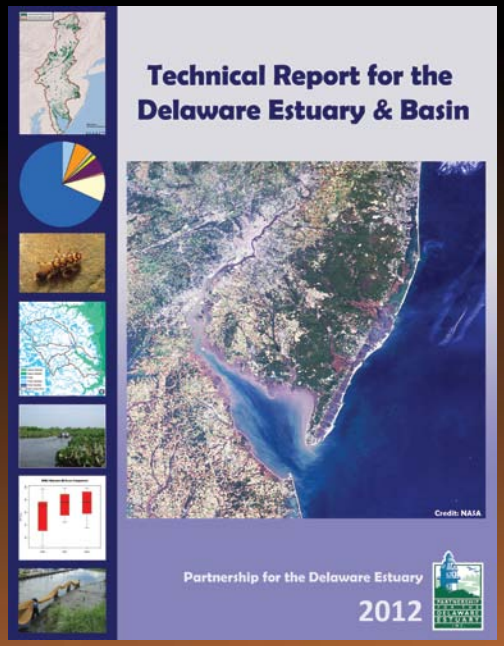
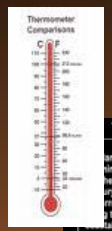
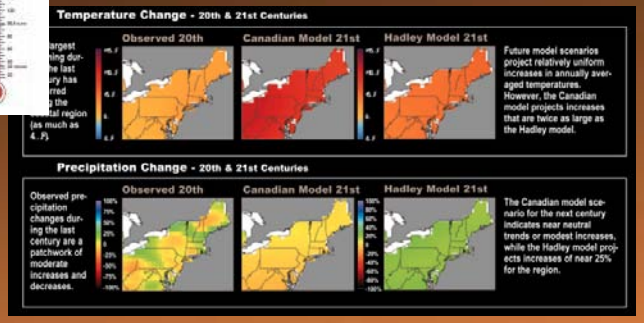
2012 Technical Report for the Delaware Estuary and River Basin: Key Findings and Next Steps

Danielle Kreeger, Susan Kilham, Jennifer Adkins and Priscilla Cole

Delaware Estuary Science & Environmental Summit
January 28, 2013







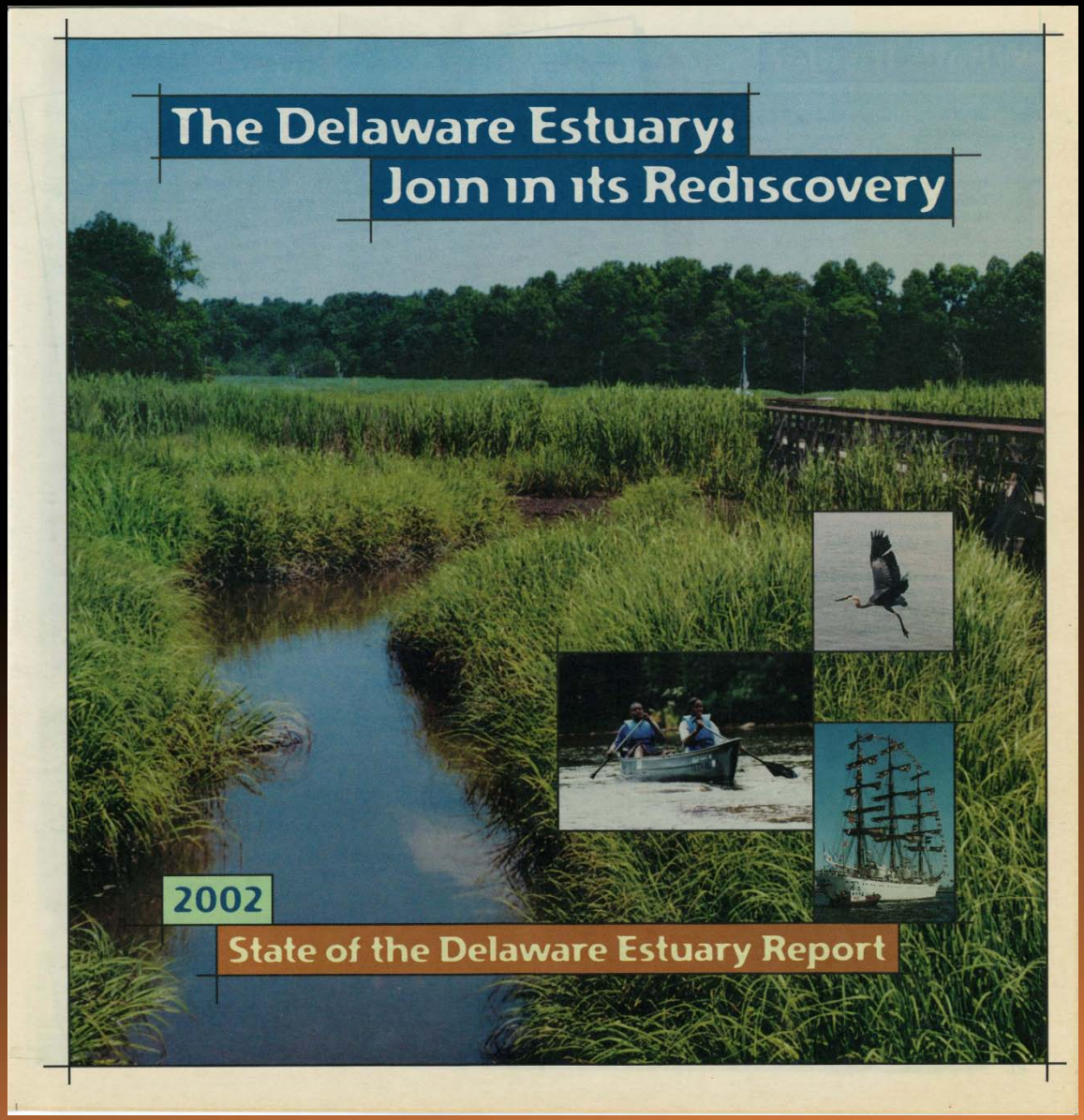
Adaptive Management

Goals

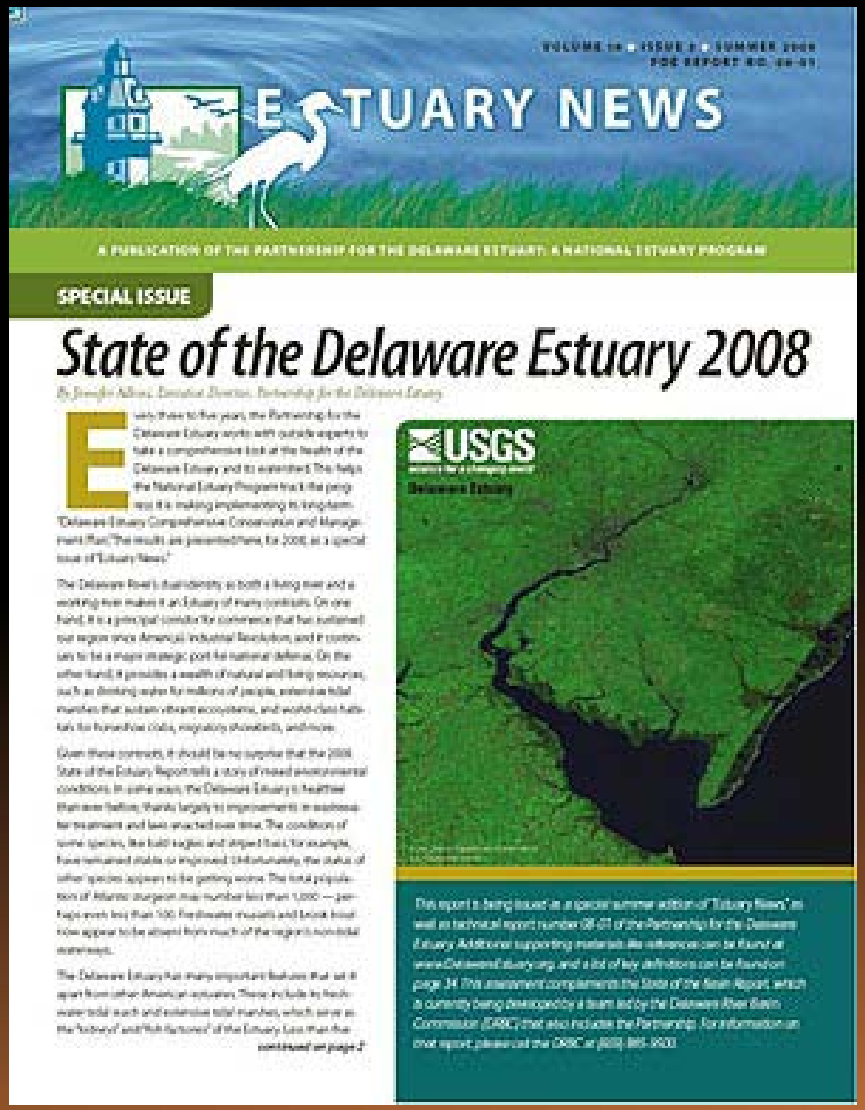
Monitoring

Indicators

State of the Estuary Report 2002



State of the Estuary Report 2008



ESTUARY NEWS

A PUBLICATION OF THE PARTNERSHIP FOR THE DELAWARE ESTUARY, A NATIONAL ESTUARY PROGRAM

SPECIAL ISSUE

State of the Delaware Estuary 2008

By Jennifer Adkins, Executive Director, Partnership for the Delaware Estuary

Every three to five years, the Partnership for the Delaware Estuary works with outside experts to take a comprehensive look at the health of the Delaware Estuary and its watershed. This helps the National Estuary Program track the progress it is making implementing its long-term "Delaware Estuary Comprehensive Conservation and Management Plan." The results are presented here, for 2008, as a special issue of "Estuary News."

The Delaware River's dual identity as both a living river and a working river makes it an Estuary of many contrasts. On one hand, it is a principal corridor for commerce that has sustained our region since America's Industrial Revolution, and it continues to be a major strategic port for national defense. On the other hand, it provides a wealth of natural and living resources, such as drinking water for millions of people, extensive tidal marshes that sustain vibrant ecosystems, and world-class habitats for horseshoe crabs, migratory shorebirds, and more.

Given these contrasts, it should be no surprise that the 2008 State of the Estuary Report tells a story of mixed environmental conditions. In some ways, the Delaware Estuary is healthier than ever before, thanks largely to improvements in wastewater treatment and laws enacted over time. The condition of some species, like bald eagles and striped bass, for example, have remained stable or improved. Unfortunately, the status of other species appears to be getting worse. The total population of Atlantic sturgeon may number less than 1,000 — perhaps even less than 100. Freshwater mussels and brook trout now appear to be absent from much of the region's non-tidal waterways.

The Delaware Estuary has many important features that set it apart from other American estuaries. These include its freshwater tidal reach and extensive tidal marshes, which serve as the "kidneys" and "fish factories" of the Estuary. Less than five

continued on page 2

This report is being issued as a special summer edition of "Estuary News" as well as technical report number 08-01 of the Partnership for the Delaware Estuary. Additional supporting materials like references can be found at www.DelawareEstuary.org, and a list of key definitions can be found on page 34. This assessment complements the State of the Basin Report, which is currently being developed by a team led by the Delaware River Basin Commission (DRBC) that also includes the Partnership. For information on that report, please call the DRBC at (609) 883-9500.

Tidal Wetlands

POSITIVE

NEGATIVE

INDICATOR DESCRIPTION: Coastal wetlands are one of the Delaware Estuary's most important and characteristic habitats, and they are a premier environmental indicator for the area's ecosystem. The Estuary has one of the largest freshwater tidal prisms in the world running from Trenton, New Jersey, to approximately Wilmington, Delaware. The gradual transition from fresh to salt water allows for abundant and rare freshwater tidal wetlands in the Upper Estuary, brackish marshes in the Middle Estuary, and salt marshes surrounding Delaware Bay. Together, these marshes form a nearly continuous perimeter fringing the tidal system. Tidal wetlands furnish essential spawning, foraging, and nesting habitat for fish, birds, and other wildlife. These wetlands are considered by many scientists to function like the ecosystem's "kidneys," absorbing contaminants, nutrients, and suspended sediments. Other scientists regard them as "fish factories" that are crucial to the success of important finfisheries. They also provide a first line of defense against storm surge and flooding. Acre for acre, tidal wetlands likely provide more ecosystem services than any other habitat type in the region.

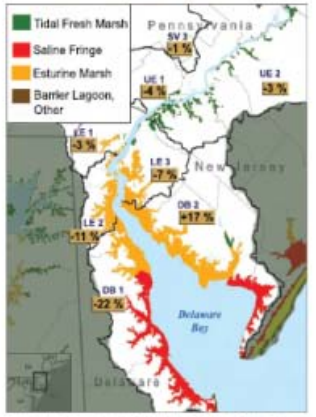
STATUS: A 1992 to 2001 land cover data comparison (for both tidal and non-tidal wetlands combined) showed wetland loss throughout the Estuary, except along the New Jersey side of Delaware Bay where extensive marsh restoration may have offset this trend (see map). During the preceding decade, a more in-depth analysis showed that Delaware's tidal marshes dropped by 12 percent and the proportion of marshes with degraded conditions almost doubled.

TRENDS: For over 300 years, the extent and integrity of tidal wetlands has been under assault across the Estuary. Perhaps 50 percent of the natural marshes have been lost to development, conversion, or degradation associated with human activities. Losses have been most severe in the urban corridor where perhaps only five percent of pre-settlement acreage of the nationally rare freshwater tidal marsh remains. Despite proactive laws protecting marshes, a growing awareness of their ecological value, and mounting restoration attention, marsh acreage and condition are still lost from human-caused impairments, land uses, and sea level rise.

ACTIONS AND NEEDS: Tidal wetlands are a hallmark feature of our watershed that suffer continued losses of both area and condition. Coordinated monitoring and assessment programs are urgently needed to regularly and carefully track tidal marsh extent and condition across the three Estuary states. A better scientific understanding is also needed of the factors that govern wetland well-being, such as sediment supply, water quality, and ecology. Studies of their ecosystem services and natural capital value would benefit land-use and regional-restoration planning.

A coconut fiber log is deployed along the edge of a tidal marsh in Bivalve, New Jersey, in an effort to establish a "living-shoreline" reef that may soon protect against erosion.

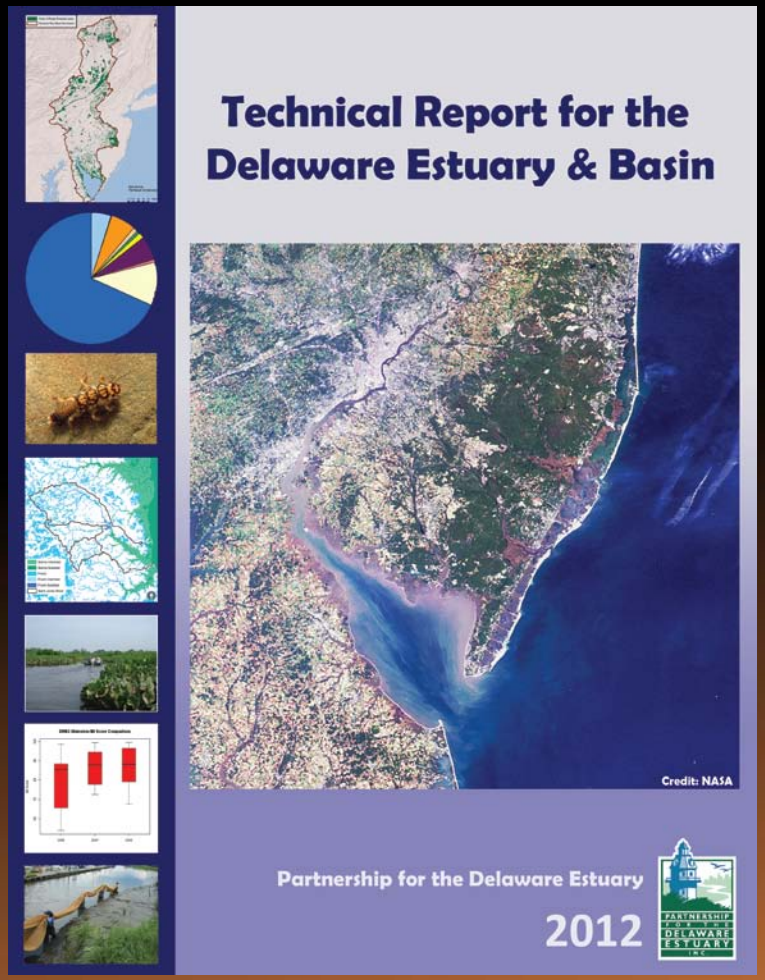
Relative Change in Wetland Acreage 1992-2001



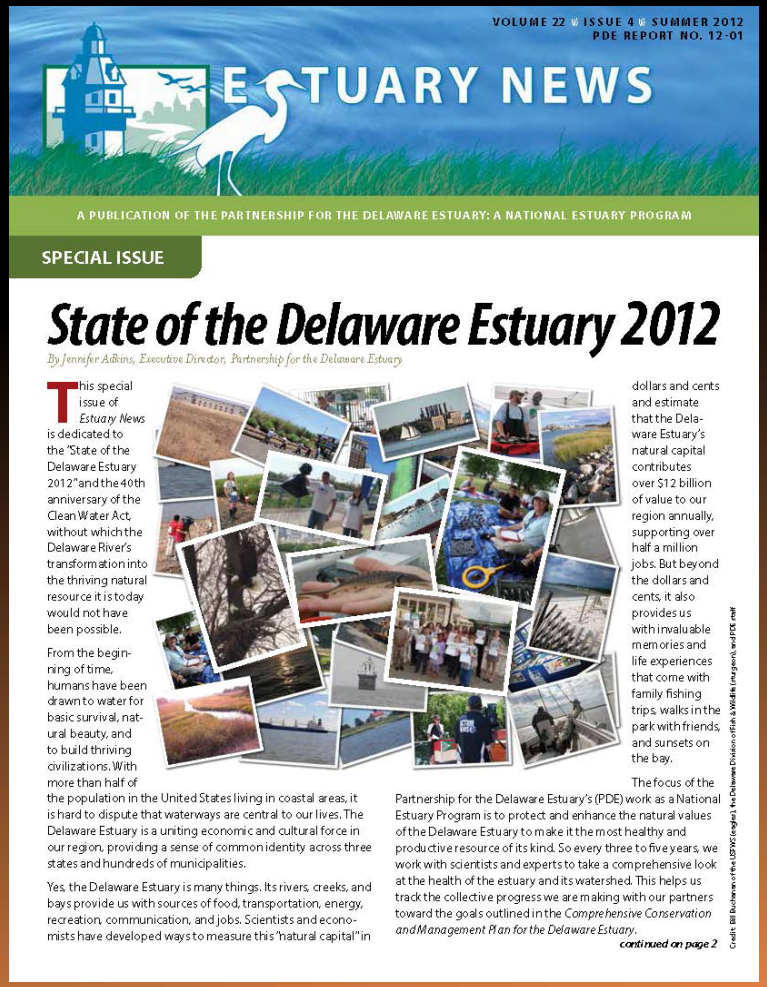
Please refer to the map on page 31 to view the full range of each region.

State of the Estuary Reporting 2012

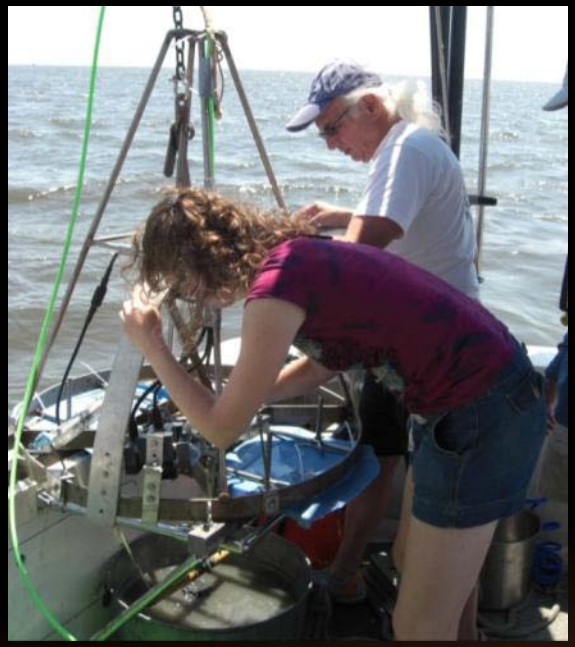
Technical
50 indicators – 255 p.

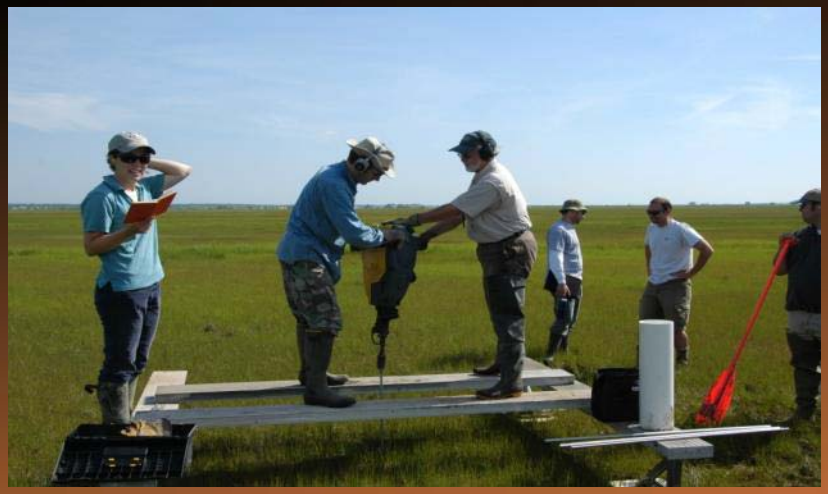


Public
15 indicators – 28 p.



Monitoring





Although it is not drawn to scale, this graphic depicts the monitoring components that could someday be incorporated into DEWOOS. Red items are monitoring activities and hardware, the green areas are natural resources, and the black symbols represents system attributes and issues.

Preliminary Indicator List

STAC-MAC Workshops 2009

Goals:

Strengthen existing indicators

Improve data quality, density, comparability and sharing

Develop new indicators for linkages

Discuss ways to Improve monitoring

Indicator Category	OBJECTIVE	Indicator	Secondary Indicator	Used in 2008 Reports	Data?
Water Quality	1.) To achieve water quality that will maintain and enhance estuarine use designations consistent with the Clean Water Act 2.) To promote and enhance ample and high quality water based and associated terrestrial based recreational opportunities with sustained availability for public use.	Dissolved Oxygen		x	x
		Salinity Line, Chloride			x
		Chlorophyll-a, Nutrient Balance			x
		Total Nitrogen/Total Phosphorus		x	x
		Total Suspended Sediment (Solids)		x	x
		Fish Consumption Advisories		x	x
		Organics	PCB, Alkazine, Metalachlor	x	x
		Bacteria			x
		Temperature			x
		Emerging Contaminants		x	
		Toxics		x	x
		Specific Conductivity		x	
		Macro-invertebrates(relating to living resources)		x	
Water Quantity	To provide an adequate supply of freshwater to the Estuary to maintain habitats, distribution of salinity, and human populations in 2020	Population		x	x
		Land Use		x	x
		Source water supply and demand		x	x
Hydrology & Geomorphology	To optimize sediment quantity and quality in a manner that maintains or enhances a balanced indigenous estuarine biota and habitat.	Surface water flow		x	x
		Sediment and Material			
		Ground water availability, quality			x
		Flooding		x	x
		Dams (Hydrologic Impairment)		x	
		Climate Change- Sea level rise		x	
Living Resources	Restore healthy populations of harvestable finfish and invertebrate species to levels that will support sustainable recreational and commercial fisheries.	Shellfish	Oyster	x	x
			Horseshoe crab	x	x
			Blue crab	x	x
			Freshwater mussels	x	
		Fish	American Shad	x	x
			Trout	x	
			Striped Bass	x	x
			Weakfish	x	x
			Summer Flounder		x
			American Eels		x
			Sturgeon (shortnosed and Atlantic)	x	
	To restore or maintain populations of birds, amphibians, reptiles, and mammals dependent on the DE Estuary to levels deemed attainable by comprehensive		Shorebirds (red knots)	x	x
			Ospreys		
			Bald Eagle	x	x
		Amphibians	Frogs, toads, salamanders		
Aquatic Habitat	To maintain or restore an assemblage of organisms and their habitat throughout the DE estuary and tidal wetlands that a contribute to the ecological diversity, stability, productivity, and aesthetic appeal of the	Tidal Wetlands		x	x
		Tidal Wetland Buffers		x	
		Total Wetlands		x	x
		Freshwater wetlands		x	x
		Fish Passage		x	x
		Riparian Buffers		x	
Land Use / Landscape Conditions	To preserve acreage and enhance quality of shoreline and littoral habitat to sustain a balanced natural system. To restore and maintain the phys balanced environmental conditions necessary to achieve target levels of estuarine species.	Population Change		x	x
		Condition Changes/Trends		x	x
		Preserved land		x	x
		Land conversion ration		x	x
		% Impervious Cover		x	x
		% Agriculture		x	x
		% Forest		x	x
		% Wetlands		x	x
		% Open Space		x	x
		% Forest/Wetlands/Open Space		x	x
		Public Access Points			x
		Contaminated/Superfund Sites		x	x
		Land Acquisition	Preservation, Conservation	x	x
		Developed Land per Capita		x	x
		Natural Capital Value	e.g., applied to % wetland or landuse		
		Stormwater Management			
Functions and Linkages	New indicators are sought to assess the status of physical-chemical-biological linkages and functional processes	Ecosystem Model			
		Food Web Linkages	P/B Ratios?		
		Ecosystem Services	C, N Removal? Biofiltration? Etc		
		FW Inputs to Estuary			
		Buffering Capacity, Resilience			

TREB Table of Contents

Chapter 1 – **Watersheds & Landscapes**

Population, Land Use, Protected Lands

Chapter 2 – **Water Quantity & Hydrology**

Water Withdrawals, Groundwater, Consumption

Chapter 3 – **Water Quality**

DO, Nitrogen, PCBs

Chapter 4 – **Sediments**

Loadings, Organic Carbon, Dredging

Chapter 5 – **Aquatic Habitats**

Benthic, Tidal Wetlands, Fish Passage

Chapter 6 – **Living Resources**

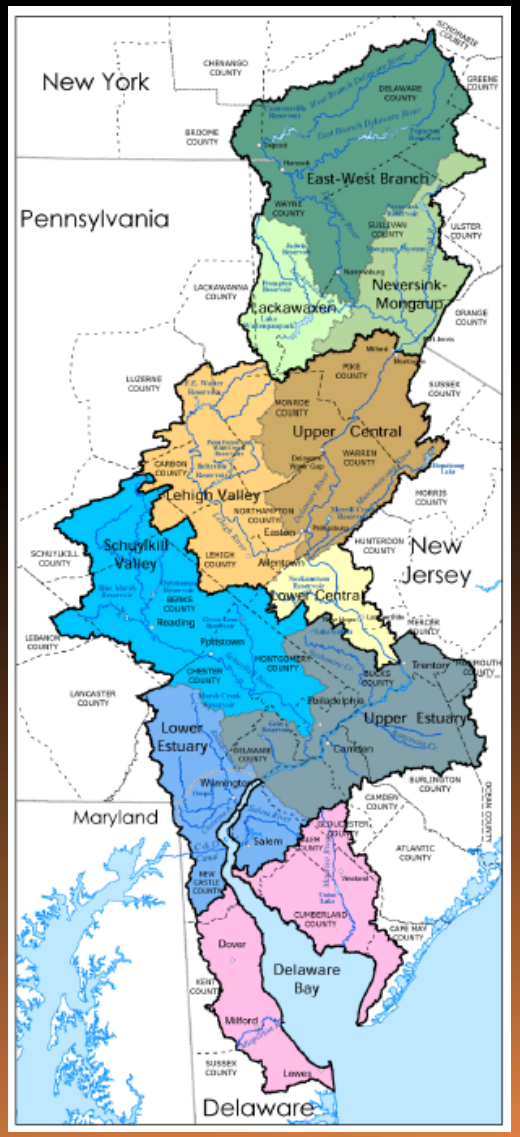
Horseshoe Crabs, Oysters, Macroinvertebrates

Chapter 7 – **Climate Change**

Temperature, Heat Waves, Precipitation, SLR

Chapter 8 – **Restoration**

Acres Restored, Types, Investment



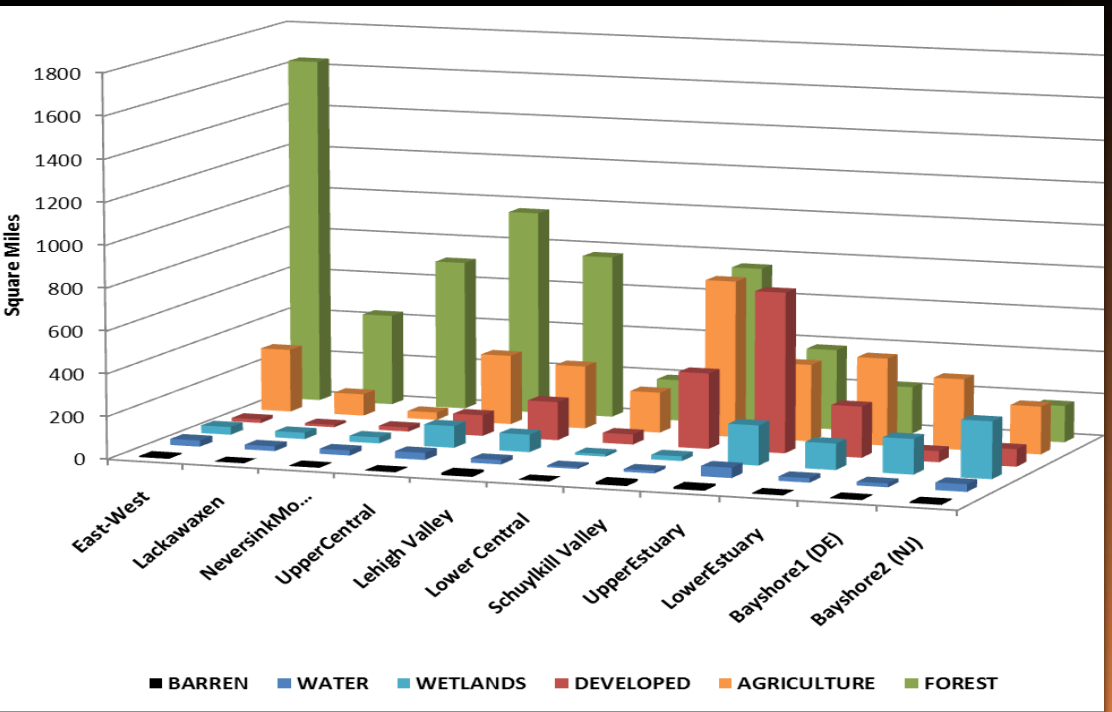
Chapter 1

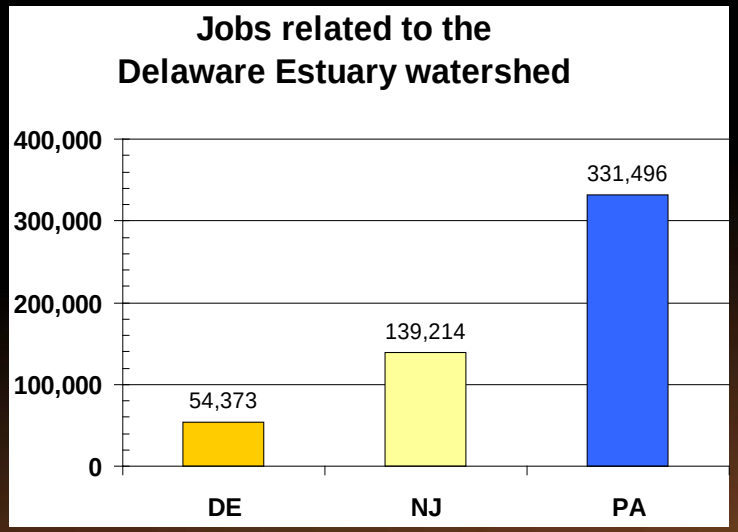
Watersheds & Landscapes

Authors – J. Rittler Sanchez, J. Kauffman, A.Homsey, K. Reavy

Example Findings:

- Between 1996-2006, the Basin lost 50 sq.mi. of forest.
- The Estuary supports 500,000 jobs and $10 billion in wages annually





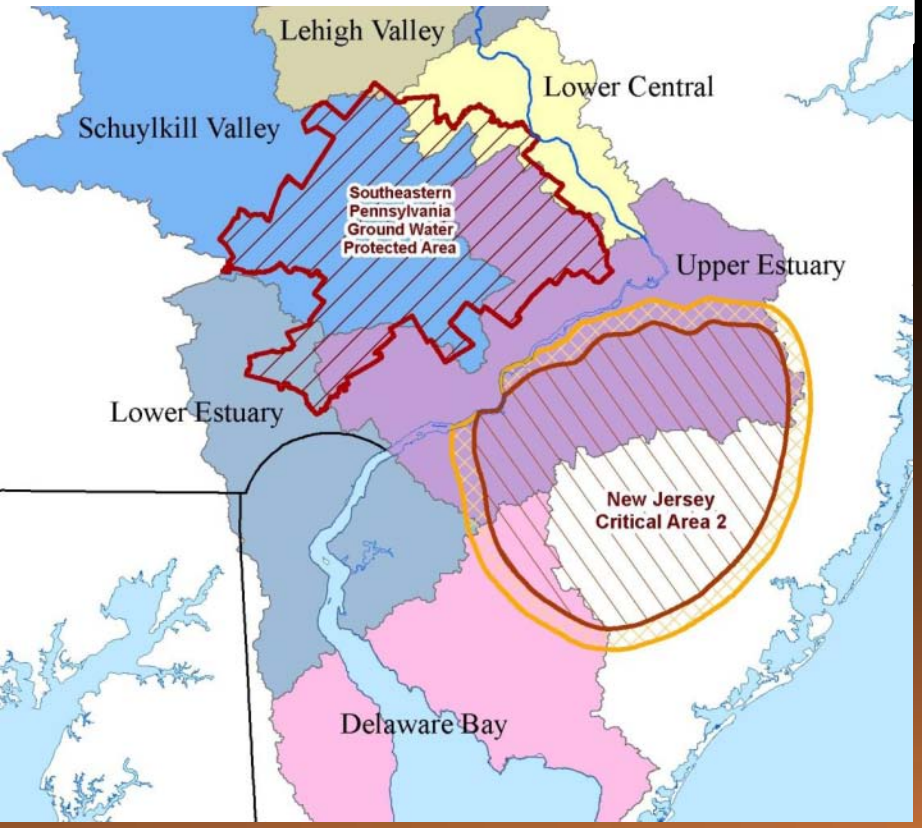
Action/Need: Higher resolution land cover data, and consistency between states

Chapter 2

Water Quantity & Hydrology

Authors – D. Sayers , J.K. Barr

Areas of Groundwater Stress



Example Findings:

- Power generation and PWS sectors each account for 30% of Consumptive use.
- Water use for natural gas drilling will increase demands on upper basin supplies.

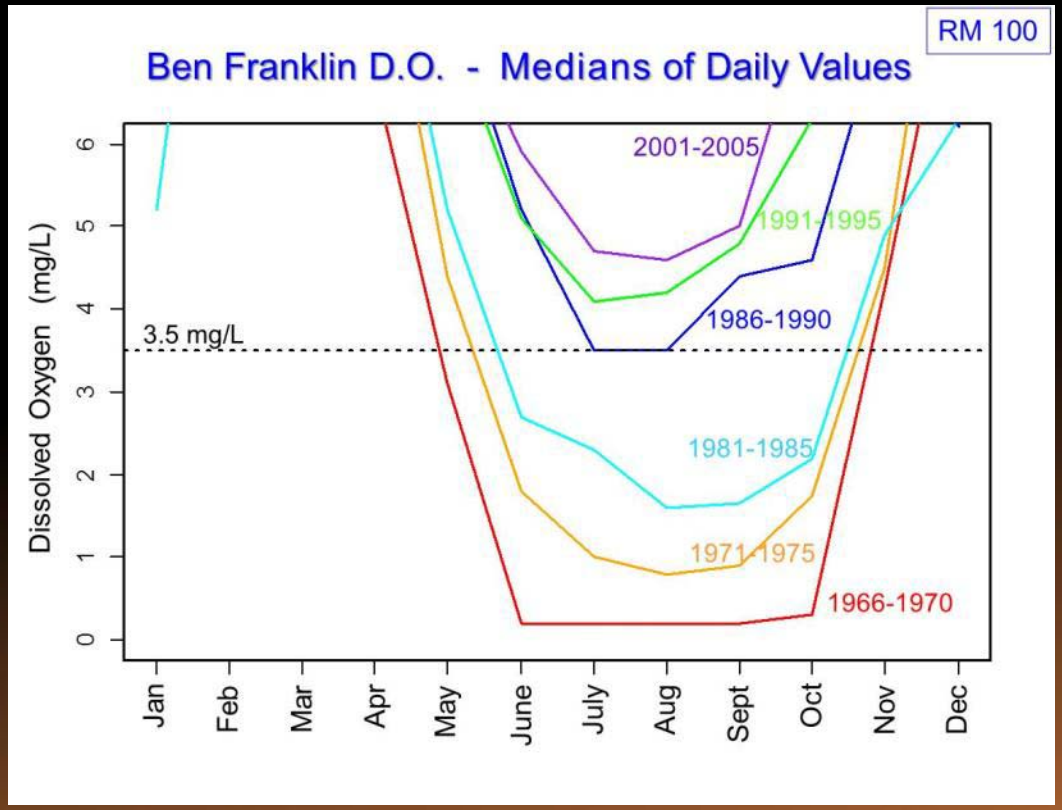
Action/Need:

- Better means of quantifying instream needs of aquatic ecosystems.

Chapter 3

Water Quality

Authors– J. Yagecic, R. MacGillivray, E. Silldorff, E. Vowinkel



Example Finding:

Phosphorus and Nitrogen concentrations have declined since the 1960s.

Actions/Needs:

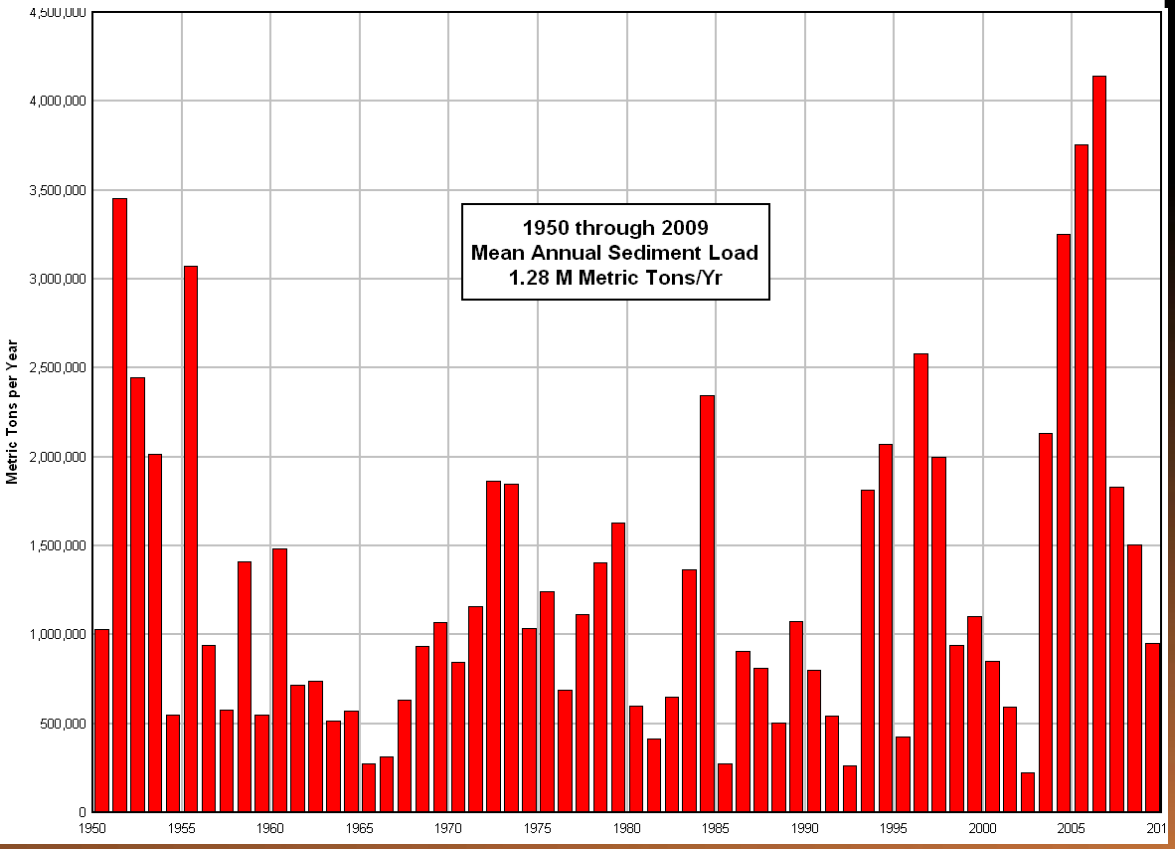
Since dioxin / furan assessments suggest that concentrations may exceed water quality criteria, direct measurement and assessment is required.

Chapter 4

Sediments

Authors - J. Gerbert, R. Searfoss

Sediment Load Time Series (1950 – 2009)



1950 2010

Example Finding:

The mean annual sediment discharge to the estuary is 1.28 million metric tons.

Action/Need:

Improve our understanding of sediment transport and budget, incl. contributions from storm and sewer discharges.

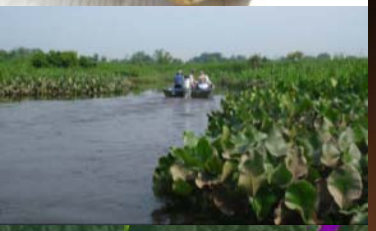
Chapter 5

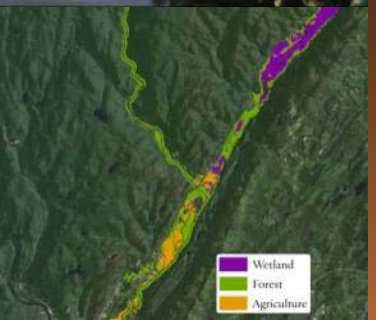
Aquatic Habitats

- **Subtidal** – Benthic Habitats
- **Intertidal** – Salt and brackish marshes
- **Non-tidal** – wetlands, riparian, fish passage

Authors

D. Miller, A. Padeletti, D. Kreeger, A. Homsey, R. Tudor, E. Creveling, M. DePhilip, C. Pindar





Example Findings:

- New Communities discovered – "sponge gardens"
- More than 3300 acres of tidal marshes were lost between 1996-2006, mainly in NJ Bayshore (~8%)
- Fish ladders and dam removals in the Schuylkill have opened up 85 river miles of fish habitat since 2006

Example Actions/Needs:

- DEBI should be repeated on a 5 year cycle
- Enhanced wetland monitoring and adaptive management
- Study of ecological flows to protect ecological communities

Chapter 6

Living Resources

Authors – G. Breese, J. Mohler, D. Kahn, R. Wong, J. Kraeuter , D. Burke, G. Bright, D. Kreeger, J. Clark

Tidal

- Horseshoe Crabs
- Atlantic Sturgeon
- Striped Bass
- Blue Crab
- Weakfish
- American Eel
- Oyster
- Osprey
- White Perch

Non Tidal

- Macroinvertebrates
- Freshwater Mussels

Example Finding:

- Eel abundance declined in the 1980s, but increased to higher levels in the mid-2000s.
- Since the 1998 moratorium on sturgeon harvest, early stage juveniles dramatically increased in 2009, indicating successful spawning and suitable habitat.

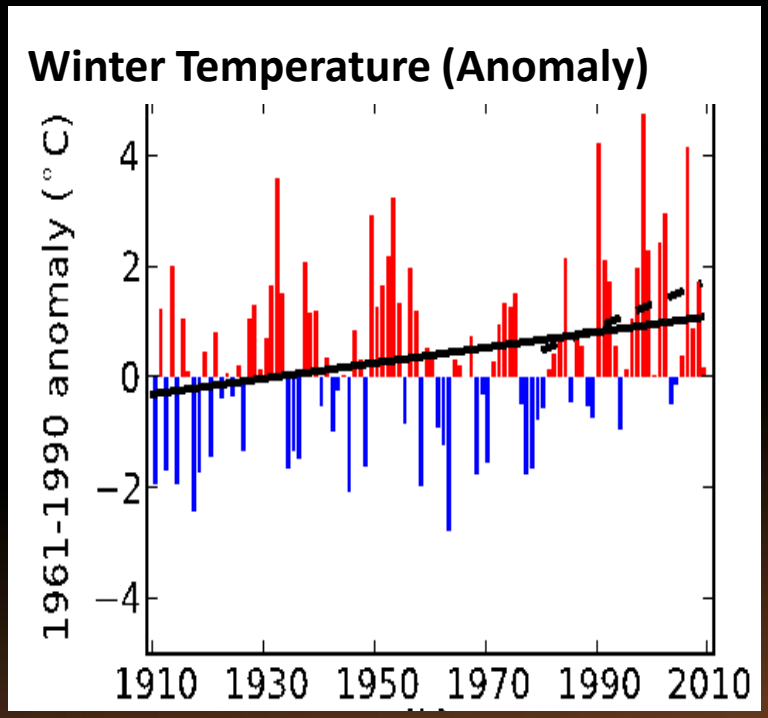
Action/Need:

- Dam removal or improvements in fish passage devices could facilitate American shad in the Delaware River.

Chapter 7

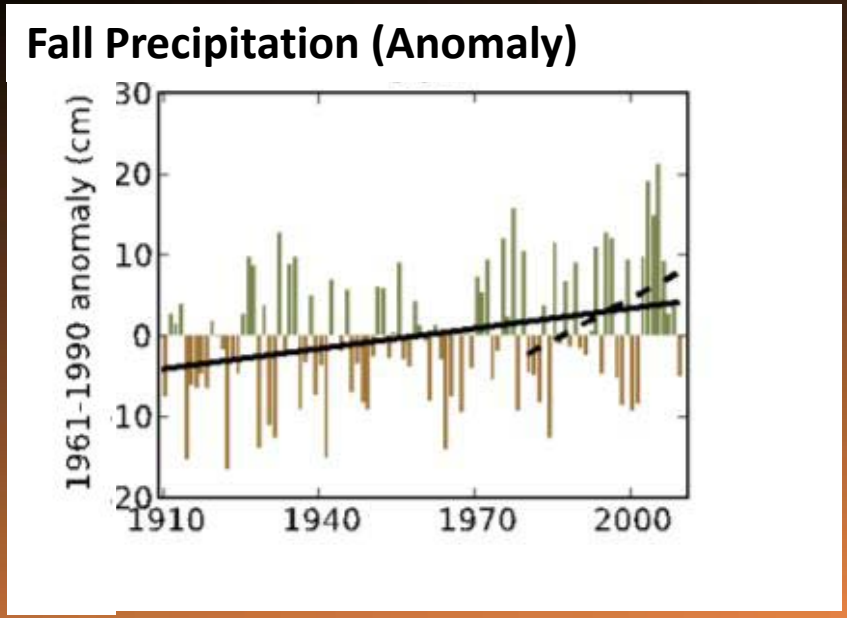
Climate

Authors - R. Najjar, A. Ross, D. Kreeger, S. Kilham



Example Finding:

Temperature warmed by 1 degree Celsius in the past century, mainly in past 30 yrs.



Action/Need:

Analysis of *daily* high and low temperatures to investigate long-term temperature trends.

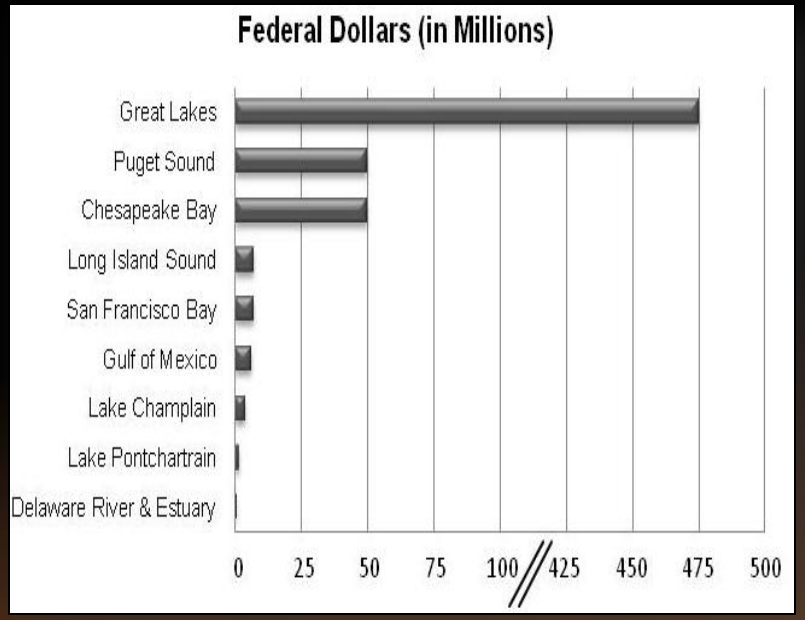
Chapter 8

Restoration

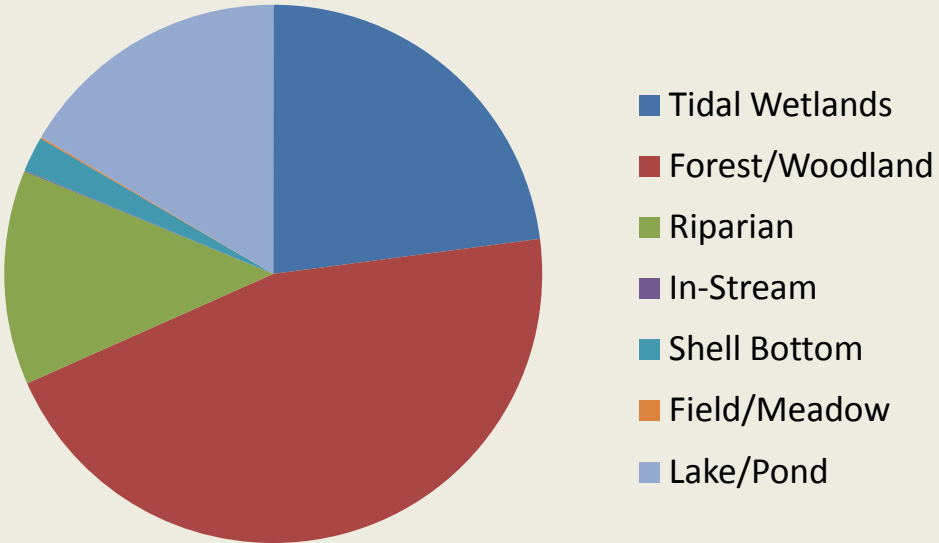
Leads – L. Whalen, S. Hahn, D. Kreeger, J. Adkins

Example Finding:

>25,000 acres were restored 2006 - 2011 (NEPORT).



Restored (ha) by habitat type in 2011



Action/Need:

The Delaware River Basin receives far less restoration funding than other large US estuaries

TREB Speakers

Historical Climate Change and Variability in the Delaware River Basin
Ray Najjar et al.

Assessment of Water Quantity and Quality Indicators in the 2012 TREB
John Yagecic and David Sayers

See also other sessions (e.g. sediments, living resources, habitats)

Handouts

TREB Executive Summary

TREB CD's

State of Estuary 2012
(see Wool talk)

Executive Summary

VOLUME 22 ▪ ISSUE 4 ▪ SUMMER 2012
PDE REPORT NO. 12-01

ESTUARY NEWS

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SPECIAL ISSUE

State of the Delaware Estuary 2012

By Jennifer Adkins, Executive Director, Partnership for the Delaware Estuary

This special issue of *Estuary News* is dedicated to the "State of the Delaware Estuary 2012" and the 40th anniversary of the Clean Water Act, without which the Delaware River's transformation into the thriving natural resource it is today would not have been possible.

From the beginning of time, humans have been drawn to water for basic survival, natural beauty, and to build thriving civilizations. With more than half of the population in the United States living in coastal areas, it is hard to dispute that waterways are central to our lives. The Delaware Estuary is a uniting economic and cultural force in our region, providing a sense of common identity across three states and hundreds of municipalities.

Yes, the Delaware Estuary is many things. Its rivers, creeks, and bays provide us with sources of food, transportation, energy, recreation, communication, and jobs. Scientists and economists have developed ways to measure this "natural capital" in dollars and cents and estimate that the Delaware Estuary's natural capital contributes over $12 billion of value to our region annually, supporting over half a million jobs. But beyond the dollars and cents, it also provides us with invaluable memories and life experiences that come with family fishing trips, walks in the park with friends, and sunsets on the bay.

The focus of the Partnership for the Delaware Estuary's (PDE) work as a National Estuary Program is to protect and enhance the natural values of the Delaware Estuary to make it the most healthy and productive resource of its kind. So every three to five years, we work with scientists and experts to take a comprehensive look at the health of the estuary and its watershed. This helps us track the collective progress we are making with our partners toward the goals outlined in the *Comprehensive Conservation and Management Plan for the Delaware Estuary*.

continued on page 2

Credit: Bill Buchanan of the USFWS (eagle), the Delaware Division of Fish & Wildlife (sturgeon), and PDE staff

Examples in Executive Summary

Ten Positives

Indicator	Condition
Ecosystem Services	Worth >$12 billion annually
Consumptive Use (Public)	Declined per capita 1990-2008
Horseshoe Crabs	Male spawning activity increased 1999-2010
Striped Bass	Population increased to become a major spawning stock
Ice Jams	Decreased over period of record
Habitat Type	Restoration and conservation have addressed priorities

Ten Negatives

Indicator	Condition
Forest Cover	Declined almost 50 square miles (127 km^2) 1996-2006
Consumptive Water Use (Industry)	Increased about 20% between 1994-2008
Atlantic Sturgeon	Listed as federally endangered in 2011
Freshwater Mussels	Abundance and range continued to decline
Precipitation	Increased, especially in past 30 years, increasing flooding
Funding	Investment remained low compared to other large estuaries

TREB Conclusions

Taken together, overall environmental conditions in the Delaware Estuary and River Basin are fair, with a mix of both improving and declining status indicators.

The human population is expected to increase by 80% by 2100. Increases are expected also in temperature, precipitation, sea level, salinity, and likely storms. Natural resources will, on balance, be increasingly taxed by these changes.

Continued careful monitoring of key indicators will be critical so that environmental managers can make adaptive decisions to sustain crucial life-sustaining ecosystem services, worth billions of dollars per year.

Next Steps

Estuary Program Goals - 2012-2013

Inventory Monitoring Infrastructure - 2014

Science & Environmental Summit – 2015

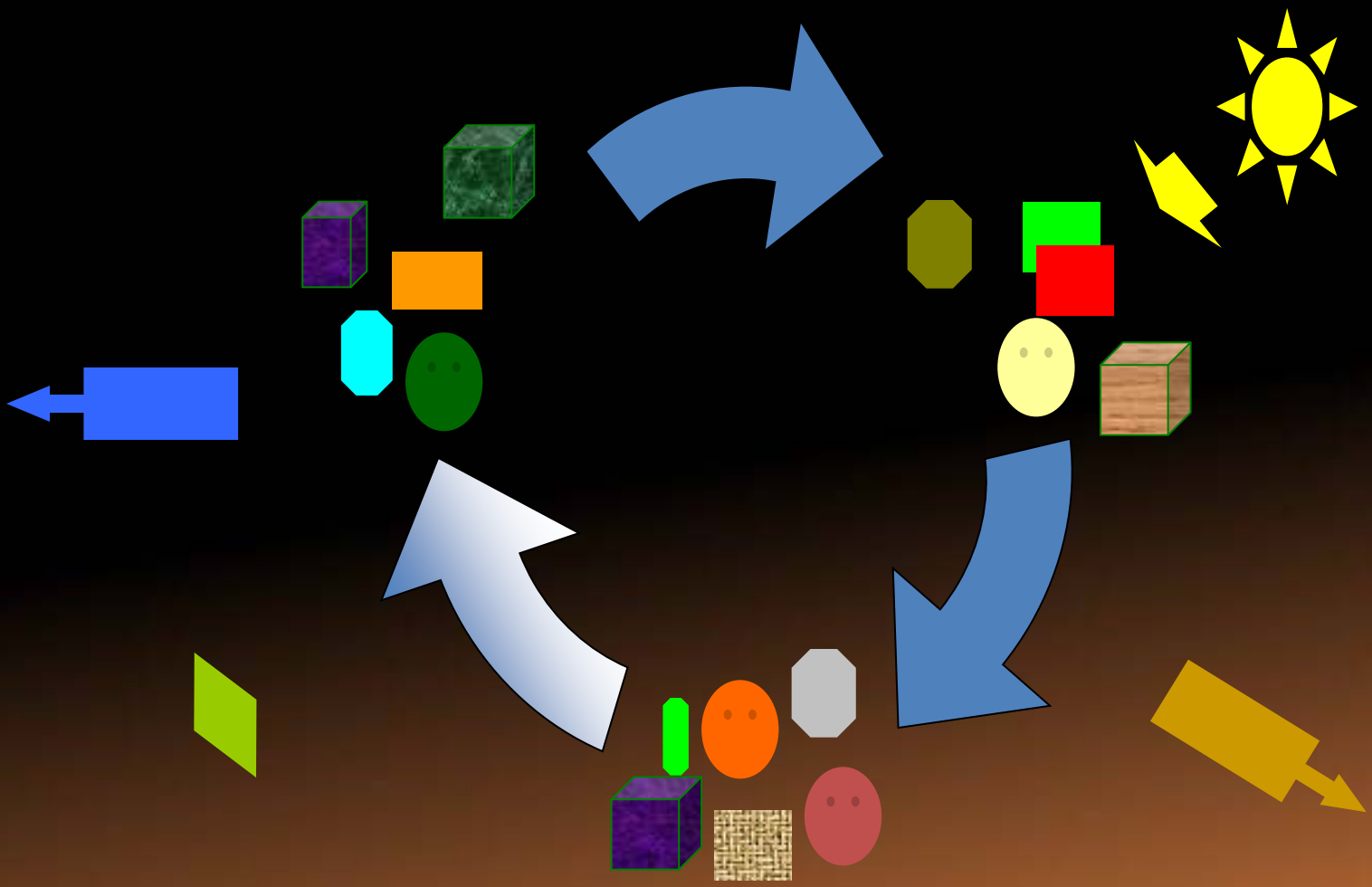
repeat 2005 needs assessment, 10 years

White Paper on Science and Management Needs – 2016

repeat 2006 needs assessment, 10 years

TREB, State of the Estuary – 2016-2017

Next Gen Indicators: Function



What is there?

Structure

How is it Working?

Function

Emerging Threats