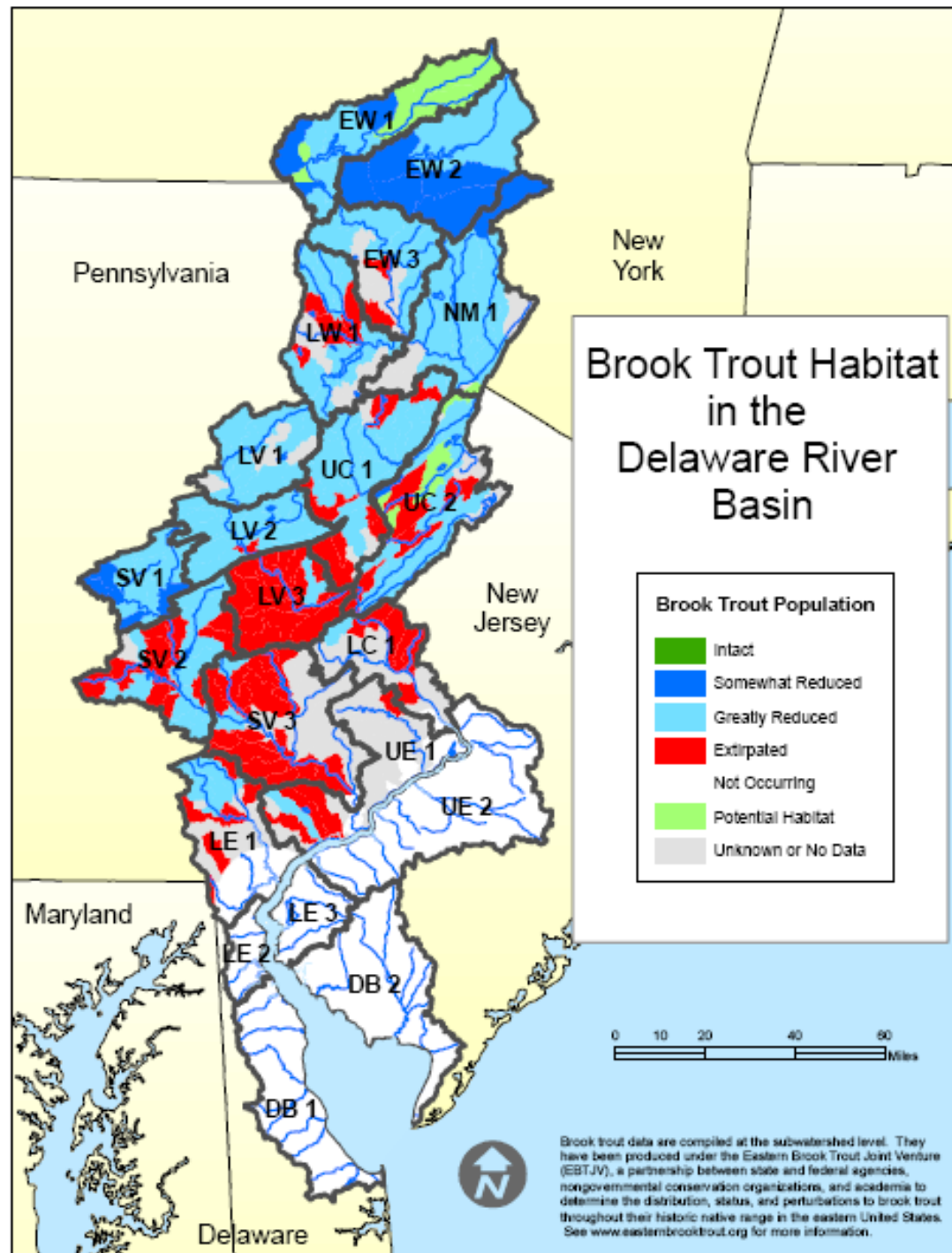
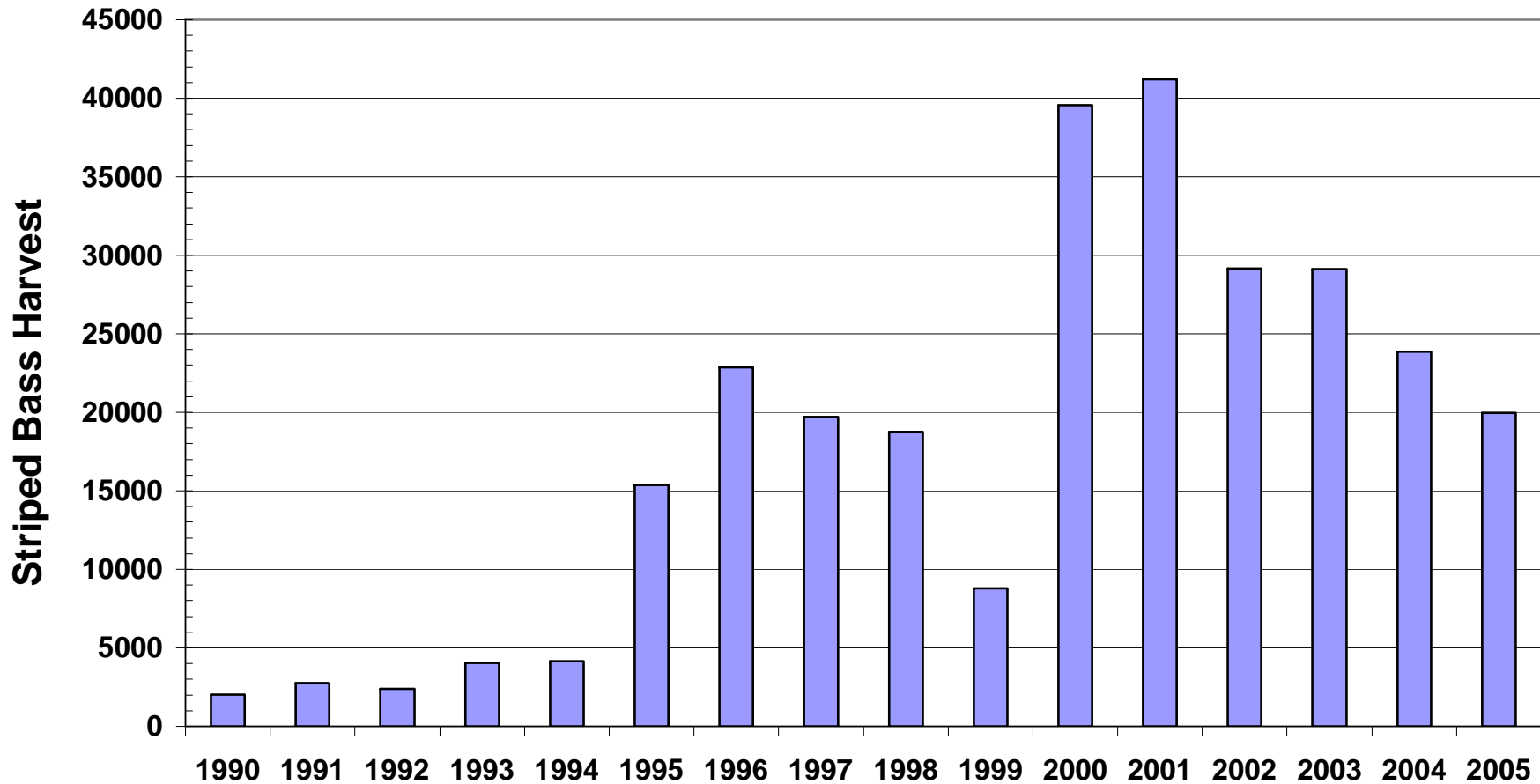


Figure 8. Commercial landings (lbs) of American shad, by state, in the Delaware River Basin, 1954-2006 (Source: ASMFC 2007a, NJ Division of Fish and Wildlife, DE Division of Fish and Wildlife). Landings from the State of Delaware are not available before 1985.

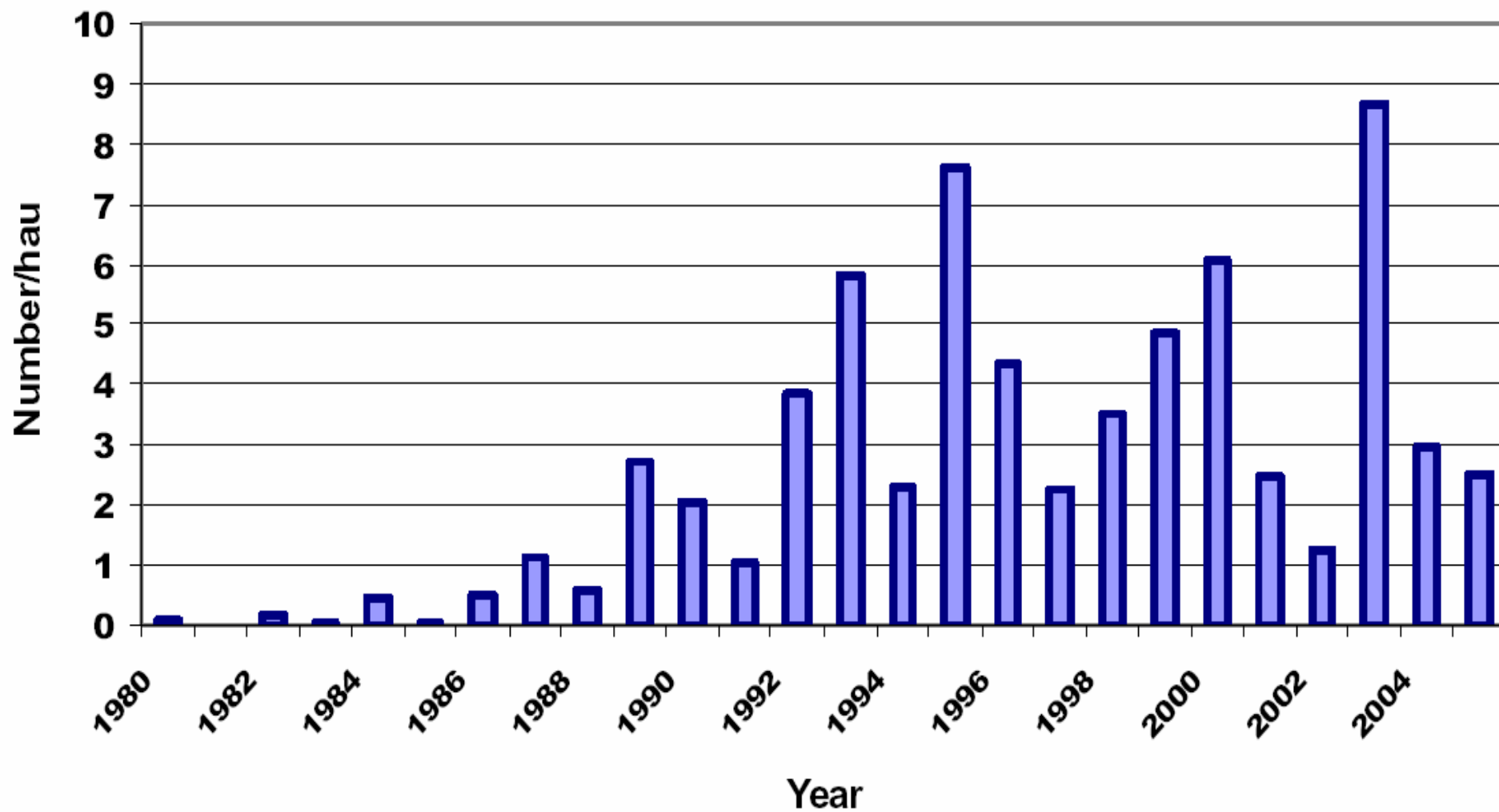




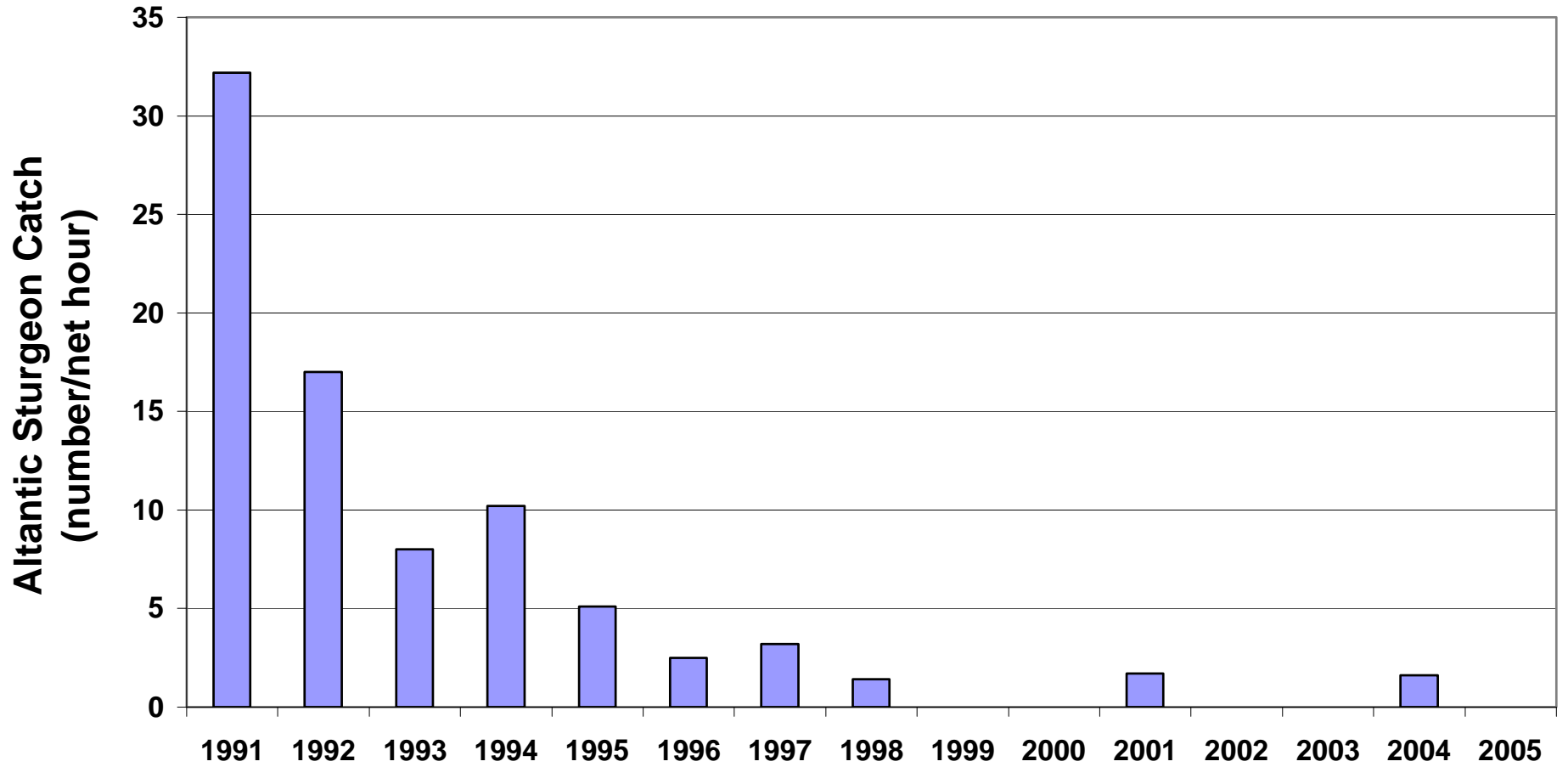
Recreational Striped Bass Harvest Delaware Estuary

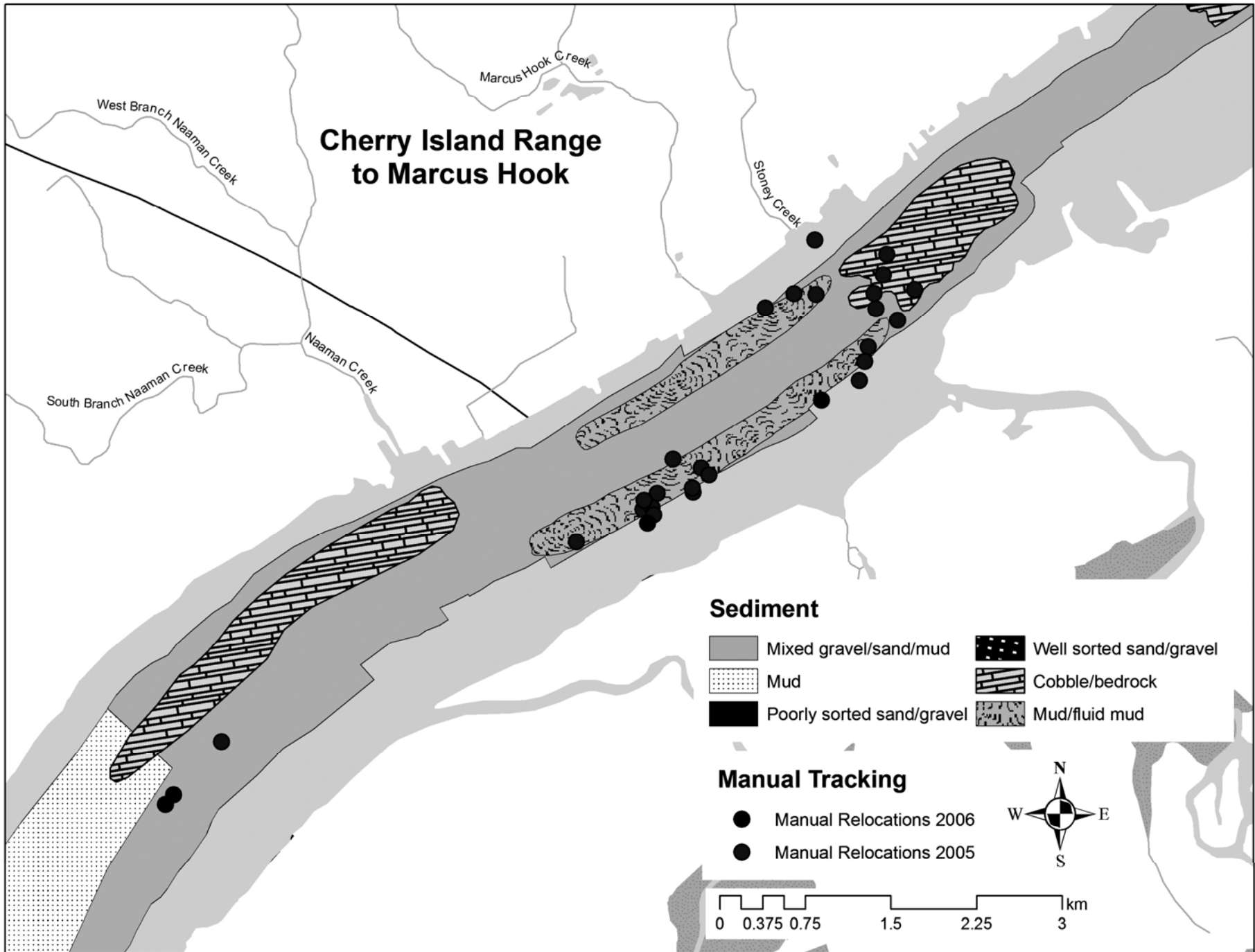


Delaware River Striped Bass Juvenile Index- Arith. Mean

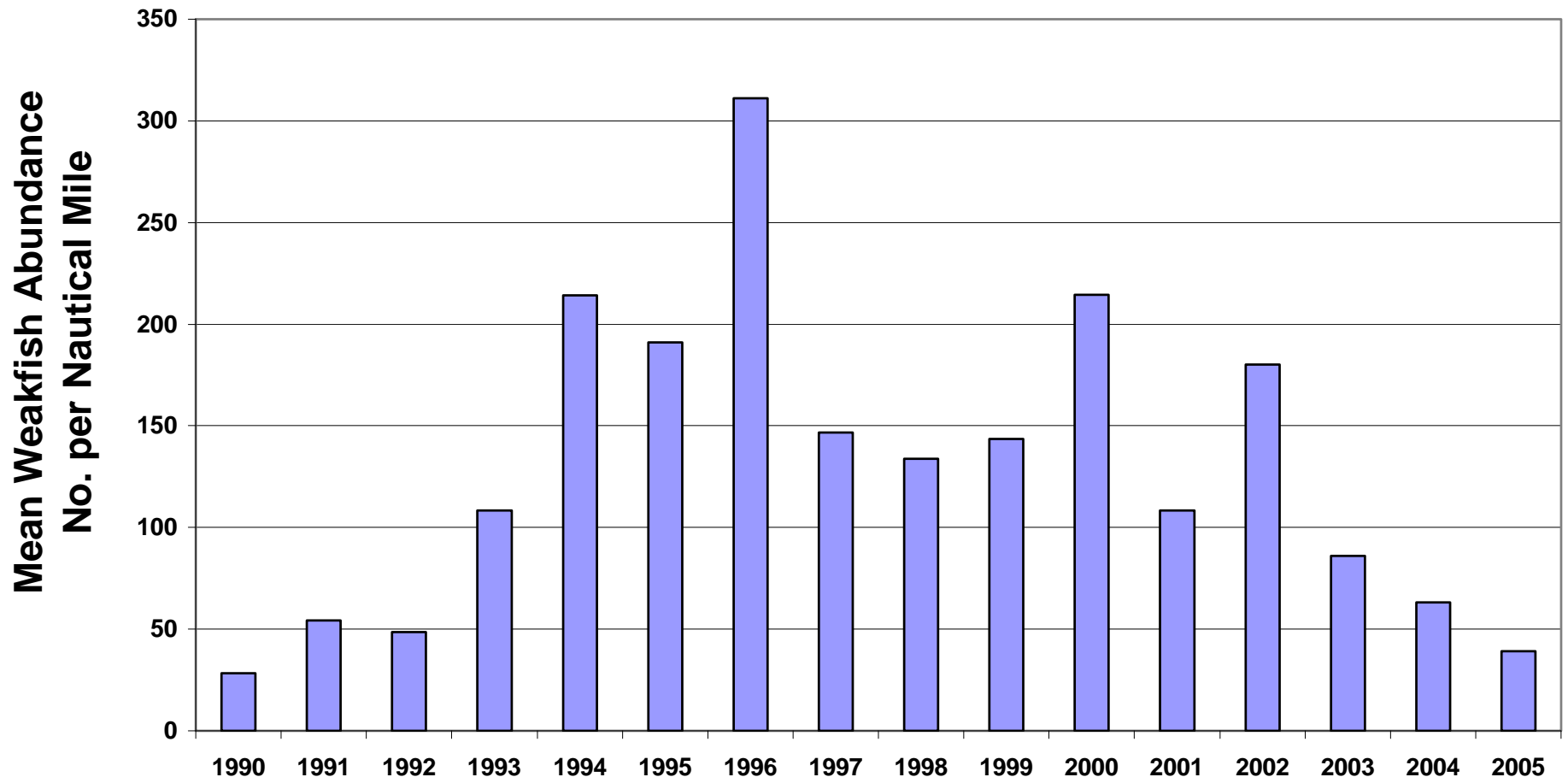


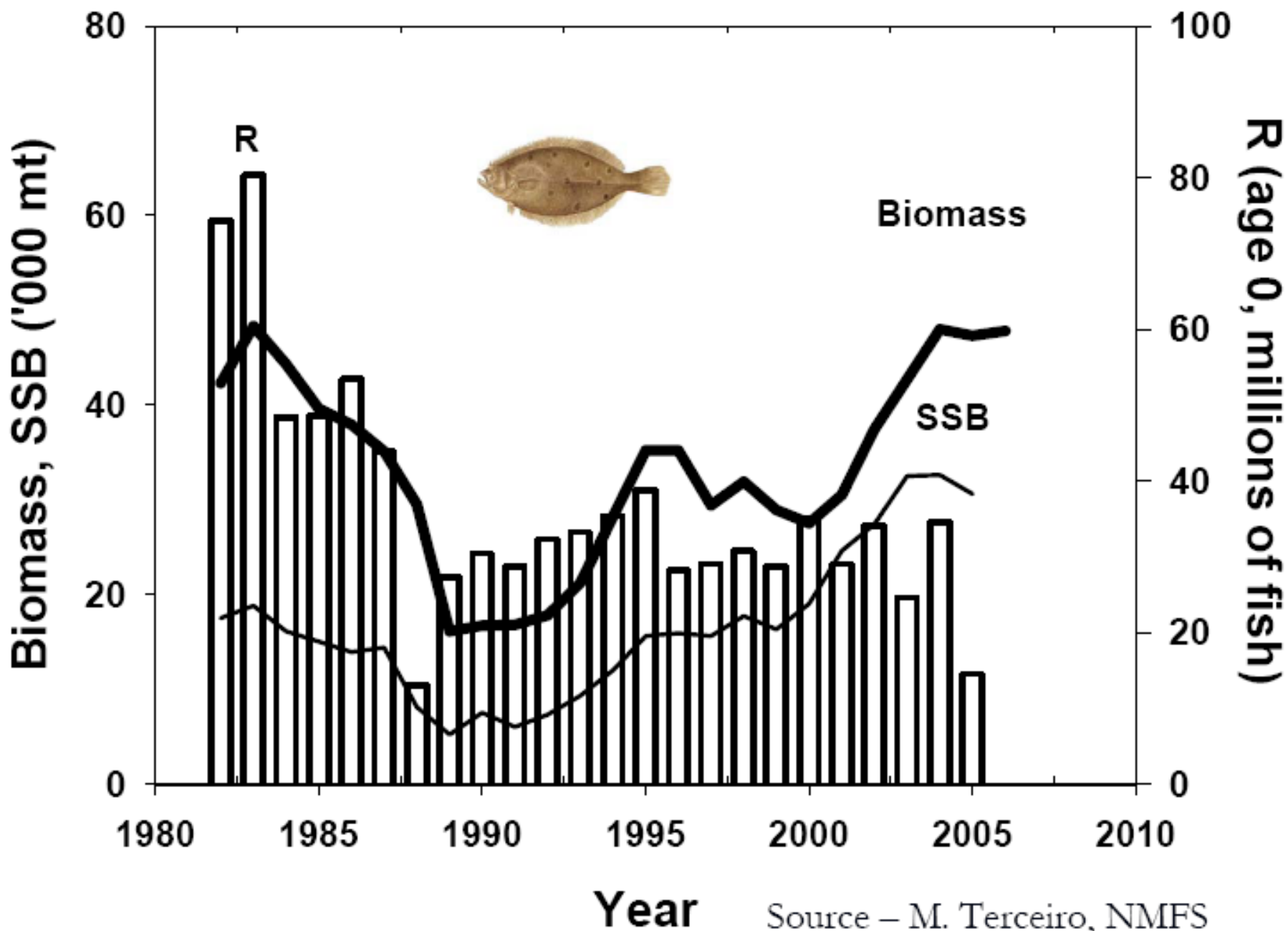
Annual Catch Rates of Atlantic Sturgeon Delaware River

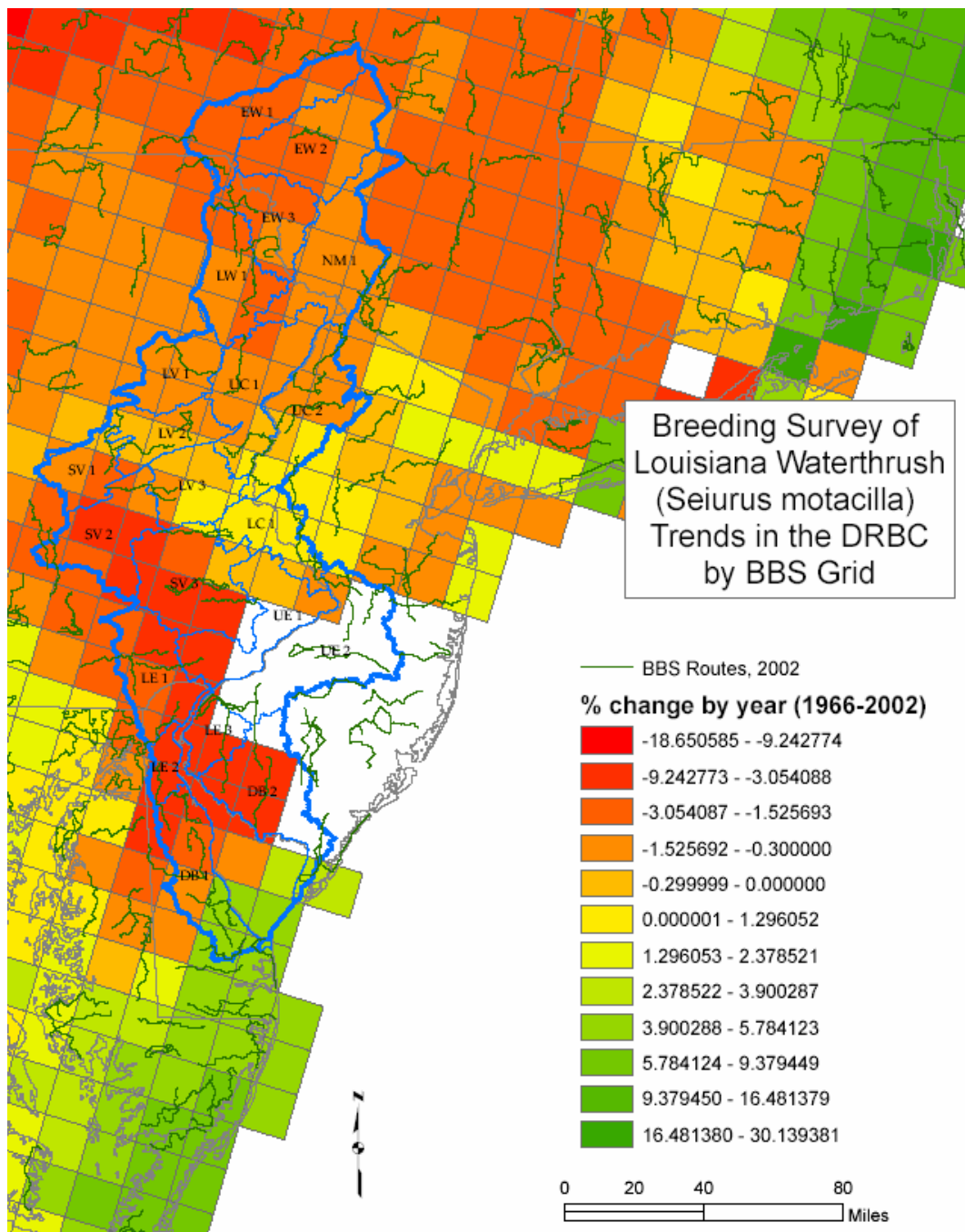




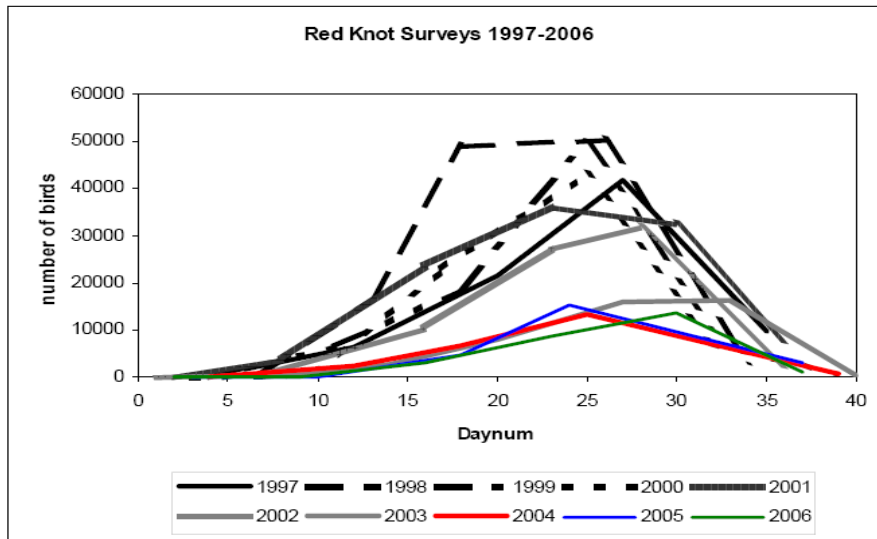
Mean Weakfish Abundance 1990-2005 Delaware Estuary



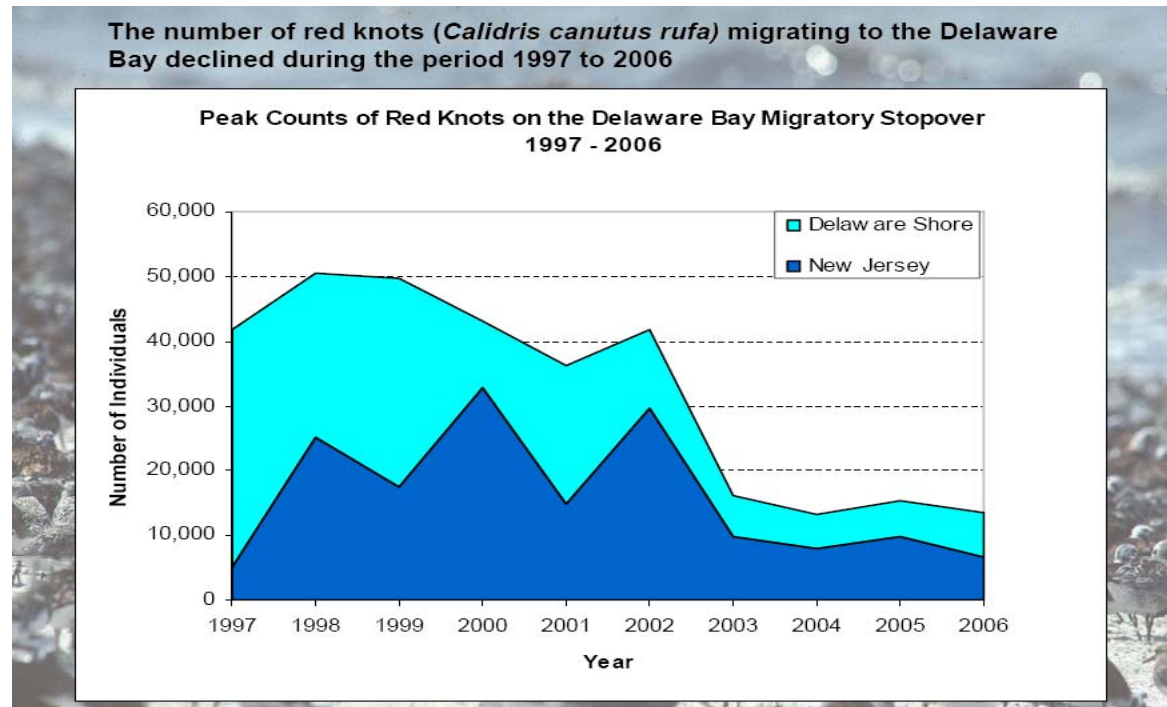


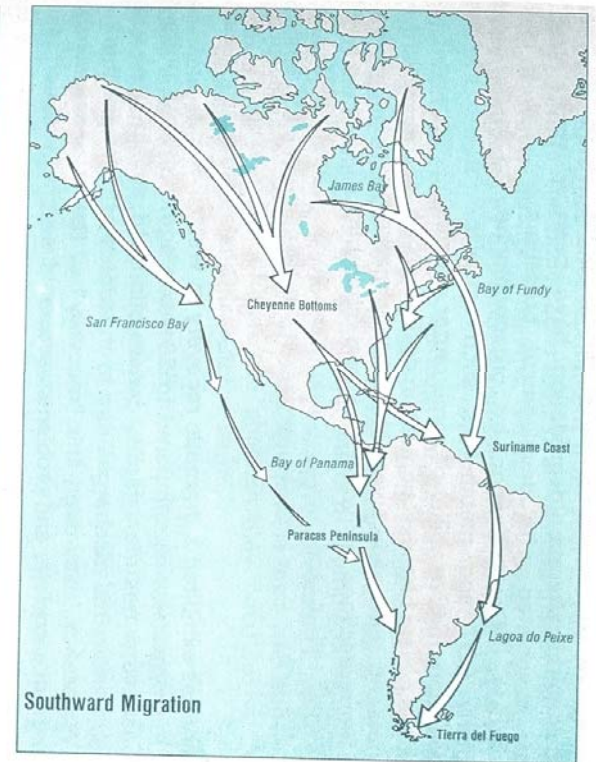
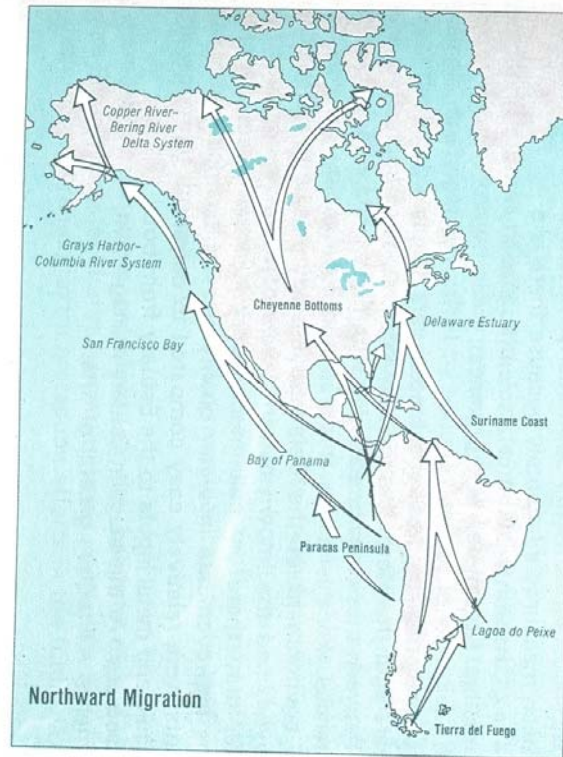


The Delaware Bay stopover population has been declining since 1997. Peak numbers of red knots of over 100,000 in the 1980's have fallen to 13,455 in 2006 and have not recovered

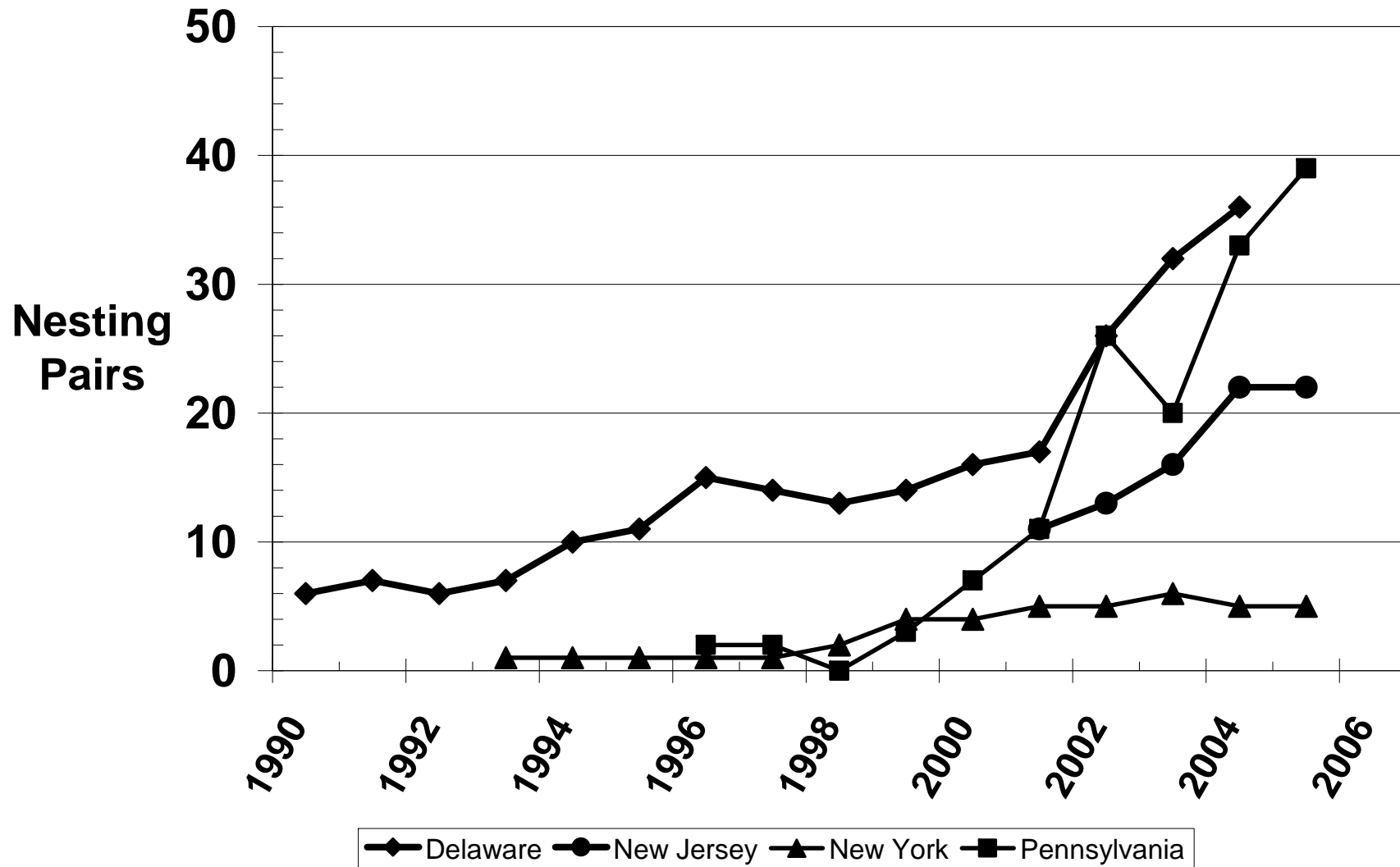


The number of red knots (*Calidris canutus rufa*) migrating to the Delaware Bay declined during the period 1997 to 2006

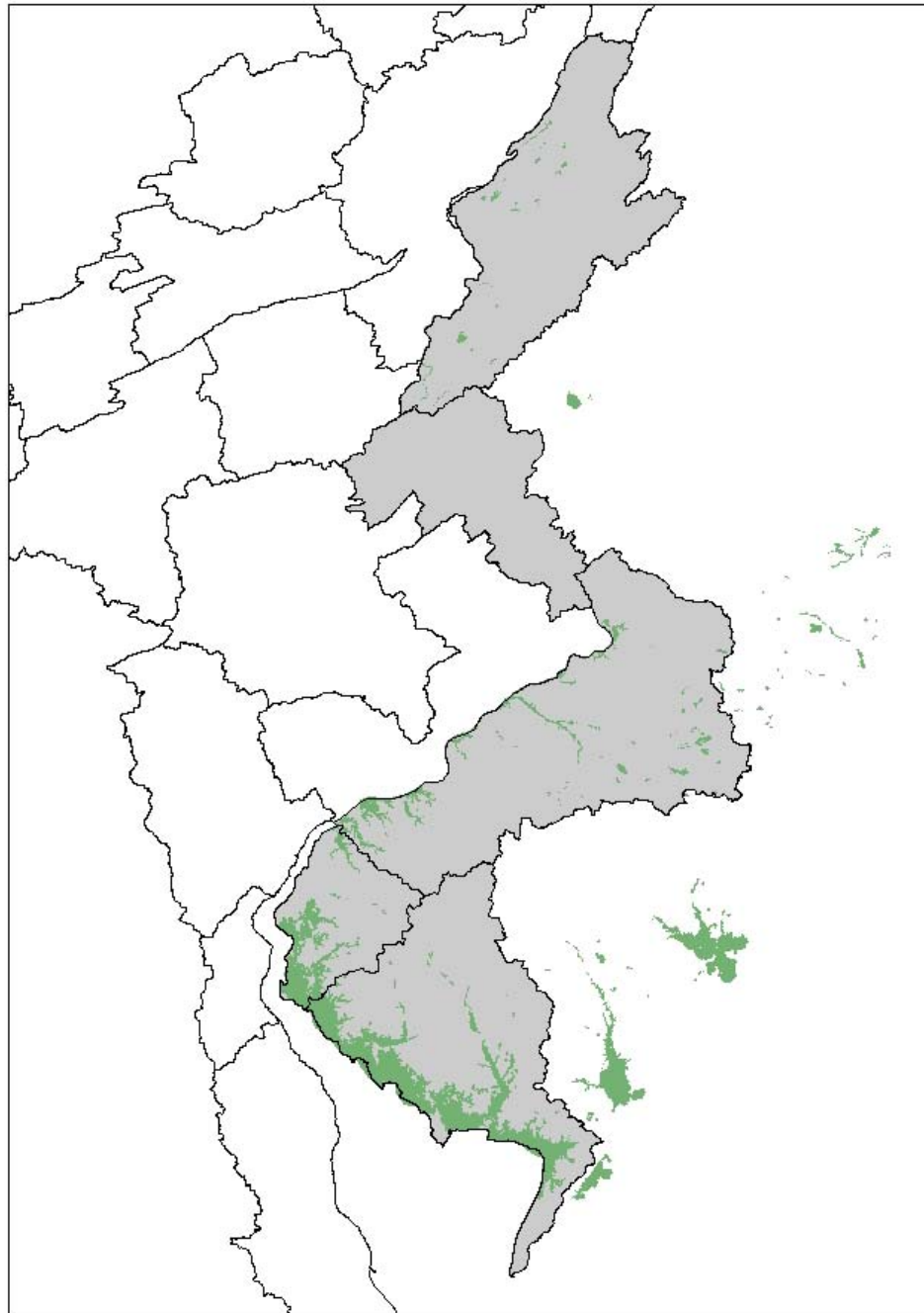




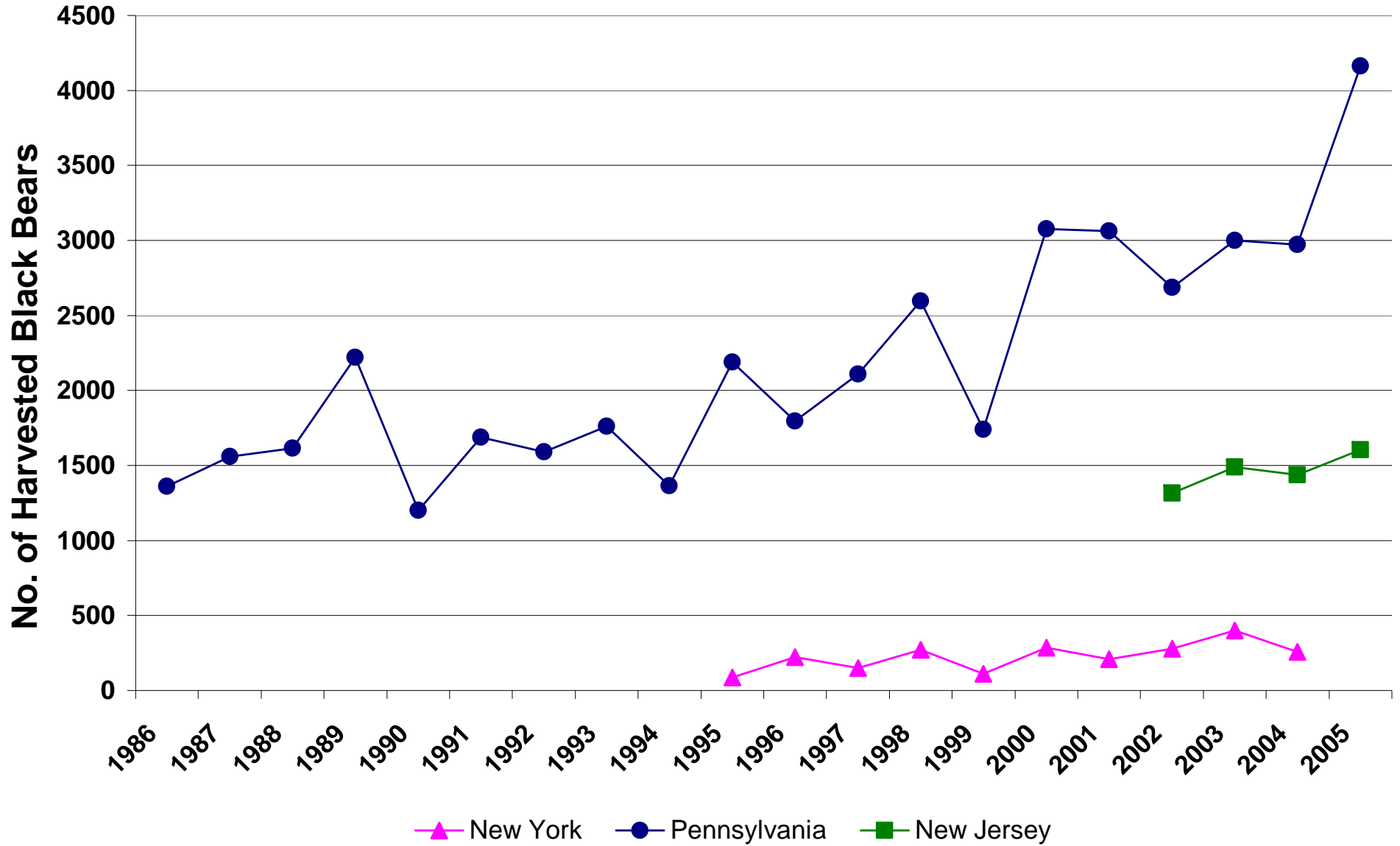
Bald Eagle Nesting Pairs in the Delaware River Basin

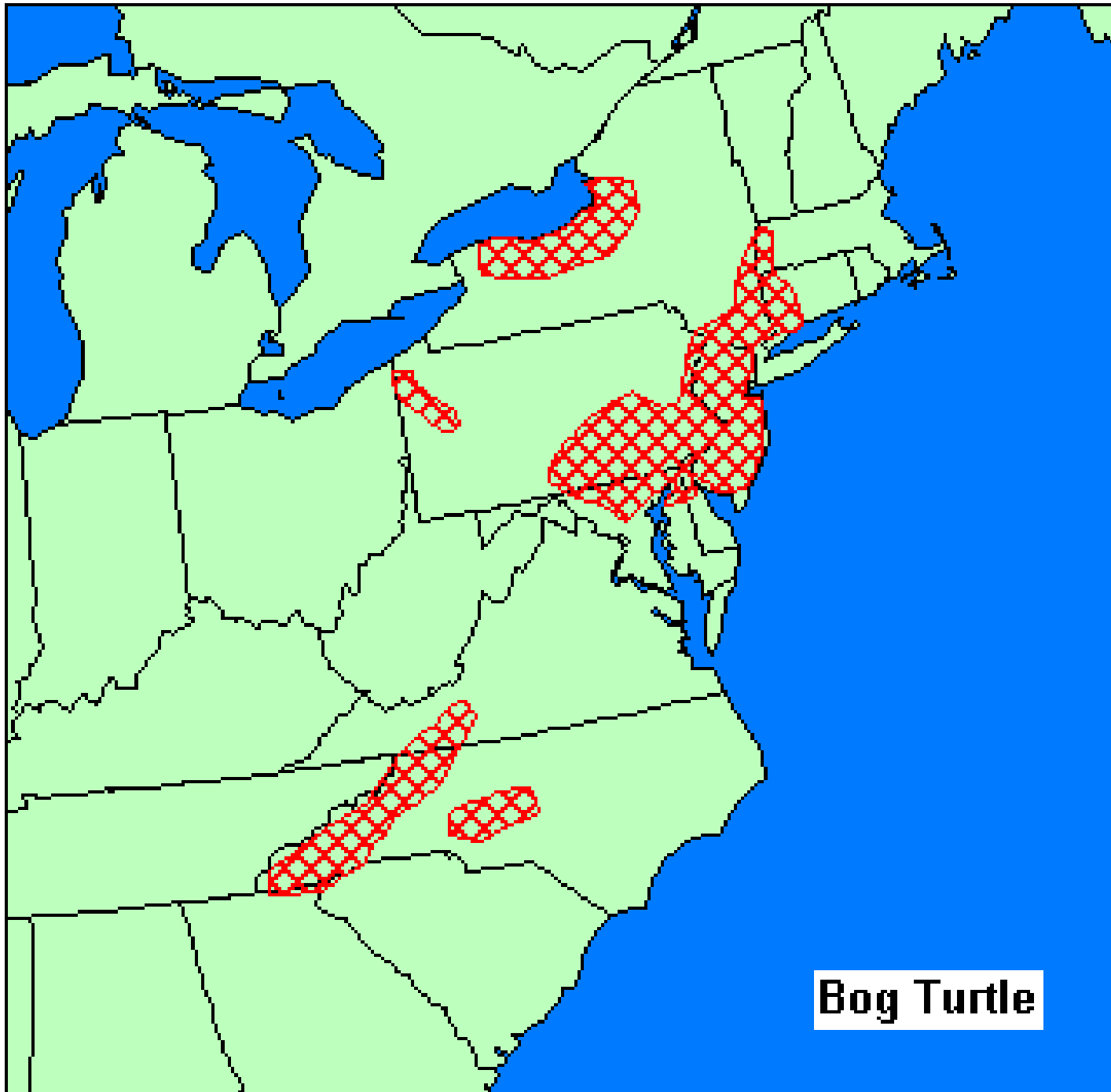


Bald Eagle Distribution 2004



Black Bear Harvest Delaware River Basin States





Bog Turtle

