

# Overview of DuPont Delaware River / Estuary Study.

Mid-Atlantic JAT  
Meeting

Sept 26, 2007

# Acknowledgements

The DuPont Delaware River study is a collaborative effort between scientists and engineers at Arcadis, Integral Consulting, and DuPont.

Arcadis - Tim Iannuzzi and Dave Ludwig

Integral Consulting - Judi Durda, Betsy Day, and Damian Preziosi

DuPont - Amanda DeSantis, Bob Hoke, Bart Ruiten, Dick Schwer, and Ralph Stahl



## Step 1: 2005 - 2007. A Study of the Delaware River / Estuary.

- Objectives
  - Understand our local sites in context of river history.
  - Apply a risk-based decision making framework.
  - Engage the academic, environmental and regulatory communities.
  - Learn from other river-focused initiatives
  - Obtain external peer review
  - Communicate and publish

# Science Advisory Team

These individuals provided peer review, comments and guidance on the Study and reports:

**Dr. Jeffrey Ashley - ANSP**

**Mr. Michael McCabe - McCabe and Associates**

**Dr. Charlie Menzie - Menzie/Cura and Associates  
(Exponent)**

**Dr. Jonathan Sharp - University of Delaware**

Special Thanks to:

**Dr. Wayne Landis - Western Washington University - Reviewed  
the application of the RRM**

# Why Do This?

**Because the Delaware River Estuary is:**

- An urban river impacted by multiple stressors (chemical, physical and biological)
- Subject to management under a number of regulatory programs at the state and federal level

**Because realistic and effective restoration actions cannot be developed without understanding:**

- What is impaired
- What is the cause(s)
- How cause and effect are linked

**This is the first of several steps !**

# Benefits of the Study

**Augment existing initiatives by synthesizing the wealth of information collected to date:**

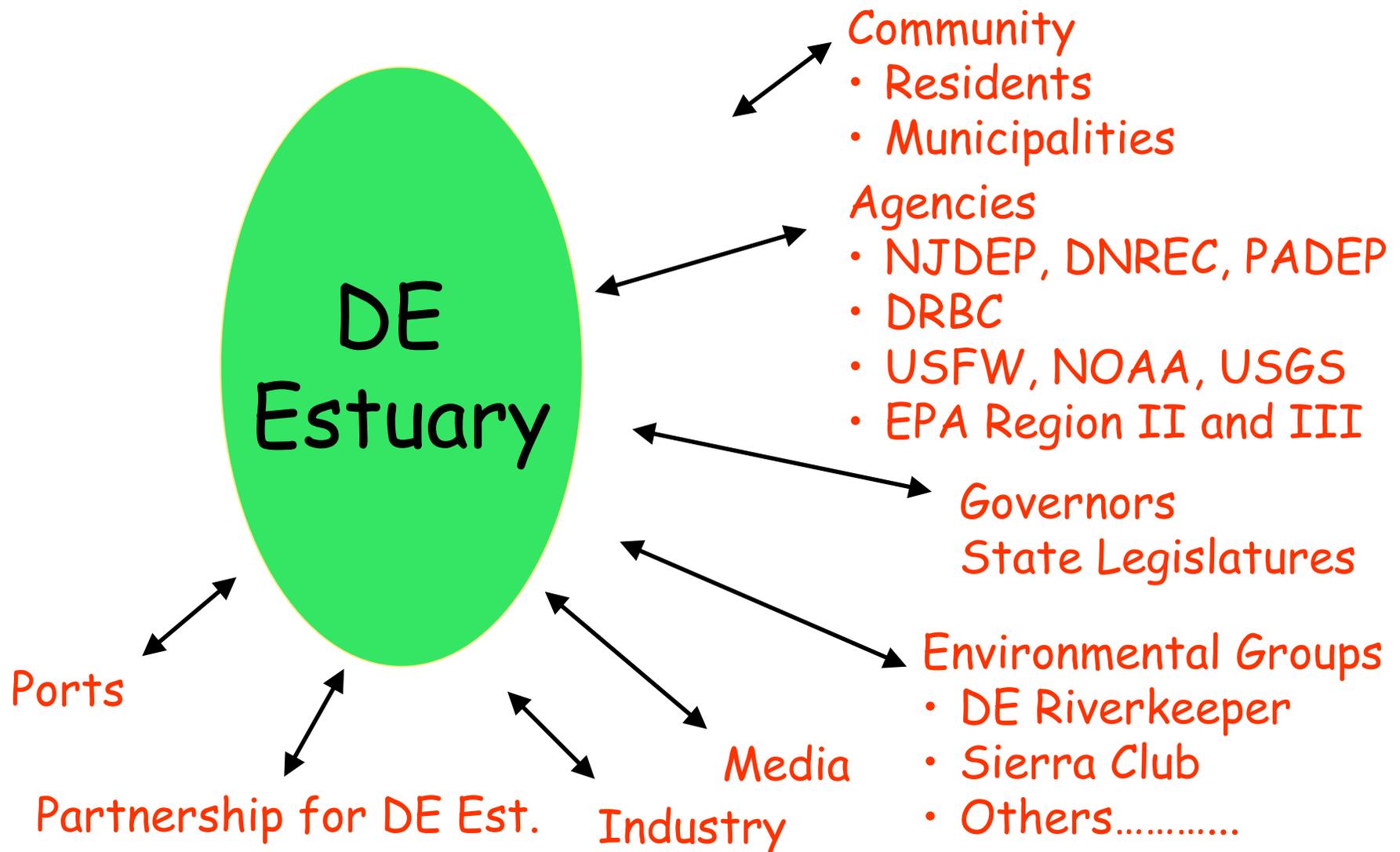
- Data/information clearinghouse

**Facilitate on-going programmatic initiatives by committing resources and increasing public/private awareness**

**Aid in decision-making:**

- Focus efforts
- Data to support agency initiatives
- Data to support DuPont facility-specific efforts

## DE Estuary -- Many Players



# DELAWARE RIVER/ESTUARY

## History

1950s Delaware one of the most polluted rivers in the world

Zero dissolved oxygen at Philadelphia

Significant improvements in 60's and Clean Water Act of 1972

## Today..

90% swimmable & fishable

Recovering stocks of Shad, Striped Bass, Sturgeon, Bald Eagle

Struggling - Oysters, American River Otter

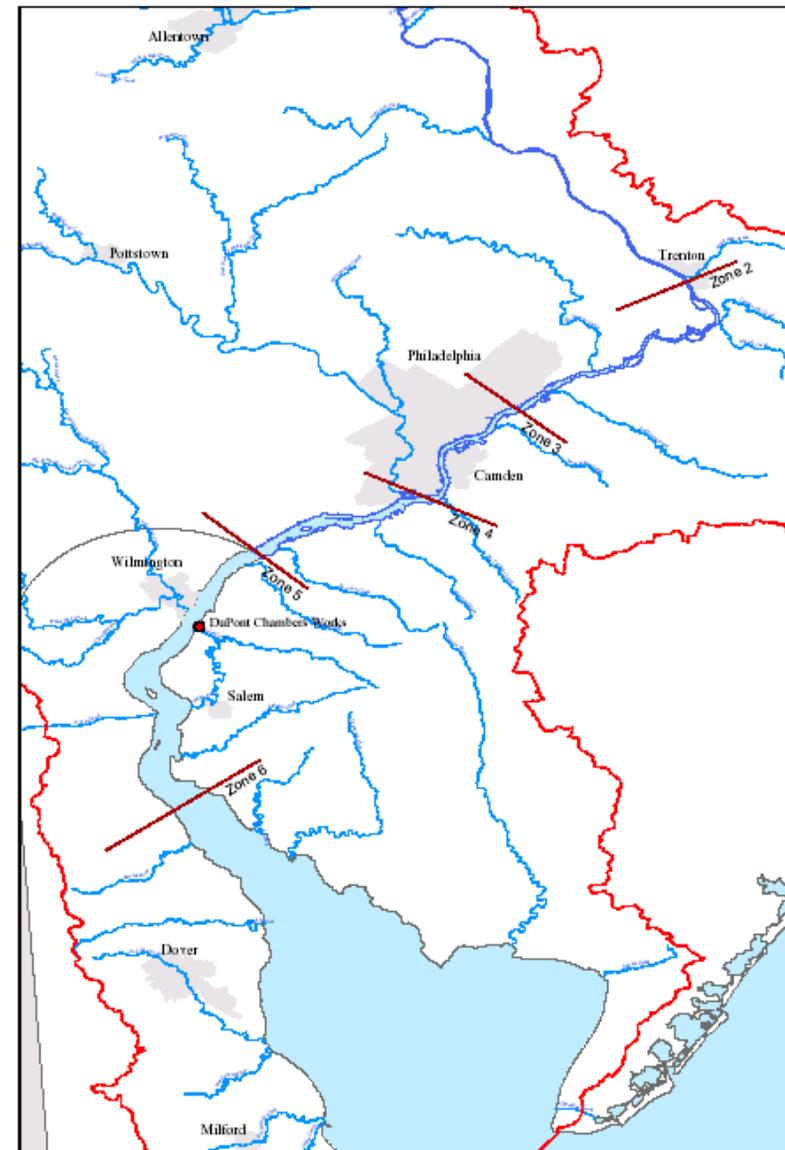
Sitings - Belton, American River Otter

## Unique to the Delaware

- Largest contiguous salt marsh in Northeast
- Shorebird Phenomenon (Red Knot/Horseshoe Crab)
- Coastal Zone Act (1971)

Figure 1

Delaware River Zone Designations



# Management Objectives -DE Estuary

## -CCMP 1996

Restore population levels of finfish and invertebrates - sustainable recreational and commercial fisheries

Restore or maintain populations of birds dependent on the Delaware Estuary

Restore or maintain populations of estuarine-dependent amphibians, reptiles and mammals

Maintain or restore an assemblage of organisms and their habitats throughout the Delaware Estuary

Preserve acreage and enhance quality of shoreline and littoral habitat to sustain balanced natural system

Ensure an adequate supply of freshwater to maintain habitats, distribution of salinity, and human population in 2020.

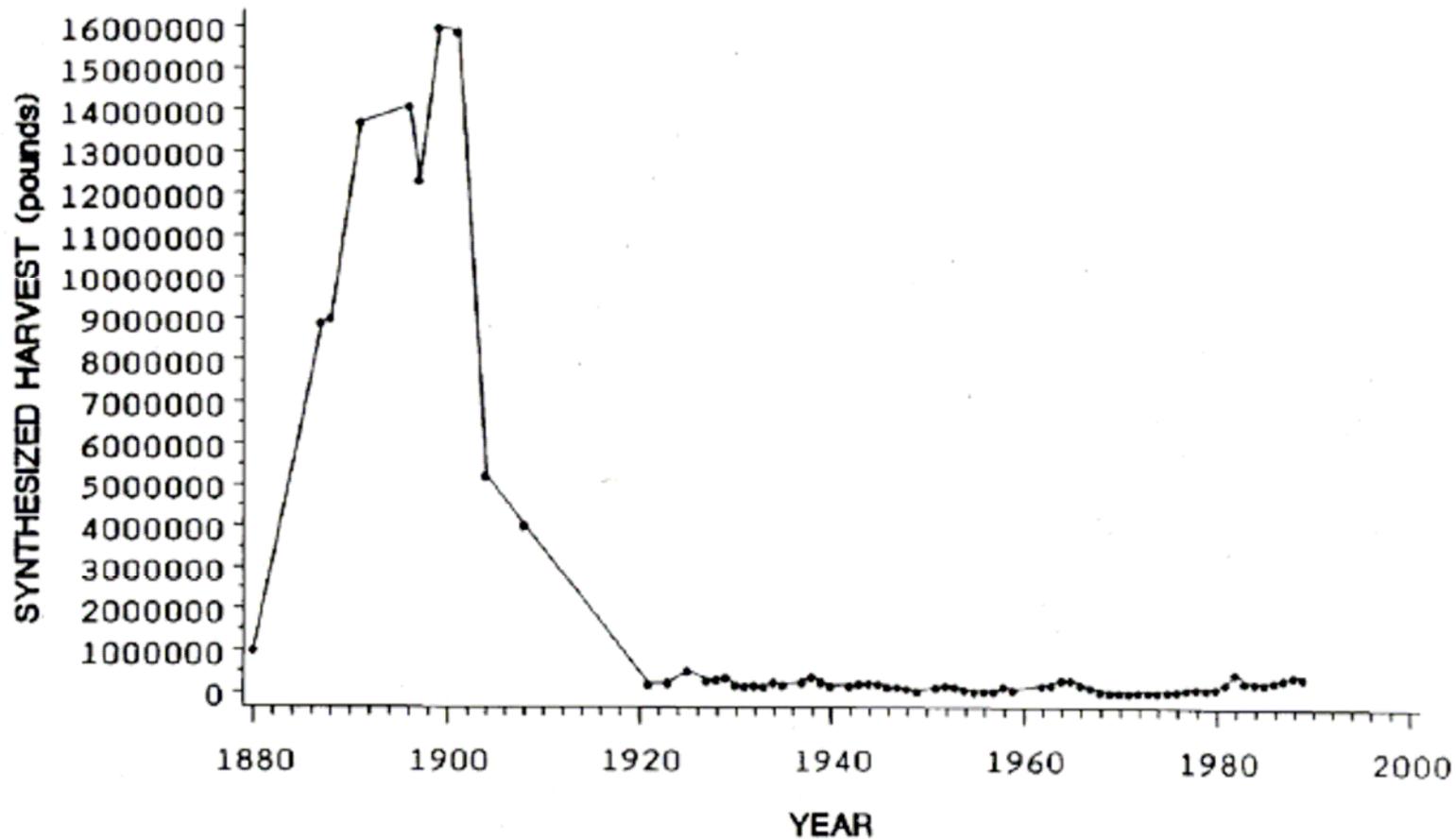
Promote pollution prevention technologies and strategies that protect estuarine resources from point and non-point pollution sources, and if possible, from all types of catastrophic oil or chemical spills.

# PDE - 2006 White Paper

- Emphasizes need for better linkage between science and management actions
- Provides a blueprint for addressing needs
  - **Lists Ten Priority Technical Needs**
    - Contaminants and Substances of Emerging Concern; Tidal Wetlands and Sea Level Rise; Ecologically Significant Species and Critical Habitats; Ecological Flows; Physical-Chemical-Biological Linkages; Food Web Dynamics; Nutrients; Ecosystem Functions; Habitat Restoration and Enhancement; Invasive Species
  - **Lists Six Priority Operational Needs**
    - Science and Management Linkages; Conceptual Framework; Ecosystem Management; Monitoring, Indicators, and Goals; Data Issues; Education and Public Identity

*“PDE intends to lead by facilitating and strengthening science coordination and marshalling resources to address these critical shortcomings”*

# Shad Harvest - Delaware River



*Handwritten notes:*  
Synthesized harvest  
Shad  
Shad

## Example of Physical Stressor - Wetland (Habitat) Loss

TABLE 4-11  
WETLAND LOSS AND CONVERSION AT SPECIFIC SITES ALONG THE DELAWARE ESTUARY

State	River Location	Historic Acreage	Wetland Loss (Acres)	Wetland Conversion (Acres)
Pennsylvania	South Philadelphia (Camden and Philadelphia shores of the Delaware)	3,670	3,670	
Pennsylvania	Tinicum Island (downriver of League Island and south to the mouth of the Schuylkill)	1,510	1,510	
Delaware	Christina River	2,520	2,520	
New Jersey	Woodbury/Mantua Creeks	780	780	
New Jersey	Raccoon/Oldmans Creeks	2,910	2,910	
Delaware	Red Lion - C&D Canal	1,265	1,195	70
Delaware	Killcohook/Artificial Island	2,920	2,330	590

Source:

Wetlands Research Associates (1995)

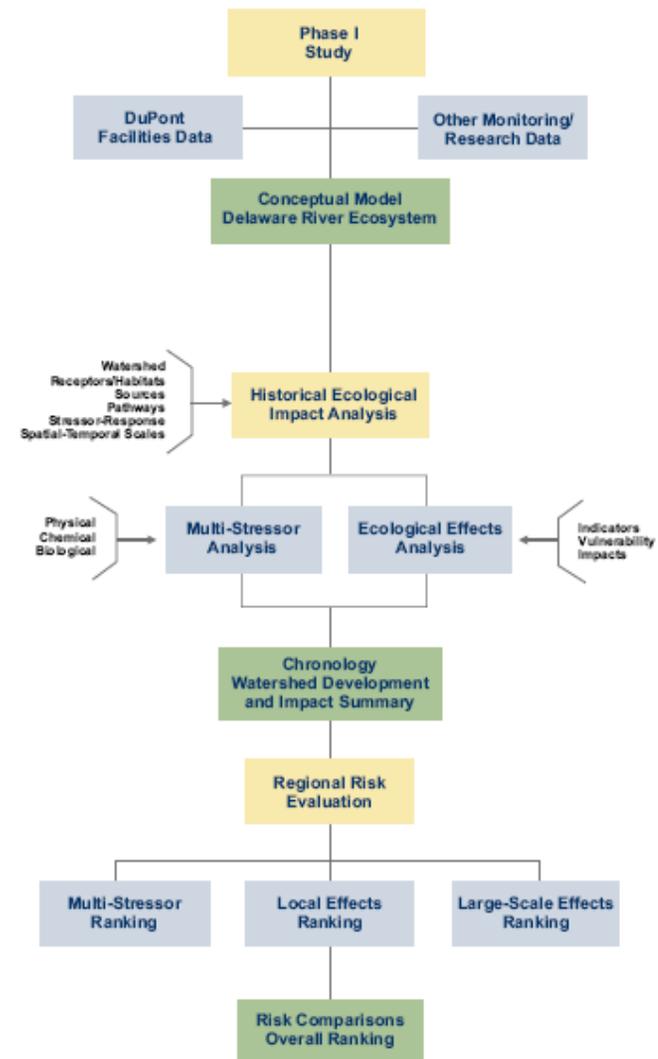
Notes:

Wetland loss consists of acres filled for development, open water, highway, or dredging

Wetland conversion consists of created open water or created tidal areas

# Overall Phase I Study Approach

Historical Ecology  
 Stressor  
 Characterization  
 Regional (or  
 Relative)  
 Assessment



# Applying the RRM - 10 Years of Experience

Human and Ecological Risk Assessment, 13: 25–38, 2007

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DOI: 10.1080/10807030601107536

## REFLECTION

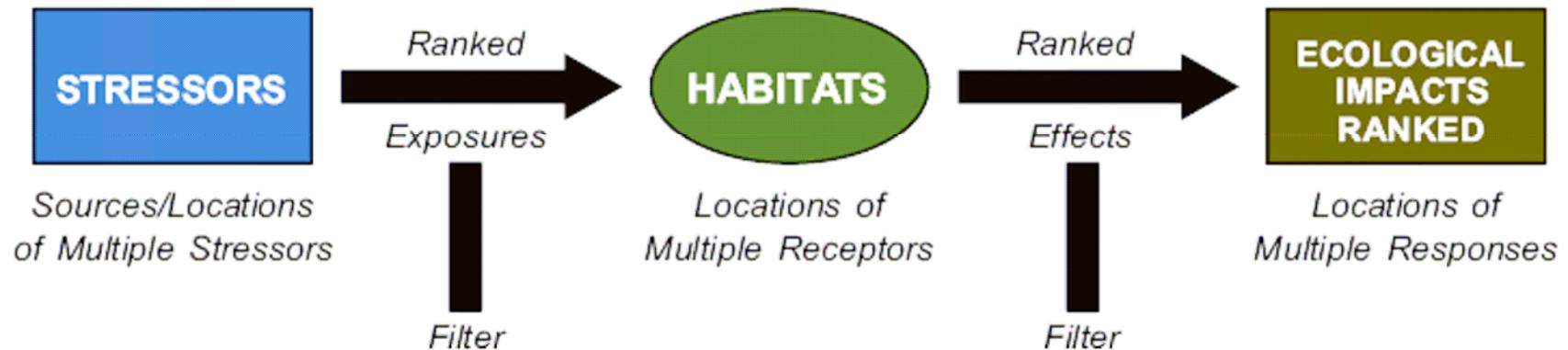
### Ten Years of the Relative Risk Model and Regional Scale Ecological Risk Assessment

Wayne G. Landis<sup>1</sup> and Janice K. Wieggers<sup>2</sup>

<sup>1</sup>Institute of Environmental Toxicology, Huxley College of the Environment, Western Washington University, Bellingham, Washington, USA;

<sup>2</sup>Alaska Department of Environmental Conservation, Fairbanks, Alaska

# Overview of Relative Risk Model Approach



**SOURCE:**  
ADAPTED FROM  
LANDIS AND WIEGERS (2005)

# Stressor Sources -DE Estuary

Dredging

Marine Operations (shipping)

Industrial Discharges

Urban Land Use / Development

Spills / Accidents

Electrical Generation

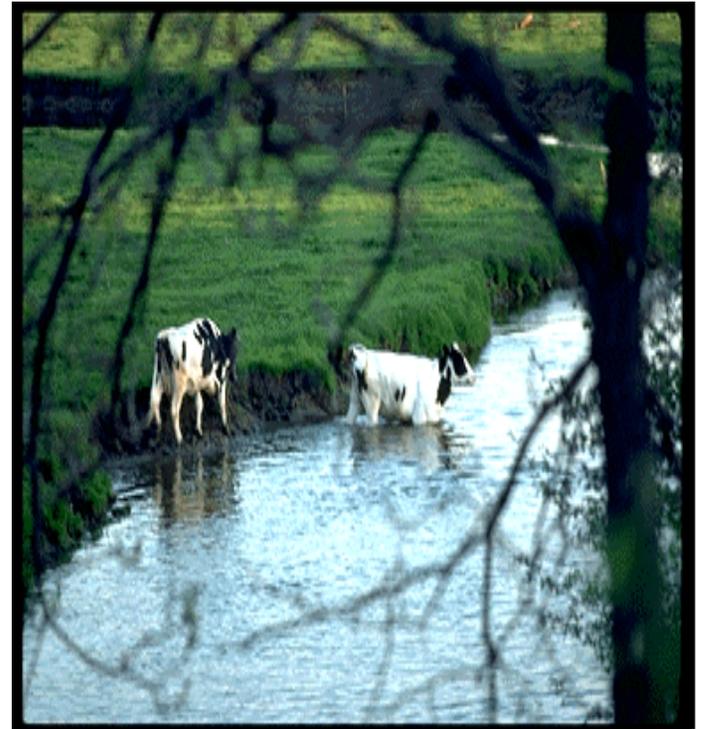
Fishing / Shellfishing / Stock Harvests

Dams and Weirs

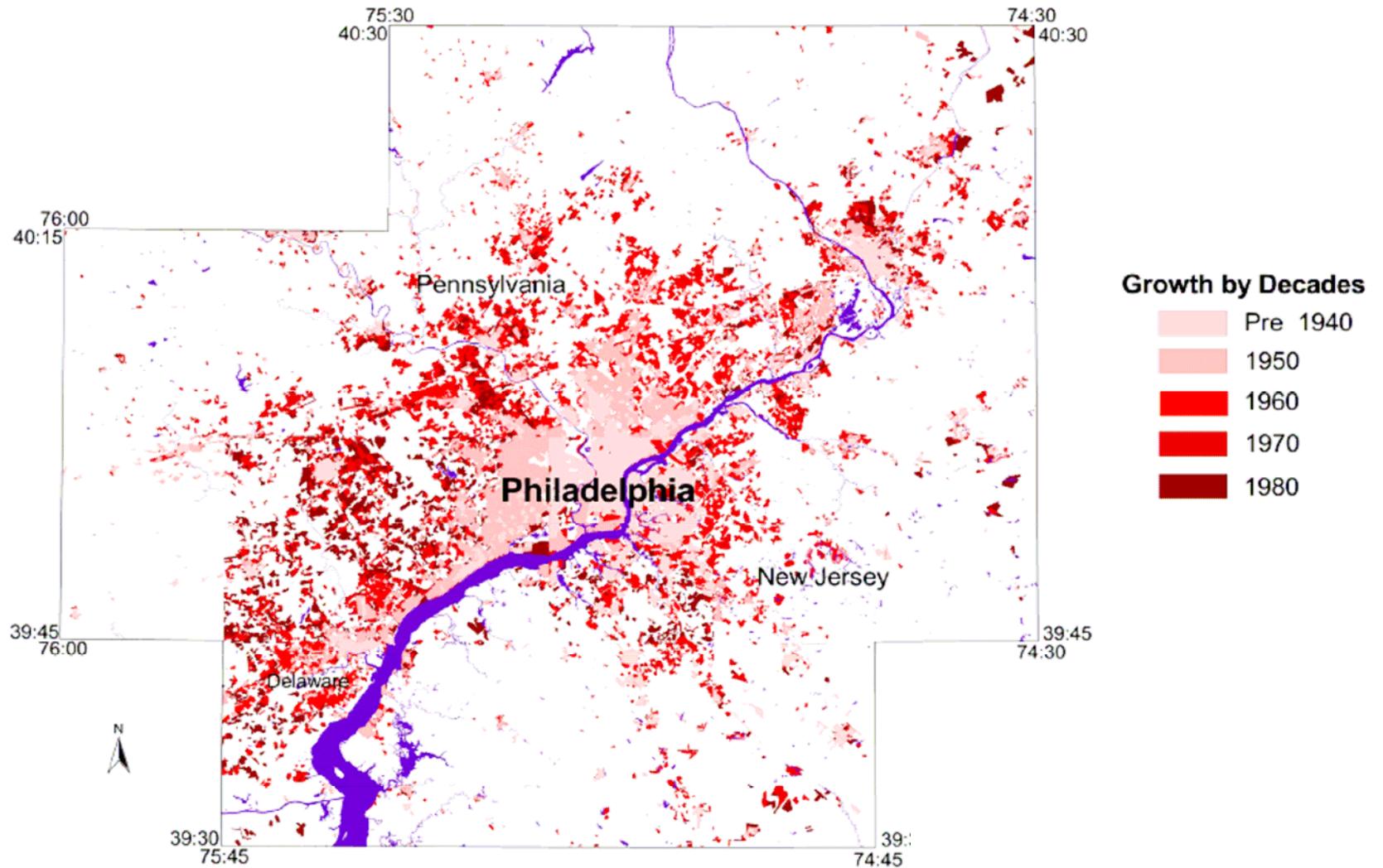
Municipal Discharges

Stormwater

Combined Sewer Overflows



## Urbanization - Key Historical Stressor in the Delaware River Estuary - We Have A Multiple Stressor Issue to Deal With.



# Major Habitat Types in the Delaware Estuary



Ecological Habitat Type	NLCD/ESI Land Cover Categories Included
Benthic Substrates	NA
Intertidal Mudflats & Sandbars	Exposed Tidal Flats
	Sheltered Tidal Flats
Open Water	Open Water
Wetlands	Woody Wetlands
	Emergent Herbaceous Wetlands
Immediately Adjacent Uplands	Agriculture
	Nearshore Upland Forest
	Transitional
	Urban/Recreational Grasses

Sources:

USGS (1992)

NOAA (2002)

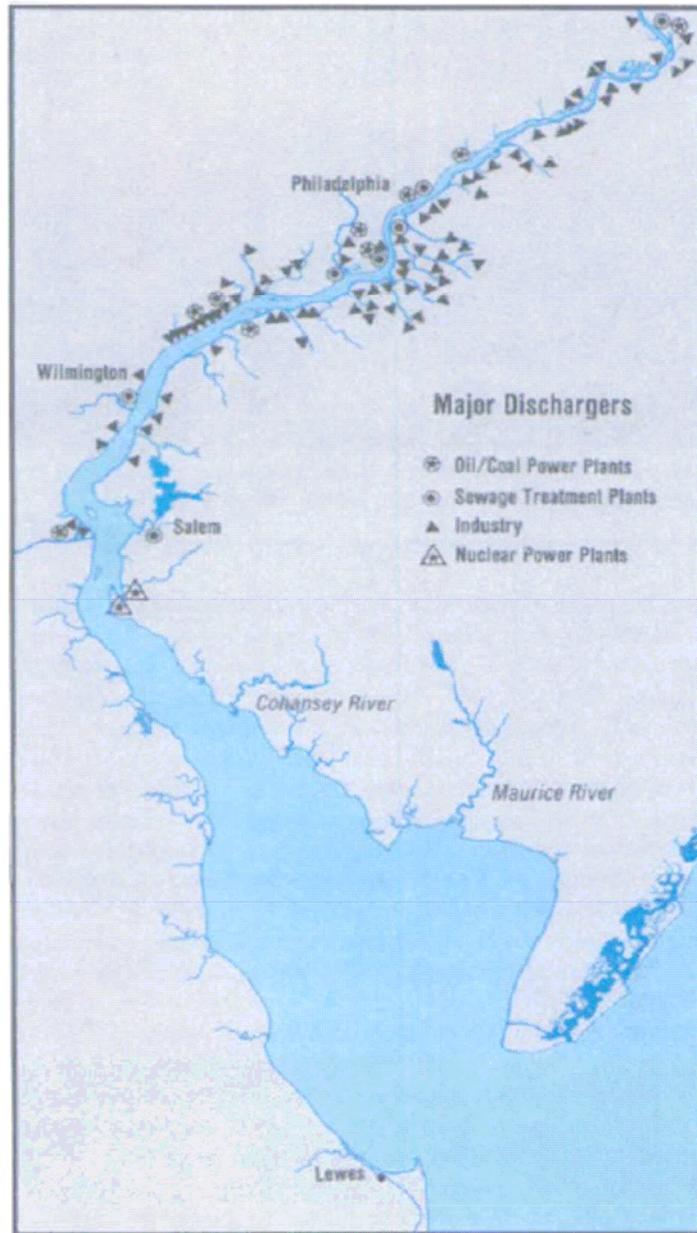
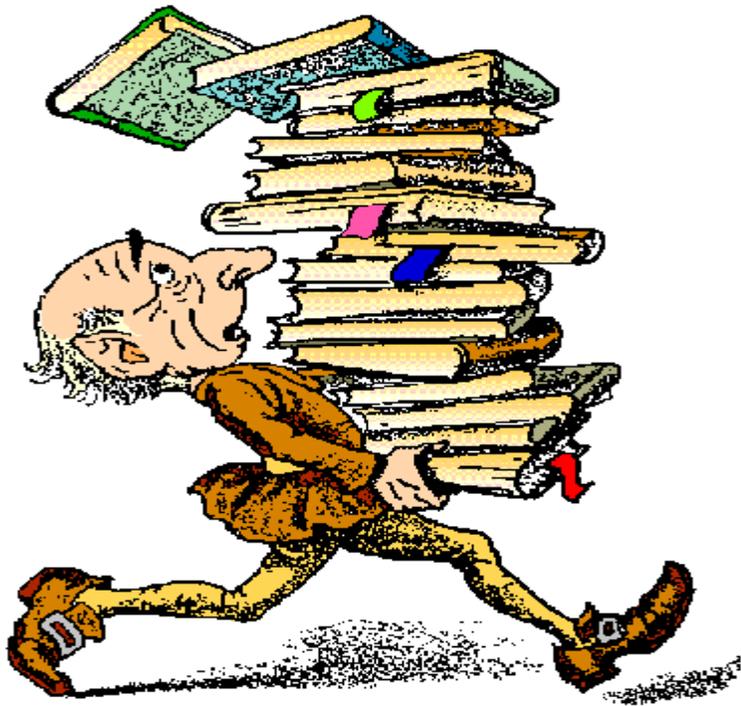
Notes:

NLCD = National Land Cover Dataset

ESI = Environmental Sensitivity Index

NA = Not Applicable

## Major Dischargers: We Have Diverse Source Issues to Deal With



# Why Choose the Relative Risk Model for the Delaware River ?

Allowed us to:

- Follow traditional ERA framework
- Use diverse (and existing) data sets
- Address multiple stressors
- Manage large spatial scale
- Call on experience - used elsewhere inside and out of the US, and on some large water bodies.



# RRM - Latest Large Scale Application

Human and Ecological Risk Assessment, 13: 120–155, 2007  
Copyright © Taylor & Francis Group, LLC  
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DOI: 10.1080/10807030601105076

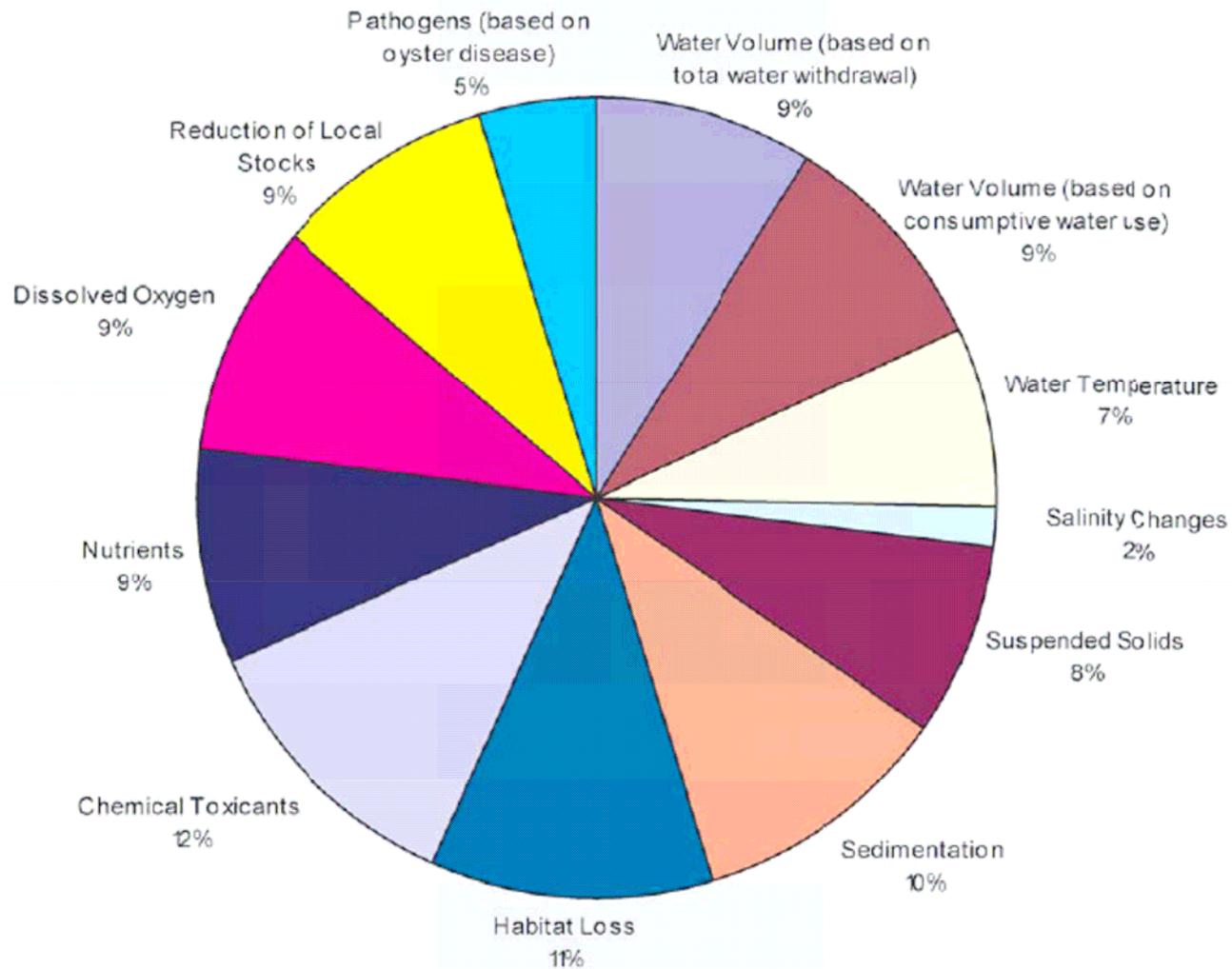
## RESEARCH ARTICLES

### Conceptual Model Development for Invasive Species and a Regional Risk Assessment Case Study: The European Green Crab, *Carcinus maenas*, at Cherry Point, Washington, USA

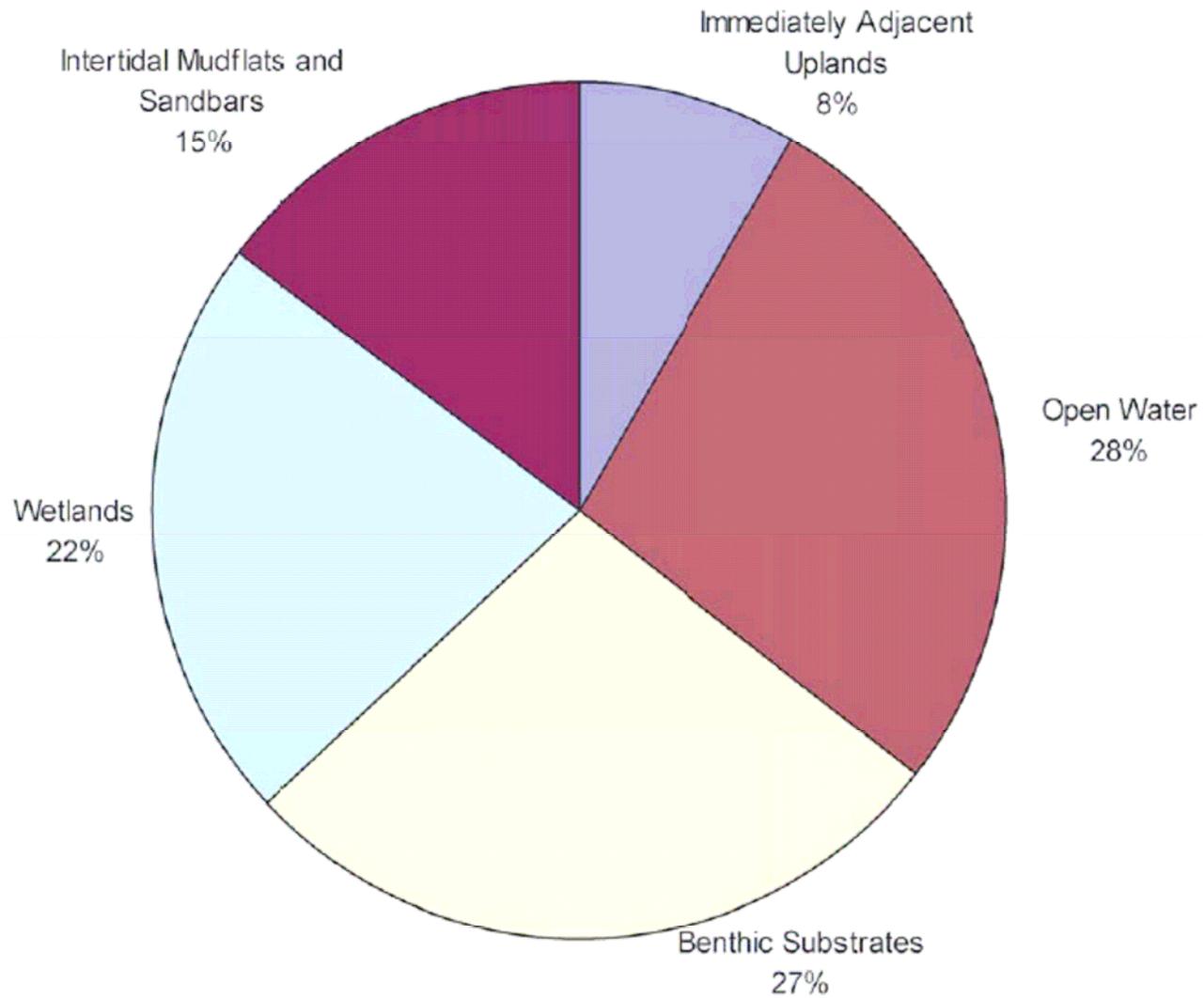
Audrey M. Colnar and Wayne G. Landis

Institute of Environmental Toxicology and Chemistry, Huxley College of the  
Environment, Western Washington University, Bellingham, Washington, USA

# Percent Relative Risk to the Delaware Estuary by Stressor



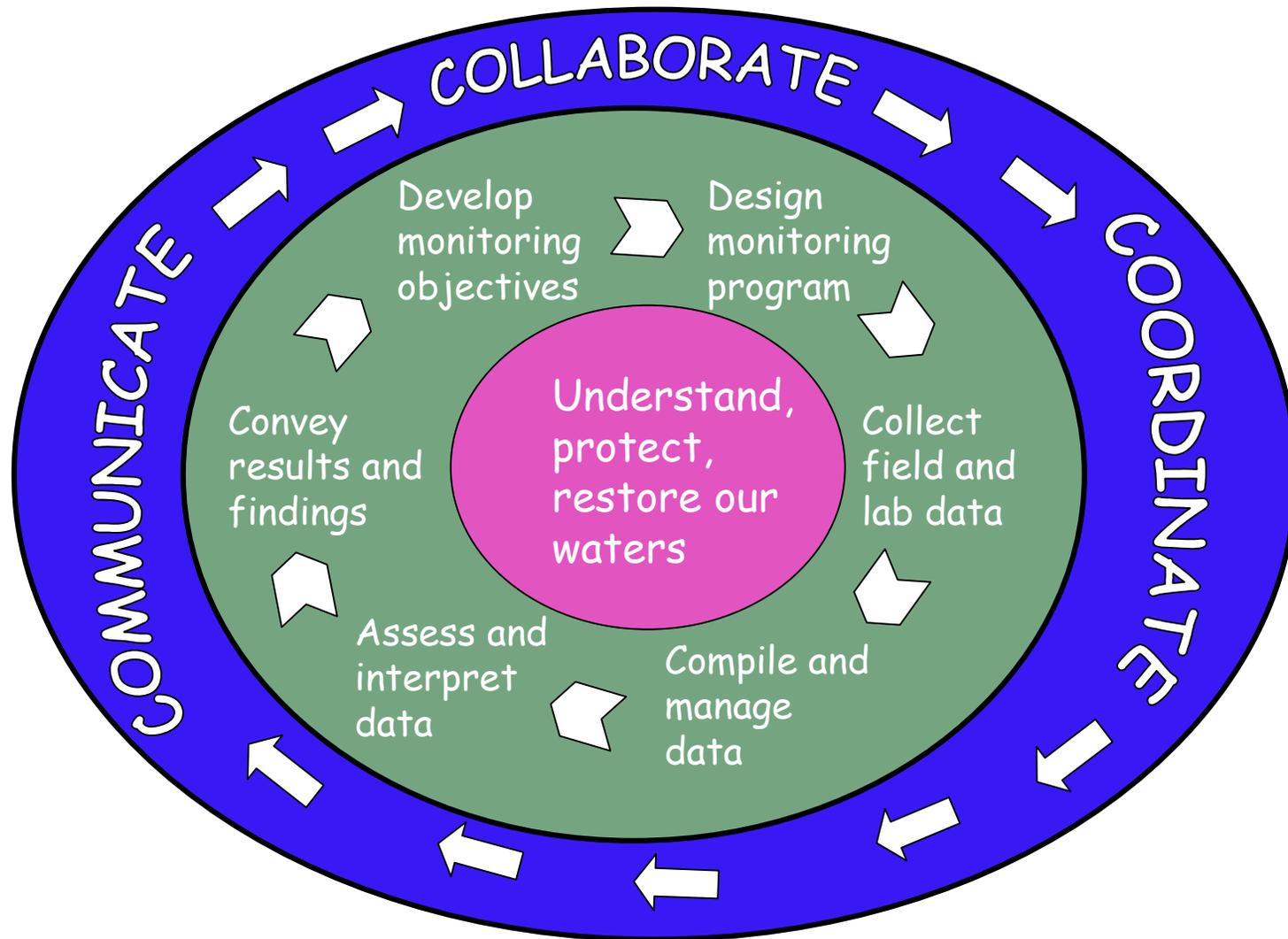
# Percent Relative Risk by Habitat Type



# Partnership for the Delaware Est. - CCMP

- Comprehensive Conservation and Management Plan
  - Delaware Estuary Vision 2020
    - *"A watershed approach to management that values interconnected habitats, preserved land, and planned efforts to protect and enhance the Estuary's natural resources, while maintaining the economic viability of the region".*
    - Environmental and economic improvements, increased public education....
  - Six Action Plans
    - Land Management, Water Use Management, Habitat and Living Resources, Toxics Action, Education and Involvement, Monitoring, and Regional Information Management Service
  - CCMP currently being revised

## Step 2: 2008 - 2012



## Summary

The public and private sector will need to work collaboratively to address problems in the Delaware Estuary.

The public is a key member of any multistakeholder effort.

The role of the scientific community is to provide the scientific data to inform decisions.

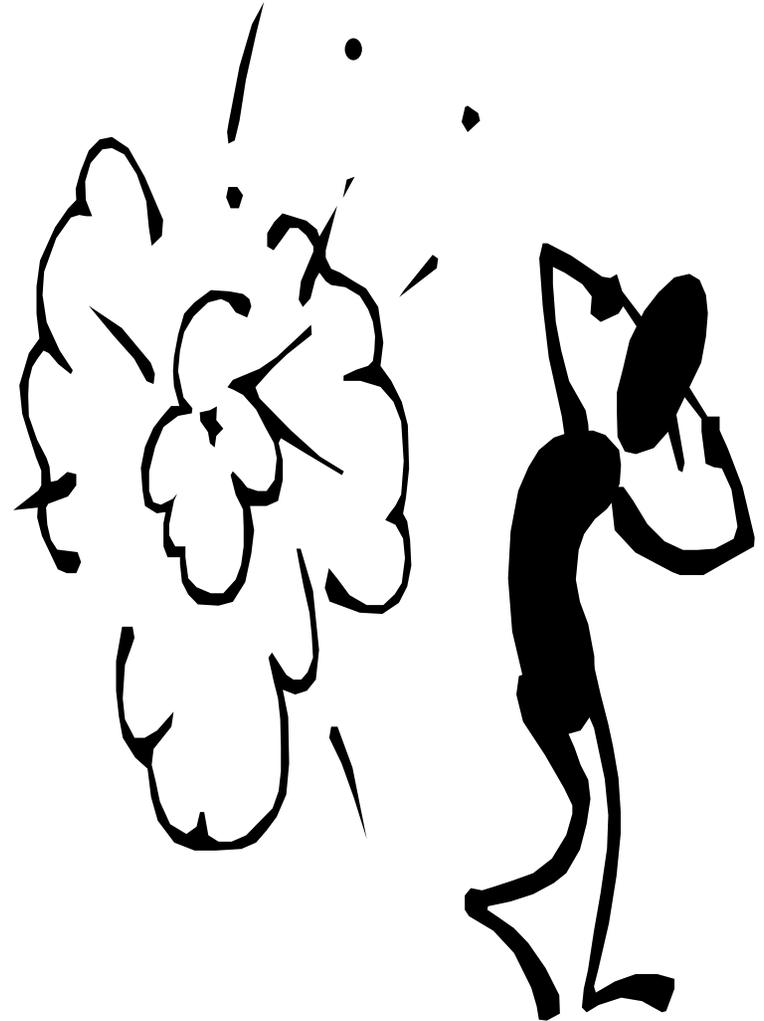
Goals and objectives must be specific, measurable, achievable, realistic and timely.

Management actions and policy decisions should be monitored, and should be revised if they do not achieve the desired outcome(s).

All involved must be held accountable for meeting goals and expectations.

## Risks & Uncertainties

- Unable to build support for collaborative approach
  - Industry, Government, NGOs, Others
- Unending struggle with “Leadership”
- Unable to sustain interest, funding, and or sweat- equity
- Conflict over regulatory framework, drivers
  - CERCLA, RCRA, CWA, NRDA



# Next Steps

Identify and prioritize regional and local data gaps

Continue to engage academic, environmental and regulatory communities

Support collaborative effort to develop a watershed / ecosystem-level, adaptive approach

data gaps, restoration projects, etc.



# Discussion



A DUPONT DELAWARE  
ESTUARY INITIATIVE

[Http://www.clearintothefuture.com](http://www.clearintothefuture.com)