New Jersey Periphyton Bioassessment Development Projects

Trophic Diatom Inference Models and Index Development for New Jersey Wadeable Streams

FINAL REPORTS
(2000 – 2005)

Submitted to
Thomas Belton, Project Manager

New Jersey Department of Environmental Protection
Division of Science, Research and Technology
401 East State Street, PO Box 409
Trenton New Jersey 08625

by
Karin Ponader and Donald Charles

Patrick Center for Environmental Research
The Academy of Natural Sciences
1900 Benjamin Franklin Parkway
Philadelphia, PA 19103-1195

Understanding the Relationship Between Natural Conditions And Loadings on Eutrophication: Algal Indicators of Eutrophication for New Jersey Streams

Final Report Year 1

Report No. 01-26

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Final Report Year 1

Introduction

The Academy of Natural Sciences (ANS) located in Philadelphia, PA has entered into a contract with the New Jersey Department of Environmental Protection (NJ DEP) for the purpose of developing algal indicators of stream and river eutrophication. These indicators would be used to assess relationships between extant water quality criteria (e.g., phosphorus and nitrogen concentrations) and overt signs of eutrophication. They could potentially be applied in a regulatory context as secondary criteria for identifying nutrient impairment. These indicators should be based on an understanding of algal dynamics in New Jersey streams, and be able to distinguish between situations where nutrient concentrations are high due to natural environmental conditions and those that result from anthropogenic influences. Protocols are needed that describe procedures for sample collection and processing, analysis and presentation of data, and interpretation of results.

This study was designed as a two-year project, initiated in July 2000, and is currently in the fourth month of the second year. Below is a table listing the primary first-year goals, as reported in the Quality Assurance Project Plan (PCER, 2000) submitted to the New Jersey DEP on 19 October 2000, and our current status in reaching them.

Year 1 Goals	Status
• collect algal samples and dissolved nutrient samples from selected sites	complete
• acquire chemistry and other habitat data from the NJ DEP	complete
• analyze diatom samples	2/3 complete
• analyze soft algae samples	in progress
• examine relationships between algal assemblages and water quality and physical parameter data to be collected by the NJ DEP	in progress
• develop algal metrics that indicate impairment due to high nutrient concentrations	in progress

The following summarizes what we have accomplished during Year 1.

Review of Year 1 Activities

Selection of study sites. We selected an initial set of 30 study sites in cooperation with NJ DEP staff, mainly Tom Belton. Because a goal of this study is to develop algal indicators of anthropogenic nutrient increases, it was important to select a suite of sites with relatively similar natural environmental conditions, but with a wide range of nutrient concentrations. The sites are restricted to the Piedmont physiographic province in northern New Jersey, and have a relatively limited range of hydrology, morphology and substrate type. This limitation helps to minimize the variability in geochemistry, a major factor affecting algal species composition. In addition, we used nutrient concentration data from the NJ DEP as an indication of watershed sources of anthropogenic phosphorus and nitrogen. For all sites, chemistry data are available either through the NJ monitoring network program or through USGS monitoring stations. Nutrient data are available for dates relatively near the times when algal samples were collected. All sites are part of the NJ Ambient Monitoring Network. We selected sites with a range of impairment from no impairment to severe impairment (see Table 1 in the Appendix). About one-third of the selected sites were studied in the same year (2000) by the NJ DEP to develop a fish IBI.

Collection of samples. Ms. Diane Winter and Mr. Michael Hoffman of ANS sampled the 30 selected sites from 9 August through 3 October 2000. We chose to sample in late summer because the influence of water quality on algal assemblage composition is greatest at this time. Samples collected during this time are also most directly comparable with sample data from other studies. Sampling was suspended for about two weeks to wait for rivers to recover from the scouring influence of high water caused by very heavy rainfall events during the second week in August. Samples were collected from natural rock substrates using techniques consistent with those used in the USGS NAWQA program (Porter et al., 1993) and the EPA Rapid Assessment protocols for periphyton (Barbour, 1999). A composite sample was created by randomly selecting 4-5 rocks from a stream. Samples from sticks, gravel or sand were collected at five sites where no rocks were available. Algae were removed from the rocks by scraping and brushing, placed in plastic containers and preserved by keeping them on ice in a cooler. In addition, the percent cover and thickness of algal growth was measured using the Rapid Periphyton Survey Method developed by the EPA (Barbour, 1999). This method provides a quantitative estimate of filamentous and other types of algae that often have patchy distributions and whose biomass is difficult to quantify. We also collected quantitative samples for measurement of chlorophyll *a* and ash-free dry mass (AFDM) by the Patrick Center for Environmental Research's (PCER) Geochemistry Section. Whole rocks were scraped, and outlines of rocks were drawn on waterproof paper. NJ DEP guidelines were followed for preservation and storage of chl *a* samples. Water chemistry samples were taken and NO_3-N, NH_3-N, O-P and TP were measured by the PCER Geochemistry Section.

Sample preparation and analysis. Samples were prepared for algal analysis using standard protocols (Velinsky and DeAlteris, 2000). Chlorophyll *a* and ash-free dry mass (AFDM) samples were analyzed by the PCER Geochemistry Section. Diatoms were permanently mounted on microscope slides; a total of 85 slides were prepared. Of these, 53 slides have been analyzed with a light microscope, including at least 1 representing each study site (see Table 3 in Appendix). Per slide, 600 valves are identified to lowest taxonomic level and counted. Identification was done using common taxonomic references available at the Academy as well as type material from the ANS Diatom Herbarium. Over 900 digital images were taken, recording 220 out of the 236 identified taxa. Taxonomic problems were discussed with PCER Phycology Section members, and problematic and/or unknown species were described and recorded in the ANS Diatom Image database (http://diatom.acnatsci.org). Also, the active participation of Karin Ponader in the Fourth, Fifth and Sixth NAWQA Taxonomy Workshops on Harmonization of Algal Taxonomy held at the Academy of Natural Sciences in October 2000, June 2001 and October 2001, helped in solving taxonomic issues in the New Jersey diatom flora. Diatom counts are recorded directly in the ANS Database using the computer program Tabulator, and QA/QC count reports are created for each count including information on assemblage composition, taxonomic notes etc. (see example in Appendix). The common soft-algae are being identified by Lont Marr and semi-quantitative estimates of their abundance are being made. Samples of abundant filamentous algae present in the study reaches are also being identified.

Preliminary Results

Assemblage composition: The diatom flora included in 40 of the completed counts is composed of 236 taxa (see Table 2 in Appendix). Diatom assemblages are dominated by pollution-tolerant species. Below is a list of the most abundant species and their maximum abundances recorded in the counts.

	Species abundance	
Taxon name	max. # valves counted	max. percentage
Achnanthidium minutissimum (Kützing) Czarnecki	467	78
Nitzschia inconspicua Grun.	311	52
Rhoicosphenia curvata (Kütz.) Grun. ex Rabh.	281	47
Achnanthes pusilla (Grunow) DeToni	271	45
Navicula perminuta Grun.	243	41
Achnanthes subhudsonis var. *kraeuselii* Cholnoky	233	39
Navicula gregaria Donk.	212	35
Navicula minima Grun.	185	31
Gomphonema kobayasii Kociolek & Kingston	176	29
Amphora pediculus (Kützing) Grun.	174	29
Cocconeis placentula var. *lineata* (Ehr.) V. H.	163	27
Sellaphora seminulum (Grun.) Mann	134	22
Staurosira construens var. *venter* (Ehr.) Hamilton	123	21
Navicula paucivisitata Patr.	117	20

Nitzschia palea (Kütz.) W. Sm.	114	19
Caloneis hyalina Hustedt	95	16
Reimeria sinuata (Greg.) Kociolek & Stoermer	76	13
Luticola goeppertiana (Bleisch in Rabh.) Mann	70	12
Navicula germainii Wallace	65	11
Synedra ulna (Nitz.) Ehr.	57	10
Navicula subminuscula Mang.	54	9
Nitzschia amphibia Grun.	52	9

Data analysis. We are analyzing data (assemblage composition) from 40 of the completed diatom counts to try a first attempt to develop a phosphorus inference model and to begin efforts to calibrate basic water quality metrics. Preliminary results were presented at the North American Diatom Symposium held in Ely, MN on 19-22 September 2001 (see copy of abstract and poster in Appendix). A CCA biplot of 30 sites and environmental variables (Fig.1 in Appendix) shows that the distribution of sites along the two major axes is influenced mainly by pH and nutrient concentrations. A CCA biplot of species and environmental variables (Fig. 2 in Appendix) shows that TP, O-P and NO_3-N probably have a strong influence on the diatom composition of New Jersey streams. Therefore, we expect successful development of a nutrient inference model. Our analysis shows a correlation between chlorophyll *a* and total phosphorous (TP) of $r^2 = 0.69$ (see Fig. 3 in Appendix). As shown in Figures 4 and 5, chlorophyll *a* increases constantly with increasing TP up to 0.07 mg/L. However when the TP range passes the 0.07 mg/L limit chlorophyll *a* does not show a response to the nutrient increase but seems to stabilize at approximately 80-100 mg/m^2. We therefore conclude that the response of chlorophyll *a* and production of algae biomass to P concentration is expressed until a certain saturation with nutrients is reached. More detailed analysis and development of metrics and final inference models will be completed after diatom count data for all the slides are available (scheduled for end of 2001).

Conclusion

Preliminary analysis of diatom assemblages of 40 samples from rivers in New Jersey in relationship with water chemistry suggest that TP, O-P and NO_3-N probably have a strong influence on the diatom composition of New Jersey streams. Also, there is a relationship between nutrients and algal biomass showing that algal growth seems to increase with increasing nutrient levels up to a TP limit of approximately 0.07 mg/L. Therefore, we expect successful development of a nutrient inference model based on diatom and soft- and filamentous algae.

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Appendix

Table 1: List of sampled sites 2000

NJ Site ID	Waterbody	Location	Impairment1	Impairment2
AN0081	Nishisakawick Ck	off Creek Rd	Non-Impaired	Non-Impaired
AN0115	Miry Run	Rt 533	Moderate	Moderate
AN0118	Assunpink Ck	Willow St	Moderate	Moderate
AN0194	Rahway R	Kenilworth Blvd	Moderate	Severe
AN0195	Rahway R	River Rd & Church St	Moderate	Severe
AN0211	Van Saun Bk	Main St & Rt 4	Moderate	Moderate
AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Non-Impaired	Non-Impaired
AN0227	Dead R	King George Rd	Moderate	Moderate
AN0238	Whippany R	Edwards Rd	Moderate	Moderate
AN0274	Passaic R	Riverview Rd	Moderate	Non-Impaired
AN0318	Spruce Run	Newport Rd	Non-Impaired	Non-Impaired
AN0321	Mulhockaway Ck	Rt 635	Non-Impaired	Non-Impaired
AN0341	Raritan R S Br	Studdiford Dr	Moderate	Non-Impaired
AN0370	Lamington R	Walsh Rd	Non-Impaired	Non-Impaired
AN0374	Raritan R N Br	Rt 202	Non-Impaired	Non-Impaired
AN0382	Millstone R	Grovers Mills Rd	Moderate	Moderate
AN0396	Heathcote Bk	Academy St	Severe	Non-Impaired
AN0414	Millstone R	Abv Raritan R conf	Moderate	Moderate
AN0424	Bound Bk	Bound Bk Rd	Moderate	Moderate
AN0439	Manalapan Bk	Federal Rd	Severe	Moderate
AN0111	Shipetaukin Ck	Rt 583 Princeton Pk	Severe	Moderate
AN0234	Whippany River	Ridgedale Ave W of Rt I-287	Severe	Non-impaired
AN0267	Ramapo River	Lenape Lane	Moderate	Non-impaired
AN0281	Saddle River	E Allendale Ave	Non-Impaired	Moderate
AN0291	Saddle River	Marsellus Place & Saddle River Ave	Severe	Moderate
AN0326	S Br Raritan River	Stanton Rd	Non-Impaired	Moderate
AN0339	Pleasant Run	Pleasant Run Rd (Rt 629)	Moderate	Non-impaired
AN0405	Pike Run	Rt 533	Moderate	Severe
AN0413	Royce Bk	Rt 533	Moderate	Severe
AN0429	Mile Run	Franklin Blvd	Moderate	Severe

Table 2: Taxa list for 40 completed diatom counts

Master NADED ID	Xtaxon
2212	Achnanthes daui Foged
2099	Achnanthes delicatula (Kützing) Grunow
2007	Achnanthes exigua Grunow
2220	Achnanthes grana Hohn & Hellermann
2141	Achnanthes harveyi Reimer
2015	Achnanthes lanceolata (Bréb. in Kütz.) Grun.
2224	Achnanthes lanceolata subsp. frequentissima Lange-Bertalot
2114	Achnanthes lanceolata var. abbreviata Reimer
2024	Achnanthes linearis (W. Smith) Grunow
2187	Achnanthes minutissima var. scotica (Carter) Lange-Bertalot
2033	Achnanthes peragalli Brun & Héribaud
2181	Achnanthes petersonii Hustedt
2034	Achnanthes pinnata Hustedt
2026	Achnanthes pusilla (Grunow) DeToni
2186	Achnanthes rupestoides Hohn
2132	Achnanthes subhudsonis var. kraeuselii Cholnoky
1010	Achnanthidium minutissimum (Kützing) Czarnecki
7031	Amphora libyca Ehrenberg
7042	Amphora montana Krasske
7001	Amphora ovalis (Kützing) Kützing
7043	Amphora pediculus (Kützing) Grun.
9001	Asterionella formosa Hassal
10008	Aulacoseira ambigua (Grunow) Simonsen
10009	Aulacoseira distans (Ehrenberg) Simonsen
10018	Aulacoseira granulata (Ehrenberg) Simonsen
10019	Aulacoseira italica (Ehrenberg) Simonsen
10007	Aulacoseira pfaffiana (Reinsch) Krammer
10015	Aulacoseira subartica (O. Müller) Haworth
76001	Bacillaria paradoxa Gmelin
12001	Caloneis bacillum (Grunow) Cleve
12009	Caloneis hyalina Hustedt
16011	Cocconeis pediculus Ehr.
16005	Cocconeis placentula var. euglypta (Ehr.) Cl.
16003	Cocconeis placentula var. lineata (Ehr.) V. H.
21002	Craticula cuspidata Mann
19002	Cyclostephanos invisitatus (Hohn & Hellerman) Theriot, Stoermer, & Hakansson
19001	Cyclostephanos tholiformis Stoerm., Hak, & Ther.
20001	Cyclotella atomus Hust.
20007	Cyclotella meneghiniana Kütz.

20009	Cyclotella ocellata Pant.
20033	Cyclotella operculata (Ag.) Kütz.
20012	Cyclotella pseudostelligera Hust.
20080	Cyclotella sp. 1 ANS NEW JERSEY KCP
20010	Cyclotella stelligera (Cl. & Grun.) V. H.
22001	Cymatopleura solea (Bréb.) W. Sm.
23048	Cymbella aspera (Ehr.) H. Perag.
23016	Cymbella naviculiformis Auersw. ex Héib.
23068	Cymbella tumida (Bréb. ex Kütz.) V. H.
25001	Denticula elegans Kütz.
197001	Diadesmis confervacea Kütz.
197002	Diadesmis contenta (Grun. ex V Heurk.) Mann
27013	Diatoma vulgaris Bory
110004	Encyonema minutum (Hilse in Rabenhorst) Mann
110010	Encyonema silesiacum (Bleic. in Raben.) Mann
187002	Eucocconeis laevis (Ostr.) Lange-Bertalot
33185	Eunotia bilunaris (Ehr.) Mills
33015	Eunotia exigua (Bréb. ex Kütz.) Rabh.
33021	Eunotia formica Ehr.
33183	Eunotia minor (Kütz.) Grun.
33040	Eunotia pectinalis var. minor (Kütz.) Rabh.
33046	Eunotia praerupta var. bidens (Ehr.) Grun.
115002	Fallacia auriculata (Hust.) Mann
115006	Fallacia omissa (Hust.) Mann
115001	Fallacia pygmaea (Kütz.) Stickle & Mann
34040	Fragilaria brevistriata var. inflata (Pant.) Hust.
34006	Fragilaria capucina Desmazieres
34109	Fragilaria capucina var. rumpens (Kütz) L-Bert
34012	Fragilaria construens (Ehr.) Grun.
34017	Fragilaria crotonensis Kitton
34066	Fragilaria fasciculata (C. Ag.) Lange-Bert.
34025	Fragilaria pinnata Ehr.
34027	Fragilaria pinnata var. lancettula (Schumann) Hust.
34158	Fragilaria sp. 1 ANS NEW JERSEY KCP
34030	Fragilaria vaucheriae (Kütz.) Peters.
192008	Fragilariforma virescens (Ralfs) Williams & Round
35024	Frustulia crassinervia (Breb.) Lange-Bertalot & Krammer
35001	Frustulia rhomboides (Ehr.) DeT.
35002	Frustulia rhomboides var. amphipleuroides (Grun.) DeT.
35011	Frustulia vulgaris (Thwaites) DeT.
35014	Frustulia weinholdii Hust.
36003	Gomphoneis herculeana (Ehr.) Cl.
36010	Gomphoneis minuta Kociolek & Stoermer
37271	Gomphonema aff. parvulum var. saprophilum ANS NEW JERSEY KCP

37002	Gomphonema affine Kütz.
37003	Gomphonema angustatum (Kütz.) Rabh.
37007	Gomphonema gracile Ehr. emend. V. H.
37197	Gomphonema kobayasii Kociolek & Kingston
37183	Gomphonema lingulatiforme Lange-Bertalot & Reichardt
37178	Gomphonema minutum (C.A. Agardh) C.A. Agardh
37062	Gomphonema olivaceoides Hust.
37010	Gomphonema parvulum (Kütz.) Kütz.
37193	Gomphonema patrickii Kociolek & Stoermer
37096	Gomphonema pumilum (Grun.) Reich. & Lange-Bert.
37152	Gomphonema sarcophagus Greg.
37272	Gomphonema sp. 1 ANS NEW JERSEY KCP
37056	Gomphonema sphaerophorum Ehr.
37022	Gomphonema truncatum Ehr.
37057	Gomphonema turris Ehr.
38001	Gyrosigma acuminatum (Kütz.) Rabh.
125001	Karayevia clevei Grun. in Cl. et Grun.
125002	Karayevia laterostrata (Hant.) Round and Bukt.
130001	Luticola goeppertiana (Bleisch in Rabh.) Mann
44073	Melosira varians Ag.
45001	Meridion circulare (Grev.) Ag.
46494	Navicula absoluta Hust.
46863	Navicula aff. hustedtii ANS NEW JERSEY KCP
46421	Navicula agrestis Hust.
46002	Navicula angusta Grun.
46003	Navicula arvensis Hust.
46005	Navicula atomus (Kütz.) Grun.
46724	Navicula atomus var. permitis (Hust.) Lange-Bert.
46007	Navicula biconica Patr.
46317	Navicula canalis Patr.
46272	Navicula capitata Ehr.
46168	Navicula capitata var. hungarica (Grun.) Ross
46661	Navicula capitatoradiata Germain
46014	Navicula cryptocephala Kütz.
46527	Navicula cryptotenella L.B. in Kramm. & L.-B.
46257	Navicula decussis Østr.
46648	Navicula erifuga Lange-Bert.
46616	Navicula germainii Wallace
46809	Navicula goeppertiana (Bleich) H.L. Sm.
46023	Navicula gregaria Donk.
46268	Navicula hustedtii Krass.
46523	Navicula ignota var. acceptata (Hust.) Lange-Bert.
46362	Navicula ingenua Hust.
46363	Navicula integra (W. Sm.) Ralfs

46032	Navicula laevissima Kütz.
46859	Navicula lanceolata (Ag.) Ehr.
46507	Navicula longicephala Hust.
46781	Navicula longicephala var. vilaplanii Lange-Bertalot & Sabater
46373	Navicula menisculus Schum.
46860	Navicula menisculus var. grunowii Lange-Bertalot
46039	Navicula minima Grun.
46472	Navicula minuscula Grun.
46512	Navicula molestiformis Hust.
46042	Navicula mutica Kütz.
46044	Navicula notha Wallace
46571	Navicula obsoleta Hust.
46865	Navicula parabilis Hohn & Hellerman
46046	Navicula paucivisitata Patr.
46289	Navicula peregrina (Ehr.) Kütz.
46538	Navicula perminuta Grun.
46051	Navicula pupula Kütz.
46649	Navicula recens Lange-Bert.
46154	Navicula rhynchocephala Kütz.
46867	Navicula sp. 1 ANS NEW JERSEY KCP
93154	Navicula sp. 2 ANS NEW JERSEY KCP
46812	Navicula stroemii Hust.
46562	Navicula subminuscula Mang.
46400	Navicula symmetrica Patr.
46401	Navicula tenelloides Hust.
46402	Navicula tenera Hust.
46104	Navicula tripunctata (O. F. Müll.) Bory
46307	Navicula trivialis Lange-Bert.
46504	Navicula veneta Kütz.
46410	Navicula viridula var. rostellata (Kütz.) Cl.
47001	Neidium affine (Ehr.) Pfitz.
47006	Neidium alpinum Hust.
48002	Nitzschia acicularis (Kütz.) W. Sm.
48347	Nitzschia acidoclinata Lange-Bert.
48413	Nitzschia aff. fonticola ANS NEWJERSEY KCP
48004	Nitzschia amphibia Grun.
48229	Nitzschia angustatula Lange-Bert.
48417	Nitzschia archibaldii Lange-Bertalot
48006	Nitzschia capitellata Hust.
48137	Nitzschia clausii Hantz.
48384	Nitzschia coarctata Grun.
48223	Nitzschia commutata Grun.
48141	Nitzschia constricta var. subconstricta Grun. in Cl. et Grun.
48008	Nitzschia dissipata (Kütz.) Grun.

48099	Nitzschia dissipata var. media (Hantz.) Grun.
48145	Nitzschia filiformis (W. Sm.) V. H.
48311	Nitzschia flexoides Geitler
48011	Nitzschia fonticola Grun.
48013	Nitzschia frustulum (Kütz.) Grun.
48015	Nitzschia gracilis Hantz. ex Rabh.
48148	Nitzschia gracilis var. minor Skabitschevsky in Proschkina-Lavrenko
48020	Nitzschia heufleriana Grun.
48122	Nitzschia inconspicua Grun.
48395	Nitzschia levidensis var. victoriae Grun.
48156	Nitzschia liebethruthii Rabh.
48023	Nitzschia linearis (Ag. ex W. Sm.) W. Sm.
48159	Nitzschia lorenziana var. subtilis Grun. in Cl. et Grun.
48025	Nitzschia palea (Kütz.) W. Sm.
48228	Nitzschia palea var. debilis (Kütz.) Grun.
48026	Nitzschia palea var. tenuirostris Grun.
48165	Nitzschia paleacea Grun. in V. H.
48126	Nitzschia perminuta (Grun.) Peragallo
48029	Nitzschia recta Hantz. ex Rabh.
48087	Nitzschia sigma (Kütz.) W. Sm.
48177	Nitzschia sigmoidea (Nitz.) W. Sm.
48233	Nitzschia sinuata var. delognei (Grun.) Lange-Bert.
48419	Nitzschia sp. 1 ANS NEW JERSEY KCP
48466	Nitzschia subconstricta Grunow
48405	Nitzschia tryblionella var. salinarum Grun. in Cl. et Grun.
48349	Nitzschia tubicola Grun. in Cl. et Grun.
48186	Nitzschia vermicularis (Kütz.) Hantz. in Rabh.
92001	Nupela sp. 1 ANS NEW JERSEY KCP
92002	Nupela sp. 2 ANS NEW JERSEY KCP
52025	Pinnularia divergens W. Sm.
52194	Pinnularia interrupta W. Sm.
52038	Pinnularia maior (Kütz.) Rabh.
52045	Pinnularia microstauron (Ehr.) Cl.
194004	Placoneis clementis (Grun) Cox
194005	Placoneis elginensis (Greg.) Cox
186001	Psammothidium bioretii (Germ.) Bukht. et Round
186008	Psammothidium subatomoides Hüst.) Bukht. et Round
186009	Psammothidium ventralis (Kras.) Bukht. et Round
73001	Pseudostaurosira brevistriata (Grun. in V.H.) Williams & Round
55002	Reimeria sinuata (Greg.) Kociolek & Stoermer
57001	Rhoicosphenia curvata (Kütz.) Grun. ex Rabh.
170014	Sellaphora seminulum (Grun.) Mann
62007	Stauroneis smithii Grun.
172005	Staurosira construens var. binodis (Ehr.) Hamilton

172006	Staurosira construens var. venter (Ehr.) Hamilton
175005	Staurosirella pinnata (Her.) Williams & Round
63002	Stenopterobia intermedia (Lewis) V. H.
64010	Stephanodiscus hantzschii Grun.
64013	Stephanodiscus minutus H. L. Sm.
65069	Surirella amphioxys W. Sm.
65002	Surirella angusta Kütz.
65068	Surirella brebissonii Kramm. & Lange-Bert.
65064	Surirella brebissonii var. kuetzingii Kramm. & Lange-Bert.
65092	Surirella splendida (Ehr.) Kütz.
65045	Surirella stalagma Hohn & Hellerm.
66053	Synedra delicatissima var. angustissima Grun.
66018	Synedra rumpens var. familiaris (Kütz.) Hust.
66024	Synedra ulna (Nitz.) Ehr.
66058	Synedra ulna var. contracta Østr.
66027	Synedra ulna var. oxyrhynchus fo. mediocontracta (Fonti) Hust.
67004	Tabellaria flocculosa (Roth) Kütz.
70008	Thalassiosira weissflogii (Grun.) Fryxell & Hasle
185035	Tryblionella aff.aerophila ANS NEW JERSEY KCP
185023	Tryblionella apiculata Greg.
185026	Tryblionella levidensis Wm. Sm.

Table 3: Count information (as of October 31, 2001)

Sample ID	Site Location ID	Collection Date/Date1	Microhabitat	Reach	Counted
NJ000001	NJAN0081	09/14/2000	Rock	Section 1	Yes
NJ000002	NJAN0081	09/14/2000	Rock	Section 2	Yes
NJ000003	NJAN0081	09/14/2000	Rock	Section 3	Yes
NJ000004	NJAN0111	09/25/2000	Rock	Riffle 1	Yes
NJ000005	NJAN0111	09/25/2000	Rock	Riffle 2	Yes
NJ000006	NJAN0115	08/09/2000	Rock	Section 1	Yes
NJ000007	NJAN0115	08/09/2000	Rock	Section 2	Yes
NJ000008	NJAN0115	08/09/2000	Rock	Section 3	No
NJ000009	NJAN0118	10/03/2000	Rock	Section 1	Yes
NJ000010	NJAN0118	10/03/2000	Rock	Section 2	Yes
NJ000011	NJAN0118	10/03/2000	Rock	Section 3	No
NJ000012	NJAN0194	09/28/2000	Sand/Silt	Section 1	Yes
NJ000013	NJAN0194	09/28/2000	Sand/Silt	Section 2	Yes
NJ000014	NJAN0194	09/28/2000	Sand/Silt	Section 3	No
NJ000015	NJAN0195	09/19/2000	Rock	Section 1	Yes
NJ000016	NJAN0195	09/19/2000	Rock	Section 2	Yes
NJ000017	NJAN0195	09/19/2000	Rock	Section 3	No
NJ000018	NJAN0211	09/28/2000	Rock	Section 1	Yes
NJ000019	NJAN0211	09/28/2000	Rock	Section 2	Yes
NJ000020	NJAN0211	09/28/2000	Rock	Section 3	No
NJ000021	NJAN0215	09/15/2000	Rock	Section 1	Yes
NJ000022	NJAN0215	09/15/2000	Rock	Section 2	Yes
NJ000023	NJAN0215	09/15/2000	Rock	Section 3	No
NJ000024	NJAN0227	10/02/2000	Sand/Silt	Section 1	Yes
NJ000025	NJAN0227	10/02/2000	Sand/Silt	Section 2	Yes
NJ000026	NJAN0227	10/02/2000	Sand/Silt	Section 3	No
NJ000027	NJAN0234	09/27/2000	Rock	Section 1	Yes
NJ000028	NJAN0234	09/27/2000	Rock	Section 2	Yes
NJ000029	NJAN0234	09/27/2000	Rock	Section 3	No
NJ000030	NJAN0238	10/02/2000	Sand/Silt	Section 1	Yes
NJ000031	NJAN0238	10/02/2000	Sand/Silt	Section 2	Yes
NJ000032	NJAN0238	10/02/2000	Sand/Silt	Section 3	No
NJ000033	NJAN0267	09/26/2000	Rock	Section 1	Yes
NJ000034	NJAN0267	09/26/2000	Rock	Section 2	Yes
NJ000035	NJAN0267	09/26/2000	Rock	Section 3	No
NJ000036	NJAN0274	10/02/2000	Rock	Section 1	Yes
NJ000037	NJAN0281	09/20/2000	Rock	Section 1	Yes
NJ000038	NJAN0281	09/20/2000	Rock	Section 2	Yes
NJ000039	NJAN0281	09/20/2000	Rock	Section 3	No
NJ000040	NJAN0291	09/29/2000	Rock	Section 1	Yes
NJ000041	NJAN0291	09/29/2000	Rock	Section 2	Yes

NJ000042	NJAN0291	09/29/2000	Rock	Section 3	No
NJ000043	NJAN0318	09/13/2000	Rock	Section 1	Yes
NJ000044	NJAN0318	09/13/2000	Rock	Section 2	Yes
NJ000045	NJAN0318	09/13/2000	Rock	Section 3	No
NJ000046	NJAN0321	09/13/2000	Rock	Section 1	Yes
NJ000047	NJAN0321	09/13/2000	Rock	Section 2	Yes
NJ000048	NJAN0321	09/13/2000	Rock	Section 3	No
NJ000049	NJAN0326	09/14/2000	Rock	Section 1	Yes
NJ000050	NJAN0326	09/14/2000	Rock	Section 2	Yes
NJ000051	NJAN0326	09/14/2000	Rock	Section 3	No
NJ000052	NJAN0339	09/07/2000	Rock	Section 1	Yes
NJ000053	NJAN0339	09/07/2000	Rock	Section 2	Yes
NJ000054	NJAN0339	09/07/2000	Rock	Section 3	No
NJ000055	NJAN0341	09/12/2000	Rock	Section 1	Yes
NJ000056	NJAN0341	09/12/2000	Rock	Section 2	Yes
NJ000057	NJAN0341	09/12/2000	Rock	Section 3	No
NJ000058	NJAN0370	09/07/2000	Rock	Section 1	Yes
NJ000059	NJAN0370	09/07/2000	Rock	Section 2	Yes
NJ000060	NJAN0370	09/07/2000	Rock	Section 3	No
NJ000061	NJAN0374	09/11/2000	Rock	Section 1	Yes
NJ000062	NJAN0374	09/11/2000	Rock	Section 2	Yes
NJ000063	NJAN0374	09/11/2000	Rock	Section 3	No
NJ000064	NJAN0382	10/03/2000	Sand/Silt	Section 1	Yes
NJ000065	NJAN0382	10/03/2000	Sand/Silt	Section 2	No
NJ000066	NJAN0382	10/03/2000	Sand/Silt	Section 3	No
NJ000067	NJAN0396	09/06/2000	Rock	Section 1	Yes
NJ000068	NJAN0396	09/06/2000	Rock	Section 2	No
NJ000069	NJAN0396	09/06/2000	Rock	Section 3	No
NJ000070	NJAN0405	09/08/2000	Rock	Section 1	Yes
NJ000071	NJAN0405	09/08/2000	Rock	Section 2	No
NJ000072	NJAN0405	09/08/2000	Rock	Section 3	No
NJ000073	NJAN0413	09/12/2000	Rock	Section 1	Yes
NJ000074	NJAN0413	09/12/2000	Rock	Section 2	No
NJ000075	NJAN0413	09/12/2000	Rock	Section 3	No
NJ000076	NJAN0414	10/02/2000	Sand/Silt	Section 1	Yes
NJ000077	NJAN0424	09/18/2000	Rock	Section 1	Yes
NJ000078	NJAN0424	09/18/2000	Rock	Section 2	No
NJ000079	NJAN0424	09/18/2000	Rock	Section 3	No
NJ000080	NJAN0429	09/18/2000	Rock	Section 1	Yes
NJ000081	NJAN0429	09/18/2000	Rock	Section 2	No
NJ000082	NJAN0429	09/18/2000	Rock	Section 3	No
NJ000083	NJAN0439	09/05/2000	Rock	Section 1	Yes
NJ000084	NJAN0439	09/05/2000	Rock	Section 2	No
NJ000085	NJAN0439	09/05/2000	Rock	Section 3	No

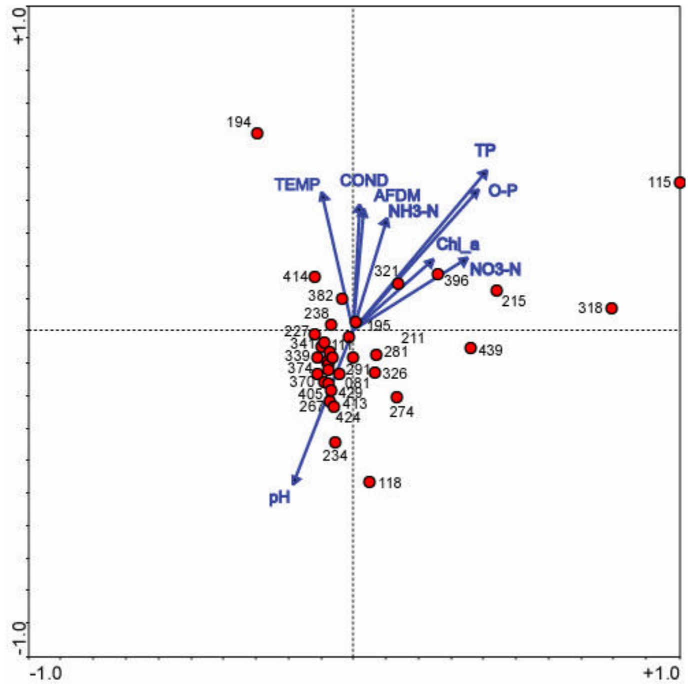


Fig. 1: CCA biplot of 30 sites and environmental variables

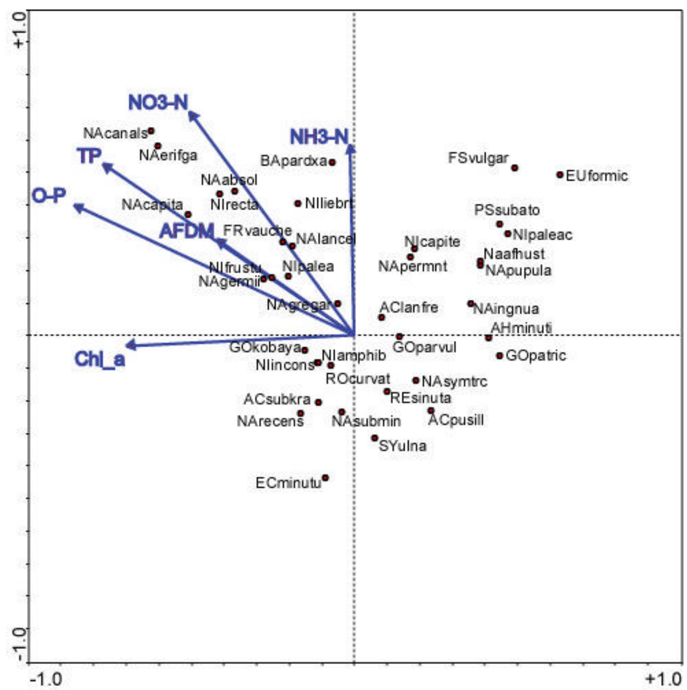


Fig. 2: CCA biplot of species and environmental variables

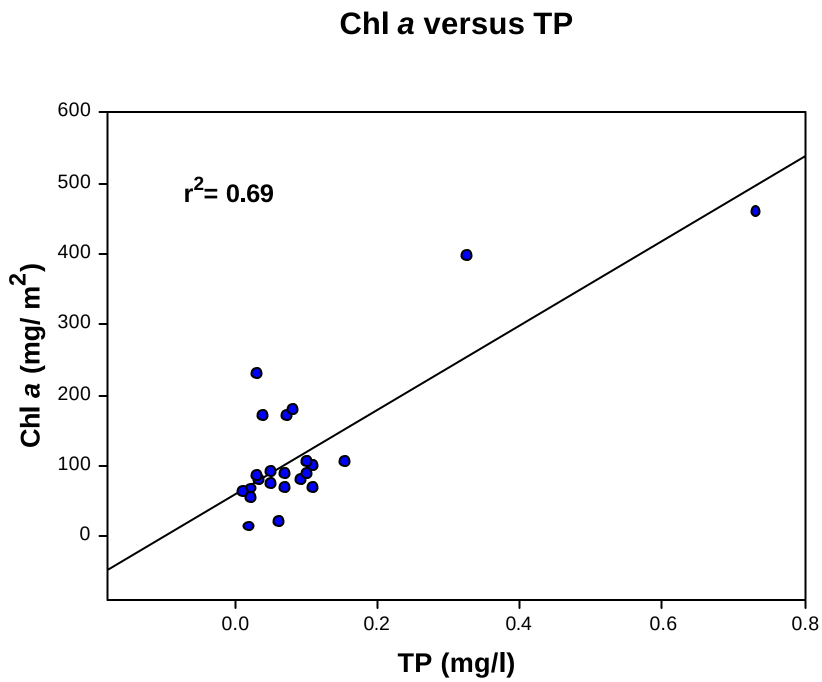


Fig. 3: correlation between chlorophyll *a* and TP

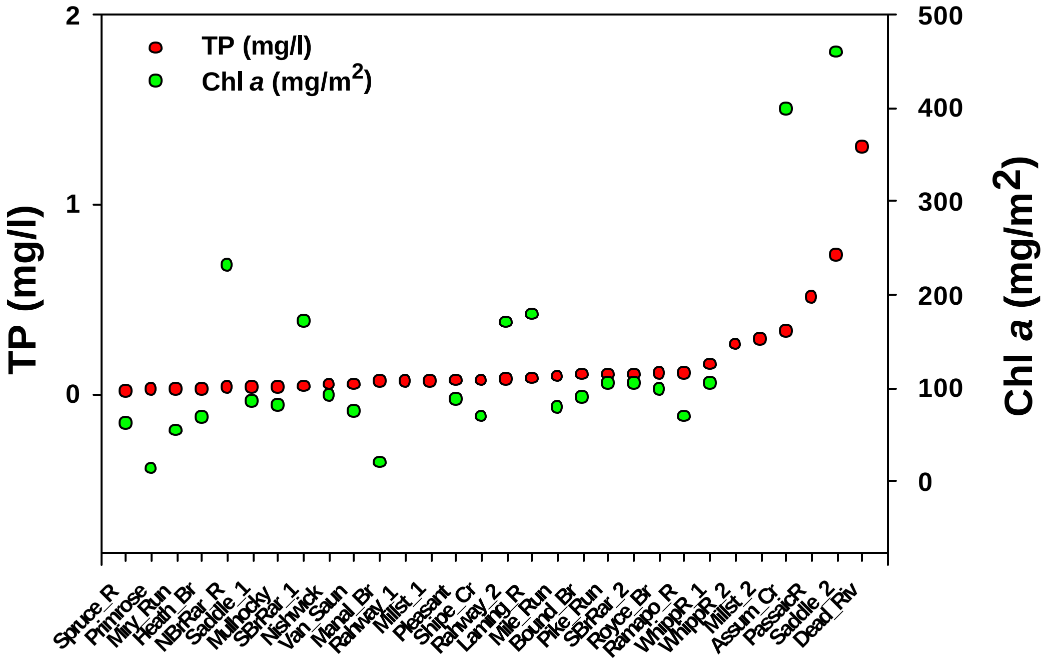


Fig. 4: Sites ordered by increasing TP

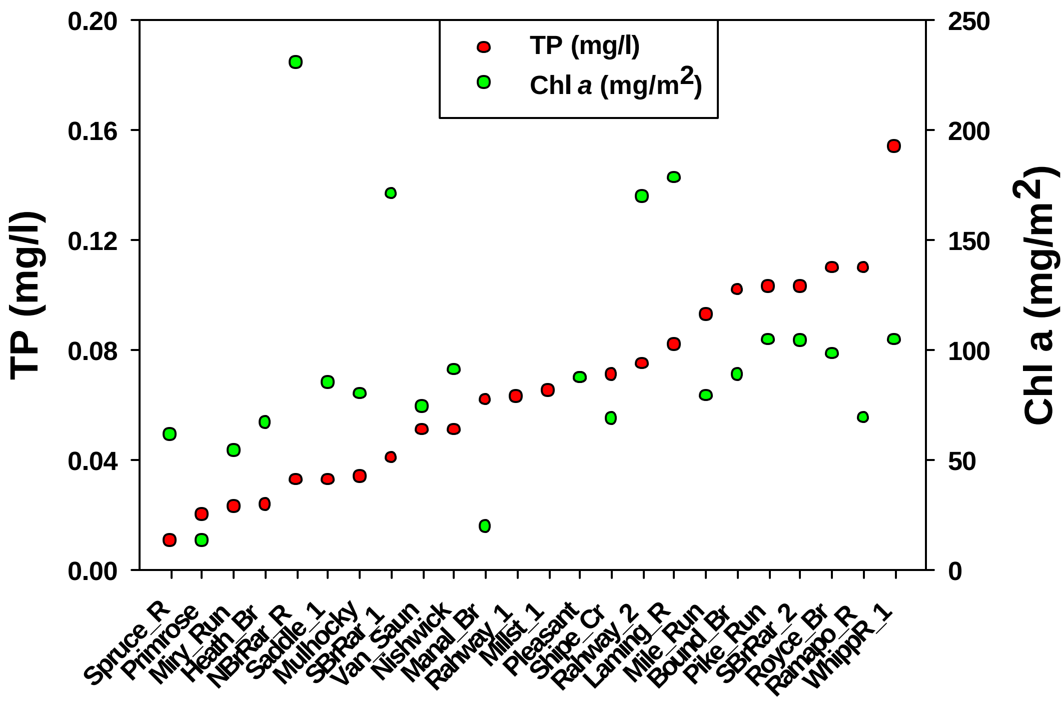
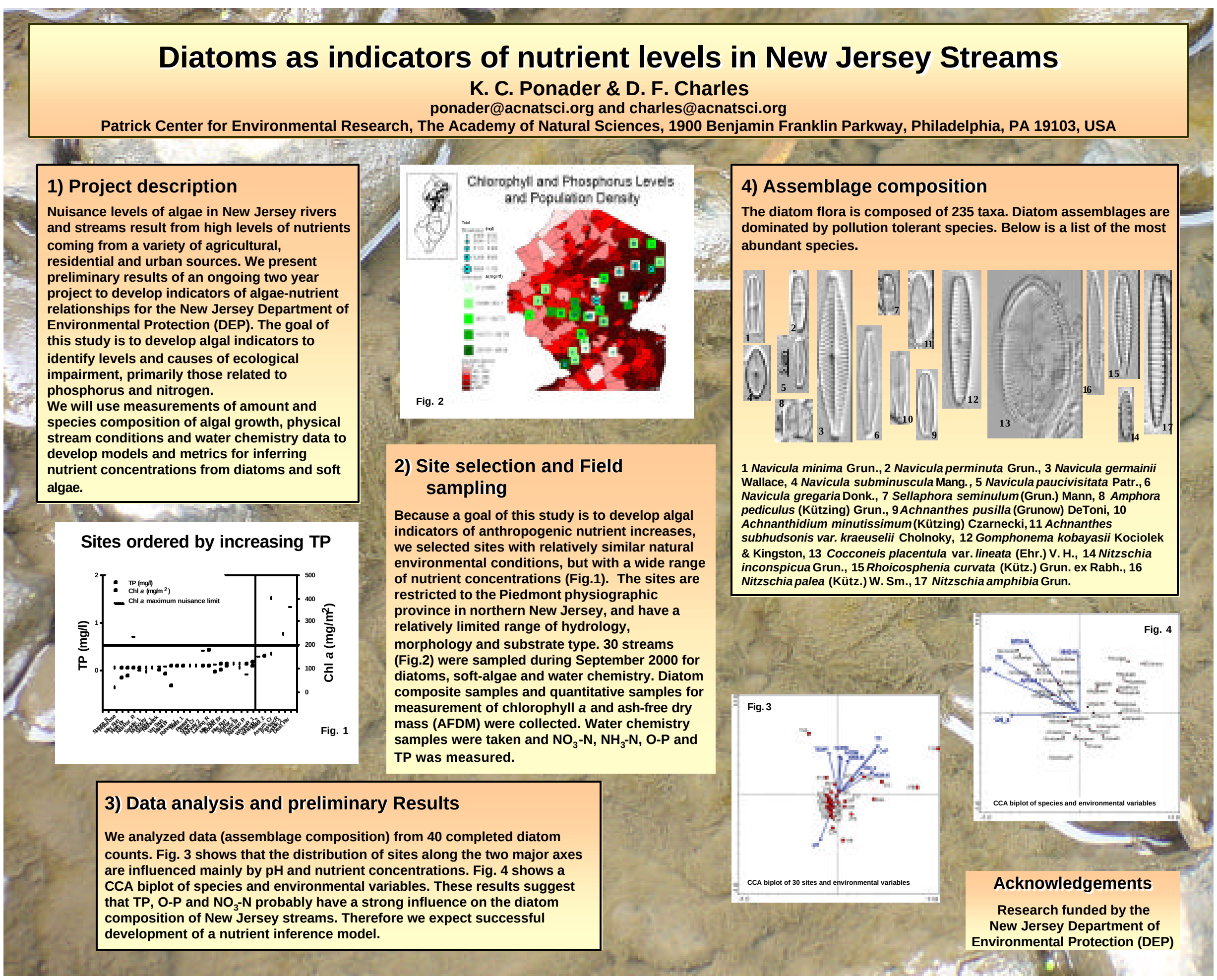


Fig. 5: Sites < 0.2 mg TP ordered by increasing TP

Abstract of the poster presentation at the North American Diatom Symposium held in Ely, Minnesota on September 19 -22, 2001.

DIATOMS AS INDICATORS OF NUTRIENT LEVELS IN NEW JERSEY STREAMS. K. Ponader and D. F. Charles, Patrick Center for Environmental Research, The Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103 (**ponader@acnatsci.org** and **charles@acnatsci.org**). Nuisance levels of algae in New Jersey rivers and streams result from high levels of nutrients coming from a variety of agricultural, residential and urban sources. We present preliminary results of an ongoing two year project to develop indicators of algae-nutrient relationships for the New Jersey Department of Environmental Protection (DEP). The goal of this study is to develop algal indicators to identify levels and causes of ecological impairment, primarily those related to phosphorus and nitrogen. 31 streams in the Piedmont region of Northern New Jersey were sampled during September 2000 for diatoms, soft-algae and water chemistry. We use measurements of amount and species composition of algal growth, physical stream conditions, and water chemistry data to develop models and metrics for inferring nutrient concentrations from diatoms and soft algae. The diatom flora is composed of 235 diatom taxa. Diatom assemblages are dominated by pollution tolerant or halophilous species like *Navicula minima* Grun., *Navicula gregaria* Donk., *Nitzschia inconspicua* Grun., *Rhoicosphenia curvata* (Kütz.) Grun. ex Rabh., *Navicula perminuta* Grun. and *Cocconeis placentula* var. *lineata* (Ehr.) V. H.



North American Diatom Ecological Database - NADED

Phycology Section, Patrick Center For Environmental Research - ANSP

Diatom Count Report

Water Body: N Br Raritan River **Site Location ID:** NJAN0374 **Sample Label:** NJ_374_1

Sample ID: NJ000061 **Client Sample ID:** AN0374

Date Sample Collected: 9/11/00 **Count Finished:** 5/16/01

Subsample ID: DT1 **Slide Replicate ID:** h **Count Replicate ID:** 1

Counted by: Karin C Ponader (KCP) **Sample Type:**

Master NADED Number	Taxon Name	Percent	Count
2015	Achnanthes lanceolata (Brébisson in Kützing) Grunow	0.17	1
2034	Achnanthes pinnata Hustedt	0.17	1
2132	Achnanthes subhudsonis var. kraeuselii Cholnoky	2.48	15
7043	Amphora pediculus (Kützing) Grun.	3.80	23
12001	Caloneis bacillum (Grunow) Cleve	0.33	2
16003	Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	4.30	26
27013	Diatoma vulgaris Bory	2.15	13
110004	Encyonema minutum (Hilse in Rabenhorst) Mann	1.32	8
37007	Gomphonema gracile Ehr. emend. V. H.	0.17	1
37197	Gomphonema kobayasii Kociolek & Kingston	3.80	23
37010	Gomphonema parvulum (Kütz.) Kütz.	1.16	7
37022	Gomphonema truncatum Ehr.	0.33	2
44073	Melosira varians Ag.	5.95	36
46421	Navicula agrestis Hust.	0.33	2
46005	Navicula atomus (Kütz.) Grun.	0.33	2
46317	Navicula canalis Patr.	0.50	3
46661	Navicula capitatoradiata Germain	0.99	6
46527	Navicula cryptotenella L.B. in Kramm. & L.-B.	0.33	2
46257	Navicula decussis Østr.	0.17	1
46616	Navicula germainii Wallace	4.30	26
46023	Navicula gregaria Donk.	8.60	52
46039	Navicula minima Grun.	3.80	23
46538	Navicula perminuta Grun.	0.33	2
46649	Navicula recens Lange-Bert.	6.12	37
46562	Navicula subminuscula Mang.	4.96	30
46400	Navicula symmetrica Patr.	3.31	20
46410	Navicula viridula var. rostellata (Kütz.) Cl.	2.64	16
48413	Nitzschia aff. fonticola ANS NEWJERSEY KCP	0.99	6
48004	Nitzschia amphibia Grun.	4.13	25

48008	Nitzschia dissipata (Kütz.) Grun.	0.33	2
48011	Nitzschia fonticola Grun.	0.99	6
48015	Nitzschia gracilis Hantz. ex Rabh.	0.33	2
48122	Nitzschia inconspicua Grun.	10.08	61
48156	Nitzschia liebethruthii Rabh.	0.33	2
48025	Nitzschia palea (Kütz.) W. Sm.	1.82	11
48177	Nitzschia sigmoidea (Nitz.) W. Sm.	0.17	1
55002	Reimeria sinuata (Greg.) Kociolek & Stoermer	5.62	3
57001	Rhoicosphenia curvata (Kütz.) Grun. ex Rabh.	2.98	18
66024	Synedra ulna (Nitz.) Ehr.	9.42	57

Report Date: 10/29/01 **Total Number of Taxa:** 39 **Total Number Counted:** 605

Count Notes:
Row 1; x: 93, y: 7; 13.5.

Difficult group of Nitzschia fonticola and N. aff. fonticola ANS NEW JERSEY KCP in the same sample. The N. aff. fonticola individuals are narrower and shorter than in previous counts.
Navicula germanii longer than usual and there are some intermediate shapes between N. germanii and N. virdula var. rostellata.