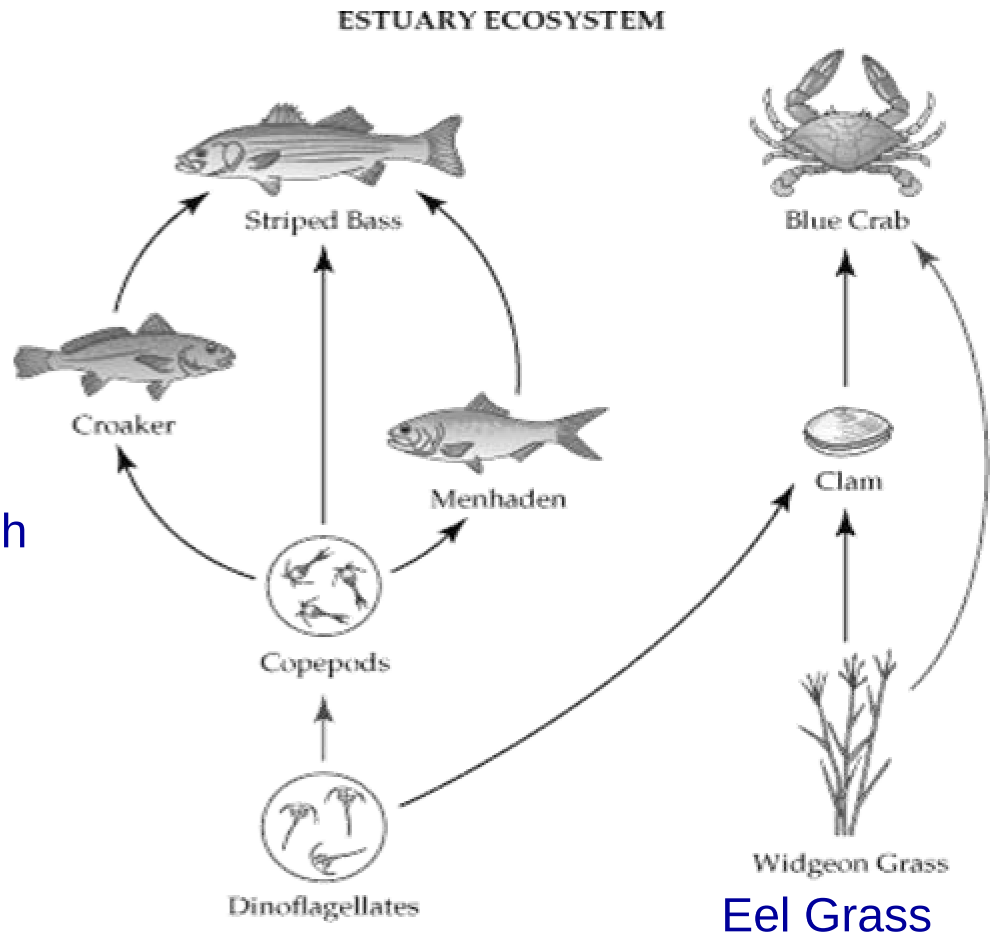

Barnegat Bay Action Plan
Comprehensive Research
Gary A. Buchanan, Ph.D.
NJDEP
Office of Science
September 29, 2011

Governor's Comprehensive Plan of Action

- Welcome!!
- 10 point plan http://www.nj.gov/dep/barnegatbay/
- Number 9: Producing more Comprehensive Research
  - Support water quality improvement (nutrient criteria)
  - Establish the baseline conditions of the bay
  - Fill in critical data gaps
  - Advance habitat restoration on the Bay

Generic Estuarine Ecosystem



Jellyfish

Eel Grass

Benthic Invertebrates

Status – September 2011

- Budget approval for $1.2M for FY12
- 10 Research Projects
- Contracting underway
- Projects start in October??
- Three years of research planned

Research Projects

1. Benthic Invertebrate Community Monitoring and Indicator Development for the Barnegat Bay-Little Egg Harbor Estuary (nutrient criteria)

2. Barnegat Bay Diatom Nutrient Inference Model (nutrient criteria)

3. Benthic-Pelagic Coupling: Hard Clams as Indicators of Suspended Particulates in the Barnegat Bay

Research Projects

4. Assessment of Fishes and Crabs Responses to Human Alteration of Barnegat Bay.

5. Assessment of the Distribution and Abundance of Stinging Sea Nettles (Jellyfishes) in Barnegat Bay

6. Baseline Characterization of Phytoplankton and Harmful Algal Blooms

Research Projects

7. Baseline Characterization of Zooplankton in Barnegat Bay

8. Multi-Trophic Level Modeling of Barnegat Bay

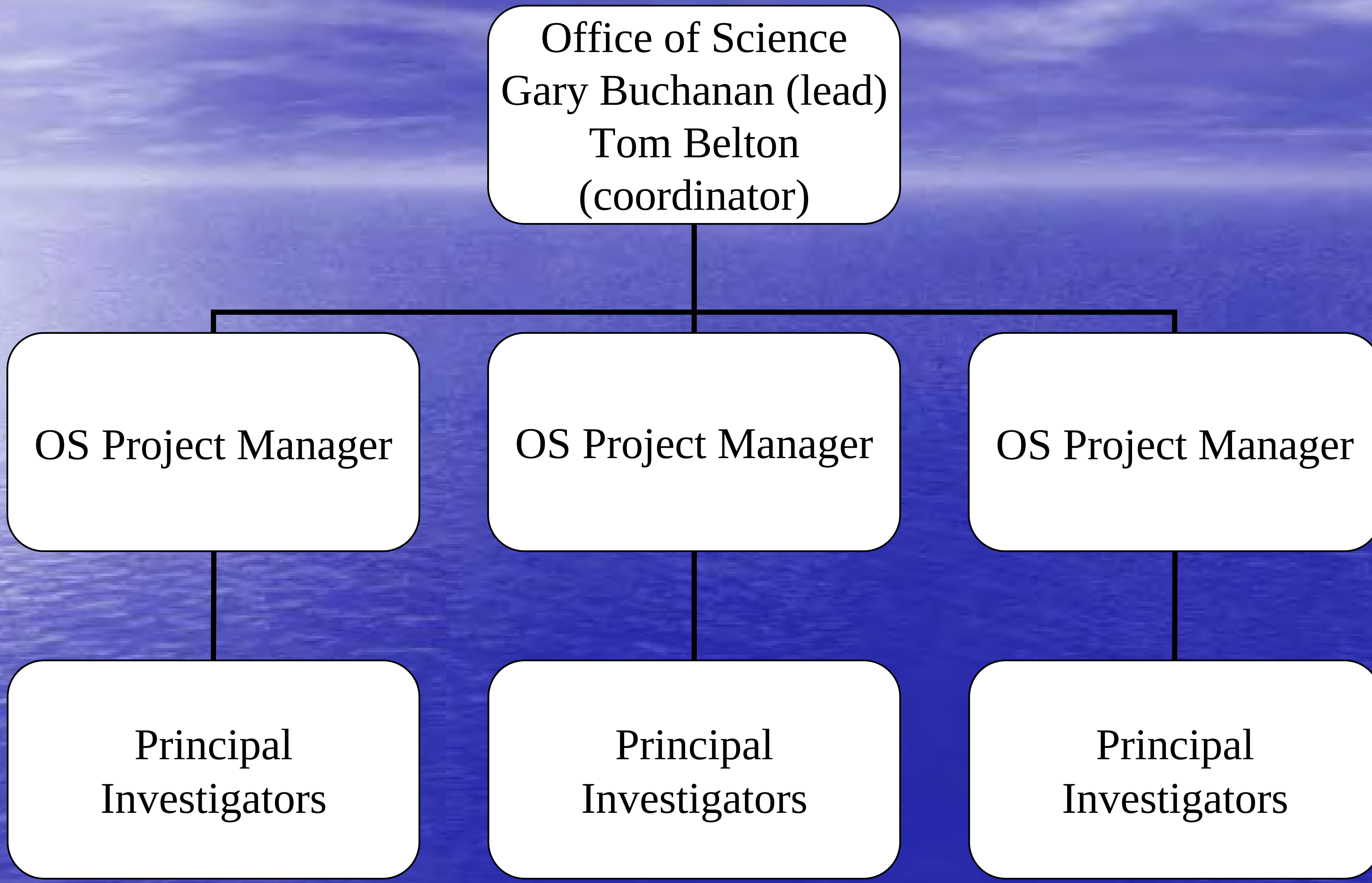
9. Tidal Freshwater and Salt Marsh Wetland Studies of Changing Ecological Function and Adaptation Strategies

10. Ecological Evaluation of Sedge Island Marine Conservation Area in Barnegat Bay

BARNEGAT BAY COMPREHENSIVE RESEARCH - OBJECTIVES

	Research Project (in order of priority)	Nutrient Bio-Criteria	TMDL	Power Plant	Tourism & Recreation	Food Safety	Comprehensive/ Baseline/Data Gaps
1	Benthic Invertebrate Community Monitoring and Indicator Development for Barnegat Bay.	X	X	X			X
2	Nutrient and Ecological Histories of Barnegat Bay	X	X				X
3	Assessment of Hard Clam Populations in Barnegat Bay			X	X		X
4	Assessment of Fishes and Crabs Responses to Human Alteration of Barnegat Bay.			X	X		X
5	Assessment of the Distribution and Abundance of Stinging Sea Nettles (Jellyfishes) in Barnegat Bay			X	X		X
6	Baseline Characterization of Phytoplankton Communities and Harmful Algal Blooms (HABs)	X	X		X	X	X
7	Baseline Characterization of Zooplankton Communities	X	X	X			X
8	Multi-Trophic Level Modeling of Barnegat Bay			X	X		X
9	Tidal Freshwater and Salt Marsh Wetland Studies of Changing Ecological Function and Adaptation Strategies				X		X
10	Ecological Evaluation of Sedge Island Marine Conservation Area in Barnegat Bay				X		X

Change in Barnegat Bay Land Use at Forked River and Oyster Creek (1931 and 2011)


Office of Science
Gary Buchanan (lead)
Tom Belton
(coordinator)
OS Project Manager
OS Project Manager
OS Project Manager
Principal Investigators
Principal Investigators
Principal Investigators

Research Project	Principal Investigators/Affiliation	Office of Science Project Managers	NJDEP Program Contact
1. Benthic Invertebrate Community Monitoring and Indicator Development for Barnegat Bay-Little Egg Harbor Estuary	Gary L. Taghon, Judith P. Grassle, Charlotte M. Fuller & Rosemarie F. Petrecca, Rutgers University, IMCS	**Tom Belton**	Bob Schuster
2. Barnegat Bay Diatom Nutrient Inference Model	Mihaela Enache & Donald Charles, NJ Sea Grant Consortium: The Academy of Natural Sciences	**Tom Belton**	Kevin Berry
3. Benthic-Pelagic Coupling: Hard Clams as Indicators of Suspended Particulates in the Barnegat Bay	V. Monica Bricelj, Rutgers University, Institute of Marine and Coastal Sciences	**Bruce Ruppel**	Mike Celestino
4. Assessment of Fishes and Crabs Responses to Human Alteration of Barnegat Bay.	Kenneth W. Able and Paul Jivoff, Rutgers University and Rider University	**Bruce Ruppel & Gary Buchanan**	Brandon Muffley
5. Assessment of the Distribution and Abundance of Stinging Sea Nettles (Jellyfishes) in Barnegat Bay	Paul Bologna and John Gaynor, Montclair State University	**Joe Bilinski**	Bruce Friedman
6. Baseline Characterization of Phytoplankton and Harmful Algal Blooms	Ling Ren, NJ Sea Grant Consortium: The Academy of Natural Sciences	**Bob Hazen & Gary Buchanan**	Bob Schuster
7. Baseline Characterization of Zooplankton in Barnegat Bay	John Tiedemann & Jim Nickels, Monmouth University and Tom Noji, National Marine Fisheries Service	**Bob Hazen & Gary Buchanan**	Bob Schuster
8. Multi-Trophic Level Modeling of Barnegat Bay	Olaf Jensen and Heidi Fuchs, Rutgers, IMCS	**Tom Belton**	Brandon Muffley
9. Tidal Freshwater and Salt Marsh Wetland Studies of Changing Ecological Function and Adaptation Strategies	David Velinsky and Tracy Quirk, NJ Sea Grant Consortium: The Academy of Natural Sciences	**Bob Hazen & Tom Belton**	Ginger Kopkash
10. Ecological Evaluation of Sedge Island Marine Conservation Area in Barnegat Bay	Paul Jivoff, Rider University - NJ Sea Grant Consortium	**Joe Bilinski**	Terry Caruso

http://www.state.nj.us/dep/dsr/barnegat/bibliography.htm

View Favorites Tools Help

NJDEP - Barnegat Bay - Bibliography by First ...

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Office of Science

Office of Science Home

A Selected Bibliography of Ecological and Land Use Studies of Barnegat Bay

Return to Office of Science - Barnegat Bay

Bibliography by year - please click here | Bibliography by category - please click here.

Alphabetical order by first author

Blue text indicates a DEP link -
Green text indicates that this link will be leaving the DEP web site.

Able KW, Fahay MP. (2011). Ecology of Estuarine Fishes: Temperate Waters of the Western North Altantic. Baltimore, MD: The Johns Hopkins University Press.

Able KW, Grothues TM. (2007). Diversity of estuarine movements of striped bass (Morone saxatilis): a synoptic examination of an estuarine system in southern New Jersey. Fishery Bulletin;105(3):426-435.

Contacts

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  - 609-984-6070

- Thomas.Belton@dep.state.nj.us
  - 609-633-3866

Barnegat Bay Water Quality Monitoring Update and Next Steps

NJDEP Water Monitoring and Standards
Jill Lipoti, PhD

Purpose of the Barnegat Bay Water Quality Monitoring Program

- Determine the locations and extent of water quality impairments
- Identify numeric criteria or loading targets for nutrients to guide restoration endpoints
- Calibrate and validate modeling tools that can be used to direct water quality restoration and/or TMDL development for the bay

Barnegat Bay Monitoring Plan Components

- Phase 1 (June-December 2011)
  - Grab water quality sampling
  - Flow monitoring
  - Continuous in-situ water quality monitoring (to be deployed soon)

- Phase 2 (January 2012- ?)
  - WQ Modeling needs
    - Bathymetric survey
    - Two intensive sampling events
    - Others (sediment flux, sediment resuspension measurement, etc.)
  - Sediment Assessment
    - Chemical analysis
    - Toxicity Test

Barnegat Bay Monitoring Plan Summary

- Fresh Water Tributaries
  - 13 water quality grab sample locations at major tribs
  - 3 new flow stations in addition to 3 existing ones
  - Continuous WQ monitoring at Toms River gaging station
- In Bay Water Quality
  - 1 fixed continuous WQ monitoring station at Mantoloking
  - 4 to 6 (phase 1/phase 2) in bay continuous water quality buoys
  - 14 in bay water quality grab sample locations
- In Bay Flow Monitoring
  - 3 continuous flow stations at ocean inlets
  - 3 in bay continuous flow stations
- Bathymetry Survey

The Partner Approach

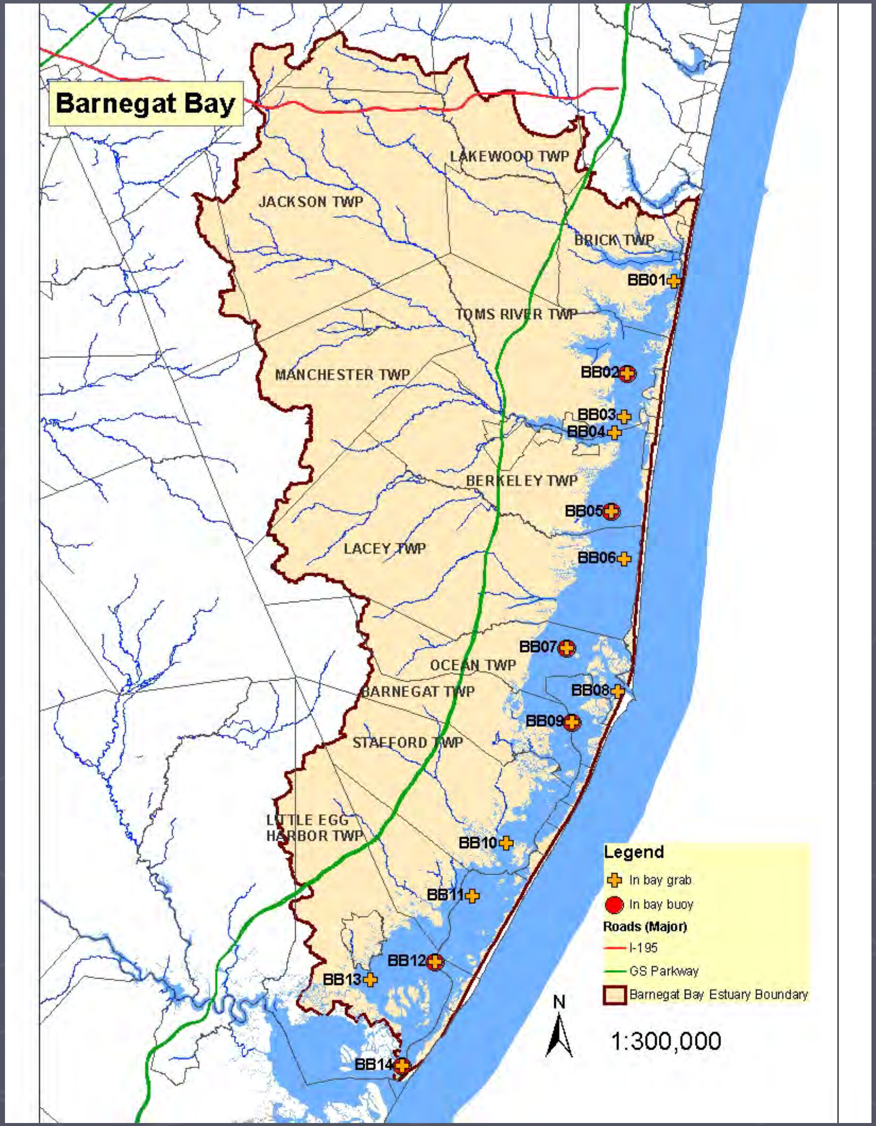
- The sampling program utilizes the assistance of 9 partner organization
  - BBP, EPA, Brick Twp MUA, OCHD, Pinelands Commission, USGS, OCMUA, Monmouth Univ, MATES
- Water quality samples are collected and delivered to 2 field laboratories for filtration and preservation
  - LEEDS Point Laboratory
  - FREC
- Preserved samples are transported to 4 laboratories for analysis
  - Nutrients, Solids Chlorophyll-LEEDS Point
  - BOD- OCUA
  - Si, Carbon (FW) Alkalinity-EPA Edison
  - Carbon(SW)- Maryland University Laboratory

Freshwater Tributaries Stations BT1-BT13

- 13 Water Quality Stations
  - Field Parameters-
    - Temp, DO, DO Sat, pH, Specific Conductance, Turbidity
  - Laboratory Parameters-
    - TSS, BOD5, CBOD5, CBOD20, Dissolved and Total Nutrients, Alkalinity, Silica, TOC, DOC

In Bay
Stations BB01-BB14

- 14 Water Quality Stations
  - Field Parameters-
    - Temp, DO, DO Sat, pH, Specific Conductance, Turbidity, Transmissionmetry, Salinity, Secchi Depth
  - Laboratory Parameters
    - TSS, Chlorophyll a, BOD5, CBOD5, CBOD20, Dissolved and Total Nutrients, Alkalinity, Silica, TOC, DOC



- 4-6 continuous water quality buoys

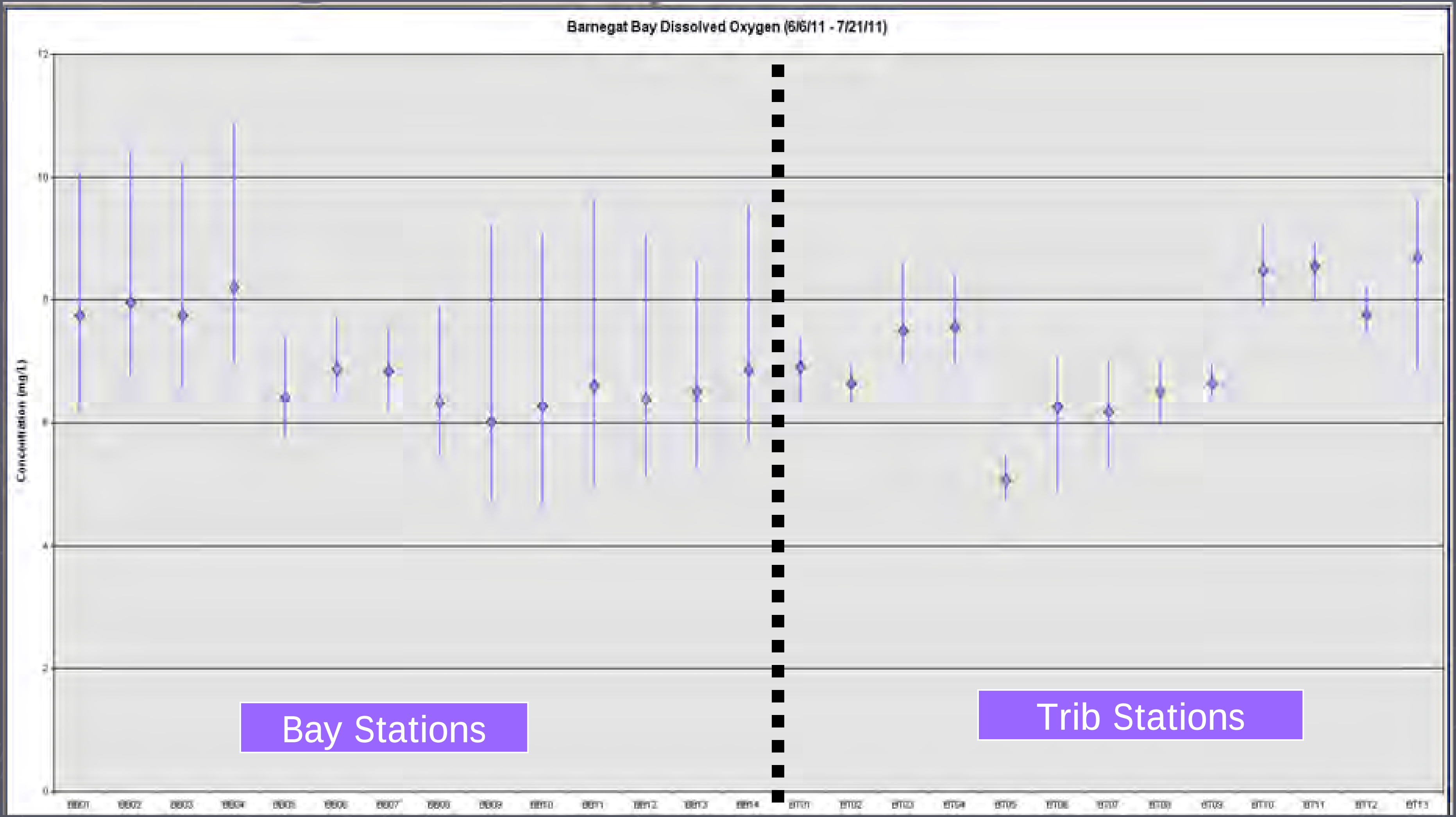
Phase 1 Status

- Phase 1 -June-December 2011
  - Continuous in-situ water quality monitoring
    - NJDEP in the process of purchasing 4 new buoys
  - Grab water quality sampling
    - 7 sampling events completed to date
    - 5 more events scheduled until end of year
    - Next event scheduled for 10/13/2011
  - Macroinvertebrate monitoring has been added
    - 11 of 13 monitoring locations
  - Flow monitoring-
    - All 3 new tributary gage stations built and running
    - Toms River
      - Continuous water quality installed
      - nitrate probe approx mid November
    - Mantoloking chlorophyll a probe approx mid November

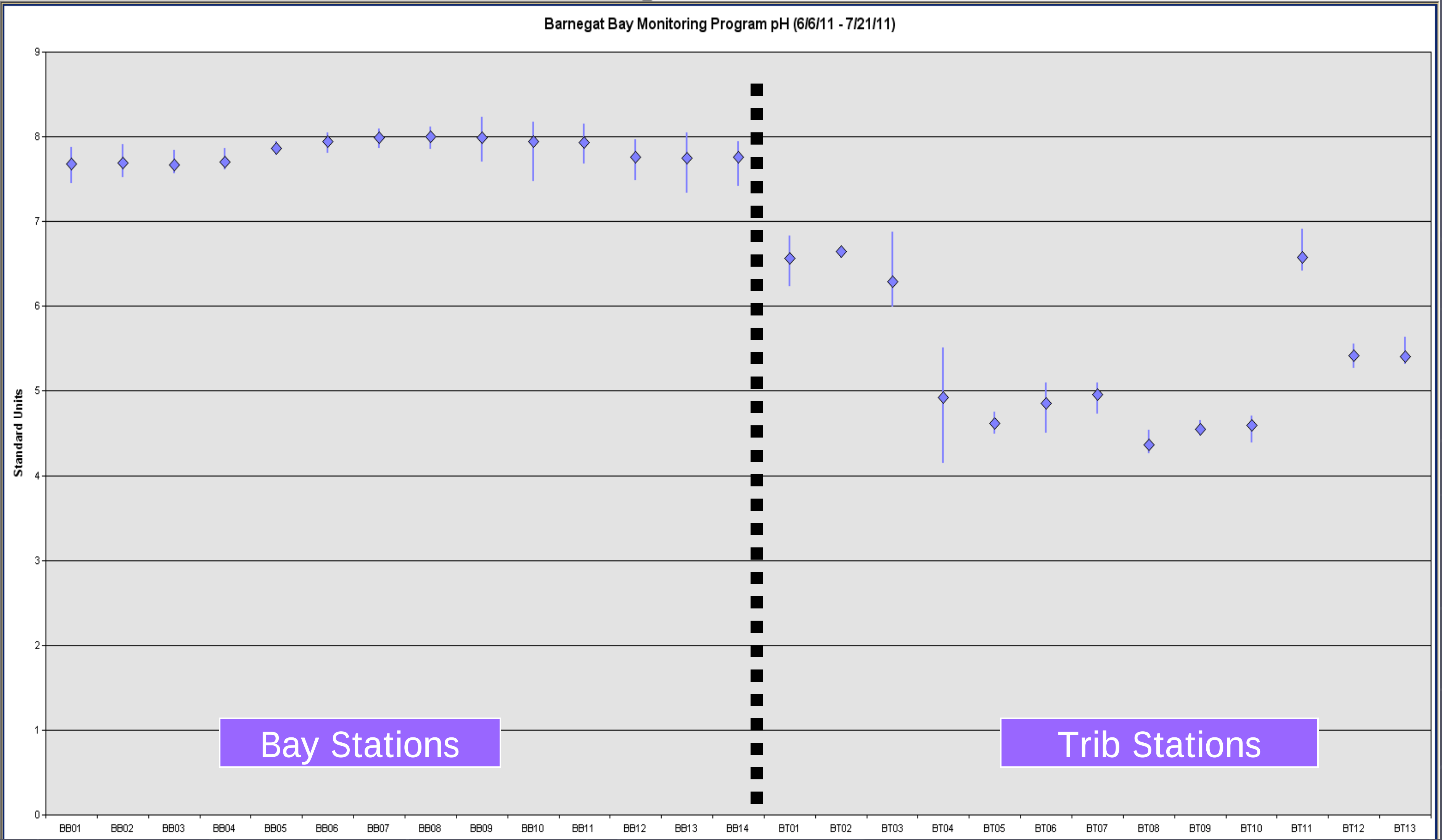
Phase 1 Published Data

- Field Parameters
  - Results from 4 sampling events
- Laboratory Parameters
  - Nutrients, Solids, Chlorophyll
    - 3 sampling events
  - BOD
    - 3 sampling events
  - Alkalinity, Carbon and Silica
    - 1 sampling event

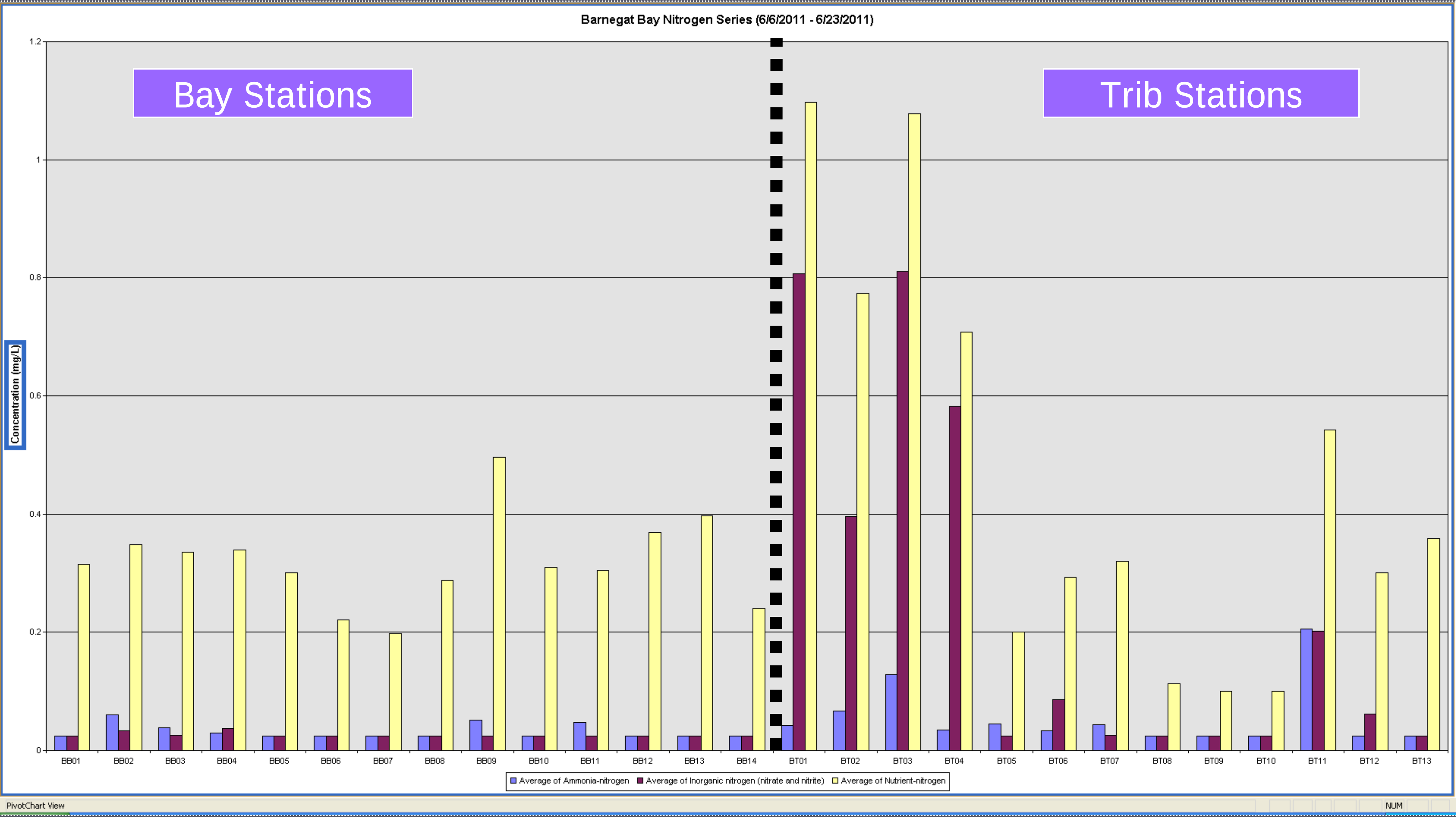
Phase 1 Data -
Dissolved Oxygen (Min/Max/Avg)

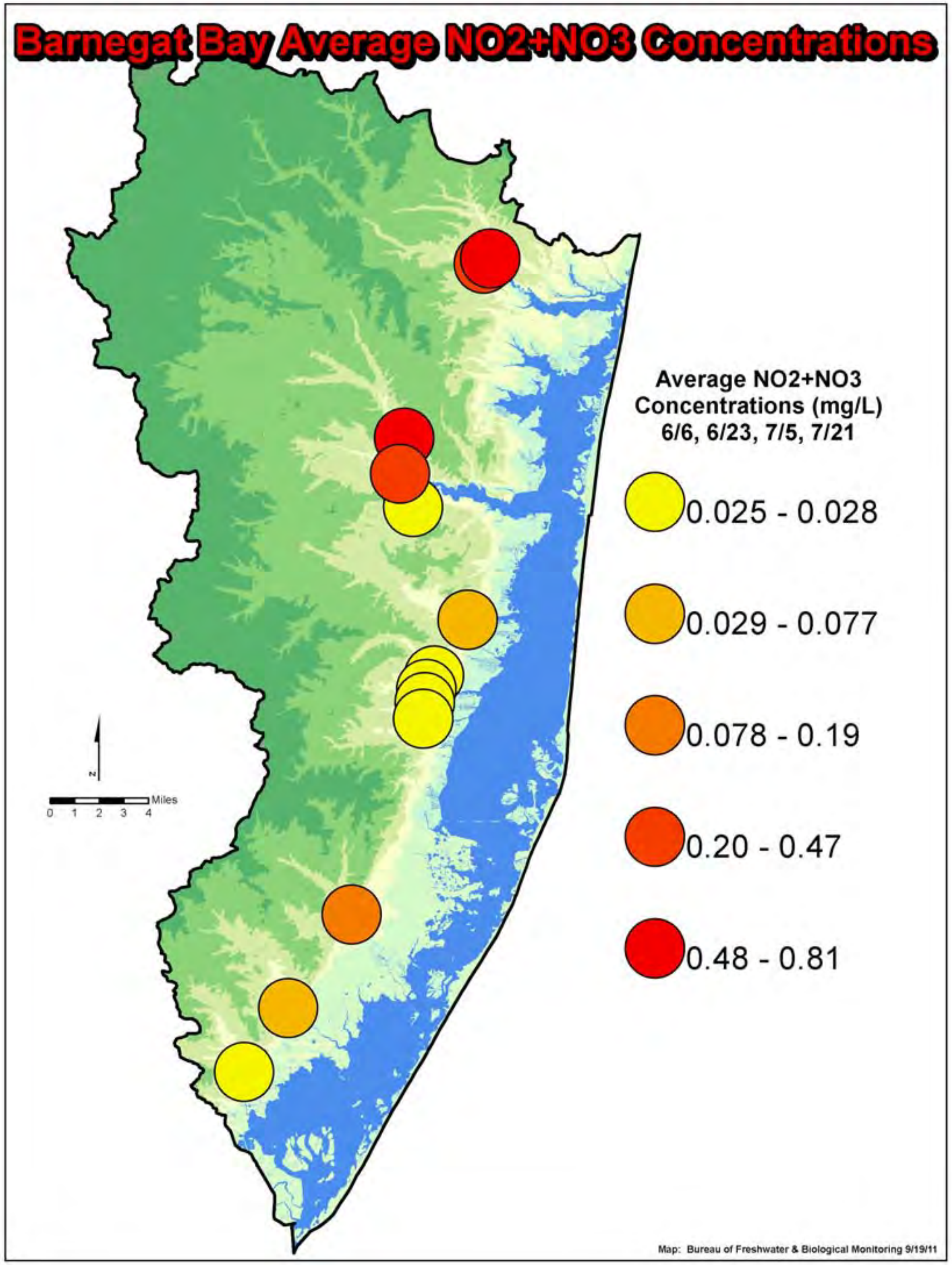


Phase 1 Data - pH (Min/Max/Avg)



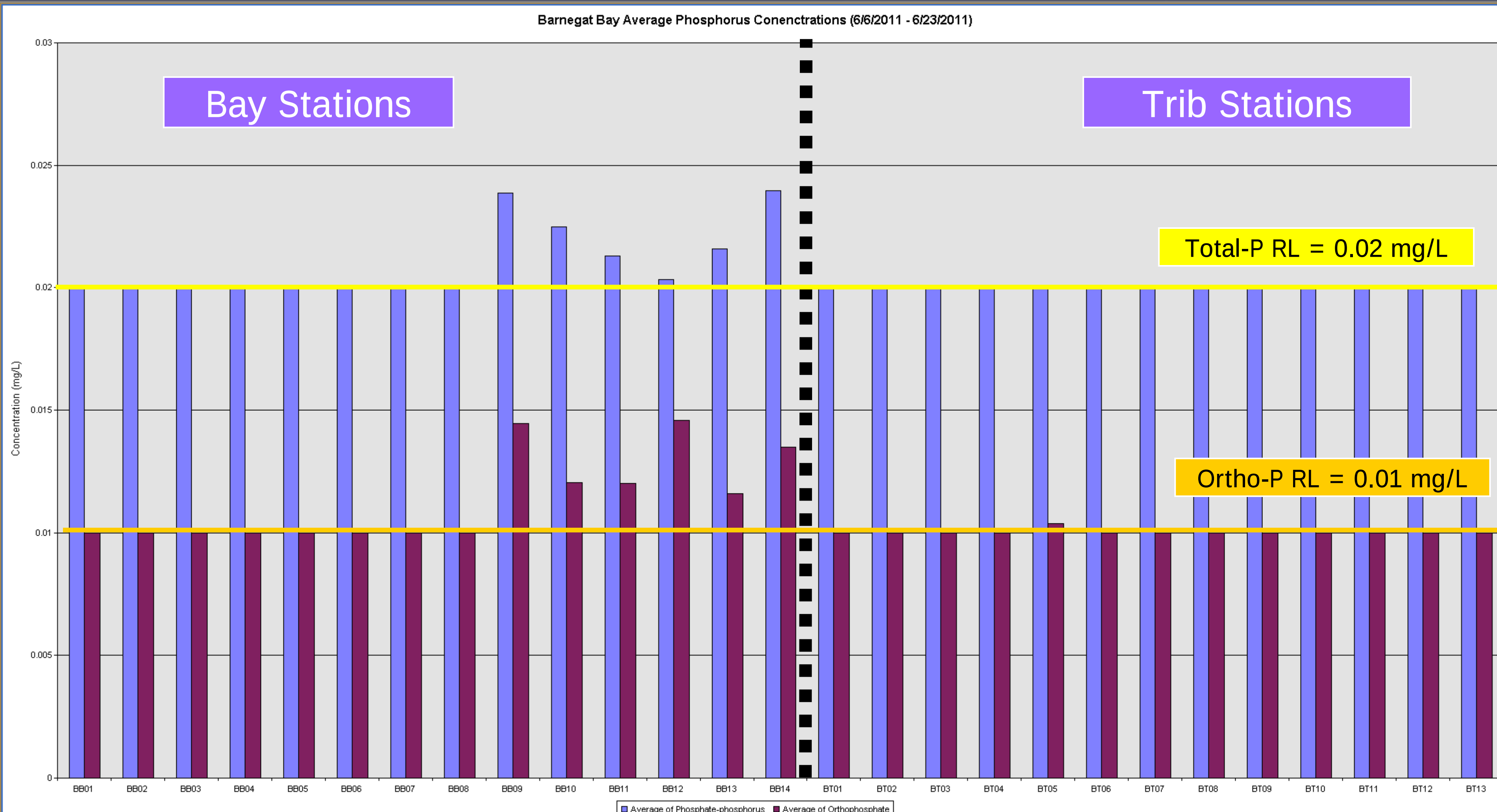
Phase 1 Data – Average Nitrogen Concentrations



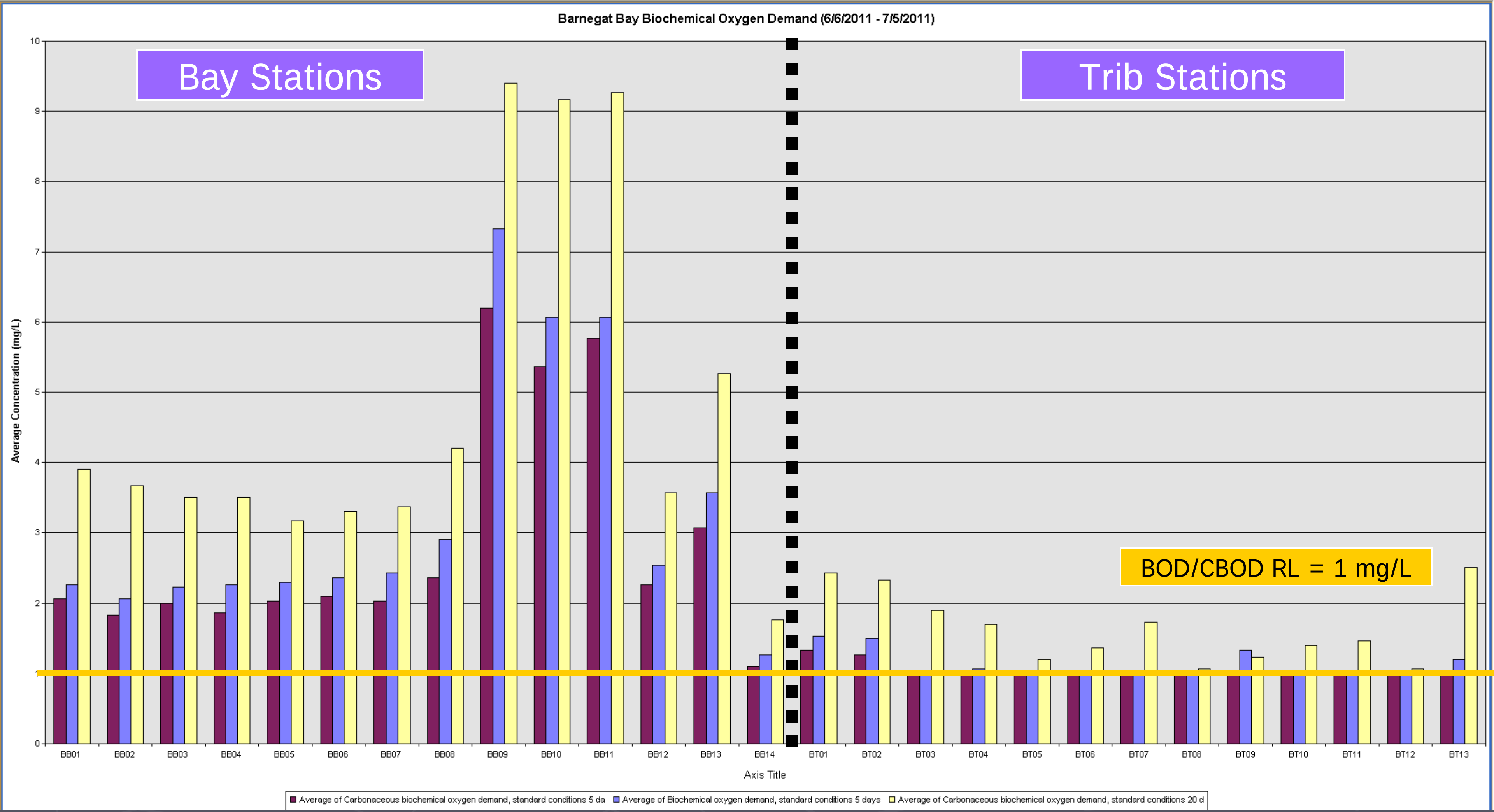


Barnegat Bay Average NO2+NO3 Concentrations
Average NO2+NO3
Concentrations (mg/L)
6/6, 6/23, 7/5, 7/21
0.025 - 0.028
0.029 - 0.077
0.078 - 0.19
0.20 - 0.47
0.48 - 0.81
N
Miles
0 1 2 3 4
Map: Bureau of Freshwater & Biological Monitoring 9/19/11

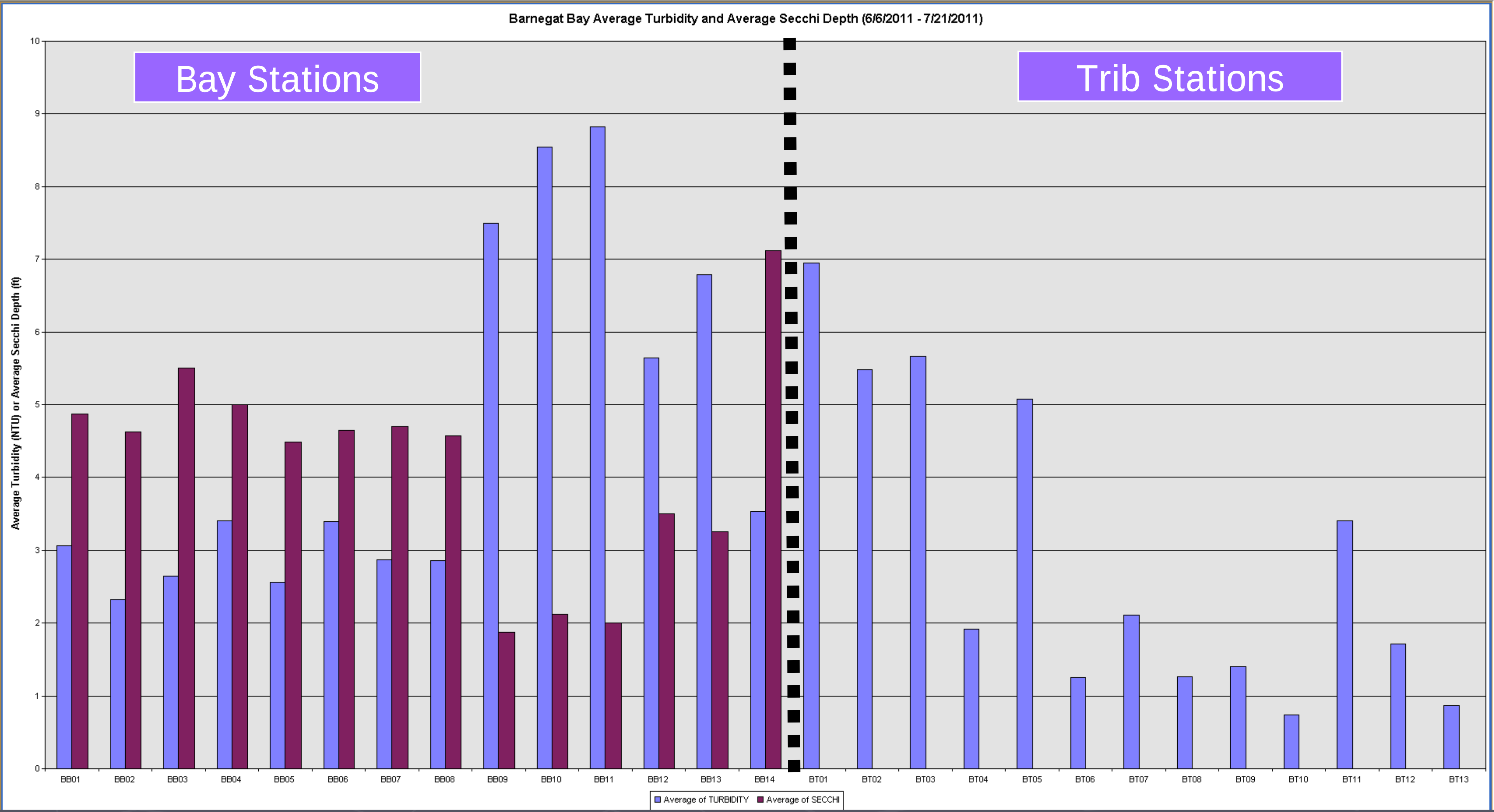
Phase 1 Data –
Average Phosphorus Concentrations



Phase 1 Data –
Average BOD and CBOD Concentrations



Phase 1 Data – Average Turbidity and Secchi Depth



BT Sites Sampled To Date For Macroinvertebrates

BT #	Stream	Date of macro sample	2011 rating	Closest AMNET SITE	AMNET 2010 rating
BT01	North Branch Metedeconk River			AN0506	Fair
BT02	South Branch Metedeconk River	9/15/11		AN0512	Fair
BT03	Toms River			AN0535	Fair
BT04a	Wrangle Brook	9/15/11		none	
BT05	Jakes Branch			AN0543	Fair
BT06	Cedar Creek	8/25/11	Good	AN0549	Excellent
BT07	North Branch Forked River			none	
BT08	Middle Br	8/25/11	Fair	none	
BT09	South Br Forked River	8/25/11	Excellent	none	
BT10	Oyster Creek	8/25/11	Good	none	
BT11	Mill Ck			AN0555	Poor
BT12	Westecunk Creek			AN0558	Excellent
BT13	Tuckerton Creek			none	

Using Phase 1 Data

- Inform the Phase 2 sampling plan
  - Need for vertically distributed samples?
  - Adding or removing sampling locations
  - Adding or removing parameters
  - Focus the sampling efforts on the critical locations
- Develop the input file for the model
- Potential validation data set for the model

Phase 2 Status

- Bathymetry Survey
  - JFA signed in July
  - Three acoustic instruments for the deeper area (depth > 1.5 m) (October, 2011)
  - Experimental Advanced Airborne Research Lidar (EAARL) for the shallow area (spring of 2012)

- Intensive sampling
  - The frequency, duration and scope are currently under evaluation.

- Additional sampling to meet the needs of modeling
  - Received some proposals
  - SOW will be refined as the project proceeds.

Thank You !!!

MATES · OCVTS

USGS
science for a changing world

THE OCEAN COUNTY UTILITIES AUTHORITY
CLEAN WATER
NEW JERSEY

BRICK UTILITIES
THE BRICK TOWNSHIP MUNICIPAL UTILITIES AUTHORITY

STATE OF NEW JERSEY · PINELANDS COMMISSION

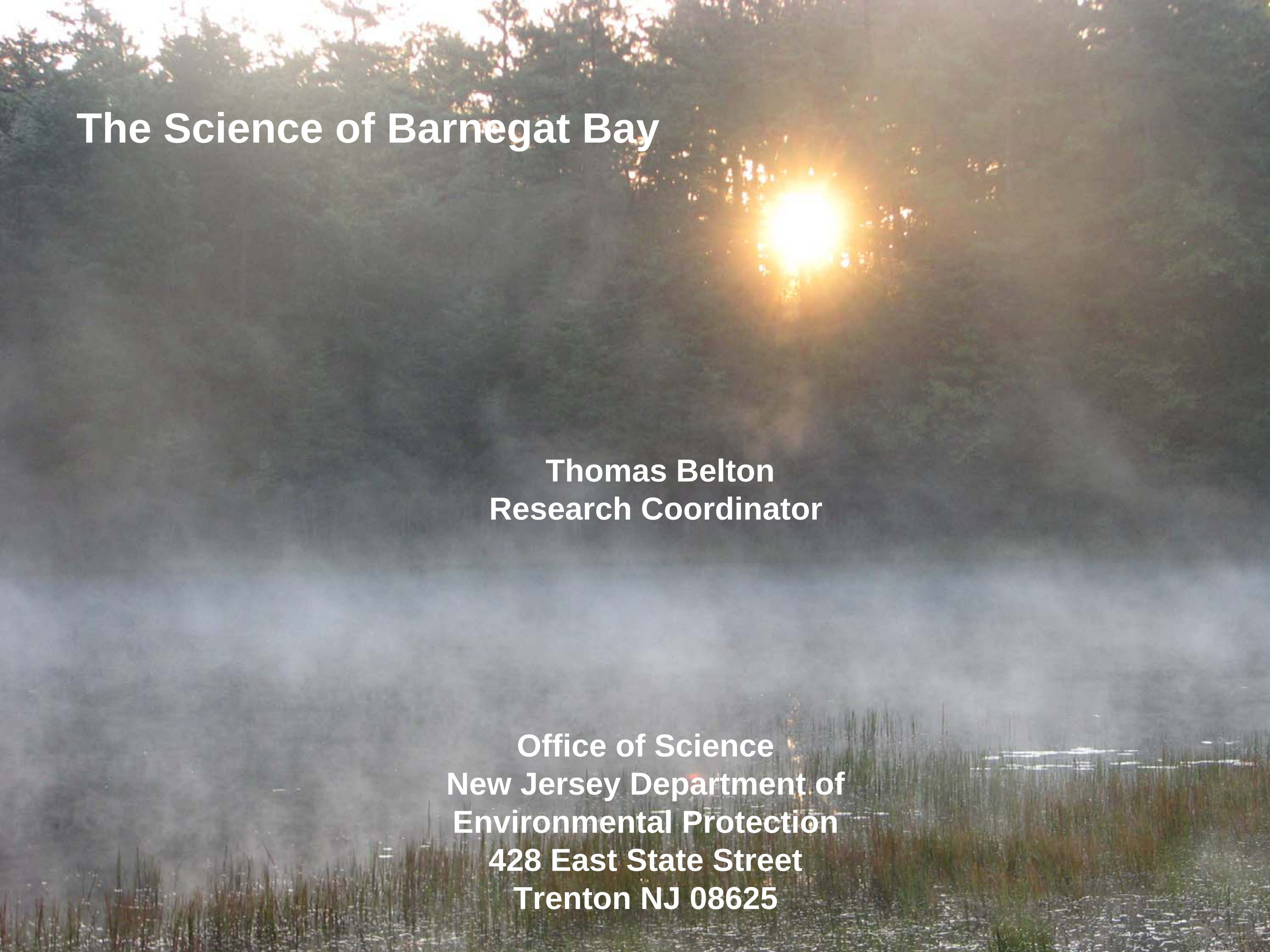
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

OCEAN COUNTY · NEW JERSEY
Ocean County Health Department

URBAN COAST INSTITUTE
MONMOUTH UNIVERSITY
WHERE LEADERS LOOK *forward*

NJ Forest Resource Education Center
Division of Parks and Forestry
FREC
Learn and Discover in Our Forest

BARNEGAT BAY PARTNERSHIP
RESEARCH · EDUCATE · RESTORE



The Science of Barnegat Bay

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Research Coordinator

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OBJECTIVES OF BARNEGAT BAY COMPREHENSIVE RESEARCH

	Research Project	Nutrient Bio-Criteria	TMDL	Power Plant	Tourism & Recreation	Food Safety	Comprehensive/Baseline/Data Gaps
1	Benthic Invertebrate Community Monitoring and Indicator Development for Barnegat Bay.	X	X	X			X
2	Nutrient and Ecological Histories of Barnegat Bay	X	X				X
3	Assessment of Hard Clam Populations in Barnegat Bay			X	X		X
4	Assessment of Fishes and Crabs Responses to Human Alteration of Barnegat Bay.			X	X		X
5	Assessment of the Distribution and Abundance of Stinging Sea Nettles (Jellyfishes) in Barnegat Bay			X	X		X
6	Baseline Characterization of Phytoplankton Communities and Harmful Algal Blooms (HABs)	X	X		X	X	X
7	Baseline Characterization of Zooplankton Communities	X	X				X
8	Multi-Trophic Level Modeling of Barnegat Bay						X
9	Tidal Freshwater and Salt Marsh Wetland Studies of Changing Ecological Function and Adaptation Strategies						X
10	Ecological Evaluation of Sedge Island Marine Conservation Area in Barnegat Bay				X		X

Steps for Developing Estuarine Nutrient Bio-Criteria

Research: Develop a scientifically defensible nutrient stressor-response model and/or reference condition for comparisons.

Standards: Select criteria supported by defensible science to protect designated uses (aquatic life, recreation, aesthetics)

Monitoring: Must be cost-effective and implementable field lab protocols for routine monitoring in support of short term water quality goals (Bi-annual 305b/303d) and long term restoration goals (TMDLs)

Assessment: Statistical protocols to assess monitoring data for meeting standards recognizing the relationships between water chemistry criteria and biocriteria (TN Vs Chl A and/or biodiversity)

Freshwater Nutrient Criteria

Total Phosphorous Criteria N.J.A.C. 7:9B-1.14(c)(5):

•Streams: Shall not exceed 0.1 mg/l TP in a stream, unless it can be demonstrated that total phosphorus is not a limiting nutrient and will not otherwise render the waters unsuitable for designated uses.

•Lakes: Shall not exceed 0.05 mg/l TP in any lake, pond or reservoir.

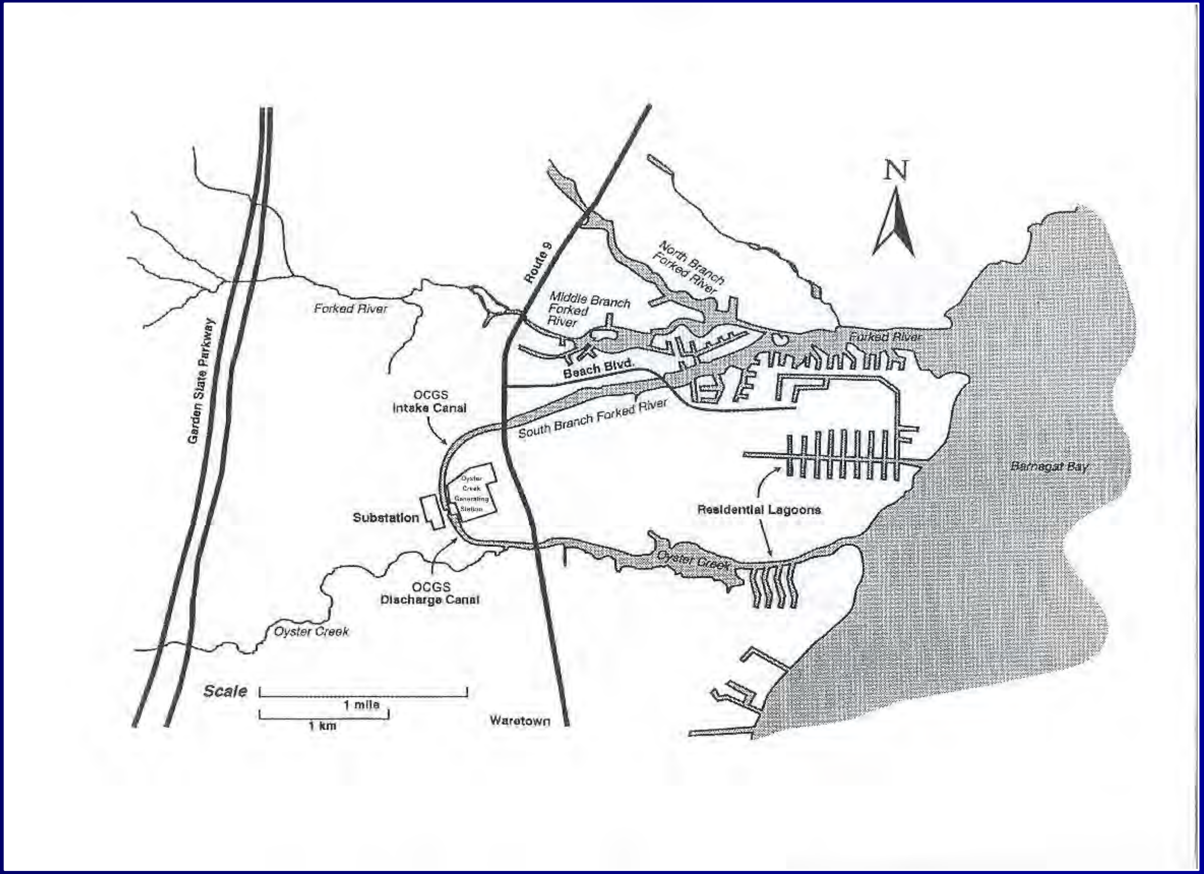
Nutrient Policies (N.J.A.C. 7:9B-1.5(g):

•Apply to all fresh waters.

•Except as due to natural conditions nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, or otherwise render the waters unsuitable for designated uses.

Parameter	Current Criterion	Criterion Status	Data needs	Science Questions	Status
Narrative Nutrient Criteria (NNC)—Bay only					
DO/pH fluctuation			Continuous data to calculate fluctuation	Degree of fluctuation that would suggest nutrient cause photosynthetic activity	Continuous data collection (needed to measure fluctuation) to commence fall 2011; literature research on thresholds.
Algal density			Comprehensive Research – 2 and 6	Threshold of nonattainment needs to be defined	Ongoing and proposed Plan 9 projects. Literature research underway on thresholds.
Nuisance aquatic vegetation			Comprehensive Research – 2, 6 and 11	Threshold for nonattainment needs to be defined	Ongoing and proposed Plan 9 projects. Literature research underway on thresholds.
Detrimental changes in aquatic community			Comprehensive Research – 1, 2, 6, and 11	Metrics to assess nonattainment needs to be defined	Ongoing and proposed Plan 9 projects.

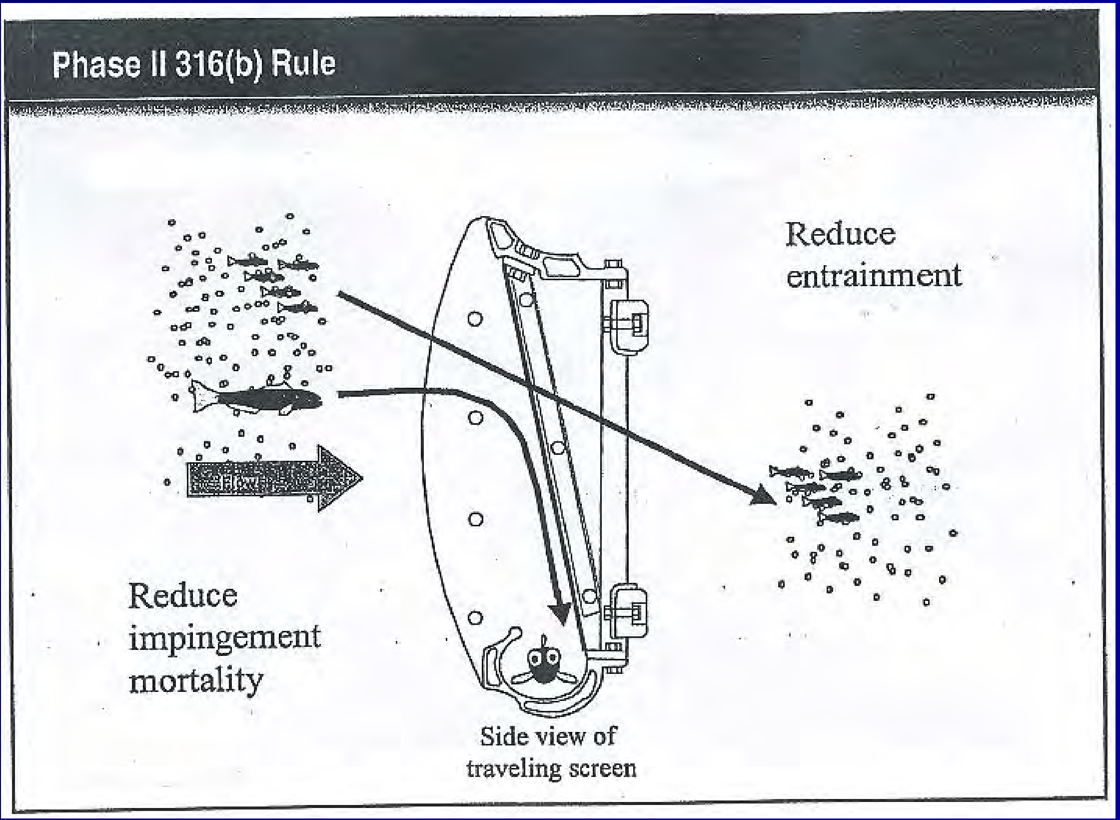
Oyster Creek Generating Station



NJPDES Permit

- Permit is the regulatory mechanism to regulate the intake and discharges
- Section 316(a) of the Clean Water Act – regulates thermal discharge
- Section 316(b) of the Clean Water Act – regulates intake

Impingement and Entrainment



316(b) Statute

- Technology Driven
- Does not require population data for area surrounding discharge
- Plant-related data is required regarding reductions in impingement and entrainment
- Frustrating to biologists – reduction in numbers of organisms impinged and entrained looks like an improvement in technology or operations but it could just be due to a decline in the surrounding population densities
- USEPA recently released draft regulation for Section 316(b) which still does not supply a definition of "adverse environmental impact" and focuses on plant related effects as opposed to populations in the waterbody

Entrainment and Impingement Analysis OCNGS

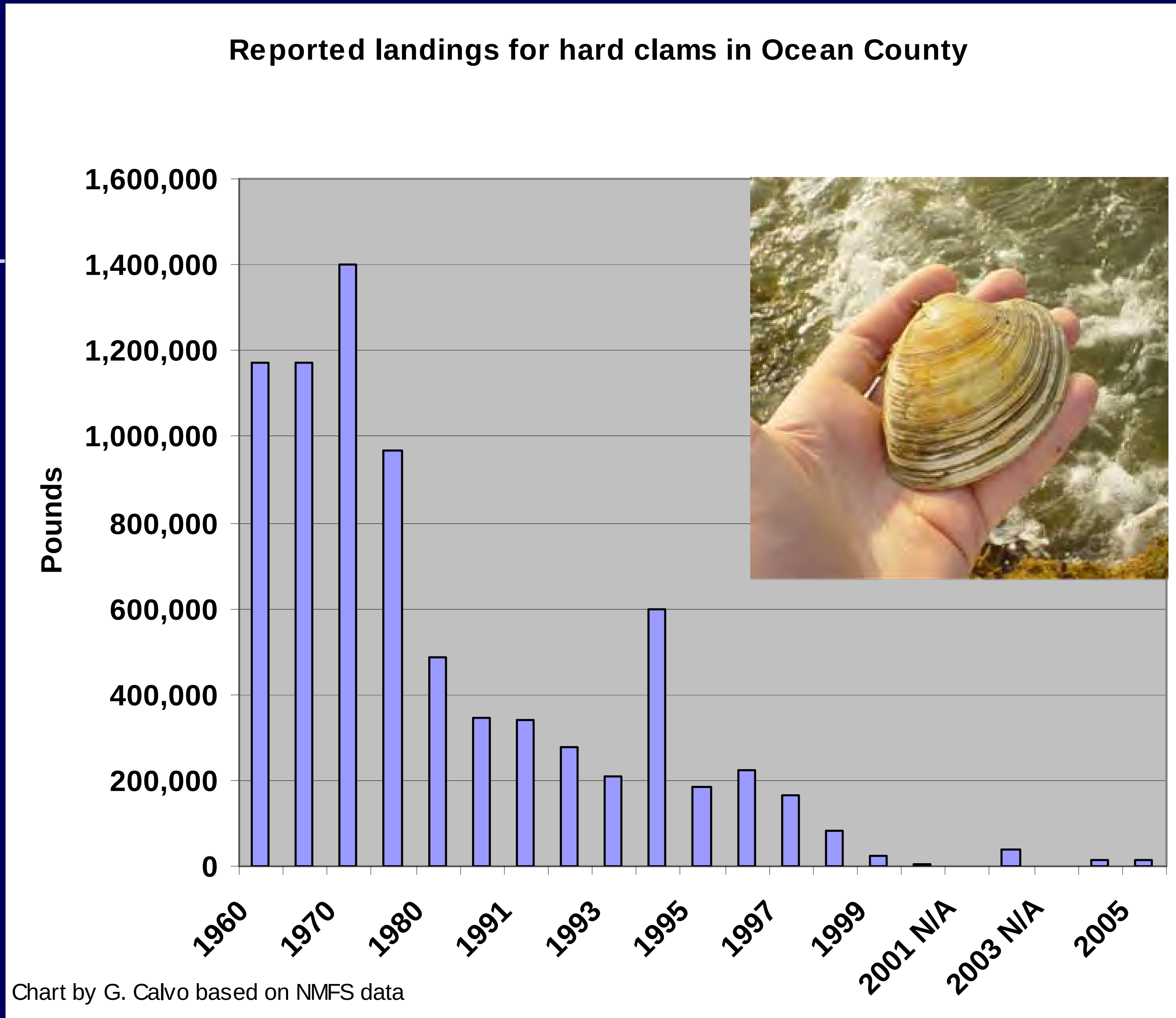
Bluefish -97%
Atlantic menhaden -95%
Bay anchovy -92%
Blueback herring -86%
Sand shrimp -84%
Winter flounder -78%
Atlantic silverside -72%
Northern puffer -55%
Blue crab -51%
Northern pipefish -34%
Summer Flounder -18
Northern kingfish +417%
Weakfish +56%

Other Ongoing Research Projects

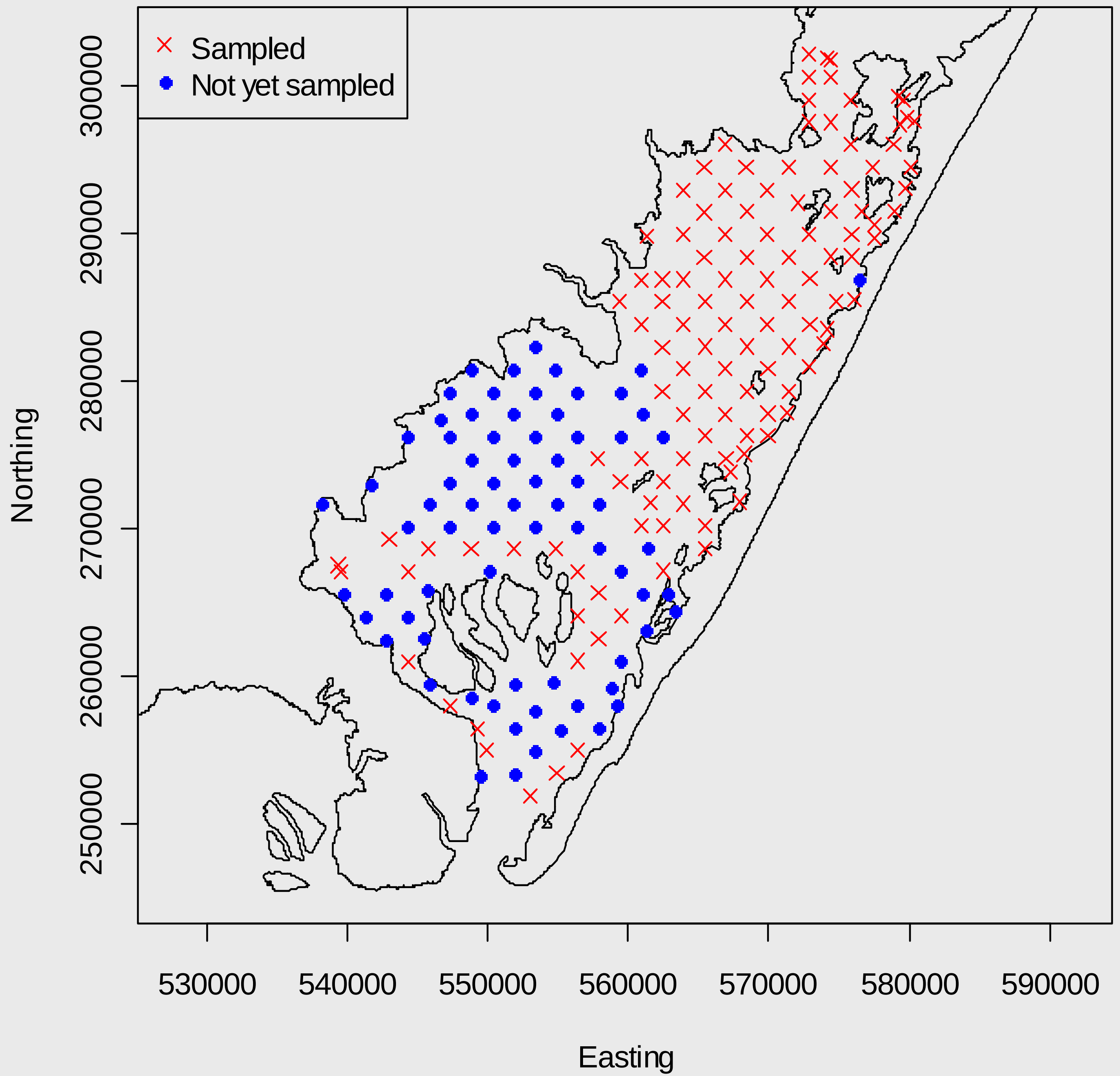
Hard Clam Survey LEH-BBay

Submerged Aquatic Vegetation (SAV)

Mid-Atlantic Coastal Wetlands Assessment.


Reported landings for hard clams in Ocean County
Pounds
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1960
1970
1980
1991
1993
1995
1997
1999
2001 N/A
2003 N/A
2005
Chart by G. Calvo based on NMFS data

NJ Bureau of Shellfisheries 2011 LEHB hard clam survey station locations

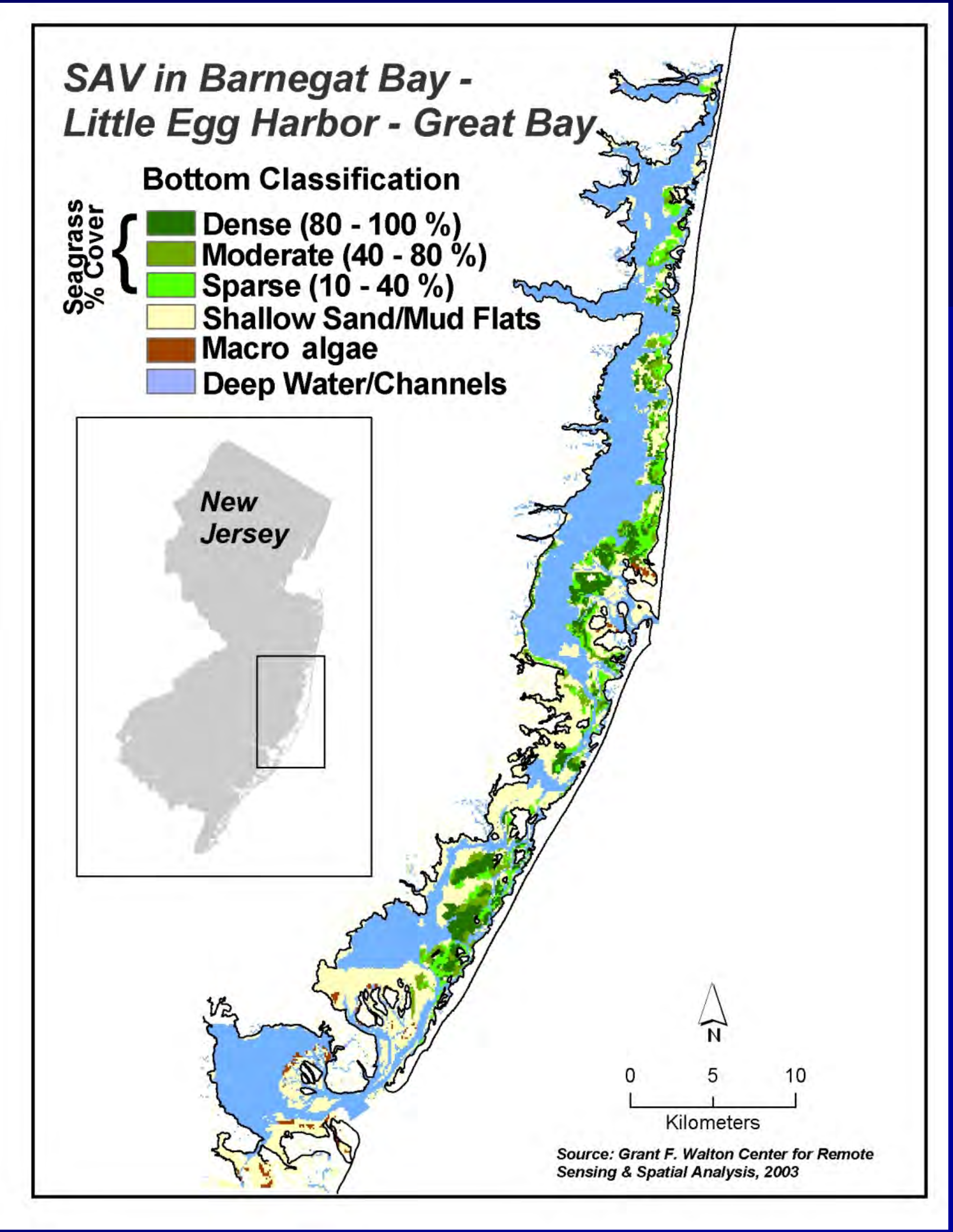


Eelgrass Decline

>60% in Little Egg Harbor (1975-2000)

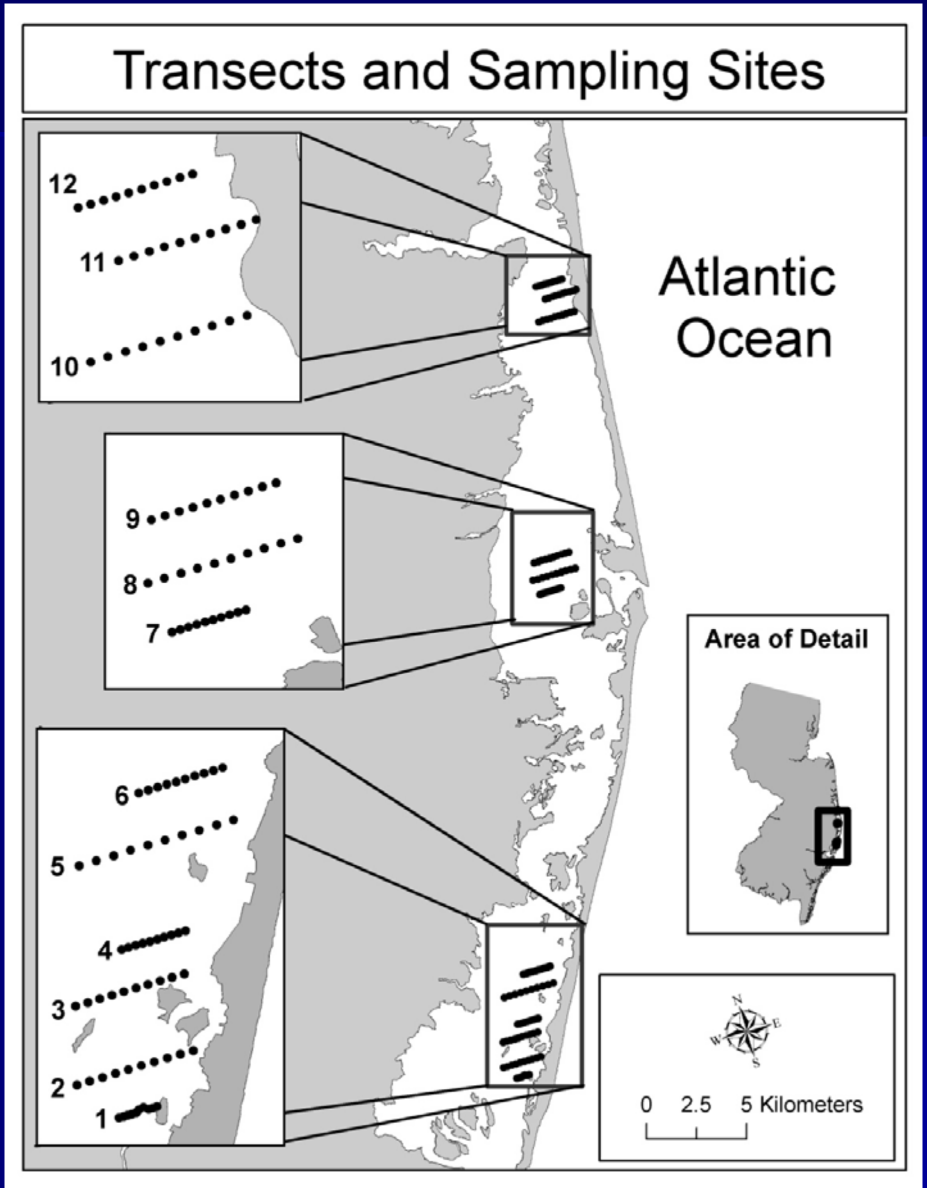
>30% in Entire Estuary

(Data Source: Paul Bologna)



Assessment of Nutrient Loading and Eutrophication in Barnegat Bay in Support of Nutrient Management*

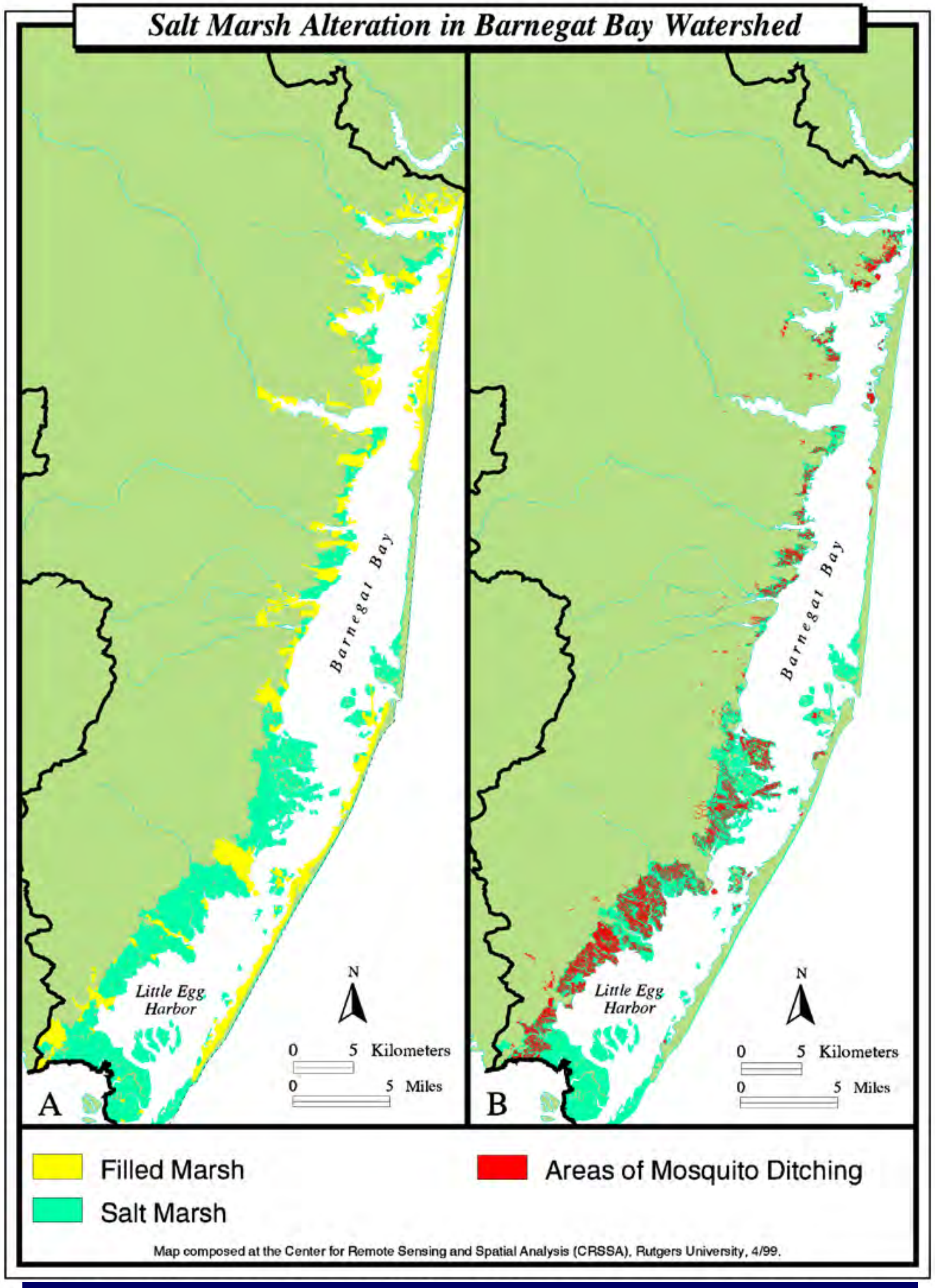
Rutgers-USGS: NEIWPCC
Kennish et al. 2010-2013



Tidal Salt Marsh Conversion/Alteration

- Barnegat Bay has lost more than one quarter of its tidal salt marshes over the past century due to filling and development.

- A large proportion of Barnegat Bay's remaining salt marshes were grid ditched or OMWM'd as a means of mosquito control.



Lathrop, R.G., M. B. Cole,* and R.D. Showalter*. 2000. Quantifying the habitat structure and spatial pattern of New Jersey (USA) salt marshes under different management regimes. Wetlands Ecology Manage. 8:163-172.

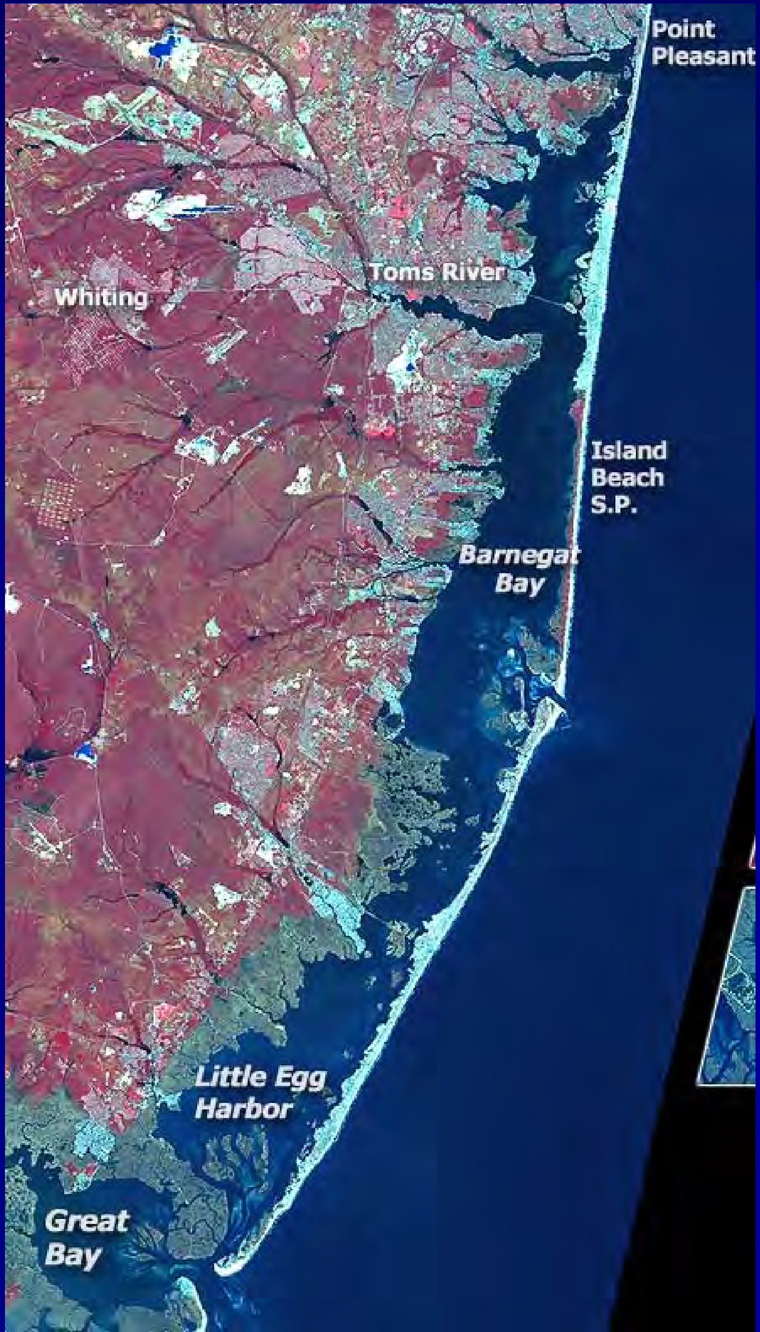
Mid-Atlantic Coastal Wetland Assessment Program (MACWAP)

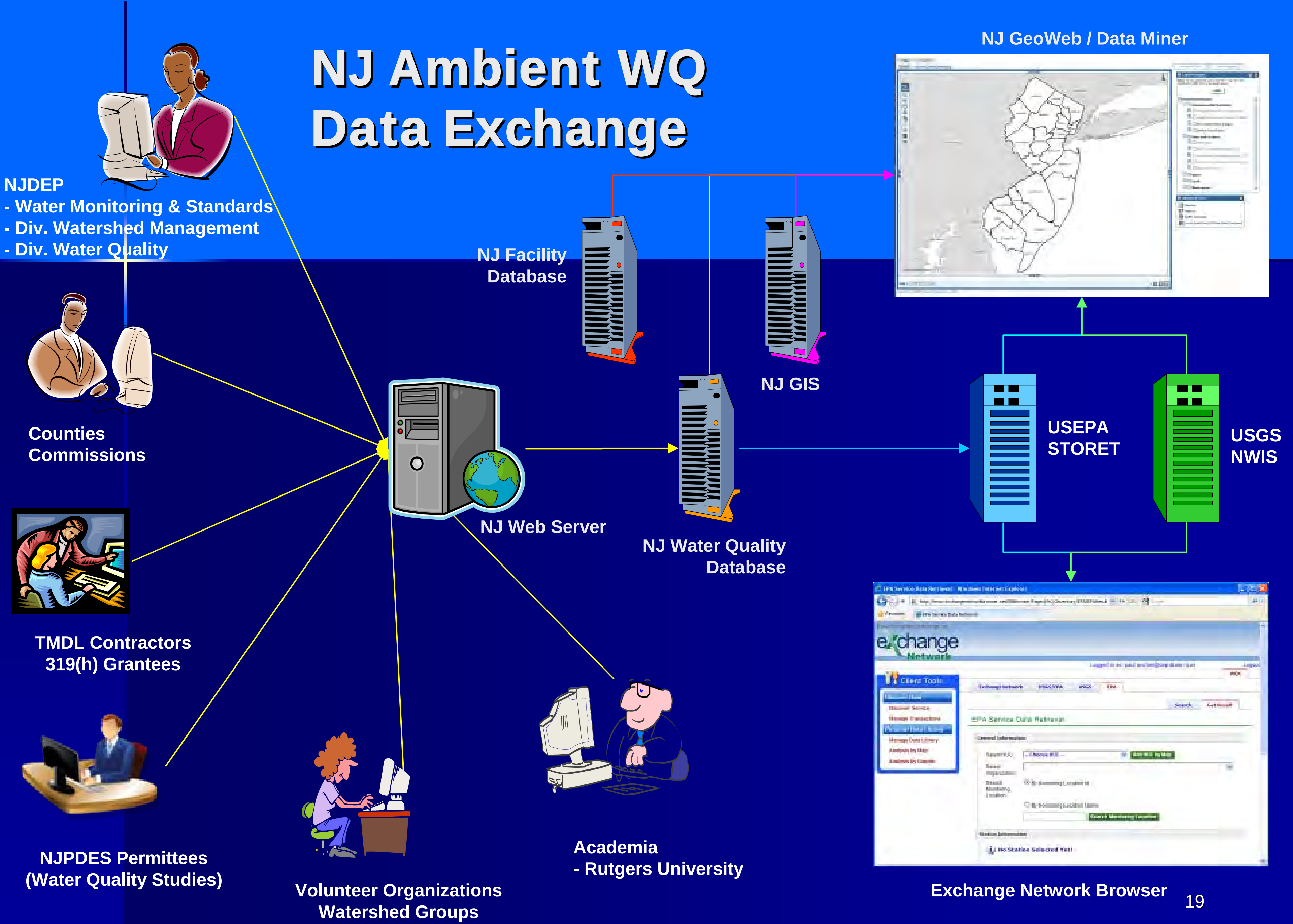
- Utilize USEPA three-tier wetlands monitoring guidance
- Establish a network of fixed monitoring stations (SET and WQ) over a range of marsh types, conditions and stressors.
- Conduct intensive geomorphology, biota and WQ (Tier 3) monitoring
- Test Rapid Assessment Methodologies (RAM)

Logistical Overview

NJDEP Data Requirements:

Data Formatting and Reporting
GIS Geo-Referencing
Data Quality Assurance




NJ Ambient WQ Data Exchange
NJDEP
- Water Monitoring & Standards
- Div. Watershed Management
- Div. Water Quality
Counties
Commissions
TMDL Contractors
319(h) Grantees
NJPDES Permittees
(Water Quality Studies)
Volunteer Organizations
Watershed Groups
Academia
- Rutgers University
NJ Web Server
NJ Facility
Database
NJ GIS
NJ Water Quality
Database
NJ GeoWeb / Data Miner
USEPA
STORET
USGS
NWIS
exchange
Network
Exchange Network Browser

Geographic Information System

In order to maximize utility of disparate data sets, and facilitate data sharing, integration, and compatibility within the GIS System, NJDEP requires that all data generated for and by the Department adhere to a set of basic standards.*

1. All digital data must meet or reference published accuracy standards regardless of scale.
2. Digital data provided to, produced for, or by, the Department are required to be in North American Datum 1983 (NAD83) horizontal geodetic datum and in the New Jersey State Plane Coordinate system (NJSPC).
3. GIS data produced for utilization in NJDEP's GIS must be documented in a metadata record that adheres to mandatory GIS elements in the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)

* http://www.state.nj.us/dep/gis/standinter.html#summary

Quality Assurance
Preparing a QAPP*

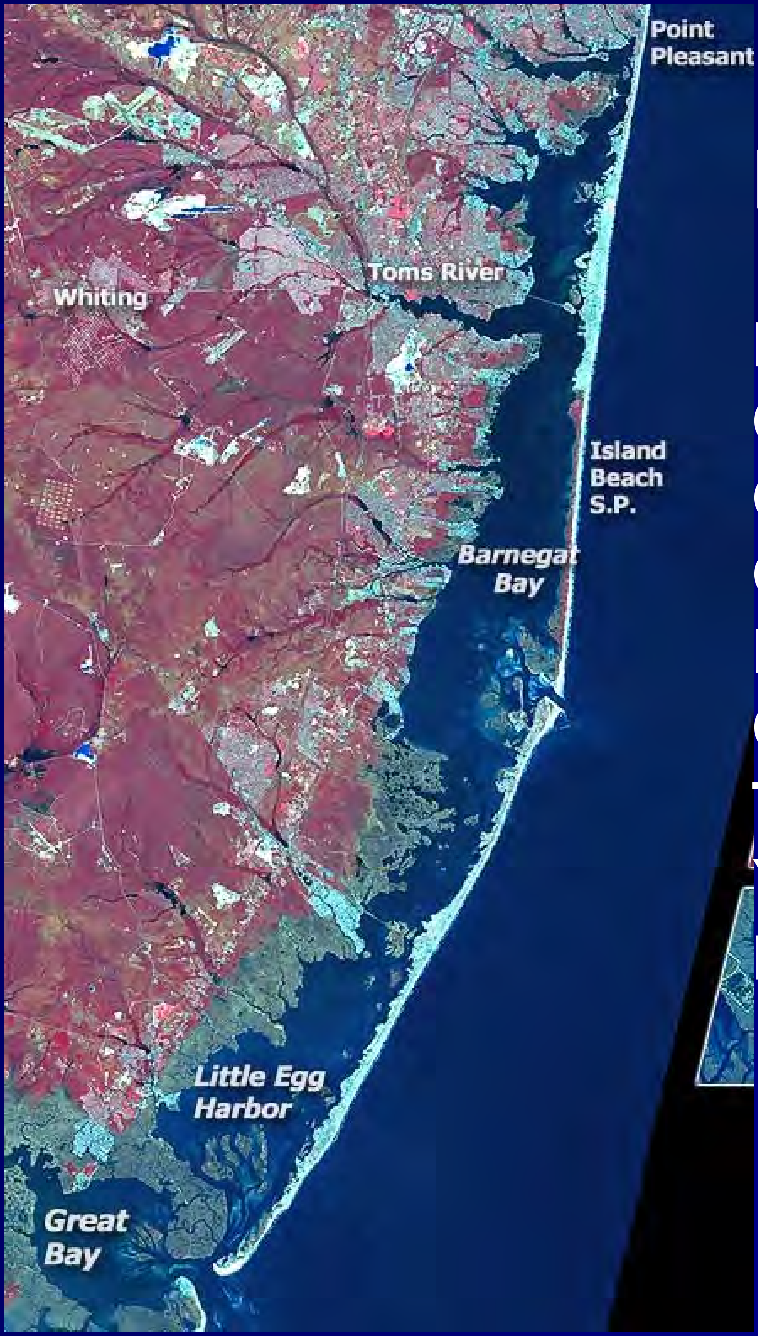
- The Quality Assurance Project Plan (QAPP) is the "blueprint" for obtaining the type and quality of environmental data needed for the identified decision or use.
- The QAPP is the end result of the planning effort providing a description of who is to do what, when, how, and why.
- The QAPP is a REQUIRED document necessary for every data generating project or program.
- Due one month after effective date of contract.

* http://www.nj.gov/dep/oqa/

Keys To Successful Projects
QAPP Approvals

- The QAPP must be:
  - signed by the representatives of all major project participants;
  - approved by the NJDEP QA Officer, Assistant Quality Assurance Officer, or approval by the designated NJDEP program person;
  - distributed to all involved parties

http://www.nj.gov/dep/oqa/



Next Steps

PMs Assigned
Contracts
QAPP – I month
Qtrly Admin Reports
Project Meetings
Co-Project Meetings
Tri-Qrtly Review/Meeting
Year 2 Proposals
Publications/Manuscripts

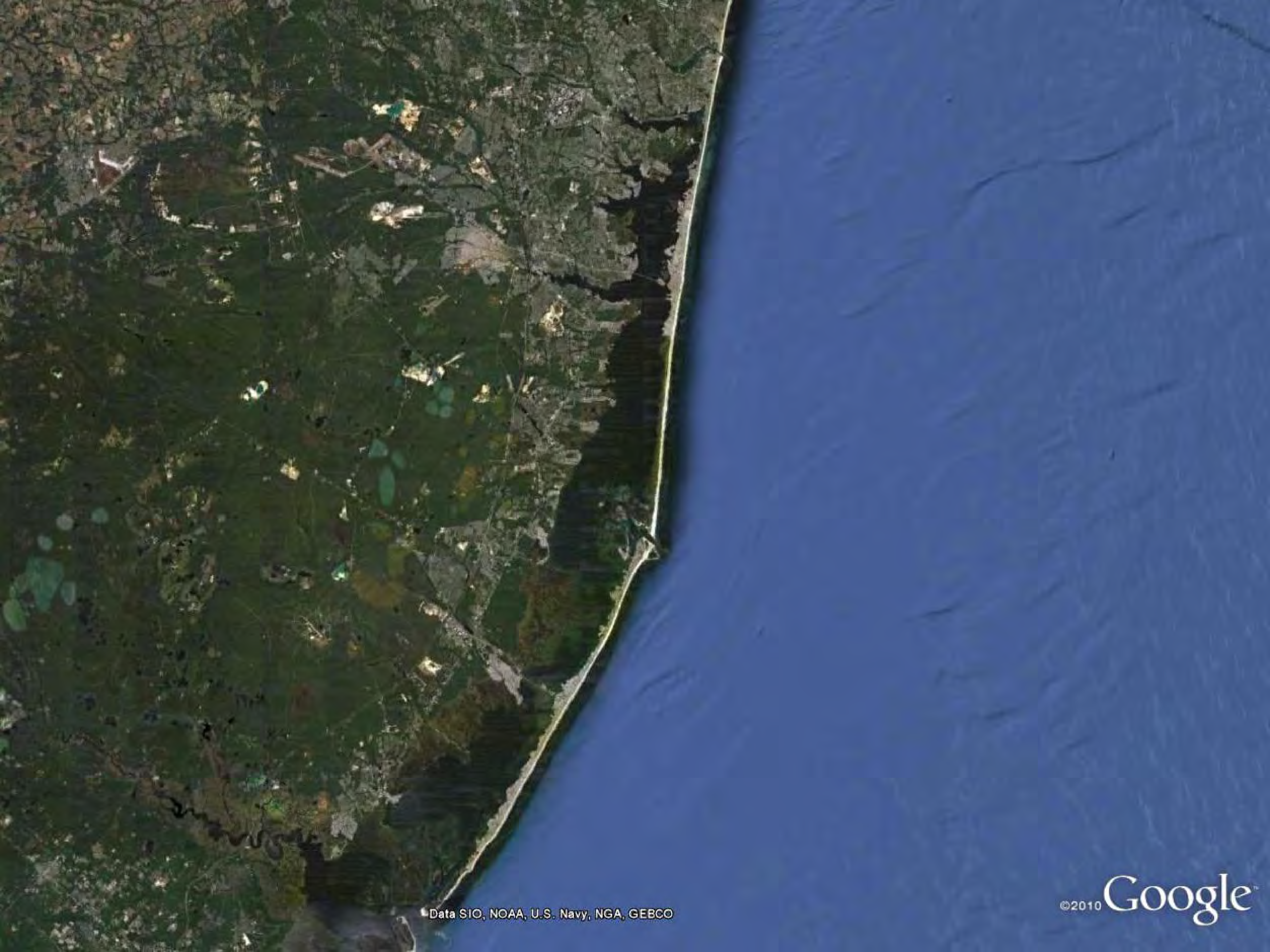
QUESTIONS?

Benthic Invertebrate Community Monitoring and Indicator Development

Gary Taghon, Judy Grassle, Charlotte Fuller, Rosemarie Petrecca

Institute of Marine and Coastal Sciences

RUTGERS
UNIVERSITY



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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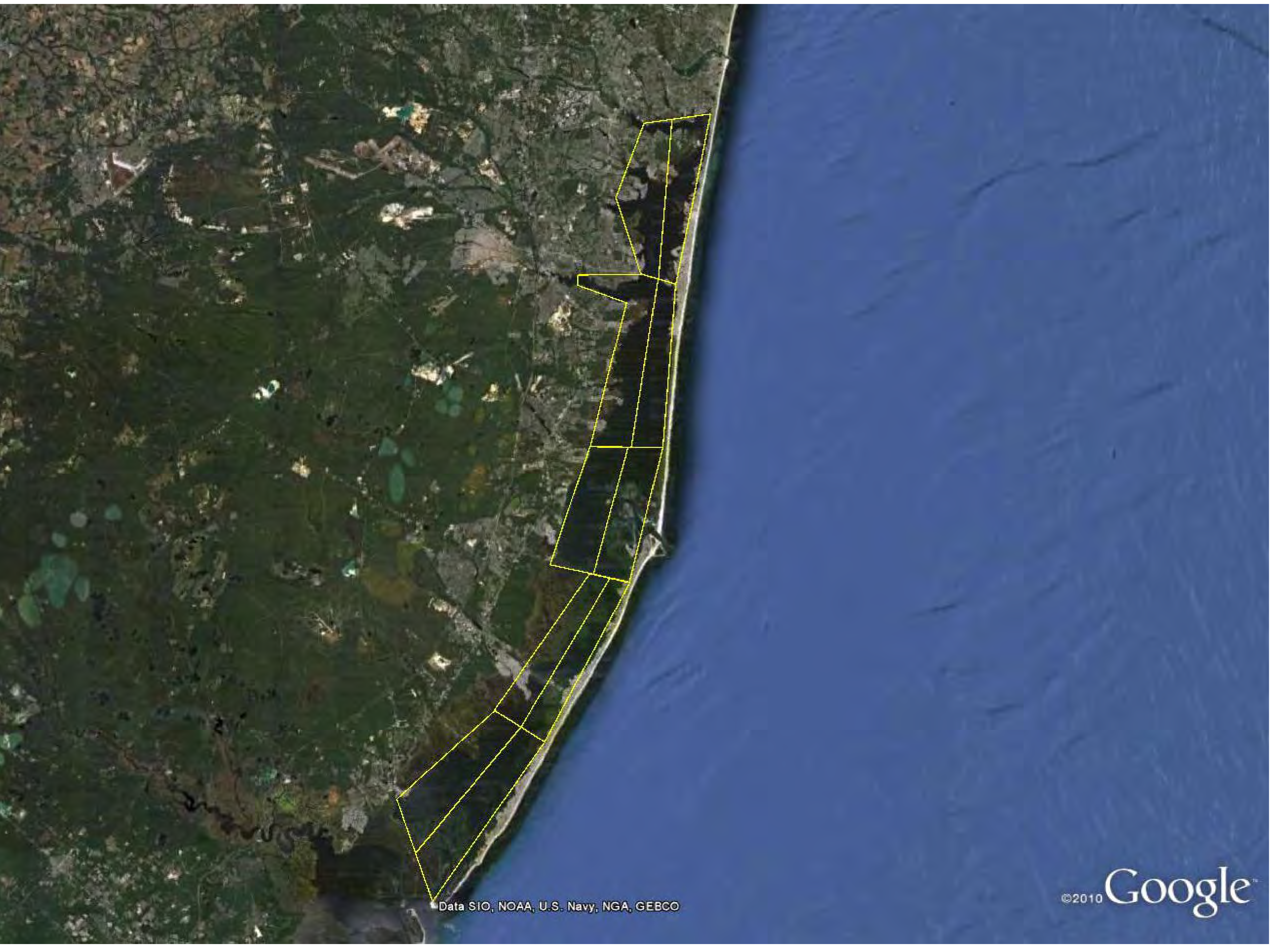
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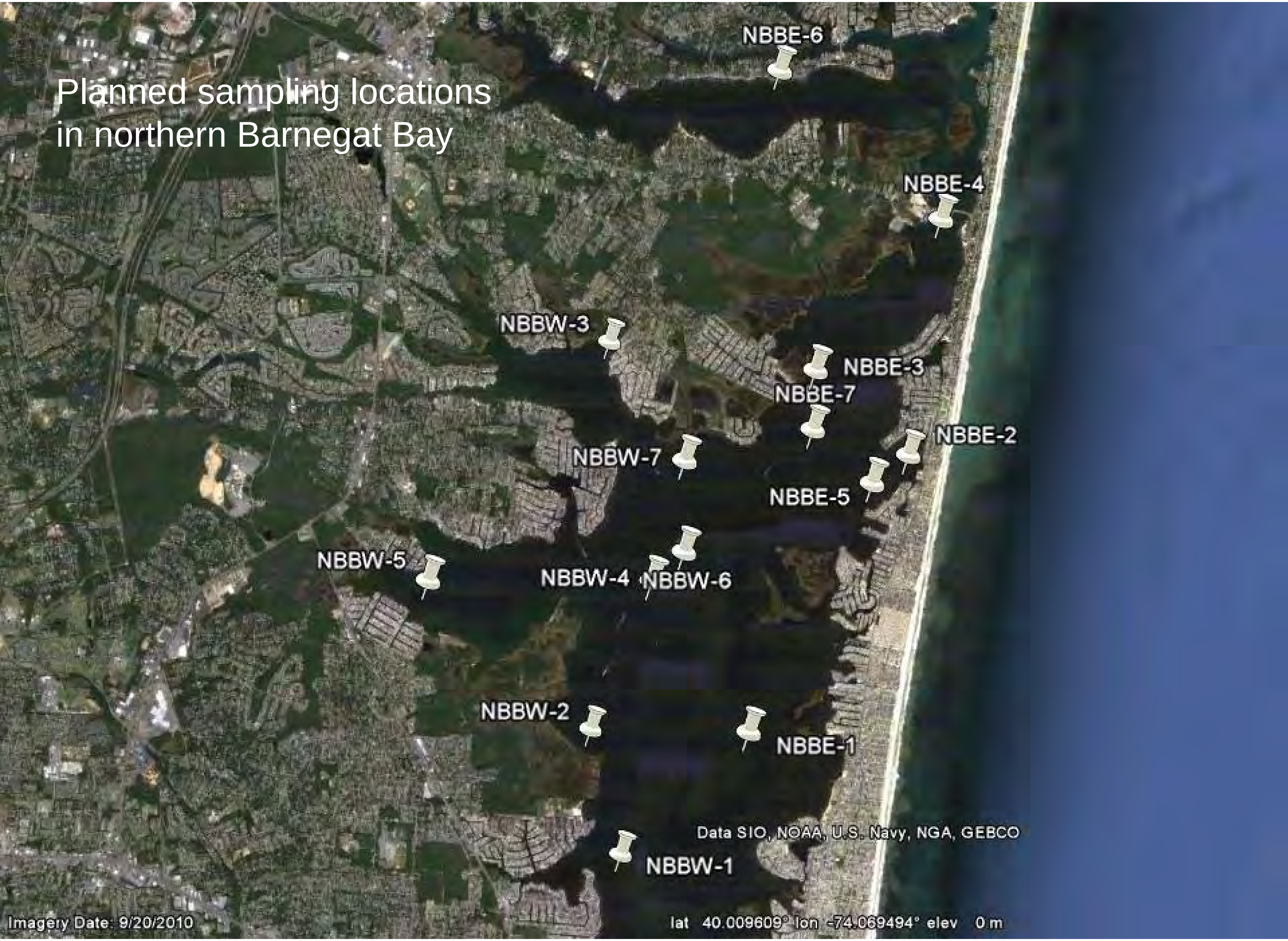
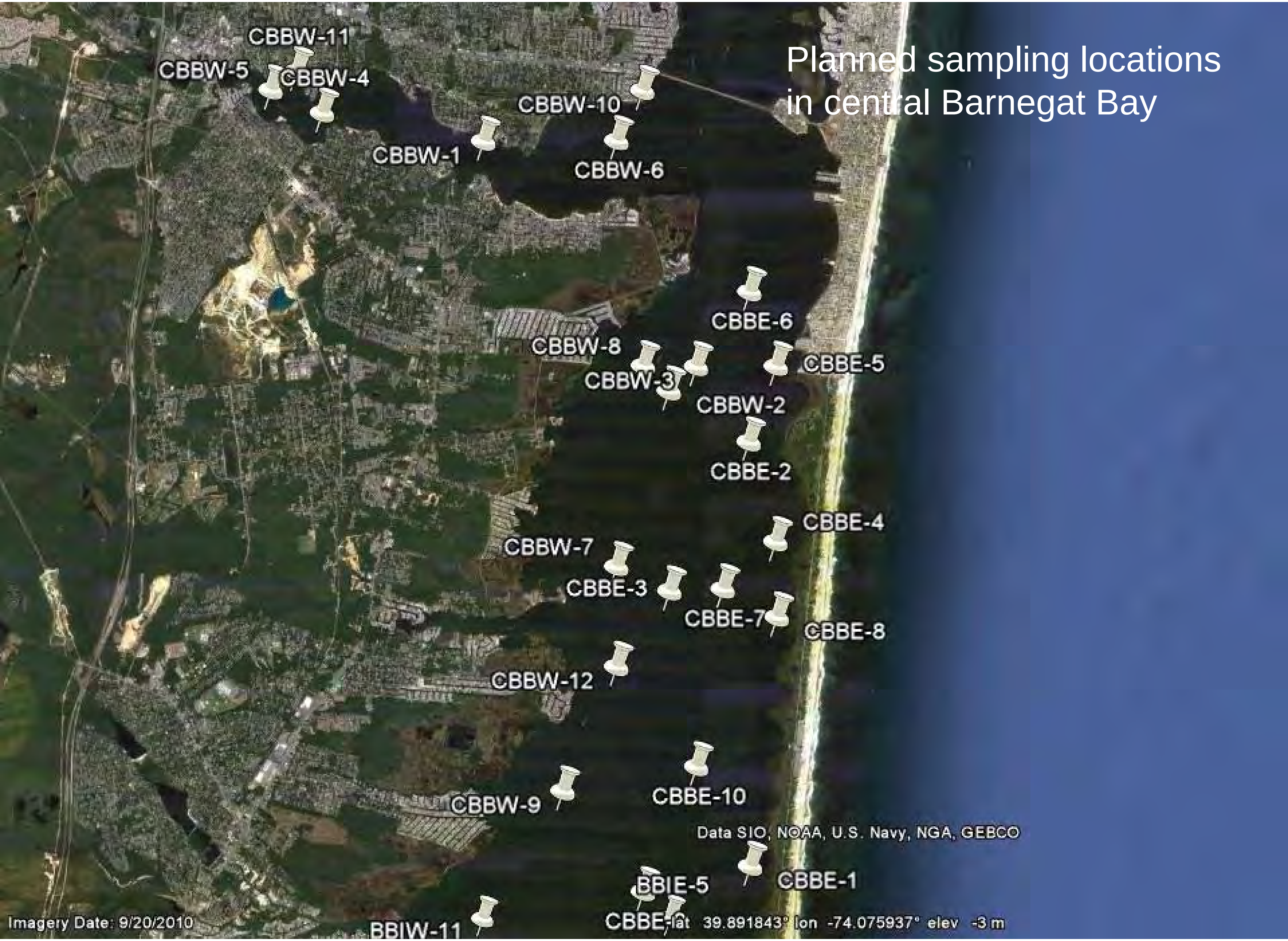
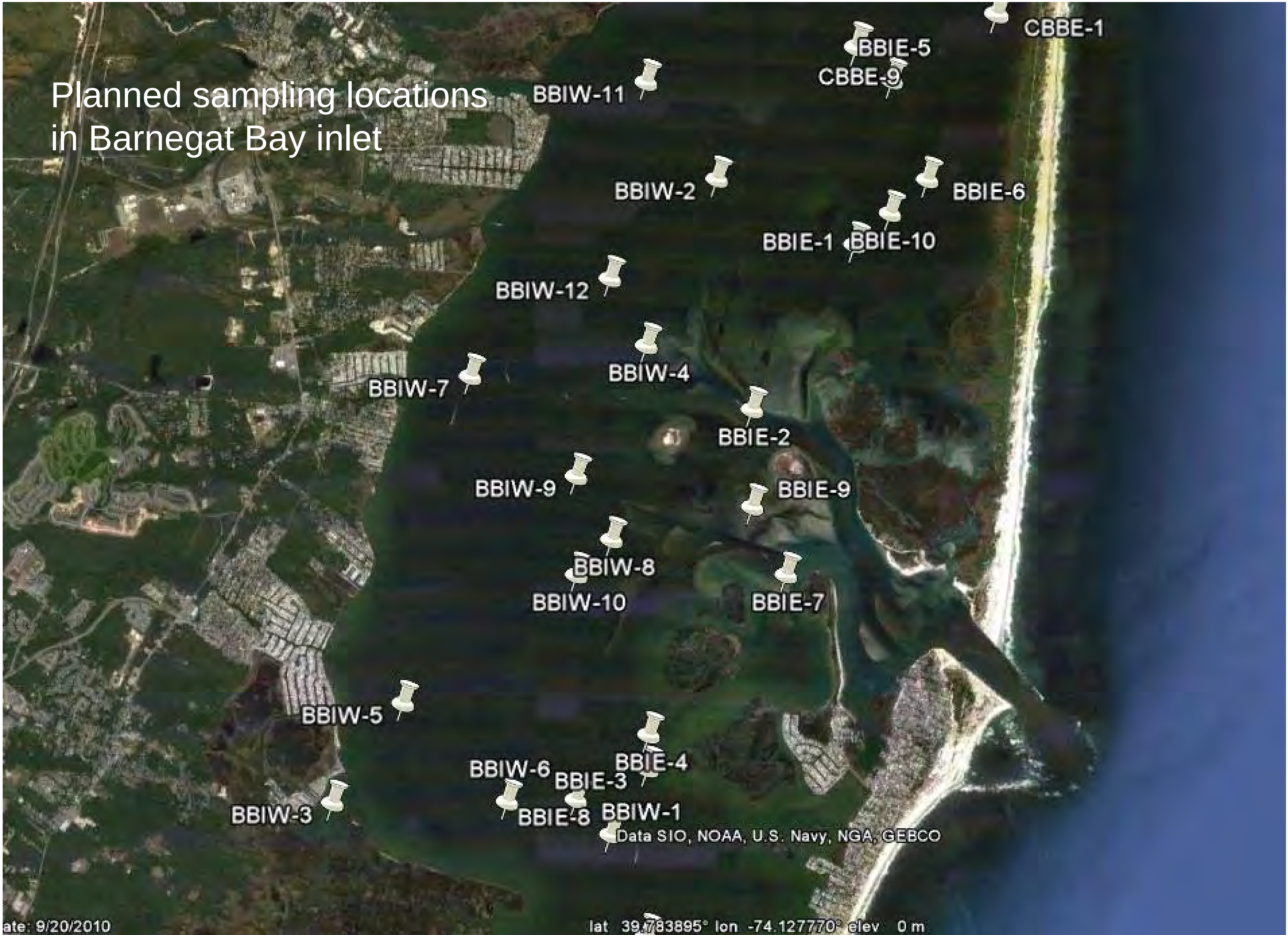
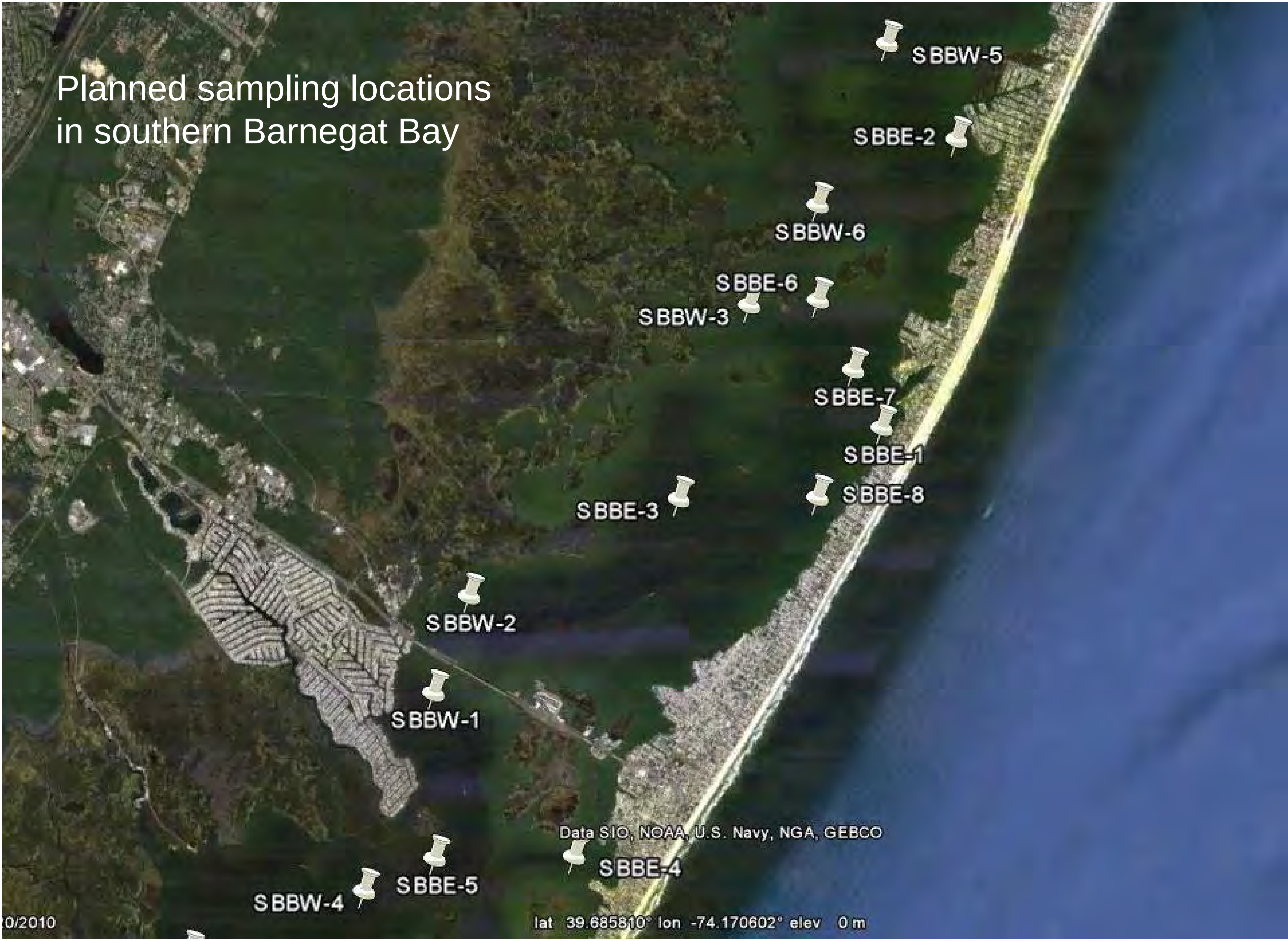
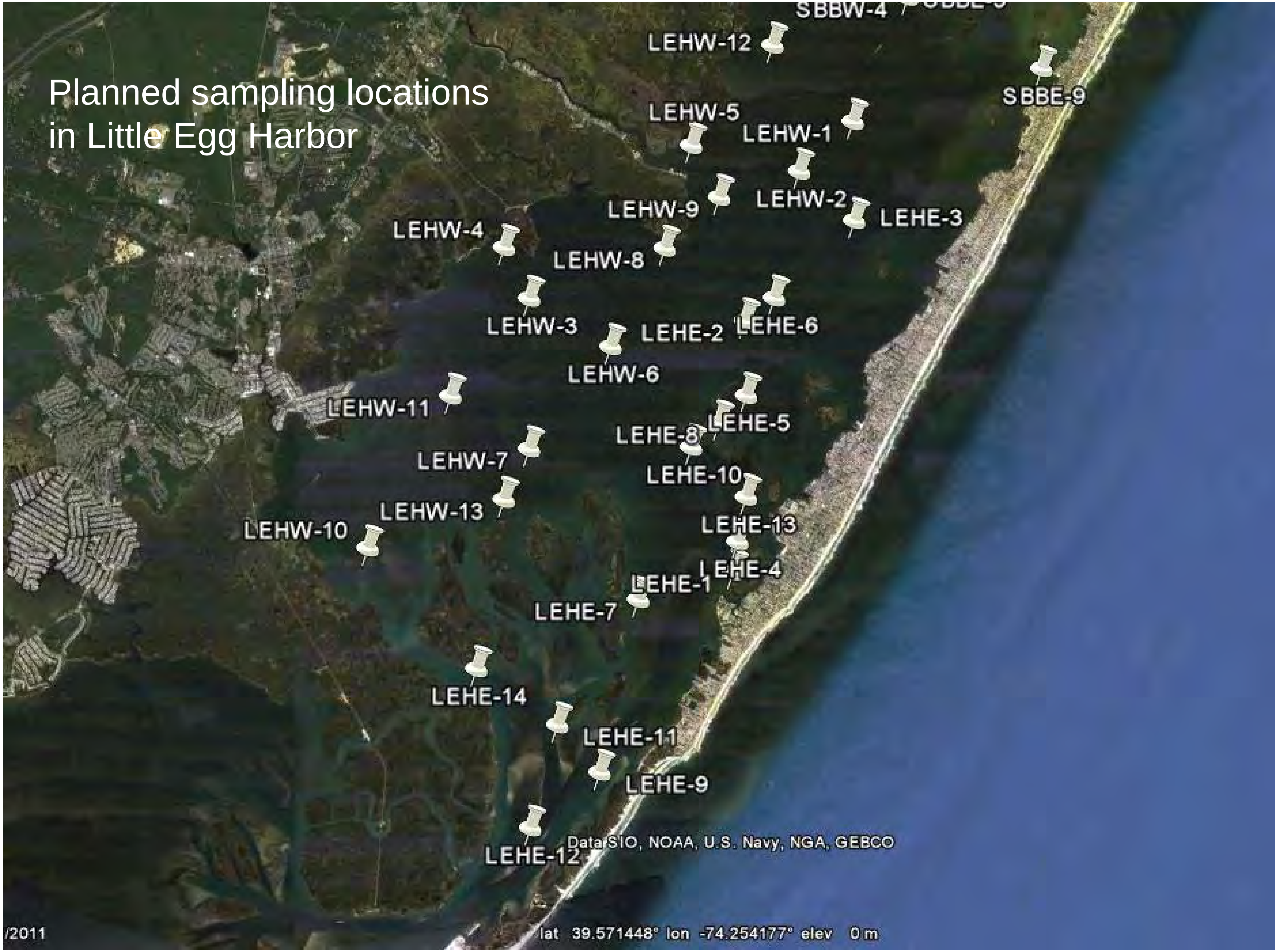

Planned sampling locations
in northern Barnegat Bay
NBBE-6
NBBE-4
NBBW-3
NBBE-3
NBBE-7
NBBE-2
NBBW-7
NBBE-5
NBBW-5
NBBW-4
NBBW-6
NBBW-2
NBBE-1
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
NBBW-1
Imagery Date: 9/20/2010
lat 40.009609° lon -74.069494° elev 0 m


Planned sampling locations
in central Barnegat Bay
CBBW-11
CBBW-5
CBBW-4
CBBW-10
CBBW-1
CBBW-6
CBBE-6
CBBW-8
CBBE-5
CBBW-3
CBBW-2
CBBE-2
CBBE-4
CBBW-7
CBBE-3
CBBE-7
CBBE-8
CBBW-12
CBBE-10
CBBW-9
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
BBIE-5
CBBE-1
Imagery Date: 9/20/2010
BBIW-11
lat 39.891843° lon -74.075937° elev -3 m


Planned sampling locations
in Barnegat Bay inlet
CBBE-1
BBIE-5
CBBE-9
BBIW-11
BBIW-2
BBIE-6
BBIE-1
BBIE-10
BBIW-12
BBIW-4
BBIW-7
BBIE-2
BBIW-9
BBIE-9
BBIW-8
BBIW-10
BBIE-7
BBIW-5
BBIE-4
BBIW-6
BBIE-3
BBIW-3
BBIE-8
BBIW-1
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
ate: 9/20/2010
lat 39.783895° lon -74.127770° elev 0 m



Planned sampling locations
in southern Barnegat Bay
SBBW-5
SBBE-2
SBBW-6
SBBE-6
SBBW-3
SBBE-7
SBBE-1
SBBE-8
SBBE-3
SBBW-2
SBBW-1
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
SBBE-4
SBBE-5
SBBW-4
lat 39.685810° lon -74.170602° elev 0 m


Planned sampling locations in Little Egg Harbor
SBBW-4
LEHW-12
SBBE-9
LEHW-5
LEHW-1
LEHW-9
LEHW-2
LEHE-3
LEHW-4
LEHW-8
LEHW-3
LEHE-2
LEHE-6
LEHW-6
LEHW-11
LEHE-5
LEHE-8
LEHW-7
LEHE-10
LEHW-13
LEHE-13
LEHW-10
LEHE-4
LEHE-1
LEHE-7
LEHE-14
LEHE-11
LEHE-9
LEHE-12
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
/2011
lat 39.571448° lon -74.254177° elev 0 m

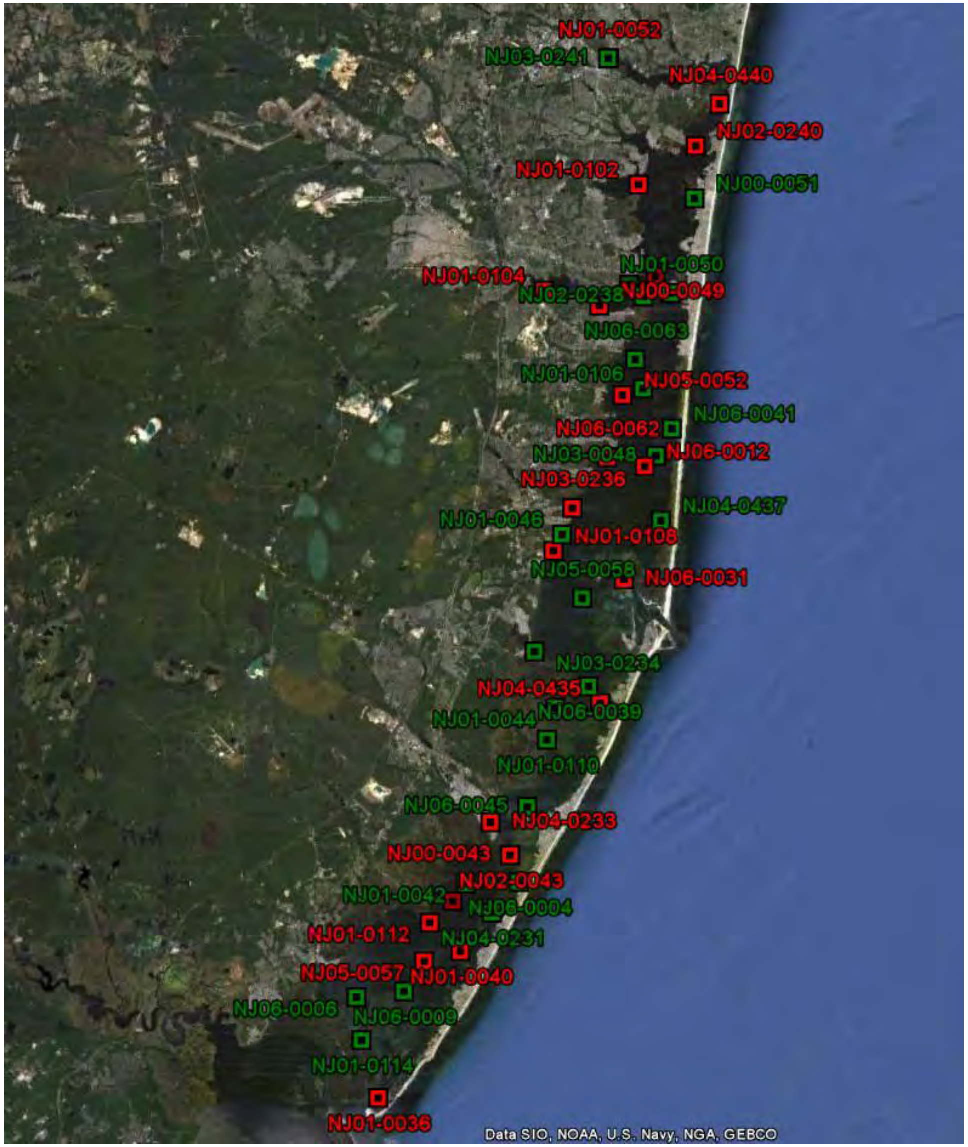
Benthic Community Monitoring

Two, 0.04 m^2 van Veen grabs at each station for benthic invertebrates, sieved on 0.5 mm mesh, sorted and identified to species

One grab for sediment properties (grain size, total N, total organic C)

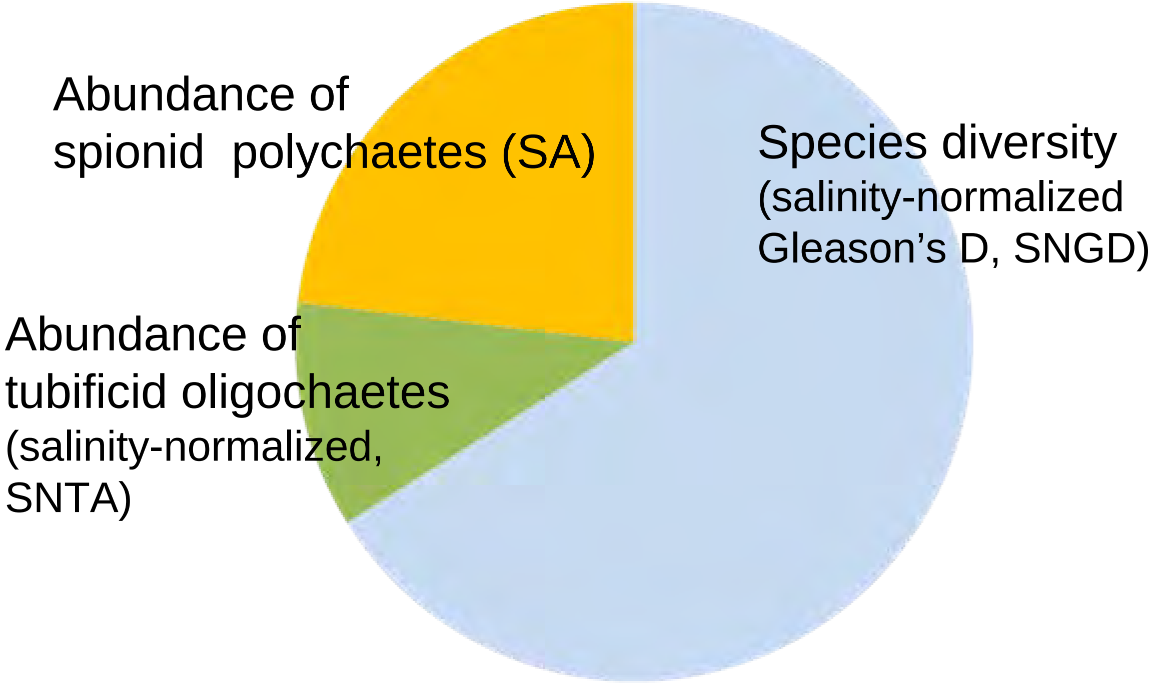
Bottom water properties (salinity, temperature, dissolved O_2, pH)

Development of Benthic Indicator

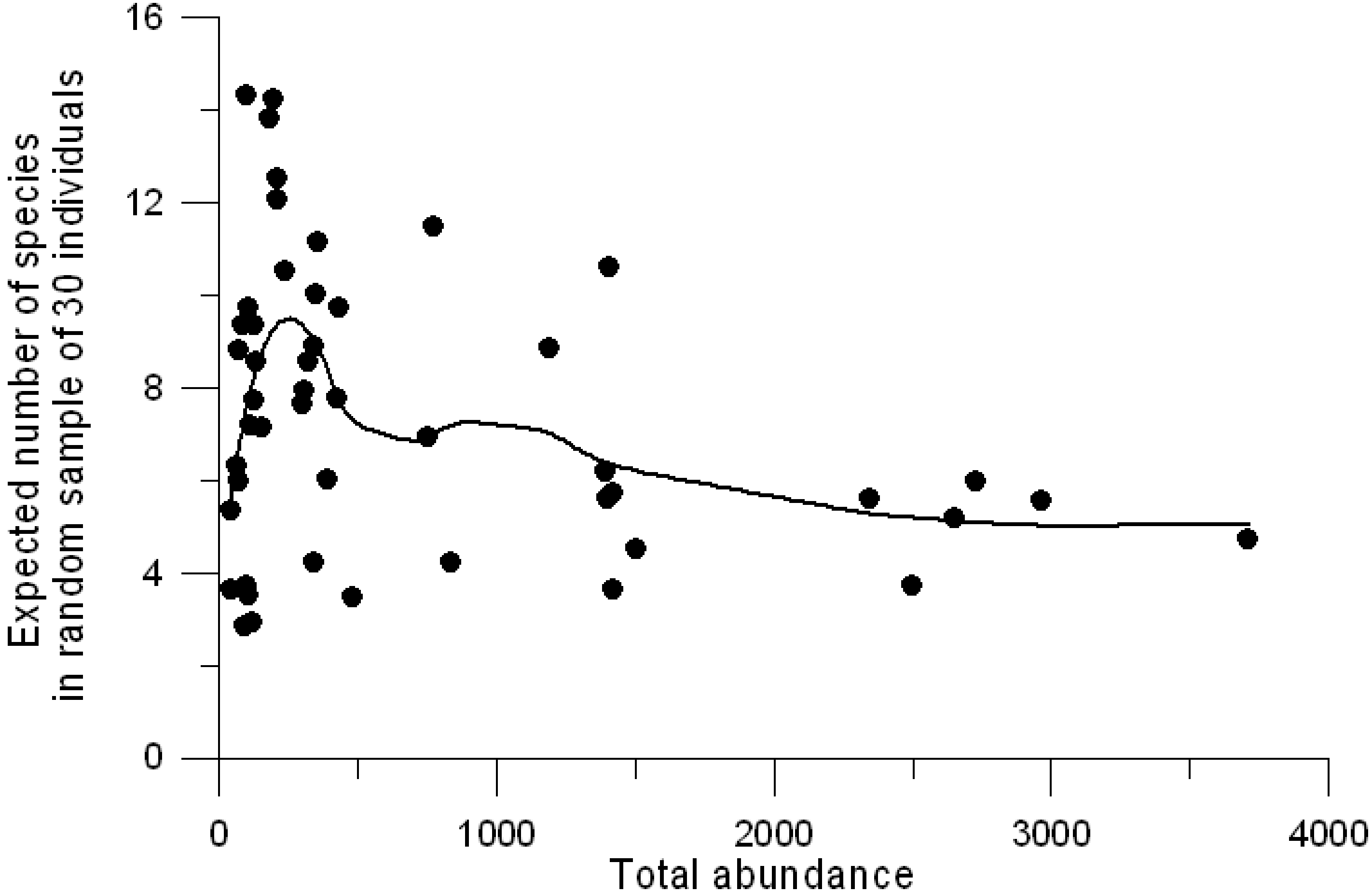


National Coastal Assessment samples in Barnegat Bay-Little Egg Harbor from 2000-2006 (n = 51), color-coded using the Virginian Province Index (Paul et al. 2001)

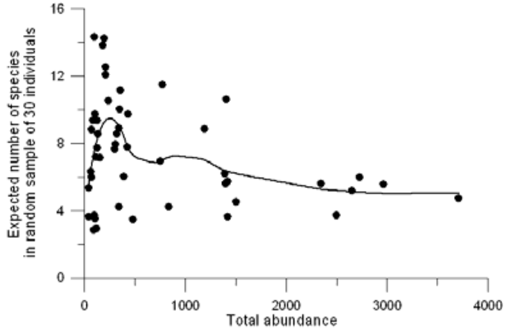
The Virginian Province Index is based on three metrics, which have different weights for the 2000-2006 data from Barnegat Bay

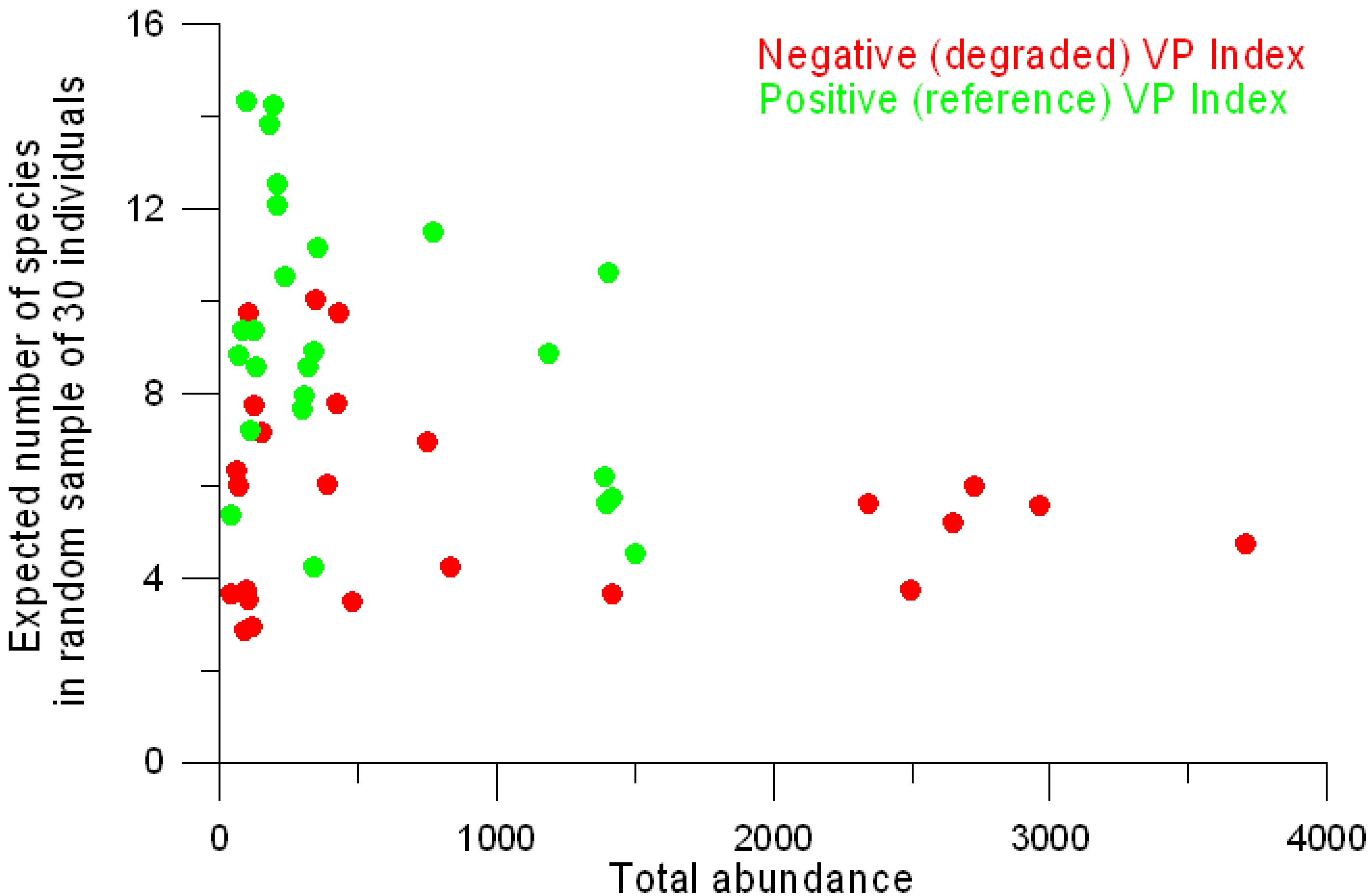


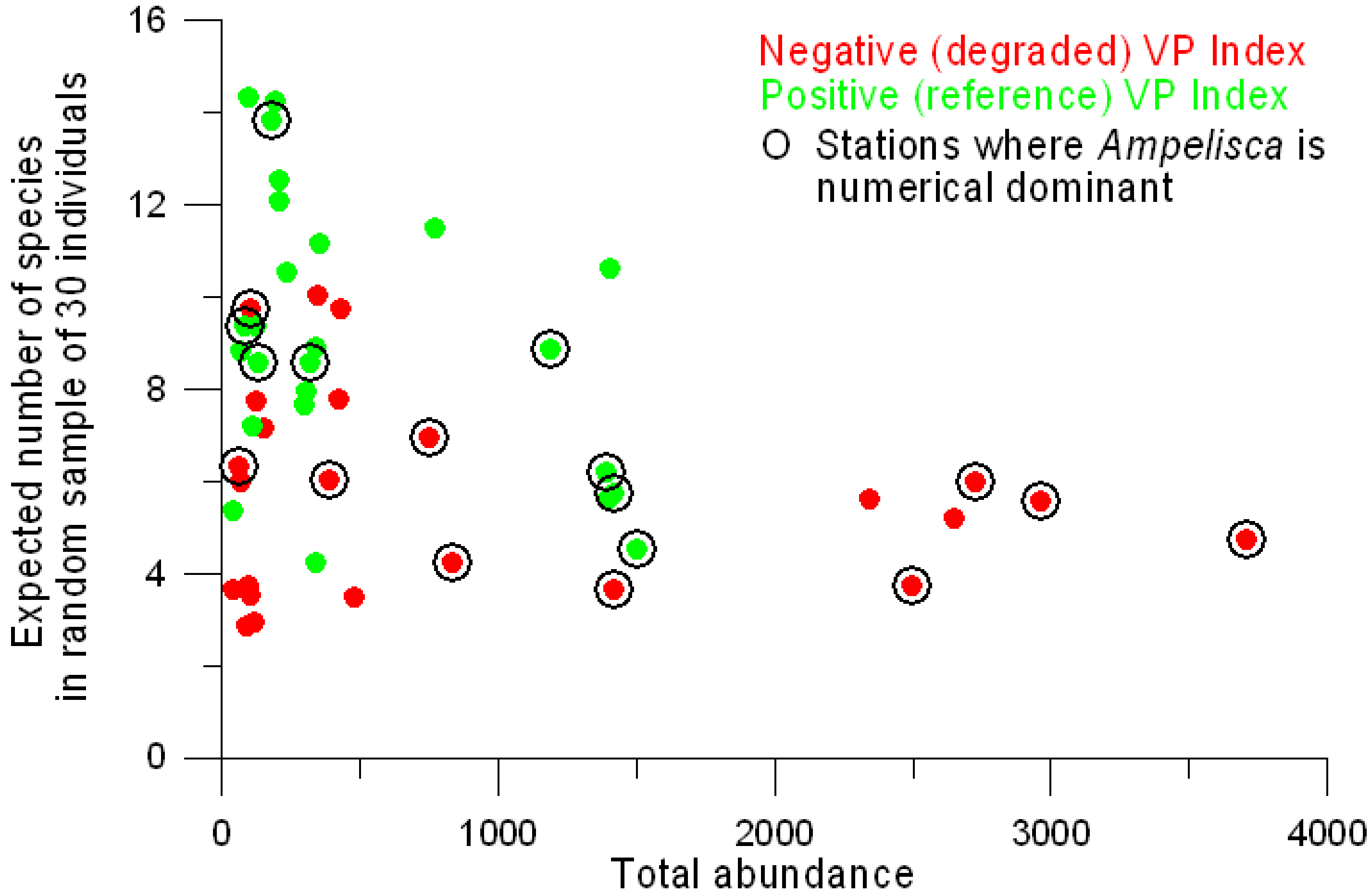
$$VPI = 0.0489 \times SNGD - 0.00545 \times SNTA - 0.00826 \times SA - 2.2$$



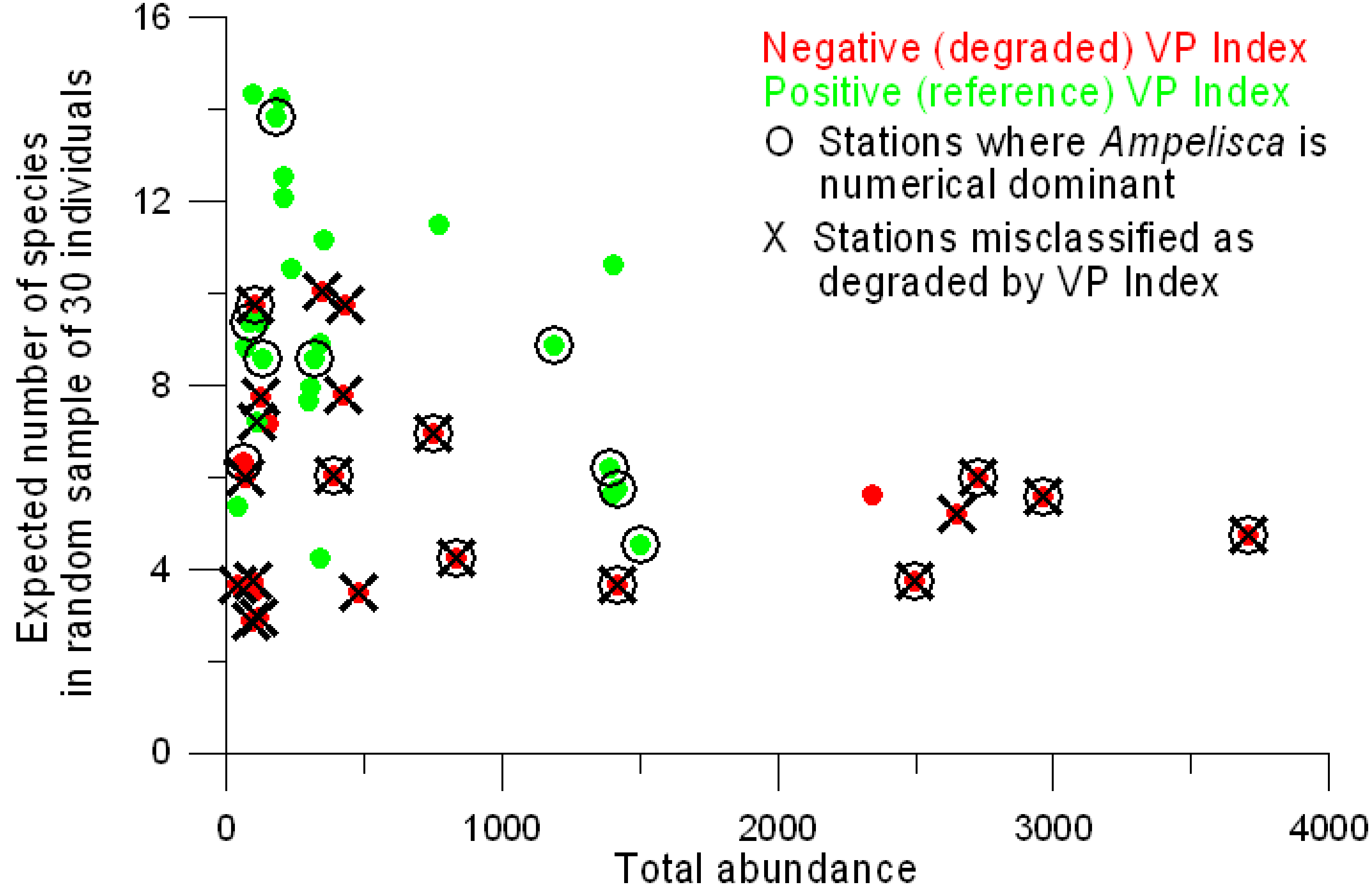
16
12
8
4
0
0
1000
2000
3000
4000
Total abundance
Expected number of species
in random sample of 30 individuals


Expected number of species in random sample of 30 individuals
Total abundance

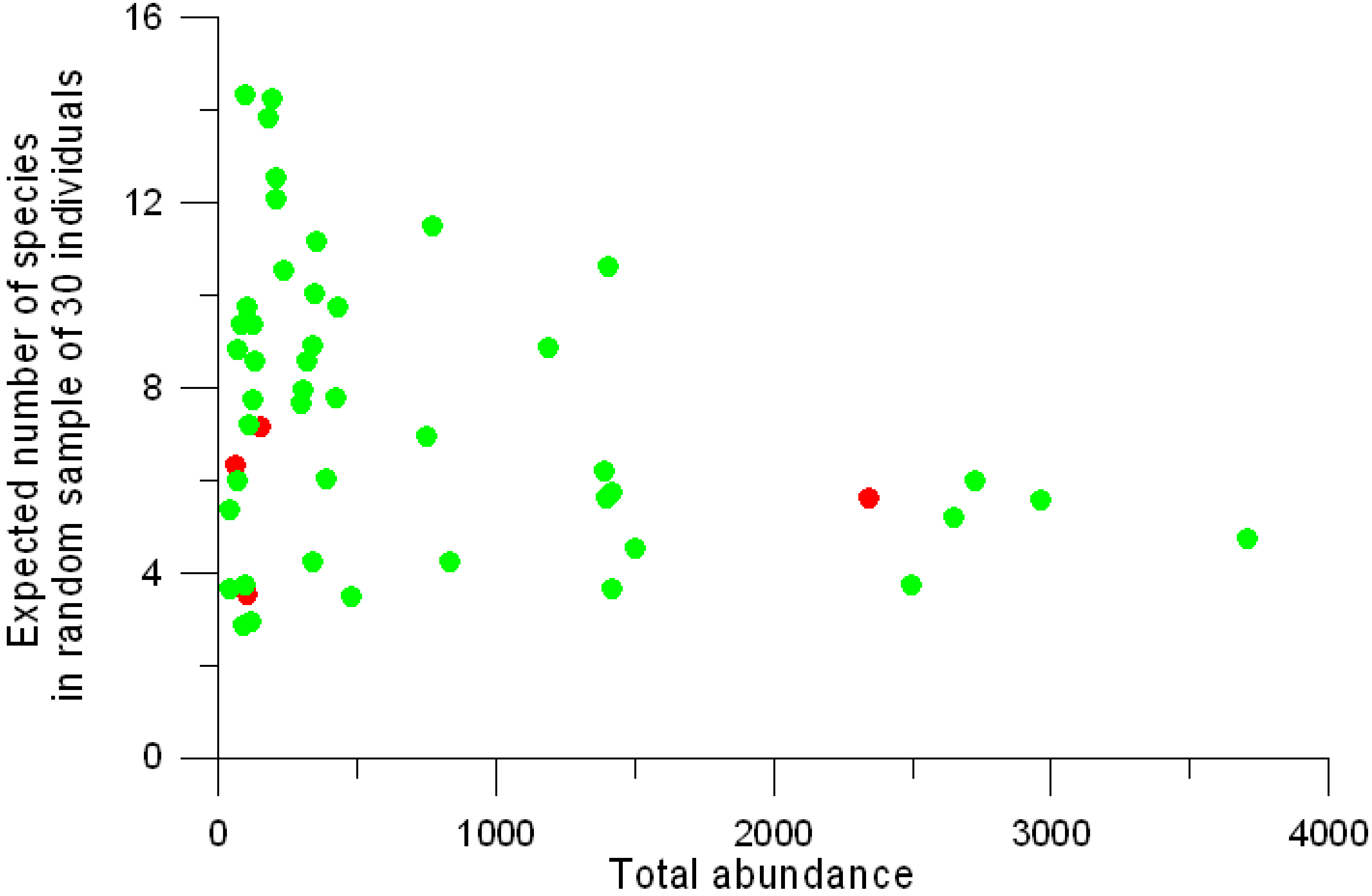

Negative (degraded) VP Index
Positive (reference) VP Index
Expected number of species in random sample of 30 individuals
Total abundance

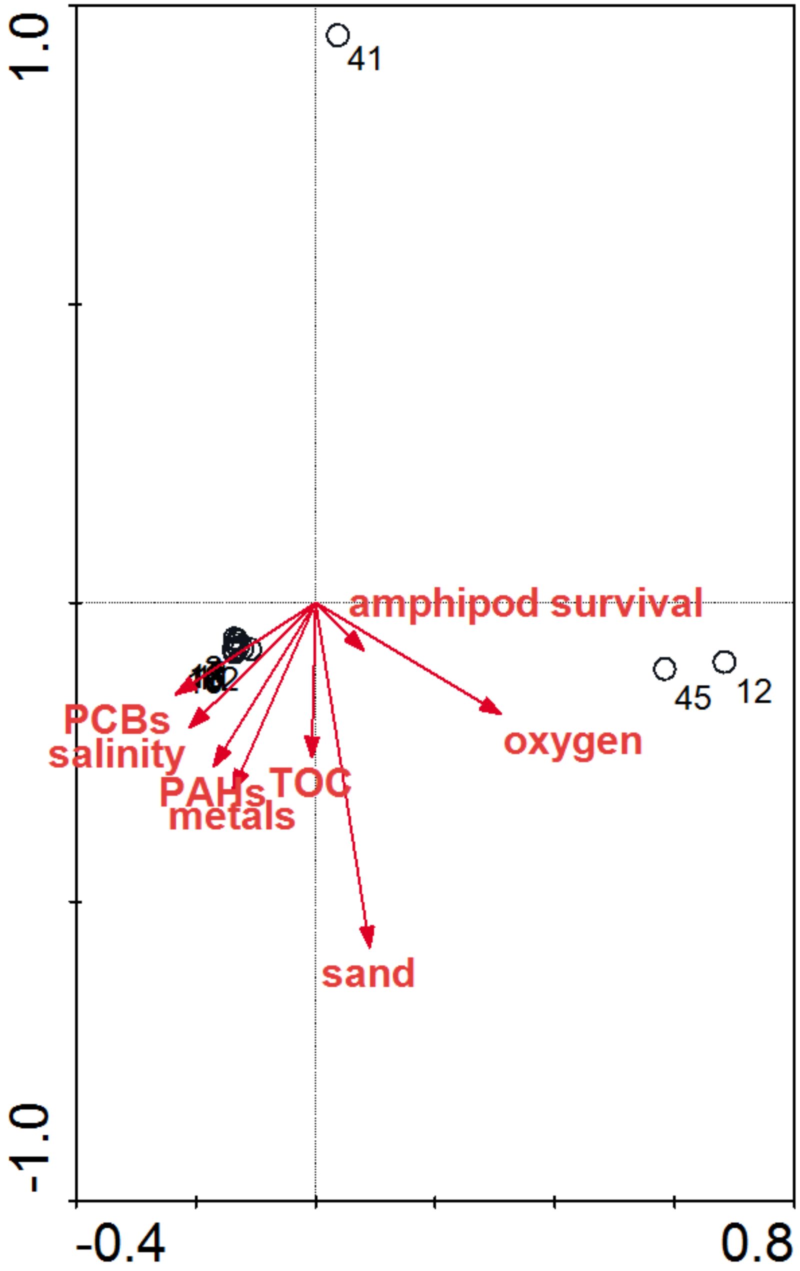


Negative (degraded) VP Index
Positive (reference) VP Index
O Stations where *Ampelisca* is numerical dominant
Expected number of species in random sample of 30 individuals
Total abundance
0
4
8
12
16
0
1000
2000
3000
4000


Negative (degraded) VP Index
Positive (reference) VP Index
O Stations where *Ampelisca* is numerical dominant
X Stations misclassified as degraded by VP Index
Expected number of species in random sample of 30 individuals
Total abundance
0
4
8
12
16
0
1000
2000
3000
4000

Classification of 2000-2006 NCA stations based on amphipod survival, dissolved O_2 levels, and Effects Range exceedences for metals and organic contaminants

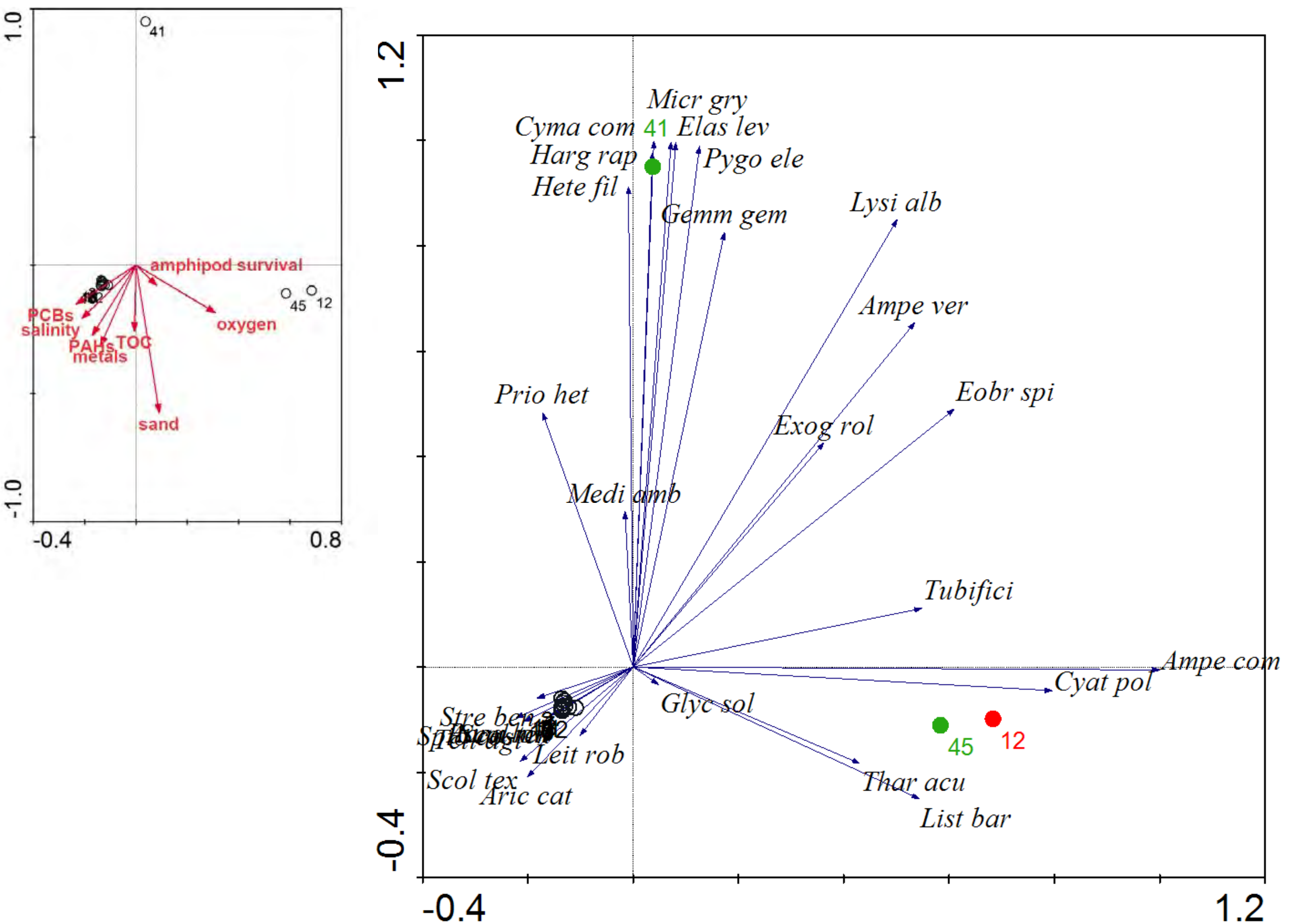


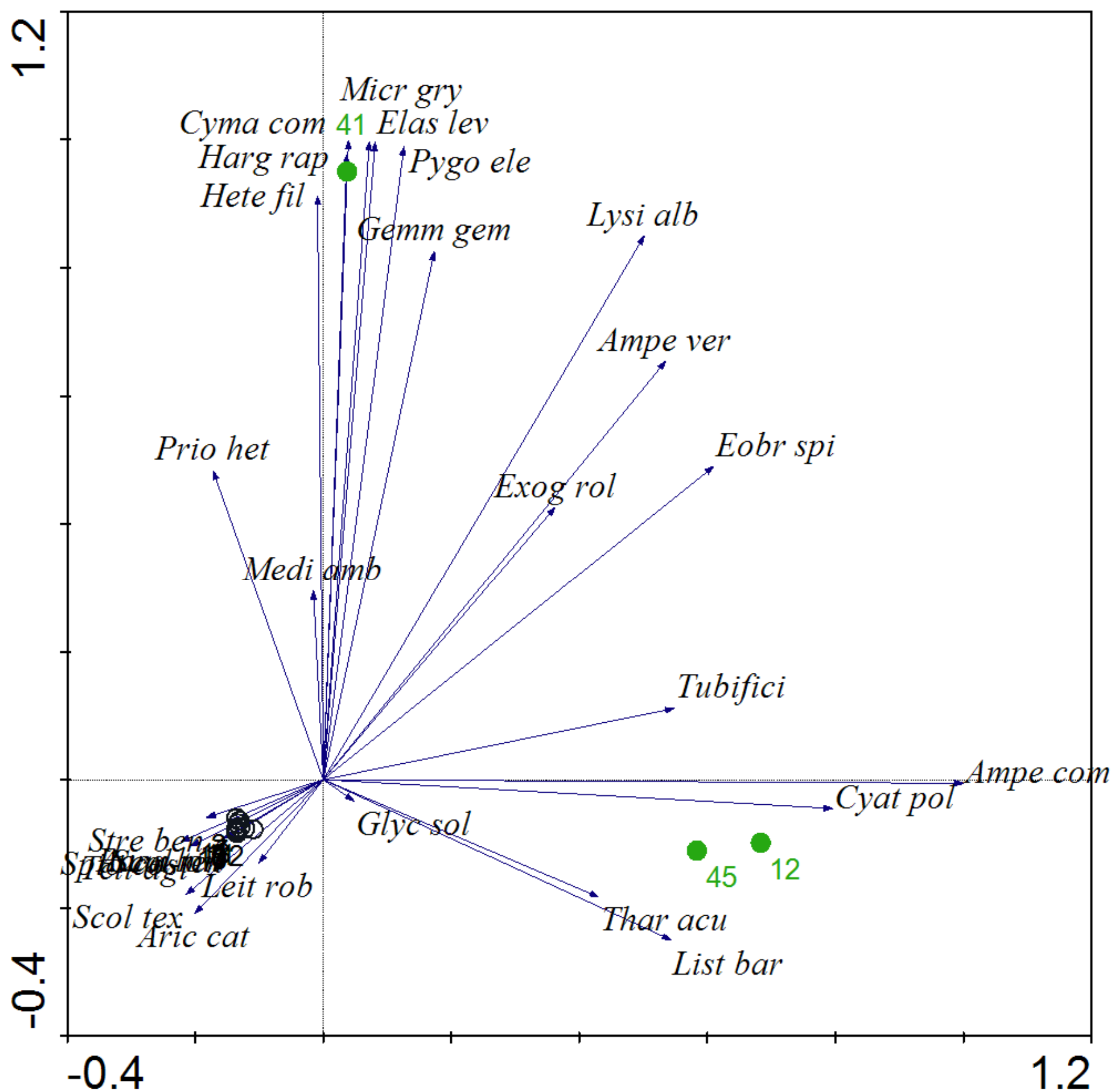


Principal Components Analysis of environmental data for 13 stations sampled in 2006

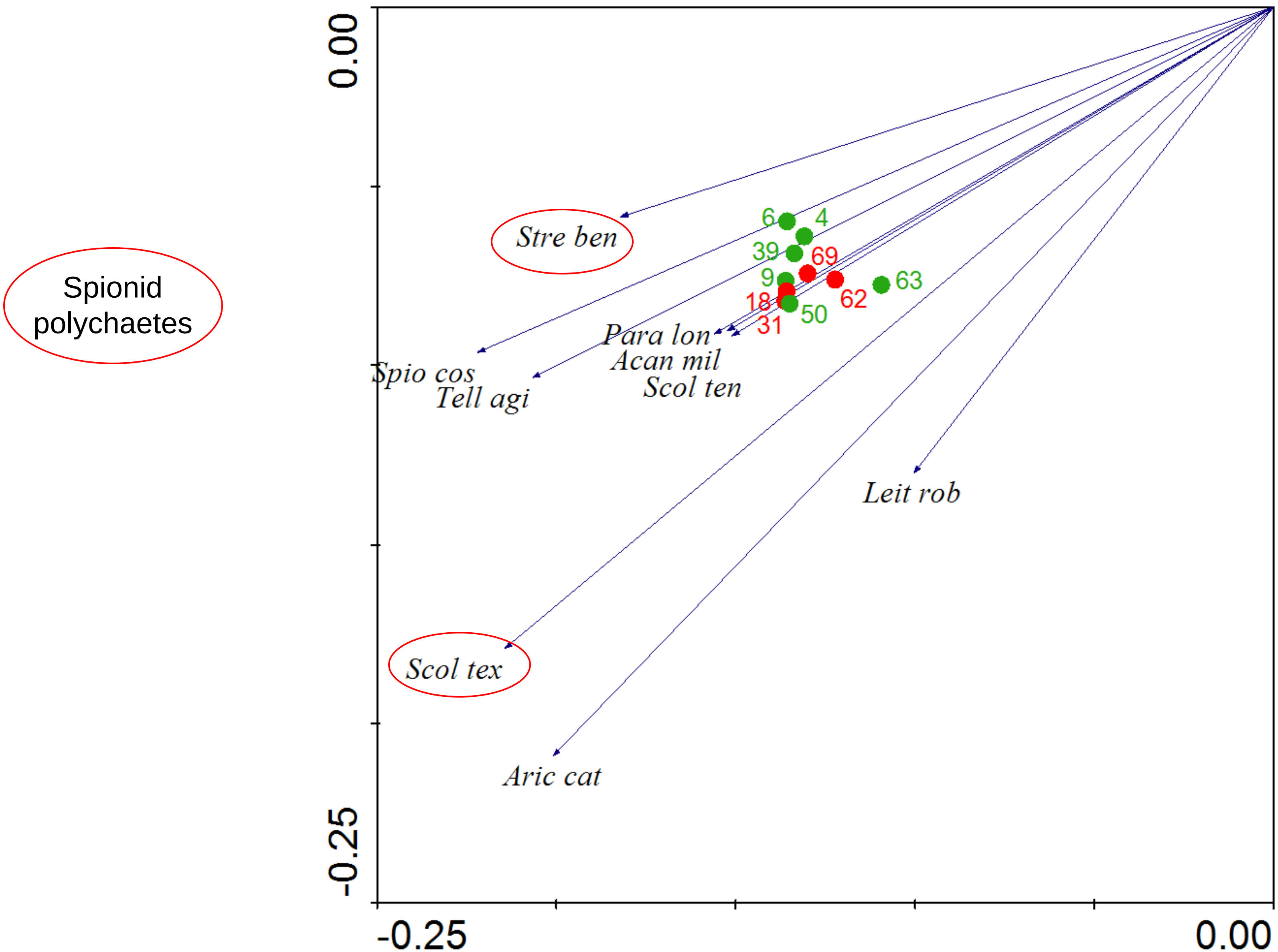
Accounts for 98% of variance in data (92% first axis, 6% second axis)

Principal Components Analysis of species data
Accounts for 98% of variance in data (92% first axis, 6% second axis)

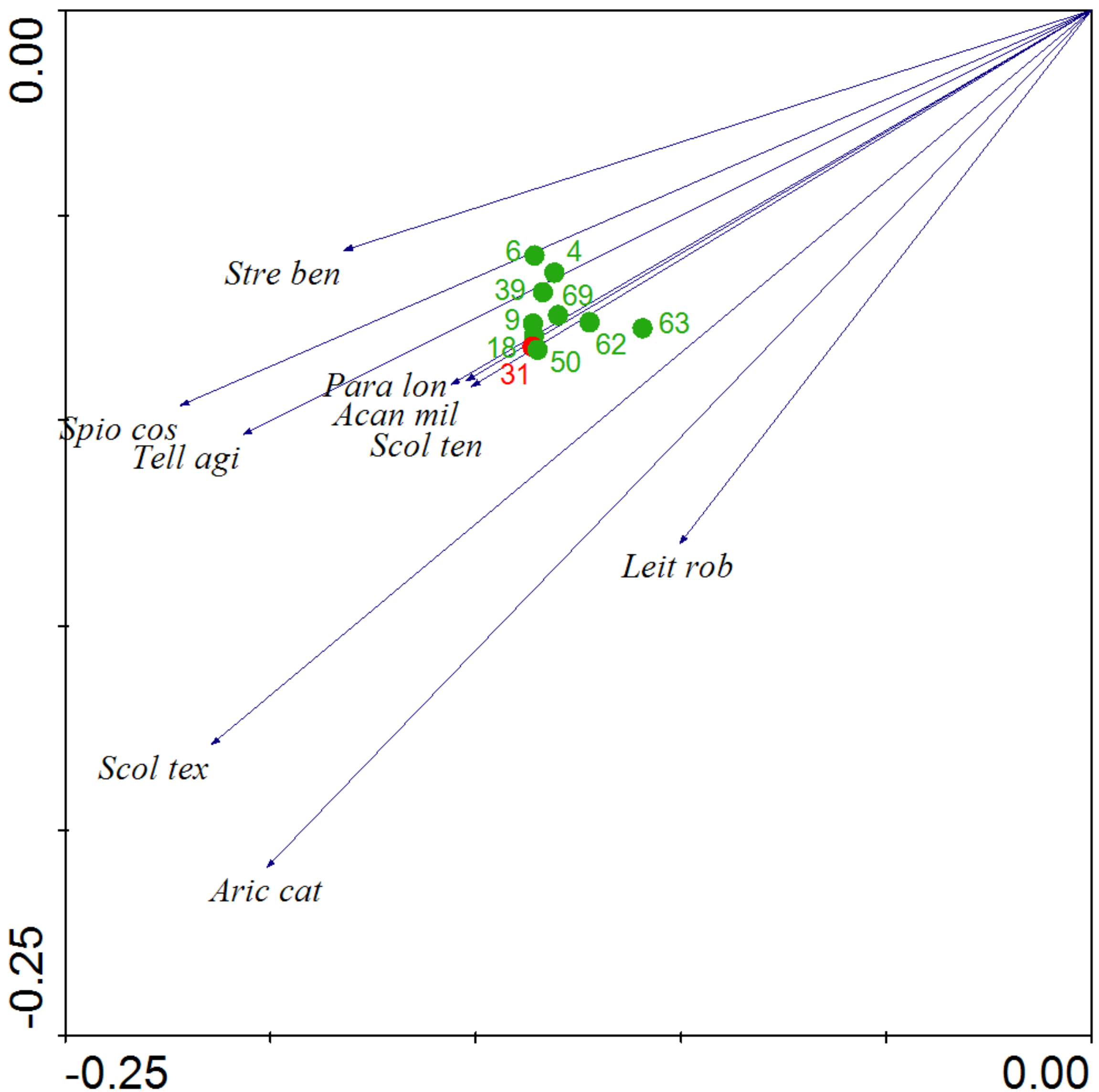



1.2
-0.4
-0.4
1.2
Micr gry
Cyma com
41
Elas lev
Harg rap
Pygo ele
Hete fil
Gemm gem
Lysi alb
Ampe ver
Eobr spi
Prio het
Exog rol
Medi amb
Tubifici
Ampe com
Cyat pol
Glyc sol
Stre ben
Leit rob
45
12
Scol tex
Aric cat
Thar acu
List bar

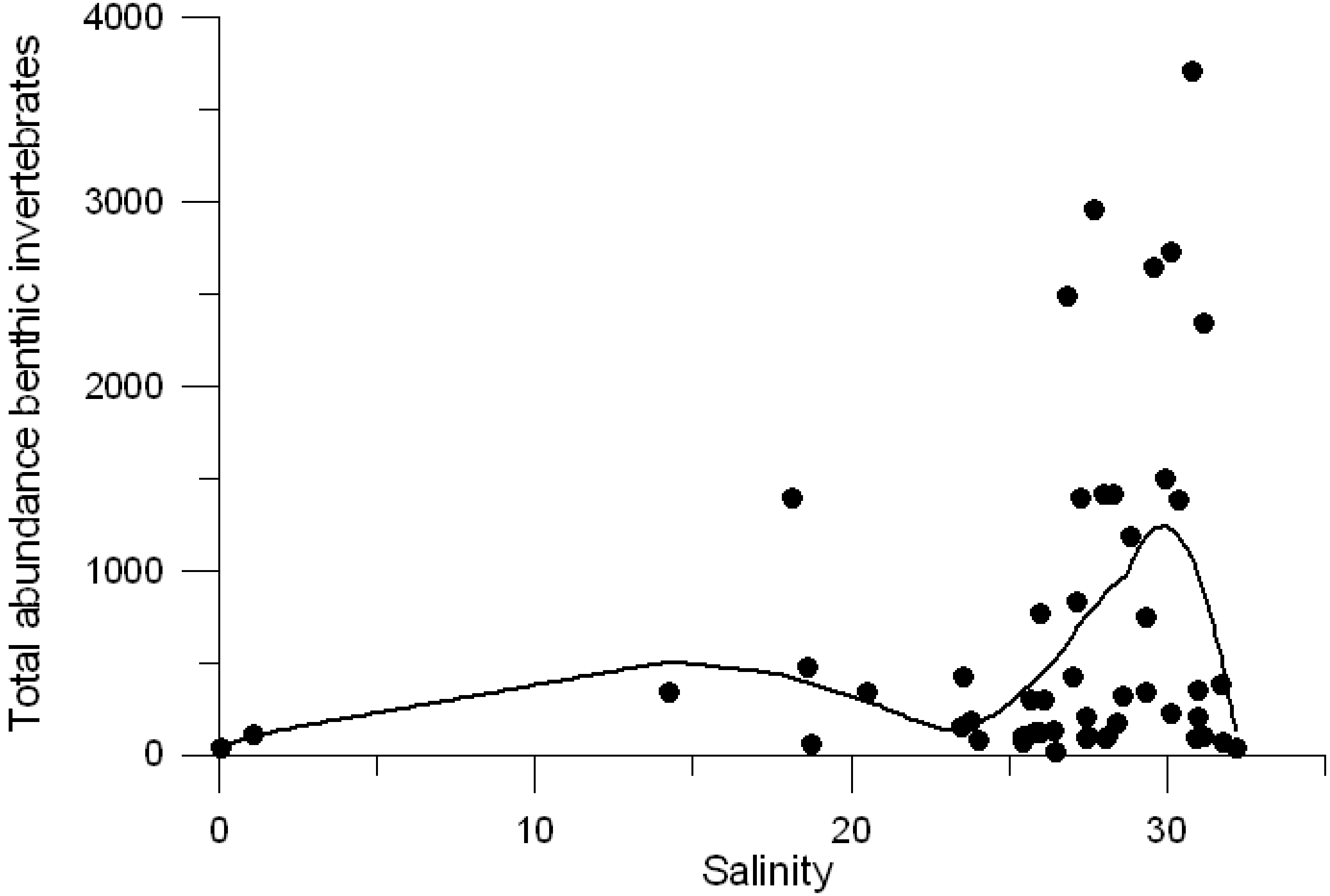
Magnification of lower left quadrant, stations color-coded by VP Index

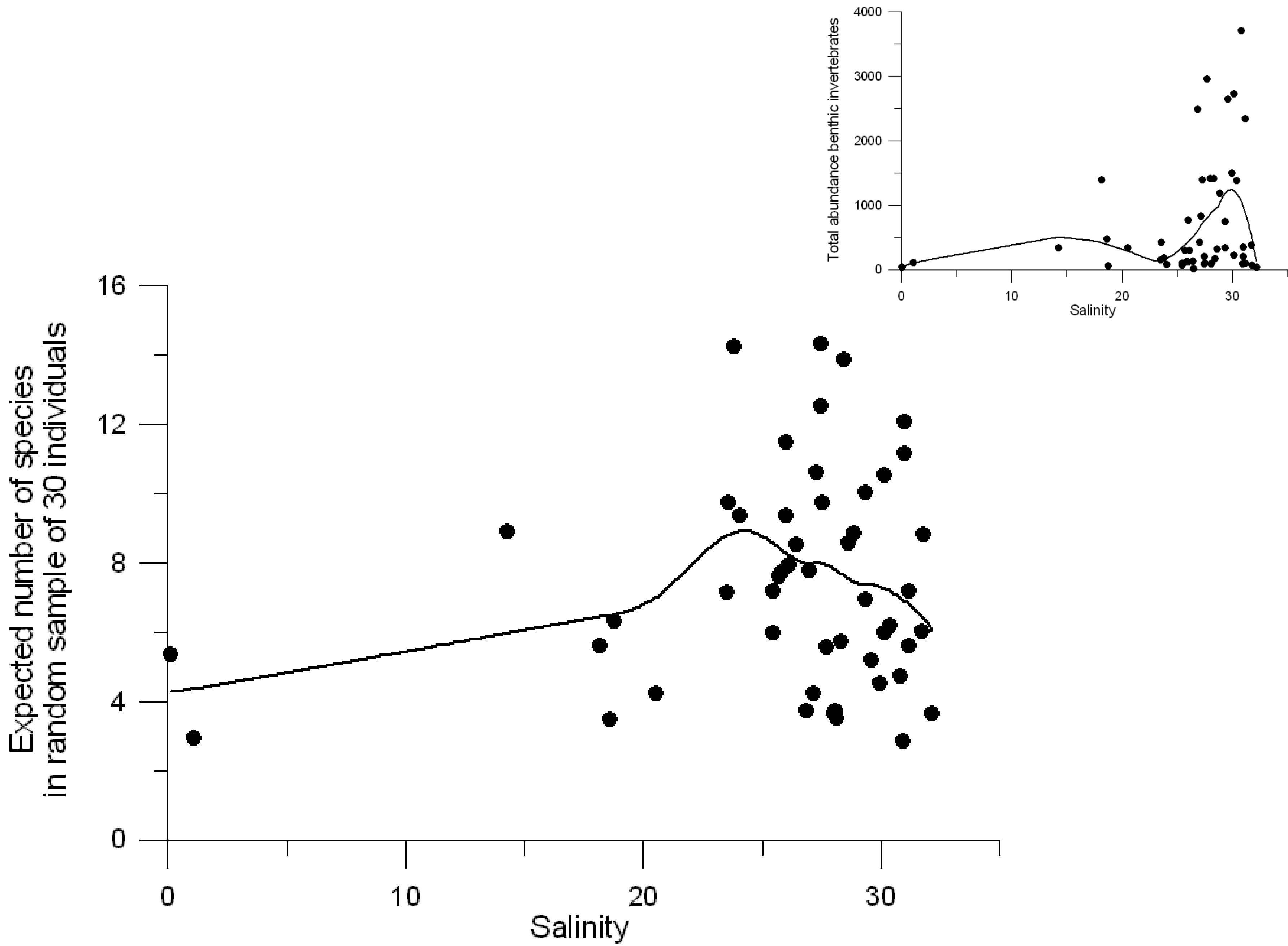


Magnification of lower left quadrant, misclassified stations corrected

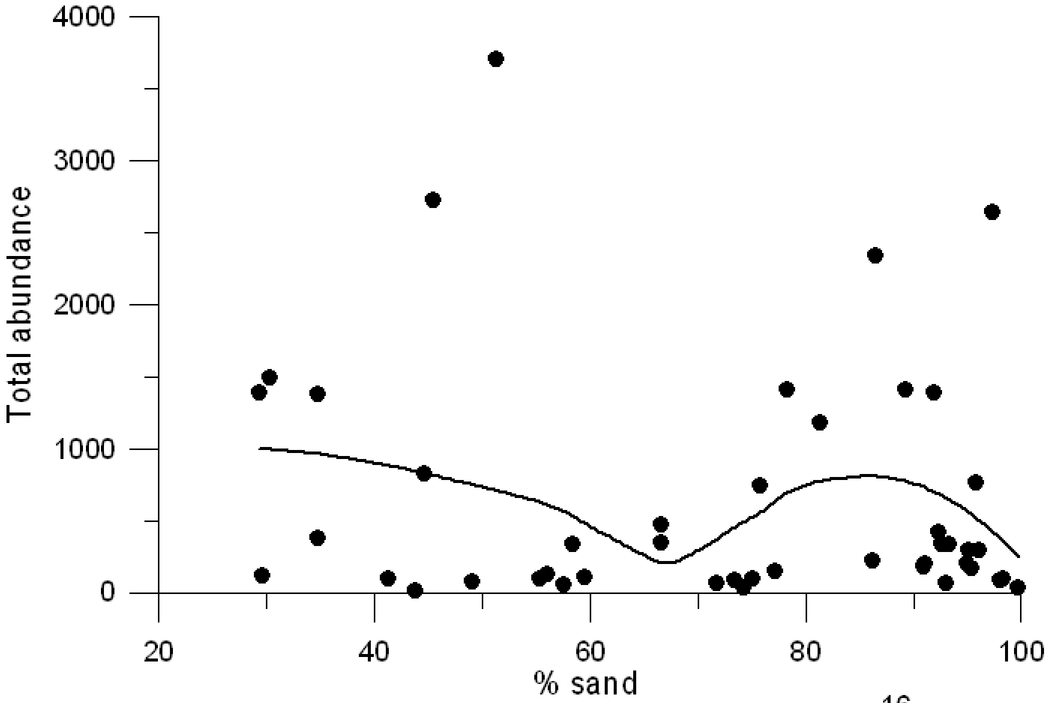


National Coastal Assessment samples in Barnegat Bay-Little Egg Harbor from 2000-2006 (n = 51)

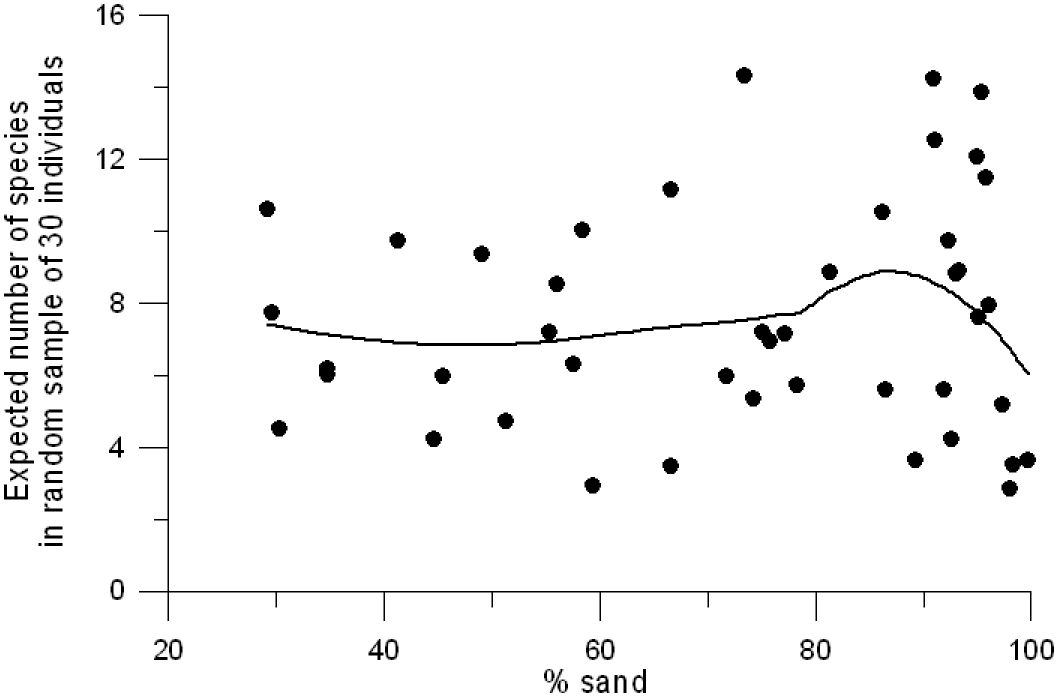




Total abundance benthic invertebrates
4000
3000
2000
1000
0
0
10
20
30
Salinity
Expected number of species
in random sample of 30 individuals
16
12
8
4
0
0
10
20
30
Salinity



Other variables (% sand, total organic C, etc.) show less correlation with abundance or species diversity



Barnegat Bay diatom water-quality calibration

Mihaela Enache, Don Charles; Patrick Center for Environmental Research

Marina Potapova; Center for Systematic Biology and Evolution

Academy of Natural Sciences

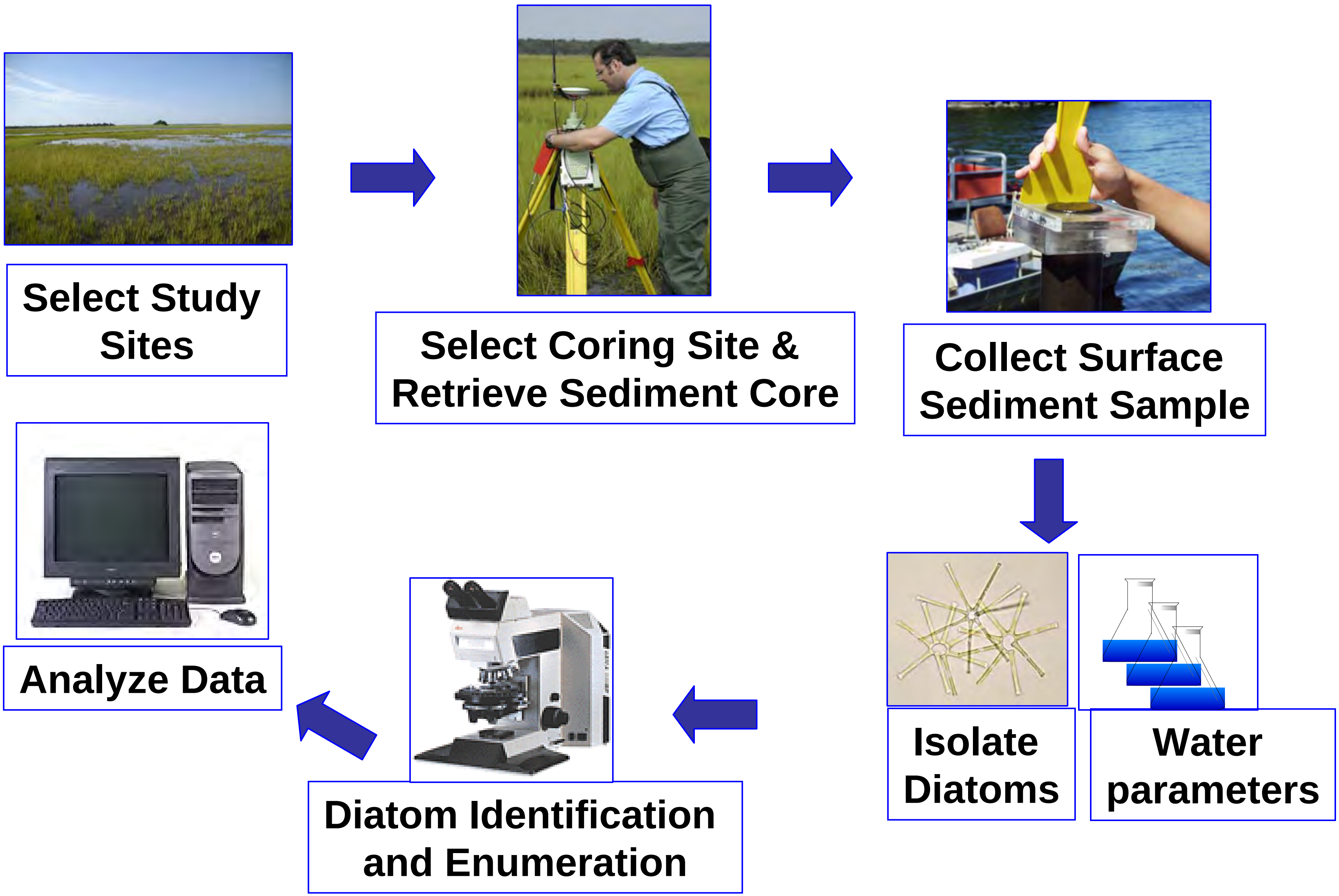
Barnegat Bay

- range of gradients of habitat types and land use
- protected by both federal and state laws
- the condition of Barnegat Bay has worsened over the last two decades

Project objectives

- create a regional calibration set of diatom assemblages and develop inference models for the Barnegat Bay tidal wetland, embayment and off-shore ecosytems (N=100)
- investigate the link between diatom indicators and anthropogenic influences in the watershed, such as urban and agricultural land use
- Provide reliable tools for future biological monitoring in the Bay and assessment of the impact of human activities

- Team work effort: PCER (Phycology; Watershed Management; and Geochemistry) and Diatom Herbarium dpts.



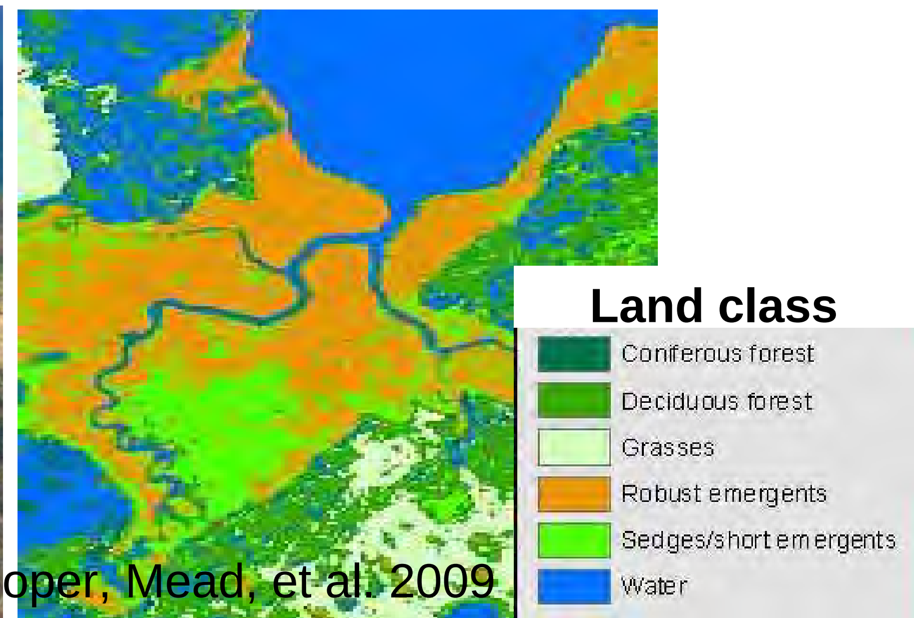
Photos courtesy of B. Cumming, R. Thomas, Dell & Leica

Project Design

- Select sampling sites along gradients of land use and habitat types (GIS)
- Collect surface sediment and water chemistry samples
- Investigate taxonomy of diatom species
- Develop a regional calibration set to relate wetland conditions to diatom communities
- Focus on nutrients

Sampling sites selection

- Acquire most recent Geoeye imagery;
- On-screen digitization of classification training points;
- Field survey of training points;
- Classification of map into classes of landcover;
- Spatial analyses of landcover at varying distances up slope from all locations in the marsh and bay;
- Use image analyses to guide site selection for coring.

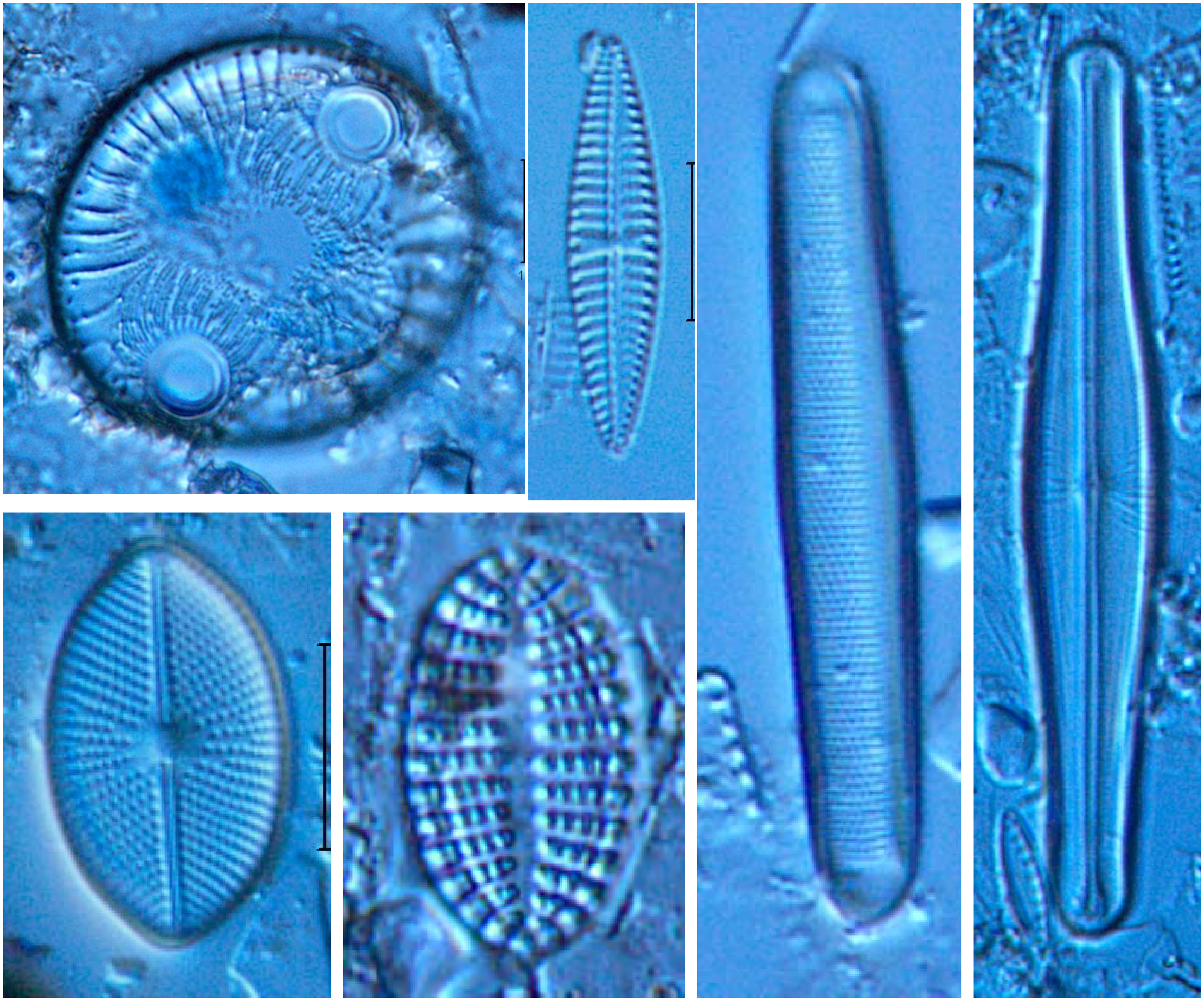


Cooper, Mead, et al. 2009

Background

- Diatoms:
- abundant in most aquatic environments
- respond quickly to changing conditions
- Mineralized (silica) cell wall (frustule) - preserves in sediments

Widely used as water quality indicators (e.g., pH, nutrients, salinity)

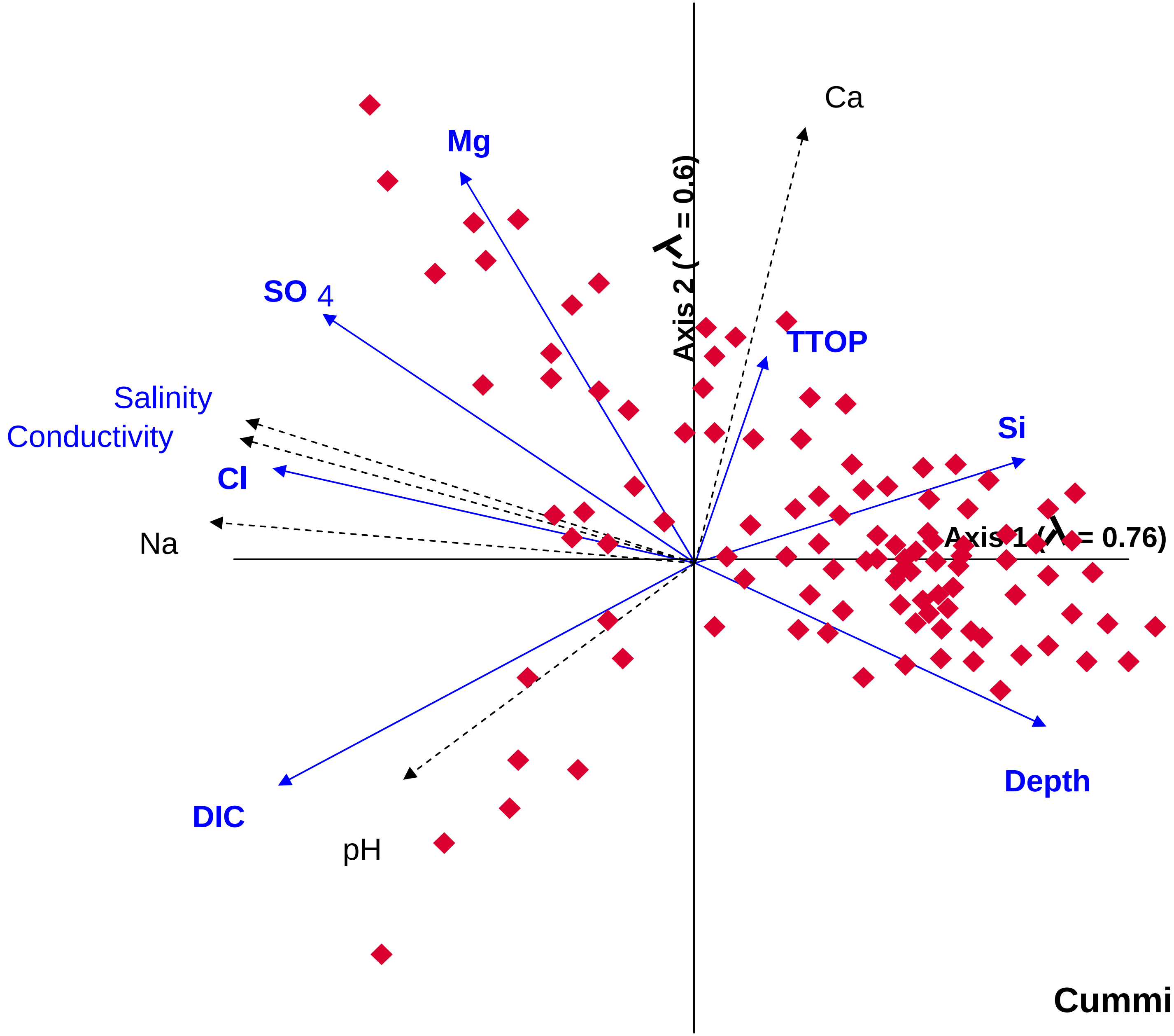


Can the measured environmental variables account for variation in the species composition?

What environmental variables explain the most variance in the species data?

Constrained Ordinations

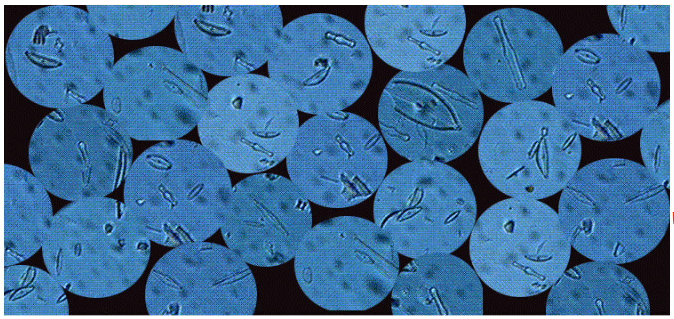
Simplified CCA Ordination Showing Relationship of Diatom Taxa to Measured Environmental Variables

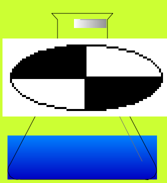


Cumming et al. 1995

Diatom-environmental parameters calibration process

surface sediment samples



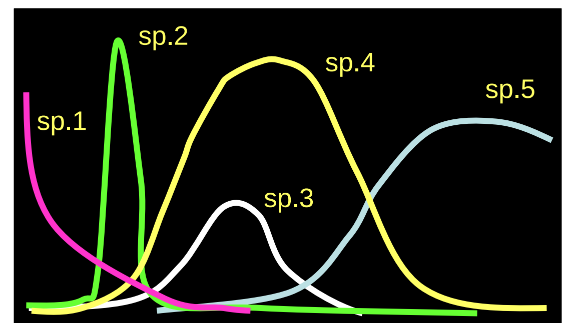


Surface area
Depth
Development
Total phosphorus
Total nitrogen
Chlorophyll *a*
Suspended solids

pH
Secchi depth
Temperature
Conductivity
Oxygen
Alkalinity
Ammonium

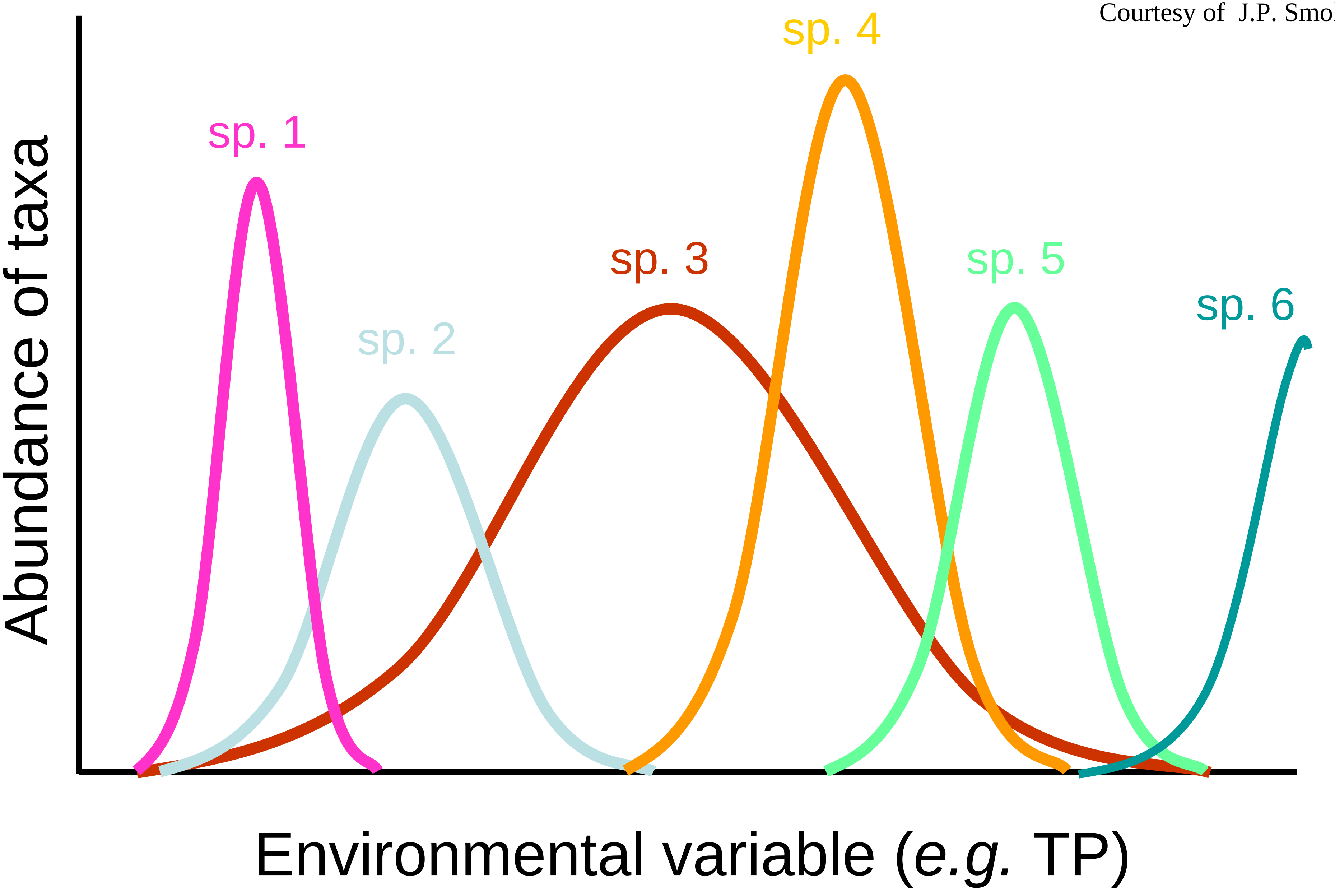
environmental data

species response curves



Courtesy of J.P. Smol

Diatoms


Courtesy of J.P. Smol
sp. 1
sp. 2
sp. 3
sp. 4
sp. 5
sp. 6
Abundance of taxa
Environmental variable (*e.g.* TP)

Diatoms in coastal environments

- Very few studies of the US coastal diatoms:
  M. Sullivan (DE)
  S. Cooper; C. Wilderman (Chesapeake Bay)
  Huvane JK (Florida)
  Hustedt (N. Carolina)
- In coastal Barnegat Bay: Diatom species poorly known (Olsen & Mahoney in Kenish et al 2001 – 35% unknown species).
- Diatom ecology not established

Baltic flora used in S. Cooper work for down-core ecological information!

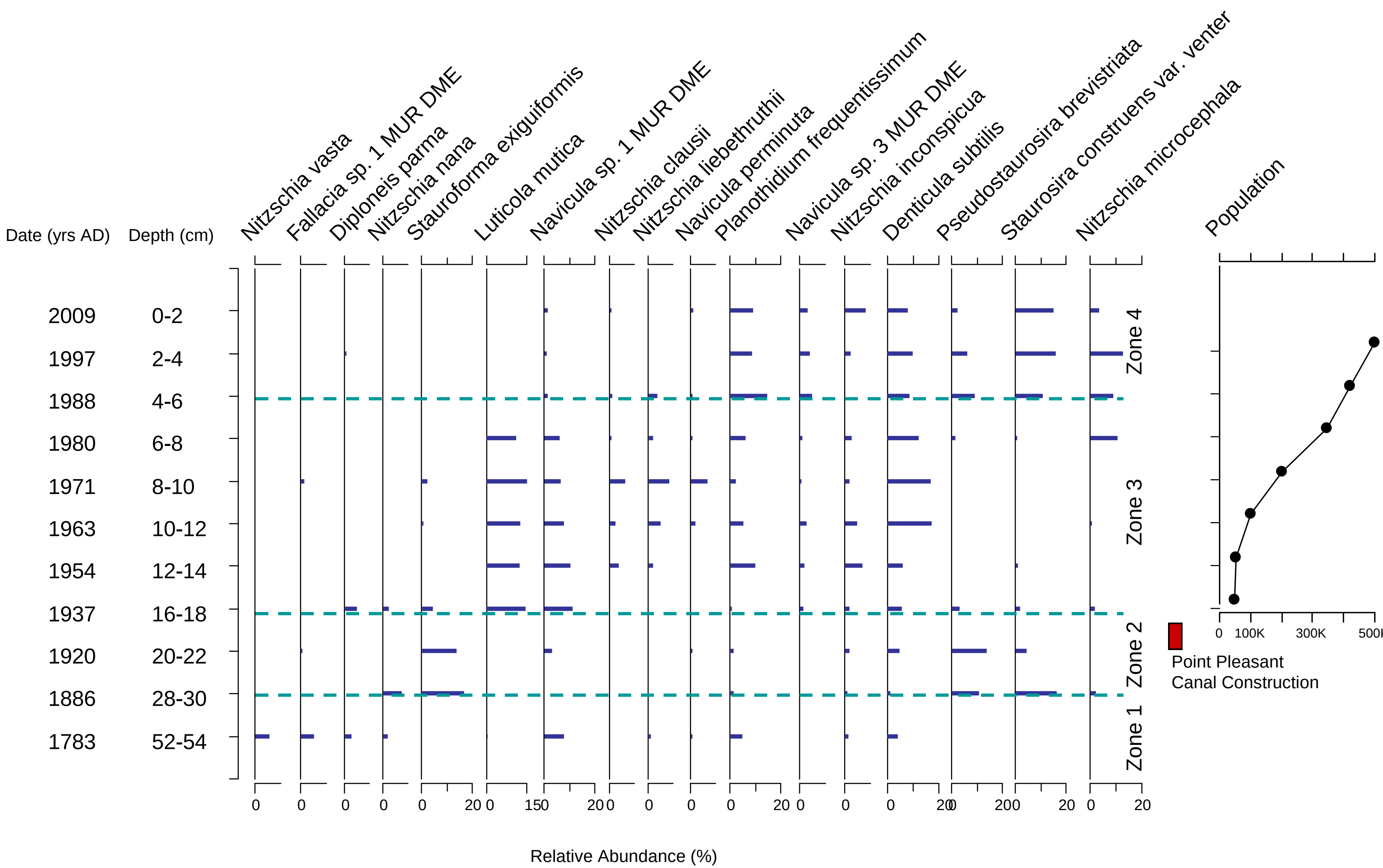
Other similar projects

- Baltic Sea calibration set (MOLTEN 2004 (http://Craticula.ncl.ac.uk/Molten/jsp/); Juggins et coll.)
- Great Lakes calibration set (Reavie et al. 2006)

Our previous investigations on Barnegat Bay Diatoms revealed:

- Important shifts in diatom communities consistent with increased population and related activities:
  - major shifts toward more eutrophic or mesotrophic conditions starting in the 1940-1950s
  - highest diatom changes reflect response to the construction of Point Pleasant and Forked River Canals
  - a 1980-1990 shift – combined effects from water pollution, nutrient inputs and climate change
  - the Bay remains impacted by anthropogenic disturbances and has not returned to its natural condition despite federal and state protection
- Many undescribed species with unknown ecology

Northern Barnegat Bay Diatom stratigraphy



Project outcomes

- Documentation of Barnegat Bay diatom species and their autecology
- Ecological metrics for future water quality monitoring
- A calibration set for diatom species and water quality parameters along human disturbance gradients
- New 2 meter resolution maps of landcover in the areas bordering the bay

Collaboration possibilities

- Sharing sediment samples with Drs T. Quirk and D. Velinsky
- Using chemistry data from on-going NJDEP water quality monitoring
- Sharing data with Dr. L Ren (GIS, diatom taxonomic results, explore diatom- algal bloom relationships)
- Sharing data with other researchers

THANKS!

Courtesy of R. Thomas

Barnegat Bay Phytoplankton and Harmful Algal Blooms

Ling Ren

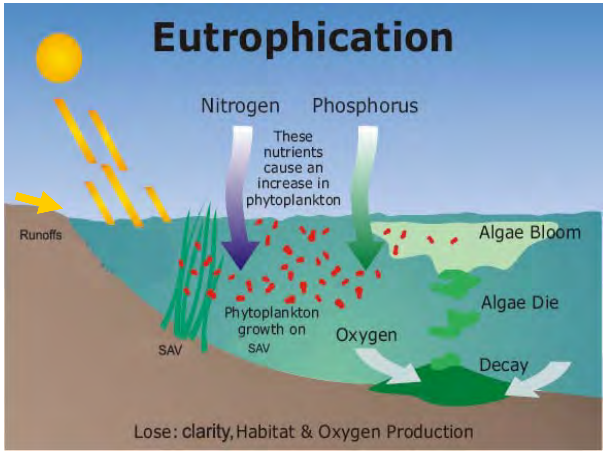
Patrick Center for Environmental Research

ANSP

Introduction

Barnegat Bay (BB)

- **Shallow, poor flushing, highly developed watershed area.**
- **Moderately eutrophic (Seitzinger & Pilling 1993)→highly eutrophic (Kennish et al. 2007)**
- **Human-induced nutrient loading, esp. non-point source N**



Symptoms (Kennish et al. 2007)

- **High primary production and chl *a***
- **Occurrence of 'brown tide' and other HABS**
- **Loss of submerged aquatic vegetation and hard clams**

http://05lovesgeography.blogspot.com/2011/02/eutrophication.html

Objectives

- Describe temporal and spatial distribution of phytoplankton
- Identify species composition and succession, and investigate the effects of environmental change on phytoplankton community
- Compare with previous studies to assess long-term change of phytoplankton community

Provide baseline information on the diversity and distribution of phytoplankton for water-quality assessment, management and restoration efforts

Common marine phytoplankton

Sampling

Synchronized with collections in QAPP

2011:

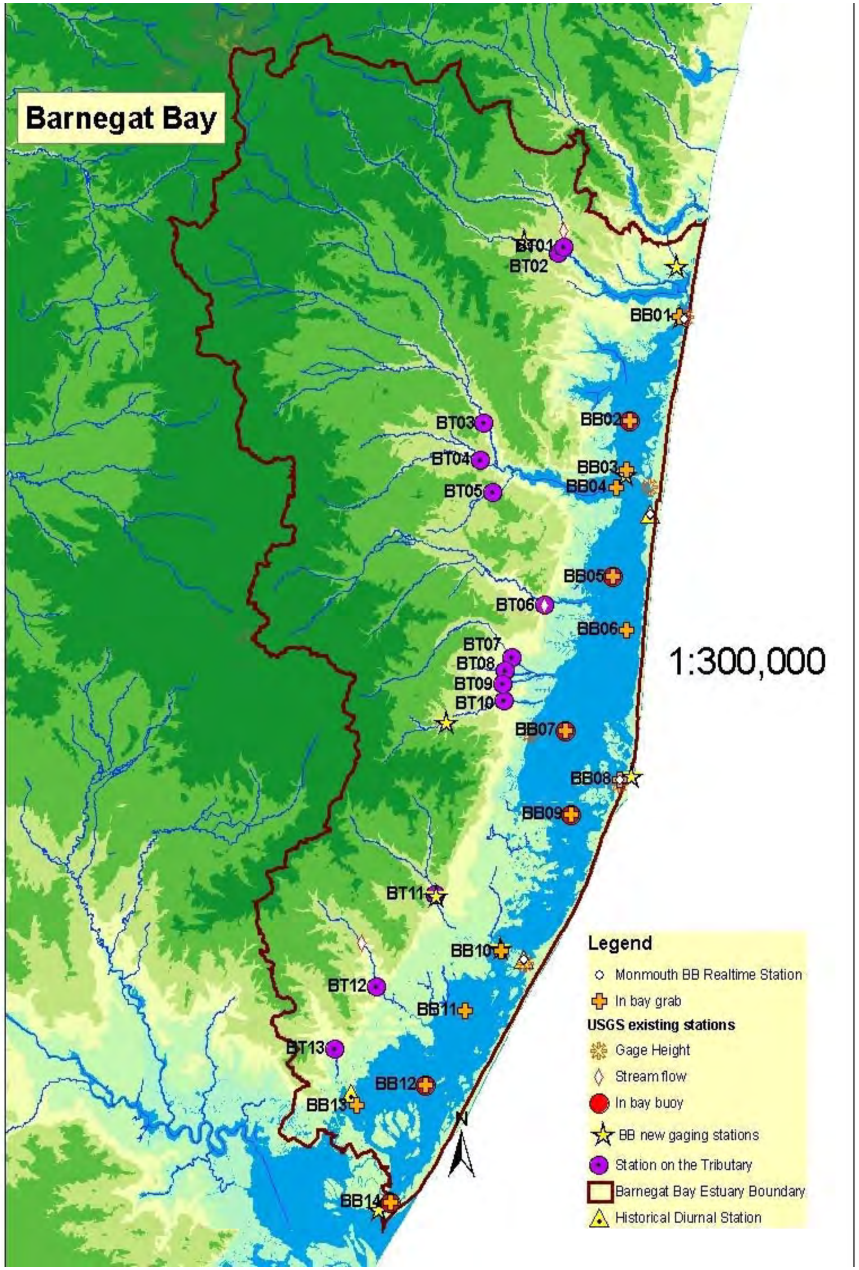
- **Started in July**
- **Biweekly Jul-Sept**
- **Monthly Oct-Dec**

2012:

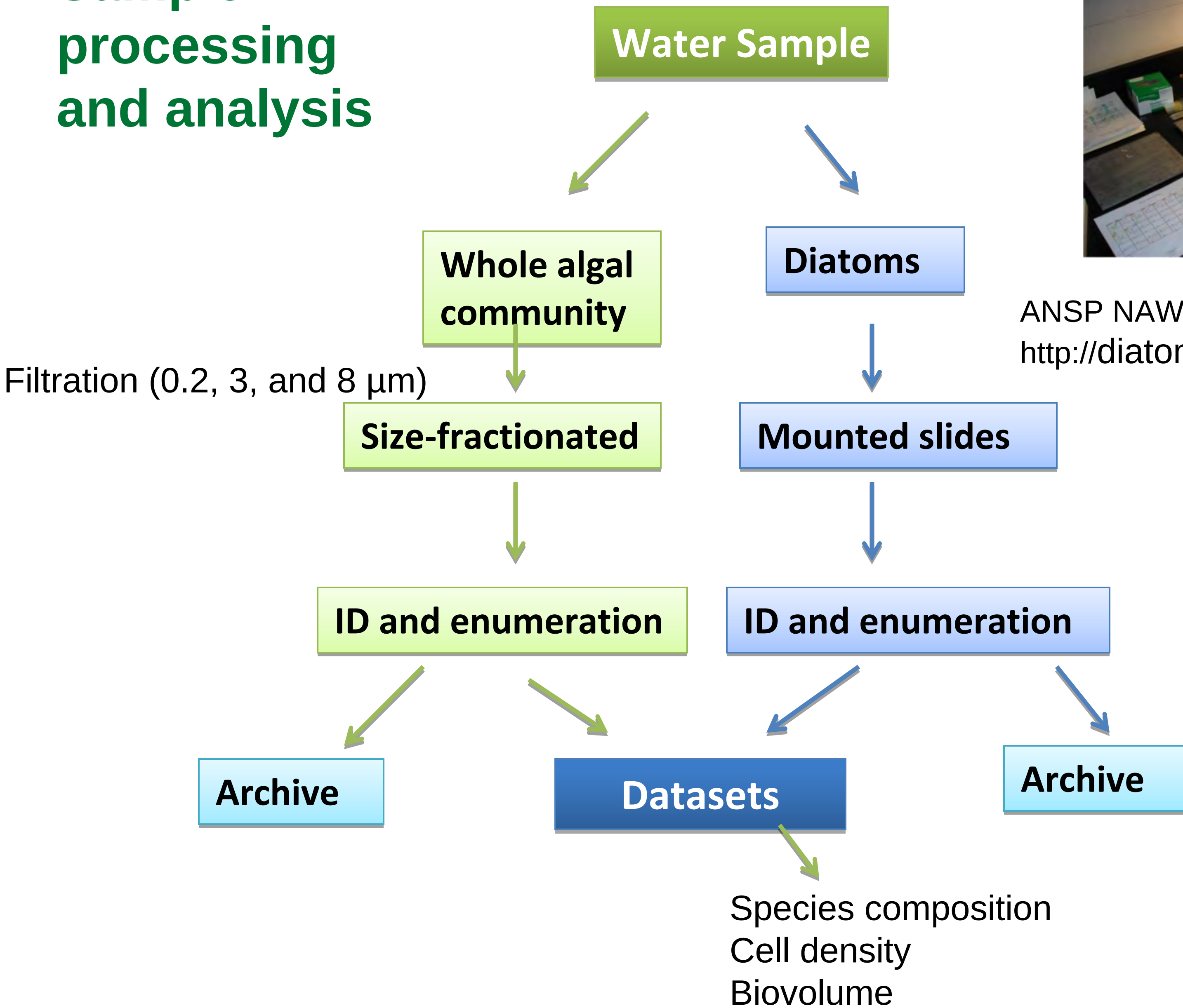
- **Biweekly Jan-Mar and Oct-Dec**
- **Weekly Apr-Sept**

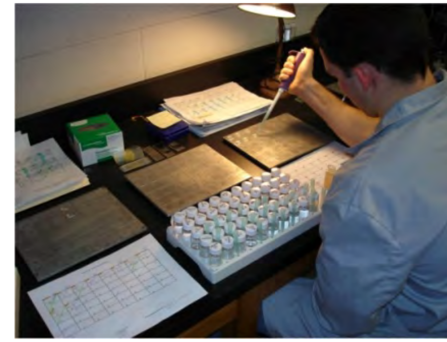
1st priority: 6 buoy stations

3 additional sites



Sample processing and analysis





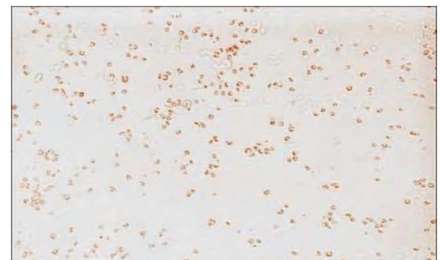
ANSP NAWQA protocol P-13-49:
http://diatom.ansp.org

Sample processing and analysis

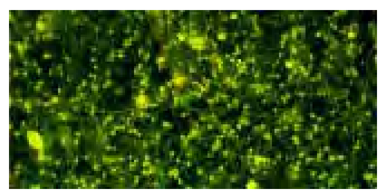
Whole algal community counts

Diatom counts

Epifluorescence Microscope (Leica DML), ANSP



http://www.sciencecodex.com



Light Microscope (Zeiss Axioskope2), ANSP

Transmission Electron Microscope (TEM), Drexel University

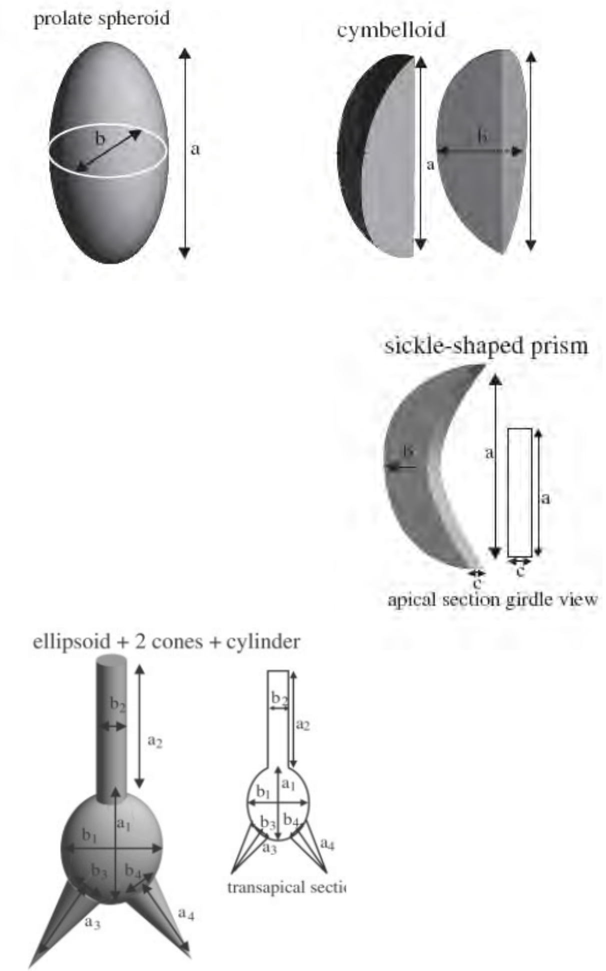
Scanning Electron Microscope (SEM), Drexel University

Datasets

- **For each sample: species composition, cell density, biovolume and C biomass**

- **Size-fractionated Chl:C ratio**

- **Species richness and diversity index from each site**

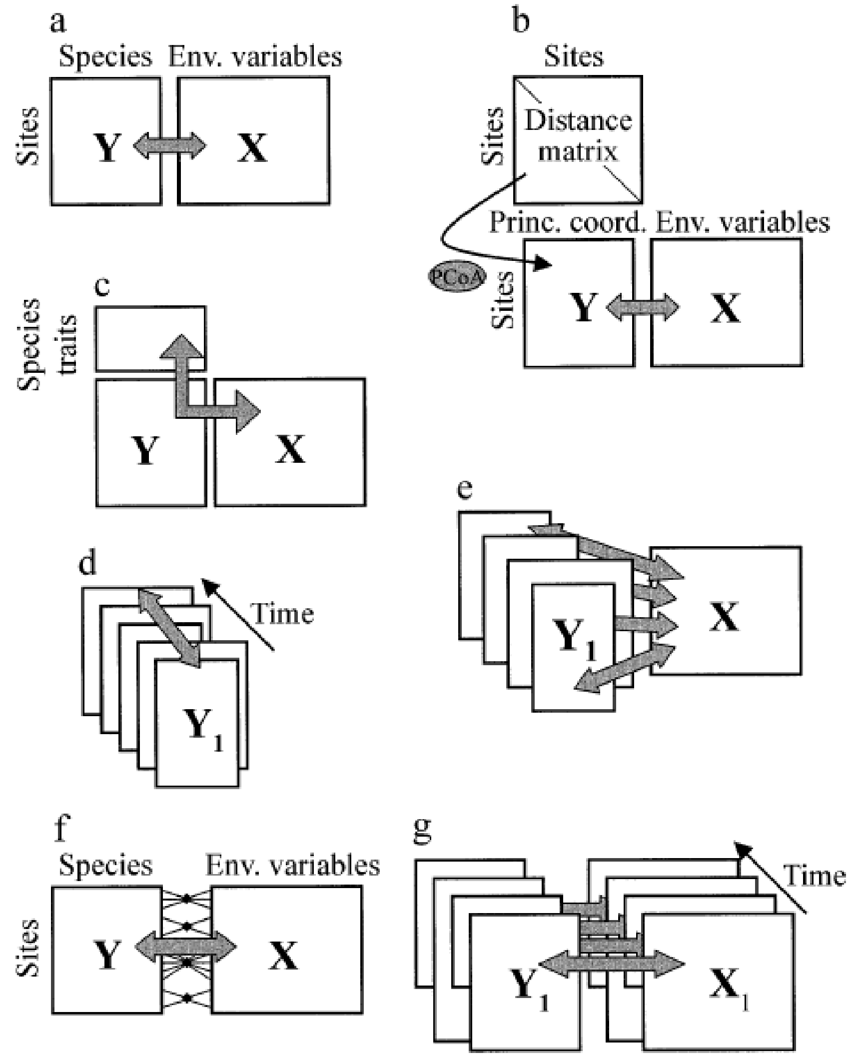


Hillebrand et al. 1999, J. of Phycology

Data analysis

➢ **Compare phytoplankton abundance and species composition among different sites**

➢ **Explore with co-inertia analysis (CIA) on relationship between species succession and environmental variables**



Dray et al. 2003, Ecology

Collaborations

With Dr. Mihaela Enache (Benthic Diatom Calibration project) on pelagic-benthic coupling on diatom compositions. Synchronized water samples will be collected from the selected sites.

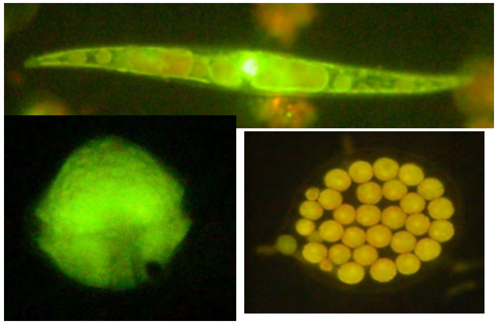
With Dr. Monica Bricelj (Rutgers University) on the effects of phytoplankton composition on the survival and growth of the larva of hard clam *Mercenaria mercenaria*

Previous and on-going phytoplankton work

Nutrient enrichments on phytoplankton growth and species succession

German Bight, North Sea: Mesocosms and modeling (Ren 2000)

Northern Gulf of Mexico: microcosms (Ren et al. 2009, and in prep)



- **Louisiana USGS phytoplankton: water quality survey related to Mississippi River discharges (2011)**

- **Biodiversity of phytoplankton in coastal East China Sea (2009-2012)**

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

September 29, 2011

- Mr. James Nickels, Marine Scientist, Urban Coast Institute*
- Dr. Ursula Howson, Assistant Professor*
- Dr. Thomas Noji, NOAA, Northeast Fisheries Science Center,   Director,* *
- Dr. Jennifer Samson, NOAA, Northeast Fisheries Science Center, Chief, Marine Chemistry Branch**

* Monmouth University

** James J. Howard Marine Sciences Laboratory, Sandy Hook

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

Project Goals

- Gather information on the status of Macro and Meso zooplankton populations in Barnegat Bay

- Determine the distribution, abundance, and species composition of important zooplankters within the bay

- Determine if species composition of important zooplankters has changed over the past several decades (where historical data is available)

Cooperative Venture between Monmouth University
and the
James J. Howard Marine Sciences Lab at Sandy Hook

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

Important Historical Studies of Zooplankton in Barnegat Bay

Nelson 1925
Loveland et al. 1969
Mountford 1971
Sandine 1973
Tatham et al. 1977
Tatham et al. 1978

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

Project Responsibilities:

Monmouth University
• Water Quality
• Sample Collection
• Sample Prep

Sandy Hook Marine Laboratory
•Sample shipping
•Sample Taxonomy and Numeration

Joint MU and SHL
•Data Reporting and Synthesis

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

SOP's Developed For All Aspects of Project

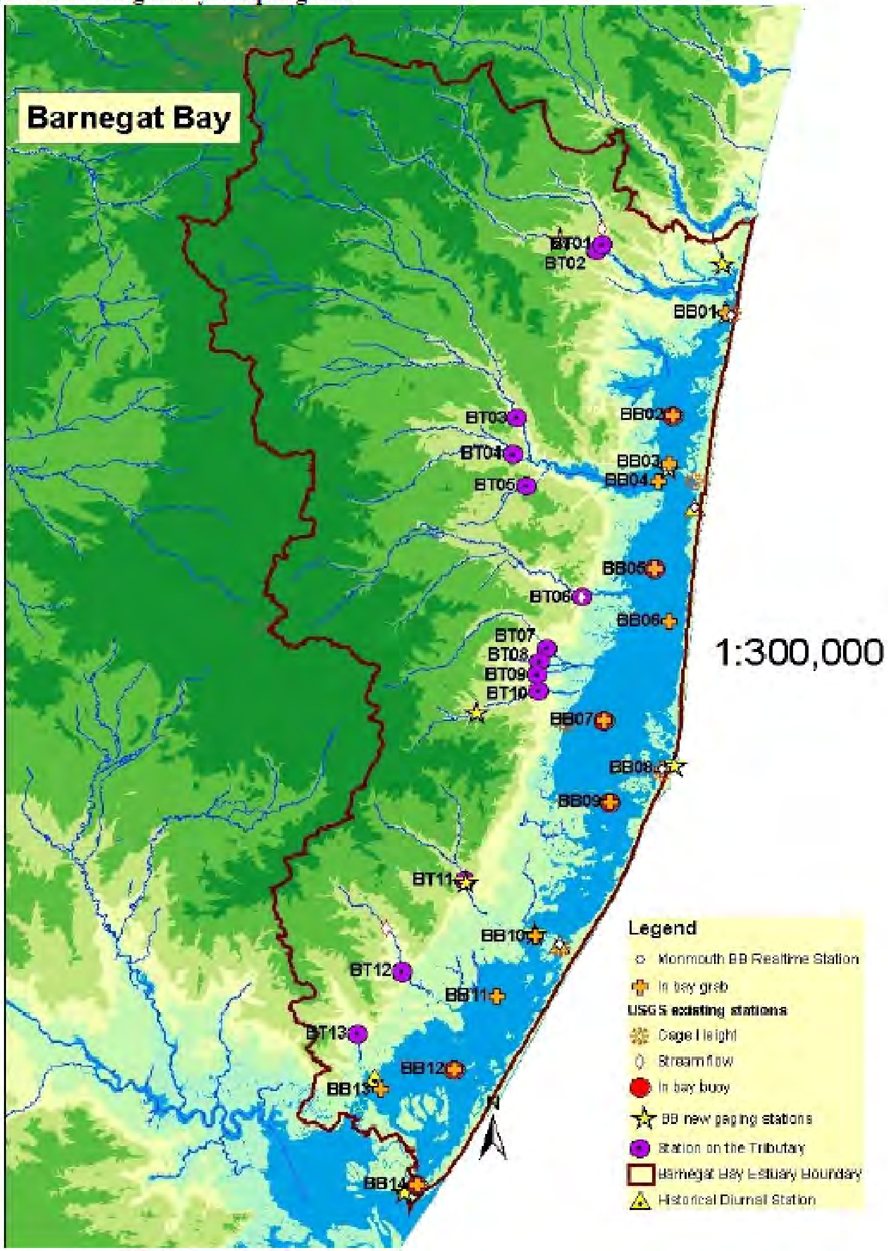
- Surface Water Quality Measurements
- Zooplankton Sample Collection
- Zooplankton Sample Handling, Preservation and Storage
- Zooplankton Sample Analysis
- Standardized Data Sheets Developed
- Data Storage in Excel

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

Study Area

Three collection sites to be selected

Figure 1: Barnegat Bay sampling sites

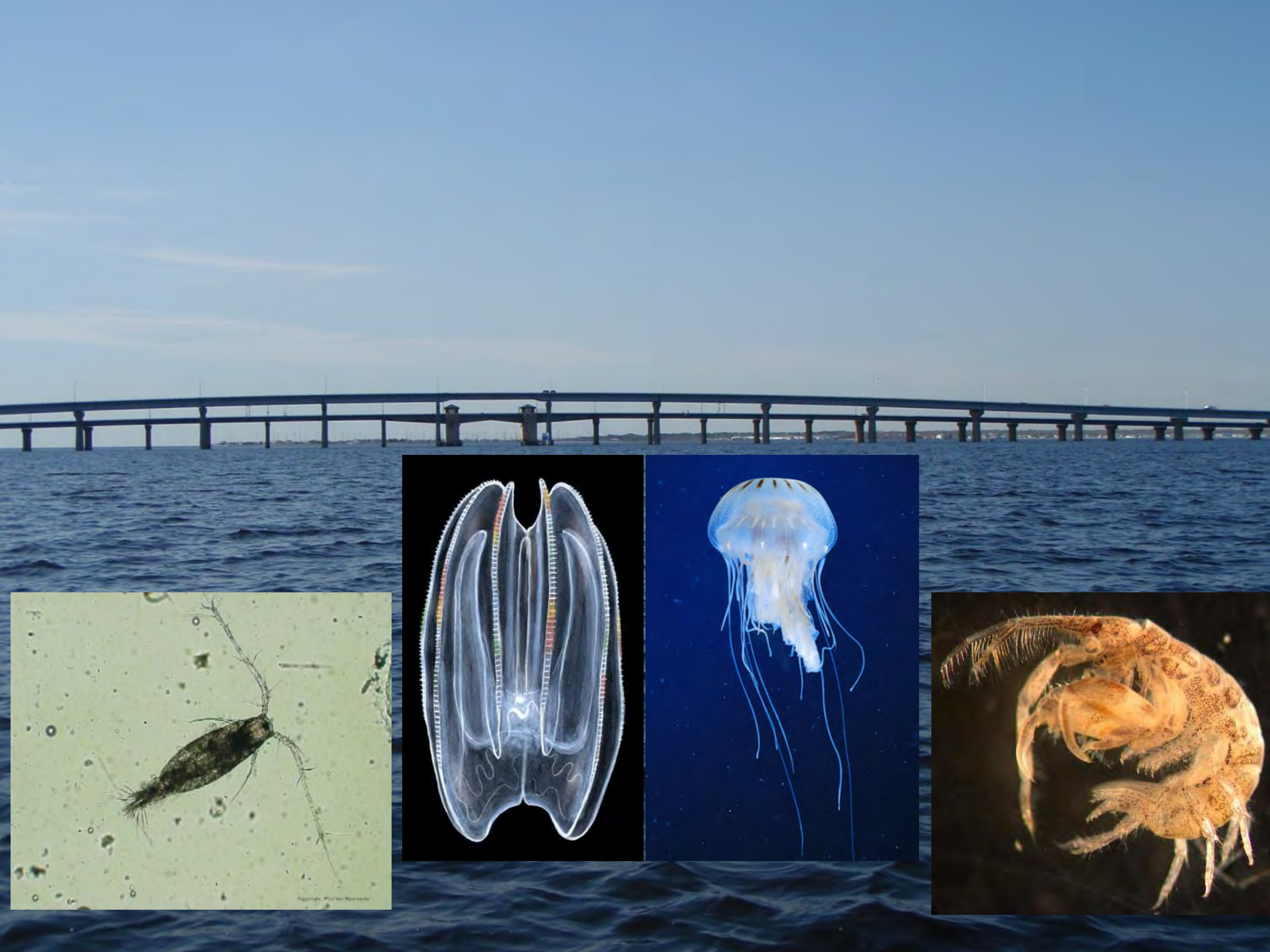


BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

Sampling events	#stations	mesh sizes	#samples /mesh size	total samples	
10	3	2	1	60	bi wkly May-Sept
2	1	2	6	24	24hr
7	*3*	*2*	*1*	*42*	*monthly Oct to Apr*
				126	EST Total Samples

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

BASELINE SURVEY OF ZOOPLANKTON OF BARNEGAT BAY

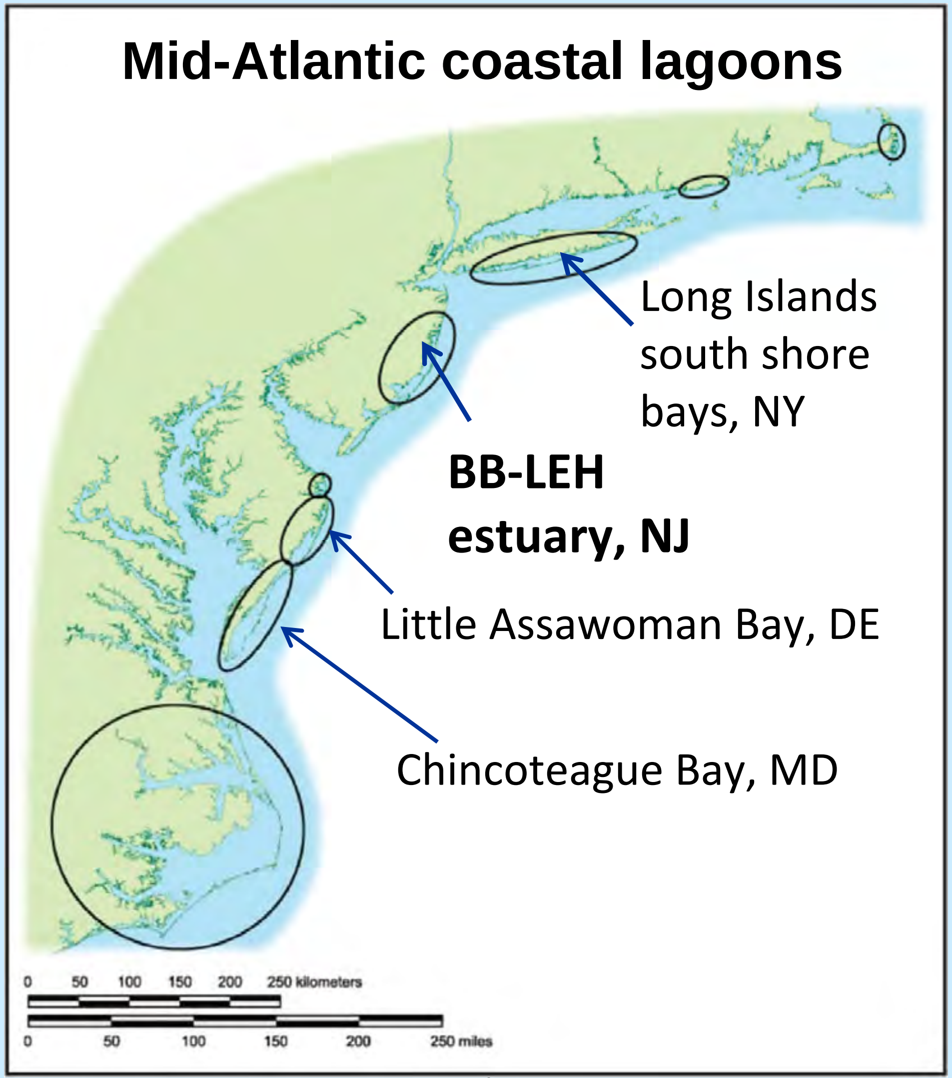



Questions

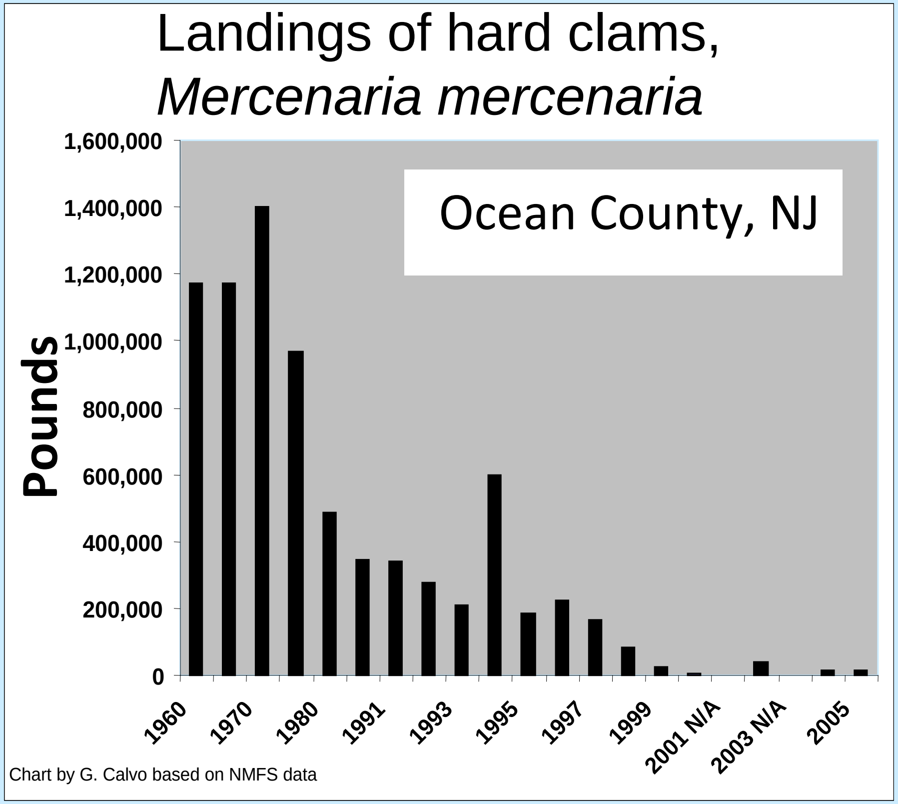
Benthic-pelagic coupling:
Hard clams as indicators of suspended particulates in the Barnegat Bay-Little Egg Harbor (BB-LEH) estuary

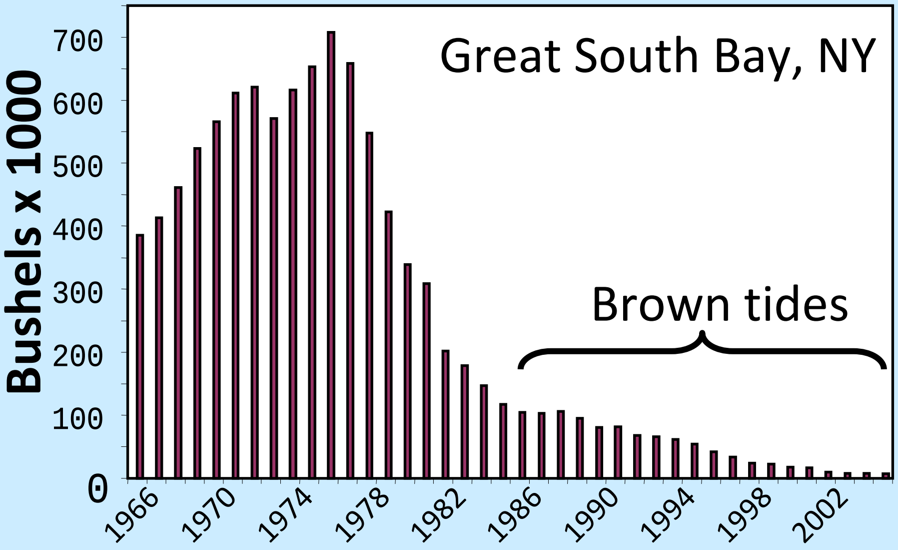
V. Monica Bricelj, John Kraeuter, & Gef Flimlin

Background



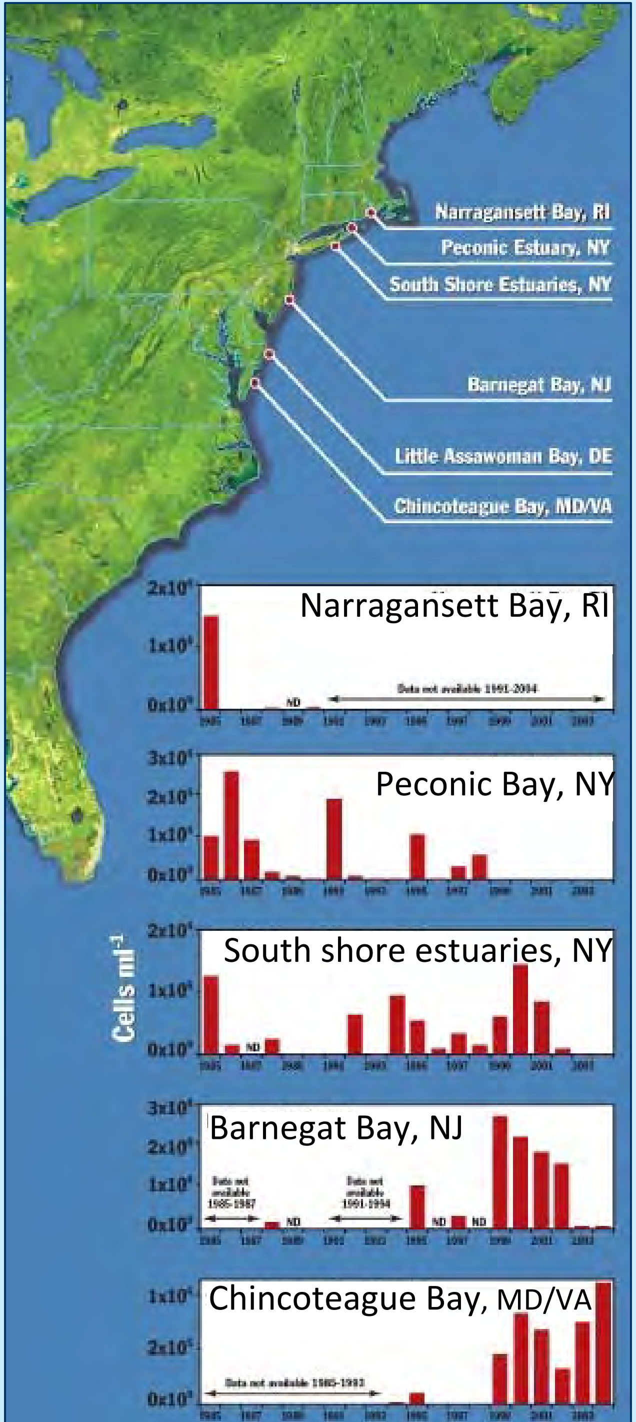
Source: W. Dennison In Kennish 2009

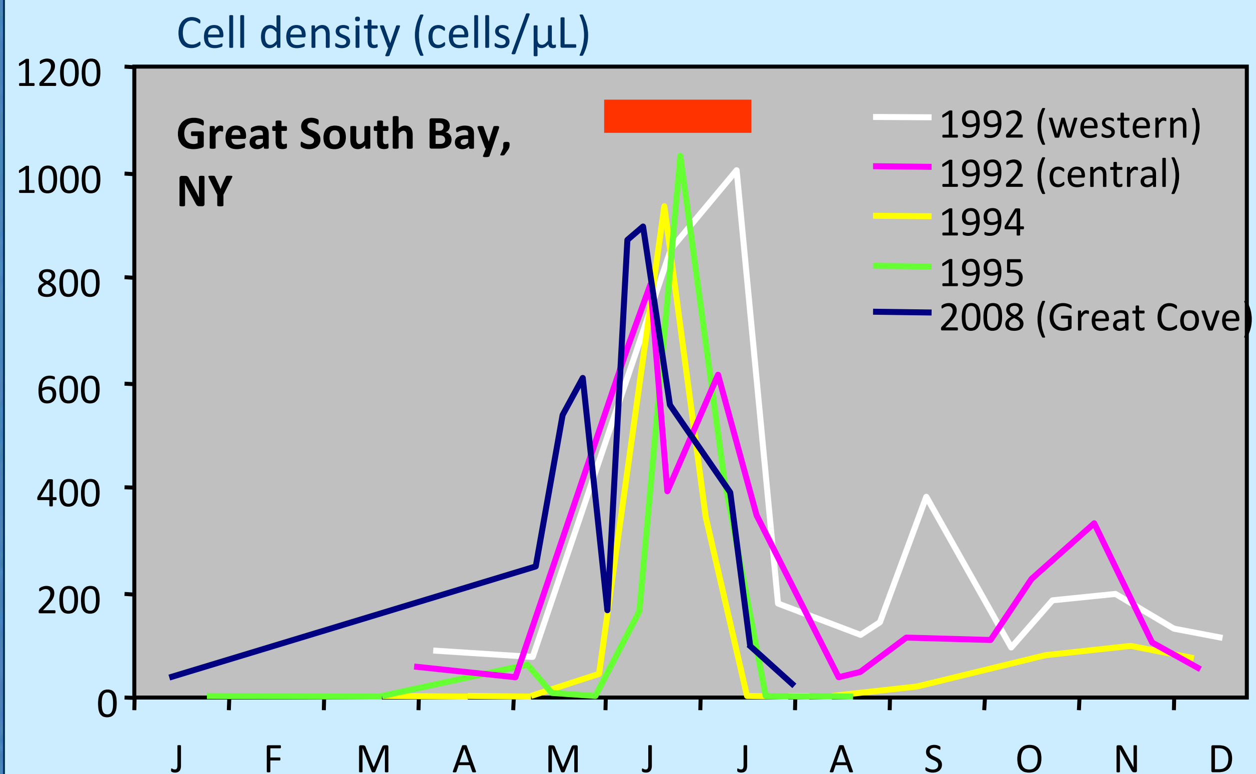




Kraeuter et al. JSR 2008

Latitudinal distribution & seasonality of brown tide in mid-Atlantic shallow estuaries: 1985-2003





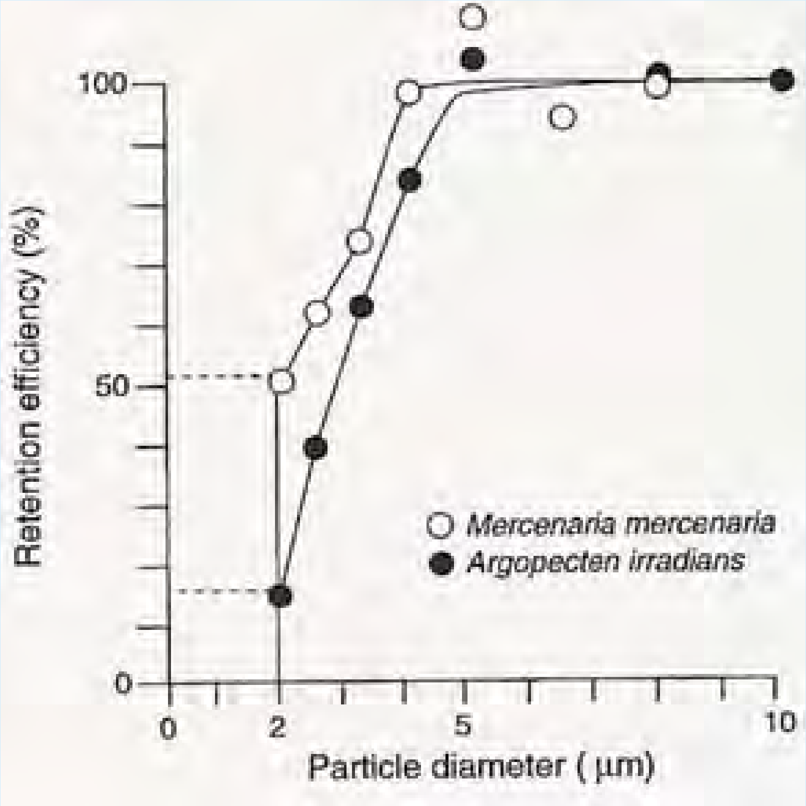
Hard clam spawning (Kassner & Malouf, 1982)

Possible factors contributing to the continued decline/slow recovery of hard clams in SSE

1. Effects of BT on larval and juvenile growth
2. Poor food supply

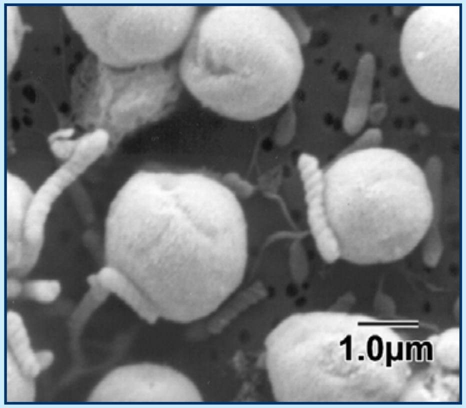
   Effects of 1 & 2 on adult reproductive output?

3. Poor fertilization success due to low clam densities
4. Change in the abundance/composition of predators



Role of "Small forms" (< 2-3 µm)

Many of these pico/nanoplankters are inefficiently retained, poorly digested &/or toxic to bivalves



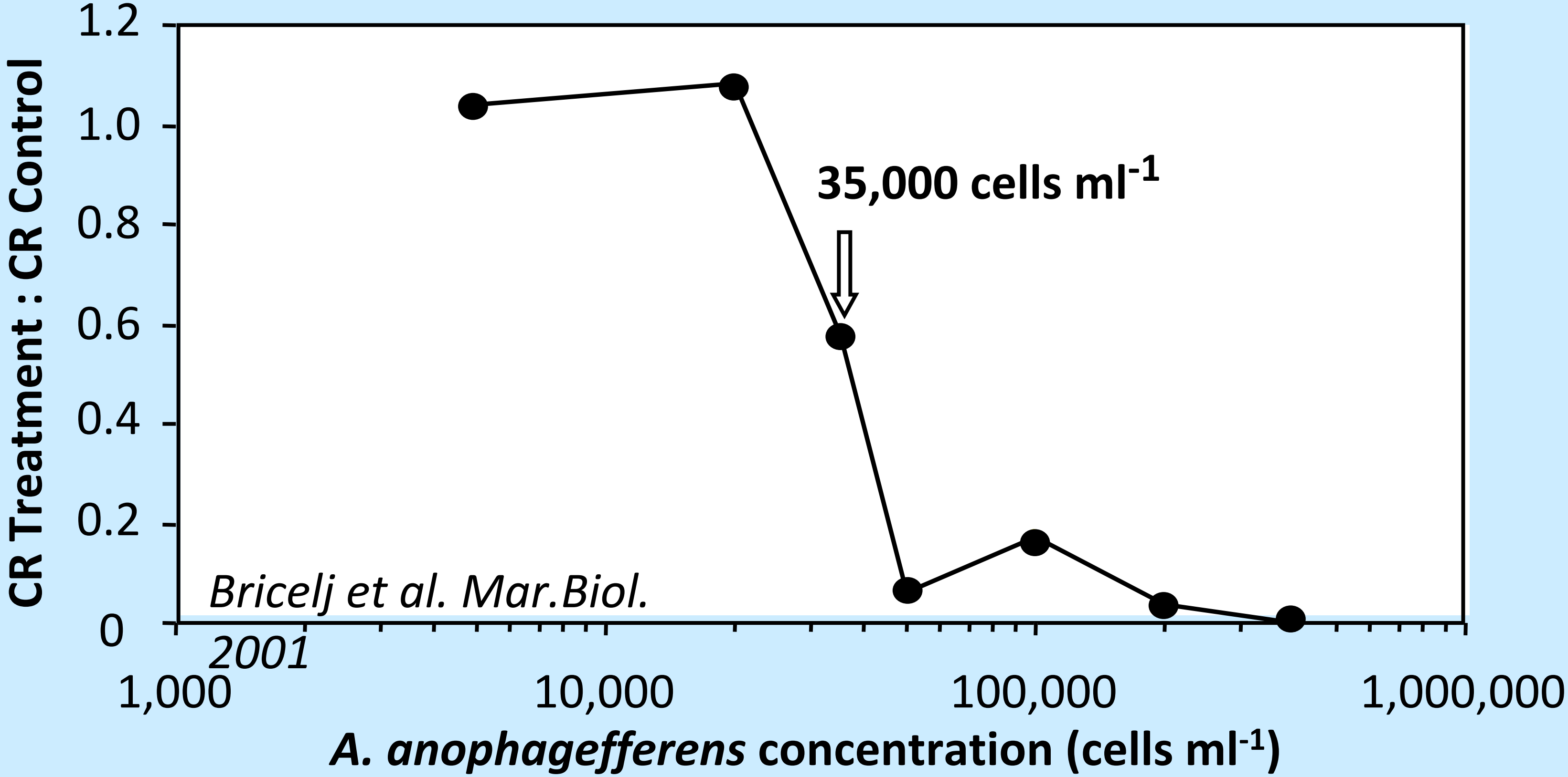
Aureococcus anophagefferens (Pelagophyceae)

Minutocellus polymorphus (Bacillariophyceae)

Nannochloropsis (= *Stichococcus*) spp
Synechococcus spp.
} Cyanobacteria

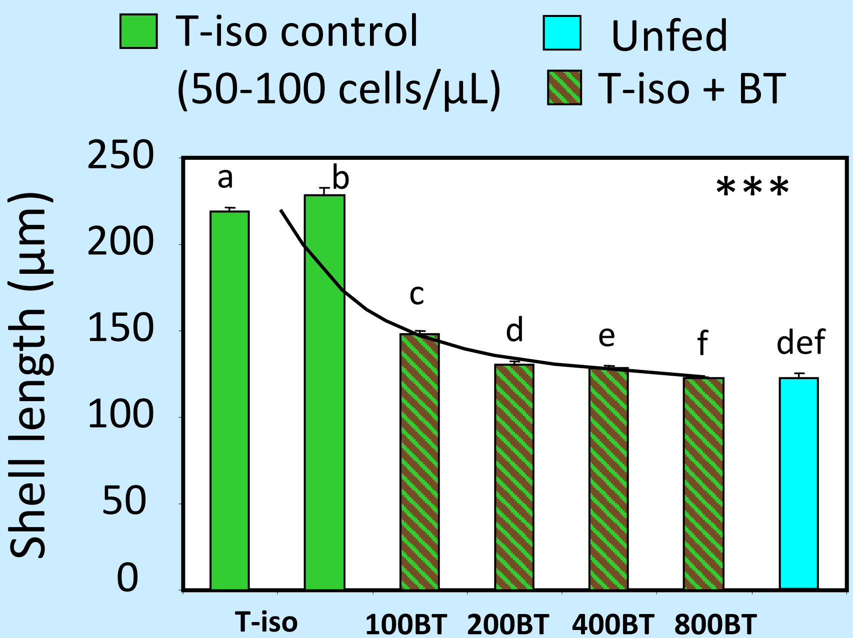
Ostreococcus
Nannochloris spp.
Chlorella spp.
} Chlorophyceae

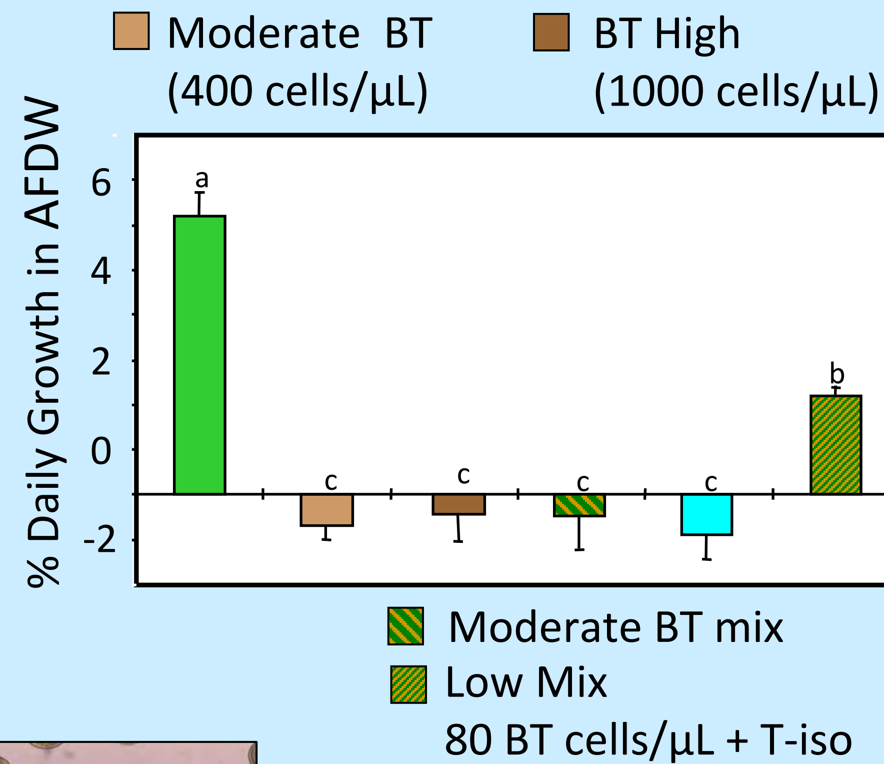
Effects of brown tide (BT)

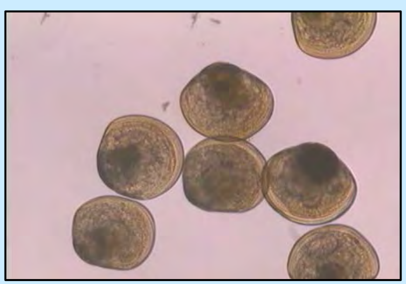


- Adverse effects at densities ≥ 35,000 cells/ml that do not cause water discoloration
- Blooms > $1x10^6$ cells/ml in BB-NEH between 1995 and 2002, but monitoring for BT ceased

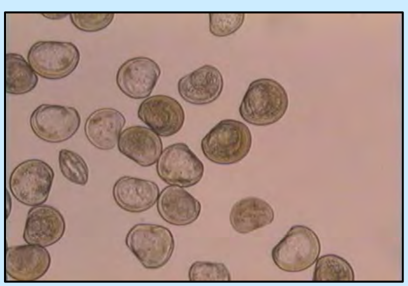
Density-dependent effects of brown tide on growth of clam larvae and juveniles



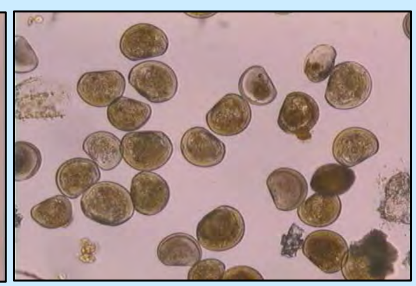




T-iso (50 cells/µL)



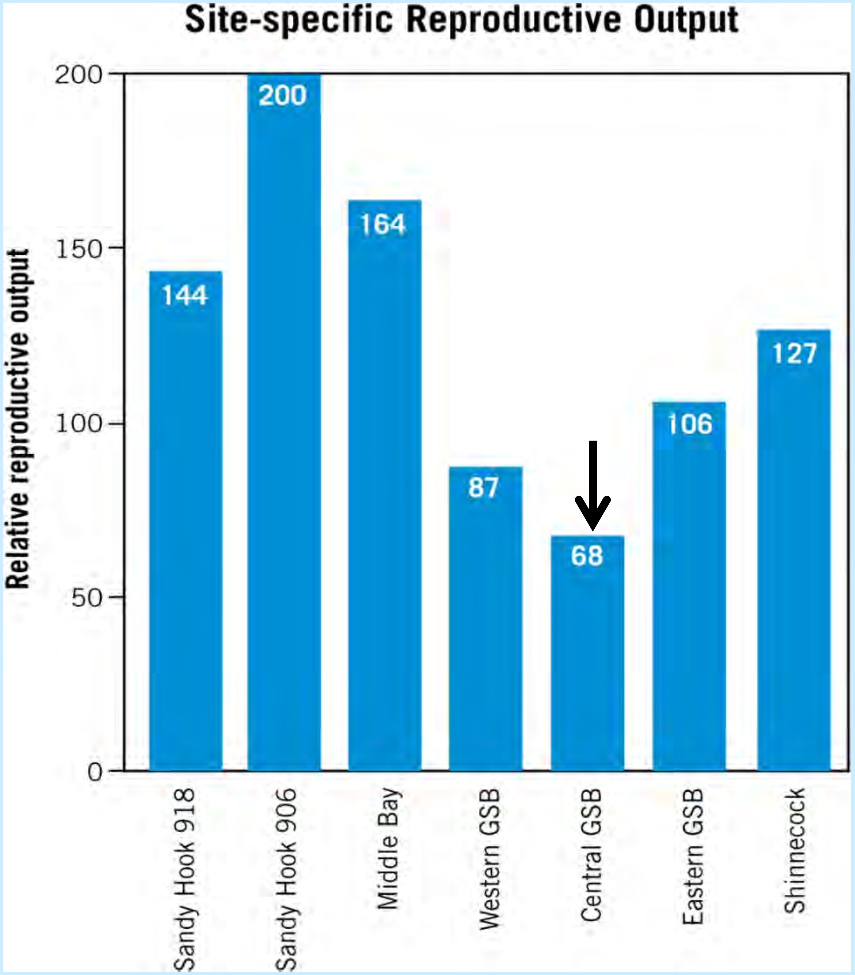
800 BT + 50 T-iso (cells/µL)

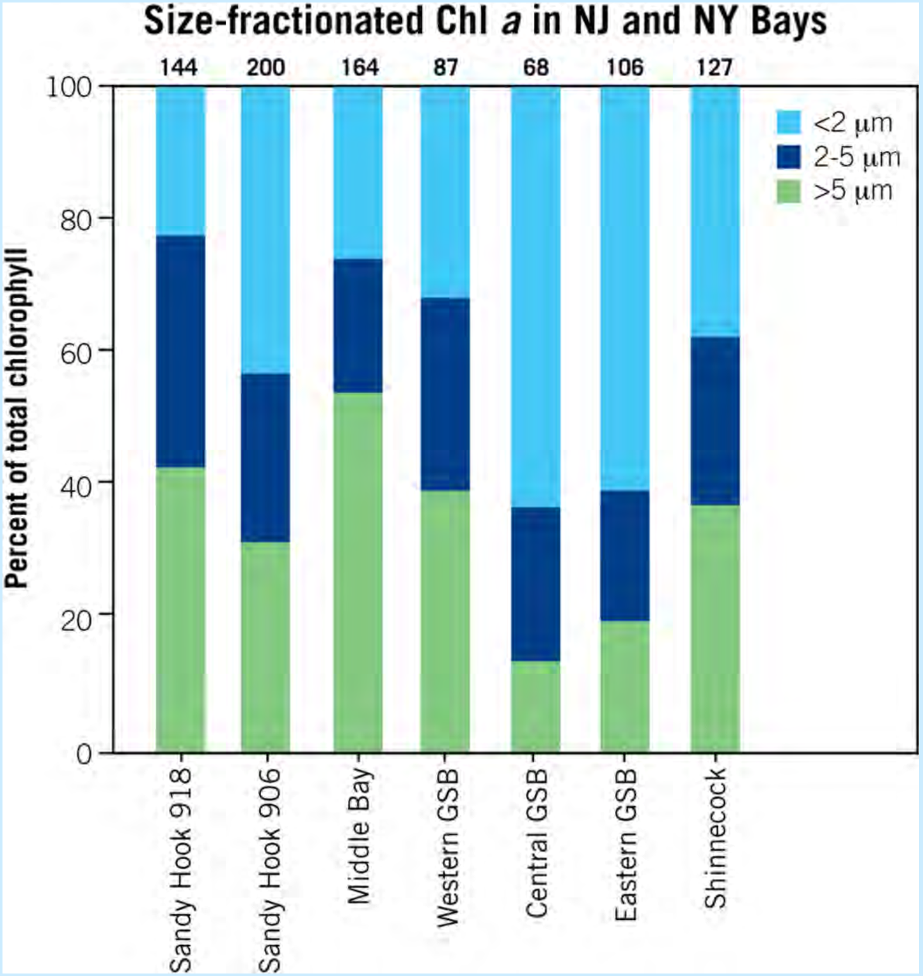


Unfed

Bricelj & MacQuarrie, MEPS (2006)

Bricelj & MacQuarrie, MEPS (2004)





W → E

- Hard clam reproductive output & juvenile growth may be inversely related to the contribution of picoplankton to total chlorophyll

Newell et al. MEPS 2009; Weiss et al. JEMBE 2007

Objectives

To characterize the seasonal quality/quantity of seston for bivalve suspension-feeders in the BB-LEH using the hard clam, *M. mercenaria*, as a biosensor

Determine *in situ seasonal* growth, condition & survival of juvenile hard clams at 5-6 sites in LEH-central BB in relation to key characteristics of the seston/food supply, temperature & salinity

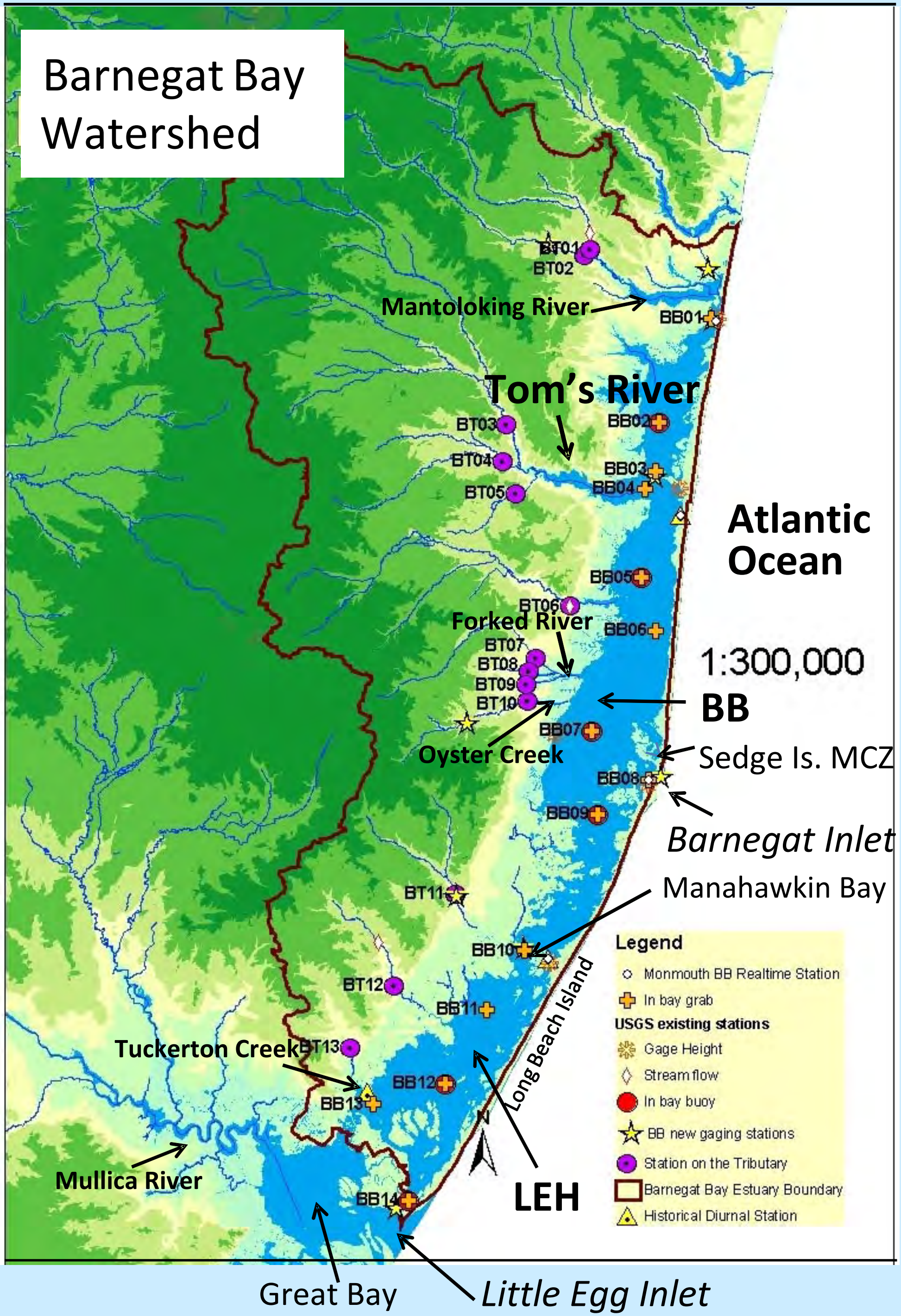
Management Applications

Relate spatial/temporal patterns in this water quality index to those of other indices used to date, e.g. DO, level of eutrophication, nutrient ratios. ***Do they contribute to changes in the food web?***

Make recommendations on the potential for clam restoration

Why *M. mercenaria* ?

- Bivalves are primary consumers, sedentary, filter large volumes of water. They are traditionally used to monitor water quality (algal toxins, pollutants)
- Supported commercial and recreational fisheries in lagoonal ecosystems, including BB-NEH
- Provide important ecosystem services. May be of interest for restoration
- Juveniles provide a rapid, time-integrated response of phytoplankton quality/quantity



Methods

Clam deployment in pearl nets (n = 5 per site) ~ 50 cm off-bottom within areas of salinity compatible with clam survival, growth & reproduction (> 15 ppt), i.e. S of Tom's River along a N to S gradient

3-4 wk deployment in spring, summer, fall

No confounding effects of substrate type & predation

Seston parameters measured:

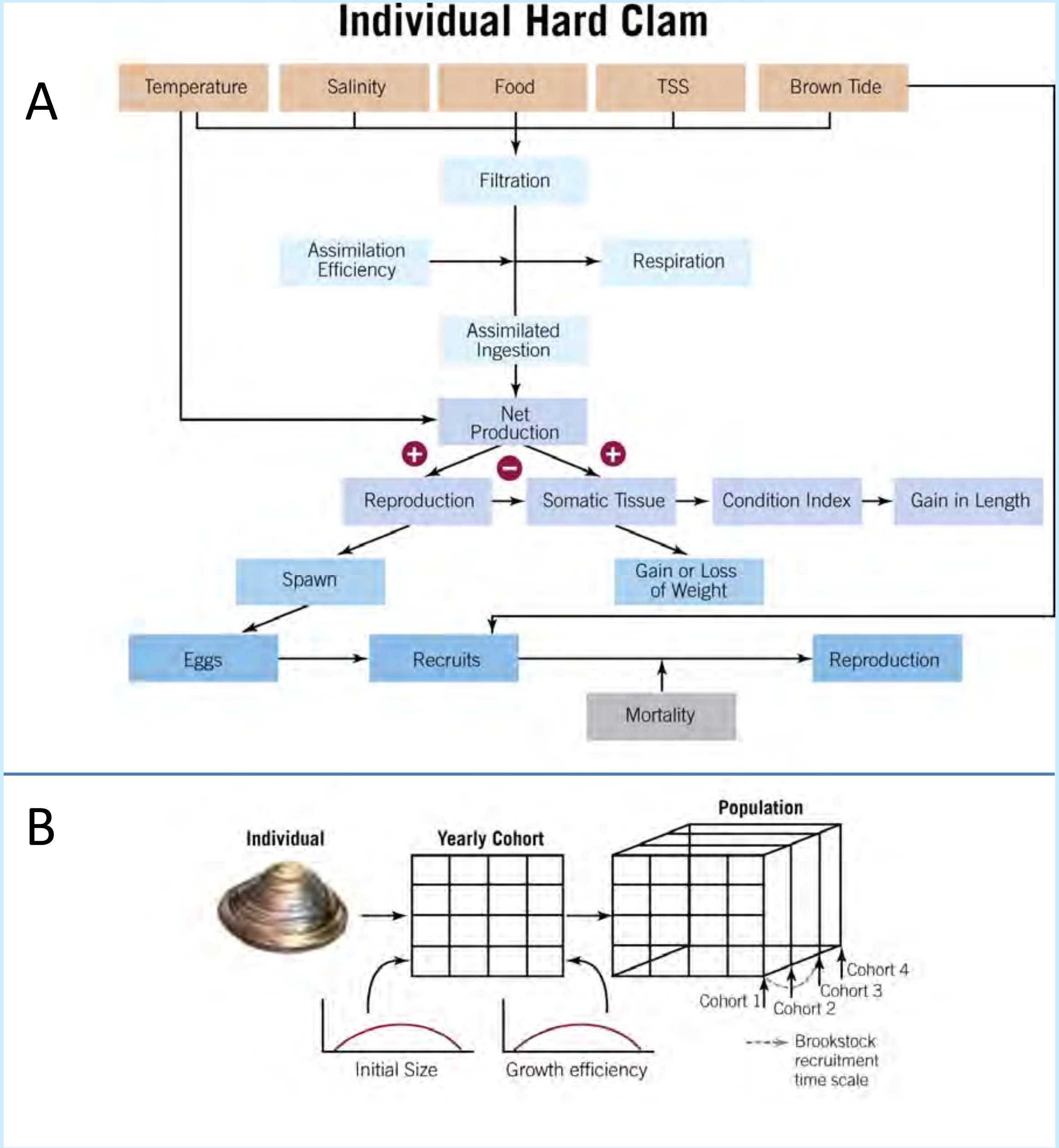
- Phytoplankton size structure: size-fractionated chl *a* (total & < 5 µm)
- Turbidity: TSS (Dry wt.), PIM (Ash wt.)
- POM, POC, PON: includes detrital food source
- Phytoplankton species composition & biovolume of major groups (L. Ren, Philadelphia Academy of Natural Sciences)
- *A. anophagefferens* cell density by immunofluorescence (R. Schuster, NJDEP Bureau of Marine Monitoring)

Physiologically-based hard clam model (A) - scaling allows individuals to be incorporated into a population model (B)

(Hofmann et al. 2006)

(+) net production results in formation of reproductive and somatic tissue; (-) production results in resorption of tissue

+ Biochemically-based hard clam larval model (unpubl.)

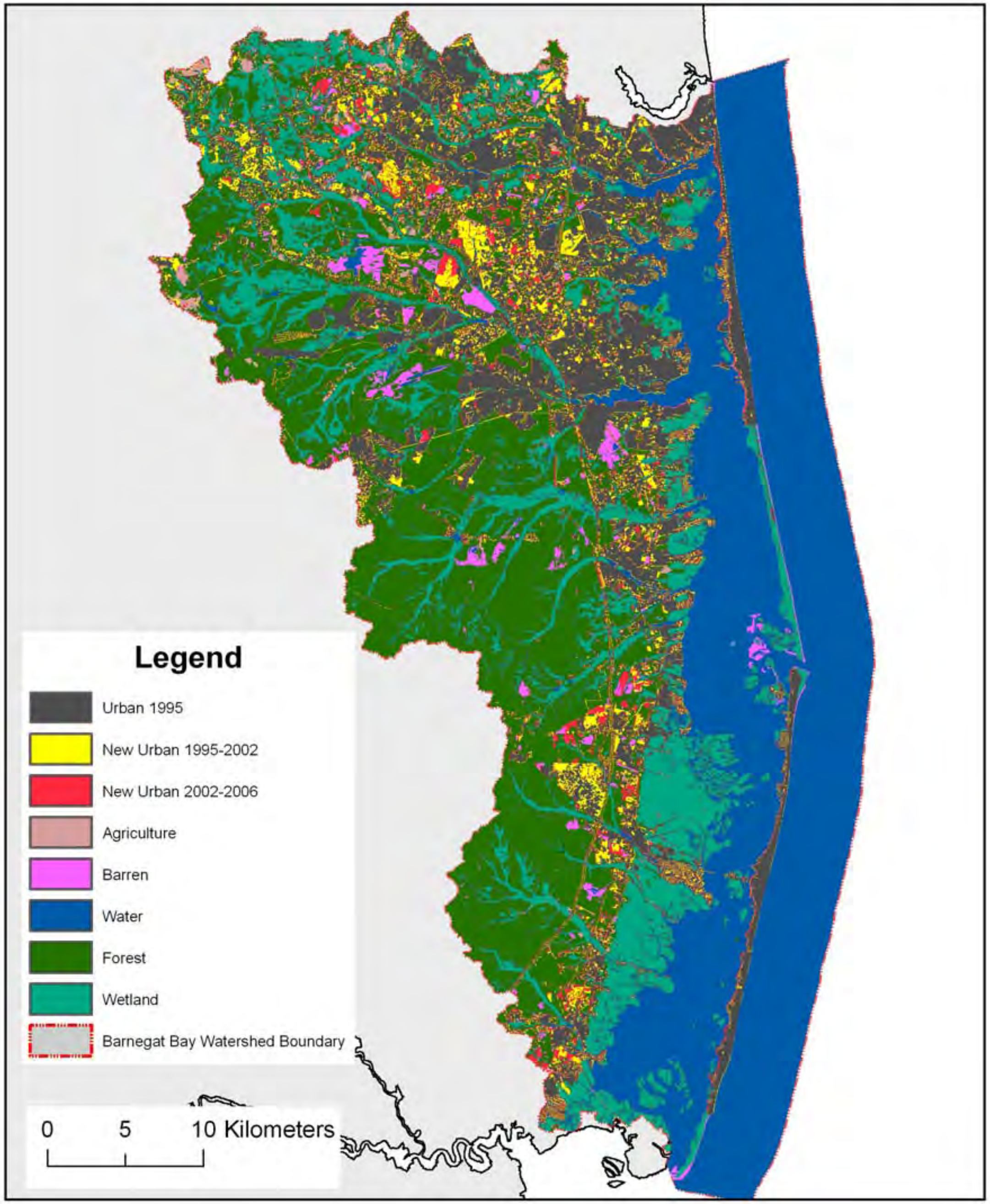


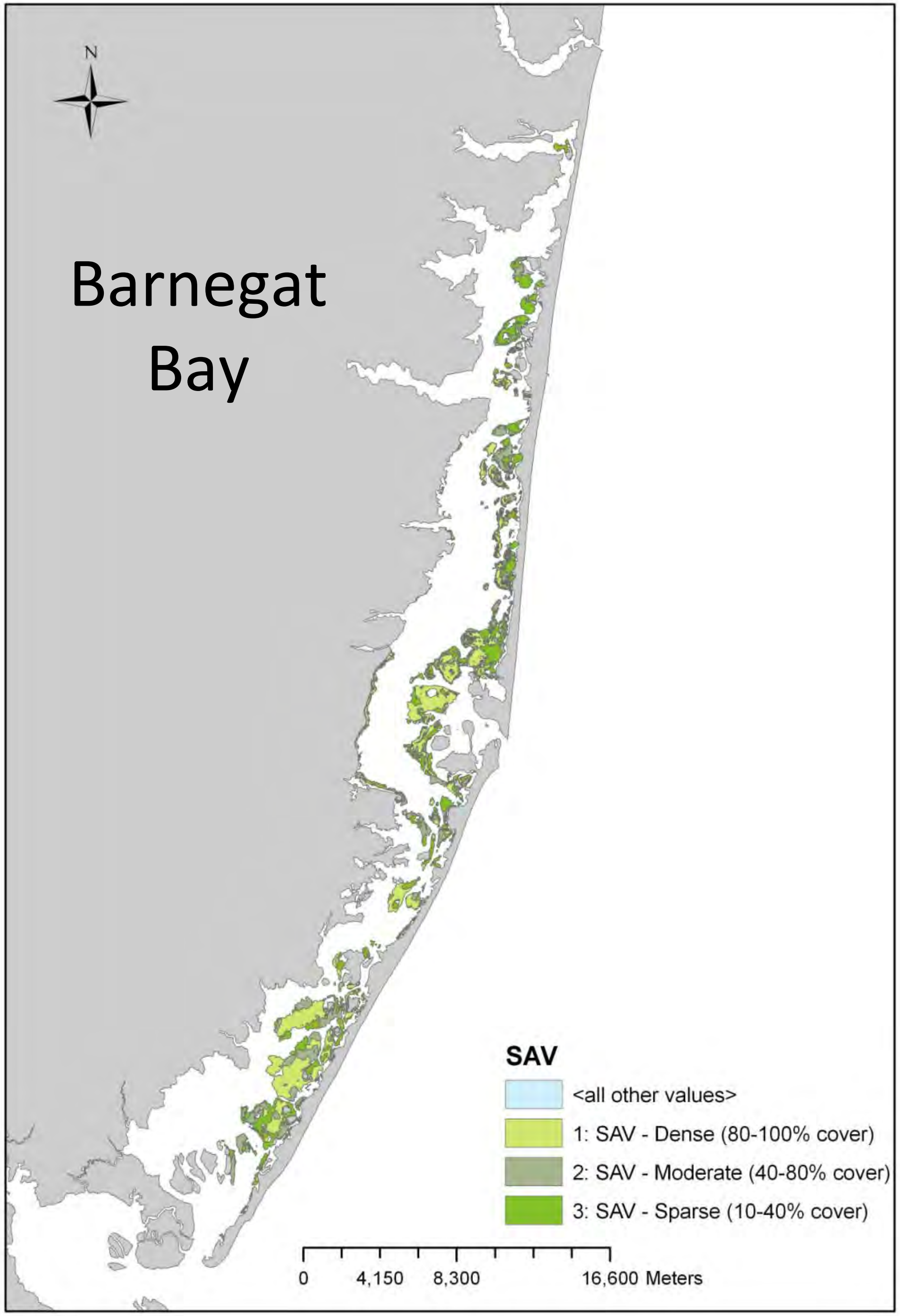
Assessment of Fish and Crab Response to Human Alteration in Barnegat Bay

Kenneth W. Able, Thomas M. Grothues
Rutgers University Marine Field Station
Paul Jivoff
Rider University

New Jersey Department of Environmental Protection–
Office of Science

2006 Land Cover for the Barnegat Bay Watershed




N
Barnegat
Bay
SAV
<all other values>
1: SAV - Dense (80-100% cover)
2: SAV - Moderate (40-80% cover)
3: SAV - Sparse (10-40% cover)
0
4,150
8,300
16,600 Meters

Rationale

Focus on fishes and crabs because

- Make up a large component of the faunal biomass
- Central to ecosystem function (predators and prey)
- Harvested in recreational and commercial fisheries

LONG TERM GOAL

- determine how fish and crabs respond to human alterations in Barnegat Bay

YEAR ONE

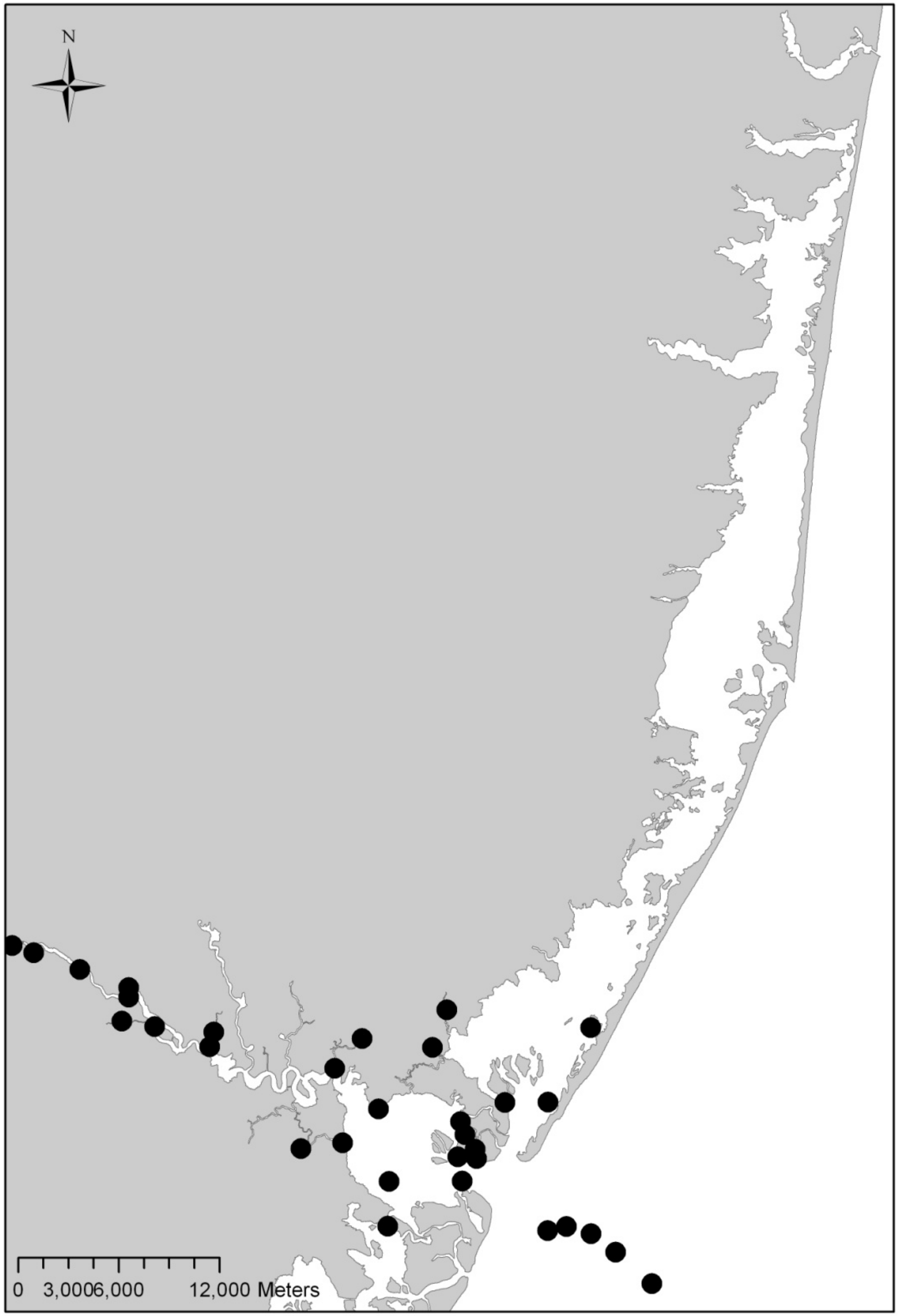
- compare the temporal (annual, seasonal) and spatial (along the gradient of human alterations) variation in the bay

1) Determine seasonal variation in species composition and abundance for larval fishes
2) Determine juvenile and adult fish and crab distribution and abundance across habitats (SAV, non-SAV and in subestuary/tidal creek tributary, open bay)

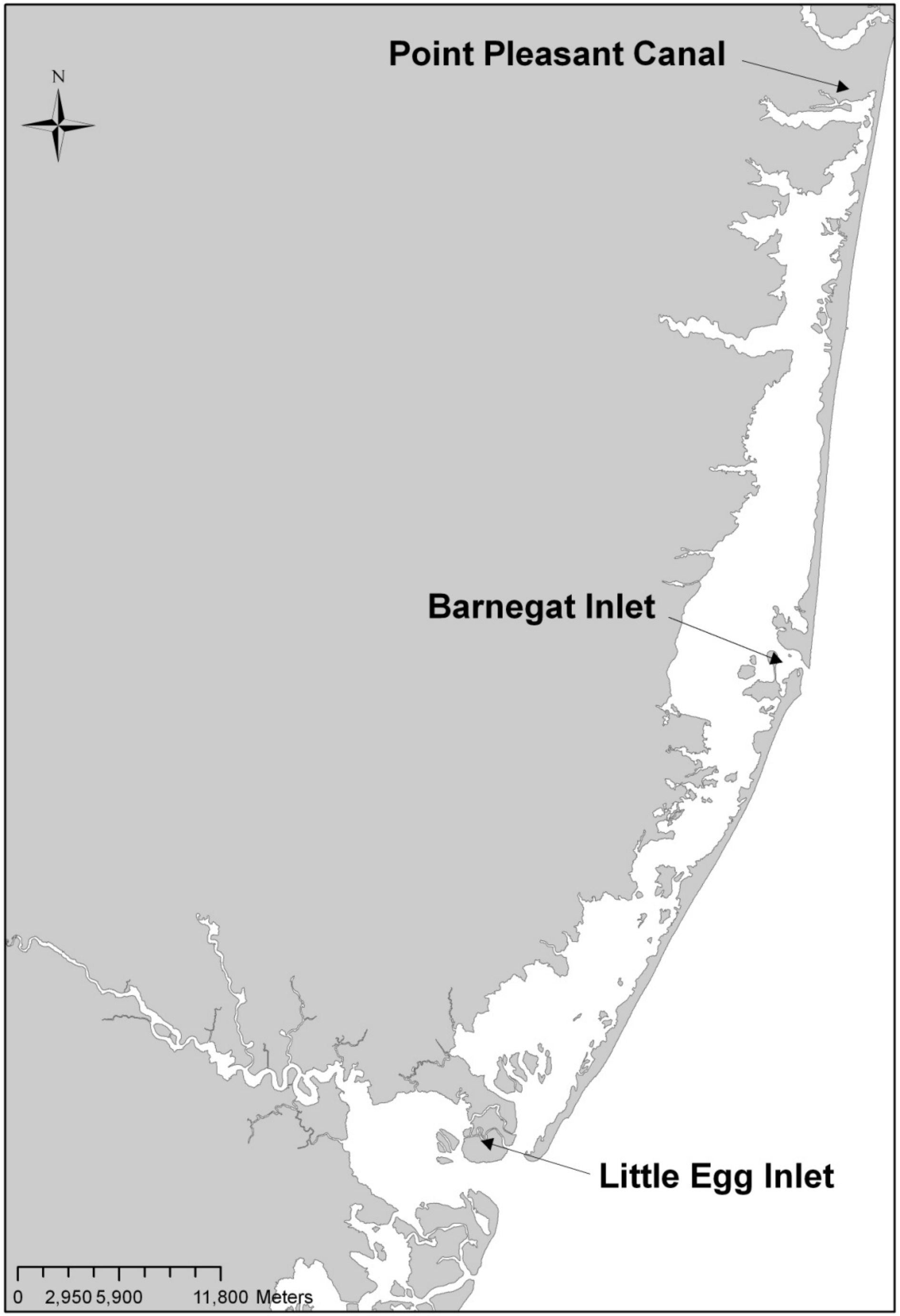
Proposed sampling effort in Barnegat Bay

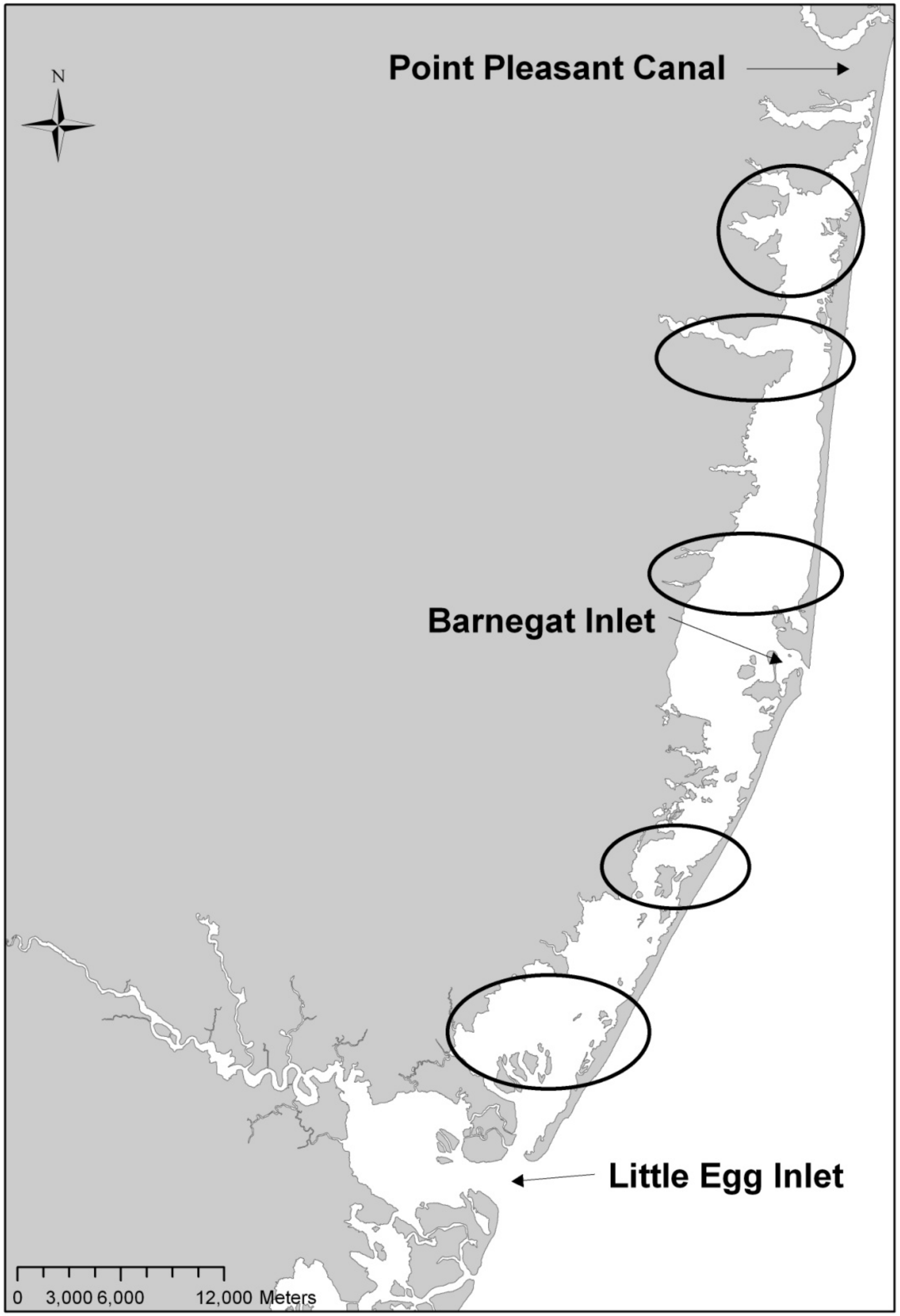
Faunal Group/ Life History Stage	Gear	Seasonality	Number of Stations
Fishes			
Larvae	Plankton Net (1 m, 1.0 mm mesh)	Winter, Spring, Summer, Fall	3
Juveniles	Otter trawl (4.9 m, 6.0 mm mesh)	Winter, Spring, Summer, Fall	≈50
Adults	Gill Net (multi-mesh)	Spring, Summer, Fall	27
Crabs			
Juveniles/Adults	Otter trawl (4.9 m, 6.0 mm mesh)	Winter, Spring, Summer, Fall	≈50
Adults	Gill Net (multi-mesh)	Spring, Summer, Fall	27


Plankton Sampling
Gillnetting
RUTGERS STATE UNIV
RUTGERS STATE
MARITIME
Skiff 16
Otter trawling



N
0
3,0006,000
12,000 Meters


Point Pleasant Canal
N
Barnegat Inlet
Little Egg Inlet
0 2,950 5,900 11,800 Meters



N
Point Pleasant Canal
Barnegat Inlet
Little Egg Inlet
0 3,000 6,000 12,000 Meters

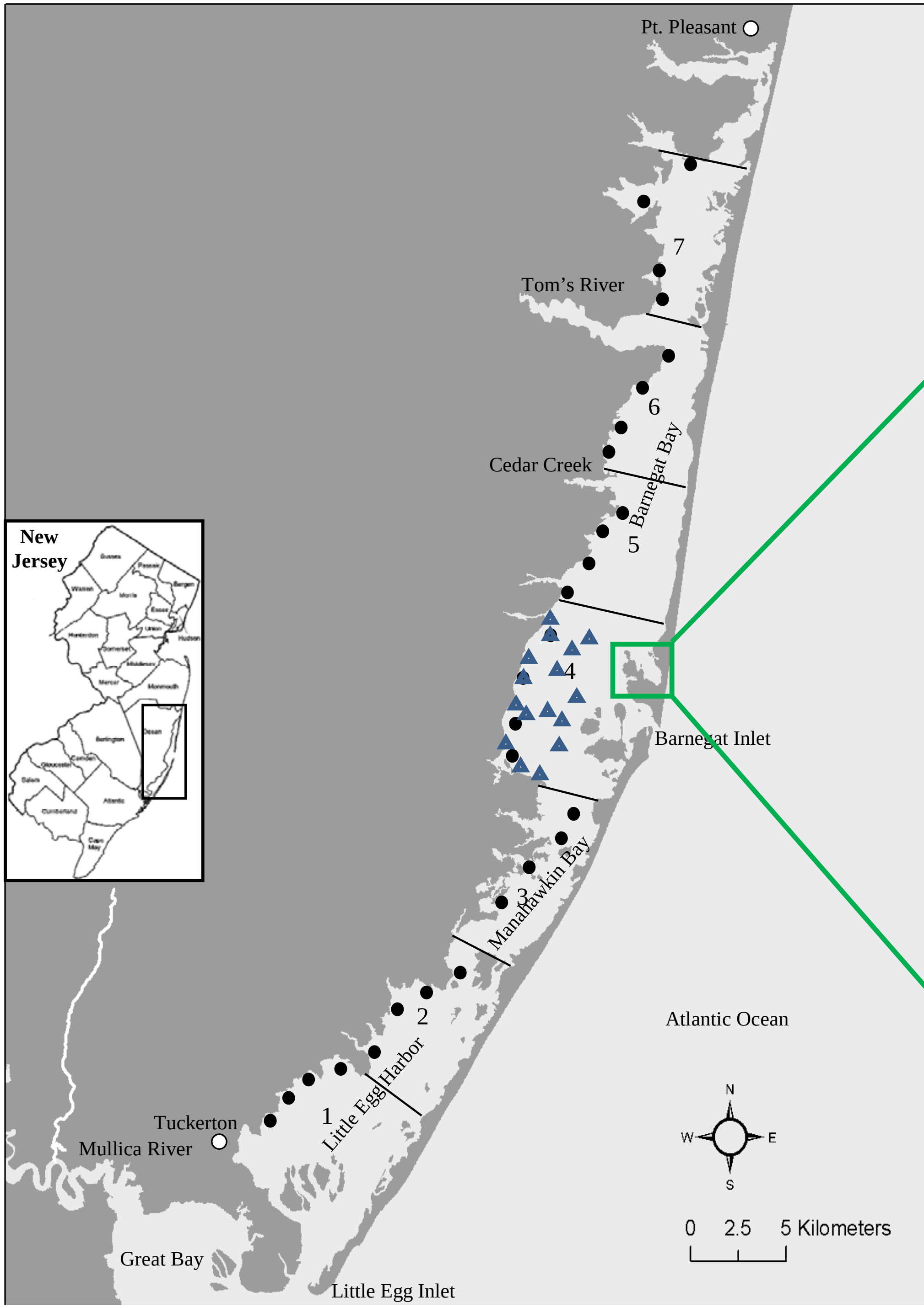
Potential Collaborations?

Timeline for 2011 - 2012

	2011	2012			
	Fall	Winter	Spring	Summer	Fall
Reconnaissance	x				
Plankton (fishes)		x	x	x	x
Otter trawl sampling (fishes and crabs)		x	x	x	x
Gill net sampling (fishes and crabs)		x	x	x	x
Environmental variables		x	x	x	x

Ecological Evaluation of Sedge Island Marine Conservation Area in Barnegat Bay

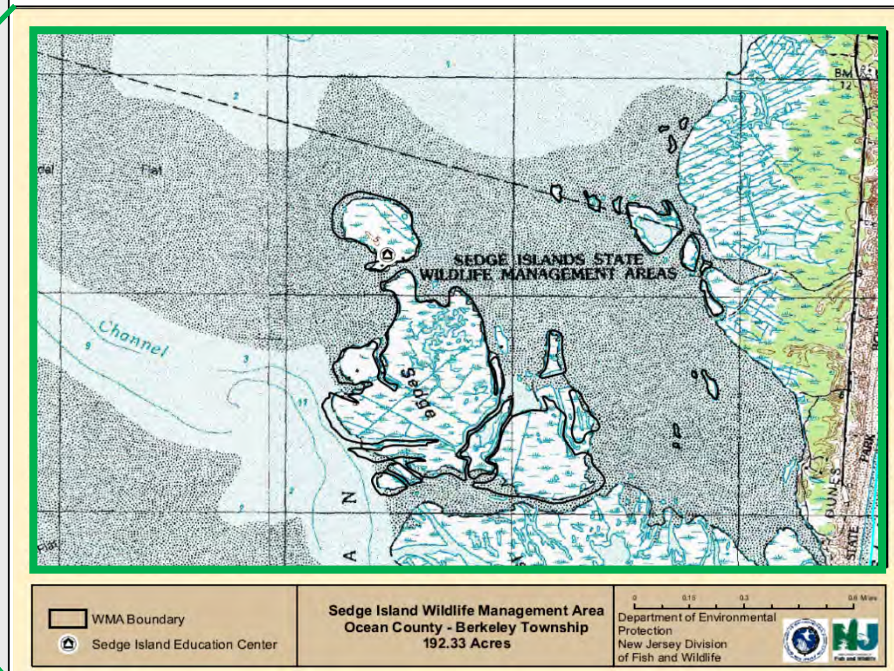
Paul Jivoff
Department of Biology
1865 RIDER UNIVERSITY



Rationale

-NJ's First Marine Conservation Zone….
for preserving diversity of essential habitats

-Little work to assess habitats present or evaluate effectiveness for organisms

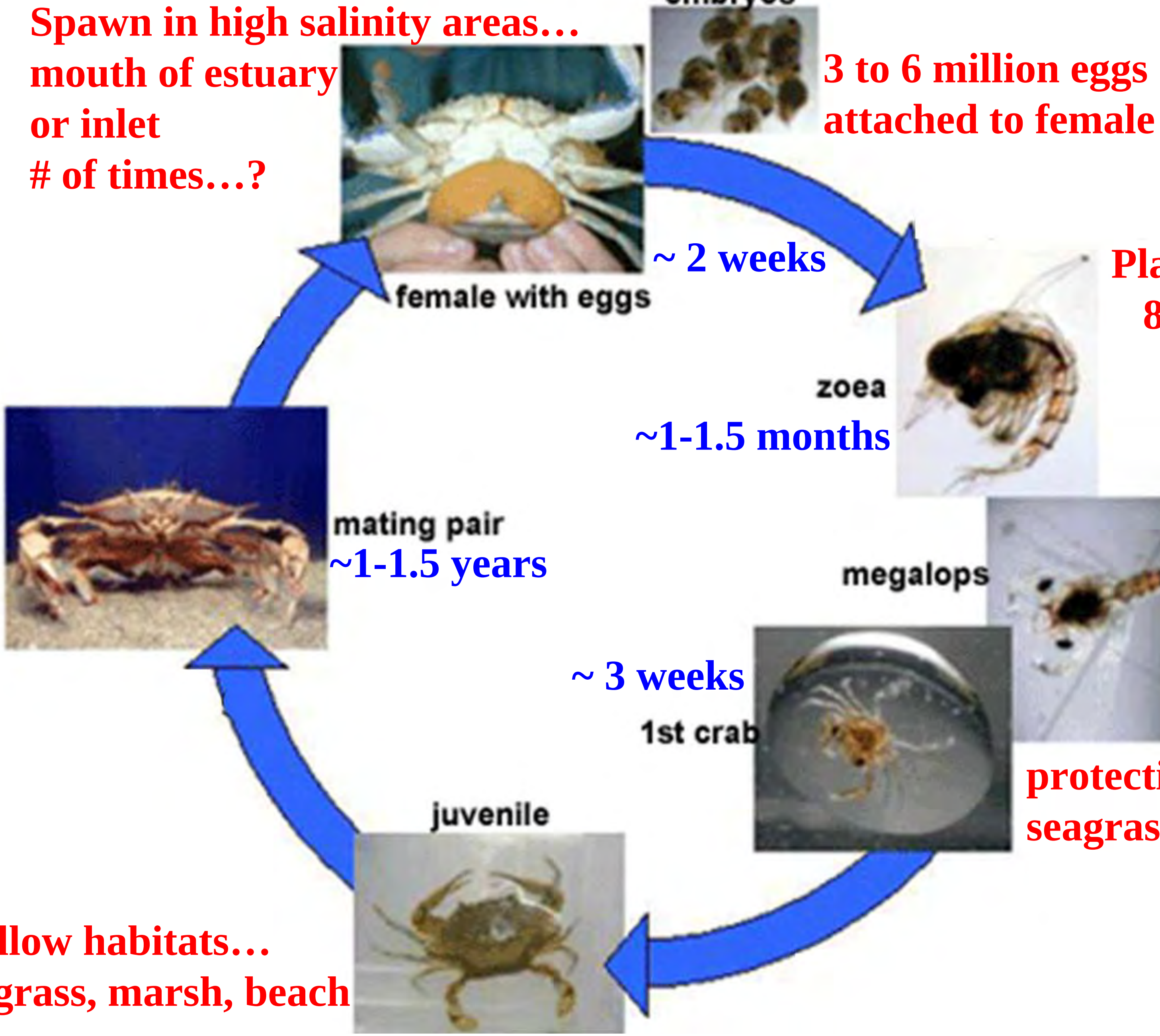


Objectives

-Use blue crab as a model organism for evaluating relative effectiveness of SIMCZ

-Increase understanding of factors influencing blue crab fecundity

Blue Crab Life History



Methodology

Blue Crab Characteristics: Inside vs Outside the SIMCZ

(1) population structure of adult crabs: abundance, size, sex ratio

a. Field data: SIMCZ vs central bay vs western shore using traps

monthly May-August   2010 data   2008-2009 data

2010 data

2011-fish & crabs

(2) female reproductive success

a. Field data: brood size, egg viability, spatial variation, duration of season

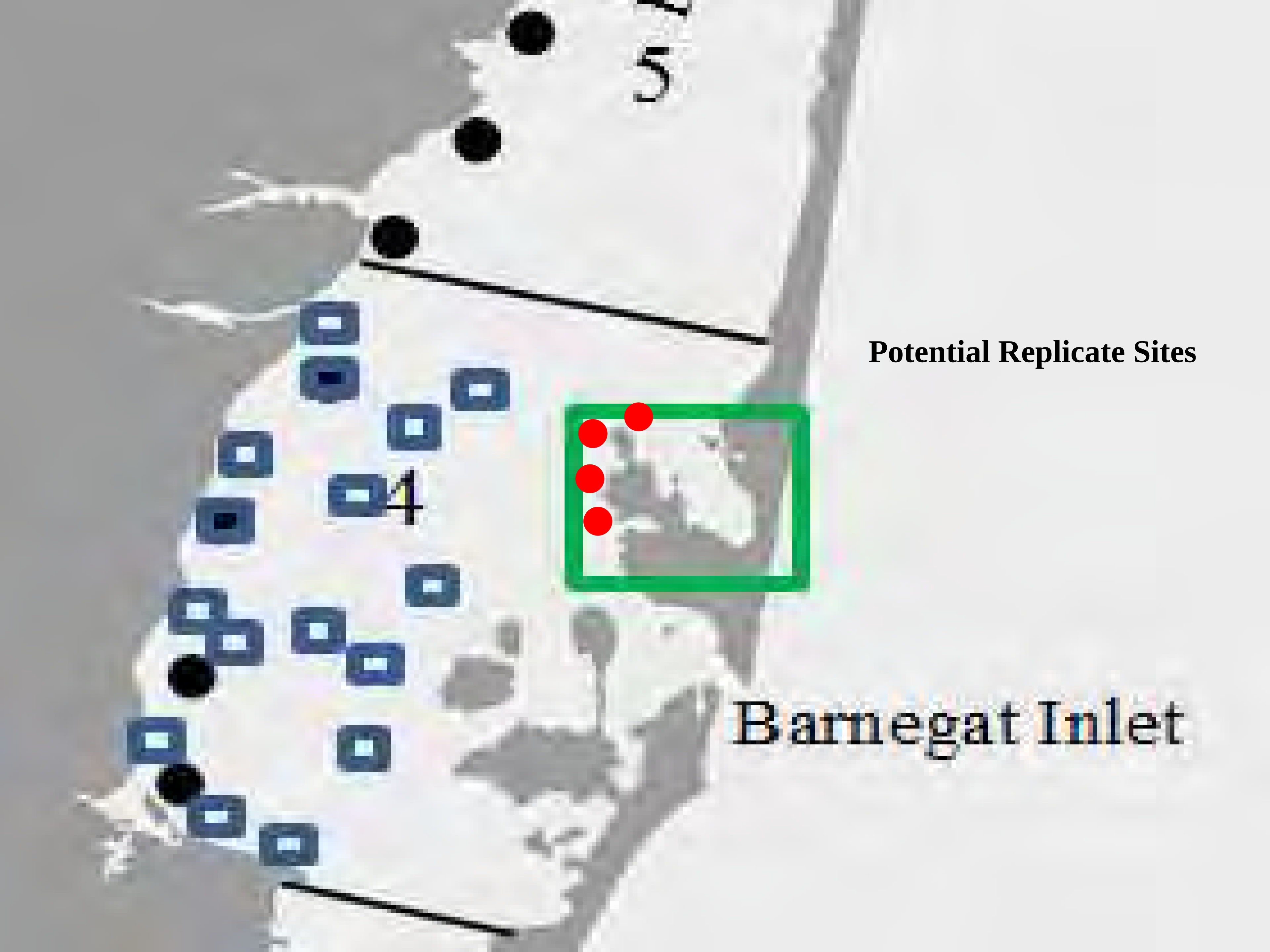
b. Field experiment: brood size, timing & number, egg viability

location, female size, food level

(3) abundance of juvenile crabs: seagrass, macroalgae, and unvegetated areas

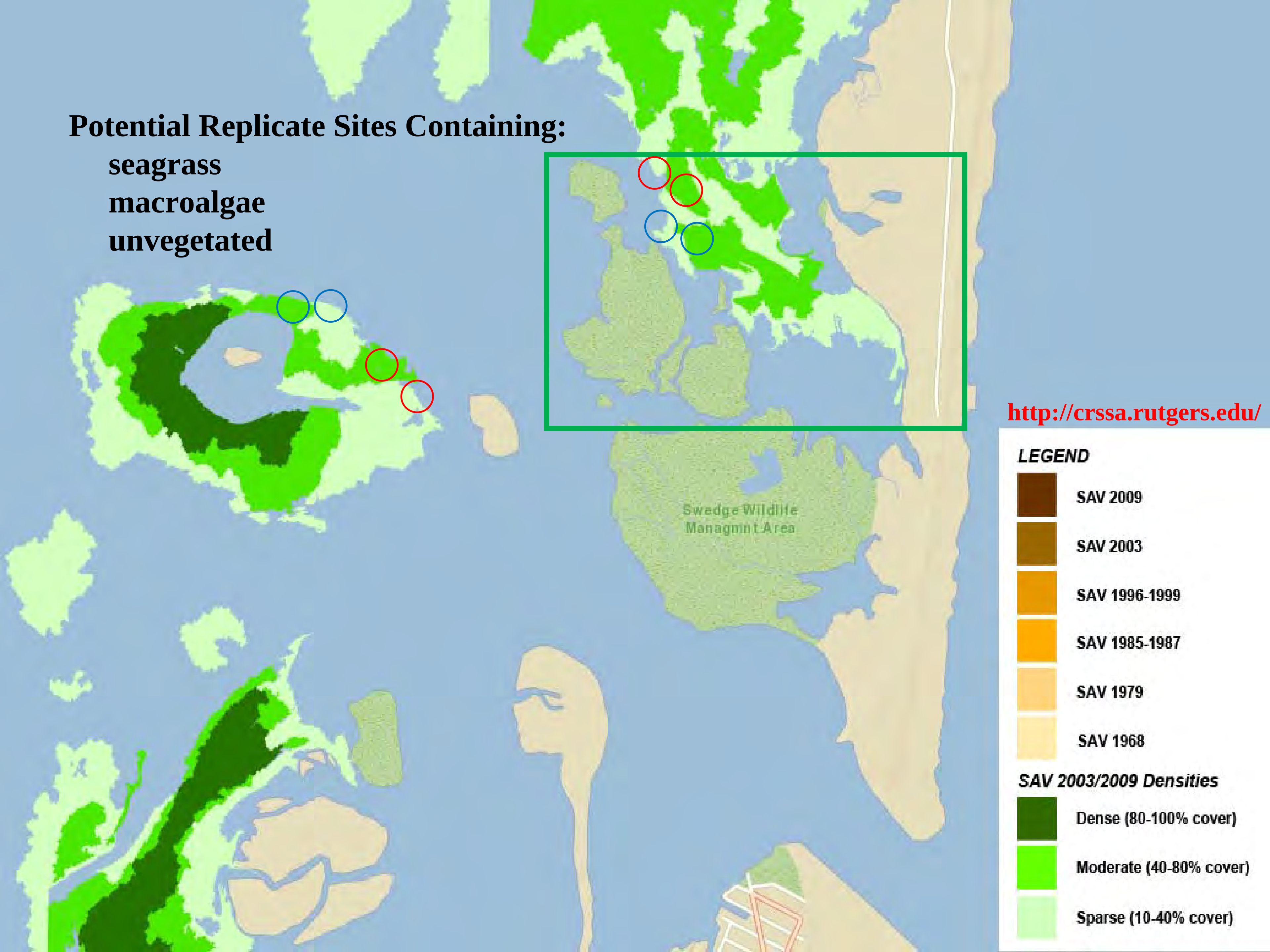
a. Field data: SIMCZ vs outside using cylinder (throw-trap) sampling

monthly May-August


5
4
Potential Replicate Sites
Barnegat Inlet

Potential Replicate Sites Containing:

- seagrass
- macroalgae
- unvegetated



Assessment of *Chrysaora quinquecirrha* (sea nettle) in Barnegat Bay

Paul Bologna
Jack Gaynor
Department of Biology and Molecular Biology

MONTCLAIR STATE UNIVERSITY

Jersey Shore

Greenheads

vs.

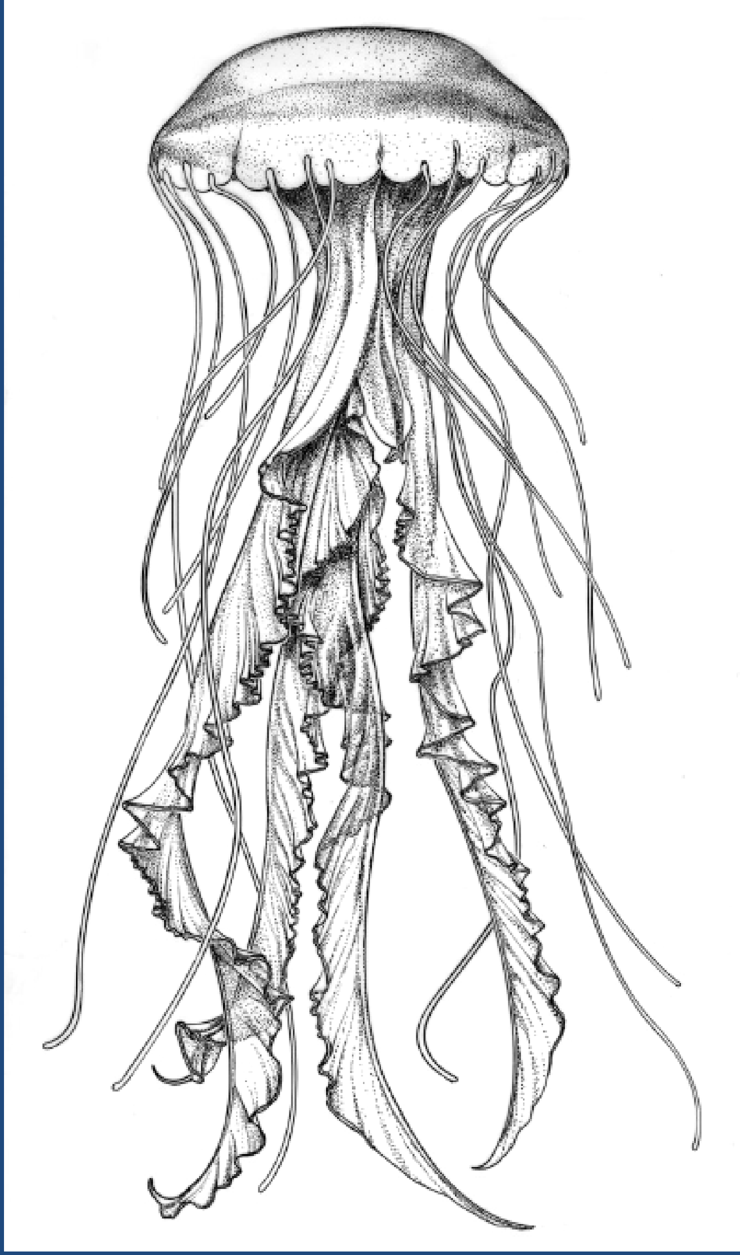
Sea Nettles

Sea Nettles

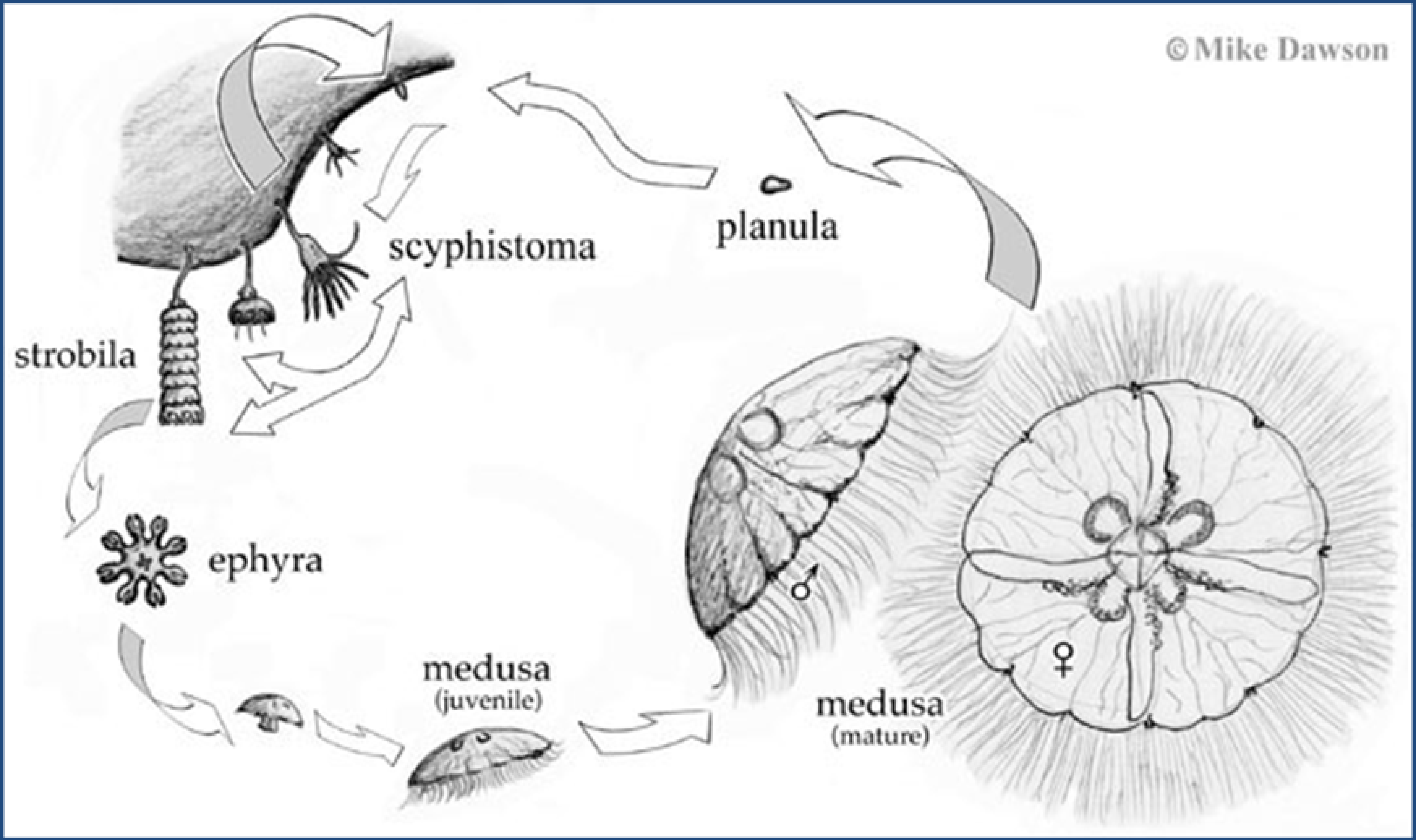
- Cnidarians: Jellyfish

- Two Phase Life History
- Adults Produce Gametes
- Larvae Produce Polyps
- Polyps produce Adults
- Polyps produce more Adults

- Repeat!!!



Life History



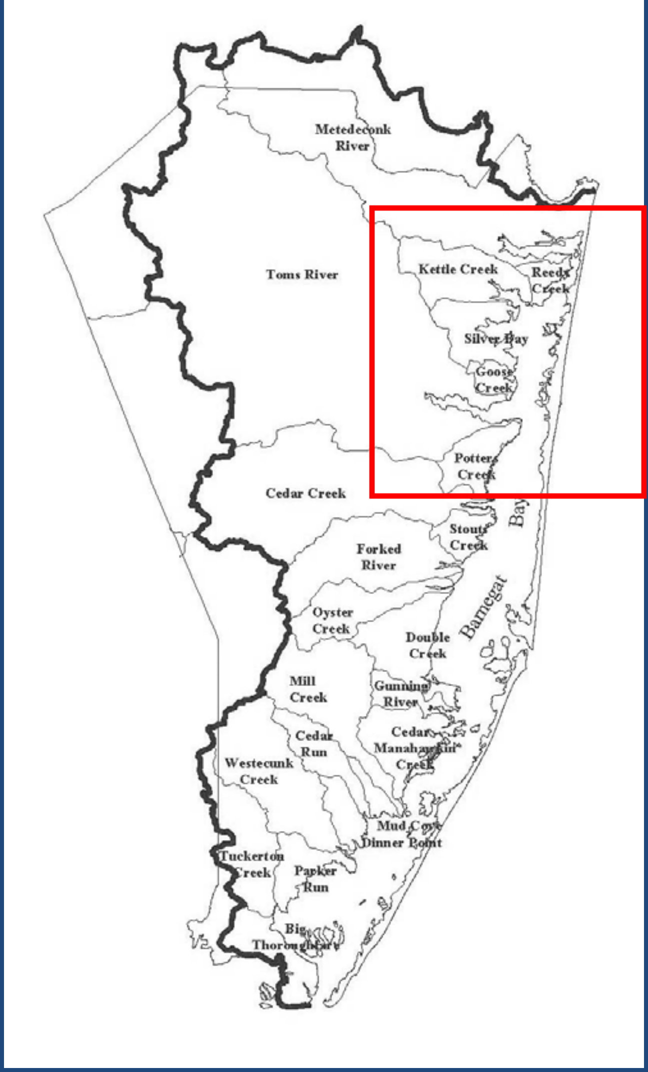
How did they get here?

- They have been around for a long time.
- **How did they become a Nuisance?**
  - **Changes in Water Quality**
  - **Rising sea temperatures**
  - **Polyp Settlement Habitat (e.g., docks, bulkheads)**
  - **Changes in food webs (i.e., overfishing)**
  - **Genetic Adaptation**

Habitat Preferences

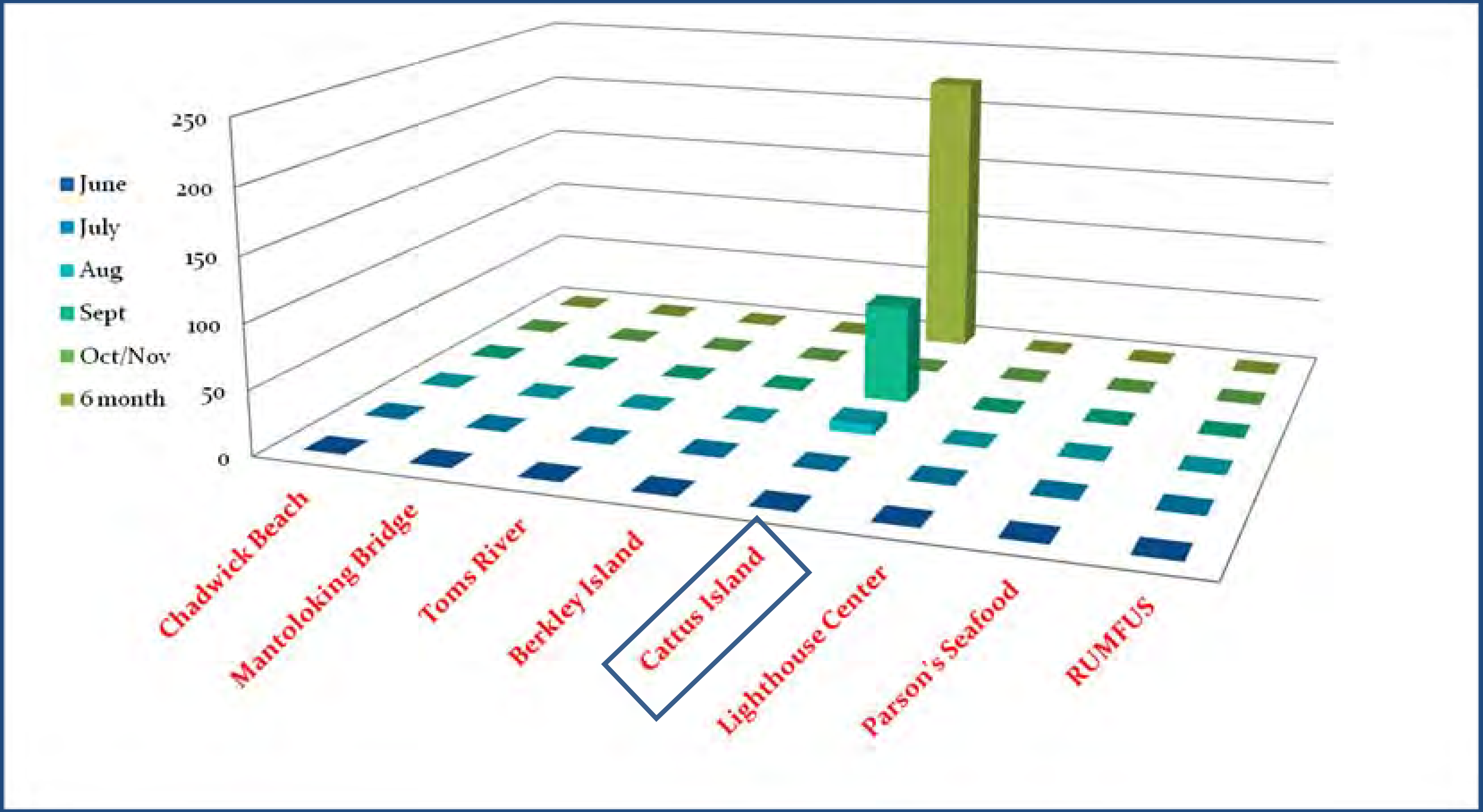
- Hard substrate for Polyp settlement
  - Oyster Shell, Rocks
  - Bulkheads, Docks, etc..
- Mesohaline regions (12-25 ppt)
  - Concentrated in Northern Bay
- Tolerances
  - Low Oxygen Demand (Polyp and Adult)
  - Winner by Default

Where are they a big problem?



- Northern Barnegat Bay
- Lower Salinity
- Eutrophication leads to O_2 reduction
- Substantial Settlement Sites

Research: Polyp Distribution



BBP Funded 2010-2011

Research: Molecular Biology

Summary of Molecular Findings on *Chrysaora quinquecirrha*

1. Sequenced regions of both mitochondrial and nuclear genomes
2. We have developed a very sensitive molecular assay to detect the presence of CQ DNA in bay water.
3. Demonstrated that molecular assays can generate quick turnaround of water samples, useful for predicting blooms
4. Generated genomic library of Barnegat Bay CQ
5. We have successfully cultured polyps for 14 months in the laboratory; we have induced strobilation to produce ephyra
6. Barnegat Bay CQ looks unlike any other *Chrysaora* that has been examined worldwide (based on DNA sequence analysis in Genbank).

Project Objectives

1. Create a field-sample **predictive model** for *Chrysaora* blooms using real-time PCR.

2. Assess the **distribution of gelatinous zooplankton** and impacts on planktonic community structure.

3. Assess the distribution and density of **settling *Chrysaora* polyps** and development of resting podocysts.

Study Sites:

- 10 paired East-West regions
- Riverine Regions (salinity preference)

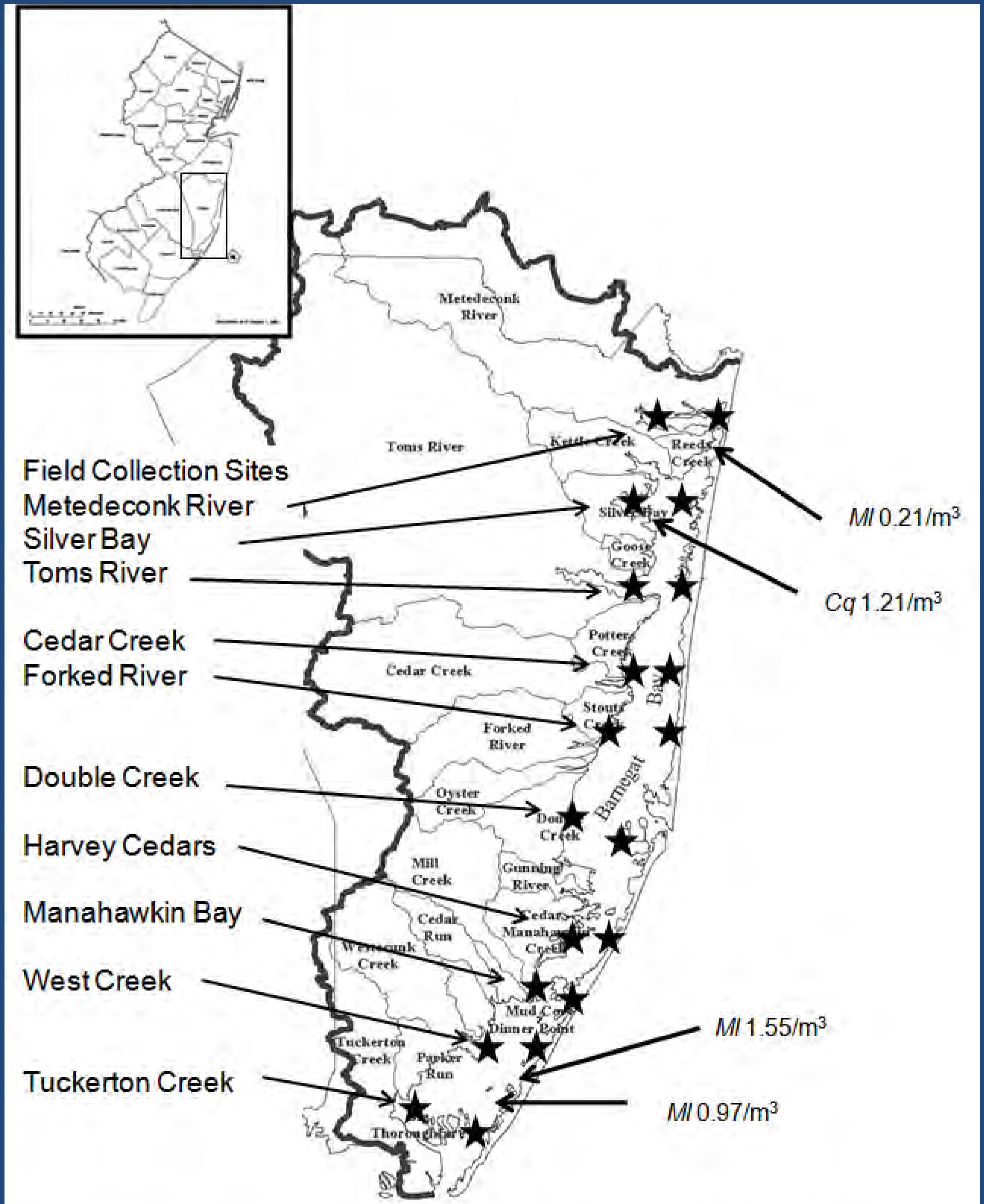


Figure 1. Proposed Research Sites and preliminary assessment of gelatinous zooplankton. Values represent density of *Chrysaora quinquecirrha (Cq)* and *Mnemiopsis leidya (Ml)* in Barnegat Bay (N=66 lift net samples).

Create a field-sample predictive model for *Chrysaora* blooms using real-time PCR.

- Collection of water Samples
- Filtration for ephyra/larvae/gametes
- DNA Extraction, Amplification, Quantification
- Post-Analysis of presence with field collection of later stages (time-lag assessment)
- Couple time-lag with water quality from fixed stations in the bay (BBP, NJDEP, and JCNERR)

Distribution of gelatinous zooplankton and impacts on planktonic community structure.

- Field collection of Adults using lift nets

- Field collection of juveniles and early stage individuals using plankton nets (335µm)
  - Assess other zooplankton abundance
  - Compare among regions and sea nettle vs. comb jelly abundance

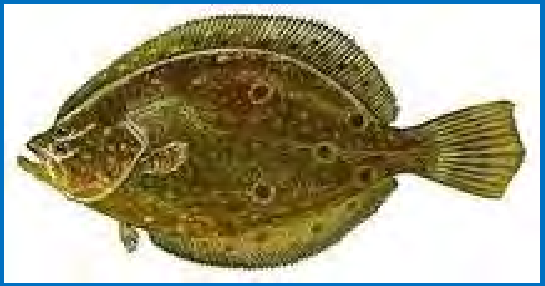
Distribution and density of settling *Chrysaora* polyps and development of resting podocysts.

- Placement of Settlement substrate
  - Oyster Shell
  - Plastic ‘non-toxic’ material (i.e., dock-bulkhead mimic)
- Retrieval of Substrate
  - Fall 2012: Season settlement rate and density
  - Spring 2013: overwintering survival

Potential Collaborations

- Water Quality: NJDEP, BBP, JCNERR
- Trophic Assessment: Phytoplankton, Zooplankton, larval fish/crab
- Fish-Crab Responses: Top pelagic predators on larval fish and crabs

Ecosystem modeling of Barnegat Bay



Olaf Jensen, Heidi Fuchs, and Jim Vasslides

RUTGERS

Goals

Short-term

- Develop a conceptual model of ecosystem processes and identify key species groups and interactions through interviews with Bay scientists and managers
- Develop two ecosystem models (lower & upper trophic levels) based on historical data for Barnegat Bay and similar systems
- Dynamically link the two models
- Create model “place-holders” for Barnegat Bay – specific data
- Create scenarios of ecosystem changes (climate, fisheries, nutrients) to be run in the models

Long-term

- An ecosystem-level decision support tool
- Quantitative predictions with estimates of uncertainty
- Expand the conceptual model to include stakeholders

Ecosystem Model

Ecosystem Model

Nutrient-Phytoplankton-Zooplankton (NPZ)

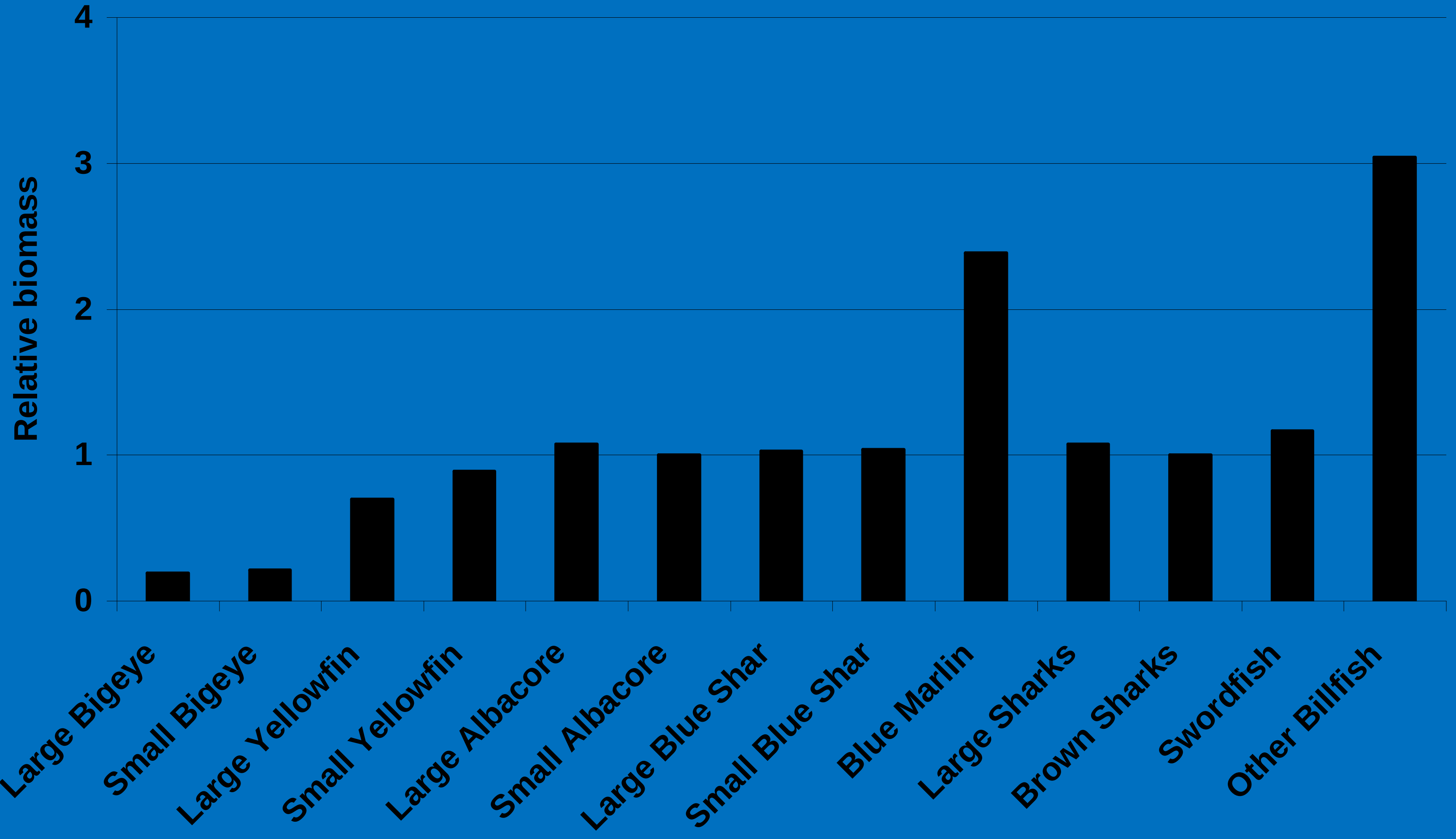
- Effects of nutrient inputs, grazing by zooplankton, plankton size structure
- Led by Heidi Fuchs (Rutgers, Biological Oceanographer)

Ecopath with Ecosim (EwE)

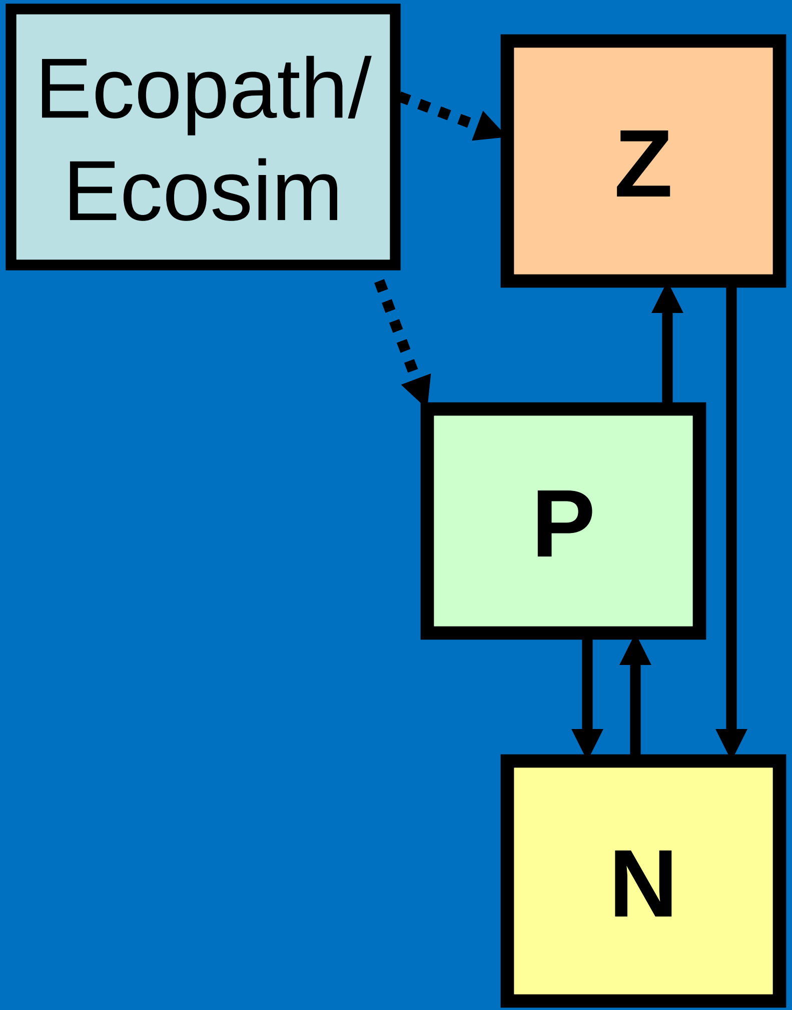
- Energy mass balance
- Predator-prey interactions
- Simulate future impacts based on changes to one or more groups
- Flexibility to use data from other systems when local info is not available

Deep hook results (Suzuki)

Relative biomass after 30 years



Nutrient-Phytoplankton-Zooplankton model



Potential modifications

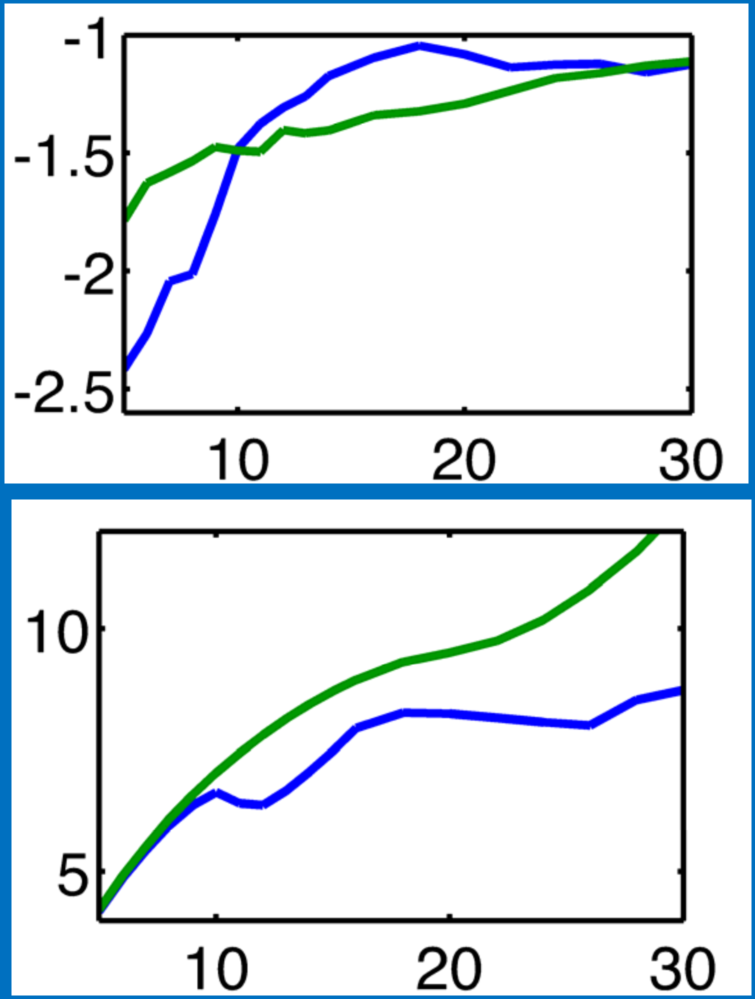
- Nutrients & detritus
- Size structure
- Functional groups

Sample output of NPZ model

(size-structured model)

Slope of Biomass Spectrum

Phytoplankton Biomass



Total Nutrient (μmol N)

Small predator-prey size ratio

Large predator-prey size ratio

Potential Data Sources

NJDEP resource surveys (e.g. hard clams)

Commercial landings data

OCNGS planning and operation reports

RUMFS technical reports

Primary scientific literature

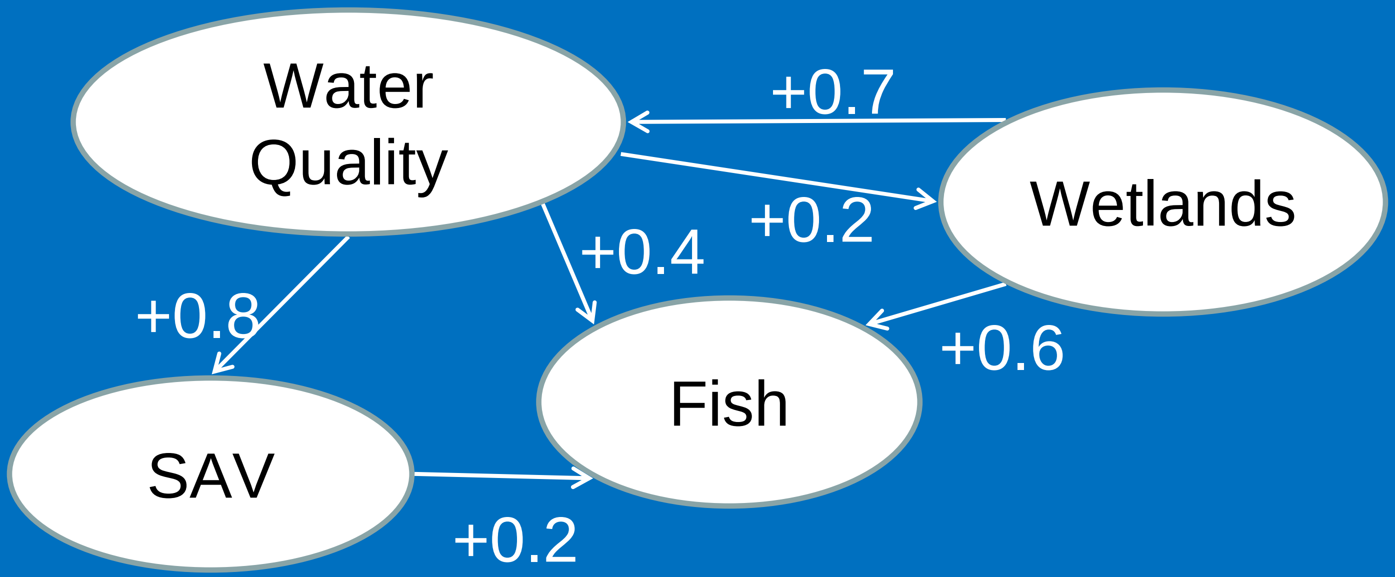
Other ongoing field sampling programs

Directed data collection projects

*****Other NJDEP Initiative Projects*****

FUZZY COGNITIVE MAPPING

Conduct interviews with knowledgeable individuals throughout the watershed



Code maps to create an adjacency matrix that can then be combined to create a social cognitive map or otherwise analyzed (*i.e.* scientists compared to baymen compared to general public).

Wetland Studies of Ecological Function and Adaptation: Denitrification

T. Quirk and D.J. Velinsky;
Patrick Center-Academy of Natural Sciences
and
A. Smyth and M. Piehler
University of North Carolina
September 29, 2011

Barnegat Bay Comprehensive Research

Nature 1994

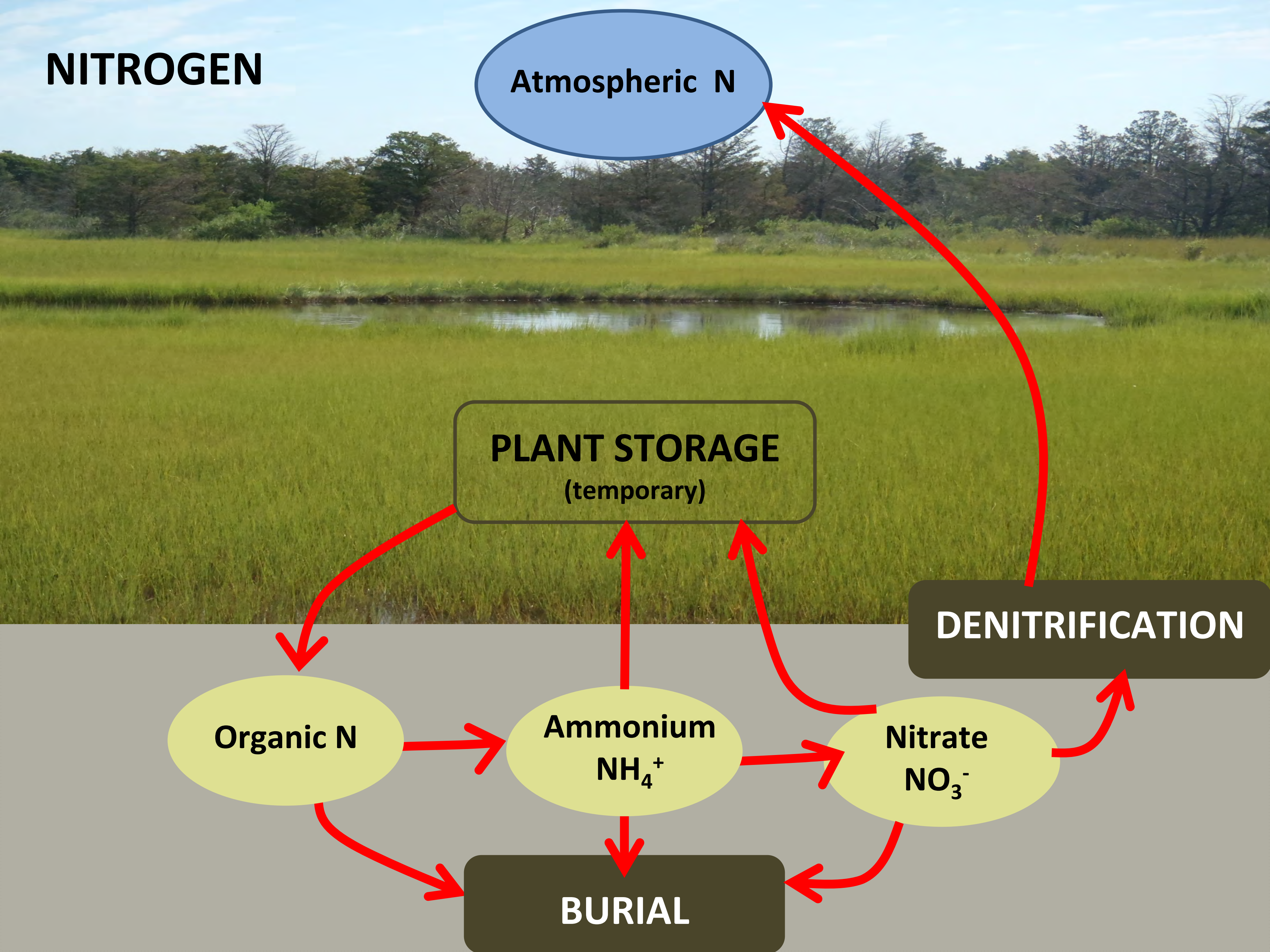
articles

The value of the world's ecosystem services and natural capital

Robert Costanza*†, Ralph d'Arge‡, Rudolf de Groot§, Stephen Farber‖, Monica Grasso†, Bruce Hannon¶, Karin Limburg#☆, Shahid Naeem**, Robert V. O'Neill††, Jose Paruelo‡‡, Robert G. Raskin§§, Paul Sutton‖‖ & Marjan van den Belt¶¶

	Ecosystem services (1994 US$ ha^{-1} yr^{-1})								
Biome	Disturbance regulation	Nutrient cycling	Waste treatment	Biological control	Habitat/ refugia	Food production	Raw materials	Recreation	Cultural
Coastal marine	88	3677		38	8	93	4	82	62
Estuaries	567	21,100		78	131	521	25	381	29
Seagrass/algae beds		19,002					2		
Coral reefs	2,750		58	5	7	220	27	3,008	1
Shelf		1,431		39		68	2		
Tidal marsh/mangroves	1,839		6,696		169	466	162	658	70
TOTAL COASTAL	**5244**	**45210**	**6754**	**160**	**315**	**1368**	**222**	**4129**	**162**
% OF GLOBAL	**31%**	**97%**	**30%**	**82%**	**30%**	**71%**	**26%**	**73%**	**6%**

???



NITROGEN
Atmospheric N
PLANT STORAGE
(temporary)
DENITRIFICATION
Organic N
Ammonium
NH_4^+
Nitrate
NO_3^-
BURIAL

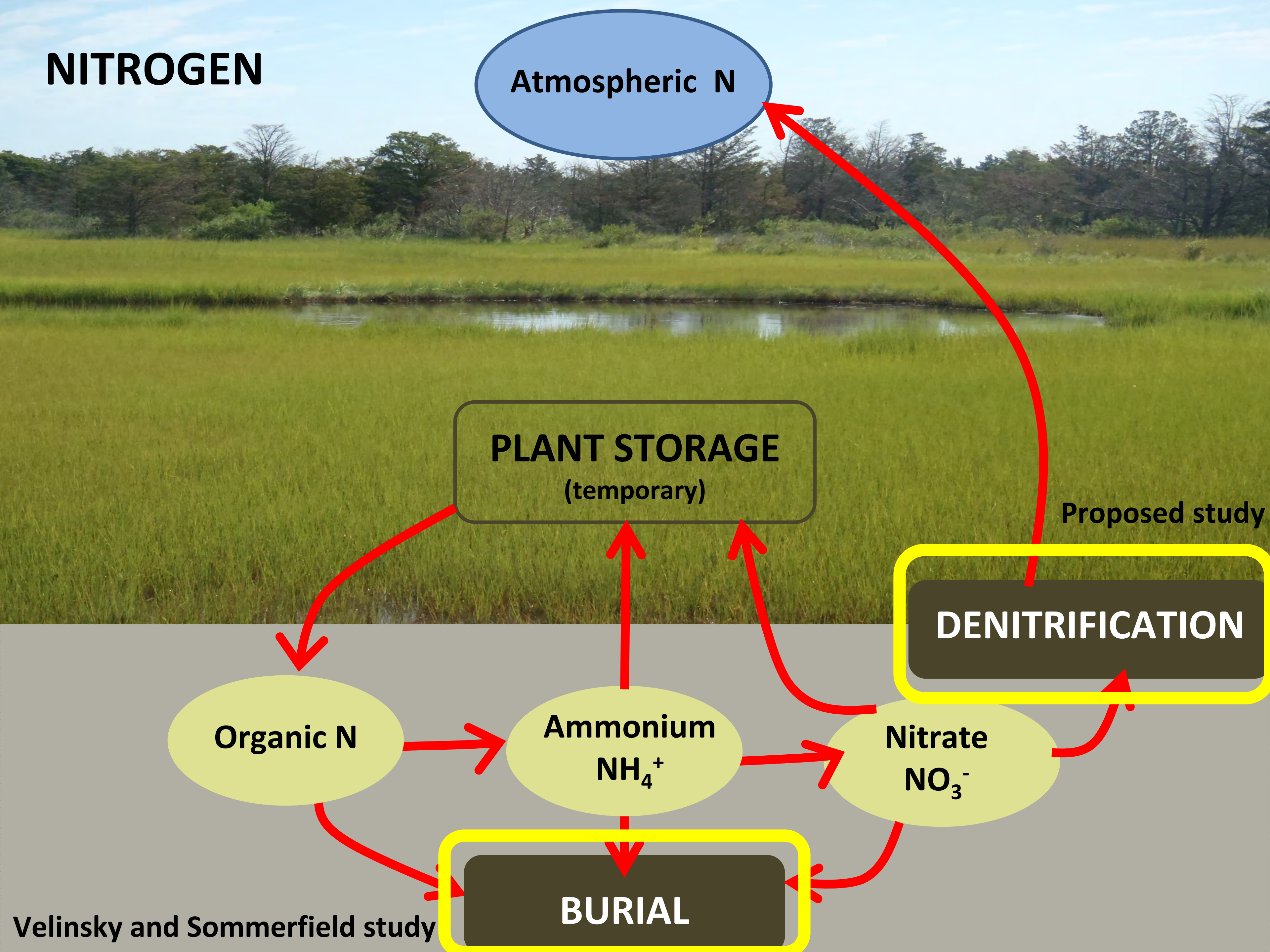
Barnegat Bay

Watershed N load: 6.9 x 10^5 kg N yr^{-1}

(Kennish et al. 2007)

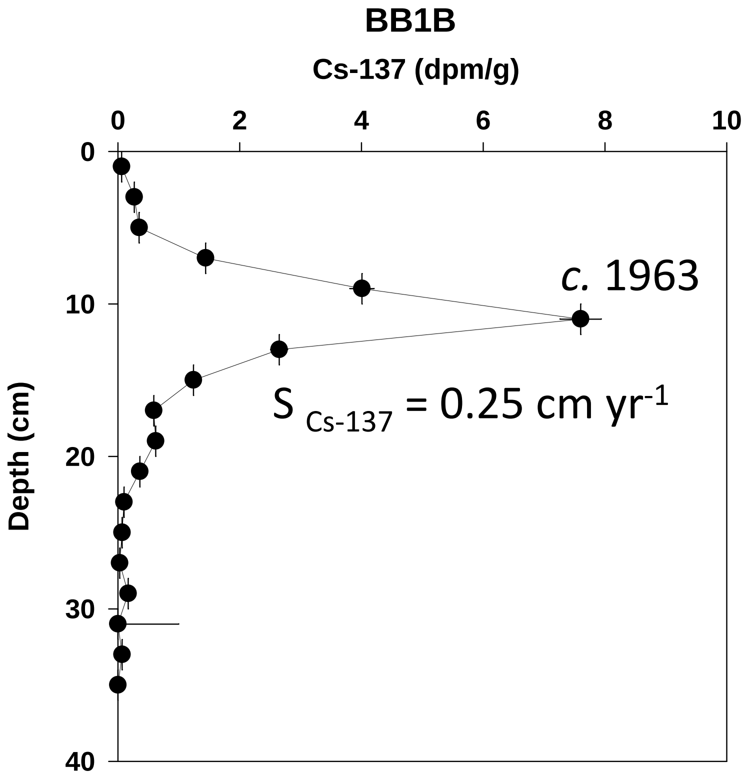
Symptoms of Eutrophication

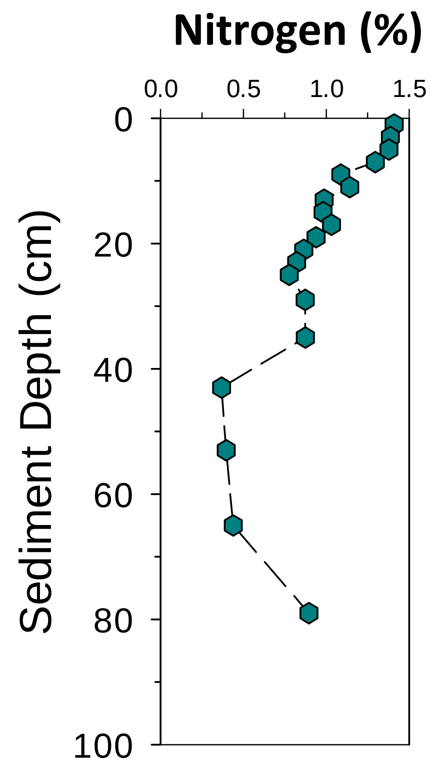
- phytoplankton and macroalgae blooms
- brown tide and HABs
- alteration of benthic communities
- loss of seagrass and shellfish beds



NITROGEN
Atmospheric N
PLANT STORAGE
(temporary)
Proposed study
DENITRIFICATION
Organic N
Ammonium
NH_4^+
Nitrate
NO_3^-
BURIAL
Velinsky and Sommerfield study

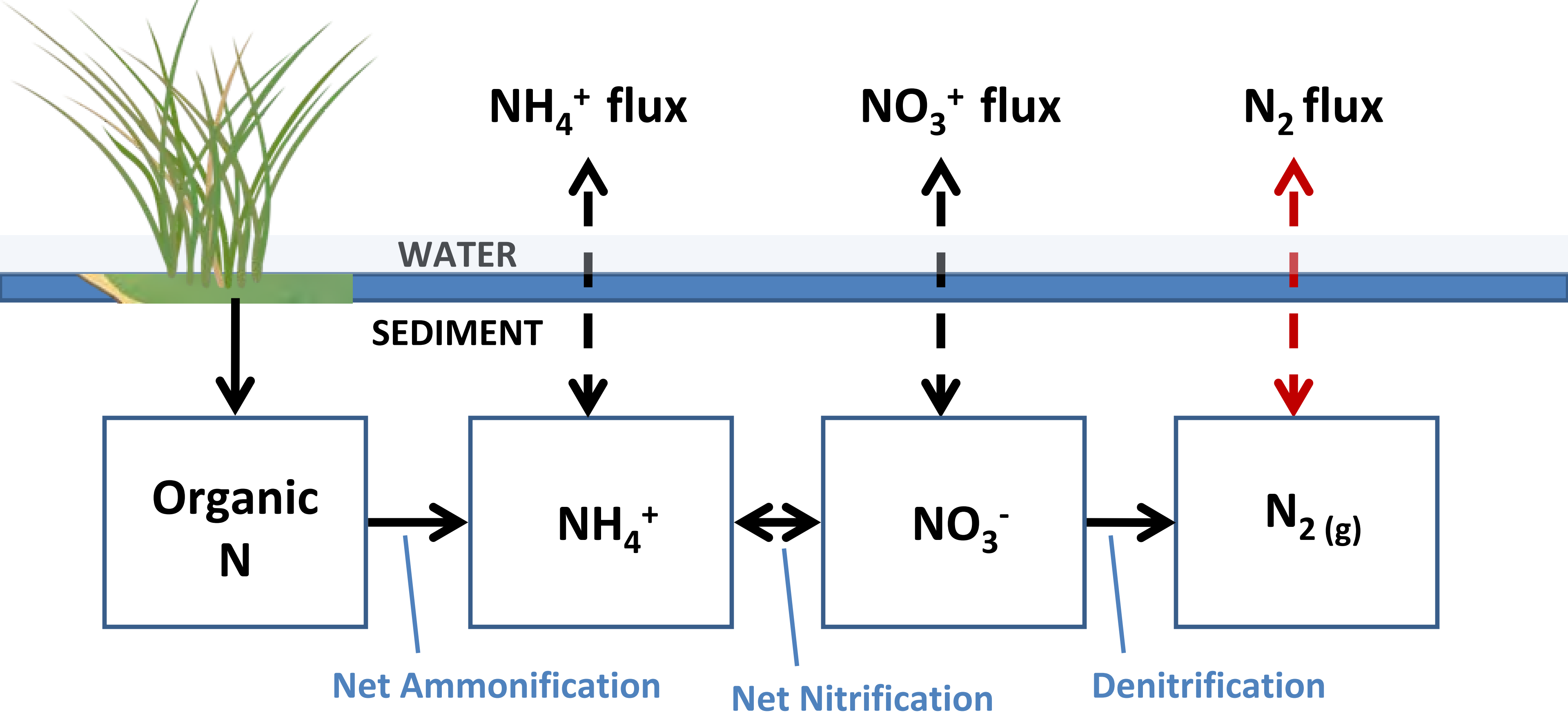
N burial in Barnegat Bay wetlands





Burial rate = 5.21 g N m^{-2} yr^{-1} (n = 4)

Velinsky et al. 2010



adapted from Kemp et al. 1990

NJDEP Barnegat Bay Comprehensive Research

Objectives of proposed project:

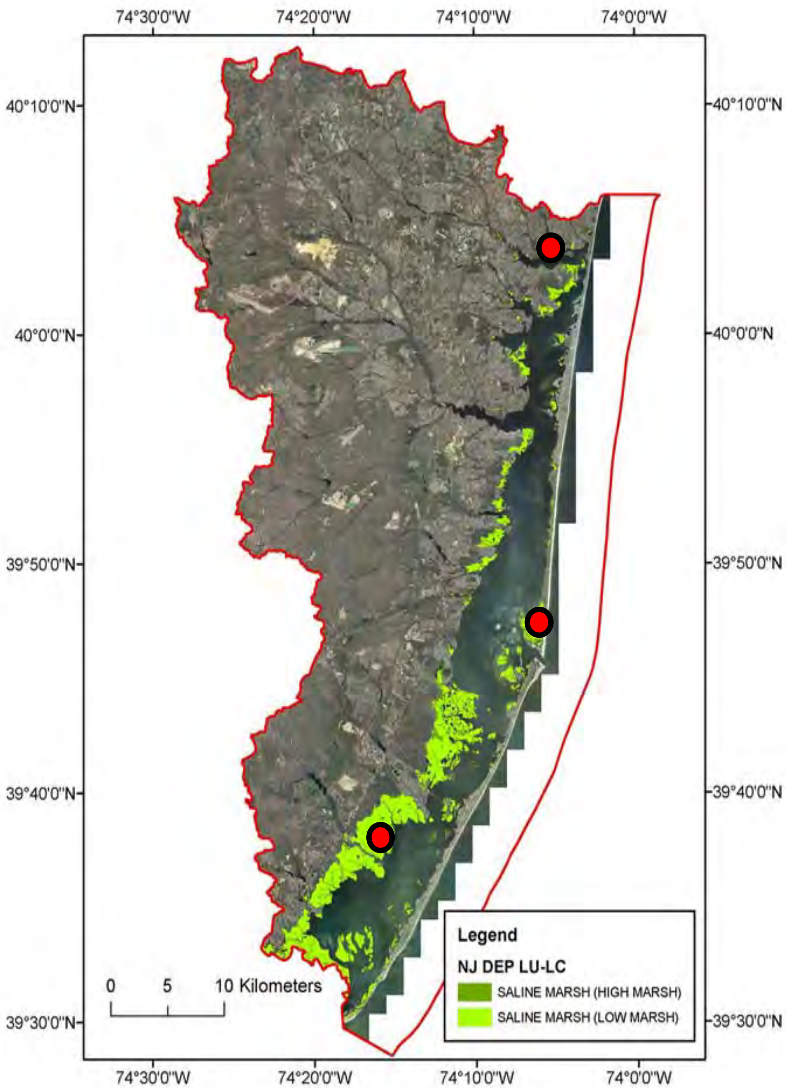
1. Evaluate permanent nitrogen (N) removal services provided by Barnegat Bay coastal wetlands

    - *Bay-wide* seasonal denitrification rates in salt marshes

    - Salinity gradient effect from salt marsh to tidal fresh

2. Combine data with existing N burial rates (Velinsky et al. 2010) to obtain an overall estimate of N removal services provided by Barnegat Bay wetlands

Barnegat Bay



Spatial coverage of the bay

- North
  - -High nutrient input
  - -Lower salinity
- Mid-bay Barrier Island
- South
  - -Lower nutrient input
  - - Higher salinity

Ongoing Research

Wetlands designated as a long-term monitoring sites

Mid-Atlantic Coastal Wetlands Assessment (MACWA)

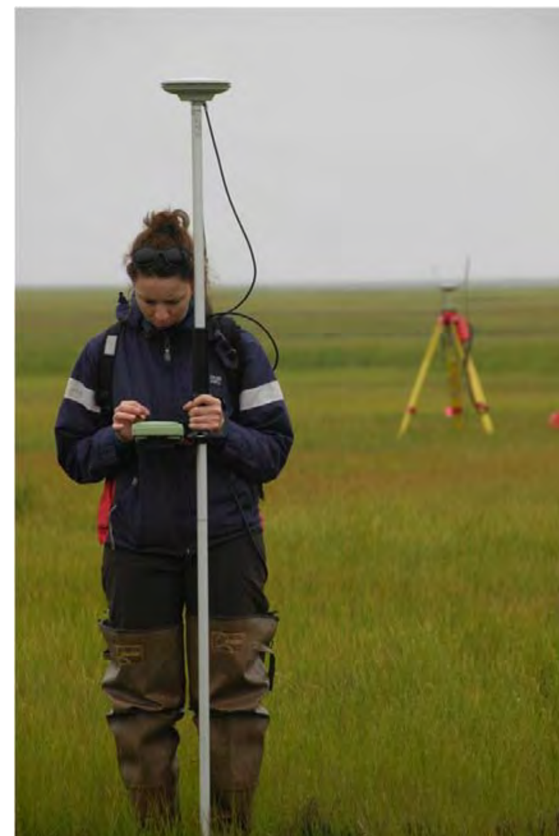
Barnegat Bay Partnership
RESEARCH · EDUCATE · RESTORE

MACWA Partners

- Barnegat Bay Partnership
- Partnership for Delaware Estuary
- NJDEP
- US Fish and Wildlife Refuges
- Rutgers University

Monitoring activities

- Surface elevation changes
- Plant production
- Soil chemistry
- Water quality



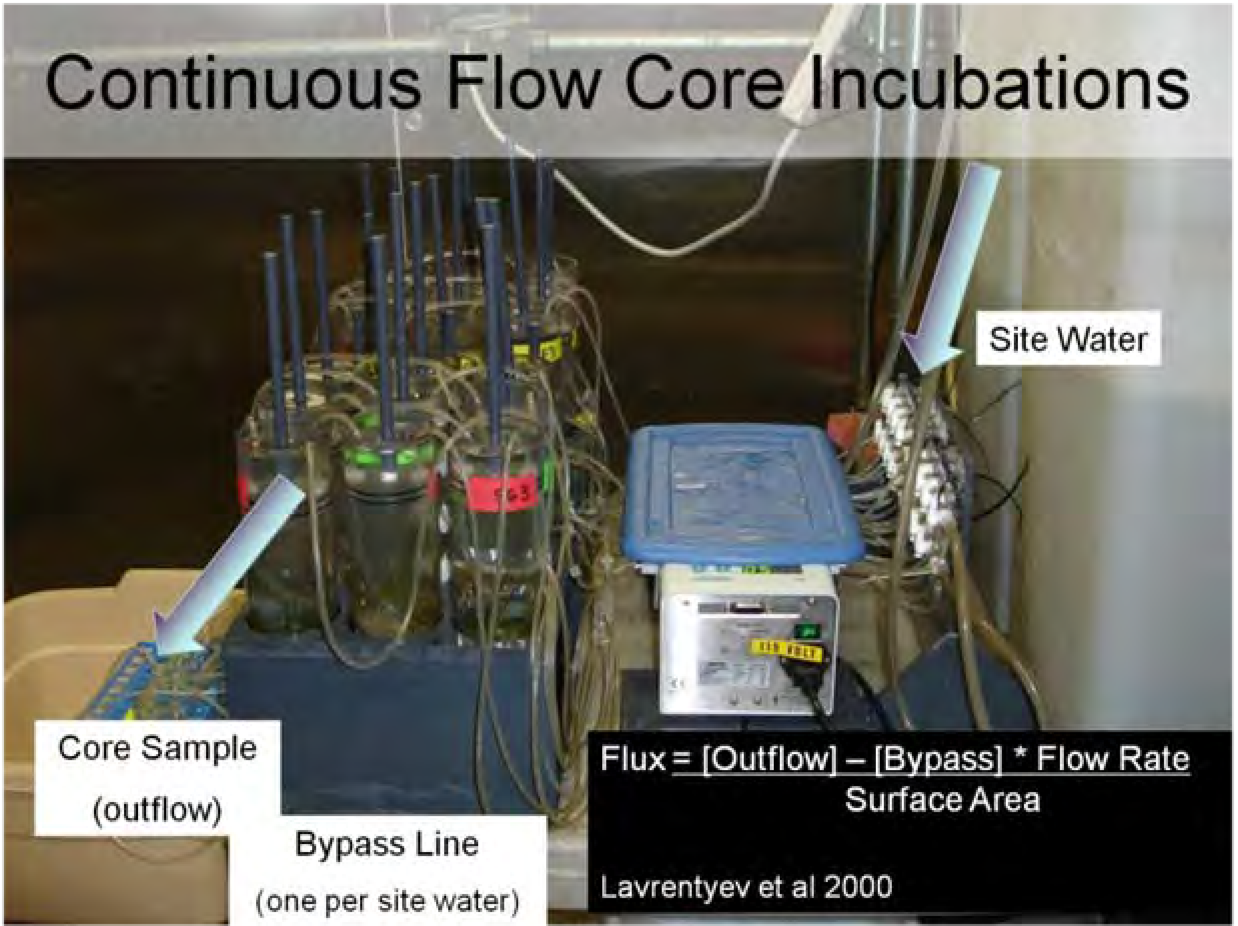
Influence of salt water

Sulfide and salinity dampen denitrification rates

Implication:

Salt water intrusion and loss of tidal fresh marshes will reduce the N removal services

Membrane Inlet Mass Spectrometry



Proposed research

1. Seasonal denitrification rates
    - 3 salt marshes in north, mid-, and south bay
    - 7 cores per marsh
    - 3 times per year (April, July, October)
    - Analyze cores for N- fluxes, oxygen demand, soil carbon and nutrients
    - Determine average bay-wide flux rates (g N m^{-2} d^{-1})

Proposed research

2. Denitrification along a salinity gradient
   - 5 – 7 sites along salt marsh to tidal fresh gradient
   - 3 cores minimum collected per site
   - Mid-summer when rates are the highest
   - Analyze cores for N- fluxes, oxygen demand, soil carbon and nutrients
   - Determine average flux rates along in along salt gradient (g N m^{-2} d^{-1})

Application

1. Expand the N budget for Barnegat Bay to include wetland removal services

2. Relay to managers and policy makers our evaluation of this ecosystem service and the importance of maintaining tidal wetlands as sea level rises