

Division of Science, Research & Environmental Health

Update on Current and Recently Completed Research Projects

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Director

NJDEP

November 18, 2016

DEP/AW&MA Conference



NJDEP Vision Statement

- ✦ Regulations that are balanced, incorporate **science**, provide flexibility and accurately evaluate potential impacts including cost-benefit analyses.
- ✦ We must make permitting and inspection of individuals, businesses, governmental bodies and other organization both timely and predictable, basing our decisions on **science**, data, facts and cost-benefit analyses.
- ✦ **Science**-based decisions based on input from our Science Advisory Board and the State's colleges and universities.

DSREH Goals:

- ✖ Provide the department with, and access to, **expertise and information** that supports its technical, program and policy needs.
- ✖ Act as liaisons to the **Science Advisory Board** and Standing Committees that will help provide the DEP with outside expertise on scientific issues.
- ✖ Perform **research** to meet the information and problem-solving needs of the department, and to identify and understand **emerging issues** that require the department's attention and response.
- ✖ Advocate and integrate the **multi-disciplinary perspective** into the department's identification, analysis and resolution of environmental issues.

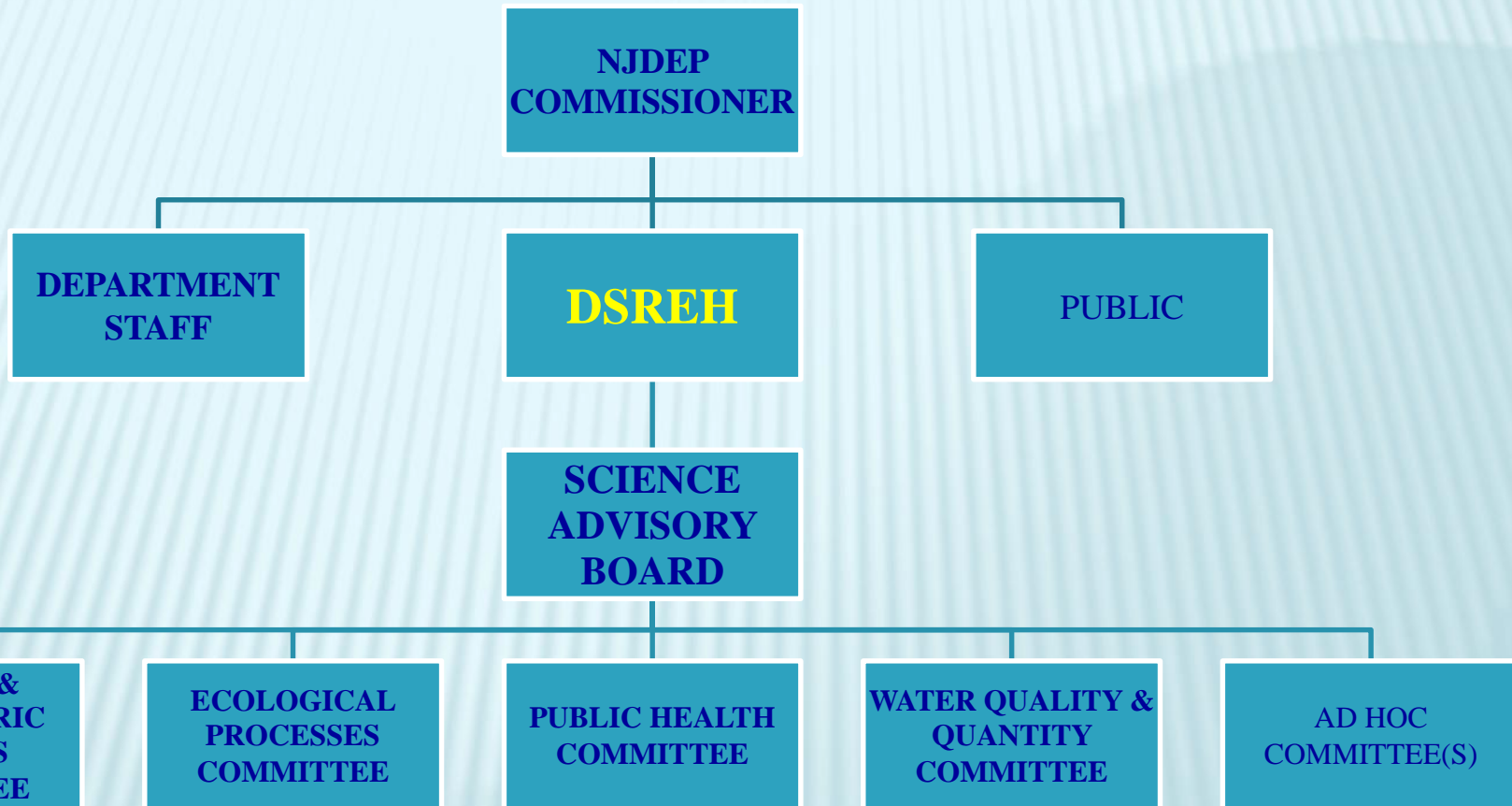
Staff Expertise

- Toxicologists/Risk Assessment
- Biologists/Ecologists
- Air Quality/Modeling Specialists
- Water Quality Specialists
- GIS
- Chemist
- Statistician
- Microbiologist
- Environmental Scientists

Science Based Support

- Air Monitoring/Modeling
- Fish Monitoring & Consumption Advisories
- Human Health Risk Assessment
- Standards Development
- Data Analysis & Interpretation
- Analytical Chemistry
- Literature Reviews

Science Advisory Board



SCIENCE ADVISORY BOARD - COMPLETED

- × Water Quality Data Evaluation and Interpretation – January 2016
- × NJ Climate Change – January 2016
- × Human Health Impacts of Microplastics and Nanoplastics – December 2015
- × Management of Waste Wallboard – Nov 2015
- × [See <http://www.state.nj.us/dep/sab/>](http://www.state.nj.us/dep/sab/)

SCIENCE ADVISORY BOARD – ONGOING WORK

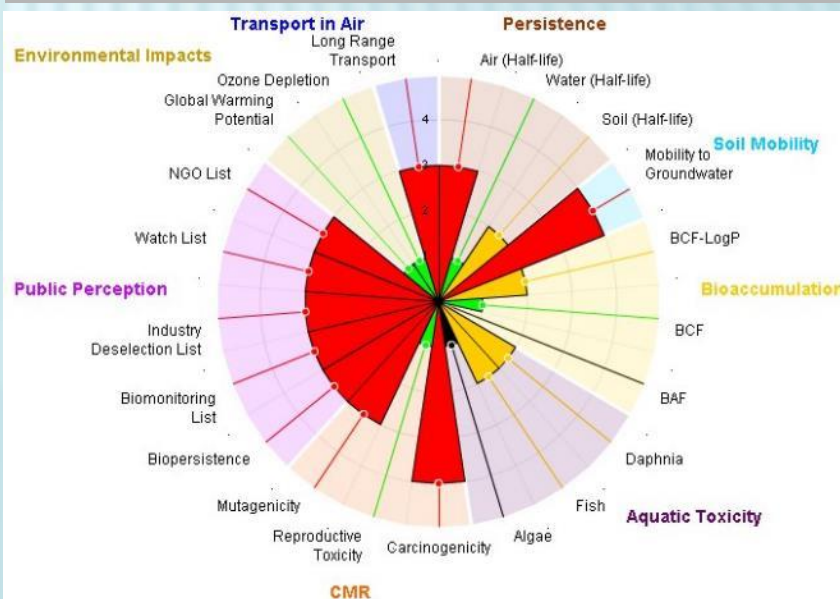
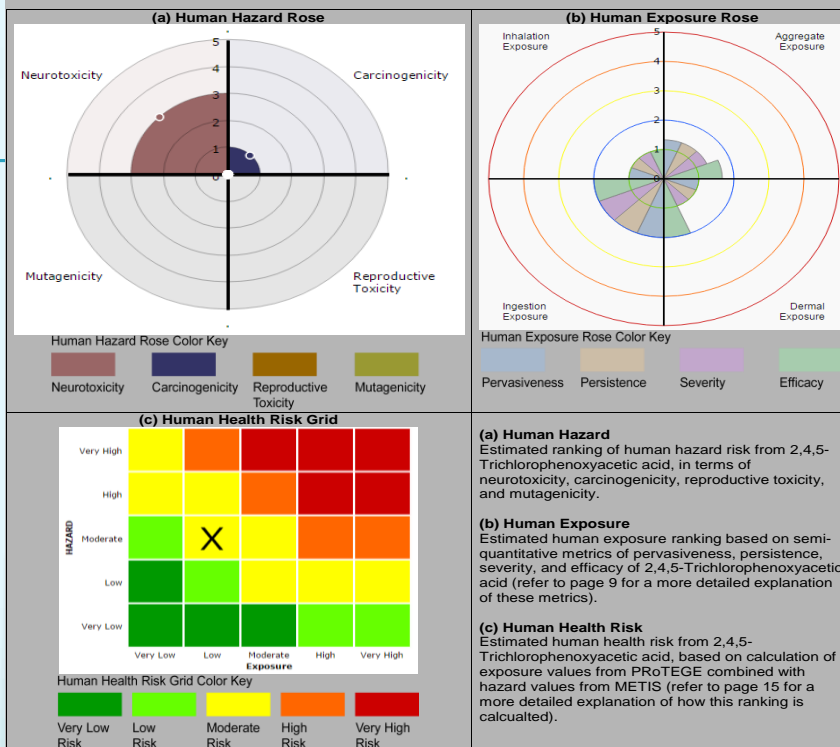
- × Marine Dissolved Oxygen
- × Acrylamide Monomer
- × Nutrient Issues – e.g., nitrogen criterion
- × Long-term Effects of Eutrophication
- × Impacts of Dredging and Dredge Material Management on Coastal Ecosystems

Active Research

NJRISK

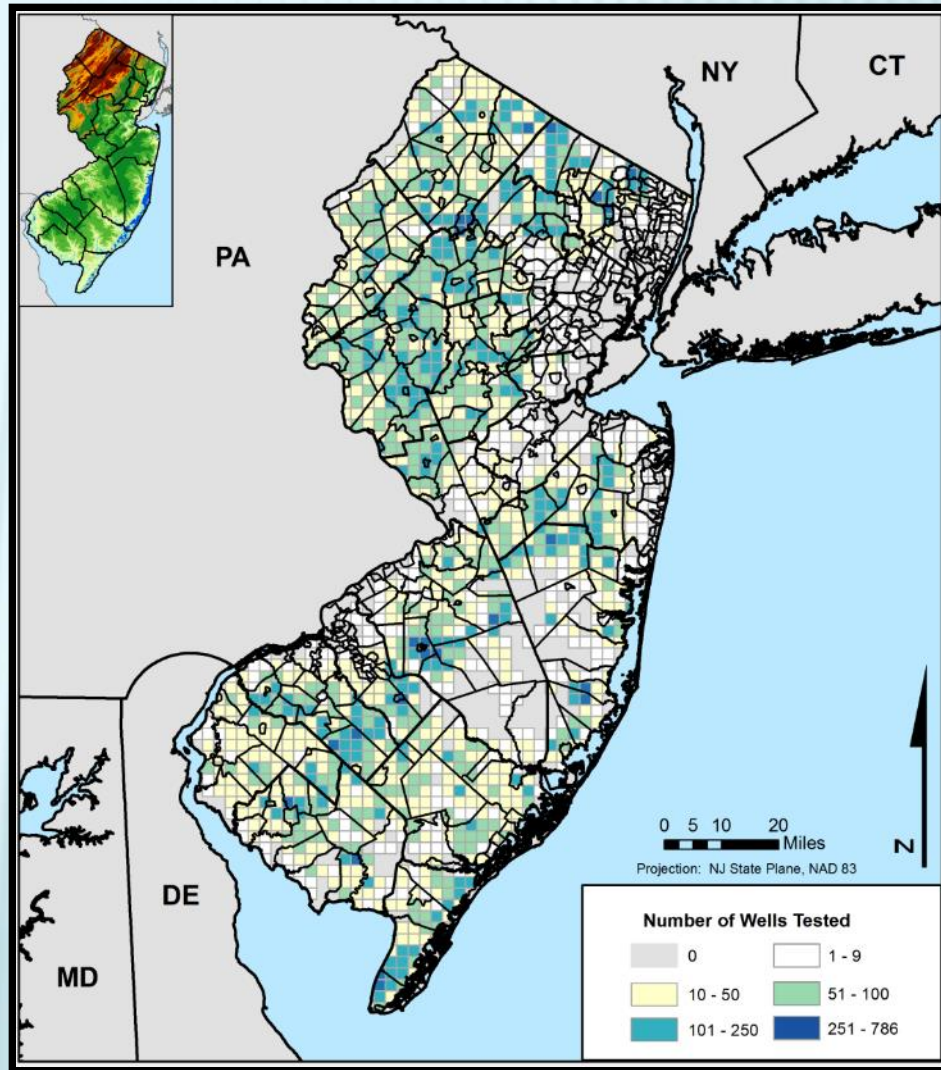
- ✖ DEP has a need to evaluate the hazardous effects and exposure potential of chemicals in various environmental media
- ✖ Computational tool to provide immediate information about chemical contaminants
 - + Combining METIS and Protégé databases developed by DuPont and Rutgers University

NJrisk Preliminary Results for 2,4,5-Trichlorophenoxyacetic acid



NEW JERSEY PRIVATE WELL TESTING

- ✖ Approximately 400,000 private wells (13 % of residents) in NJ.
- ✖ Wells are required to be tested for bacteria, nitrates, 26 volatile organic compounds, lead, pH, iron, and manganese. Mercury, arsenic, and radium (gross alpha) are only required in certain counties.
- ✖ Analysis of data show the variability in the concentration for each parameter in relation to State standards.
- ✖ Data from the PWTa can be used to identify vulnerable communities and direct outreach efforts.
- ✖ Data is also used by SDW, SRP, and NJGWS.



ENVIRONMENTAL TRENDS

- × 39 chapters on the status of key environmental parameters
- × Each chapter is updated with input from program areas as new data become available
- × Provides a summary of a major environmental issue
- × Each chapter includes references, DEP contacts, and sources of additional information

TRENDS REPORTS

Division of Science, Research and Environmental Health

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ENVIRONMENTAL TRENDS

The New Jersey Department of Environmental Protection (DEP) is charged with protecting the natural environment and those aspects of human health directly related to environmental factors. Historically this has meant controlling discharges to air, water and land, and working to both minimize and remedy the pollution of these media. Regulation of releases to the environment from point sources like waste discharge pipes and smokestacks, and the management of wastes themselves, have been particular focus areas. It has become increasingly clear that protection of the environment and human health requires a more comprehensive approach. Today, the DEP strives to protect and manage uses of land and other resources to ensure that not only future generations of people can thrive so to can wild plants, animals and their critical habitats. The DEP continues its efforts to preserve environmental resources including air, water, land, and healthy ecosystems.

Periodic assessments of environmental conditions can provide insight into the effectiveness of the DEP's current efforts and offer guidance for future efforts. In monitoring and reporting on environmental conditions, it is useful to focus on measures, or indicators, of environmental health. Environmental indicators are quantitative measures of conditions and trends that are used to assess the state of the environment and natural resources and, where possible, to gauge progress towards specific goals. Indicators are necessary because the condition of an environmental factor, such as water or air quality, is often made up of many different components and it can be difficult or impossible to directly measure them all. The choice of measures is also limited to those environmental parameters for which there are accurate and appropriate data, preferably long-term data that can clarify and illustrate any trends that may exist.

Since 1998, the DEP has been updating "State of The Environment" reports that provide general information on trends and conditions for a variety of environmental factors that, together, comprise an overall assessment of our state's environmental health. Currently, "New Jersey's Environment Trends" consist of 39 chapters that cover Air, Climate/Energy, Open Space and Land Use, Pollution Prevention/Solid Waste, Water, Plants and Wildlife. Each chapter describes a specific area in which the DEP has been working to improve conditions and presents a specific environmental measure or category of measurements meaningful in gauging the current status of the environment in New Jersey. Chapters are updated on a rolling basis.

Some of these measures have been discussed in earlier DEP reports and the DEP believes it is important to continue tracking them. Reasonably good data exist for each of these measures. Where goals or end points are associated with a measure, these are presented. Some goals are expressed formally in laws or rules. For example, a clear-cut goal noted in the chapter "Ozone" is compliance with the federal ozone standard. Other measures can be compared with assumed or implied goals, such as a stable or increasing population of a wildlife species like the bald eagle. For example, in the chapter "Wildlife Populations: Bald Eagle," the recently increasing population of these birds can be considered a positive development, despite the lack of a formal goal of a specific number of breeding pairs of these birds.

Report Chapters (all in PDF)	Updated
Air	
▶ Air Toxics	April 2013
▶ Atmospheric Deposition: Acidity and Nutrients	November 2015
▶ Greenhouse Gas Emissions	May 2012
▶ Mercury Emissions	March 2013
▶ NOx and VOCs	March 2016
▶ Ozone	March 2016
▶ PM2.5	March 2016
▶ Vehicle Miles Traveled	March 2016
Climate/Energy	
▶ Climate Change in NJ: Trends in Temperature & Sea Level	June 2013
▶ Energy Use & Renewable Energy Sources	May 2013
Open Space and Land Use	
▶ Beach Replenishment	March 2010
▶ Land Use and Land Cover	May 2013
▶ Open Space Preservation	March 2016
▶ State Parks and Forests	April 2013
▶ Urban and Community Forests	September 2014
Pollution Prevention/Solid Waste	
▶ Pesticides	October 2012
▶ Site Remediation	September 2014
▶ Solid Waste and Recycling	October 2012
Water	
▶ Beach Closings	March 2016
▶ Dissolved Oxygen Levels in Coastal Waters	September 2014
▶ Drinking Water Quality	March 2016
▶ Estuarine Algal Conditions	September 2014
▶ Fish: Concentrations of Key Contaminants	September 2014
▶ Fresh Water Pollution: Streams: Ambient Biomonitoring Network & Fish Index of Biotic Integrity Network	May 2011
▶ Groundwater	March 2013
▶ Marine Water Pollution: Shellfish Waters	September 2014
▶ Surface Water Quality: Streams: Chemical and Physical Measurements	March 2012
▶ Water Supply	December 2012
Plants and Wildlife	
▶ Endangered Plants	January 2013
▶ Wildlife Chapters	March 2016

Barnegat Bay



Barnegat Bay Research - status

- × Three years of research completed!
- × Years 1, 2 and 3 – Reports posted
- × Results presented at various locations over the past year.
- × Baseline conditions & relative health of the bay
- × Science/data is being used to develop management/action plan

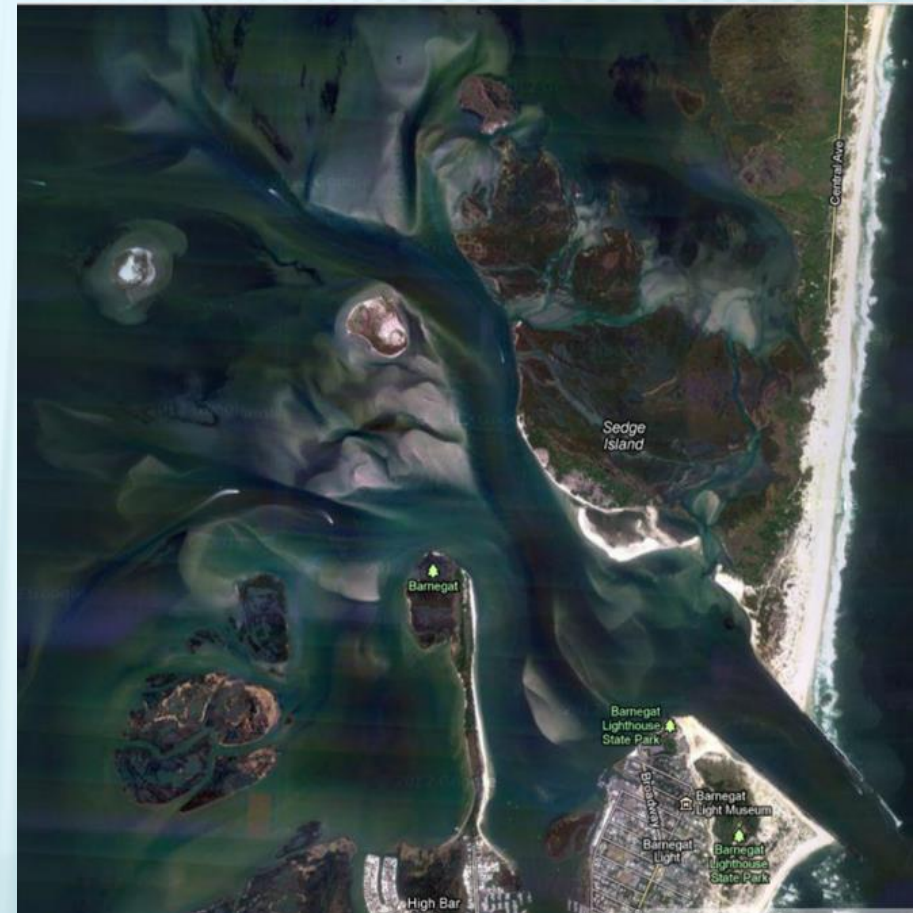
ECOLOGICAL EVALUATION OF THE SEDGE ISLAND CONSERVATION ZONE – SICZ (RIDER UNIVERSITY)

Objectives:

- ✖ Examine the temporal and spatial variation in the species diversity and abundance of fish and select decapod crustaceans (esp. blue crabs), among three common estuarine habitats inside vs. outside the SICZ (SAV, Algae, Open Water)
- ✖ Develop Monitoring Plan for DEP

Status:

- ✖ Field work completed in August (effort coordinated with DFW and Sedge interns).
- ✖ Report will provide results and outline for routine monitoring.



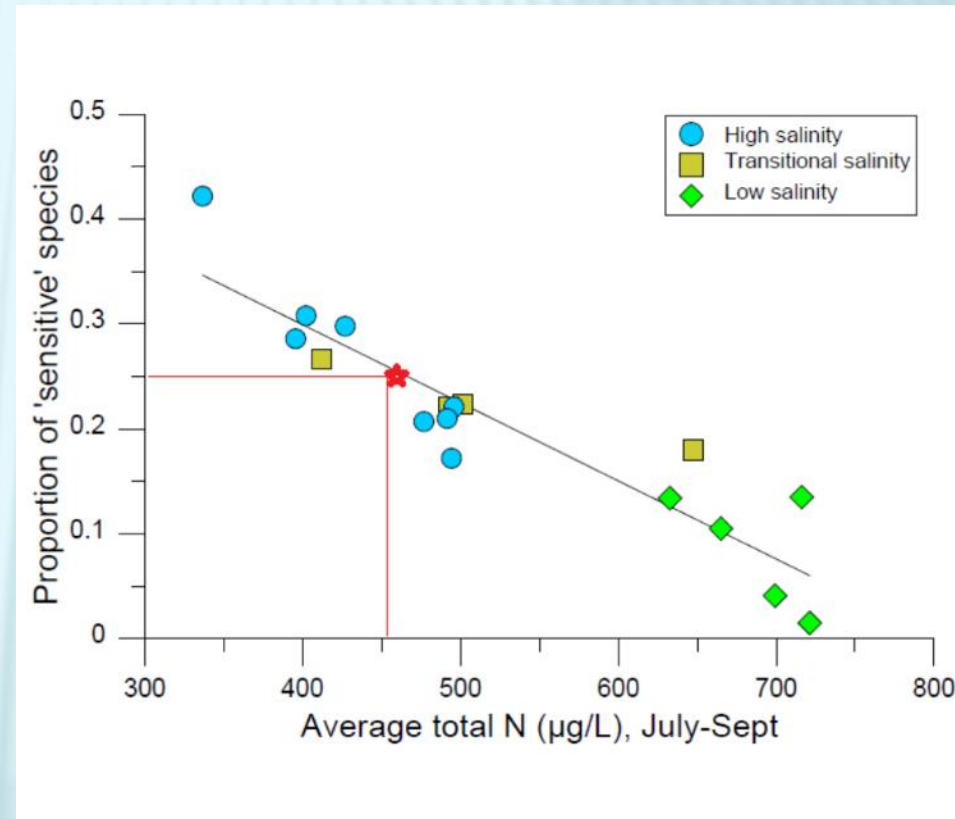
CONTINUED DEVELOPMENT OF BENTHIC INVERTEBRATE INDEX FOR BARNEGAT BAY (RUTGERS UNIVERSITY)

Objectives:

- ✗ Conduct additional sampling and analysis of benthic invertebrate communities to further calibrate index relating community composition to water quality.
- ✗ Focus on total nitrogen (TN) content.



Status:

- ✗ 2016 field work and sampling have been completed; samples sent to lab for processing.
- ✗ Report in 2017.


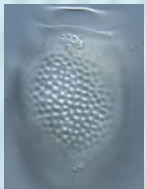


BASELINE CHARACTERIZATION OF PHYTOPLANKTON AND DEVELOPMENT OF PHYTOPLANKTON INDEX OF BIOTIC INTEGRITY (P-IBI) IN BARNEGAT BAY –LITTLE EGG (BB-LEH) HARBOR

Project objectives:

- 
- 
- ✖ To develop season-salinity specific phytoplankton index of biotic integrity (P-IBI) for BB-LEH.
 - ✖ To document phytoplankton species composition and succession (2011-2015).
 - ✖ To characterize their temporal and spatial changes.
 - ✖ To understand the relationships between the changes of species composition and environmental variables.

Summary of findings:

- 
- 
- Study revealed significant inter-annual changes in the phytoplankton community. Species composition in northern Barnegat Bay was more affected by Hurricane Sandy due to salt water intrusion.
 - Seasonal and spatial changes of phytoplankton were controlled by temperature and salinity, but also significantly related to TN, TP, dissolved silica, DO, and TOC/DOC.
 - P-IBI scores showed good separation between impaired and least-impaired for most season-salinity zones, correctly classifying 57-81% of the calibration set samples.
 - Project continuing in 2016-2017 to provide additional data necessary to refine P-IBI development in BB-LEH.

BIOLOGICAL CONTROL OF SEA NETTLES USING NUDIBRANCHS (MONTCLAIR STATE UNIVERSITY)

Objectives:

- ✗ Identify potential nudibranch predators of sea nettle polyps in Barnegat Bay.
- ✗ Assess nudibranch potential as a biological control of sea nettle polyps.
- ✗ Field assessment of nudibranch feeding.

Status:

- ✗ Laboratory work underway; feeding trials on polyps have started with a few different species.
- ✗ DNA analysis has been initiated for species identification.



Coryphella sp. Source: njscuba.net

ASSESSMENT AND DISTRIBUTION OF CLINGING JELLYFISH (MSU)

Objectives:

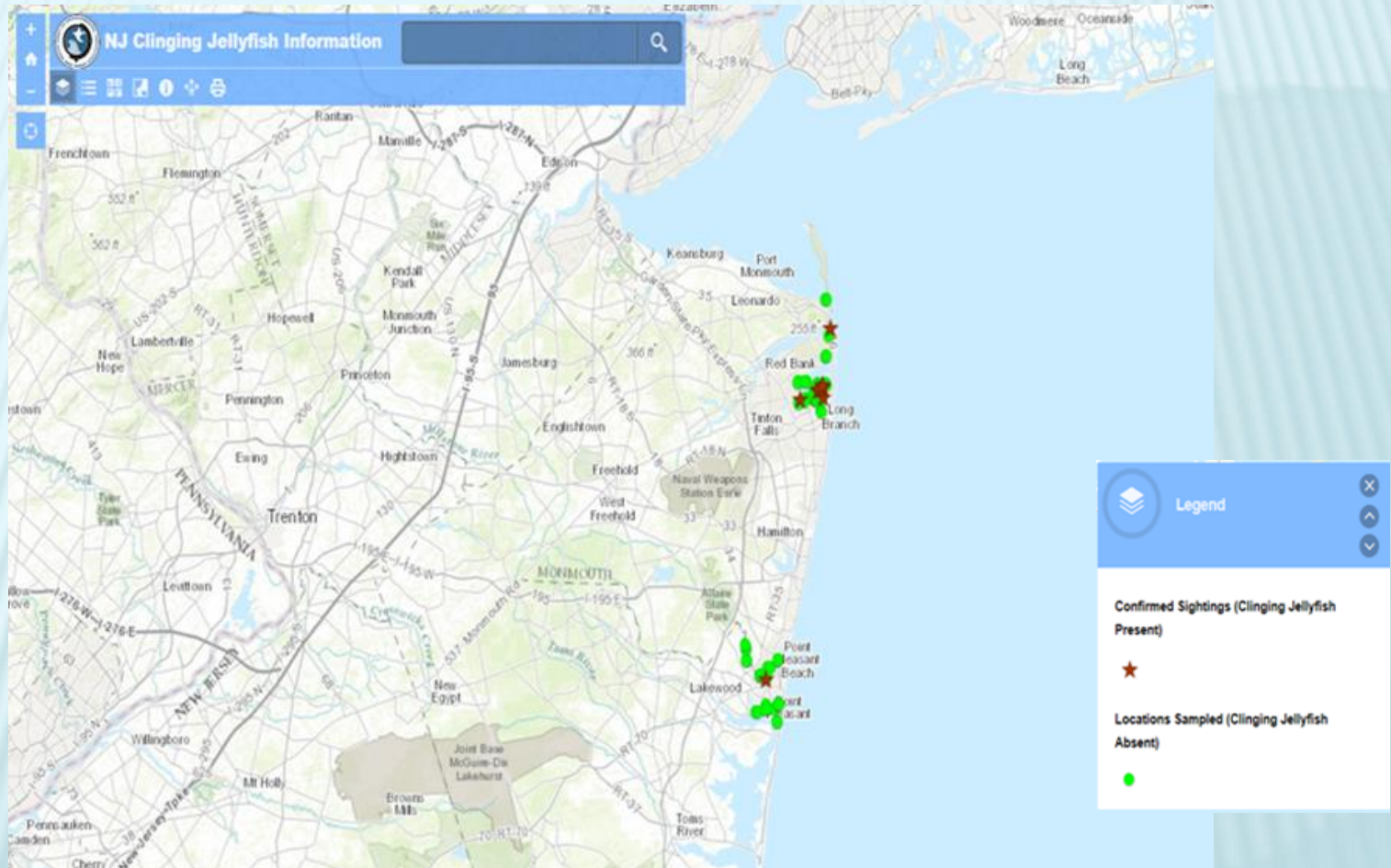
- ✖ Extent of clinging jellyfish in Shrewsbury River and Manasquan River.
- ✖ Provide an estimate of density per transect/area.
- ✖ Are medusa being transported to other waters?

Status:

- ✖ NJDEP Interactive clinging jellyfish map created to track confirmed sightings.
- ✖ Field sampling in the Shrewsbury and Manasquan Rivers, and Northern Barnegat Bay complete.
- ✖ Jellyfish Attracting Devices (JADs) analyzed for clinging jellyfish polyps.
- ✖ DNA sequencing and analyses on all media complete.

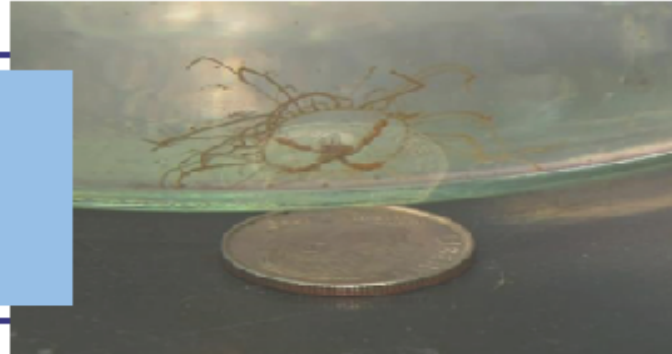


CLINGING JELLYFISH – INVASIVE SPECIES



FACT SHEET

CLINGING Jellyfish



WHAT IS IT?

The Clinging Jellyfish (*Gonionemus vertens*) is a small jellyfish about the size of a dime that can be found in bay waters.

WHERE ARE THEY FOUND?

Clinging Jellyfish are native to the Pacific Ocean. They were introduced to the eastern Atlantic Coast as early as 1894 in Woods Hole, Massachusetts, but can be found from Maine to North Carolina. They are found in shallow bay waters and cling to vegetation, such as eel grass, during the day. They typically feed at night in the water column on small marine animals (zooplankton). They are not typically found in ocean coastal waters.

HOW BIG DO THEY GET?

This is a small jellyfish that only grows to about 25 mm (1 inch) in diameter, but it can expand to about three inches in diameter. They have 60-80 tentacles that contain the nematocysts or stinging cells.

WHY ARE THEY IN NEW JERSEY WATERS THIS YEAR?

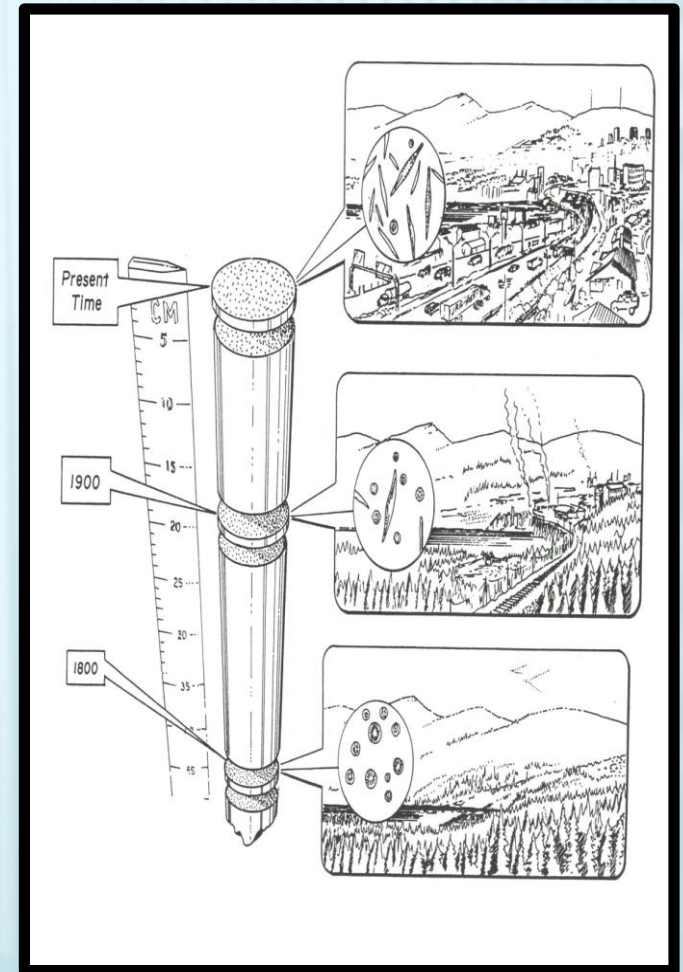
They have been found from time to time in New Jersey waters, primarily in bays. They do not produce large populations as some other jellyfish, but can be found in local areas in small to moderate numbers.

WHAT CAN WE EXPECT THIS SUMMER?

This jellyfish is considered to be an erratic species, meaning that it is not often densely populated. They are often active during periods of unseasonably warm weather and increased water temperatures. Additionally, clinging jellyfish are not likely to be abundant in areas heavily used by swimmers, but could affect casual waders and people gathering shellfish near eelgrass beds.

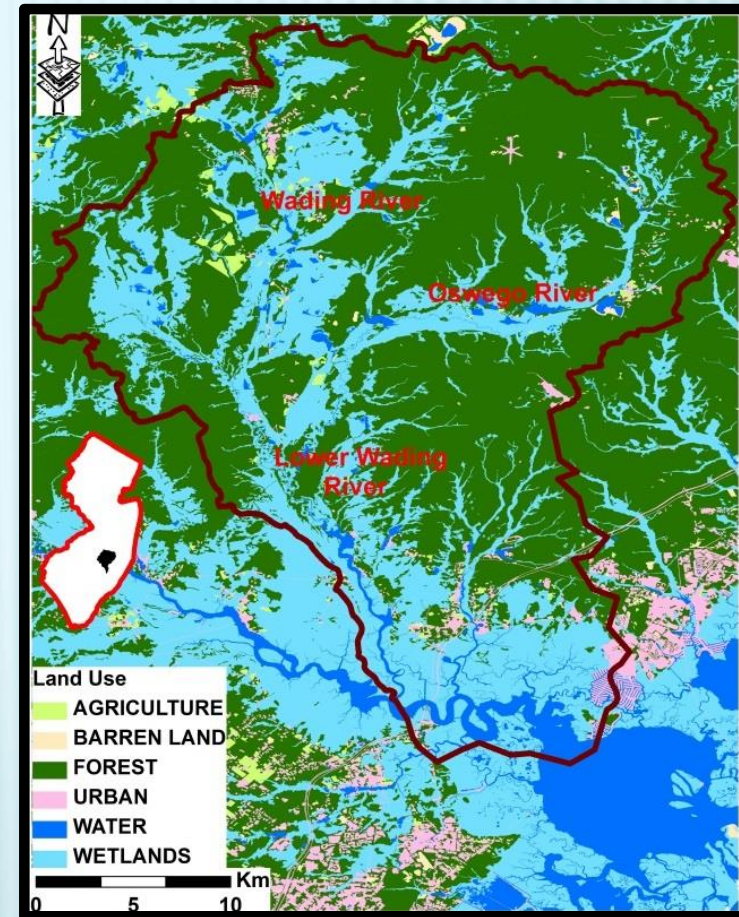
NJ Wetlands Past, Present and Future

- ✖ Funded by EPA Grant.
- ✖ Lack of reference conditions is a knowledge gap.
- ✖ Reconstruction of wetland systems based on investigations of sediment cores.
- ✖ Objectives:
 - + Assess wetland reference conditions and impact of anthropogenic activities.
 - + Assess the impact of climate and natural events on wetland characteristics.
 - + Refine the use of diatom species as indicators of wetland ecological condition.



Developing a Wetland Baseline at the Watershed Scale (EPA Grant)

- ✕ Tidal wetlands support of secondary production of nekton.
- ✕ Up to 80% of commercial/recreational fishes, shellfish and their forage base in coastal regions have “estuarine dependent” early life stages.
- ✕ Objectives:
 - + conduct a meta-analysis of existing literature that relates the role of riverine fresh, tidal fresh, and tidal saline marshes as essential habitat for the secondary production of fauna that use this habitat;
 - + use aerial photo interpretation and remote sensing to develop qualitative measures of vegetation coverage, diversity, and “vigor”;
 - + establish quantitative metrics that relate marsh geo-morphology to species access to the marsh surface;
 - + describe any potential impacts of the invasive variety of *P. australis* on marsh planform and functions.



EPA GRANT

- × **Developing a Metric to Identify and Rank the Status of NJ Imperiled Wetlands**
- × Monitoring of the various coastal wetland systems throughout NJ would enable us to compare, contrast and make informed decisions on the status, trends, health and continued ability of wetlands to provide ecosystem services.
- × Objectives are to:
 - + Develop a decision making matrix of science-based metrics to identify, quantify and rank the status of wetland degradation and link to the most appropriate restoration technique(s);
 - + Expand the long-term wetlands monitoring system to be inclusive of coastal wetland systems found in NJ.



DEMONSTRATION PROJECT – DRINKING WATER

- ✖ Two facilities under the influence of contaminated GW plumes were retrofitted with carbon pressure vessels.
- ✖ Evaluated the ability of 3 commercially available carbon types to remove trace contaminants through water treatment systems.
 - + Coconut shell
 - + Filtrasorb 300
 - + Filtrasorb 600
- ✖ Advanced low level analysis of unregulated contaminants was conducted at:
 - + NJDOH health laboratory using 525.2 low level
 - + Rutgers EOHSI using GC/MS solid phase microextraction (SPME)
 - + HPLC/MS



PFAS SOURCE TRACK DOWN IN COOPERATION WITH SITE REMEDIATION AND AIR PROGRAMS

- ✖ A research and implementation effort to identify potential sources of Perfluoroalkyl Substances (PFAS) to NJ's environment
 - + Review of identified contaminated wells and surrounding industrial facilities
 - + Review of NAICS and SIC codes to determine likely, potential sources,
 - + Review of air permits
 - + Site inspections, working with DEP Compliance and Enforcement, in determining the occurrence, fate and transport of PFAS by examining methods of use and current pollution controls.



MONITORING AND TARGETED RESEARCH OF SELECTED CHEMICAL CONTAMINANTS IN NEW JERSEY FISH

- ✕ **Task 1 - Routine Monitoring of Toxics in Fish**
 - + Includes the monitoring of fish tissue Statewide, evaluating multiple target contaminants, fish species and water bodies;
 - + Informs the appropriateness of current fish consumption advisories and need for modifications;
 - + Examine new species, contaminants, and waterbodies; and
 - + Support education and outreach efforts in protecting the public.



MONITORING AND TARGETED RESEARCH OF SELECTED CHEMICAL CONTAMINANTS IN NEW JERSEY FISH

- ✦ Task 2- Investigate Levels of Perfluoroalkyl Substances (PFAS) in NJ Fish Species
 - + As an emerging compound, PFAS, particularly PFOS, have been found to accumulate in fish tissue if a source is present.
 - + Contamination has been identified in public and private drinking water wells, and potential sources have been identified, NJ fish and consumers may be impacted.
 - + Concentrations in fish tissue will be quantified and evaluated along with health criteria.



Passaic River

HEALTH-RISK BASED STANDARD SETTING FOR GROUNDWATER

× Formal risk assessment approach

- + Full review of scientific literature
- ↓
- + Identification of relevant adverse health outcomes
- ↓
- + Dose-response modeling of data for critical health endpoints
- ↓
- + Calculation of human-equivalent doses
- ↓
- + Characterization of uncertainties
- ↓
- + Assessment of drinking water exposures
- ↓
- + **Recommendation of health-protective drinking water criterion**

HEALTH-BASED STANDARD SETTING FOR PFCs IN GROUNDWATER

- × PFNA (Perfluorononanoic Acid) - completed (Nov. 2015)
- × PFOA (Perfluorooctanoic Acid) - ongoing
- × PFOS (Perfluorooctanoic Sulfonate) - ongoing

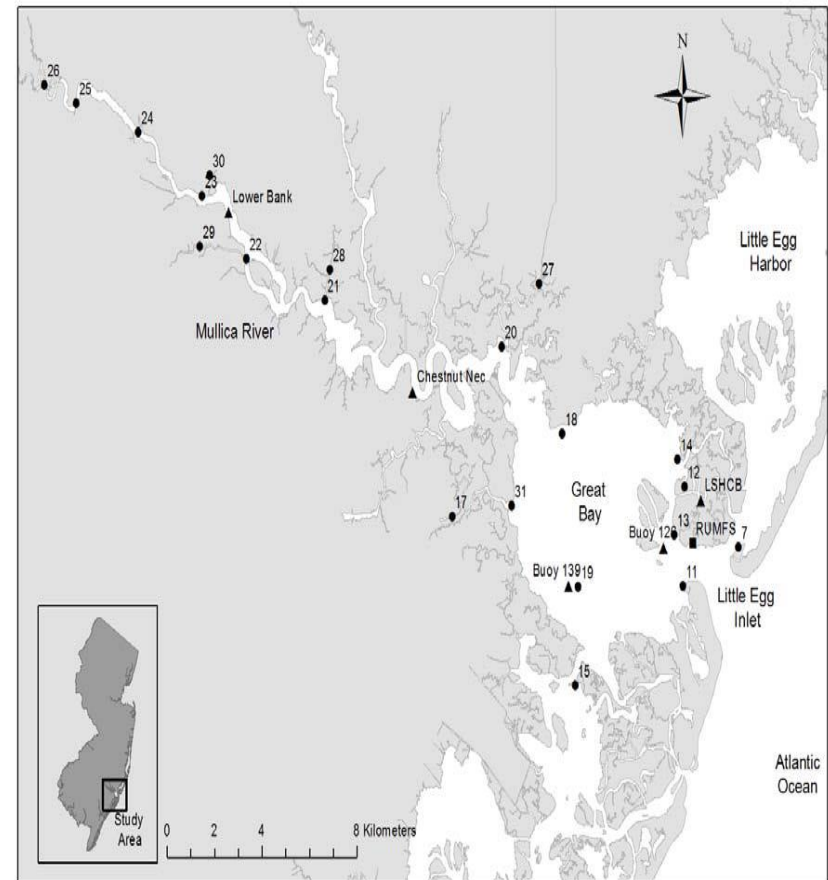
OTHER RECENT HEALTH-RISK STANDARD/GUIDELINES DEVELOPED BY DSREH

- ✖ Vapor intrusion guidelines for:
 - + Chlorotrifluoroethylene (CTFE)
 - + 1,2-dichloro-1,2,2-trifluoroethane (HCFC-123a)
- ✖ Recreational exposure guidelines for toxins associated with harmful algal blooms (HABs)
 - + Microcystins
 - + Cylindrospermopsin
 - + Anatoxin-a

COMPREHENSIVE ESTUARINE FISH INVENTORY PROGRAM: GREAT BAY-MULLICA RIVER

KENNETH W. ABLE AND THOMAS M. GROTHUES, RUTGERS UNIVERSITY

- ✧ **Objectives:** Assess the current status of New Jersey estuaries. Examine water quality, habitat characteristics, and distribution and abundance of fishes and ecologically important invertebrates such as crabs and jellyfishes
- ✧ **Benefits:** These data are critical for recreational and commercial fisheries management programs within NJDEP and federal agencies to better understand the relationships between changing environmental conditions, larval and juvenile fish dynamics, stock assessments and in supporting the appropriate fishery management planning and decision making.



NEW JERSEY'S COASTAL ESTUARIES INVENTORY

MARK SULLIVAN AND STEVE EVERT, STOCKTON UNIVERSITY

- ✧ **Objective 1** – Foster cooperation with local stakeholders and colleagues through data collection, training, collaboration, and data transfer.
- ✧ **Objective 2** – Collect accurate and comprehensive scientific data that is relevant to multiple life stages of commercial and recreational species managed by DEP / ASMFC.
- ✧ **Objective 3** – Produce data reports for DEP fishery scientists in stock assessment and population model development.
- ✧ **Objective 4** - Develop protocols that are transferable to other systems/estuaries in NJ.



A PILOT TRAP SURVEY OF ARTIFICIAL REEFS IN NEW JERSEY FOR MONITORING OF BLACK SEA BASS, TAUTOG, AND AMERICAN LOBSTER – OLAF JENSEN, RUTGERS UNIVERSITY

- ✧ **Objectives:** 1) characterize seasonal and spatial variation in community composition and relative abundance of structure-associated species on artificial reefs off of the New Jersey coast and 2) to provide the information necessary to design a statistically robust trap survey for NJDEP fisheries management programs
- ✧ **Benefits:** The data generated will provide:
 - (1) A characterization of seasonal changes in the fish and invertebrate communities inhabiting two artificial reefs (i.e., Sea Girt and Little Egg Reefs).
 - (2) A comparison between different artificial reef materials: Concrete-based structures and Metal structures.
 - (3) Develop design recommendations for a long-term trap survey that can provide a statistically valid index of relative abundance for the three target species.



Completed Research

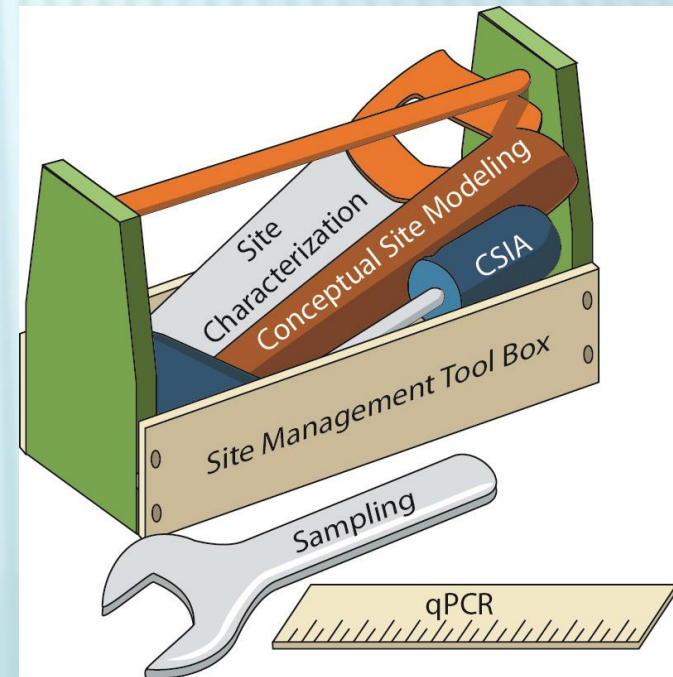
Donna Fennel, Rutgers University

Robert Mueller, DSREH

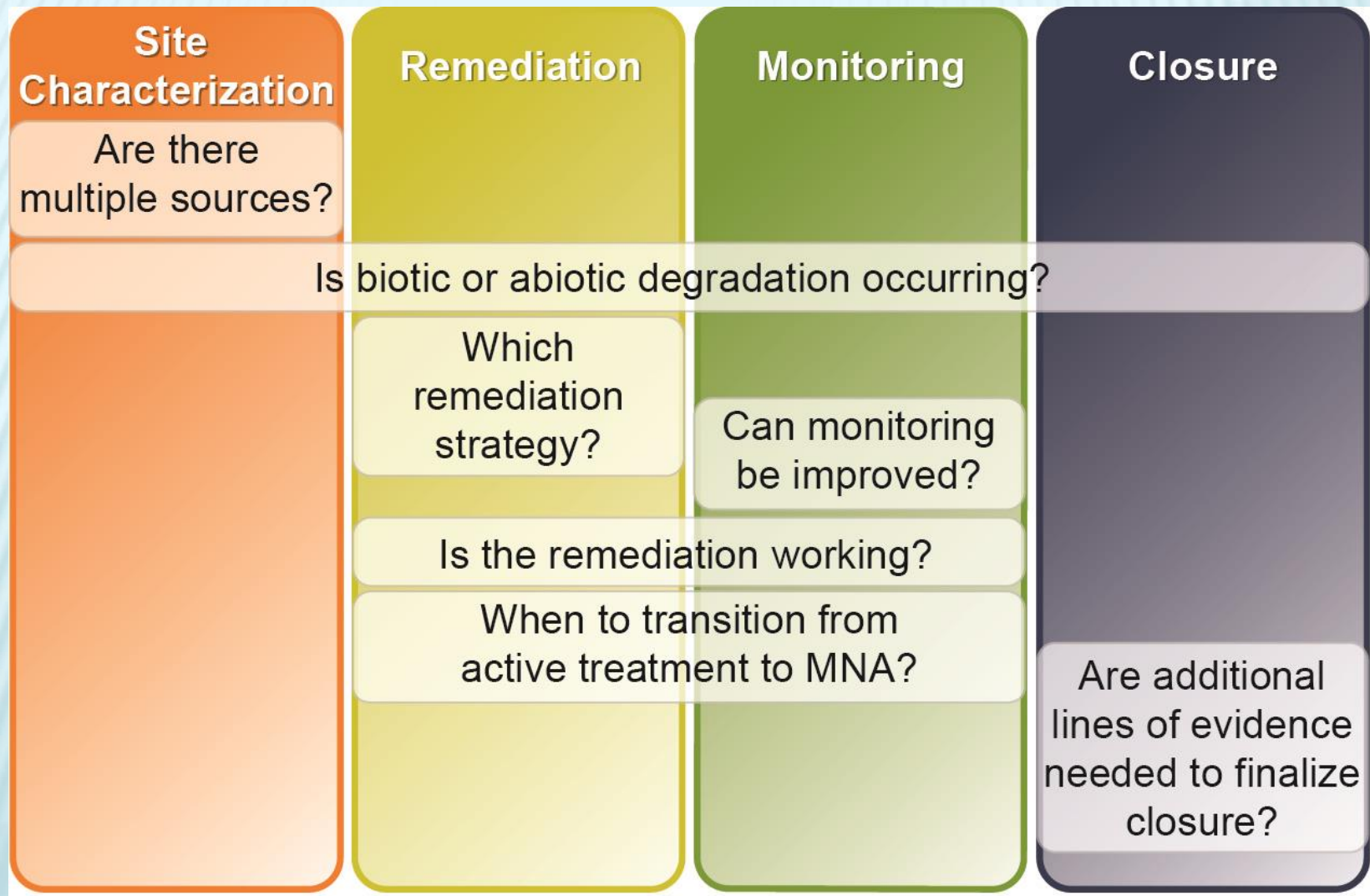
USE OF ENVIRONMENTAL DIAGNOSTIC TOOLS AT NJ PUBLICLY FUNDED SITES

WHAT ARE ENVIRONMENTAL MOLECULAR DIAGNOSTICS (EMDS)?

- ✖ Group of analytical techniques
 - + Used to analyze biological and chemical characteristics of soil, sediment, and water samples
- ✖ Developed for medicine
 - + Adapted for environmental site management
- ✖ Two major categories
 - + Chemical techniques
 - + Molecular biological techniques (MBTs)



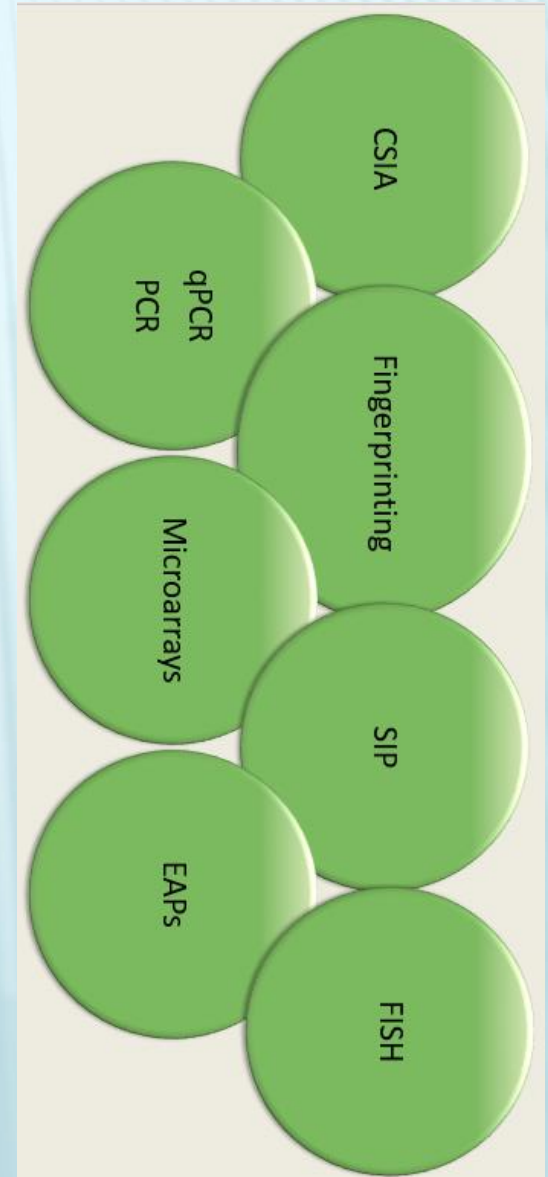
USING EMDS THROUGHOUT SITE MANAGEMENT



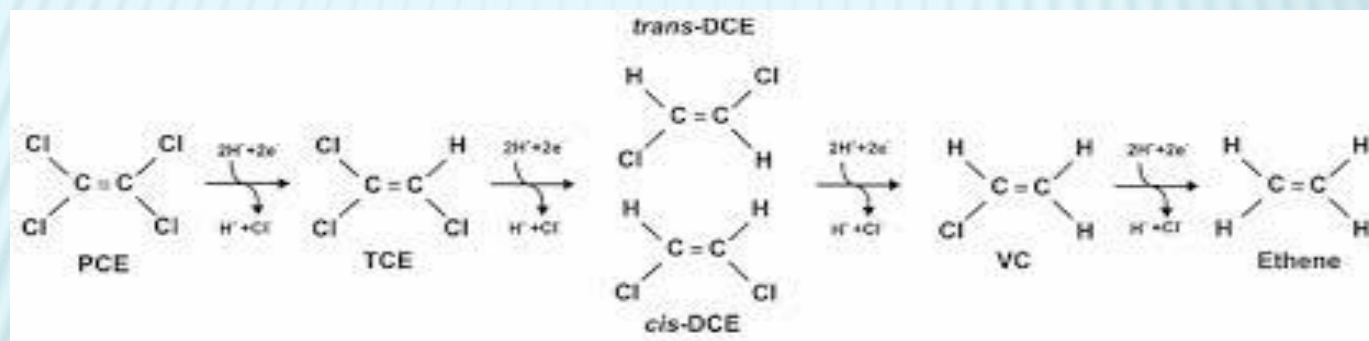
ENVIRONMENTAL MOLECULAR DIAGNOSTICS

× EMDs can:

- + tell whether the contaminants at a site are being degraded through biodegradation or being decreased through dilution
- + Establish rates that contaminants are being degraded
- + Decrease the size of your monitoring network and thereby reduce the cost of monitoring
- + Offer line of evidence that may be needed to close a site



REDUCTIVE DECHLORINATION



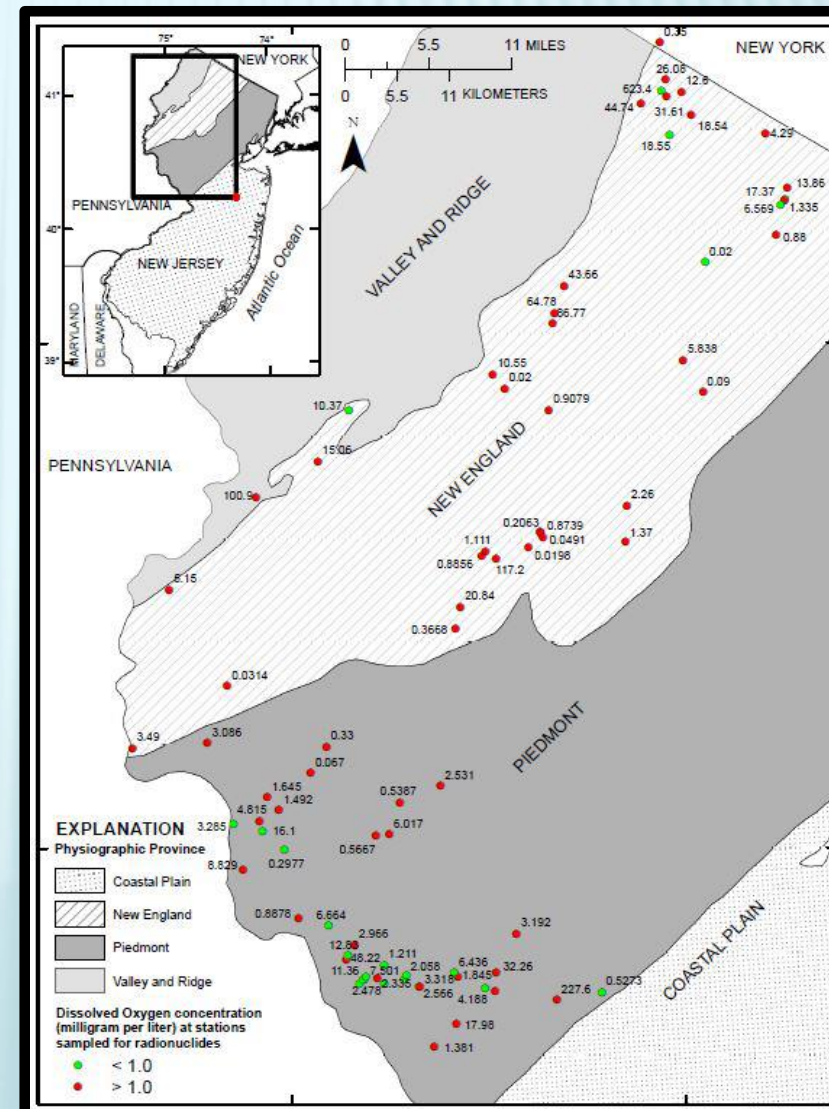
Many times a remediation 'stalls' at this point

NJ SITES STUDIED

- × Pagan-Martinez Site
 - + DCE Stall – Stable Isotope Probing (SIP), qPCR
 - × Microcosm studies in lab to see what was needed to continue bio-remediation.
 - × Results redesigned the treatment train to include add'l bacteria as well as most appropriate electron donors.
- × Hackensack River Sediments
 - + Using qPCR and SIP to identify organisms and microcosms to design appropriate bio-augmentation and bio-stimulation
- × Identification of Aniline Degrading Organisms
 - + Former Chemical Manufacturer in NJ
 - + Aniline difficult to bio-remediate – not much known about bacteria responsible.
 - × SIP used in microcosm study along with qPCR to identify a previously unknown bacteria responsible for aniline degradation

CONTRIBUTION OF NATURALLY OCCURRING RADIOISOTOPES TO GROSS ALPHA-PARTICLE ACTIVITY IN GROUND WATER IN BEDROCK AQUIFERS OF NORTHERN NEW JERSEY - USGS

- ✕ Analyze ground water samples in the Highlands and Piedmont Provinces of NJ for:
 - + Gross alpha-particle activity
 - + Isotopes of uranium and radium
 - + Other water-quality parameters
 - + To ascertain the relative contribution of isotopes to the overall alpha particle activity.
- ✕ Evaluate the general relationships
- ✕ General conclusion:
 - + Uranium isotope ratios are extremely variable in some areas of the Piedmont and uranium may account for more of the gross alpha-particle activity in these areas than is evident from a simple uranium mass measurement.



ID PFCs IN THE METEDECONK RIVER WATERSHED

- ✖ Brick Township MUA initiated a PFC source track down study with the DSREH.
- ✖ BTMUA documented a localized area of high-level PFC contamination along the River.
- ✖ Located a groundwater contamination plume emanating from an industrial park as the likely source of PFCs.



Future Research

- × Marine Fisheries
- × Emerging Contaminants, e.g., PFCs
- × Priority Issues

Division of Science, Research & Environmental Health

- × Acknowledgements: DSREH Scientists, DEP Programs, Principal Investigators and their Universities
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 - ❖ 609-984-6070
- × Information and Publications:
www.state.nj.us/dep/dsr/
- × Check for new reports!