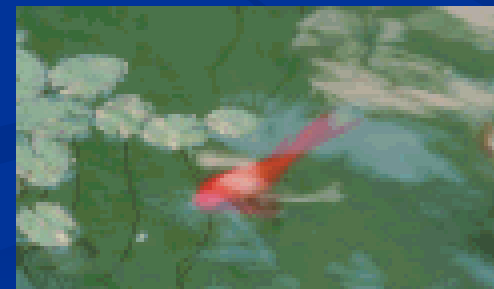




Water Quality
Standards

New Jersey's Nutrient Management Plan

Water Quality
Assessment



Typical Nutrient Impairments

- Aesthetic/recreational uses - Nuisance algal and macrophyte growth
- Water supply/human health - Algae causing "taste and odor" and trihalomethane formation
- Aquatic life - Low dissolved oxygen, toxic releases from sediments, habitat loss, community composition shifts
- Aquatic life/human health - Toxic Algal Blooms, *Pfisteria piscicida*

New Jersey's Phosphorus Criteria Historical Prospective

December 1974

- 0.05 mg/l for lakes, reservoirs and tributaries

March 1981

- 0.1 mg/l for freshwater rivers and streams
- design flow MA7CD10

New Jersey's Phosphorus Criteria Historical Prospective

April 1985

- Nutrient policies
- Effluent standard of 1.0 mg/l for discharges

December 2001

- Added provision to establish watershed specific criteria

NJ Surface Water Quality Standards

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.

Top Impairments 2006



Impaired Waterbodies List

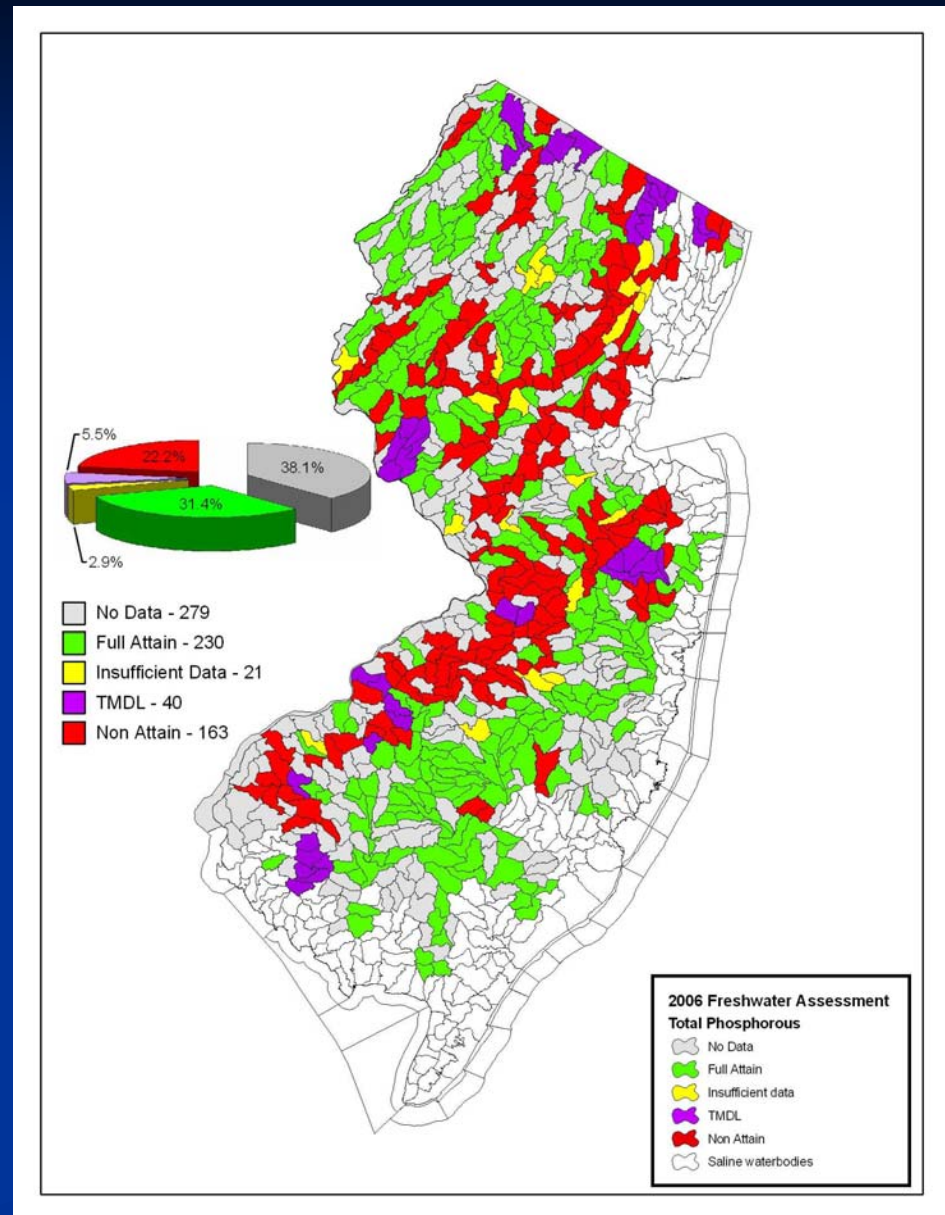
- Identifies waters that violate water quality criteria
- Waters listed for phosphorus exceeded the 0.1 mg/l criteria in at least 2 samples
- Narrative nutrient policies not evaluated

2006 Phosphorus Impairment

Total Phosphorus
criteria apply to
11,700 freshwater
river miles

Unimpaired river
miles = 32 %

Impaired river miles
= 32 %



Historical Prospective of New Jersey's Permitting Strategy

- Permits for new facilities or expansions included TP limits
- 85 Permits issued based on the 1985 Effluent Standard of 1.0 mg/l
- 50 Permits with water quality-based effluent limits

New Jersey's Current Permitting Strategy

- Starting in 2002 included WQBELs for permit renewals on impaired waters
- Resulted in phosphorus criteria as an “end of pipe” limit
- Developed technical manual to allow dischargers to demonstrate that waters not rendered unsuitable (Narrative Criteria)

Exit Ramp Studies

- Summer study upstream and downstream of the discharge
- Studies completed for 20 Point Sources
- Diurnal Dissolved Oxygen - 24 hour average and minimum DO level
- Chlorophyll a
 - Periphyton– seasonal mean $>150\text{mg}/\text{m}^2$ or single sample $> 200 \text{ mg}/\text{m}^2$
 - Phytoplankton – seasonal mean $> 24 \text{ ug}/\text{l}$ or single sample $>32 \text{ ug}/\text{l}$
- Nutrient concentrations – TP and TN

Nutrient Related TMDLs

TMDLs Completed for 303(d) Listed Waters

- 41 Lakes, Ponds, or Reservoirs
- 29 Streams and Rivers

TMDLs under development

- Raritan River – 79 Point Sources
- Passaic River – 53 Point Sources

TMDL document online at:

www.state.nj.us/dep/watershedmgt/tmdl

Nutrient-Related Indicators

- Algal biomass – Chl a ; visual assessment
- Nutrient concentrations – TP and N
- Diatom Indices based on algal species composition
- Benthic Community Composition
- All recommended by EPA for setting nutrient criteria
- All have uncertainties and need further study to refine and set criteria values
- Perhaps advantages to multiple approaches



Five Year Study to Develop Algae Indicators for NJ Streams

GOAL:

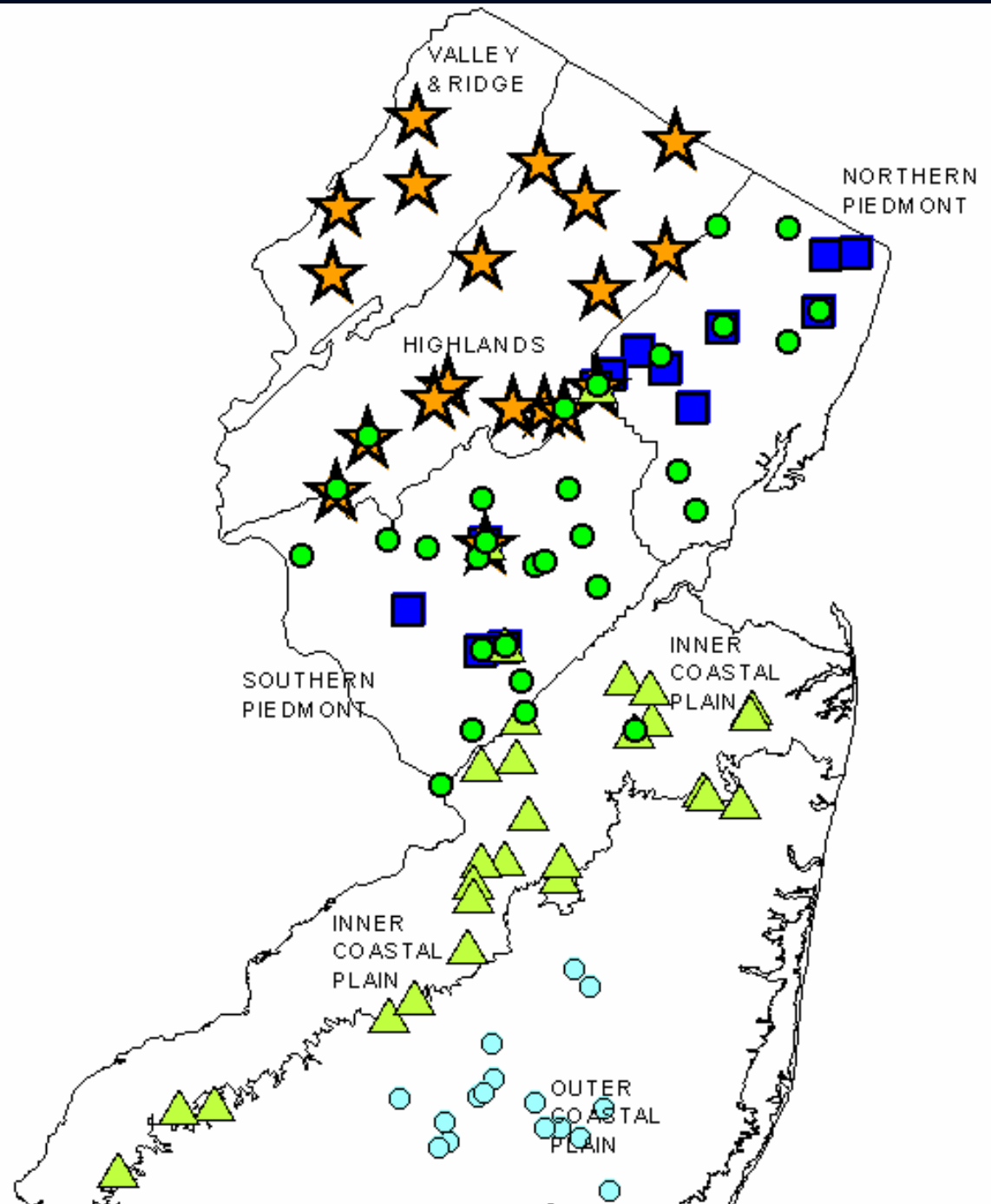
**Use algal indicators to identify
levels and causes
of ecological impairment,
primarily those related to
the nutrients phosphorus and nitrogen**

Study sites:

all 4 years

total:
77 sites,

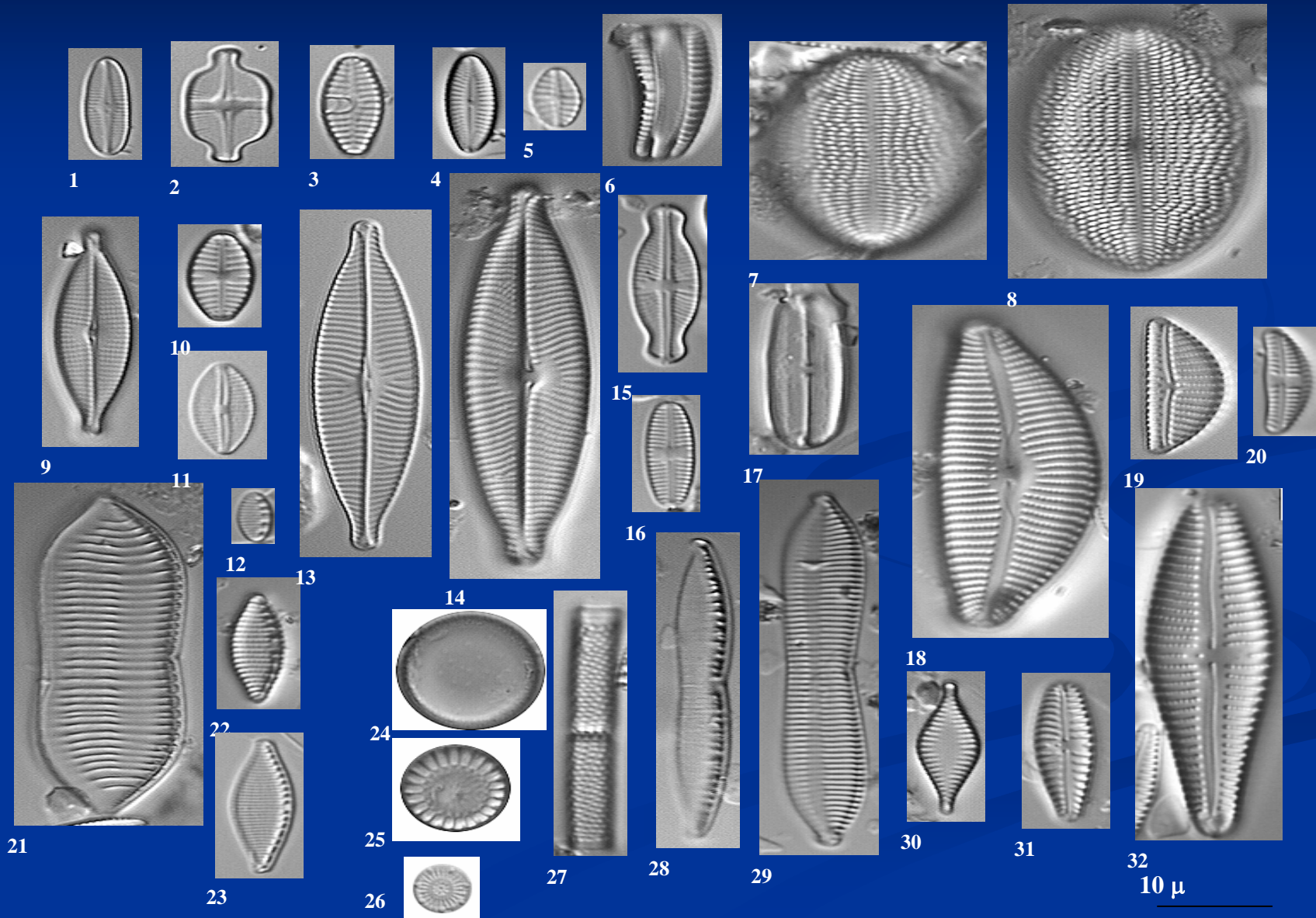
13
resampled



Study design

- Sampling period - August - October
- Analyze diatoms, filamentous algae, biomass and water chemistry
- Quantify ecological characteristics of taxa
- Develop models and metrics
- Sample additional sites
- Test models and metrics

New Jersey Diatoms





Diatom-based TP and TN inference models and indices for monitoring nutrient enrichment of New Jersey streams

Karin C. Ponader^{a,*}, Donald F. Charles^a, Thomas J. Belton^b

^a Patrick Center for Environmental Research, The Academy of Natural Sciences,
1900 Benjamin Franklin Parkway, Philadelphia, PA 19103, USA

^b New Jersey Department of Environmental Protection, Science and Research,
401 East State Street, PO Box 409, Trenton, NJ 08625, USA

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Abstract

We evaluated the potential for using diatoms to assess and monitor nutrient enrichment in New Jersey streams and rivers, and propose inference models and indices for regulatory purposes. We assessed the relationship between benthic diatom and water chemistry samples ($n = 101$) collected from 45 sites in 3 ecoregions: Northern Piedmont, Northeastern Highlands and Ridge and Valley. Diatom assemblages were dominated by pollution-tolerant taxa. Multivariate analysis showed that nutrient concentrations explained significant proportions of the variation in diatom species composition. Weighted-averaging partial least square (WA-PLS) total phosphorus (TP) and total nitrogen (TN) inference models ($n = 91$) showed good predictive ability (TP model: $r_{\text{apparent}}^2 = 0.87$; $r_{\text{boot}}^2 = 0.72$; $\text{RMSE}_{\text{boot}} = 0.23 \log_{10} \mu\text{g L}^{-1}$ TP; TN model: $r_{\text{apparent}}^2 = 0.88$; $r_{\text{boot}}^2 = 0.58$; $\text{RMSE}_{\text{boot}} = 0.23 \log_{10} \mu\text{g L}^{-1}$ TN). Diatom TP and TN indices were created to simplify presentation of results for the general public by rescaling the inferred TP and TN values from 0 to 100. The obtained index scores were assigned to nutrient impairment categories for regulatory assessment purposes.

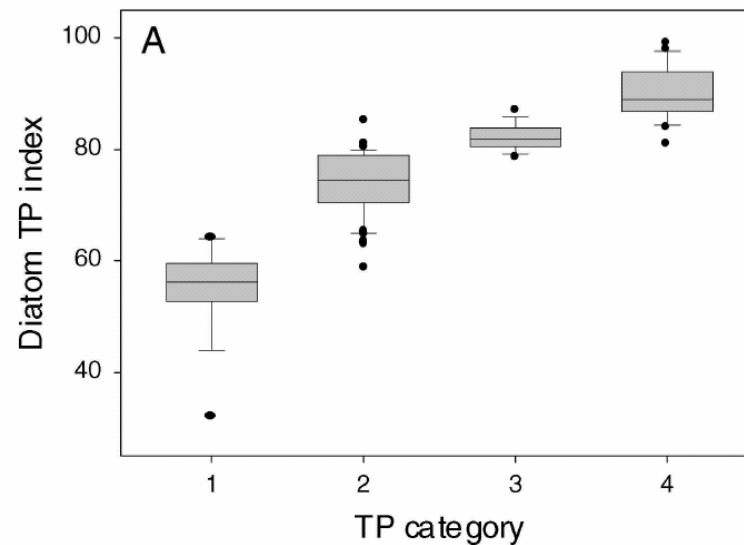
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Keywords: Diatoms; Nutrients; Inference model; Index; Streams; USA

Possible TDI unit-less index scores

- > 60 Pristine waters with no impairments.
- 60-81 Community structure altered toward pollution tolerant.
- 81-86 Important food web organisms missing.
Community structure dominated by several pollution tolerant organisms.
- < 86 Periphyton blanketing substrata. D.O. of stream showing diurnal fluctuations of over 3 mg/L.

* See 2007 Research Slide (TALU Project)



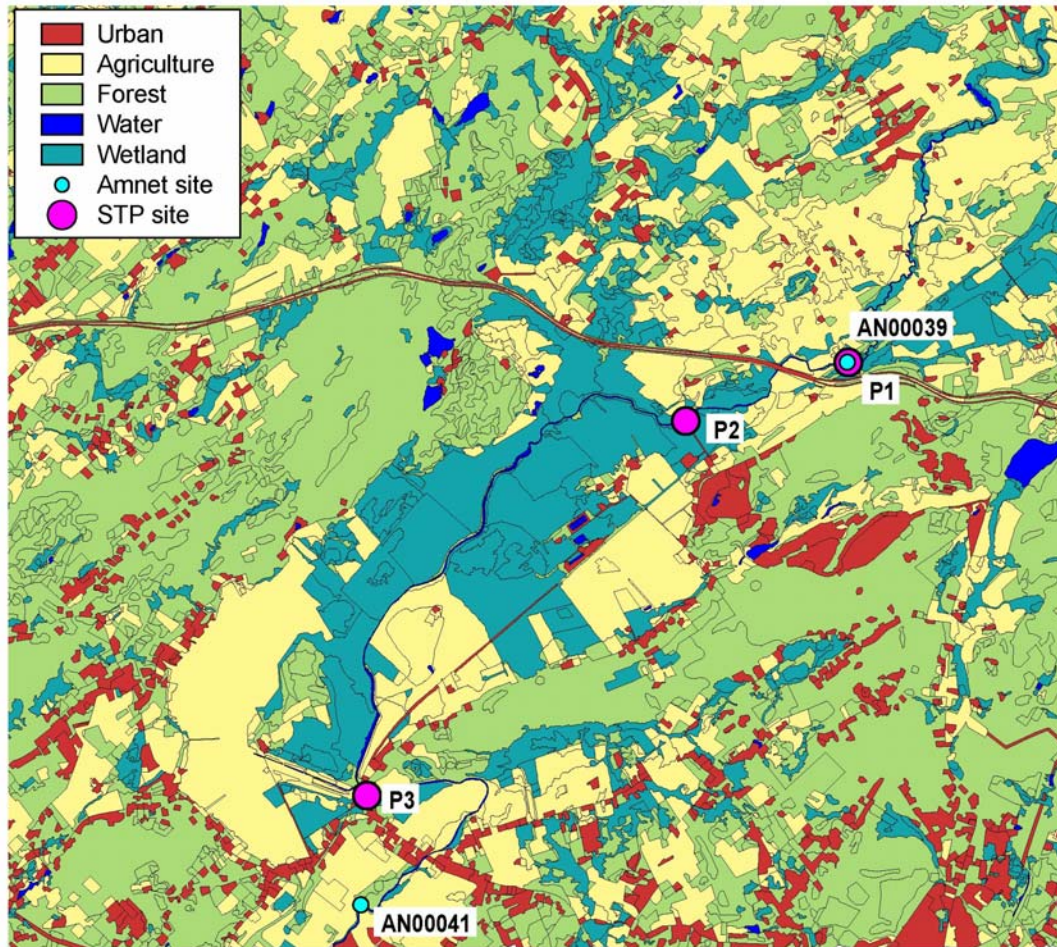
Five Year Study to Develop Algae Indicators for NJ Streams

- Report in Draft Review
- Final March 2007

Exit Ramp Studies

- Investigate whether diatoms and specifically TDI developed for northern NJ could be used to give more detailed information on biotic integrity above and below STP outfalls
- Selected the Musconetcong River and the Pequest River because MUAs were already conducting Exit Ramp Studies

2004 Exit Ramp STP Studies



Conclusions

- TP and TN diatom inference models and indices are promising tools to monitor and infer nutrient conditions on an ecoregional and routine monitoring basis.
- Diatom assemblages provided useful information for assessing biotic integrity of streams with respect to nutrient conditions.
- Species composition differed among sites. The differences can be explained by variation in nutrient concentrations.
- Diatom indices indicated relatively high nutrient conditions at all STP sampling sites and between-site differences consistent with measured values.

Future Research - Summer 2007

- Paleolimnology Lakes Study
- Summer 2007 collect bottom cores for diatoms and chironimids to model against nutrient and hypolimnetic conditions.
- Joint NYDEP and NYSDEC
- Funding: EPA Standards Program



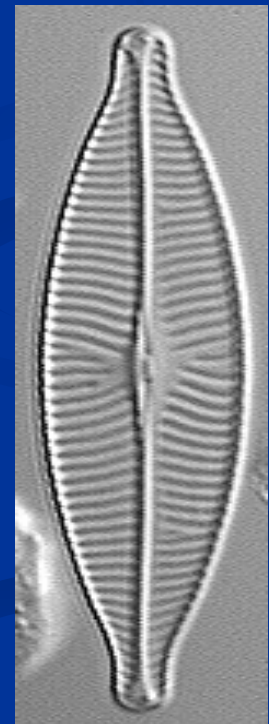
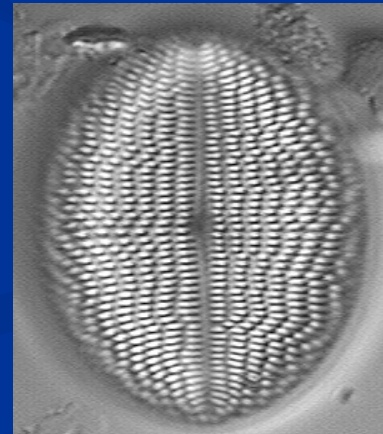
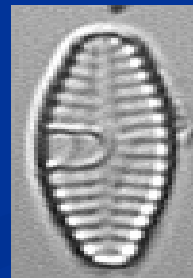
Future Research - Summer 2007

- Nutrient Biotic Index (NBI) Study
 - Calculate Nutrient Biotic Index using NYSDEC Model and NJ AMNET data.
 - Funding: EPA Nutrients Program



Future Research - Summer 2007

- TALU Process for NJ Diatom Data
- Calculate extant, and develop new, auto-ecological indicators from TDI data then implement TALU assessment using expert panels
- Funding: NJDEP



Potential Water Quality Standards Enhancements

- Better define “render unsuitable”
- Propose incorporation of numeric values for response indicators into SWQS
- Biological criteria based on Diatom and/or Macroinvertebrate Index
- Provisions to adopt waterbody-specific criteria through TMDL process

More Information

Debra Hammond, Chief
Bureau of Water Quality Standards and
Assessment

(609)777-1753

Debra.Hammond@dep.state.nj.us

<http://www.state.nj.us/dep/wms/bwqsa/>