MONITORING THE ECOLOGICAL INTEGRITY OF PINELANDS WETLANDS

VARIATIONS IN SHALLOW, COASTAL PLAIN LAKE COMMUNITIES ASSOCIATED WITH LAND-USE-DEGRADATION GRADIENTS AND THRESHOLDS

FINAL REPORT SUBMITTED TO THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

DECEMBER 2007

Chatsworth Lake
Chatsworth, NJ

Bullfrog
Rana catesbeiana

Pumpkinseed
Lepomis gibbosus

Inflated bladderwort
Utricularia inflata

Golden club
Orontium aquaticum

Blackbanded sunfish
Enneacanthus chaetodon

Carpenter frog
Rana virgatipes

Indian Mills Lake
Indian Mills, NJ

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VARIATIONS IN SHALLOW, COASTAL PLAIN LAKE COMMUNITIES ASSOCIATED WITH LAND-USE-DEGRADATION GRADIENTS AND THRESHOLDS

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THE NEW JERSEY PINELANDS COMMISSION

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INTRODUCTION

The concept of degradation thresholds has been used to describe the level of urbanization and associated impervious surface that results in stream impairment (Klein 1979, Steedman 1988, Arnold and Gibbons 1996, May et al. 1997). Although the concept is valid in areas dominated by urban-land use, it fails to account for the effect of agriculture on the ecological integrity of surface waters in areas with mixed land uses since both urban land and agriculture can result in water-quality degradation (Osborne and Wiley 1988, Johnson et al. 1997, Carpenter et al. 1998, Herlihy et al. 1998, Rhodes et al. 2001, Sliva and Williams 2001, Tufford et al. 2003) and associated changes in the composition of aquatic communities (Lenat and Crawford 1994, Wang et al. 1997, Carpenter and Waite 2000, Leland and Porter 2000, Waite and Carpenter 2000, Stepenuck et al. 2002).

New Jersey Pinelands streams are representative of blackwater coastal plain streams found along the east coast and Gulf Coast of the United States (Patrick 1996). Urban land and upland agriculture are generally good predictors of Pinelands stream-water quality when considered separately, but both land uses must be considered together to more fully describe the relationship between watershed disturbance and water quality (Zampella et al. 2007a). Pinelands water-quality and diatom-, macrophyte-, anuran-, and fish-community gradients are associated with variations in the extent of altered land (combined percentage of urban land and upland agriculture) in a watershed (Zampella 1994, Zampella and Laidig 1997, Zampella and Bunnell 1998, Dow and Zampella 2000, Zampella et al. 2001, 2003, 2005, 2006a, 2006b, 2007b). The purpose of this paper is to describe land-use gradients and thresholds associated with changes in water quality and the composition of diatom-, plant-, fish-, and anuran-assemblages found in Pinelands lakes.

METHODS

Land use and study-site selection

Most Pinelands lakes are artificial stream impoundments that were created for sawmills, ironworks, papermaking, and cranberry production (Patrick et al. 1979, Wacker 1979). Other lakes and ponds were created by sand mining and beaver activity. Although a prominent feature of the Pinelands landscape, these water bodies have received relatively little study compared to streams. There are nearly four hundred impoundments in the region. These impoundments are typically less than four hectares and are generally shallow with a mean depth of about one meter (New Jersey Division of Fish and Game 1950, 1951, 1957).

From a pool of 43 stream impoundments initially considered for the study, we selected 30 impoundments that represented a range of watershed conditions characterized by the percentage of developed land and upland-agricultural land (Figure 1, Appendix 1). Land-use/land-cover profiles for the entire watershed associated with each impoundment and for eight variable-width buffers surrounding each impoundment (0-25 m, 0-50 m,…0-200 m) were prepared using ArcView software (Environmental Systems Research Institute Inc., Redlands, CA, 1999-2006) and digital land-use/land-cover data obtained from the New Jersey Department of Environmental Protection (NJDEP, 1995/97 Land Use/Land Cover Update 2001). The NJDEP data set classifies land uses using a modified Anderson et al. (1976) system.

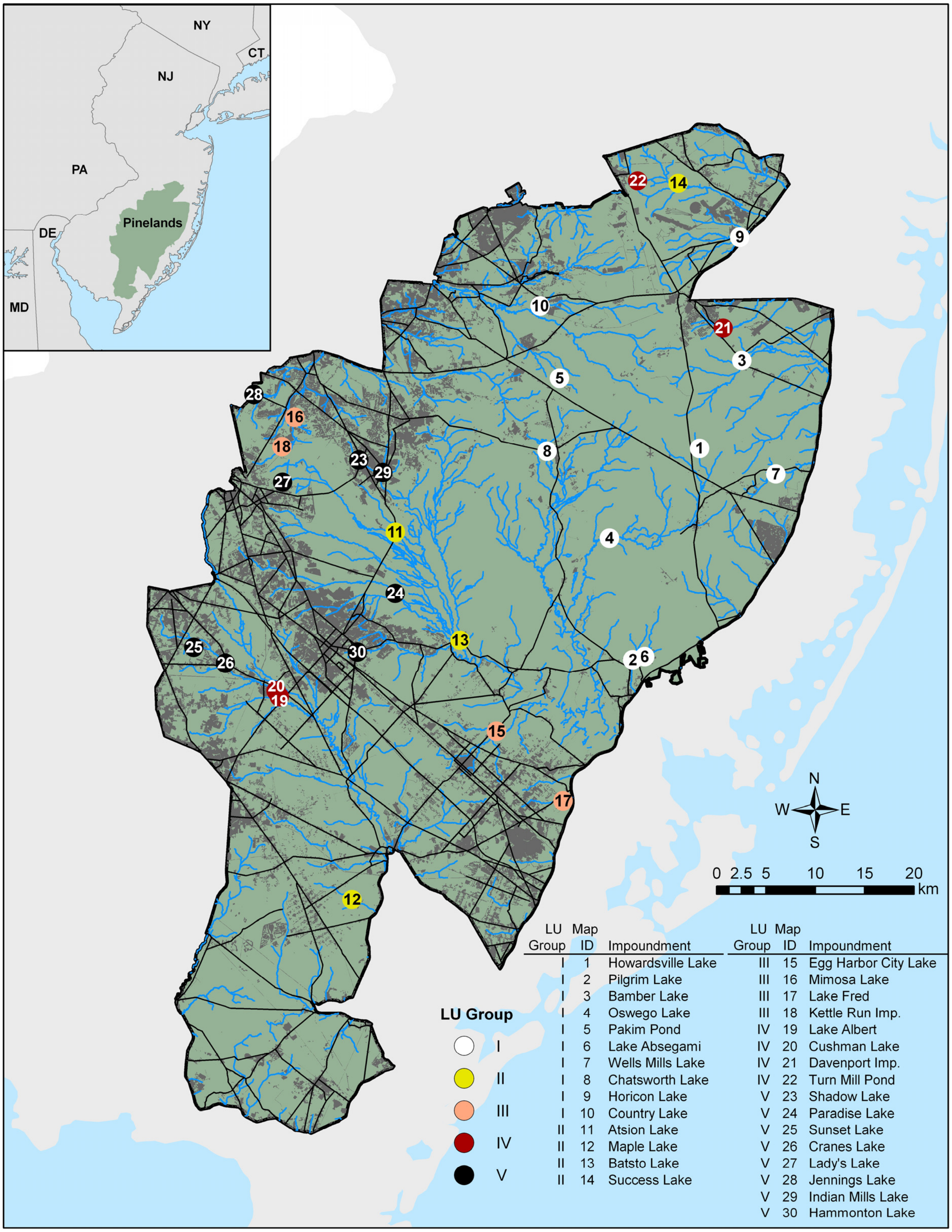

Figure 1. Location of 30 Pinelands impoundments representing five land-use groups. Altered land (upland agriculture and developed land) is shown in gray. Refer to Table 1 for the range of altered-land percentages assigned to each group.

In this paper, we refer to the Anderson-type land-use classes of urban land and agriculture as developed land and upland agriculture, respectively. Collectively, we refer to developed land and upland agriculture as altered land. Each impoundment was placed in one of five groups based on the percentage of altered land in the associated drainage basin (Table 1, Appendix 2). The five land-use groups were < 10%, 10-19.9%, 20-29.9%, 30-39.9%, and ≥ 40% altered land, with each group represented by a Roman numeral (I-V). The percentage of altered land in the 30 study basins ranged from an average of 3.4% for Group I impoundments to 49.1% for Group V impoundments (Table 1). Altered land was absent in one watershed. On average, developed land and upland agriculture represented 69% and 31% of altered land in the other 29 drainage basins.

Table 1. Land-use, water-quality, impoundment-area, and nearshore-habitat characteristics of 30 Pinelands stream impoundments. The five land-use groups are defined by the percentage of altered land (developed land and upland agriculture) in the associated watersheds. Water-quality and vegetation-cover-rank values are group medians. All other values are group means (± 1 SD). Both pH and specific conductance values are based on samples collected over a three-year period (2003-2005).

	Land-use groups and the percentage of altered land (developed land and upland agriculture) associated with each land-use group.				
	I	II	III	IV	V
	<10%	10-19.9%	20-29.9%	30-39.9%	≥40%
Land-use/habitat factors	n = 10	n = 4	n = 4	n = 4	n = 8
Developed land (%)	2.8 ± 2.5	8.2 ± 2.6	18.8 ± 7.9	18.7 ± 11.9	33.3 ± 13.2
Upland agriculture (%)	0.6 ± 0.8	5.8 ± 3.7	6.7 ± 7.0	16.1 ± 11.1	15.9 ± 11.0
Altered land (%)	3.4 ± 3.0	14.0 ± 1.3	25.5 ± 4.6	34.8 ± 2.1	49.1 ± 6.5
Impoundment area (ha)	19.0 ± 13.3	26.2 ± 11.9	7.4 ± 5.5	18.0 ± 10.6	11.4 ± 8.3
pH	4.4	5.1	5.8	6.2	6.6
Specific conductance ($\mu S\ cm^{-1}$)	51.8	50.3	68.5	63.2	104.4
Nearshore-water depth (cm)	40.3 ± 9.0	41.0 ± 9.1	38.9 ± 17.3	40.2 ± 5.7	45.1 ± 5.9
Sand (%)	73.0 ± 17.4	82.5 ± 12.9	86.7 ± 13.6	84.2 ± 13.6	48.1 ± 38.0
Emergent-cover rank	1.0	0.8	0.0	0.3	0.7
Floating-cover rank	0.0	0.0	0.3	0.3	0.5
Submerged-cover rank	2.3	1.8	4.0	1.3	3.3

Environmental factors

Water quality. We sampled pH, specific conductance, and temperature monthly at all 30 impoundments from April through October 2003, March through October 2004, and March through September 2005 (Appendix 3). The period March through October represents the growing season. From April through December 2006, we measured the same variables at 24 of the 30 impoundments (Appendix 2). Nitrite as nitrogen (NO_2-N), nitrate as nitrogen (NO_3-N), orthophosphate as phosphorus (PO_4-P), sulfate as sulfur (SO_4-S), and chloride (Cl) also were measured at the 24 impoundments during the June, August, October, and December 2006 water-quality-sampling rounds. All water-quality measurements were completed under baseflow conditions.

Specific conductance was measured with an Orion model-122 meter and pH was measured using an Orion model-250A meter. Anion analyses were completed using a Dionex ICS90 ion chromatograph following Standard Methods (1998).

Shoreline habitats. At each impoundment, we established ten 4 x 10-m plots along representative shoreline habitats. Each plot extended 1-m above (terrestrial portion) and 3-m below (aquatic portion) the water line. To characterize the dominant-nearshore sediment, we subjectively classified substrate as gravel, sand, detritus, or mud (muck and silt) at 1-m intervals along transects located perpendicular to the water line at the middle and ends of each plot for a total of 9 measurements per plot. Based on the number of points where each type of substrate was found, we calculated the frequency of occurrence of each sediment type within each plot. We also measured water depth at the same 9 sampling points and used these data to calculate a mean water depth for each plot.

Biological surveys

Plants. At the 30 impoundments, we surveyed vegetation on a single occasion during the latter part of the growing season (July through early October). All surveys were conducted from 2003 through 2005. Separate presence/absence tallies were completed for each 4 x 10-m plot, resulting in ten sampling areas for each impoundment. These tallies were used to calculate a frequency of occurrence value for each species for each impoundment.

We used the Braun-Blanquet cover scale (Mueller-Dombois and Ellenberg 1974), where + = < 1%, 1 = 1-5%, 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, and 5 = > 75% cover, to estimate the total abundance of emergent, floating-leaved, and submerged/free-floating vegetation within the aquatic portion of each plot. The plot values were used to calculate median cover values for each impoundment. Frequency of occurrence data for all plant species encountered in each impoundment are presented in Appendix 4. Taxonomic nomenclature follows Gleason and Cronquist (1991).

Diatoms. We used periphyton samplers that held 16 glass microscope slides to collect diatom samples at the outlet of 20 of the 30 impoundments. The samplers were placed in the stream below each impoundment for a 14-day period in July 2006 and again in September 2006. A spherical densiometer was used to measure canopy cover directly above the points where diatoms were sampled. Mean canopy cover for each site was based on four spherical-densiometer readings.

Slides from the two dates were pooled as a single sample and the samples were prepared following the methods described in Zampella et al. (2007b). Using a light microscope, diatoms were identified to species and enumerated until a total of at least 500 diatoms were counted. Species richness and relative abundance measures were based on all taxa collected, including those taxa identified only to genus. The complete diatom-data set is presented in Appendix 5.

Fish. We surveyed fish at the 30 impoundments on the same day that plant surveys were conducted. Using a 4-mm mesh nylon seine extending 3-m from the shore, we made two passes within each plot.

The number of individuals collected from each plot was used to determine presence/absence and relative abundance for each species in each plot. Relative abundance was calculated as: (number of individuals of a species/total number of individuals) × 100. Some juvenile *Esox* species (*E. niger* or *E. americanus*), *Enneacanthus* species (*E. obesus* or *E. gloriosus*), and *Lepomis* species (*L. gibbosus* or *L. macrochirus*) could not be identified to species and were not included in subsequent data analyses. Plot values were used to calculate frequency of occurrence and mean relative abundance for each species in each impoundment. The fish-survey data, which include the number of individuals of each species collected at each plot and the frequency of occurrence and mean relative abundance of each species for each impoundment, are presented in Appendices 6 - 8. Taxonomic nomenclature follows that used in Page and Burr (1991).

Anurans. We conducted nighttime vocalization surveys at the 30 impoundments in June 2005. June is the calling season for both bullfrogs and carpenter frogs (Zampella et al. 2001), the two species that were the focus of our surveys. Each site was visited on one occasion. The number of calling individuals of all anuran species heard during a five-minute period was recorded. No attempt was made to count beyond 10 individuals of a given species so the maximum number for these species may be conservative. The time, temperature, and relative humidity were also recorded during each visit.

Tadpoles collected during the fish surveys were identified to species. No bullfrog or carpenter frog tadpoles were found at several sites where vocalizing bullfrogs or carpenter frogs were previously heard. These sites were revisited in September 2005 and a dip net was used to intensely sample nearshore habitats for tadpoles.

The anuran-survey data, which includes the number of individuals of each anuran species heard and the time, air temperature, relative humidity, and weather conditions recorded during site visits, are presented in Appendix 9. The presence of carpenter frog and bullfrog tadpoles at each site is also indicated. Taxonomic nomenclature follows Conant and Collins (1998).

Voucher collection

The Pinelands Commission maintains voucher collections for diatoms, plants, and fish. The diatoms found at each site are mounted in Naphrax on microscope slides. The herbarium collection includes voucher specimens for many of the plant species encountered during the surveys. The fish collection includes voucher specimens for all species collected at each impoundment.

Biogeography and wetland plant status

Following Zampella et al. (2006a), we refer to plant, fish, and anuran species whose distribution is limited to the Pinelands as restricted-native species, species that are native to both the Pinelands and other areas of New Jersey as widespread-native species, and species that are native to regions outside the Pinelands, including exotics, as nonnative species (Table 2). In the Pinelands, nonnative plant, fish, and anuran species are associated with watershed disturbance and water-quality degradation (Zampella and Laidig 1997, Zampella and Bunnell 1998, 2000, Zampella et al. 2006a).

Diatom pH categories

Pinelands streams draining developed lands and upland agriculture are dominated by diatom assemblages that are characteristic of circumneutral conditions, whereas acid-water diatoms dominate assemblages found in streams with little altered land in the watershed (Zampella et al. 2007b). Using Meriläinen (1967), Lowe (1974), van Dam et al. (1994), Charles (1985), and Dixit et al. (1999) and the methods described in Zampella et al. (2007b), we assigned diatom taxa to pH classes that describe the occurrence of diatoms in relation to pH. Indifferent or circumneutral species (pH around 7) were classified as indifferent. Acidobiontic ($pH < 7$), acidophilous ($pH \leq 7$), and acidophilous-indifferent taxa were classified as acidobiontic-acidophilous. Alkaliphilous ($pH \geq 7$), alkalibiontic ($pH > 7$), and indifferent-alkaliphilous diatoms were classified as alkalibiontic-alkaliphilous.

Table 2. Biogeographic classification of plant, fish, and anuran species based on Stone (1911), Hastings (1984), and Conant (1979), respectively. Nonnative-plant species also include species described as exotic by Gleason and Cronquist (1991).

Classification	Plants	Fish	Anurans
Restricted-native species	Pine Barrens District species	Restricted-characteristic species	Pine Barrens species
Widespread-native species	Species common to the Pine Barrens and Middle Districts	Widespread-characteristic species	Wide-ranging species
Nonnative species	Species restricted to the Middle District	Peripheral and introduced species	Border-entrant species

Data analysis

Analysis of variance. We used Kruskal-Wallis ANOVA tests to assess differences in mean water depth, mean sediment frequency, median pH, median specific conductance, mean canopy cover at diatom-sampling sites, median NO_3-N concentrations, diatom-, plant-, fish-, and anuran-species richness, and the percentage of plant, fish, and anuran species classified as restricted native, widespread native, and nonnative between the five land-use groups. Kruskal-Wallis ANOVAs were also used to compare fish- and anuran-relative abundance and the percentage of dominant diatoms classified as acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent between groups. Dominant diatoms were those species that comprised more than 75% of a sample. Plant-species-richness attributes included herbaceous- and woody-species richness. The percentage of acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent species was based on the number of species assigned a classification rather than the total number of dominant species. Similarly for plants, the percentage of restricted-native, widespread-native, and nonnative species was based on the number of species assigned a classification. Unclassified diatoms represented 7.0% of all dominant-diatom species. Plants not assigned a biogeographic classification represented 11.7% and 6.3% of the total number of all herbaceous and woody species, respectively. Separate Kruskal-Wallis ANOVAs were performed using median growing season (March through October) pH and specific conductance values for the 2003-2005 and 2006 periods. Post-hoc comparisons were conducted using multiple comparisons of mean ranks (Siegel and Castellan 1988).

Correlations. Spearman rank correlation was used to relate altered land in entire watersheds to median pH and median specific conductance based on 2003–2005 growing season data, and median pH, specific conductance, NO_3-N, SO_4-S, and chloride based on data collected in June, August, October, and December in 2006 at the subset of 24 impoundments. Specific conductance and pH were also related to altered land in the variable-width buffers surrounding all 30 impoundments. We also used rank correlation to evaluate the relationship of diatom-species richness and pH classification and plant, fish, and anuran richness and biogeography to land-use and water-quality factors. Water-quality data collected during the 2003-2005 period were used in the analysis of plants, fish, and anurans. For diatoms, we used pH and specific conductance data collected in 2006.

MRPP. Nonparametric multi-response permutation procedures (MRPP, McCune and Mefford 1999) were used to compare selected biological attributes between the five land-use groups. Biological attributes included relative abundance for diatoms and anurans, frequency of occurrence for plants and fish, and mean relative abundance for fish. The MRPP analyses were based on Euclidean distance. We report the p and A values for each significant result. The p value describes the likelihood that an observed difference is due to chance. The A statistic (chance-corrected within-group agreement) describes agreement within land-use groups. $A = 1$ when all attributes within a group are identical, $A = 0$ when within group heterogeneity equals that expected by chance, and $A < 0$ when within-group heterogeneity is greater than expected by chance.

Indicator-species analysis. We used indicator-species analysis, a method that complements MRPP by describing how well each species separates among groups (Dufrêne and Legendre 1997, McCune and Grace 2002, McCune and Mefford 1999), to contrast diatom, plant, fish, and anuran species present in the five land-use-based impoundment groups. Indicator values, which are usually based on relative-abundance and relative-frequency values, can range from zero to 100. We used relative-abundance data for diatoms, fish, and anurans and frequency of occurrence data for plants in the indicator-species analyses. A maximum indicator value is obtained when a species is unique to a group and is found in all samples of that group.

Logistic regression. Using logistic regression, we determined the probability of finding various percentages of nonnative-plant species, nonnative-fish species, and alkalibiontic-alkaliphilous or indifferent diatom species in relation to the percentage of altered land in a drainage basin. The nonnative-species percentage cutoffs were ≥ 10%, ≥ 20%, ≥ 30%, and ≥ 40% of total classified-species richness. The same cutoff values were applied to the percentage of diatom species characterized as either alkalibiontic-alkaliphilous or indifferent. For anurans, we determined the probability of encountering restricted-native carpenter frogs and nonnative bullfrogs.

Statistical significance. An alpha level of 0.05 was used to assess significance for the Kruskal-Wallis ANOVAs and the MRPP and correlation analyses. Significance levels for related correlation tests and Kruskal-Wallis ANOVAs and the multiple MRPP post-hoc tests were adjusted using the sequential Bonferroni method (Rice 1989, 1990). In these cases, we used a single asterisk to denote tests significant at the initial p value and a double asterisk for those tests that were significant following the Bonferroni adjustment. Statistical significance of the indicator-species values was determined by a Monte Carlo method using 1,000 randomizations. We used $p = 0.10$ as the criteria for identifying species indicative of a particular land-use group. MRPP and indicator species analyses were performed using PC-ORD for Windows Version 5.0 (MjM Software, Gleneden Beach, OR). The ANOVA and correlation analyses were completed using Statistica 7.1 (StatSoft, Inc., Tulsa, OK).

RESULTS

Environmental factors

Water quality. For pH and specific conductance, group medians for the three-year sampling period at all 30 impoundments ranged from 4.4 to 6.6 and 50.3 to 104.4 $\mu S\ cm^{-1}$, respectively (Table 1). Both pH ($r = 0.85$, $p < 0.001$**) and specific conductance ($r = 0.75$, $p < 0.001$**) were positively correlated with the percentage of altered land in a drainage basin. The relationship between altered land and both water-quality variables did not improve when the proximity of altered land was considered (Figure 2). The Kruskal-Wallis ANOVAs revealed a difference in pH ($p = 0.006$**) and specific conductance ($p = 0.004$**) between groups. Based on the post-hoc tests, the median pH of Group I impoundments differed from Group V impoundments ($p < 0.001$), and the median specific conductance of Group V impoundments differed from Group I ($p = 0.039$) and Group II ($p = 0.006$) impoundments.

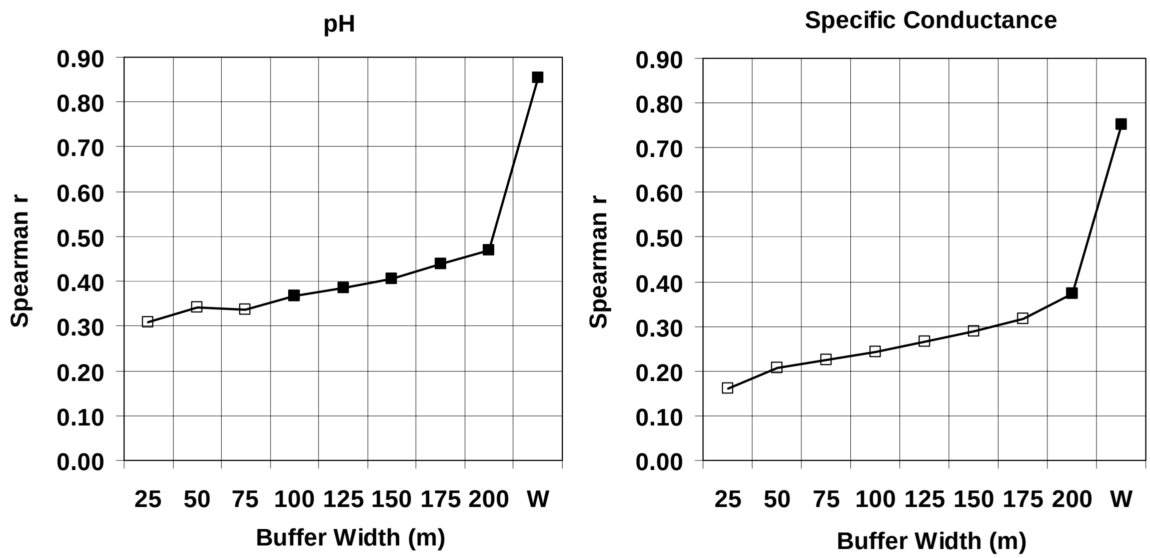

Figure 2. Spearman rank correlations (r) relating pH and specific conductance to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the entire upstream watershed (W). Solid squares denote Spearman rank correlations that were significant at an initial *p* value of 0.05.

For the subset of 24 impoundments, median nitrite concentrations were below detection at all sites (Appendix 3). Phosphorus concentrations were below detection at all but two of these sites (Appendix 3). The other water-quality variables sampled over four months in 2006 varied in relation to the percentage of altered land in a basin and most were intercorrelated (Table 3 and 4). Although concentrations of NO_3-N, chloride, and SO_4-S were positively correlated with altered land, based on the Kruskal-Wallis ANOVAs, only NO_3-N differed between land-use groups ($p = 0.003$**). The post-hoc tests indicated that NO_3-N differed between Group I and Group V ($p = 0.003$) impoundments.

The results of the Kruskal-Wallis ANOVAs based on the subset of 20 diatom-sampling sites were similar to those obtained using the full data set. The ANOVAs revealed a difference in pH ($p = 0.006$**) and specific conductance ($p = 0.042$**) between land-use groups. Based on the post-hoc tests, the pH ($p = 0.021$) and specific conductance ($p = 0.029$) of Group I impoundments differed from Group V. As with the full data set, both pH (r = 0.77, $p < 0.001$**) and specific conductance (r = 0.73, $p < 0.001$**) were positively correlated with the percentage of altered land in a basin. Canopy cover at the 20 diatom-sampling sites did not differ between land-use groups ($p = 0.833$).

Shoreline habitats. Mean nearshore-water depth for the 30 impoundments was similar across groups, with group means (± 1 SD) ranging from 38.9 ± 17.3 cm for the Group III sites to 45.1 ± 5.9 cm for the Group V sites (Table 1). Sediments other than sand or mud (muck or silt) were rarely encountered. Sand was the dominant sediment at most sites, whereas mud was dominant at only four sites. Because mud values are generally the inverse of the sand values, the substrate analysis was limited to the frequency of occurrence of sand. The Kruskal-Wallis ANOVAs revealed no difference in water depth, substrate, or vegetation cover between land-use groups.

Table 3. Spearman rank correlations between water-quality variables and the percentage of altered land (developed land and upland agriculture) in a basin for a subset of 24 impoundments. Median values used in the correlations were based on four samples collected in June, August, October, and December 2006. For all correlations, n = 24. All correlations except pH vs. specific conductance and SO_4-S were significant following the Bonferroni adjustment. The three-year (2003-2005) median pH and specific conductance values for the full set of 30 impoundments were also positively correlated with the percentage of altered land in a drainage basin (pH: r = 0.85, $p < 0.001$** and specific conductance: r = 0.75, $p < 0.001$**).

	Altered Land	pH	Specific conductance	NO_3-N	SO_4-S
pH	0.82				
Specific conductance	0.62	0.40			
NO_3-N	0.76	0.69	0.52		
SO_4-S	0.54	0.24	0.69	0.56	
Chloride	0.64	0.53	0.92	0.59	0.57

Table 4. Group median water-quality values (mg L^{-1}) from a subset of 24 impoundments. The five land-use groups are characterized by the percentage of altered land (developed land and upland agriculture) in the associated watersheds. Significance levels (*p*) are shown for each Kruskal-Wallis ANOVA. Only nitrate-nitrogen (NO_3-N) differed significantly between groups both before and after the Bonferroni adjustment. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Variable	*p*	I n = 8	II n = 3	III n = 3	IV n = 3	V n = 7
NO_3-N	0.003**	0.04	0.07	0.24	0.18	0.27
SO_4-S	0.071	1.2	1.3	1.8	1.3	1.9
Chloride	0.099	5.5	6.9	11.1	8.4	13.7

Vegetation

Herbaceous species. A total of 188 herbaceous species were encountered in the vegetation surveys (Appendix 4). The overall mean (± 1 SD) herbaceous richness for all impoundments was 33.9 ± 10.8. Mean herbaceous-species richness ranged from 26.4 ± 8.0 for Group I impoundments to 42.5 ± 14.0 for Group IV impoundments (Figure 3). Although species richness did not differ between groups ($p = 0.053$), between-group differences in the percentage of restricted-native ($p = 0.036$*), widespread-native ($p = 0.024$*), and nonnative ($p = 0.002$**) species were observed. Post-hoc tests attributed these differences to a higher percentage of restricted-native species in Group I compared to Group V ($p = 0.019$) impoundments, a lower percentage of nonnative species in Group I compared to Group V ($p < 0.001$) impoundments, and a higher percentage of widespread-native species in Group IV compared to Group V ($p = 0.034$) impoundments.

Richness and biogeographical attributes also varied along water-quality and land-use gradients (Table 5). Herbaceous-species richness increased, the percentage of restricted-native species decreased, and the percentage of nonnative species increased as pH and the percentage of altered land in a watershed increased. The percentage of restricted-native and nonnative species also varied with specific conductance. The relationship between altered land and the percentage of nonnative plants did not improve when the proximity of altered land was considered (Figure 4).

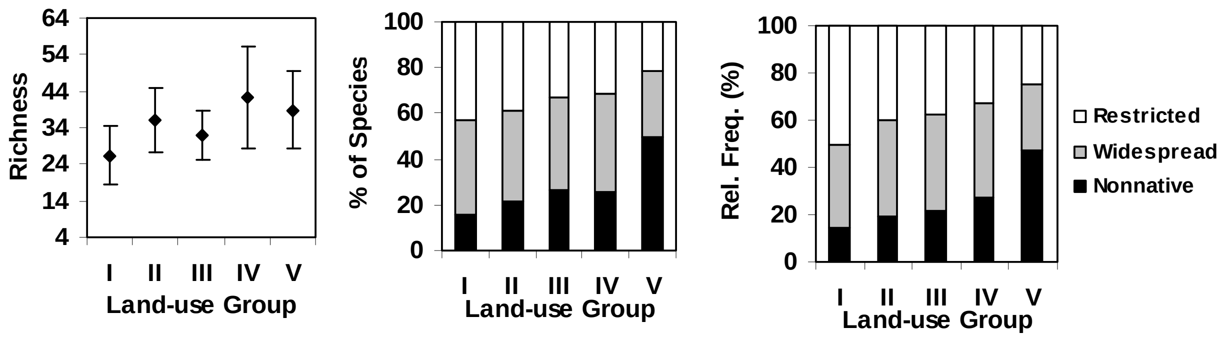

Figure 3. Mean (± 1 SD) herbaceous-species richness by land-use group and mean percentage biogeographic composition and relative frequency by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

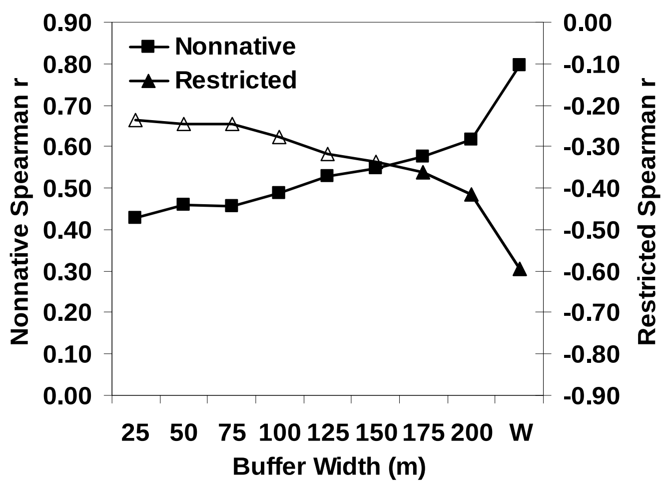

Figure 4. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative herbaceous-plant species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Solid symbols denote Spearman rank correlations that were significant at an initial *p* value of 0.05.

Table 5. Spearman rank correlations between herbaceous-species attributes and watershed-disturbance variables. Biogeographic values represent the percentage of the total number of species classified as restricted native, widespread native, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 30.

	Altered land			pH			Specific conductance		
Attribute	r	*p*		r	*p*		r	*p*	
Species richness	0.50	0.005	**	0.56	0.001	**	0.29	0.126	
% Restricted native	-0.60	0.001	**	-0.64	<0.001	**	-0.41	0.023	*
% Widespread native	-0.32	0.088		-0.33	0.075		-0.28	0.132	
% Nonnative	0.80	<0.001	**	0.81	<0.001	**	0.54	0.002	**

The MRPP analysis showed an overall difference in herbaceous-species composition between land-use groups (A = 0.055, p < 0.001). Post-hoc comparisons revealed a difference between Group I and Groups III (A = 0.029, p = 0.035*), IV (A = 0.058, p = 0.002**), and V (A = 0.066, p < 0.001**) and between Group II and Group V (A = 0.033, p = 0.006**) impoundments.

The between-group differences revealed by the MRPP analysis were associated with a contrast in the biogeography of herbaceous species identified through the indicator-species analysis (Table 6). The more heavily altered sites were characterized by a greater number of nonnative-herbaceous-indicator species, with the highest number of nonnative-species indicators found in Group V impoundments. Conversely, the less-altered sites were characterized by native-herbaceous-indicator species.

The logistic regression analyses revealed a positive relationship between the percentage of altered land and the occurrence of at least 10% (p = 0.001**), 20% (p < 0.001**), 30% (p = 0.003**), and 40% (p < 0.001**) nonnative-herbaceous species in an impoundment (Figure 5). The probability of nonnative species comprising at least 10% of all species increased rapidly and was 100% when altered land covered 10% of a watershed. The probability of encountering plant assemblages with a greater percentage of nonnative species increased more slowly as the percentage of altered land increased.

Table 6. Biogeography of herbaceous-indicator species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

	Comparisons													
	All groups					I-III		I-IV		I-V		II-V	
Biogeography	I	II	III	IV	V	I	III	I	IV	I	V	II	V
Restricted native	0	2	0	1	0	0	1	0	4	4	0	4	0
Widespread native	0	1	1	6	0	1	1	0	9	3	5	5	0
Nonnative	0	0	1	2	16	0	4	0	8	0	19	0	1

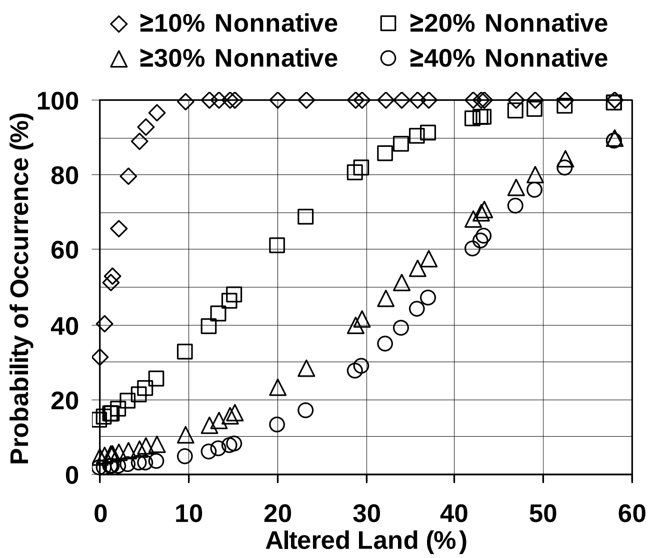

Figure 5. Logit curves describing the probability of encountering at least 10%, 20%, 30%, or 40% nonnative-herbaceous species at varying percentages of upstream-altered land.

Woody species. A total of 64 woody species were found during the vegetation surveys (Appendix 4). Mean (± 1 SD) woody-species richness ranged from 14.1 ± 7.3 for Group V impoundments to 21.8 ± 4.8 for Group III impoundments (Figure 6). The percentage of both restricted-native (p = 0.037*) and nonnative woody species (p = 0.029*) differed between impoundment groups. Post-hoc tests attributed these differences to a higher percentage of restricted-native species (p = 0.026) and a lower percentage of nonnative species (p = 0.045) in Group I compared to Group V impoundments.

The correlation analysis revealed that the percentage of restricted-native species decreased and the percentage of nonnative species increased as pH, specific conductance, and the percentage of altered land increased (Table 7). The relationship between the percentage of restricted- and nonnative-woody species and altered land was similar regardless of whether proximate or watershed-wide land use was considered (Figure 7).

The MRPP analysis revealed an overall difference in the composition of woody vegetation between land-use groups (A = 0.070, p = 0.003). The post-hoc comparisons indicated differences between Group I and Groups IV (A = 0.055, p = 0.015*) and V (A = 0.088, p = 0.002**) and between Group III and Groups IV (A = 0.088, p = 0.019*) and V (A = 0.124, p = 0.004**).

Based on the indicator-species analysis, restricted-native indicator species were associated with Group I and were absent from Group IV and Group V impoundments (Table 8). A single nonnative-indicator species, poison ivy (*Toxicodendron radicans)*, was associated with the contrast between Groups I and IV. Similarly, only one nonnative-indicator species, Virginia creeper (*Parthenocissus quinquefolia*), was associated with the contrast between Groups I and V. The contrast between Group III and Groups IV and V was also associated with the presence of restricted-native-indictor species in Group III impoundments and the absence of these species in Groups IV and V (Table 8).

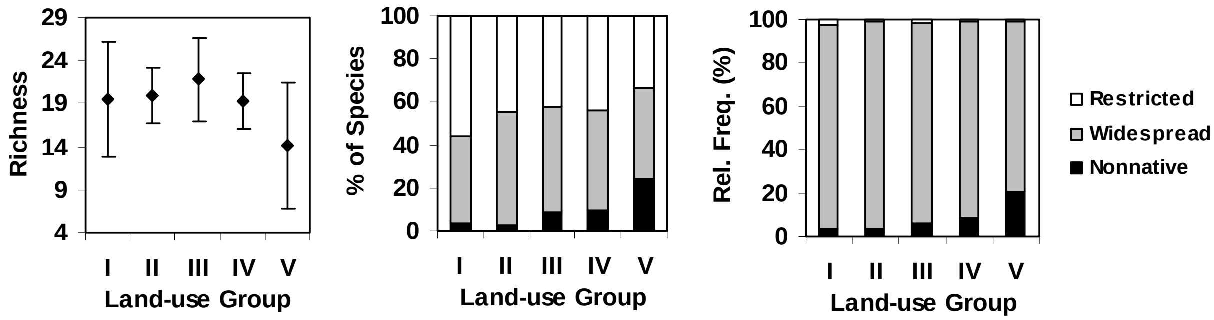

Figure 6. Mean (± 1 SD) woody-species richness by land-use group and mean percentage biogeographic composition and relative frequency by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

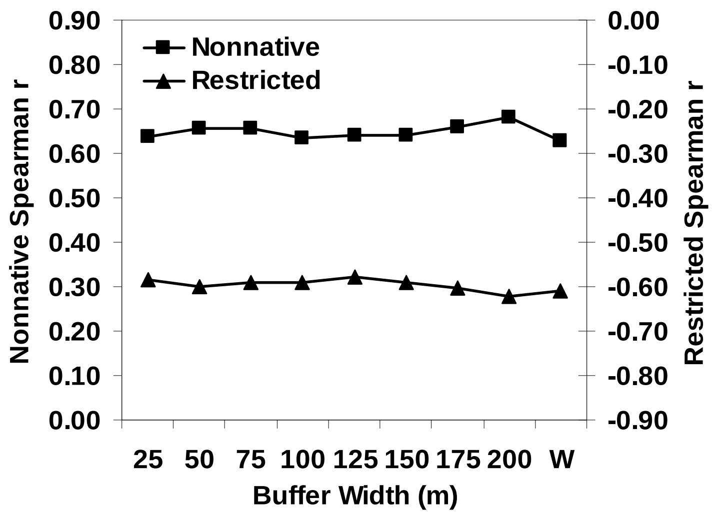

Figure 7. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative woody-plant species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). All correlations were significant at the initial *p* value of 0.05.

As with herbaceous species, a positive relationship was found between the percentage of altered land and the occurrence of ≥ 10% (p = 0.003**) and ≥ 20% (p = 0.035**) nonnative-woody species in an impoundment (Figure 8). However, unlike herbaceous species, the probability of nonnative species comprising at least 10% or 20% of all classified species increased more slowly as the percentage of altered land in a watershed increased and did not reach 100%. The probability of encountering ≥ 30% or ≥ 40% nonnative species was not modeled because nonnative-woody species exceeded 30% at only one impoundment.

Table 7. Spearman rank correlations between woody-species attributes and watershed-disturbance variables. Biogeographic values represent the percentage of the total number of species classified as restricted native, widespread native, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 30.

	Altered land			pH			Specific conductance		
Attribute	r	*p*		r	*p*		r	*p*	
Species richness	-0.19	0.314		0.00	0.985		-0.20	0.287	
% Restricted native	-0.61	<0.001	**	-0.71	<0.001	**	-0.38	0.041	*
% Widespread native	0.13	0.494		0.28	0.137		-0.04	0.820	
% Nonnative	0.63	<0.001	**	0.63	<0.001	**	0.47	0.009	**

Table 8. Biogeography of woody-indicator species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

	Comparisons													
	All groups					I-IV		I-V		III-IV		III-V	
Biogeography	I	II	III	IV	V	I	IV	I	V	III	IV	III	V
Restricted native	2	0	4	0	0	3	0	8	0	3	0	6	0
Widespread native	0	0	1	1	0	1	3	1	1	1	1	4	0
Nonnative	0	0	1	0	2	0	1	0	1	0	0	1	0

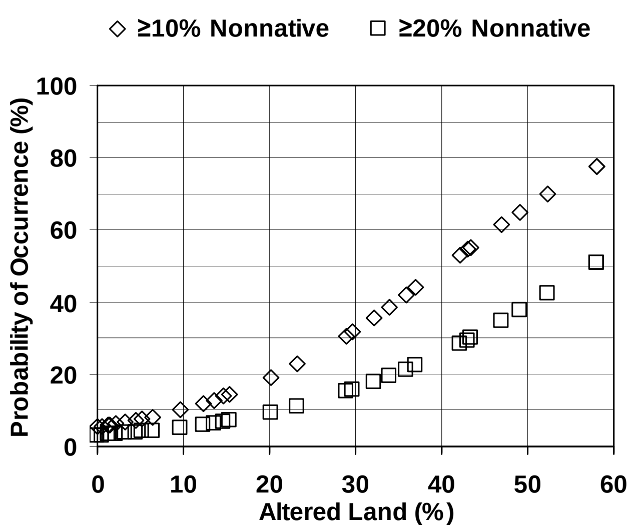

Figure 8. Logit curves describing the probability of encountering at least 10% or 20% nonnative woody species at varying percentages of upstream-altered land. The probability of encountering at least 30% or 40% nonnative species was not modeled because nonnative-woody species exceeded 30% at only one impoundment.

Diatoms

A total of 169 taxa, including 16 identified only to genus, were collected from the 20 sites (Appendix 5). Three small and difficult to distinguish species of *Aulacoseira*, including *A. distans*, *A. paraglabra*, and *A. distans var. septentrionalis*, were combined as one composite species in the analysis. For similar reasons, *Staurosirella pinnata* and *Staurosirella pinnata* var. *lancettula* were combined, as were *Stauroforma* sp. and *Stauroforma exiguaformis*. Combining these species resulted in a final total of 165 taxa. Neither richness nor pH classes were found to differ between land-use groups (Figure 9).

Analysis of dominant species indicated that the percentage of species classified as acidobiontic-acidophilous diatoms decreased as the percentage of altered land in a watershed increased (Table 9). The opposite trend was observed for indifferent species. Specific conductance was positively correlated with species richness and the percentage of both indifferent and alkalibiontic-alkaliphilous species and negatively correlated with the percentage of acidobiontic-acidophilous species. An increase in the percentage of indifferent species was the only trend found for pH. The logistic regression analysis also revealed a positive relationship between the percentage of altered land and the probability of encountering diatom assemblages in which the combined percentage of indifferent and alkalibiontic-alkaliphilous species comprised at least 10% (p = 0.005**) and 20% (p = 0.013**) of the total number of dominant-diatom species (Figure 10). Although the probability of encountering assemblages in which the indifferent and alkalibiontic-alkaliphilous species together comprised at least 30% (p = 0.113) and 40% (p = 0.067) of the total number of dominant species is also shown in Figure 10, the relationships were not significant.

Results of the MRPP analysis of the diatom data showed an overall difference in composition between land-use groups (A = 0.084, p < 0.031). Post-hoc comparisons revealed differences between Group I and Groups IV (A = 0.093, p = 0.029*) and V (A = 0.105, p = 0.006*). The separation of groups in the MRPP analysis was associated with a contrast in the pH class of species identified through the indicator-species analysis (Table 10). The contrast between Group I and Group IV was characterized by the presence of Group IV indicator species classified as indifferent and alkalibiontic-alkaliphilous. In the comparison between Group I and Group V, all six Group I indicators were acidobiontic-acidophilous diatoms, whereas eight of 10 Group V indicator species were indifferent or alkalibiontic-alkaliphilous diatoms.

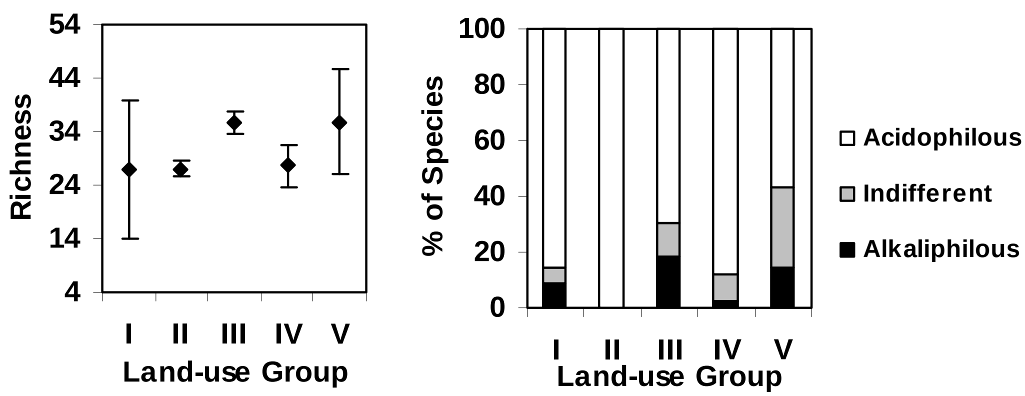

Figure 9. Mean (± 1 SD) diatom-species richness by land-use group and mean relative abundance by pH class and land-use group. Refer to Table 1 for altered-land-percentage ranges. The number of impoundments (n) for each land-use group was: Group I (7), II (2), III (2), IV (3), and V (6).

Table 9. Spearman rank correlations between diatom-species attributes and watershed-disturbance variables. The pH-category values represent the percentage of the total number of dominant-diatom species classified as acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent (circumneutral). Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 20.

	Altered land			pH			Specific conductance		
Attribute	r	*p*		r	*p*		r	*p*	
Species richness	0.41	0.075		0.35	0.127		0.70	0.001	**
% acidobiontic-acidophilous	-0.54	0.013	**	-0.33	0.159		-0.69	0.001	**
% indifferent (circumneutral)	0.71	<0.001	**	0.52	0.019	*	0.53	0.016	**
% alkalibiontic-alkaliphilous	0.34	0.148		0.25	0.282		0.61	0.005	**

Table 10. Diatom pH classes associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of dominant pH-indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

	Comparisons								
	All groups					I-IV		I-V	
pH Class	I	II	III	IV	V	I	IV	I	V
Acidobiontic-acidophilous	0	4	2	1	0	1	6	6	1
Indifferent	0	0	2	0	2	0	5	0	5
Alkalibiontic-alkaliphilous	0	0	1	1	0	0	2	0	3
Unclassified	0	1	1	1	1	0	1	0	1

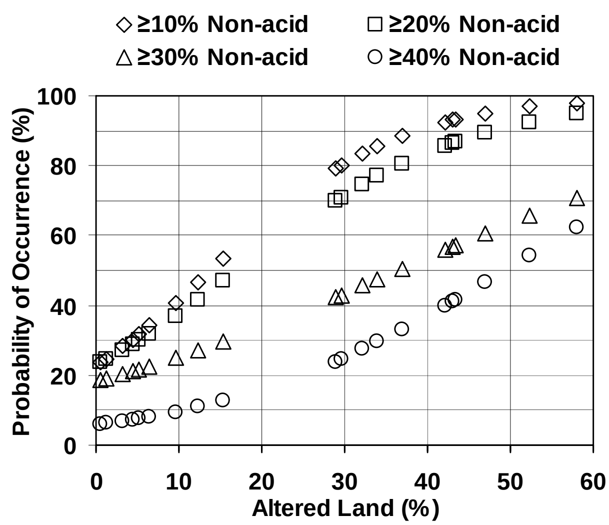

Figure 10. Logit curves describing the probability of encountering diatom assemblages in which non-acid (indifferent and alkalibiontic-alkaliphilous) species comprised at least 10%, 20%, 30%, or 40% of the total number of dominant-diatom species at varying percentages of upstream-altered land.

Fish

Twenty fish species were collected during the surveys, including six restricted species, six widespread species, and eight nonnative species (Table 11). A total of 8,300 individual fish were collected from the 30 impoundments, including 5,712 individuals identified to the species level and 2,588 individuals identified only to the genus level. Those identified only to genus (i.e., *Esox*, *Enneacanthus*, and *Lepomis*) were excluded from the analysis. The overall relative abundance of restricted, widespread, and nonnative species was 18%, 59%, and 23%, respectively.

Of the four species-richness measures, only nonnative-species richness differed between land-use groups (p = 0.003**). Post-hoc tests revealed that nonnative-species richness was lower for Group I impoundments compared to Group V impoundments (p = 0.005).

The percentage of restricted species (p = 0.017**), widespread species (p = 0.015**), and nonnative species (p = 0.005**) differed between land-use groups (Figure 11). Based on post-hoc tests, the percentage of restricted species was higher (p = 0.027) and the percentage of nonnative species was lower (p = 0.011) in Group I impoundments compared to Group V impoundments. Post-hoc tests also indicated that the percentage of widespread species was higher (p = 0.023) for Group I impoundments compared to Group III impoundments.

Table 11. Fish species collected from 30 Pinelands impoundments. Refer to Table 2 for explanation of biogeographic classifications.

Restricted Species	
Acantharchus pomotis	mud sunfish
Ameiurus natalis	yellow bullhead
Aphredoderus sayanus	pirate perch
Enneacanthus chaetodon	blackbanded sunfish
Enneacanthus obesus	banded sunfish
Etheostoma fusiforme	swamp darter
Widespread Species	
Anguilla rostrata	American eel
Enneacanthus gloriosus	bluespotted sunfish
Erimyzon oblongus	creek chubsucker
Esox niger	chain pickerel
Noturus gyrinus	tadpole madtom
Umbra pygmaea	eastern mudminnow
Nonnative Species	
Ameiurus nebulosus	brown bullhead
Fundulus diaphanus	banded killifish
Lepomis gibbosus	pumpkinseed
Notemigonus crysoleucas	golden shiner
Perca flavescens	yellow perch
Lepomis macrochirus	bluegill
Micropterus salmoides	largemouth bass
Pomoxis nigromaculatus	black crappie

The relative abundance of restricted species (p = 0.003**) and nonnative species (p = 0.001**) also differed between land-use groups (Figure 11). Based on post-hoc tests, the relative abundance of restricted species was higher in Group I impoundments compared to Groups IV (p = 0.037) and V (p = 0.008) impoundments. In contrast, the relative abundance of nonnative species was lower in Group I compared to Groups IV (p = 0.004) and V (p = 0.011).

Total species richness and the percentage and relative abundance of nonnative species increased and the percentage and relative abundance of restricted species decreased as the percentage of upstream-altered land and pH increased (Table 12). Altered land and the percentage of widespread species were also positively correlated. Specific conductance was positively correlated only with the percentage of nonnative species. As with herbaceous-plant species, the strongest relationship between altered land and the percentage of restricted- and nonnative-fish species was found at the watershed level (Figure 12).

The MRPP analyses revealed an overall difference in both the frequency of occurrence (A = 0.087, p = 0.001) and relative abundance (A = 0.076, p = 0.006) of fish species between the five land-use groups. Post-hoc comparisons based on frequency of occurrence data revealed differences between land-use Group I and Groups II (A = 0.035, p = 0.038*), IV (A = 0.122, p < 0.001**), and V (A = 0.103, p < 0.001**), Groups III and IV (A = 0.081, p = 0.036*), and Groups III and V (A = 0.069, p = 0.016**). Post-hoc comparisons based on relative-abundance data indicated differences between impoundment Group I and Groups IV (A = 0.140, p = 0.001**) and V (A = 0.075, p = 0.002**) and between Group III and IV (A = 0.185, p = 0.021*). Similar results were obtained when individuals that were identified only to genus were also included in the two MRPP analyses.

Differences between impoundment groups revealed by the MRPP analysis of relative-abundance data reflected the contrast in the biogeography of fish species identified through the indicator-species analysis (Table 13). Impoundments in the least altered drainages were characterized by native-fish-indicator species, whereas impoundments in more heavily altered basins were characterized by a greater number of nonnative-fish-indicator species.

Logistic regression results revealed a positive relationship between the percentage of upstream-altered land and the occurrence of at least 10% (p < 0.001**), 20% (p < 0.001**), 30% (p < 0.001**), and 40% (p = 0.036**) nonnative-fish species in an assemblage (Figure 13). For example, the probability of encountering a fish assemblage comprised of at least 10% or 20% non-native fish is about 100% when altered land covers 30% of a watershed.

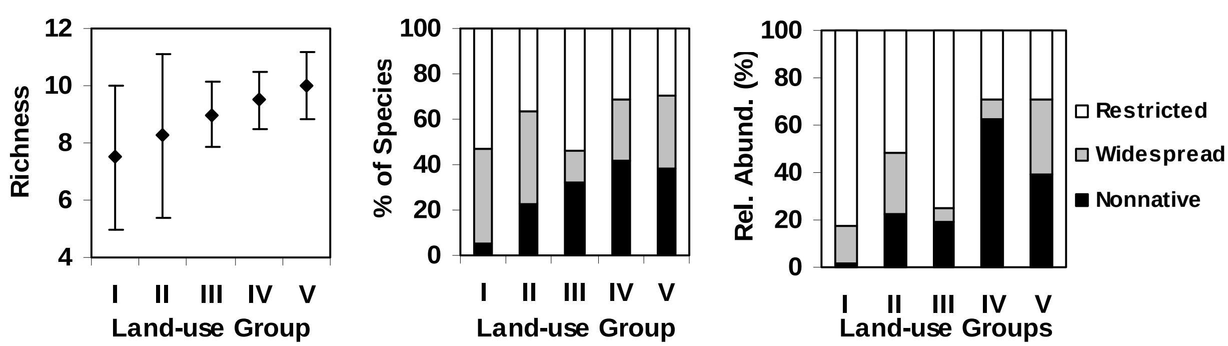

Figure 11. Mean (± 1 SD) fish-species richness by land-use group and mean percentage biogeographic composition and relative abundance by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

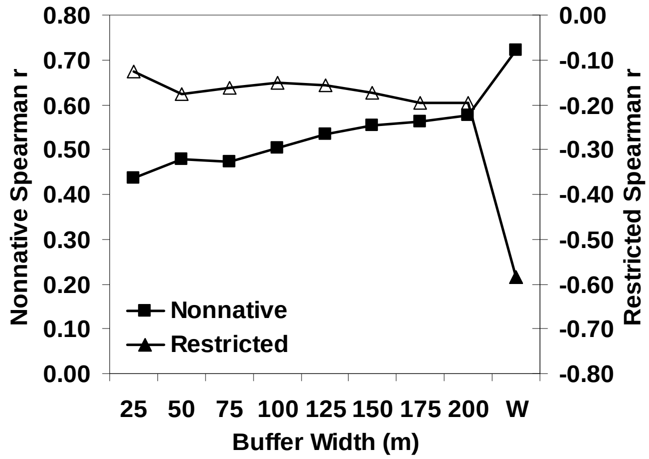

Figure 12. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative fish species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Open symbols denote Spearman rank correlations that were not significant at an initial *p* value of 0.05.

Table 12. Spearman rank correlation results between fish-species attributes and watershed-disturbance variables. Biogeographic attributes include both the percentage of the total number of fish species (% species) and the relative abundance of individuals (% individuals) classified as restricted, widespread, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 30.

	Altered land			pH			Specific conductance		
Attribute	r	*p*		r	*p*		r	*p*	
Species richness	0.47	0.008	**	0.42	0.022	**	0.33	0.073	
% Restricted species	-0.59	<0.001	**	-0.69	<0.001	**	-0.36	0.053	
% Widespread species	-0.40	0.027	**	-0.32	0.090		-0.24	0.205	
% Nonnative species	0.72	<0.001	**	0.79	<0.001	**	0.42	0.019	*
% Restricted individuals	-0.63	<0.001	**	-0.81	<0.001	**	-0.15	0.415	
% Widespread individuals	-0.02	0.919		0.15	0.430		-0.14	0.467	
% Nonnative individuals	0.73	<0.001	**	0.79	<0.001	**	0.34	0.067	

Table 13. Biogeography of fish species associated with land-use groups shown to be different through the MRPP analysis based on relative-abundance data. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

	Comparisons										
	All groups					I-IV		I-V		III-IV	
Biogeography	I	II	III	IV	V	I	IV	I	V	III	IV
Restricted native	1	0	1	0	0	2	0	2	0	1	0
Widespread native	0	1	0	0	0	1	1	0	0	0	0
Nonnative	0	0	0	3	1	0	4	0	4	0	1

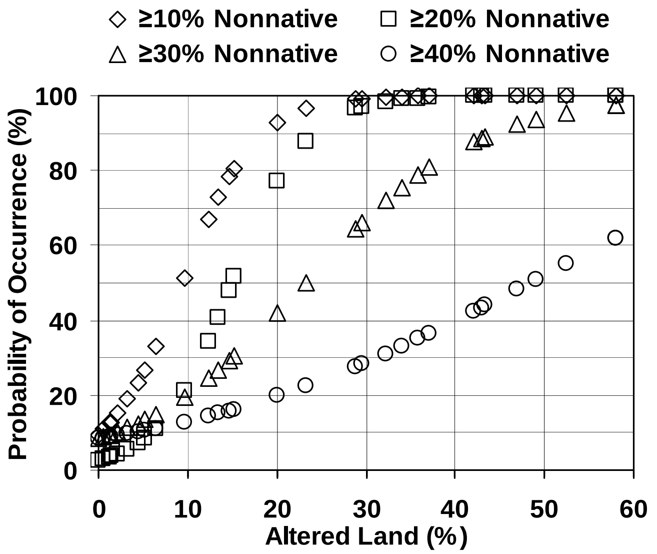

Figure 13. Logit curves describing the probability of encountering at least 10%, 20%, 30%, or 40% nonnative-fish species at varying percentages of upstream-altered land.

Anurans

Seven anuran species were heard during the surveys, including two restricted species, three widespread species, and two nonnative species (Table 14). Nonnative-species richness differed between the five land-use groups (p = 0.010**). Post-hoc tests revealed that nonnative-species richness was lower in Group I compared to Group V impoundments (p = 0.032). The percentage of species classified as restricted species (p = 0.045*) and nonnative species (p = 0.001**) also differed between land-use groups (Figure 14). Post-hoc tests revealed no difference between individual impoundment groups for the percentage of restricted species, but the percentage of nonnative species was lower (p = 0.001) in Group I compared to Group V impoundments.

A total of 408 individuals were heard calling at the 30 impoundments. As previously mentioned, this number is conservative because the maximum number of individuals counted for a species during a visit was limited to ten or fewer. Restricted, widespread, and nonnative species represented 35%, 45%, and 20% of the total number of anurans heard. The relative abundance of restricted species (p = 0.045*) and nonnative species (p < 0.001**) differed between land-use groups (Figure 14). Post-hoc tests revealed no differences between individual impoundment groups for the percentage of restricted species, but the percentage of nonnative species was lower (p < 0.001) for Group I compared to Group V impoundments.

The percentage and relative abundance of restricted species decreased and the percentage and relative abundance of nonnative species increased as pH, specific conductance, and the percentage of upstream altered land increased (Table 15). Neither the percentage nor the relative abundance of widespread species was related to any of the watershed-disturbance variables. The relationship between altered land and the percentage of restricted and nonnative species was strongest at the watershed scale (Figure 15).

Table 14. Anuran species heard calling from 30 Pinelands impoundments. Refer to Table 2 for explanation of biogeographic classifications.

Restricted Species	
Hyla andersonii	Pine Barrens treefrog
Rana virgatipes	carpenter frog
Widespread Species	
Bufo woodhousei fowleri	Fowler's toad
Rana clamitans melanota	green frog
Rana utricularia	southern leopard frog
Nonnative Species	
Acris c. crepitans	northern cricket frog
Rana catesbeiana	bullfrog

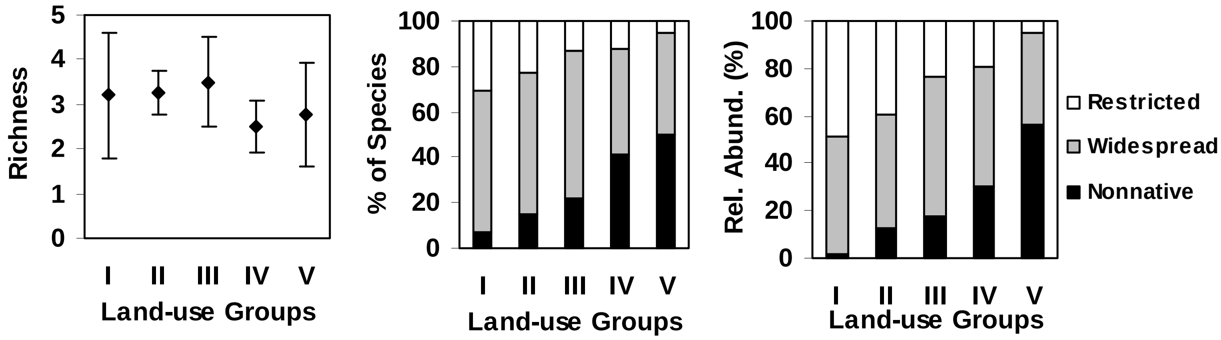

Figure 14. Mean (± 1 SD) anuran-species richness by land-use group and mean percentage biogeographic composition and relative abundance by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

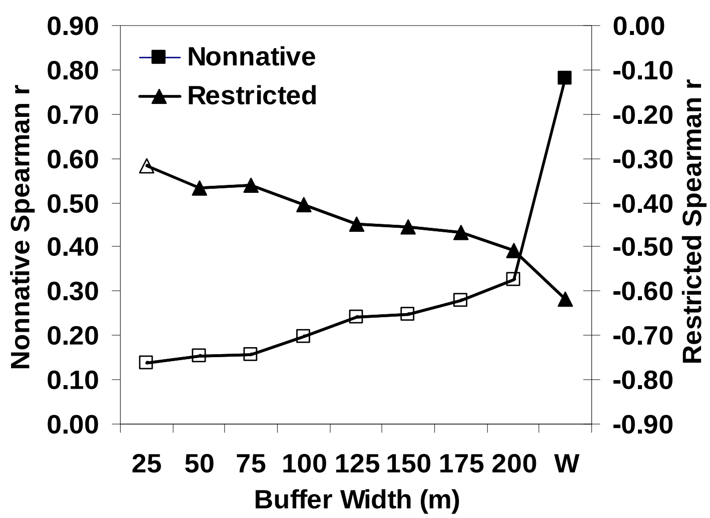

Figure 15. Spearman rank correlation (r) relating the percentage of nonnative-anuran species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Open symbols denote Spearman rank correlations that are not significant at an initial *p* value of 0.05.

Results of the MRPP analyses indicated an overall difference in both the presence-absence (*A* = 0.097, $p = 0.005$) and relative abundance (*A* = 0.101, $p = 0.013$) of anuran species between the five land-use groups. Post-hoc comparisons completed on anuran presence-absence data revealed differences between impoundment Group I and Groups IV (*A* = 0.102, $p = 0.006$*) and V (*A* = 0.120, $p = 0.001$**). Post-hoc comparisons of relative-abundance data indicated differences between land-use Groups I and V (*A* = 0.221, $p < 0.001$**) and between Group II and V (*A* = 0.116, $p = 0.020$*). Differences between impoundment groups revealed by the MRPP analysis of anuran relative abundance were associated with a contrast in the biogeography of anuran species identified through the indicator-species analysis (Table 16). Group I impoundments were characterized by two native-anuran indicator species, including the restricted carpenter frog and the widespread Fowler's toad, whereas the most heavily altered Group V impoundments were characterized by the nonnative bullfrog.

Table 15. Spearman rank correlation results between anuran-species attributes and watershed-disturbance variables. Biogeographic attributes include both the percentage of the total number of anuran species (% species) and the relative abundance of individuals (% individuals) classified as restricted, widespread, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 30.

	Altered Land			pH			Specific Conductance		
Attribute	r	*p*		r	*p*		r	*p*	
Species richness	-0.32	0.088		-0.29	0.118		-0.21	0.274	
% Restricted species	-0.62	<0.001	**	-0.64	<0.001	**	-0.39	0.031	*
% Widespread species	-0.24	0.194		-0.20	0.298		-0.09	0.622	
% Nonnative species	0.78	<0.001	**	0.74	<0.001	**	0.45	0.013	**
% Restricted individuals	-0.59	0.001	**	-0.65	<0.001	**	-0.44	0.014	*
% Widespread individuals	-0.03	0.866		0.02	0.923		0.17	0.381	
% Nonnative individuals	0.80	<0.001	**	0.81	<0.001	**	0.39	0.032	*

The restricted carpenter frog was heard calling from 16 impoundments and the nonnative bullfrog was heard at 20 impoundments. These two species were heard calling together at eight sites, including at least one impoundment from each of the five land-use groups. Carpenter frog larvae were collected from 12 impoundments and bullfrog larvae were found at 14 impoundments. Tadpoles were present only at sites where adults of the species were heard calling. Tadpoles of both species were found together at one Group IV impoundment and two Group V impoundments.

The frequency of occurrence of carpenter frog adults and larvae decreased, whereas the frequency of occurrence of bullfrog adults and larvae increased along the watershed-disturbance gradient represented by the five impoundment groups (Figure 16). Logistic regression results revealed a negative relationship between the percentage of upstream-altered land and the occurrence of carpenter frog adults ($p = 0.003$**) and tadpoles ($p = 0.046$**) and a positive relationship between upstream altered land and the occurrence of bullfrog adults ($p < 0.001$**) and tadpoles ($p < 0.001$**) (Figure 17). For both species, the predicted probability of hearing adults was higher than the predicted probability of finding larvae, but the adult and larval probabilities converged for each species as the percentage of upstream-altered land increased. The probability of encountering adult and larval carpenter frogs was about 10% for impoundments in the most degraded watersheds, whereas the probability of encountering adult and larval bullfrogs was nearly 100% at these sites.

Table 16. Biogeography of anuran species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

	Comparisons								
	All groups					I-V		II-V	
Biogeography	I	II	III	IV	V	I	V	II	V
Restricted	0	0	0	0	0	1	0	1	0
Widespread	0	0	1	0	0	1	0	1	0
Nonnative	0	0	0	0	2	0	1	0	1

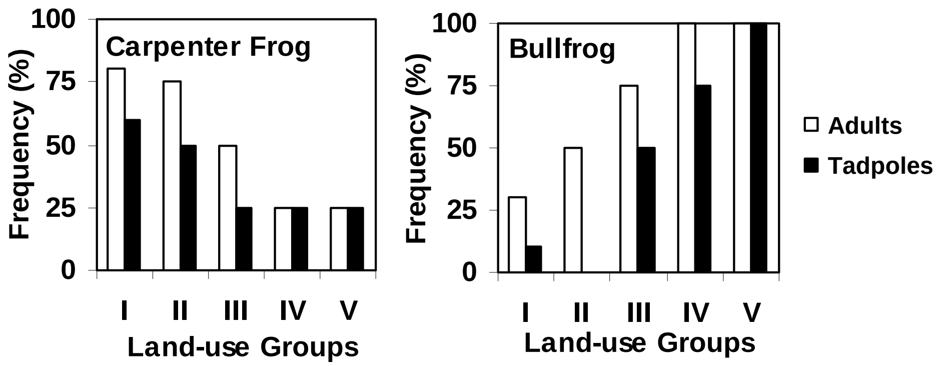

Figure 16. Frequency of occurrence of carpenter frog and bullfrog adults and tadpoles for five impoundment land-use groups. Refer to Table 1 for altered-land-percentage ranges associated with each land-use group.

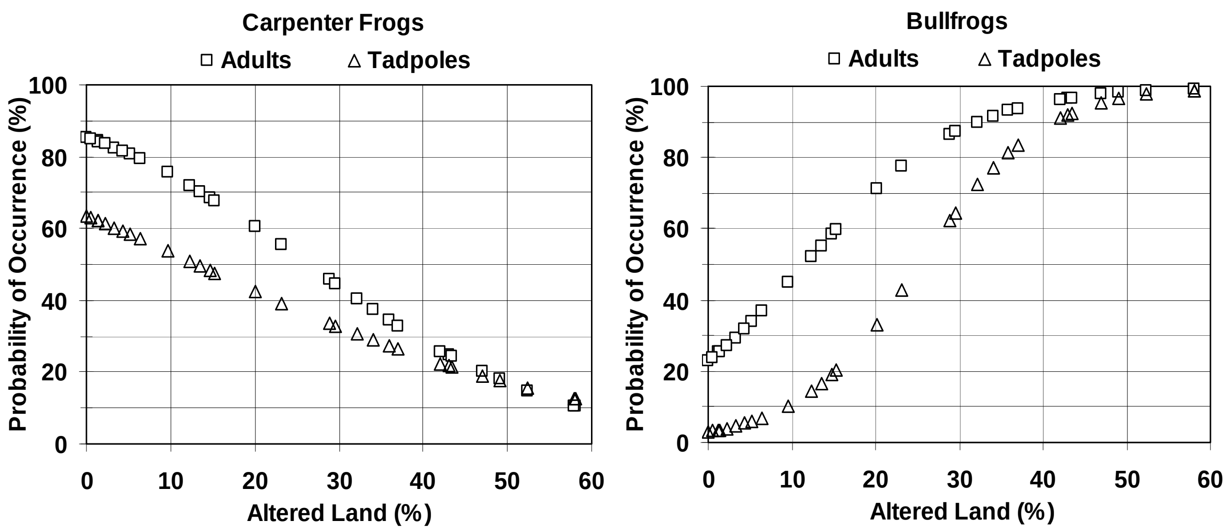

Figure 17. Logit curves describing the probability of encountering carpenter frog and bullfrog adults and tadpoles at varying percentages of upstream-altered land.

SUMMARY

Differences in water-quality and species-composition between land-use groups were most apparent when comparing impoundments in watersheds with less than 10% altered land and those in watersheds with ≥ 40% altered land (Table 17). Differences in community composition between impoundments in the least-altered watersheds and both Group IV (30-39.9% altered land) and Group V (≥ 40% altered land) impoundments were evident across taxonomic groups, suggesting that at least for the impoundments we studied, community-composition variables are more sensitive measures of degradation thresholds than either water-quality or species-richness measures.

Table 17. Summary of water-quality, species-richness, and species-composition variables that differed between land-use groups. Water-quality and species-richness results were based on Kruskal-Wallis ANOVAs. Species-richness results are due to differences in restricted-, widespread-, and/or nonnative-species richness. Species-composition results were based on MRPP analyses, with results based on fish-frequency and anuran-presence/absence data represented by open symbols and results based on fish- and anuran-relative-abundance data represented by closed symbols. Land-use-group comparisons are ordered according to the number of variables shown to differ. Refer to Table 1 for the range of altered-land percentages assigned to each group.

		Land-use Group Comparisons							
	Variables	I-V	I-IV	II-V	III-IV	III-V	I-III	I-II	IV-V
Water Quality	pH	■							
	Specific conductance	■		■					
	NO_3-N	■							
Species Richness	Herbaceous plants	■							■
	Woody plants	■							
	Fish	■					■		
	Anurans	■							
Species Composition	Herbaceous plants	■	■	■			■		
	Woody plants	■	■		■	■			
	Diatoms	■	■						
	Fish	□■	□■		□■	□		□	
	Anurans	□■	□	■					

The relationships between both biological-community and water-quality gradients and watershed-disturbance gradients were similar to those reported in other Pinelands studies (Zampella and Laidig 1997, Zampella and Bunnell 1998, Zampella et al. 2006a, 2006b, 2007a, 2007b). Specific conductance, pH, and NO_3-N thresholds were also similar to those reported by Zampella et al. (2007a) for streams in the Mullica River Basin. Unlike the present study, chloride and sulfate concentrations in the Mullica River Basin streams differed between different altered-land-use classes. The finding that the relationship between altered land and both pH and specific conductance did not improve when the proximity of altered land was considered is also similar to that reported by Zampella et al. (2007a).

The contrast in species composition between reference sites, represented by impoundments with less than 10% altered land in the associated watersheds, and the more highly altered impoundments was consistent across taxonomic groups. Restricted-native plant, fish, and anuran species, and diatoms more typical of acid waters, characterized the reference-site impoundments, whereas nonnative plant and animal species and diatoms typical of circumneutral and alkaline waters were associated with the more degraded impoundments.

The relationship between altered land and pH, specific conductance, and nonnative herbaceous-plant, fish, and anuran species was stronger when using watershed-wide land use rather than adjacent land use. Species richness was not a consistent indicator of watershed disturbance across all taxonomic groups.

Even though the contrast between land-use groups from opposite ends of the watershed-disturbance gradient was most evident, the correlation, logistic regression, and graphical analyses indicated that variations in environmental and biological conditions occurred along a disturbance gradient represented by an increase in the percentage of upstream-altered land associated with each impoundment. As Booth et al. (2002) indicated, although a progressive decline in biological conditions may be evident only in more heavily altered watersheds, significant degradation can occur at any level of disturbance, and biological indicators typically demonstrate a continuum of responses to human disturbance rather than a threshold response.

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LITERATURE CITED

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey Professional Paper 964.

Arnold, C. L. and C. J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. Journal of the American Planning Association 62:243-258.

Booth, D. B., D. Hartley, and R. Jackson. 2002. Forest cover, impervious-surface area, and the mitigation of stormwater impacts. Journal of the American Water Resources Association 38:835-845.

Carpenter, K. D. and I. R. Waite. 2000. Relations of habitat-specific algal assemblages to land use and water chemistry in the Willamette Basin, Oregon. Environmental Monitoring and Assessment 64:247-257.

Carpenter, S. R., N. F. Caraco, D. L. Correll, R. W. Howarth, A. N. Sharpley, and V. H. Smith. 1998. Nonpoint pollution of surface waters with phosphorus and nitrogen. Ecological Applications 8:559-568.

Charles D. F. 1985. Relationships between surface sediment diatom assemblages and lakewater characteristics in Adirondack lakes. Ecology 66:994-1011.

Conant, R. 1979. A zoogeographical review of the amphibians and reptiles of southern New Jersey, with emphasis on the Pine Barrens. Pages 467-488 *in* R.T.T. Forman, editor. Pine Barrens: ecosystem and landscape. Academic Press, New York, New York, USA.

Conant, R. and J. T. Collins. 1998. A field guide to reptiles and amphibians of eastern and central North America, 3rd Edition. Houghton Mifflin Co., Boston, Massachusetts, USA.

Dixit, S. S., J. P. Smol, D. F. Charles, R. M. Hughes, S. G. Paulsen, and G. B. Collins. 1999. Assessing water quality changes in the lakes of the northeastern United States using sediment diatoms. Canadian Journal of Fisheries and Aquatic Sciences 56:131-152.

Dow, C. L. and R. A. Zampella. 2000. Specific conductance and pH as indicators of watershed disturbance in streams of the New Jersey Pinelands, USA. Environmental Management 26:437-445.

Dufrêne, M. and P. Legendre. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs 67:345-366.

Gleason, H. A. and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, 2nd Edition. New York Botanical Garden, Bronx, New York, USA.

Hastings, R.W. 1984. The fishes of the Mullica River, a naturally acid water system of the New Jersey Pine Barrens. Bulletin of the New Jersey Academy of Science 29:9-23.

Herlihy, A. T., J. L. Stoddard, and C. B. Johnson. 1998. The relationship between stream chemistry and watershed land cover data in the Mid-Atlantic Region, U.S. Water, Air, and Soil Pollution 105:377-386.

Johnson, L. B., C. Richards, G. E. Host, and J. W. Arthur. 1997. Landscape influences on water chemistry in midwestern stream ecosystems. Freshwater Biology 37:193-208.

Klein, R. D. 1979. Urbanization and stream quality impairment. Water Resources Bulletin 15: 948-963.

Leland, H. V. and S. D. Porter. 2000. Distribution of benthic algae in the upper Illinois River basin in relation to geology and land use. Freshwater Biology 44:279-301.

Lenat, D. R. and J. K. Crawford. 1994. Effects of land use on water quality and aquatic biota of three North Carolina Piedmont streams. Hydrobiologia 294:185-199.

Lowe, R. L. 1974. Environmental requirements and pollution tolerance of freshwater diatoms. EP A-670/4-74-005. U. S. Environmental Protection Agency, Cincinnati, Ohio, USA.
May, C. W., R. R. Horner, J. R. Karr, B. W. Mar, and E. B. Welch. 1997. Effects of urbanization on small streams in the Puget Sound ecoregion. Watershed Protection Techniques 2:483-494.
McCune, B. and M. J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, Version 4. MjM Software Design, Gleneden Beach, Oregon, USA.
McCune, B. and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, Oregon, USA.
Meriläinen, J. 1967. The diatom flora and the hydrogen-ion concentration of the water. Annales Botanici Fennici 4:51-58.
Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, Inc., New York, New York, USA.
New Jersey Division of Fish and Game. 1950. Fisheries survey report no. 1. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
New Jersey Division of Fish and Game. 1951. Fisheries survey report no. 2. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
New Jersey Division of Fish and Game. 1957. Fisheries Survey Report no. 3. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
Osborne, L. L. and M. J. Wiley. 1988. Empirical relationships between land use/cover and stream water quality in an agricultural watershed. Journal of Environmental Management 26:9-27.
Page, L. M. and B. M. Burr. 1991. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Co., New York, New York, USA.
Patrick, R. 1996. Rivers of the United States. Volume III: the eastern and southeastern states. John Wiley and Sons, Inc., New York, New York, USA.
Patrick, R., B. Matson, and L. Anderson. 1979. Streams and lakes in the Pine Barrens. Pages 169-193 *in* R.T.T. Forman, editor. Pine Barrens: ecosystem and landscape. Academic Press, New York, New York, USA.
Rhodes, A. L., R. M. Newton, and A. Pufall. 2001. Influences of land use on water quality of a diverse New England watershed. Environmental Science and Technology 35:3640-3645.
Rice, W. R. 1989. Analyzing tables of statistical tests. Evolution 43:223-225.
Rice, W. R. 1990. A consensus combined p-value test and family-wide significance of component tests. Biometrics 46:303-308.
Siegel, S. and N. J. Castellan, Jr. 1988. Nonparametric statistics for the behavioral sciences. Second Edition. McGraw-Hill Inc., New York, New York, USA.
Sliva, L. and D. D. Williams. 2001. Buffer zone versus whole catchment approaches to studying land use impact on river water quality. Water Research 35:3462-3472.
Standard Methods for the Examination of Water and Wastewater. 1998. 20th Edition. American Public Health Association, American Water Works Association, Water Environment Federation, Washington D.C., USA.
Steedman, R. J. 1988. Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario. Canadian Journal of Fisheries and Aquatic Sciences 45:492-501.
Stepenuck, K. F., R. L. Crunkilton and L. Wang. 2002. Impacts of urban landuse on macroinvertebrate communities in southeastern Wisconsin streams. Journal of the American Water Resources Association 38:1041-1051.
Stone, W. 1911. The plants of southern New Jersey. Report of the New Jersey State Museum 1910. Trenton, New Jersey, USA.

Tufford, D. L., C. L. Samarghitan, H. N. Mckellar, Jr., D. E. Porter, and J. R. Hussey. 2003. Impacts of urbanization on nutrient concentrations in small southeastern coastal streams. Journal of the American Water Resources Association 39:301-312.

van Dam, H., A. Mertens, and J. Sinkeldam. 1994. A coded checklist and ecological indicator values of freshwater diatoms from The Netherlands. Netherlands Journal of Aquatic Ecology 28:117-133.

Wacker, P. O. 1979. Human exploitation of the New Jersey Pine Barrens before 1900. Pine Barrens: ecosystem and landscape. Pages 3-23 *in* R.T.T. Forman, editor. Pine Barrens: ecosystem and landscape. Academic Press, New York, New York, USA.

Waite, I. R., and K. D. Carpenter. 2000. Associations among fish assemblage structure and environmental variables in Willamette Basin Streams, Oregon. Transactions of the American Fisheries Society 129:754-770.

Wang, L., J. Lyons, P. Kanehl, and R. Gatti. 1997. Influences of watershed land use on habitat quality and biotic integrity in Wisconsin streams. Fisheries 22:6-12.

Zampella, R. A. 1994. Characterization of surface water quality along a watershed disturbance gradient. Water Resources Bulletin 30:605-611.

Zampella, R. A. and J. F. Bunnell. 1998. Use of reference-site fish assemblages to assess aquatic degradation in Pinelands streams. Ecological Applications 8:645-658.

Zampella, R. A. and J. F. Bunnell. 2000. The distribution of anurans in two river systems of a Coastal Plain watershed. Journal of Herpetology 34:210-221.

Zampella, R. A. and K. J. Laidig. 1997. Effect of watershed disturbance on Pinelands stream vegetation. Journal of the Torrey Botanical Society 124:52-66.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin: a report to the Pinelands Commission on the status of the landscape and selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2003. The Rancocas Creek Basin: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2005. The Great Egg Harbor River Watershed Management Area: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2006a. Using multiple indicators to evaluate the ecological integrity of a coastal plain stream system. Ecological Indicators 6:644-663.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2006b. The Barnegat Bay Watershed: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.

Zampella, R. A., N. A. Procopio, R. G. Lathrop, and C. L. Dow. 2007a. Relationship of land-use/land-cover patterns and surface-water quality in the Mullica River Basin. Journal of the American Water Resources Association 43:594-604.

Zampella, R. A., K. J. Laidig, and R. L. Lowe. 2007b. Distribution of diatoms in relation to land use and pH in blackwater Coastal Plain streams. Environmental Management 39:369-384.

Appendix 1. Site-location information for 43 impoundments in the New Jersey Pinelands. An asterisk next to the site code denotes the 13 impoundments that were not selected for biological surveys. With one exception (HHOCUSHM), site codes match those used in previous Pinelands Commission reports. Latitude, longitude, and USGS 7.5 minute topographic quadrangle names are in parentheses. Latitude and longitude represent the water-quality sampling points. Sites are ordered alphabetically by impoundment name.

Impoundment Name and Description	Site Code
Atco Lake Waterford Twp., Camden Co. (lat 39°45'32.42", long 74°53'00.58", Clementon quad).	MHAATCOL*
Atsion Lake Waterford Twp., Camden Co. (lat 39°44'25.42", long 74°43'35.57", Atsion quad).	MMUATSIO
Bamber Lake Lacey Twp., Ocean Co. (lat 39°53'50.25", long 74°18'58.63", Keswick Grove quad).	CCEBAMBR
Batsto Lake Washington Twp., Burlington Co. (lat 39°38'31.50", long 74°38'59.62", Atsion quad).	BBATLAKE
Breeches Branch Impoundment Washington Twp., Burlington Co. (lat 39°44'04.20", long 74°29'31.47", Oswego Lake quad).	OBRESTRM*
Cedar Lake Buena Vista Twp., Atlantic Co. (lat 39°35'07.29", long 74°54'06.21", Buena quad).	HMAJACKS*
Centennial Lake Medford Twp., Burlington Co. (lat 39°50'31.91", long 74°50'58.25", Medford Lakes quad).	WHACENTL*
Chatsworth Lake Woodland Twp., Burlington Co. (lat 39°48'51.99", long 74°32'49.34", Chatsworth quad).	WWE532LK
Country Lake Pemberton Twp., Burlington Co. (lat 39°56'48.68", long 74°33'20.12", Browns Mills quad).	GPOWISSA
Cranes Lake Monroe Twp., Gloucester Co. (lat 39°37'14.09", long 74°55'37.29", Buena quad).	HHORT538
Cushman Lake Folsom Boro, Gloucester Co. (lat 39°35'44.03", long 74°52'00.64", Newtonville quad).	HHOCUSHM
Davenport Impoundment Lacey Twp., Ocean Co. (lat 39°55'35.97", long 74°20'17.97", Keswick Grove quad).	RDALACEL
Diamond Lake Monroe Twp., Gloucester Co. (lat 39°36'42.06", long 74°55'08.27", Buena quad).	HHODIAMO*
Egg Harbor City Lake Egg Harbor City Twp., Atlantic Co. (lat 39°33'33.20", long 74°36'24.18", Green Bank quad)	LINLAKEU
Hammonton Lake Hammonton Twp., Atlantic Co. (lat 39°37'51.67", long 74°46'16.13", Hammonton quad).	LHAMLAKE
Harrisville Pond Washington/Bass River Twp., Burlington Co. (lat 39°39'48.45", long 74°31'24.44", Jenkins quad).	OOSHARLK*
Horicon Lake Lakehurst Twp., Ocean Co. (lat 40°00'34.82", long 74°19'06.74", Lakehurst quad).	TUNHORIC
Howardsville Impoundment Barnegat Twp., Ocean Co. (lat 39°49'01.34", long 74°21'59.93", Brookville quad).	OOSHOWIM
Indian Mills Lake Shamong Twp., Burlington Co. (lat 39°47'41.70", long 74°44'29.73", Indian Mills quad).	BMULAKED
Jennings Lake Evesham Twp., Burlington Co. (lat 39°51'56.45", long 74°53'40.96", Clementon quad).	WBAJENNL
Kettle Run Impoundment Medford Twp., Burlington Co. (lat 39°49'05.01", long 74°51'40.11", Medford Lakes quad).	WKEGIRLS
Lady's Lake Waterford/Medford Twp., Camden/Burlington Co. (lat 39°47'09.39", long 74°51'36.53", Medford Lakes quad).	MMULADYL
Lake Absegami Bass River Twp., Burlington Co. (lat 39°37'37.79", long 74°25'54.80", New Gretna quad).	AEAABSDW

Impoundment Name and Description	Site Code
Lake Albert Buena Vista Twp., Atlantic Co. (lat 39°35'25.42", long 74°51'46.62", Newtonville quad).	HMAALBER
Lake Fred Galloway Twp., Atlantic Co. (lat 39°29'44.82", long 74°31'40.83", Green Bank quad).	LMOSTOCK
Lake Pine Medford Twp., Burlington Co. (lat 39°51'59.41", long 74°50'53.73", Medford Lakes quad).	WHAPINEL*
Manahawkin Lake Stafford Twp., Ocean Co. (lat 39°41'46.62", long 74°15'35.91", West Creek quad).	MMIMANAH*
Maple Lake Estell Manor City, Atlantic Co. (lat 39°24'19.58", long 74°46'35.54", Dorothy quad).	LSTMAPLE
Mimosa Lake Medford Twp., Burlington Co. (lat 39°50'42.31", long 74°50'45.59", Medford Lakes quad).	WHATRPON
Mount Misery Impoundment Pemberton Twp., Burlington Co. (lat 39°55'44.97", long 74°31'52.13", Browns Mills quad).	GMOUCAMP*
Oswego Lake Washington/Bass River Twp., Burlington Co. (lat 39°44'04.11", long 74°29'31.46", Oswego Lake quad).	OOSWLAKE
Pakim Pond Woodland Twp., Burlington Co. (lat 39°52'51.98", long 74°31'56.83", Browns Mills quad).	GCOPAKIM
Paradise Lake Hammonton Twp., Atlantic Co. (lat 39°41'05.64", long 74°43'35.56", Atsion quad).	NALPARAD
Pilgrim Lake Bass River Twp., Burlington Co. (lat 39°37'27.38", long 74°26'45.22", New Gretna quad).	AWEPILGL
Presidential Lake Pemberton Twp., Burlington Co. (lat 39°54'38.13", long 74°34'41.00", Browns Mills quad).	GBIPRESD*
Shadow Lake Shamong Twp., Burlington Co. (lat 39°48'22.73", long 74°46'12.31", Medford Lakes quad)	BINSHADW
Success Lake Jackson Twp., Ocean Co. (lat 40°03'31.48", long 74°23'29.58", Cassville quad).	TSHSUCCE
Sunset Lake Monroe Twp., Gloucester Co. (lat 39°38'05.30", long 74°57'51.84", Williamstown quad).	HWHSUNSL
Taunton Lake Medford Twp., Burlington Co. (lat 39°51'10.24", long 74°51'14.50", Medford Lakes quad).	WHATAUNT*
Timber Lakes - lower Monroe Twp., Gloucester Co. (lat 39°38'18.14", long 74°56'53.92", Williamstown quad).	HHOWHITE*
Turn Mill Pond Jackson Twp., Ocean Co. (lat 40°03'39.84", long 74°26'23.36", Cassville quad).	TSHTURNL
Victory Lake Monroe Twp., Gloucester Co. (lat 39°38'02.01", long 74°56'59.82", Williamstown quad).	HWHWHITE*
Wells Mills Lake Ocean Twp., Ocean Co. (lat 39°47'37.26", long 74°16'34.74", Brookville quad).	COYWELLS

Appendix 2. Environmental variables for 30 impoundments in the New Jersey Pinelands. Specific conductance and pH were measured during 2003-2005. Plants, fish, and anurans were sampled at all 30 impoundments. An "x" indicates impoundments where diatoms and nutrients were also sampled. Impoundments are ordered by increasing percentage of altered land within each land-use group. Altered land represents the combined percentages of developed land and upland agriculture. Refer to Table 1 for the range of altered-land percentages assigned to each group and Appendix 1 for impoundment-site descriptions.

Site Name	Land-use Group	Developed Land (%)	Upland Agriculture (%)	Altered Land (%)	Lake Area (ha)	Median pH	Median Specific Conductance ($\mu S\ cm^{-1}$)	Mean Water Depth (cm)	Mean Frequency of Occurrence of Sand (%)	Median Emergent-cover Rank	Median Floating-cover Rank	Median Submerged-cover Rank	Diatoms	Nutrients
Howardsville Imp.	I	0.0	0.0	0.0	5.7	4.38	45.9	30.1	81.1	0.0	0.0	5.0		
Pilgrim Lake	I	0.4	0.2	0.6	8.6	4.58	35.2	42.3	75.6	1.0	0.0	5.0	x	x
Bamber Lake	I	0.8	0.5	1.3	24.4	4.76	30.2	45.5	64.4	0.0	2.0	5.0	x	x
Oswego Lake	I	1.0	0.4	1.4	44.2	4.42	40.0	41.6	60.0	2.0	0.5	0.0		x
Pakim Pond	I	2.2	0.0	2.2	1.8	4.14	51.5	49.6	53.3	1.5	0.0	1.5		
Lake Absegami	I	3.3	0.0	3.3	21.3	4.40	80.0	34.1	100.0	2.0	0.0	0.0	x	x
Wells Mills Lake	I	4.0	0.4	4.4	9.6	4.68	52.7	38.9	58.9	1.0	0.0	3.0	x	x
Chatsworth Lake	I	2.9	2.3	5.2	34.0	4.31	52.1	37.1	90.0	2.0	0.0	0.0	x	x
Horicon Lake	I	5.7	0.7	6.4	24.0	4.34	57.6	56.9	53.3	0.0	0.3	3.5	x	x
Country Lake	I	8.0	1.6	9.6	16.3	4.48	58.5	26.8	93.3	0.0	0.0	0.0	x	x
Atsion Lake	II	9.5	2.8	12.3	41.3	4.69	53.3	46.9	91.1	0.0	0.0	2.0	x	x
Maple Lake	II	11.1	2.4	13.5	12.4	5.98	38.2	49.6	88.9	1.0	0.0	3.0		
Batsto Lake	II	5.4	9.3	14.7	27.4	5.54	47.2	37.9	86.7	3.0	0.5	1.5		x
Success Lake	II	6.7	8.6	15.3	23.6	4.49	55.5	29.6	63.3	0.5	0.0	0.0	x	x
Egg Harbor City Lake	III	11.0	9.1	20.1	7.3	4.29	62.0	21.5	96.7	0.0	0.0	5.0		x
Mimosa Lake	III	23.0	0.2	23.2	2.9	5.78	57.1	60.1	100.0	0.0	0.0	3.0		
Lake Fred	III	13.4	15.5	28.9	15.1	5.72	74.9	28.5	74.4	0.3	0.5	5.0	x	x
Kettle Run Imp.	III	27.7	1.9	29.6	4.1	6.12	77.9	45.3	75.6	0.0	2.0	1.5	x	x
Lake Albert	IV	7.6	24.6	32.2	7.7	6.22	49.5	44.1	93.3	0.5	0.0	0.5	x	x
Cushman Lake	IV	18.9	15.1	34.0	26.8	6.26	56.8	33.9	97.8	0.0	0.0	1.0	x	x
Davenport Imp.	IV	35.1	0.8	35.9	9.9	4.84	69.5	45.9	68.9	0.5	1.0	1.5		
Turn Mill Pond	IV	13.1	23.9	37.0	27.5	6.27	84.1	37.0	76.7	0.0	0.5	4.0	x	x
Shadow Lake	V	28.7	13.4	42.1	3.5	6.03	87.3	47.8	28.9	0.3	0.5	2.0	x	x
Paradise Lake	V	18.8	24.2	43.0	8.9	6.17	76.8	56.6	21.1	1.5	0.0	2.0	x	x
Sunset Lake	V	25.3	18.1	43.4	19.4	6.65	53.3	40.2	76.7	1.5	0.0	1.5	x	x
Cranes Lake	V	24.3	22.7	47.0	15.3	6.63	61.8	39.7	93.3	1.5	2.0	4.5	x	x
Lady's Lake	V	42.2	6.9	49.1	4.6	6.63	164.2	46.4	66.7	0.0	0.5	5.0		
Jennings Lake	V	50.8	1.6	52.4	1.2	6.78	173.7	43.0	1.7	1.0	1.0	5.0	x	x
Indian Mills Lake	V	23.8	34.2	58.0	13.2	6.57	214.5	47.7	5.6	0.0	4.5	0.0	x	x
Hammonton Lake	V	52.3	5.8	58.1	24.8	6.64	121.5	39.1	91.1	0.0	0.0	5.0		x

Appendix 3. Water-quality data for 43 impoundments in the New Jersey Pinelands. With four exceptions, water-quality sampling occurred at the outflow of the impoundments. For the four exceptions, sampling occurred at the outflow of the lower Egg Harbor City Lake, at the inflow of Oswego Lake, downstream from Mount Misery Lake at Route 70, and downstream from Pilgrim Lake at Stage Road. For water-quality variables, SC = specific conductance, D.O. = dissolved oxygen, DOC = dissolved organic carbon, NO_2-N = nitrite as nitrogen, NO_3-N = nitrate as nitrogen, PO_4-P = orthophosphate as phosphorus, SO_4-S = sulphate as sulphur, and Cl = chloride. Values below detection limits (NO_2-N = 0.05 mg L^{-1}, NO_3-N = 0.03 mg L^{-1}, and PO_4-P = 0.05 mg L^{-1}) are noted with ND. Refer to Appendix 1 for impoundment-site descriptions.

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Atco Lake	04/28/03	13:10	6.31	164.4			21.7						
Atco Lake	05/19/03	13:40	6.60	169.0			20.3						
Atco Lake	06/24/03	13:15	6.08	137.0			27.2						
Atco Lake	07/15/03	12:10	6.35	126.0			24.8						
Atco Lake	08/25/03	12:15	6.68	147.8			24.5						
Atco Lake	10/21/03	9:30	6.31	152.3			14.0						
Atco Lake	03/23/04	12:50	6.51	192.0			10.6						
Atco Lake	04/19/04	13:40	6.63	164.3			23.9						
Atco Lake	05/10/04	13:50	6.57	158.5			26.6						
Atco Lake	06/08/04	14:00	6.39	156.1			28.3						
Atco Lake	08/19/04	13:50	6.48	159.8			27.8						
Atco Lake	09/13/04	13:20	6.37	146.7			26.4						
Atco Lake	10/12/04	12:54	6.14	141.5			15.4						
Atco Lake	03/21/05	12:35	6.30	223.0			11.2						
Atco Lake	04/19/05	12:15	6.34	174.6			20.6						
Atco Lake	05/09/05	12:55	6.36	166.2			22.1						
Atco Lake	06/13/05	13:10	6.52	154.4			29.5						
Atco Lake	07/12/05	13:04	6.71	152.9			31.0						
Atco Lake	08/17/05	13:41	6.65	156.4			28.5						
Atco Lake	09/06/05	13:32	6.58	156.2			25.2						
Atsion Lake	04/29/03	10:25	4.54	61.1			18.5						
Atsion Lake	05/20/03	10:25	4.61	55.3			16.4						
Atsion Lake	06/25/03	9:45	4.21	49.0			25.6						
Atsion Lake	07/14/03	10:45	4.73	43.0			25.0						
Atsion Lake	08/21/03	10:35	4.73	51.7			27.1						
Atsion Lake	10/20/03	15:05	4.79	45.9			15.4						
Atsion Lake	03/23/04	15:30	4.53	66.0			7.9						
Atsion Lake	04/19/04	11:00	4.88	65.4			17.8						
Atsion Lake	05/10/04	11:00	4.64	57.2			19.8						
Atsion Lake	06/08/04	10:50	4.86	52.4			24.1						
Atsion Lake	08/19/04	10:37	4.38	54.2			23.3						
Atsion Lake	09/13/04	10:35	4.51	47.8			22.5						
Atsion Lake	10/12/04	10:25	4.61	44.2			14.5						
Atsion Lake	03/21/05	10:19	4.59	58.3			9.3						
Atsion Lake	04/19/05	15:45	4.73	56.3			18.6						
Atsion Lake	05/09/05	10:36	4.76	55.3			15.6						
Atsion Lake	06/13/05	10:33	4.65	51.9			26.6						
Atsion Lake	07/12/05	10:23	4.80	55.6			25.6						
Atsion Lake	08/17/05	10:21	4.92	48.8			24.7						
Atsion Lake	09/06/05	11:05	5.09	45.1			22.6						
Atsion Lake	04/18/06	11:11	4.97	56.6	9.16	94.2	17.0						
Atsion Lake	05/10/06	10:01	4.77	49.6	8.52	89.0	17.5						
Atsion Lake	06/19/06	11:11	4.87	35.5	6.11	78.6	26.5	9.3	ND	0.079	ND	1.00	6.65
Atsion Lake	07/19/06	10:00	4.45	56.1	7.42	88.8	27.1						
Atsion Lake	08/14/06	11:07	4.62	47.7	5.25	62.5	24.7	33.5	ND	0.067	ND	1.39	8.28
Atsion Lake	09/20/06	10:10	4.08	64.5	7.38	78.4	19.8						
Atsion Lake	10/16/06	10:38	4.36	49.8	8.48	75.1	12.1	8.5	ND	0.038	ND	0.99	6.44
Atsion Lake	11/20/06	10:05	3.89	53.3	9.59	81.7	9.8						
Atsion Lake	12/04/06	10:58	4.43	52.0	9.70	96.6	8.3	9.9	ND	0.092	ND	1.35	7.13
Bamber Lake	04/30/03	11:45	4.63	33.8			16.5						
Bamber Lake	05/21/03	11:40	5.72	31.3			16.4						
Bamber Lake	06/26/03	13:00	4.27	29.0			24.9						
Bamber Lake	07/16/03	14:10	3.95	24.0			23.1						
Bamber Lake	08/22/03	10:35	4.78	33.9			24.3						
Bamber Lake	10/20/03	10:30	4.83	32.9			11.3						
Bamber Lake	03/24/04	10:50	4.39	31.0			6.4						
Bamber Lake	04/20/04	15:00	4.59	36.4			19.7						
Bamber Lake	05/11/04	15:10	4.82	30.0			24.3						
Bamber Lake	06/10/04	13:00	4.91	28.0			25.4						
Bamber Lake	08/20/04	14:15	4.57	41.9			28.0						
Bamber Lake	09/14/04	14:20	5.05	22.1			22.4						
Bamber Lake	10/13/04	14:47	5.07	25.1			15.0						
Bamber Lake	03/22/05	14:20	4.72	27.8			9.8						
Bamber Lake	04/20/05	13:15	4.64	33.1			17.5						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Bamber Lake	05/10/05	14:28	4.73	30.3			17.8						
Bamber Lake	06/14/05	12:31	4.98	29.8			27.6						
Bamber Lake	07/13/05	13:08	4.64	32.8			25.1						
Bamber Lake	08/18/05	14:15	5.03	25.5			25.3						
Bamber Lake	09/07/05	12:27	5.72	29.0			22.2						
Bamber Lake	04/19/06	12:25	4.82	25.5	9.47	98.3	16.7						
Bamber Lake	05/11/06	11:41	5.04	22.2	8.65	89.9	16.6						
Bamber Lake	06/20/06	12:31	5.00	19.3	8.21	87.2	24.9	3.8	ND	ND	ND	0.48	3.31
Bamber Lake	07/20/06	12:20	4.98	25.4	8.01	83.2	26.9						
Bamber Lake	08/15/06	12:40	4.92	23.0	8.13	93.5	23.3	4.0	ND	ND	ND	0.54	4.48
Bamber Lake	09/21/06	12:26	4.86	38.8	7.94	78.3	17.2						
Bamber Lake	10/17/06	9:06	4.67	34.3	9.07	83.7	11.0	6.5	ND	ND	ND	0.68	4.07
Bamber Lake	11/21/06	12:25	3.98	35.6	9.01	93.2	8.3						
Bamber Lake	12/05/06	12:10	4.34	36.1	8.65	70.3	5.4	6.3	ND	ND	ND	0.91	3.99
Batsto Lake	04/29/03	15:00	4.75	52.1			17.2						
Batsto Lake	05/20/03	13:50	5.83	45.8			15.7						
Batsto Lake	06/25/03	12:35	4.65	41.0			22.4						
Batsto Lake	07/14/03	13:35	5.51	33.0			22.2						
Batsto Lake	08/21/03	13:45	5.87	50.3			24.1						
Batsto Lake	10/20/03	14:30	5.56	38.6			13.3						
Batsto Lake	03/24/04	14:30	4.54	60.0			6.8						
Batsto Lake	04/20/04	10:50	4.08	57.5			18.5						
Batsto Lake	05/11/04	11:25	5.62	52.2			20.9						
Batsto Lake	06/09/04	14:00	5.88	42.7			23.0						
Batsto Lake	08/20/04	10:12	5.12	51.3			23.1						
Batsto Lake	09/14/04	11:05	5.48	44.6			19.8						
Batsto Lake	10/13/04	11:00	5.40	37.0			13.1						
Batsto Lake	03/22/05	11:05	5.34	50.8			8.8						
Batsto Lake	04/20/05	9:25	4.55	52.1			15.9						
Batsto Lake	05/10/05	10:51	5.67	47.6			16.0						
Batsto Lake	06/14/05	9:02	5.83	46.8			24.4						
Batsto Lake	07/13/05	9:21	5.60	66.7			23.8						
Batsto Lake	08/17/05	16:00	5.92	46.2			23.6						
Batsto Lake	09/07/05	8:35	5.77	32.2			17.8						
Batsto Lake	04/18/06	13:55	5.61	38.0	8.94	90.2	15.9						
Batsto Lake	05/10/06	13:33	6.11	34.9	8.91	89.5	16.8						
Batsto Lake	06/20/06	9:11	5.93	30.5	8.08	93.5	23.2	5.4	ND	0.239	ND	0.89	5.31
Batsto Lake	07/19/06	13:35	5.77	41.2	7.83	79.8	28.9						
Batsto Lake	08/14/06	14:47	6.33	27.0	6.45	78.4	20.8	5.6	ND	0.084	ND	0.95	4.67
Batsto Lake	09/20/06	13:58	4.45	51.2	7.65	73.8	17.2						
Batsto Lake	10/16/06	14:55	4.50	54.1	8.75	86.6	10.4	7.8	ND	0.086	ND	1.65	6.98
Batsto Lake	11/20/06	13:40	4.13	54.1	9.32	98.1	9.5						
Batsto Lake	12/04/06	10:11	4.83	52.6	9.55	78.7	7.3	9.0	ND	0.193	ND	1.58	6.48
Breeches Branch Imp.	05/21/03	13:50	4.66	48.2			17.3						
Breeches Branch Imp.	06/26/03	15:25	4.05	39.0			31.2						
Breeches Branch Imp.	07/16/03	11:40	3.11	35.0			19.5						
Breeches Branch Imp.	08/22/03	12:50	4.25	43.9			29.2						
Breeches Branch Imp.	10/20/03	12:35	4.34	42.3			14.2						
Breeches Branch Imp.	03/24/04	13:15	4.12	49.0			9.9						
Breeches Branch Imp.	04/20/04	12:30	4.15	51.7			21.4						
Breeches Branch Imp.	05/11/04	12:52	4.30	44.4			26.0						
Breeches Branch Imp.	06/10/04	9:20	4.74	34.9			25.3						
Breeches Branch Imp.	08/20/04	11:43	4.36	45.1			27.8						
Breeches Branch Imp.	09/14/04	12:05	4.42	37.6			23.7						
Breeches Branch Imp.	10/13/04	12:20	4.30	42.6			15.7						
Breeches Branch Imp.	03/22/05	12:05	4.18	45.1			11.2						
Breeches Branch Imp.	04/20/05	11:10	4.08	49.7			18.2						
Breeches Branch Imp.	05/10/05	12:14	4.30	42.1			19.5						
Breeches Branch Imp.	06/14/05	10:14	4.29	41.7			28.6						
Breeches Branch Imp.	07/13/05	10:28	4.33	43.8			26.3						
Breeches Branch Imp.	08/18/05	11:20	4.31	44.7			25.3						
Breeches Branch Imp.	09/07/05	9:46	4.55	40.3			22.1						
Breeches Branch Imp.	04/19/06	10:26	4.30	38.3	8.53	87.5	17.0						
Breeches Branch Imp.	05/11/06	10:00	4.38	37.6	7.45	81.4	18.0						
Breeches Branch Imp.	06/20/06	10:58	4.36	27.7	5.85	70.9	27.2	5.4	ND	ND	ND	0.80	3.31
Breeches Branch Imp.	07/20/06	10:40	4.25	40.1	6.89	77.9	28.0						
Breeches Branch Imp.	08/15/06	11:14	4.16	37.3	7.48	91.9	24.9	4.8	ND	ND	ND	1.41	4.56
Breeches Branch Imp.	09/21/06	10:46	4.18	45.3	6.55	74.3	18.3						
Breeches Branch Imp.	10/16/06	13:10	4.25	44.6	6.78	80.5	16.8	9.5	ND	ND	ND	0.88	4.54
Breeches Branch Imp.	11/21/06	10:45	3.75	50.1	7.89	87.9	9.0						
Breeches Branch Imp.	12/05/06	9:50	3.87	48.9	7.39	58.2	5.7	14.3	ND	ND	ND	0.83	3.63

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Cedar Lake	04/28/03	14:45	5.02	57.4			22.0						
Cedar Lake	05/19/03	15:10	5.53	54.9			21.6						
Cedar Lake	06/24/03	14:30	4.91	41.0			26.8						
Cedar Lake	07/15/03	13:50	5.61	43.0			26.6						
Cedar Lake	08/25/03	13:50	6.23	63.7			28.6						
Cedar Lake	10/21/03	13:00	5.94	50.1			15.3						
Cedar Lake	03/23/04	14:15	5.46	49.0			9.4						
Cedar Lake	04/19/04	14:50	5.71	50.0			22.5						
Cedar Lake	05/10/04	14:55	6.04	49.4			25.2						
Cedar Lake	06/09/04	11:15	5.97	51.7			24.3						
Cedar Lake	08/19/04	15:44	6.11	55.8			26.4						
Cedar Lake	09/13/04	14:40	6.06	53.3			23.2						
Cedar Lake	10/12/04	14:10	6.10	50.6			15.6						
Cedar Lake	03/21/05	13:50	5.79	58.1			9.9						
Cedar Lake	04/19/05	13:25	6.25	54.5			19.0						
Cedar Lake	05/09/05	14:14	6.24	58.0			20.8						
Cedar Lake	06/13/05	14:20	6.35	61.4			27.5						
Cedar Lake	07/12/05	14:10	6.10	51.4			27.3						
Cedar Lake	08/17/05	14:49	6.52	56.5			25.4						
Cedar Lake	09/06/05	14:44	6.76	59.8			23.9						
Centennial Lake	04/28/03	11:40	4.95	72.7			17.7						
Centennial Lake	05/19/03	11:35	5.71	70.9			14.7						
Centennial Lake	06/24/03	12:15	4.73	56.0			20.9						
Centennial Lake	07/15/03	11:20	5.58	55.0			25.0						
Centennial Lake	08/25/03	11:35	6.73	81.2			24.7						
Centennial Lake	10/21/03	10:10	6.15	68.2			15.2						
Centennial Lake	03/23/04	10:30	4.73	63.0			7.0						
Centennial Lake	04/19/04	12:40	4.90	63.7			19.4						
Centennial Lake	05/10/04	12:55	5.34	70.3			23.5						
Centennial Lake	06/08/04	12:50	5.97	74.1			26.7						
Centennial Lake	08/19/04	12:52	5.36	69.2			27.2						
Centennial Lake	09/13/04	12:20	5.57	62.6			24.1						
Centennial Lake	10/12/04	11:58	5.80	58.4			15.6						
Centennial Lake	03/21/05	11:41	5.27	76.5			9.1						
Centennial Lake	04/19/05	11:20	5.37	63.9			17.6						
Centennial Lake	05/09/05	12:01	5.51	72.5			16.2						
Centennial Lake	06/13/05	11:55	6.35	75.5			28.8						
Centennial Lake	07/12/05	12:11	6.30	73.7			27.7						
Centennial Lake	08/17/05	12:34	6.55	72.4			27.3						
Centennial Lake	09/06/05	12:47	6.78	75.9			24.9						
Chatsworth Lake	04/30/03	14:55	4.14	63.6			20.3						
Chatsworth Lake	05/21/03	14:15	5.00	59.3			17.1						
Chatsworth Lake	06/25/03	14:10	4.04	46.0			28.7						
Chatsworth Lake	07/14/03	14:55	4.32	43.0			25.7						
Chatsworth Lake	08/21/03	15:00	4.31	51.9			28.1						
Chatsworth Lake	10/20/03	15:50	4.41	48.7			14.4						
Chatsworth Lake	03/23/04	9:30	3.96	58.0			6.0						
Chatsworth Lake	04/19/04	10:30	4.62	63.0			16.4						
Chatsworth Lake	05/10/04	10:20	4.21	54.5			20.7						
Chatsworth Lake	06/08/04	10:10	4.31	50.4			23.0						
Chatsworth Lake	08/19/04	10:07	4.21	53.3			23.5						
Chatsworth Lake	09/13/04	10:05	4.83	36.9			21.8						
Chatsworth Lake	10/12/04	9:57	4.49	40.8			14.2						
Chatsworth Lake	03/21/05	9:47	4.19	54.1			9.3						
Chatsworth Lake	04/19/05	9:50	3.65	55.0			15.9						
Chatsworth Lake	05/09/05	10:00	4.19	52.2			16.3						
Chatsworth Lake	06/13/05	9:56	4.15	52.7			26.1						
Chatsworth Lake	07/12/05	9:50	4.34	50.7			27.4						
Chatsworth Lake	08/17/05	9:49	4.73	42.5			24.6						
Chatsworth Lake	09/06/05	10:30	5.72	45.6			21.4						
Chatsworth Lake	04/19/06	9:06	4.23	47.2	8.65	90.7	17.3						
Chatsworth Lake	05/10/06	9:20	4.46	43.8	8.60	86.9	15.7						
Chatsworth Lake	06/19/06	10:38	5.27	29.0	6.26	74.7	24.9	7.5	ND	ND	ND	1.08	4.68
Chatsworth Lake	07/19/06	9:20	4.09	47.9	6.49	53.2	28.6						
Chatsworth Lake	08/14/06	10:00	5.23	38.8	6.03	69.0	22.2	8.7	ND	ND	ND	1.41	7.61
Chatsworth Lake	09/20/06	9:41	4.15	44.3	6.24	61.4	18.5						
Chatsworth Lake	10/16/06	9:32	4.09	50.5	8.37	62.5	12.4	7.0	ND	ND	ND	1.18	5.35
Chatsworth Lake	11/20/06	9:23	3.46	64.1	9.46	89.6	9.2						
Chatsworth Lake	12/04/06	9:12	3.61	58.4	9.82	98.3	6.6	14.3	ND	ND	0.111	1.34	5.66
Country Lake	04/30/03	16:00	4.29	67.6			21.3						
Country Lake	05/21/03	15:25	5.22	68.3			17.2						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Country Lake	06/26/03	11:05	4.15	50.0			25.9						
Country Lake	07/16/03	10:15	4.73	48.0			24.6						
Country Lake	08/22/03	14:15	4.52	58.9			26.7						
Country Lake	10/20/03	16:35	4.91	56.1			13.6						
Country Lake	03/24/04	8:30	4.25	56.0			6.6						
Country Lake	04/19/04	8:45	3.84	64.1			15.5						
Country Lake	05/10/04	9:10	3.84	63.5			20.1						
Country Lake	06/08/04	9:05	4.68	68.9			22.0						
Country Lake	08/19/04	9:10	4.46	54.6			24.0						
Country Lake	09/13/04	9:00	4.83	56.4			21.5						
Country Lake	10/12/04	8:55	4.50	52.0			14.7						
Country Lake	03/21/05	8:57	4.16	61.7			8.2						
Country Lake	04/19/05	8:45	4.40	54.7			15.9						
Country Lake	05/09/05	9:05	4.39	56.3			15.4						
Country Lake	06/13/05	9:01	4.54	58.1			27.0						
Country Lake	07/12/05	8:55	4.44	83.2			26.0						
Country Lake	08/17/05	8:52	5.06	59.9			24.5						
Country Lake	09/06/05	9:18	4.91	62.4			22.7						
Country Lake	04/19/06	8:35	4.25	53.6	8.45	85.8	16.4						
Country Lake	05/10/06	8:55	4.51	55.6	7.68	80.3	16.9						
Country Lake	06/19/06	10:10	4.60	43.6	6.57	79.7	24.3	13.9	ND	ND	ND	1.46	7.16
Country Lake	07/19/06	8:40	4.31	53.4	6.65	72.1	27.8						
Country Lake	08/15/06	14:40	4.81	57.0	7.04	84.5	25.9	19.1	ND	ND	ND	1.51	13.38
Country Lake	09/20/06	9:00	4.24	46.5	6.43	64.8	17.8						
Country Lake	10/16/06	8:58	3.92	61.0	8.69	84.9	12.7	12.9	ND	0.042	0.085	1.54	7.06
Country Lake	11/21/06	15:30	4.45	62.3	7.82	85.3	8.8						
Country Lake	12/05/06	14:35	4.44	67.3	8.42	68.9	7.6	18.7	ND	0.073	ND	1.49	6.54
Cranes Lake	04/29/03	12:10	6.44	70.4			19.9						
Cranes Lake	05/19/03	15:45	6.35	65.9			15.6						
Cranes Lake	06/24/03	15:10	5.99	53.0			27.1						
Cranes Lake	07/15/03	14:40	6.53	54.0			26.6						
Cranes Lake	08/25/03	14:35	6.83	61.0			26.7						
Cranes Lake	10/21/03	12:45	6.76	59.1			16.0						
Cranes Lake	03/23/04	14:00	6.20	64.0			7.6						
Cranes Lake	04/19/04	14:30	6.48	61.8			21.5						
Cranes Lake	05/10/04	14:35	6.73	65.6			24.7						
Cranes Lake	06/09/04	11:50	6.64	61.8			25.7						
Cranes Lake	08/19/04	15:17	6.80	66.7			27.8						
Cranes Lake	09/13/04	14:20	6.75	58.3			25.7						
Cranes Lake	10/12/04	13:50	6.56	54.9			15.6						
Cranes Lake	03/21/05	13:30	6.44	81.8			9.4						
Cranes Lake	04/19/05	13:10	6.62	67.1			19.2						
Cranes Lake	05/09/05	13:54	6.86	72.4			20.2						
Cranes Lake	06/13/05	13:58	7.00	66.3			29.3						
Cranes Lake	07/12/05	13:52	6.37	60.7			30.0						
Cranes Lake	08/17/05	14:31	6.78	60.4			28.0						
Cranes Lake	09/06/05	14:28	6.82	61.4			25.1						
Cranes Lake	04/19/06	15:32	6.72	69.4	8.73	98.5	20.5						
Cranes Lake	05/10/06	15:25	5.40	69.8	8.89	89.0	20.1						
Cranes Lake	06/19/06	14:25	6.72	50.7	7.28	91.3	27.5	6.8	ND	0.136	ND	0.95	7.17
Cranes Lake	07/19/06	15:30	5.38	67.2	8.42	80.3	28.1						
Cranes Lake	08/14/06	15:41	6.16	59.1	5.10	68.8	26.5	6.4	ND	0.069	ND	1.57	10.16
Cranes Lake	09/20/06	16:00	5.18	68.5	8.12	74.6	18.3						
Cranes Lake	10/16/06	17:28	5.71	55.4	7.80	73.7	14.9	7.5	ND	0.164	ND	1.20	7.18
Cranes Lake	11/20/06	15:35	4.23	52.4	9.68	89.5	8.1						
Cranes Lake	12/04/06	15:40	5.58	39.7	9.24	85.2	7.3	10.2	ND	0.387	ND	1.44	7.35
Cushman Lake	04/28/03	14:30	5.43	63.0			19.1						
Cushman Lake	05/19/03	14:45	5.93	59.1			15.6						
Cushman Lake	06/24/03	14:15	5.18	50.0			23.1						
Cushman Lake	07/15/03	13:25	6.16	47.0			24.8						
Cushman Lake	08/25/03	13:30	6.44	58.0			27.9						
Cushman Lake	10/21/03	13:45	6.37	56.7			16.5						
Cushman Lake	03/23/04	14:40	5.62	60.0			8.2						
Cushman Lake	04/19/04	15:20	5.48	56.5			20.4						
Cushman Lake	05/10/04	15:30	6.28	56.5			26.2						
Cushman Lake	06/09/04	11:00	6.29	53.6			25.9						
Cushman Lake	08/19/04	16:15	6.56	59.8			28.6						
Cushman Lake	09/13/04	15:15	6.34	55.1			28.1						
Cushman Lake	10/12/04	14:38	6.50	53.2			16.9						
Cushman Lake	03/21/05	14:24	5.86	72.4			9.7						
Cushman Lake	04/19/05	13:45	6.24	59.8			18.8						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Cushman Lake	05/09/05	14:54	6.04	56.9			19.3						
Cushman Lake	06/13/05	14:47	6.67	57.2			29.7						
Cushman Lake	07/12/05	14:52	6.02	52.4			27.6						
Cushman Lake	08/17/05	15:11	6.78	50.0			28.1						
Cushman Lake	09/06/05	15:10	6.87	59.2			25.1						
Cushman Lake	04/18/06	12:14	5.91	60.7	7.89	82.2	17.9						
Cushman Lake	05/10/06	14:20	6.39	58.3	7.84	88.3	21.0						
Cushman Lake	06/19/06	15:22	6.33	44.9	8.14	104.7	27.9	8.3	ND	0.087	ND	0.97	8.30
Cushman Lake	07/19/06	14:25	6.29	56.2	7.03	84.2	28.0						
Cushman Lake	08/14/06	16:05	6.25	59.1	6.43	74.6	28.0	11.6	ND	ND	ND	1.43	12.70
Cushman Lake	09/20/06	14:46	6.15	47.6	6.85	71.5	18.2						
Cushman Lake	10/16/06	17:48	5.77	54.2	7.96	89.3	15.2	6.9	ND	0.102	ND	1.19	8.07
Cushman Lake	11/20/06	14:30	5.72	62.5	9.25	94.2	8.8						
Cushman Lake	12/04/06	14:30	5.59	55.6	8.66	83.6	8.1	10.4	ND	0.252	ND	1.42	8.51
Davenport Imp.	04/30/03	11:30	4.70	74.9			18.0						
Davenport Imp.	05/21/03	11:25	5.53	63.4			16.4						
Davenport Imp.	06/26/03	12:50	4.54	53.0			29.5						
Davenport Imp.	07/16/03	14:20	4.64	54.0			26.5						
Davenport Imp.	08/22/03	10:25	4.87	74.1			26.3						
Davenport Imp.	10/20/03	10:15	5.18	66.3			12.4						
Davenport Imp.	03/24/04	10:40	5.15	61.0			7.1						
Davenport Imp.	04/20/04	15:15	4.53	73.4			22.0						
Davenport Imp.	05/11/04	15:20	4.83	72.6			27.6						
Davenport Imp.	06/10/04	13:10	4.84	71.7			27.9						
Davenport Imp.	08/20/04	14:24	4.67	76.3			30.2						
Davenport Imp.	09/14/04	14:30	4.91	64.6			21.6						
Davenport Imp.	10/13/04	14:55	5.08	64.5			16.9						
Davenport Imp.	03/22/05	14:30	4.76	72.8			10.2						
Davenport Imp.	04/20/05	13:20	4.74	75.8			19.8						
Davenport Imp.	05/10/05	14:45	4.80	70.2			19.7						
Davenport Imp.	06/14/05	12:38	4.93	71.3			29.1						
Davenport Imp.	07/13/05	13:14	4.79	67.6			26.1						
Davenport Imp.	08/18/05	12:25	5.09	68.7			25.9						
Davenport Imp.	09/07/05	12:34	5.54	66.2			23.0						
Diamond Lake	04/29/03	12:30	6.26	66.9			20.5						
Diamond Lake	05/19/03	15:55	5.94	101.7			15.7						
Diamond Lake	06/24/03	15:15	5.75	43.0			27.2						
Diamond Lake	07/15/03	14:50	5.99	48.0			24.9						
Diamond Lake	08/25/03	14:50	6.68	58.0			26.4						
Diamond Lake	10/21/03	12:50	6.51	56.5			15.8						
Diamond Lake	03/23/04	14:05	6.20	63.0			8.3						
Diamond Lake	04/19/04	14:40	5.85	57.9			21.5						
Diamond Lake	05/10/04	14:45	6.46	59.6			23.2						
Diamond Lake	06/09/04	12:00	6.40	56.8			26.2						
Diamond Lake	08/19/04	15:25	6.67	58.3			27.2						
Diamond Lake	09/13/04	14:25	6.52	53.8			24.6						
Diamond Lake	10/12/04	13:57	6.58	50.7			15.2						
Diamond Lake	03/21/05	13:38	6.26	74.1			9.0						
Diamond Lake	04/19/05	13:15	6.55	61.6			19.3						
Diamond Lake	05/09/05	14:02	6.71	63.4			20.4						
Diamond Lake	06/13/05	14:09	6.49	62.9			29.2						
Diamond Lake	07/12/05	14:00	6.28	55.5			29.5						
Diamond Lake	08/17/05	14:37	6.74	58.0			28.4						
Diamond Lake	09/06/05	14:35	6.83	55.7			25.4						
Egg Harbor City Lake	04/29/03	14:45	4.08	75.8			19.9						
Egg Harbor City Lake	05/20/03	13:05	4.40	77.7			17.4						
Egg Harbor City Lake	06/25/03	12:15	4.05	56.0			26.9						
Egg Harbor City Lake	07/14/03	13:15	4.34	54.0			25.3						
Egg Harbor City Lake	08/21/03	13:15	4.21	55.4			28.9						
Egg Harbor City Lake	10/20/03	13:55	4.31	61.9			15.7						
Egg Harbor City Lake	03/24/04	15:00	4.08	67.0			9.9						
Egg Harbor City Lake	04/20/04	10:25	4.25	66.8			19.4						
Egg Harbor City Lake	05/11/04	11:00	4.26	64.3			25.1						
Egg Harbor City Lake	06/09/04	13:40	4.48	58.5			28.3						
Egg Harbor City Lake	08/20/04	9:50	6.07	62.1			24.5						
Egg Harbor City Lake	09/14/04	10:45	4.42	57.6			23.9						
Egg Harbor City Lake	10/13/04	10:39	4.39	58.4			15.2						
Egg Harbor City Lake	03/22/05	10:50	4.23	69.4			10.2						
Egg Harbor City Lake	04/20/05	9:45	3.98	68.9			17.5						
Egg Harbor City Lake	05/10/05	10:28	4.25	62.1			16.7						
Egg Harbor City Lake	06/14/05	8:43	4.33	61.5			27.8						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Egg Harbor City Lake	07/13/05	9:00	4.41	58.9			26.5						
Egg Harbor City Lake	08/18/05	9:15	4.15	71.7			26.2						
Egg Harbor City Lake	09/07/05	8:14	5.69	53.3			21.2						
Egg Harbor City Lake	04/18/06	14:16	4.33	60.4	9.05	98.2	19.4						
Egg Harbor City Lake	05/11/06	8:32	4.37	60.3	8.42	90.2	18.6						
Egg Harbor City Lake	06/20/06	8:41	4.55	43.2	6.02	76.8	26.1	6.6	ND	0.080	ND	1.86	6.06
Egg Harbor City Lake	07/20/06	9:02	4.33	58.7	8.16	85.1	28.6						
Egg Harbor City Lake	08/15/06	10:12	4.18	55.5	7.14	83.3	25.9	8.5	ND	ND	ND	2.28	8.30
Egg Harbor City Lake	09/21/06	9:10	4.28	60.1	8.03	81.1	18.8						
Egg Harbor City Lake	10/16/06	15:20	4.23	57.3	7.98	77.1	16.1	7.1	ND	ND	ND	1.72	5.81
Egg Harbor City Lake	11/21/06	9:07	3.35	68.3	9.16	95.1	10.1						
Egg Harbor City Lake	12/05/06	8:42	4.04	65.9	9.64	79.2	5.3	11.2	ND	ND	ND	1.61	5.97
Hammonton Lake	04/28/03	13:25	6.48	118.6			19.3						
Hammonton Lake	05/20/03	11:05	6.96	114.4			17.7						
Hammonton Lake	06/25/03	10:20	6.52	77.0			26.5						
Hammonton Lake	07/14/03	11:20	6.63	89.0			25.6						
Hammonton Lake	08/21/03	11:05	6.65	132.1			27.5						
Hammonton Lake	10/20/03	14:40	6.80	110.2			16.7						
Hammonton Lake	03/23/04	13:15	7.05	130.0			9.0						
Hammonton Lake	04/19/04	15:45	6.67	122.8			20.7						
Hammonton Lake	05/11/04	9:10	6.90	118.4			23.0						
Hammonton Lake	06/09/04	10:00	7.59	120.8			25.4						
Hammonton Lake	08/20/04	9:02	7.13	150.6			27.4						
Hammonton Lake	09/14/04	9:55	6.72	120.7			23.9						
Hammonton Lake	10/13/04	9:46	6.37	97.2			14.9						
Hammonton Lake	03/21/05	14:50	6.45	183.6			9.8						
Hammonton Lake	04/19/05	15:10	6.00	127.6			20.9						
Hammonton Lake	05/10/05	9:32	6.62	119.8			18.0						
Hammonton Lake	06/14/05	7:54	6.91	122.1			27.8						
Hammonton Lake	07/13/05	8:10	6.43	122.4			25.8						
Hammonton Lake	08/17/05	15:37	6.50	138.9			29.7						
Hammonton Lake	09/07/05	7:15	6.10	145.2			22.0						
Hammonton Lake	04/18/06	13:30	6.78	125.9	8.02	82.5	18.4						
Hammonton Lake	05/10/06	13:12	6.91	117.2	8.33	90.2	21.0						
Hammonton Lake	06/20/06	7:35	6.45	98.2	7.25	87.6	25.9	8.7	ND	0.130	ND	0.54	22.19
Hammonton Lake	07/19/06	13:18	6.84	118.2	7.58	81.2	29.2						
Hammonton Lake	08/14/06	13:56	6.57	112.3	6.21	76.6	27.5	10.0	ND	ND	ND	0.36	30.19
Hammonton Lake	09/20/06	13:50	6.67	124.3	7.33	78.7	19.4						
Hammonton Lake	10/16/06	16:20	6.12	90.0	8.93	83.9	16.9	6.5	ND	0.076	ND	0.70	15.17
Hammonton Lake	11/20/06	13:23	6.08	111.2	8.57	91.3							
Hammonton Lake	12/04/06	9:58	4.98	92.2	9.01	93.3	7.8	8.0	ND	0.325	ND	1.16	16.18
Harrisville Pond	04/29/03	16:10	4.31	50.4			17.4						
Harrisville Pond	05/20/03	15:15	4.63	50.6			16.2						
Harrisville Pond	06/25/03	13:35	4.15	36.0			24.5						
Harrisville Pond	07/14/03	14:30	4.42	34.0			23.7						
Harrisville Pond	08/21/03	14:45	4.44	45.3			24.7						
Harrisville Pond	10/20/03	12:50	4.42	46.0			12.7						
Harrisville Pond	03/24/04	13:30	3.84	43.0			6.8						
Harrisville Pond	04/20/04	11:29	3.87	52.5			18.1						
Harrisville Pond	05/11/04	11:45	4.44	44.1			22.9						
Harrisville Pond	06/09/04	14:30	4.41	39.9			23.8						
Harrisville Pond	08/20/04	10:43	4.25	49.7			25.4						
Harrisville Pond	09/14/04	11:55	4.41	40.7			22.6						
Harrisville Pond	10/13/04	12:00	4.35	42.2			13.9						
Harrisville Pond	03/22/05	11:55	4.34	42.8			9.6						
Harrisville Pond	04/20/05	10:55	4.19	48.7			17.6						
Harrisville Pond	05/10/05	11:52	4.31	42.0			17.3						
Harrisville Pond	06/14/05	10:02	4.39	43.1			27.0						
Harrisville Pond	07/13/05	10:16	4.33	42.7			24.7						
Harrisville Pond	08/18/05	10:40	4.39	39.9			23.9						
Harrisville Pond	09/07/05	9:34	4.55	45.5			20.5						
Horicon Lake	04/30/03	11:10	4.42	71.8			15.9						
Horicon Lake	05/21/03	11:00	5.21	61.6			15.6						
Horicon Lake	06/26/03	12:30	4.02	51.0			23.6						
Horicon Lake	07/16/03	14:50	3.61	46.0			25.2						
Horicon Lake	08/22/03	9:55	4.44	53.4			25.1						
Horicon Lake	10/20/03	9:55	4.45	56.2			12.2						
Horicon Lake	03/24/04	9:15	4.16	68.0			5.7						
Horicon Lake	04/20/04	15:30	4.20	72.4			19.6						
Horicon Lake	05/11/04	15:45	4.32	61.8			26.4						
Horicon Lake	06/10/04	13:30	4.47	55.2			26.1						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Horicon Lake	08/20/04	14:47	4.25	72.4			28.2						
Horicon Lake	09/14/04	14:45	4.29	49.6			20.9						
Horicon Lake	10/13/04	15:12	4.38	51.7			15.6						
Horicon Lake	03/22/05	14:45	4.26	61.0			9.5						
Horicon Lake	04/20/05	13:40	4.33	65.8			18.7						
Horicon Lake	05/10/05	15:03	4.34	57.2			18.3						
Horicon Lake	06/14/05	12:54	4.44	58.0			28.1						
Horicon Lake	07/13/05	13:31	4.32	58.3			26.1						
Horicon Lake	08/18/05	15:25	4.56	48.0			25.2						
Horicon Lake	09/07/05	13:08	4.74	51.1			24.2						
Horicon Lake	04/19/06	12:56	4.27	60.4	8.97	94.3	18.0						
Horicon Lake	05/11/06	12:00	4.41	53.1	8.25	83.9	16.4						
Horicon Lake	06/20/06	12:55	4.41	41.5	7.22	87.7	25.2	5.2	ND	0.042	ND	1.03	7.53
Horicon Lake	07/20/06	12:35	4.38	48.7	7.92	78.8	27.8						
Horicon Lake	08/15/06	13:00	4.47	46.1	7.09	89.5	24.2	6.6	ND	ND	ND	1.18	9.66
Horicon Lake	09/21/06	12:40	4.22	51.2	7.65	77.8	18.1						
Horicon Lake	10/17/06	9:25	4.26	68.7	8.49	87.7	12.0	8.9	ND	ND	ND	1.42	7.81
Horicon Lake	11/21/06	12:40	3.84	54.5	8.93	88.7	8.7						
Horicon Lake	12/05/06	12:30	4.20	72.9	9.72	75.3	5.8	10.3	ND	ND	ND	1.39	7.60
Howardsville Imp.	04/30/03	13:50	4.52	44.7			16.3						
Howardsville Imp.	05/21/03	13:00	4.29	50.5			16.5						
Howardsville Imp.	06/26/03	14:40	4.35	34.0			29.4						
Howardsville Imp.	07/16/03	12:10	5.13	26.0			25.4						
Howardsville Imp.	08/22/03	12:10	4.38	49.3			28.5						
Howardsville Imp.	10/20/03	12:05	4.51	42.3			13.4						
Howardsville Imp.	03/24/04	12:55	4.38	40.0			8.5						
Howardsville Imp.	04/20/04	13:40	4.36	47.1			19.8						
Howardsville Imp.	05/11/04	14:35	4.87	36.8			23.5						
Howardsville Imp.	06/10/04	11:40	5.56	39.1			23.0						
Howardsville Imp.	08/20/04	12:45	4.70	48.2			27.6						
Howardsville Imp.	09/14/04	12:55	4.27	46.2			24.9						
Howardsville Imp.	10/13/04	13:15	4.35	45.6			16.5						
Howardsville Imp.	03/22/05	13:55	4.22	50.0			9.9						
Howardsville Imp.	04/20/05	12:50	4.41	48.4			20.2						
Howardsville Imp.	05/10/05	13:02	4.43	39.6			18.9						
Howardsville Imp.	06/14/05	11:08	4.34	48.5			29.5						
Howardsville Imp.	07/13/05	11:22	4.90	33.4			24.6						
Howardsville Imp.	08/18/05	12:10	4.16	46.1			26.8						
Howardsville Imp.	09/07/05	10:46	4.30	53.5			23.8						
Indian Mills Lake	04/29/03	9:55	6.41	216.0			19.0						
Indian Mills Lake	05/20/03	9:55	6.94	207.0			17.9						
Indian Mills Lake	06/25/03	9:10	6.40	155.0			25.6						
Indian Mills Lake	07/14/03	10:20	6.96	171.0			26.3						
Indian Mills Lake	08/21/03	10:05	8.12	205.0			26.4						
Indian Mills Lake	10/20/03	15:20	6.72	210.0			15.2						
Indian Mills Lake	03/23/04	10:00	6.56	284.0			6.1						
Indian Mills Lake	04/19/04	11:15	6.51	210.0			19.1						
Indian Mills Lake	05/10/04	11:10	8.76	226.0			21.7						
Indian Mills Lake	06/08/04	11:10	9.03	219.0			23.8						
Indian Mills Lake	08/19/04	10:50	6.70	215.0			25.6						
Indian Mills Lake	09/13/04	10:45	6.54	214.0			24.3						
Indian Mills Lake	10/12/04	10:37	6.12	208.0			14.0						
Indian Mills Lake	03/21/05	10:30	6.26	252.0			10.0						
Indian Mills Lake	04/19/05	10:15	6.36	231.0			18.1						
Indian Mills Lake	05/09/05	10:47	9.76	221.0			17.6						
Indian Mills Lake	06/13/05	10:44	6.80	230.0			28.3						
Indian Mills Lake	07/12/05	10:57	6.47	176.9			29.3						
Indian Mills Lake	08/17/05	10:58	6.53	209.0			25.9						
Indian Mills Lake	09/06/05	11:44	6.57	244.0			24.8						
Indian Mills Lake	04/18/06	10:53	7.02	222.0	10.10	101.3	16.4						
Indian Mills Lake	05/10/06	11:02	8.98	218.0	11.39	121.5	17.2						
Indian Mills Lake	06/19/06	12:07	7.16	180.6	12.10	154.5	28.3	9.1	ND	1.510	ND	6.64	30.85
Indian Mills Lake	07/19/06	11:08	6.42	141.2	10.05	118.3	28.8						
Indian Mills Lake	08/14/06	12:14	6.52	238.0	6.11	62.1	25.1	11.4	ND	0.660	ND	11.06	52.42
Indian Mills Lake	09/20/06	11:30	6.22	153.6	9.48	89.9	19.2						
Indian Mills Lake	10/16/06	10:55	5.68	184.9	8.34	77.1	12.2	10.3	ND	2.069	ND	5.92	24.00
Indian Mills Lake	11/20/06	11:13	5.33	132.5	10.14	101.3	10.2						
Indian Mills Lake	12/04/06	11:06	5.27	221.0	9.26	88.3	6.9	7.0	ND	2.684	ND	5.37	25.64
Jennings Lake	04/28/03	10:25	6.59	163.3			15.7						
Jennings Lake	05/19/03	11:10	7.01	169.5			13.4						
Jennings Lake	06/24/03	11:40	6.81	139.0			23.5						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Jennings Lake	07/15/03	10:50	6.32	119.0			23.0						
Jennings Lake	08/25/03	11:05	6.76	144.5			23.1						
Jennings Lake	10/21/03	10:40	6.92	164.7			13.8						
Jennings Lake	03/23/04	12:00	6.72	224.0			7.1						
Jennings Lake	04/19/04	12:20	6.83	202.0			19.8						
Jennings Lake	05/10/04	12:30	7.10	172.2			22.0						
Jennings Lake	06/08/04	12:42	7.21	180.1			25.1						
Jennings Lake	08/19/04	12:23	6.86	169.2			25.5						
Jennings Lake	09/13/04	11:55	6.65	174.1			22.1						
Jennings Lake	10/12/04	11:39	6.48	162.8			13.2						
Jennings Lake	03/21/05	11:38	6.71	307.0			9.9						
Jennings Lake	04/19/05	11:00	6.55	178.8			15.4						
Jennings Lake	05/09/05	11:38	7.16	182.8			17.0						
Jennings Lake	06/13/05	11:42	6.91	185.4			27.2						
Jennings Lake	07/12/05	11:58	6.24	181.1			26.8						
Jennings Lake	08/17/05	12:17	6.80	173.3			26.2						
Jennings Lake	09/06/05	12:30	6.71	192.9			21.9						
Jennings Lake	04/18/06	9:39	6.40	206.0	8.44	80.0	14.3						
Jennings Lake	05/10/06	11:50	6.79	193.4	7.92	81.7	17.7						
Jennings Lake	06/19/06	13:10	6.60	144.3	6.37	94.1	26.7	12.3	ND	0.123	ND	2.75	26.54
Jennings Lake	07/19/06	11:55	6.56	124.3	6.98	75.1	28.2						
Jennings Lake	08/14/06	12:55	6.23	194.8	7.19	85.4	23.3	11.5	ND	ND	ND	4.62	47.32
Jennings Lake	09/20/06	12:25	6.07	177.3	6.55	72.5	18.5						
Jennings Lake	10/16/06	12:03	6.15	159.1	8.98	84.2	10.6	9.3	ND	0.193	ND	3.80	26.23
Jennings Lake	11/20/06	12:00	5.44	114.7	8.56	85.4	9.4						
Jennings Lake	12/04/06	12:09	5.54	169.9	9.69	80.9	6.7	11.3	ND	0.455	ND	4.14	27.61
Kettle Run Imp.	04/28/03	11:50	5.76	67.1			17.3						
Kettle Run Imp.	05/19/03	12:20	6.66	77.4			14.1						
Kettle Run Imp.	06/24/03	12:25	5.82	70.0			22.1						
Kettle Run Imp.	07/15/03	11:35	5.48	58.0			22.6						
Kettle Run Imp.	08/25/03	11:45	6.86	84.4			23.0						
Kettle Run Imp.	10/21/03	10:00	6.60	71.1			14.2						
Kettle Run Imp.	03/23/04	12:20	5.93	70.0			7.3						
Kettle Run Imp.	04/19/04	13:00	5.47	79.2			18.7						
Kettle Run Imp.	05/10/04	13:15	6.28	78.8			21.2						
Kettle Run Imp.	06/08/04	13:30	6.27	79.6			22.4						
Kettle Run Imp.	08/19/04	13:20	6.13	72.8			24.7						
Kettle Run Imp.	09/13/04	12:45	6.07	71.9			22.7						
Kettle Run Imp.	10/12/04	12:20	5.67	69.4			14.4						
Kettle Run Imp.	03/21/05	12:03	5.54	96.2			9.3						
Kettle Run Imp.	04/19/05	11:45	5.70	78.4			16.5						
Kettle Run Imp.	05/09/05	12:22	6.11	81.0			16.7						
Kettle Run Imp.	06/13/05	12:21	6.41	81.6			26.6						
Kettle Run Imp.	07/12/05	12:33	6.35	80.0			26.4						
Kettle Run Imp.	08/17/05	13:00	6.48	80.3			25.2						
Kettle Run Imp.	09/06/05	13:08	6.69	75.6			22.4						
Kettle Run Imp.	04/18/06	10:09	6.13	81.3	10.55	106.9	16.0						
Kettle Run Imp.	05/10/06	12:23	6.67	75.9	9.25	94.2	17.5						
Kettle Run Imp.	06/19/06	13:40	6.72	61.4	8.89	107.5	26.2	5.1	ND	0.434	ND	1.53	11.85
Kettle Run Imp.	07/19/06	12:30	6.57	71.2	8.89	89.5	27.1						
Kettle Run Imp.	08/14/06	13:15	6.30	72.2	8.89	95.8	23.5	6.5	ND	0.322	ND	2.02	16.42
Kettle Run Imp.	09/20/06	12:51	6.33	68.9	8.42	85.3	17.3						
Kettle Run Imp.	10/16/06	12:28	4.96	73.9	8.90	85.5	12.9	4.6	ND	0.594	ND	1.76	11.11
Kettle Run Imp.	11/20/06	12:35	5.88	69.3	9.41	95.4	9.0						
Kettle Run Imp.	12/04/06	12:27	5.59	83.4	9.91	77.4	8.2	6.0	ND	0.802	ND	1.65	9.92
Lady's Lake	04/28/03	12:50	5.96	187.3			19.6						
Lady's Lake	05/19/03	13:20	6.73	228.0			20.1						
Lady's Lake	06/24/03	13:00	6.20	141.0			26.1						
Lady's Lake	07/15/03	12:00	6.23	142.0			25.2						
Lady's Lake	08/25/03	12:05	7.02	164.2			25.0						
Lady's Lake	10/21/03	9:45	6.70	146.4			14.0						
Lady's Lake	03/23/04	12:30	6.76	158.0			7.3						
Lady's Lake	04/19/04	13:25	6.45	176.2			20.9						
Lady's Lake	05/10/04	13:30	6.79	168.3			24.9						
Lady's Lake	06/08/04	13:45	7.08	164.2			26.4						
Lady's Lake	08/19/04	13:40	6.75	151.1			27.1						
Lady's Lake	09/13/04	13:05	6.65	151.3			25.1						
Lady's Lake	10/12/04	12:42	5.82	137.6			14.9						
Lady's Lake	03/21/05	12:20	6.33	406.0			9.8						
Lady's Lake	04/19/05	12:00	6.30	193.0			18.5						
Lady's Lake	05/09/05	12:41	6.53	187.9			19.3						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Lady's Lake	06/13/05	12:54	7.20	180.1			29.3						
Lady's Lake	07/12/05	12:50	6.37	165.8			28.2						
Lady's Lake	08/17/05	13:30	6.62	152.0			27.5						
Lady's Lake	09/06/05	13:21	6.64	151.0			24.9						
Lake Absegami	04/29/03	15:50	4.27	83.5			18.2						
Lake Absegami	05/20/03	14:40	4.62	78.2			20.6						
Lake Absegami	06/25/03	13:20	4.11	70.0			23.3						
Lake Absegami	07/14/03	14:10	4.56	59.0			26.0						
Lake Absegami	08/21/03	14:20	4.51	79.0			28.9						
Lake Absegami	10/20/03	13:00	4.57	61.7			14.5						
Lake Absegami	03/24/04	14:00	4.30	72.0			10.0						
Lake Absegami	04/20/04	11:50	3.88	93.5			18.7						
Lake Absegami	05/11/04	12:25	4.41	83.8			24.1						
Lake Absegami	06/09/04	15:00	4.38	74.7			27.8						
Lake Absegami	08/20/04	11:11	4.46	74.2			28.1						
Lake Absegami	09/14/04	11:35	4.53	67.9			24.3						
Lake Absegami	10/13/04	11:35	4.55	61.8			16.0						
Lake Absegami	03/22/05	11:30	4.37	82.9			9.6						
Lake Absegami	04/20/05	10:30	4.28	95.8			17.9						
Lake Absegami	05/10/05	11:37	4.35	85.8			16.7						
Lake Absegami	06/14/05	9:42	4.32	94.4			27.9						
Lake Absegami	07/13/05	10:00	4.41	80.9			26.6						
Lake Absegami	08/18/05	10:15	4.39	93.1			27.1						
Lake Absegami	09/07/05	9:17	4.62	94.1			22.6						
Lake Absegami	04/19/06	9:58	4.28	81.7	8.72	90.8	17.5						
Lake Absegami	05/11/06	9:20	4.46	89.8	7.95	83.7	18.7						
Lake Absegami	06/20/06	10:21	4.39	72.7	6.42	78.6	27.1	5.0	ND	0.098	ND	1.32	17.55
Lake Absegami	07/20/06	9:50	4.35	78.5	7.65	76.4	28.4						
Lake Absegami	08/15/06	10:50	4.24	80.4	7.80	91.3	25.7	5.3	ND	ND	ND	1.22	23.60
Lake Absegami	09/21/06	9:55	4.19	74.3	7.34	70.1	18.5						
Lake Absegami	10/16/06	14:23	4.31	76.2	9.09	82.8	16.4	5.3	ND	ND	ND	0.87	14.05
Lake Absegami	11/21/06	9:55	3.78	68.5	8.65	86.4	9.8						
Lake Absegami	12/05/06	9:23	4.01	90.2	9.54	77.6	6.6	8.0	ND	ND	ND	1.15	18.43
Lake Albert	04/28/03	14:15	5.63	52.3			18.5						
Lake Albert	05/19/03	14:30	5.83	54.2			14.6						
Lake Albert	06/24/03	14:00	4.91	42.0			21.5						
Lake Albert	07/15/03	13:00	5.31	39.0			24.4						
Lake Albert	08/25/03	13:20	6.21	51.3			26.6						
Lake Albert	10/21/03	15:30	6.22	46.5			16.3						
Lake Albert	03/23/04	14:30	5.89	44.0			8.6						
Lake Albert	04/19/04	15:00	5.63	50.0			21.5						
Lake Albert	05/10/04	15:10	6.15	48.1			24.6						
Lake Albert	06/09/04	10:40	6.28	48.6			24.5						
Lake Albert	08/19/04	16:00	6.63	52.0			29.2						
Lake Albert	09/13/04	15:00	6.49	45.4			27.8						
Lake Albert	10/12/04	14:20	6.42	42.8			17.6						
Lake Albert	05/09/05	14:41	6.51	49.5			19.4						
Lake Albert	06/13/05	14:39	6.63	51.4			29.0						
Lake Albert	07/12/05	14:40	6.35	49.4			27.4						
Lake Albert	08/17/05	15:16	6.72	52.7			27.8						
Lake Albert	09/06/05	15:25	4.76	58.9			25.1						
Lake Albert	04/18/06	12:36	6.30	50.6	8.54	90.5	18.0						
Lake Albert	05/10/06	14:35	6.08	53.4	7.78	86.8	21.0						
Lake Albert	06/19/06	15:10	6.30	37.9	8.21	105.4	28.5	7.6	ND	0.148	ND	0.81	5.79
Lake Albert	07/19/06	14:40	5.98	55.6	6.81	75.4	28.5						
Lake Albert	08/14/06	16:25	6.42	46.3	5.41	74.1	25.4	10.5	ND	ND	ND	1.04	8.09
Lake Albert	09/20/06	15:01	5.80	48.8	6.68	72.3	18.7						
Lake Albert	10/16/06	18:08	5.82	45.5	7.42	75.0	15.8	6.5	ND	0.214	ND	1.00	5.34
Lake Albert	11/20/06	14:45	5.25	68.3	8.81	85.5	9.3						
Lake Albert	12/04/06	14:48	5.54	47.4	9.52	84.5	8.2	8.9	ND	0.349	ND	1.47	6.25
Lake Fred	04/29/03	14:00	5.19	79.2			20.9						
Lake Fred	05/20/03	12:45	5.74	75.3			19.1						
Lake Fred	06/25/03	11:40	4.82	61.0			26.1						
Lake Fred	07/14/03	12:44	5.57	60.0			25.4						
Lake Fred	08/21/03	12:50	6.09	94.3			28.5						
Lake Fred	10/20/03	13:40	5.60	64.1			14.1						
Lake Fred	03/24/04	15:20	5.12	72.0			10.7						
Lake Fred	04/20/04	10:00	5.03	74.5			20.8						
Lake Fred	05/11/04	10:35	5.47	76.8			24.9						
Lake Fred	06/09/04	13:15	5.73	71.1			27.7						
Lake Fred	08/20/04	9:30	6.35	70.4			26.9						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Lake Fred	09/14/04	10:25	6.08	79.0			23.2						
Lake Fred	10/13/04	10:20	6.25	64.3			14.5						
Lake Fred	03/22/05	10:30	5.45	78.8			10.8						
Lake Fred	04/20/05	10:00	4.95	83.1			18.6						
Lake Fred	05/10/05	10:00	5.83	73.6			17.1						
Lake Fred	06/14/05	8:24	5.99	78.8			27.5						
Lake Fred	07/13/05	8:38	6.10	81.2			26.3						
Lake Fred	08/18/05	9:35	5.71	73.2			25.9						
Lake Fred	09/07/05	7:53	6.15	85.6			20.2						
Lake Fred	04/18/06	14:48	5.85	78.4	8.82	97.4	19.5						
Lake Fred	05/11/06	7:55	5.83	72.3	8.33	88.6	18.3						
Lake Fred	06/20/06	8:19	6.35	57.7	6.79	85.2	25.8	6.0	ND	ND	ND	2.08	10.79
Lake Fred	07/20/06	8:30	5.42	68.9	8.01	81.0	28.3						
Lake Fred	08/15/06	9:30	5.28	76.6	6.87	74.0	25.2	6.4	ND	ND	ND	3.09	18.34
Lake Fred	09/21/06	8:28	5.32	64.5	7.98	78.4	18.6						
Lake Fred	10/16/06	15:38	5.17	75.2	7.64	86.5	15.4	4.5	ND	0.155	ND	2.35	11.39
Lake Fred	11/21/06	8:35	4.58	72.5	9.01	91.4	9.7						
Lake Fred	12/05/06	8:12	4.18	83.6	9.91	68.4	5.0	8.7	ND	0.331	ND	2.50	10.85
Lake Pine	04/28/03	10:10	5.82	90.5			16.8						
Lake Pine	05/19/03	10:55	6.32	93.6			14.5						
Lake Pine	06/24/03	11:25	5.21	26.0			20.9						
Lake Pine	07/15/03	10:35	6.17	61.0			24.8						
Lake Pine	08/25/03	10:55	6.39	76.6			24.6						
Lake Pine	10/21/03	10:55	6.41	78.7			14.6						
Lake Pine	03/23/04	10:55	5.50	72.0			5.2						
Lake Pine	04/19/04	12:00	5.34	72.9			20.1						
Lake Pine	05/10/04	12:05	5.94	78.3			22.4						
Lake Pine	06/08/04	12:10	6.28	85.5			25.1						
Lake Pine	08/19/04	12:00	5.75	80.1			25.2						
Lake Pine	09/13/04	11:35	5.76	74.3			23.3						
Lake Pine	10/12/04	11:10	5.98	72.7			14.0						
Lake Pine	03/21/05	11:00	6.06	124.3			9.1						
Lake Pine	04/19/05	10:45	5.95	77.4			16.4						
Lake Pine	05/09/05	11:24	7.12	79.7			17.1						
Lake Pine	06/13/05	11:20	6.18	83.7			28.2						
Lake Pine	07/12/05	11:30	6.11	80.7			26.3						
Lake Pine	08/17/05	11:28	6.33	79.8			26.6						
Lake Pine	09/06/05	12:16	6.57	81.1			24.6						
Manahawkin Lake	04/30/03	13:00	5.65	103.1			16.5						
Manahawkin Lake	05/21/03	12:05	5.46	104.6			17.3						
Manahawkin Lake	06/26/03	13:40	5.82	75.0			26.5						
Manahawkin Lake	07/16/03	12:55	5.81	73.0			23.1						
Manahawkin Lake	08/22/03	11:15	6.10	106.4			26.7						
Manahawkin Lake	10/20/03	11:30	6.01	93.5			12.9						
Manahawkin Lake	03/24/04	12:00	5.92	120.0			7.0						
Manahawkin Lake	04/20/04	14:00	6.13	99.4			19.1						
Manahawkin Lake	05/11/04	14:10	6.34	101.7			23.0						
Manahawkin Lake	06/10/04	12:30	6.92	99.3			29.6						
Manahawkin Lake	08/20/04	13:38	5.78	110.2			28.1						
Manahawkin Lake	09/14/04	13:20	6.24	93.0			23.2						
Manahawkin Lake	10/13/04	14:12	5.95	94.8			15.4						
Manahawkin Lake	03/22/05	13:00	6.18	118.5			9.6						
Manahawkin Lake	04/20/05	12:25	5.93	112.4			21.4						
Manahawkin Lake	05/10/05	13:50	6.19	103.4			17.6						
Manahawkin Lake	06/14/05	11:55	6.88	109.5			29.1						
Manahawkin Lake	07/13/05	12:33	5.61	99.5			26.2						
Manahawkin Lake	08/18/05	12:50	6.14	117.1			25.2						
Manahawkin Lake	09/07/05	11:52	5.88	121.6			23.6						
Maple Lake	04/29/03	13:20	4.73	40.5			20.4						
Maple Lake	05/20/03	11:50	6.39	52.7			17.4						
Maple Lake	06/25/03	11:00	4.73	35.0			25.6						
Maple Lake	07/14/03	12:05	5.17	32.0			23.4						
Maple Lake	08/21/03	11:55	5.86	42.9			26.6						
Maple Lake	10/21/03	14:20	6.64	37.2			16.1						
Maple Lake	03/24/04	16:00	5.32	34.0			9.4						
Maple Lake	04/20/04	9:25	4.95	42.0			19.9						
Maple Lake	05/11/04	10:00	5.82	94.3			22.5						
Maple Lake	06/09/04	12:40	6.06	36.9			27.1						
Maple Lake	08/20/04	7:52	6.32	35.9			25.9						
Maple Lake	09/13/04	15:50	6.43	35.6			27.3						
Maple Lake	10/12/04	15:10	6.39	33.1			17.0						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Maple Lake	03/22/05	9:50	5.83	38.8			8.5						
Maple Lake	04/19/05	14:35	5.17	39.0			18.7						
Maple Lake	05/09/05	15:30	5.90	36.4			17.6						
Maple Lake	06/13/05	15:40	6.41	39.2			30.8						
Maple Lake	07/12/05	15:30	6.20	37.5			28.3						
Maple Lake	08/17/05	16:40	6.65	39.0			29.7						
Maple Lake	09/06/05	16:00	6.70	48.0			25.8						
Mimosa Lake	04/28/03	11:30	5.47	54.8			17.7						
Mimosa Lake	05/19/03	11:25	6.16	56.8			15.1						
Mimosa Lake	06/24/03	12:10	5.32	48.0			22.9						
Mimosa Lake	07/15/03	11:10	5.68	41.0			24.7						
Mimosa Lake	08/25/03	11:25	6.54	54.7			25.8						
Mimosa Lake	10/21/03	10:20	6.49	52.7			14.6						
Mimosa Lake	03/23/04	10:40	4.82	51.0			7.3						
Mimosa Lake	04/19/04	12:45	5.24	57.1			18.9						
Mimosa Lake	05/10/04	13:00	5.67	57.0			22.4						
Mimosa Lake	06/08/04	13:00	6.25	57.3			24.9						
Mimosa Lake	08/19/04	13:00	5.88	58.0			25.8						
Mimosa Lake	09/13/04	12:30	5.50	54.5			23.4						
Mimosa Lake	10/12/04	12:03	5.92	53.3			15.4						
Mimosa Lake	03/21/05	11:47	5.22	66.4			8.8						
Mimosa Lake	04/19/05	11:30	5.17	59.5			17.0						
Mimosa Lake	05/09/05	12:10	5.51	62.9			16.8						
Mimosa Lake	06/13/05	12:08	6.07	63.5			27.9						
Mimosa Lake	07/12/05	12:17	6.35	62.0			26.9						
Mimosa Lake	08/17/05	12:42	6.43	61.5			27.5						
Mimosa Lake	09/06/05	12:52	6.70	63.0			23.9						
Mount Misery Imp.	04/30/03	15:40	4.19	55.1			16.4						
Mount Misery Imp.	05/21/03	15:05	5.64	48.4			13.4						
Mount Misery Imp.	06/26/03	10:50	3.99	41.0			20.6						
Mount Misery Imp.	07/16/03	10:25	3.49	31.0			19.1						
Mount Misery Imp.	08/22/03	14:00	4.70	83.9			25.3						
Mount Misery Imp.	10/20/03	16:30	4.56	38.1			11.9						
Mount Misery Imp.	03/24/04	8:40	4.24	44.0			4.1						
Mount Misery Imp.	04/19/04	9:45	4.37	54.2			14.5						
Mount Misery Imp.	05/10/04	9:25	4.32	45.2			15.6						
Mount Misery Imp.	06/08/04	9:20	4.45	38.1			18.4						
Mount Misery Imp.	08/19/04	9:20	4.20	44.7			19.7						
Mount Misery Imp.	09/13/04	9:15	4.49	38.1			17.0						
Mount Misery Imp.	10/12/04	9:05	4.44	35.6			11.6						
Mount Misery Imp.	03/21/05	9:07	4.28	43.1			7.4						
Mount Misery Imp.	04/19/05	8:55	4.36	41.4			12.3						
Mount Misery Imp.	05/09/05	9:16	4.23	38.2			12.6						
Mount Misery Imp.	06/13/05	9:11	4.32	41.4			21.6						
Mount Misery Imp.	07/12/05	9:04	4.37	74.4			21.3						
Mount Misery Imp.	08/17/05	9:02	4.80	35.1			19.5						
Mount Misery Imp.	09/06/05	9:30	4.75	36.2			17.2						
Oswego Lake	05/21/03	13:40	5.36	71.6			12.9						
Oswego Lake	06/26/03	15:10	4.06	40.0			24.7						
Oswego Lake	07/16/03	11:30	4.35	36.0			26.7						
Oswego Lake	08/22/03	12:40	4.92	36.6			21.6						
Oswego Lake	10/20/03	12:30	4.65	33.4			11.4						
Oswego Lake	03/24/04	13:10	4.28	47.0			8.3						
Oswego Lake	04/20/04	12:40	4.26	58.2			18.0						
Oswego Lake	05/11/04	13:00	4.42	45.5			21.4						
Oswego Lake	06/10/04	9:30	4.67	39.8			20.7						
Oswego Lake	08/20/04	11:53	4.31	45.1			23.3						
Oswego Lake	09/14/04	12:15	4.61	35.0			18.6						
Oswego Lake	10/13/04	12:30	4.43	35.7			12.6						
Oswego Lake	03/22/05	12:15	4.31	44.3			9.3						
Oswego Lake	04/20/05	11:15	4.09	49.5			15.6						
Oswego Lake	05/10/05	12:22	4.35	42.7			16.1						
Oswego Lake	06/14/05	10:20	4.50	38.2			22.4						
Oswego Lake	07/13/05	10:38	4.40	42.1			22.1						
Oswego Lake	08/18/05	11:25	4.54	35.5			20.2						
Oswego Lake	09/07/05	9:53	4.63	39.1			17.2						
Oswego Lake	04/19/06	10:36	4.42	36.9	8.84	83.7	12.7						
Oswego Lake	05/11/06	10:30	4.51	43.4	7.86	82.9	18.5						
Oswego Lake	06/20/06	11:12	4.47	27.3	7.45	82.4	20.9	4.3	ND	ND	ND	1.11	3.38
Oswego Lake	07/20/06	11:10	4.46	51.2	7.42	79.7	28.5						
Oswego Lake	08/15/06	11:27	4.30	34.0	7.43	76.3	20.4	3.7	ND	ND	ND	1.49	4.23

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Oswego Lake	09/21/06	11:15	4.24	49.8	7.36	80.2	18.8						
Oswego Lake	10/16/06	13:25	4.22	44.7	7.80	72.4	11.2	8.3	ND	ND	ND	0.80	4.94
Oswego Lake	11/21/06	11:15	3.96	61.3	8.42	89.7	9.5						
Oswego Lake	12/05/06	10:00	3.91	46.8	7.82	54.3	5.1	7.9	ND	ND	ND	1.22	4.83
Pakim Pond	04/30/03	15:10	3.94	75.7			21.0						
Pakim Pond	05/21/03	14:30	4.63	76.3			16.3						
Pakim Pond	06/26/03	10:20	3.83	56.0			22.0						
Pakim Pond	07/16/03	10:40	3.90	42.0			24.5						
Pakim Pond	08/22/03	13:25	4.30	62.0			30.2						
Pakim Pond	10/20/03	16:10	4.18	55.2			15.0						
Pakim Pond	03/23/04	9:10	3.89	63.0			5.2						
Pakim Pond	04/19/04	10:15	4.55	65.1			15.3						
Pakim Pond	05/10/04	10:05	4.15	34.4			19.3						
Pakim Pond	06/08/04	9:50	4.04	45.3			21.9						
Pakim Pond	08/19/04	9:45	4.01	62.7			22.4						
Pakim Pond	09/13/04	9:45	4.16	49.4			20.1						
Pakim Pond	10/12/04	9:39	4.19	45.0			13.0						
Pakim Pond	03/21/05	9:32	4.05	54.4			5.8						
Pakim Pond	04/19/05	9:25	3.36	50.3			13.5						
Pakim Pond	05/09/05	9:44	4.13	51.3			13.7						
Pakim Pond	06/13/05	9:41	4.05	48.7			25.5						
Pakim Pond	07/12/05	9:34	4.16	51.6			24.6						
Pakim Pond	08/17/05	9:30	4.56	48.0			23.3						
Pakim Pond	09/06/05	10:11	4.34	46.2			21.9						
Paradise Lake	04/29/03	10:50	5.80	76.8			16.9						
Paradise Lake	05/20/03	10:50	6.22	81.9			16.4						
Paradise Lake	06/25/03	9:55	5.34	50.0			21.9						
Paradise Lake	07/14/03	11:00	5.86	60.0			22.7						
Paradise Lake	08/21/03	10:45	5.80	85.2			23.4						
Paradise Lake	10/20/03	14:20	6.28	74.1			12.9						
Paradise Lake	03/23/04	15:20	5.74	70.0			8.7						
Paradise Lake	04/19/04	16:00	5.38	70.0			21.4						
Paradise Lake	05/11/04	8:30	6.20	78.8			19.9						
Paradise Lake	06/09/04	9:35	6.47	76.7			22.3						
Paradise Lake	08/20/04	8:40	6.35	80.1			24.3						
Paradise Lake	09/14/04	9:35	6.28	76.0			21.1						
Paradise Lake	10/13/04	9:30	5.71	70.6			12.2						
Paradise Lake	03/21/05	15:15	6.26	95.2			10.1						
Paradise Lake	04/19/05	15:30	6.23	75.6			19.8						
Paradise Lake	05/10/05	9:05	6.14	77.9			15.9						
Paradise Lake	06/14/05	7:25	6.27	83.2			25.9						
Paradise Lake	07/12/05	10:36	5.57	68.3			25.0						
Paradise Lake	08/17/05	10:37	6.10	84.3			23.7						
Paradise Lake	09/06/05	11:23	6.20	81.5			21.9						
Paradise Lake	04/18/06	11:29	6.36	76.2	9.11	88.5	14.9						
Paradise Lake	05/10/06	10:24	6.12	73.1	9.28	91.5	15.8						
Paradise Lake	06/19/06	11:38	6.18	58.7	8.47	100.3	24.4	6.1	ND	0.402	ND	1.32	10.04
Paradise Lake	07/19/06	10:22	5.70	72.9	7.14	88.2	26.7						
Paradise Lake	08/14/06	11:26	5.78	74.4	8.24	92.1	21.0	6.6	ND	0.413	ND	1.95	15.29
Paradise Lake	09/20/06	10:38	5.52	68.5	6.99	74.3	17.0						
Paradise Lake	10/16/06	10:24	5.03	69.1	9.73	84.8	9.1	7.8	ND	0.464	ND	1.77	9.32
Paradise Lake	11/20/06	10:27	4.17	65.8	8.74	89.5	8.6						
Paradise Lake	12/04/06	10:35	4.99	74.1	9.83	81.8	7.0	7.3	ND	0.722	ND	2.12	10.81
Pilgrim Lake	04/29/03	15:20	4.38	39.7			18.5						
Pilgrim Lake	05/20/03	14:15	4.58	52.1			18.2						
Pilgrim Lake	06/25/03	13:05	4.34	29.0			24.3						
Pilgrim Lake	07/14/03	13:55	4.78	27.0			23.8						
Pilgrim Lake	08/21/03	14:30	4.68	41.7			26.4						
Pilgrim Lake	10/20/03	13:15	4.51	44.5			13.3						
Pilgrim Lake	03/24/04	13:50	4.20	35.0			8.7						
Pilgrim Lake	04/20/04	11:40	3.90	39.8			18.9						
Pilgrim Lake	05/11/04	12:05	4.59	34.2			21.9						
Pilgrim Lake	06/09/04	14:40	4.65	31.5			24.7						
Pilgrim Lake	08/20/04	10:58	4.48	42.4			25.5						
Pilgrim Lake	09/14/04	11:45	4.72	29.6			22.7						
Pilgrim Lake	10/13/04	11:46	4.59	31.3			14.3						
Pilgrim Lake	03/22/05	11:40	4.58	34.4			9.5						
Pilgrim Lake	04/20/05	10:45	4.24	36.9			16.5						
Pilgrim Lake	05/10/05	11:21	4.58	32.4			16.3						
Pilgrim Lake	06/14/05	9:24	4.68	30.8			25.8						
Pilgrim Lake	07/13/05	9:44	4.65	35.8			25.1						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Pilgrim Lake	08/18/05	10:25	4.56	35.6			25.5						
Pilgrim Lake	09/07/05	9:01	5.08	35.4			21.3						
Pilgrim Lake	04/19/06	9:37	4.40	31.1	9.25	93.2	16.0						
Pilgrim Lake	05/11/06	9:01	4.73	28.3	9.05	95.7	17.6						
Pilgrim Lake	06/20/06	9:50	4.54	23.2	7.31	90.8	25.3	4.9	ND	0.061	ND	0.65	3.71
Pilgrim Lake	07/20/06	9:32	4.68	30.3	8.85	86.4	27.6						
Pilgrim Lake	08/15/06	10:36	4.34	29.4	7.80	83.4	23.3	4.9	ND	ND	ND	0.72	4.97
Pilgrim Lake	09/21/06	9:38	4.50	28.7	8.23	82.4	17.9						
Pilgrim Lake	10/16/06	14:08	4.31	37.0	8.16	82.9	13.0	7.4	ND	ND	ND	0.74	4.01
Pilgrim Lake	11/21/06	9:37	4.14	40.5	9.85	96.4	8.8						
Pilgrim Lake	12/05/06	9:08	4.02	44.3	9.86	86.7	5.0	7.4	ND	ND	ND	0.98	4.40
Presidential Lake	04/30/03	15:30	4.41	50.2			20.3						
Presidential Lake	05/21/03	14:50	5.14	59.8			17.5						
Presidential Lake	06/26/03	10:40	4.34	36.0			22.3						
Presidential Lake	07/16/03	10:35	4.45	38.0			23.2						
Presidential Lake	08/22/03	13:45	4.73	55.3			25.1						
Presidential Lake	10/20/03	16:20	4.85	47.7			13.7						
Presidential Lake	03/24/04	8:51	4.45	40.0			6.8						
Presidential Lake	04/19/04	10:00	4.73	44.8			17.6						
Presidential Lake	05/10/04	9:45	4.58	47.2			19.7						
Presidential Lake	06/08/04	9:30	4.78	45.1			20.7						
Presidential Lake	08/19/04	9:28	4.49	41.9			23.4						
Presidential Lake	09/13/04	9:30	4.93	50.8			20.4						
Presidential Lake	10/12/04	9:17	4.84	43.8			12.3						
Presidential Lake	03/21/05	9:16	4.67	42.7			8.6						
Presidential Lake	04/19/05	9:10	4.61	42.6			16.0						
Presidential Lake	05/09/05	9:25	4.78	43.3			16.0						
Presidential Lake	06/13/05	9:21	4.74	50.1			26.0						
Presidential Lake	07/12/05	9:17	4.72	55.0			24.5						
Presidential Lake	08/17/05	9:13	5.53	54.7			23.0						
Presidential Lake	09/06/05	9:47	5.70	87.2			20.6						
Shadow Lake	04/29/03	10:00	5.88	89.0			18.4						
Shadow Lake	05/20/03	10:05	6.00	83.3			16.2						
Shadow Lake	06/25/03	9:25	4.91	71.0			21.4						
Shadow Lake	07/14/03	10:30	6.67	70.0			22.1						
Shadow Lake	08/21/03	10:15	6.22	80.3			24.7						
Shadow Lake	10/20/03	15:30	6.34	82.3			14.4						
Shadow Lake	03/23/04	10:10	5.83	87.0			6.3						
Shadow Lake	04/19/04	11:30	5.25	92.8			19.2						
Shadow Lake	05/10/04	11:25	5.91	93.0			19.5						
Shadow Lake	06/08/04	11:25	6.03	82.9			23.5						
Shadow Lake	08/19/04	11:03	5.51	90.2			23.6						
Shadow Lake	09/13/04	11:00	6.02	88.6			21.9						
Shadow Lake	10/12/04	10:50	6.08	82.6			12.8						
Shadow Lake	03/21/05	10:43	6.07	89.8			9.7						
Shadow Lake	04/19/05	10:25	6.20	87.6			17.0						
Shadow Lake	05/09/05	11:03	7.57	91.6			18.1						
Shadow Lake	06/13/05	10:56	5.86	88.8			26.6						
Shadow Lake	07/12/05	11:11	5.80	88.7			25.5						
Shadow Lake	08/17/05	11:10	6.14	85.3			24.1						
Shadow Lake	09/06/05	11:57	6.61	80.1			23.4						
Shadow Lake	04/18/06	10:36	6.15	87.4	9.52	98.2	16.5						
Shadow Lake	05/10/06	11:16	5.83	82.4	8.03	84.5	18.0						
Shadow Lake	06/19/06	12:16	6.65	66.2	8.89	113.6	28.0	11.1	ND	ND	ND	2.44	11.78
Shadow Lake	07/19/06	11:21	6.04	72.4	7.76	80.5	26.9						
Shadow Lake	08/14/06	12:32	5.38	82.8	6.18	83.0	25.7	7.6	ND	0.138	ND	3.27	19.63
Shadow Lake	09/20/06	11:43	5.85	70.1	7.34	75.4	17.3						
Shadow Lake	10/16/06	11:15	5.39	95.7	8.23	88.2	11.2	12.4	ND	0.308	ND	3.93	12.25
Shadow Lake	11/20/06	11:26	5.78	67.6	9.54	90.3	8.8						
Shadow Lake	12/04/06	11:33	5.11	99.5	9.09	89.9	7.4	12.4	ND	0.275	ND	3.72	15.18
Success Lake	04/30/03	10:45	4.28	65.7			17.3						
Success Lake	05/21/03	10:35	4.95	59.4			16.7						
Success Lake	06/26/03	12:10	4.26	46.0			27.5						
Success Lake	07/16/03	15:15	4.09	42.0			26.9						
Success Lake	08/22/03	9:40	4.72	49.7			26.5						
Success Lake	10/20/03	9:35	4.70	53.7			12.3						
Success Lake	03/24/04	9:40	4.25	58.0			6.0						
Success Lake	04/20/04	13:55	3.77	61.5			21.2						
Success Lake	05/11/04	16:05	4.41	57.0			27.7						
Success Lake	06/10/04	14:00	4.79	51.1			28.4						
Success Lake	08/20/04	15:14	4.50	61.4			30.1						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Success Lake	09/14/04	15:05	4.56	45.6			21.8						
Success Lake	10/13/04	15:35	4.47	47.6			16.4						
Success Lake	03/22/05	15:10	4.34	56.8			10.4						
Success Lake	04/20/05	14:00	4.45	61.9			20.0						
Success Lake	05/10/05	15:23	4.38	54.6			17.7						
Success Lake	06/14/05	13:15	4.60	52.9			28.8						
Success Lake	07/20/05	9:35	4.61	57.1			27.1						
Success Lake	08/18/05	15:50	4.94	50.4			26.7						
Success Lake	09/07/05	13:29	4.91	56.3			23.5						
Success Lake	04/19/06	13:25	4.40	57.0	8.24	88.8	19.3						
Success Lake	05/11/06	12:40	4.53	53.0	8.01	83.5	16.9						
Success Lake	06/20/06	13:20	4.60	39.1	7.45	91.2	26.1	14.3	ND	ND	ND	0.95	6.52
Success Lake	07/20/06	13:28	4.44	51.2	7.98	80.2	26.9						
Success Lake	08/15/06	13:50	4.81	54.5	7.26	80.5	24.8	15.2	ND	ND	ND	1.19	13.02
Success Lake	09/21/06	13:32	4.36	55.3	7.78	77.3	17.2						
Success Lake	10/17/06	9:49	4.33	60.7	7.47	77.9	11.9	12.8	ND	ND	ND	1.40	7.07
Success Lake	11/21/06	13:33	3.94	61.3	8.98	90.2	8.4						
Success Lake	12/05/06	13:15	4.34	61.3	8.58	73.4	5.6	14.2	ND	ND	ND	1.55	7.01
Sunset Lake	04/29/03	11:55	6.47	58.4			20.8						
Sunset Lake	05/19/03	15:25	6.53	57.5			15.7						
Sunset Lake	06/24/03	14:55	6.00	49.0			30.4						
Sunset Lake	07/15/03	14:10	6.62	46.0			27.7						
Sunset Lake	08/25/03	14:05	6.65	65.4			26.2						
Sunset Lake	10/21/03	12:35	6.70	51.4			16.4						
Sunset Lake	09/13/04	14:10	6.67	50.4			26.9						
Sunset Lake	10/12/04	13:40	6.50	48.4			16.1						
Sunset Lake	03/21/05	13:20	6.40	57.3			9.5						
Sunset Lake	04/19/05	12:55	6.69	52.5			20.9						
Sunset Lake	05/09/05	13:40	6.91	53.9			20.9						
Sunset Lake	06/13/05	13:48	6.86	56.5			29.5						
Sunset Lake	07/12/05	13:39	6.49	45.9			30.3						
Sunset Lake	08/17/05	14:22	6.73	53.3			28.9						
Sunset Lake	09/06/05	14:28	6.92	62.5			25.2						
Sunset Lake	04/18/06	13:01	6.29	55.9	8.48	92.6	18.0						
Sunset Lake	05/10/06	14:58	4.68	65.1	8.61	85.6	19.8						
Sunset Lake	06/19/06	15:42	6.49	39.1	6.75	92.9	28.9	7.9	ND	ND	ND	0.84	6.00
Sunset Lake	07/19/06	15:02	4.72	68.1	8.54	86.7	27.8						
Sunset Lake	08/14/06	16:31	5.81	49.9	5.31	66.7	28.0	9.7	ND	ND	ND	1.24	9.48
Sunset Lake	09/20/06	15:26	4.53	64.7	8.15	80.1	18.1						
Sunset Lake	10/16/06	17:15	5.56	46.7	7.50	81.9	15.7	6.1	ND	ND	ND	1.12	6.24
Sunset Lake	11/20/06	15:07	3.68	53.7	9.84	84.6	9.8						
Sunset Lake	12/04/06	15:10	5.54	35.0	8.36	79.8	7.9	8.1	ND	0.386	ND	1.34	6.65
Taunton Lake	06/24/03	12:00	4.93	58.0			21.3						
Taunton Lake	07/15/03	11:00	5.93	59.0			24.8						
Taunton Lake	08/25/03	11:20	6.61	84.5			24.5						
Taunton Lake	10/21/03	10:30	6.13	71.2			14.5						
Taunton Lake	03/23/04	10:50	4.90	63.0			5.2						
Taunton Lake	04/19/04	12:30	5.17	70.5			18.6						
Taunton Lake	05/10/04	12:45	5.54	72.0			22.1						
Taunton Lake	06/08/04	12:25	5.96	76.7			24.1						
Taunton Lake	08/19/04	12:37	5.58	69.9			25.1						
Taunton Lake	09/13/04	12:10	5.78	68.6			23.0						
Taunton Lake	10/12/04	11:50	6.22	65.4			15.3						
Taunton Lake	03/21/05	11:10	5.32	80.1			8.7						
Taunton Lake	04/19/05	11:10	5.63	69.4			16.2						
Taunton Lake	05/09/05	11:51	5.52	75.2			16.7						
Taunton Lake	06/13/05	11:31	5.87	77.8			27.6						
Taunton Lake	07/12/05	11:41	5.62	75.2			26.4						
Taunton Lake	08/17/05	11:37	6.33	78.4			26.5						
Taunton Lake	09/06/05	12:41	6.81	79.9			24.3						
Timber Lakes - lower	04/29/03	11:45	6.37	76.4			20.4						
Timber Lakes - lower	05/19/03	15:30	6.41	71.9			15.8						
Timber Lakes - lower	06/24/03	15:00	6.07	55.0			29.0						
Timber Lakes - lower	07/15/03	14:20	6.67	60.0			26.1						
Timber Lakes - lower	08/25/03	14:15	6.71	73.0			27.0						
Timber Lakes - lower	10/21/03	12:00	6.53	66.2			16.3						
Timber Lakes - lower	03/23/04	13:50	6.44	70.0			8.2						
Timber Lakes - lower	04/19/04	14:10	6.47	65.5			20.8						
Timber Lakes - lower	05/10/04	14:15	6.71	72.7			22.7						
Timber Lakes - lower	06/09/04	11:35	6.67	69.3			25.8						
Timber Lakes - lower	08/19/04	15:00	6.75	68.5			27.5						

Impoundment	Date	Time	pH	SC (μS cm^{-1})	D.O. (mg L^{-1})	D.O. (%)	Temp. (ºC)	DOC (mg L^{-1})	NO_2-N (mg L^{-1})	NO_3-N (mg L^{-1})	PO_4-P (mg L^{-1})	SO_4-S (mg L^{-1})	Cl (mg L^{-1})
Timber Lakes - lower	09/13/04	13:45	6.56	66.0			26.0						
Timber Lakes - lower	10/12/04	13:24	6.27	62.5			15.4						
Timber Lakes - lower	03/21/05	13:09	6.46	85.4			10.4						
Timber Lakes - lower	04/19/05	12:40	6.56	73.4			19.4						
Timber Lakes - lower	05/09/05	13:23	6.67	75.8			19.9						
Timber Lakes - lower	06/13/05	13:36	6.90	75.4			29.1						
Timber Lakes - lower	07/12/05	13:29	6.36	65.0			30.4						
Timber Lakes - lower	08/17/05	14:10	6.79	72.5			28.4						
Timber Lakes - lower	09/06/05	14:16	6.74	67.7			25.1						
Turn Mill Pond	04/30/03	10:20	6.16	84.1			17.4						
Turn Mill Pond	05/21/03	10:20	6.62	85.1			16.7						
Turn Mill Pond	06/26/03	11:40	6.18	59.0			28.6						
Turn Mill Pond	07/16/03	15:30	6.06	64.0			27.7						
Turn Mill Pond	08/22/03	9:30	6.48	82.6			26.8						
Turn Mill Pond	10/20/03	9:25	6.60	89.3			12.6						
Turn Mill Pond	03/24/04	10:00	6.37	74.0			7.1						
Turn Mill Pond	04/20/04	16:20	5.91	84.5			20.4						
Turn Mill Pond	05/11/04	16:30	6.47	84.2			26.9						
Turn Mill Pond	06/10/04	14:30	6.81	83.5			27.8						
Turn Mill Pond	08/20/04	15:47	6.34	94.3			29.4						
Turn Mill Pond	09/14/04	15:25	6.12	70.4			23.7						
Turn Mill Pond	10/13/04	16:15	5.82	72.3			16.7						
Turn Mill Pond	03/22/05	15:30	6.24	86.4			12.0						
Turn Mill Pond	04/20/05	14:25	5.93	100.7			21.2						
Turn Mill Pond	05/10/05	15:48	6.23	88.1			19.9						
Turn Mill Pond	06/14/05	13:50	6.75	92.3			29.6						
Turn Mill Pond	07/20/05	9:15	6.70	80.6			28.6						
Turn Mill Pond	08/18/05	16:10	6.30	80.3			27.3						
Turn Mill Pond	09/07/05	14:00	5.89	90.2			26.3						
Turn Mill Pond	04/19/06	13:58	6.25	93.7	9.34	104.2	20.6						
Turn Mill Pond	05/11/06	13:23	6.24	83.4	8.68	82.1	18.1						
Turn Mill Pond	06/20/06	13:40	6.11	64.8	8.15	93.5	26.7	7.1	ND	ND	ND	1.67	12.77
Turn Mill Pond	07/20/06	14:58	6.16	78.9	8.42	83.3	28.2						
Turn Mill Pond	08/15/06	14:10	5.81	82.9	7.02	81.7	25.7	7.9	ND	ND	ND	1.70	22.11
Turn Mill Pond	09/21/06	15:03	5.98	76.2	8.18	79.2	18.5						
Turn Mill Pond	10/17/06	10:15	5.45	76.9	8.42	75.5	13.2	4.9	ND	ND	ND	1.85	12.65
Turn Mill Pond	11/21/06	15:03	5.14	81.3	9.42	93.3	9.2						
Turn Mill Pond	12/05/06	14:10	5.31	74.2	8.62	71.7	5.5	6.9	ND	0.179	ND	1.90	10.52
Victory Lake	04/29/03	12:05	6.53	60.7			20.9						
Victory Lake	05/19/03	15:20	6.41	58.4			19.5						
Victory Lake	06/24/03	14:45	6.25	50.0			29.7						
Victory Lake	07/15/03	14:00	6.56	50.0			28.3						
Victory Lake	08/25/03	14:00	6.73	68.3			27.5						
Victory Lake	10/21/03	12:25	6.81	57.8			16.2						
Victory Lake	03/23/04	13:55	6.58	50.0			8.4						
Victory Lake	04/19/04	14:20	6.06	56.6			22.6						
Victory Lake	05/10/04	14:25	6.81	57.6			25.1						
Victory Lake	06/09/04	11:30	6.63	53.4			27.2						
Victory Lake	08/19/04	15:06	6.98	59.8			28.3						
Victory Lake	09/13/04	13:55	6.77	55.4			25.9						
Victory Lake	10/12/04	13:33	6.48	53.1			15.4						
Victory Lake	03/21/05	13:14	6.56	62.8			9.8						
Victory Lake	04/19/05	12:45	6.67	56.3			19.8						
Victory Lake	05/09/05	13:30	6.91	56.1			20.0						
Victory Lake	06/13/05	13:42	6.98	63.4			30.0						
Victory Lake	07/12/05	13:35	6.56	52.5			31.4						
Victory Lake	08/17/05	14:14	6.72	60.0			29.2						
Victory Lake	09/06/05	14:19	6.83	57.7			25.3						
Wells Mills Lake	04/30/03	12:30	4.66	61.8			17.6						
Wells Mills Lake	05/21/03	12:30	4.65	49.8			16.3						
Wells Mills Lake	06/26/03	14:10	4.32	46.0			29.1						
Wells Mills Lake	07/16/03	13:30	4.84	40.0			26.3						
Wells Mills Lake	08/22/03	11:50	4.81	112.7			27.9						
Wells Mills Lake	10/20/03	11:00	4.64	55.6			12.1						
Wells Mills Lake	03/24/04	11:20	4.50	52.0			8.0						
Wells Mills Lake	04/20/04	14:30	4.64	58.4			21.3						
Wells Mills Lake	05/11/04	13:40	4.70	54.3			25.0						
Wells Mills Lake	06/10/04	12:00	4.61	55.8			26.8						
Wells Mills Lake	08/20/04	13:12	4.59	64.2			29.1						
Wells Mills Lake	09/14/04	13:45	4.91	36.8			23.7						
Wells Mills Lake	10/13/04	13:38	4.80	40.5			15.5						

Impoundment	Date	Time	pH	SC ($\mu S\ cm^{-1}$)	D.O. ($mg\ L^{-1}$)	D.O. (%)	Temp. (ºC)	DOC ($mg\ L^{-1}$)	NO_2-N ($mg\ L^{-1}$)	NO_3-N ($mg\ L^{-1}$)	PO_4-P ($mg\ L^{-1}$)	SO_4-S ($mg\ L^{-1}$)	Cl ($mg\ L^{-1}$)
Wells Mills Lake	03/22/05	13:30	4.69	47.8			10.8						
Wells Mills Lake	04/20/05	11:50	4.77	54.1			18.9						
Wells Mills Lake	05/10/05	13:23	4.61	53.4			18.1						
Wells Mills Lake	06/14/05	11:30	4.82	51.4			28.0						
Wells Mills Lake	07/13/05	11:58	4.55	54.5			26.1						
Wells Mills Lake	08/18/05	13:25	4.88	50.4			26.2						
Wells Mills Lake	09/07/05	11:18	5.22	48.2			22.2						
Wells Mills Lake	04/19/06	11:32	4.62	47.3	9.35	97.5	17.2						
Wells Mills Lake	05/11/06	11:00	4.88	42.9	10.08	105.8	17.5						
Wells Mills Lake	06/20/06	11:54	4.90	34.3	8.74	110.3	26.5	3.9	ND	0.061	ND	0.70	7.80
Wells Mills Lake	07/20/06	11:37	4.78	38.7	9.87	101.2	27.5						
Wells Mills Lake	08/15/06	12:02	4.72	36.2	8.76	89.1	24.9	3.9	ND	ND	ND	0.64	9.46
Wells Mills Lake	09/21/06	11:43	4.67	42.8	8.92	92.7	17.8						
Wells Mills Lake	10/17/06	8:30	4.62	51.5	9.47	85.5	11.5	5.2	ND	ND	ND	0.83	8.21
Wells Mills Lake	11/21/06	11:42	4.24	48.8	9.94	142.7	8.7						
Wells Mills Lake	12/05/06	11:40	4.33	57.4	9.12	68.9	5.1	6.1	ND	ND	ND	0.96	8.20

Appendix 4. Frequency of occurrence values for plant species found at 30 impoundments in the New Jersey Pinelands. Values represent the number of plots (10 maximum) where a species was found. Biogeographic classifications are based on Stone (1911) and include restricted-native (R), widespread-native (W), and nonnative (N) categories. Unclassified species are indicated with a hyphen. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Appendix 1 for site descriptions, and Appendix 7 for sample dates.

Species	Common Name		Group I										Group II				Group III				Group IV				Group V							
		Biogeography	Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
<u>Herbaceous plants</u>:																																
Acalypha gracilens	slender three-seeded mercury	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agrostis altissima	tall bent-grass	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
Agrostis sp.	upland bent-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
Ambrosia artemisiifolia	common ragweed	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Amphicarpaea bracteata	hog-peanut	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Andropogon virginicus var. *abbreviatus*	bushy beard-grass	W	-	-	-	-	2	1	1	-	1	-	1	-	1	9	-	-	1	1	1	-	1	2	-	-	-	-	-	-	-	-
Andropogon virginicus var. *virginicus*	broomsedge	W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apios americana	groundnut	W	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	3	-
Asclepias incarnata	swamp milkweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Aster nemoralis	bog aster	R	-	-	1	-	1	-	3	-	2	-	6	1	1	-	2	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-
Aster novi-belgii	New York aster	W	-	-	3	-	-	-	-	-	1	4	-	3	-	1	-	-	-	4	3	1	1	4	-	1	3	4	-	1	-	-
Aster sp.	aster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Bartonia paniculata	twining bartonia	W	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bartonia virginica	yellow bartonia	W	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bidens connata	purple-stemmed beggar ticks	N	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
Bidens coronata	northern tickseed-sunflower	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	6	1	1	-	-	-	2	-	-	6	-	-	-
Bidens discoidea	small beggar ticks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	-	-	-	-	-	-
Bidens sp.	beggar ticks	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	5	-	-	1	-	2	-	-	5	5	2	-	2	6
Boehmeria cylindrica	false nettle	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	4	7	3
Brasenia schreberi	water shield	R	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cabomba caroliniana	fanwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Callitriche heterophylla	larger water starwort	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	1	-	-	1
Carex albolutescens	greenish-white sedge	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-
Carex atlantica	Atlantic sedge	R	-	6	1	-	-	-	-	-	-	1	2	-	-	-	-	2	-	-	2	1	-	-	-	-	-	5	-	-	-	-
Carex atlantica var. *capillacea*	Howe's sedge	W	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex bullata	button sedge	R	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Carex comosa	bottle-brush sedge	N	-	-	-	-	1	-	-	1	-	-	4	-	-	1	-	-	-	-	2	2	-	1	7	-	-	-	-	1	-	2

Species	Common Name	Biogeography	Group I										Group II				Group III				Group IV				Group V							
			Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Carex crinita	fringed sedge	N	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex exilis	coast sedge	R	-	-	2	2	2	-	5	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Carex folliculata	long sedge	W	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex livida	livid sedge	R	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex lurida	sallow sedge	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	4	-
Carex pensylvanica	Pennsylvania sedge	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex striata	Walter's sedge	R	-	8	3	4	6	1	7	3	5	-	3	-	-	1	2	-	8	1	1	-	4	-	2	4	-	-	2	-	-	-
Carex stricta	tussock sedge	N	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	6	-	5	-	-	-	2	-	-	-	-	-	3	-	-
Carex trisperma	three-fruited sedge	R	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centaurea sp.	knapweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Ceratophyllum echinatum	prickly hornwort	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
Chasmanthium laxum	slender spike-grass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chrysopsis mariana	Maryland golden aster	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cinna arundinacea	wood-reed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Cladium mariscoides	twig-rush	R	-	1	2	-	4	-	-	2	-	-	-	-	2	1	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-
Commelina communis	Asiatic dayflower	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Cuscuta sp.	dodder	-	1	-	-	1	-	-	-	-	-	-	-	-	-	3	-	1	1	1	1	-	4	2	3	-	-	6	2	2	7	1
Cyperus dentatus	toothed cyperus	R	-	7	-	-	-	-	-	7	-	-	1	-	4	7	-	1	6	-	6	6	-	2	2	-	1	-	3	-	-	-
Cyperus retrorsus	Pine Barrens cyperus	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyperus strigosus	straw-colored cyperus	N	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-
Daucus carota	wild carrot	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Decodon verticillatus	swamp loosestrife	W	-	-	5	-	2	-	1	1	2	2	-	9	1	7	-	1	9	4	4	2	10	5	8	1	7	8	9	3	10	4
Desmodium sp.	tick trefoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Diodia teres	buttonweed	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drosera filiformis	thread-leaved sundew	R	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drosera intermedia	spatulate-leaved sundew	W	2	7	8	4	5	1	4	2	3	-	6	1	3	5	-	-	3	-	3	-	7	2	-	-	-	1	-	-	-	-
Drosera rotundifolia	round-leaved sundew	W	-	1	4	1	4	-	4	-	4	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	5	-	-	-	-
Dulichium arundinaceum	three-way sedge	N	8	8	7	2	7	1	-	9	2	-	2	3	6	9	2	1	2	5	1	-	6	1	5	2	-	1	6	4	-	-
Echinochloa muricata	American barnyard grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Eclipta prostrata	false daisy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4	1	-
Elatine minima	waterwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
Eleocharis acicularis	needle spike-rush	N	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	3	1	6	3	-	4	-	-	-	-	6	3	-	-
Eleocharis flavescens var. *olivacea*	green spike-rush	W	-	-	-	-	1	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Species	Common Name	Biogeography	Group I										Group II				Group III				Group IV				Group V							
			Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Eleocharis microcarpa	small-fruited spike-rush	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Eleocharis ovata	blunt spike-rush	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	1	5	3	-
Eleocharis palustris	creeping spike-rush	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Eleocharis robbinsii	Robbin's spike-rush	R	-	4	3	3	8	-	8	1	-	-	-	-	7	-	-	-	3	-	-	-	-	-	-	5	-	1	2	-	-	1
Eleocharis tenuis	slender spike-rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
Eleocharis tuberculosa	tubercled spike-grass	R	-	1	1	-	5	-	-	-	-	-	-	-	-	2	-	-	-	1	4	1	-	2	1	-	-	-	-	-	-	-
Elodea nuttallii	Nuttall's water-weed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Erechtites hieracifolia	pilewort	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Erigeron strigosus	rough fleabane	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Eriocaulon aquaticum	seven-angled pipewort	R	9	6	7	-	-	-	10	-	1	-	-	10	5	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	4
Eriocaulon parkeri	Parker's pipewort	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eriophorum virginicum	tawny cotton-grass	W	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eupatorium dubium	eastern joe-pye weed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-
Eupatorium pilosum	rough boneset	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eupatorium resinosum	pine barrens boneset	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-
Eupatorium rotundifolium	round-leaved boneset	W	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euthamia tenuifolia	slender-leaved goldenrod	W	-	2	-	-	-	-	-	1	-	-	1	-	1	1	-	-	2	-	2	2	1	2	-	-	-	-	2	-	-	-
Galium tinctorium	stiff marsh bedstraw	N	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	4	4	4	-	-	-	-	6	1	1	5	4	5	5	-
Glyceria obtusa	blunt manna-grass	W	-	-	3	-	-	-	-	2	-	2	2	-	1	1	-	2	2	3	2	4	4	3	7	2	-	5	5	1	-	-
Hibiscus moscheutos	swamp rose mallow	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-
Hypericum canadense	Canada Saint John's-wort	W	-	-	-	-	-	-	-	-	-	1	-	3	1	-	-	-	-	1	-	-	-	3	-	-	-	2	-	-	-	-
Hypericum mutilum	dwarf Saint John's-wort	N	-	-	1	-	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	1	5	2	1	4	-
Impatiens capensis	spotted touch-me-not	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	1	3	3	-	7	-
Iris prismatica	slender blue flag	W	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iris versicolor	larger blue flag	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	-	-	-	7	-	-	-	1
Juncus acuminatus	sharp-fruited rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Juncus biflorus	two-flowered rush	R	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juncus canadensis	Canada rush	W	-	1	-	1	-	-	1	3	-	-	2	-	3	3	-	-	6	4	4	2	1	4	4	-	-	-	4	-	-	-
Juncus effusus	common rush	W	3	-	5	-	-	-	-	-	-	6	1	-	-	4	-	-	5	3	-	1	-	5	6	3	1	4	5	4	1	-
Juncus militaris	bayonet rush	R	-	2	-	7	-	9	-	8	-	-	1	-	8	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
Juncus pelocarpus	brown-fruited rush	W	7	2	3	3	5	-	6	4	3	-	-	5	4	9	-	-	-	5	5	-	8	3	-	1	-	1	-	-	-	-
Juncus tenuis	slender rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Lachnanthes caroliniana	redroot	R	-	2	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

Species	Common Name	Biogeography	Group I										Group II				Group III				Group IV				Group V							
			Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Leersia oryzoides	rice cut-grass	N	-	2	3	1	2	-	1	6	1	4	3	6	3	6	-	3	4	4	7	6	5	4	9	4	4	8	8	10	4	1
Lemna sp.	duckweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	5	10	-
Lepidium virginicum	wild pepper-grass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Lobelia cardinalis	cardinal flower	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	6	-
Ludwigia alternifolia	seedbox	W	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	1	-	-	-
Ludwigia palustris	water purslane	N	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	2	-	4	-	1	2	-	1
Ludwigia sphaerocarpa	globe-fruited seedbox	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Lycopodium alopecuroides	foxtail-clubmoss	R	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lycopus amplectans	sessile-leaved water hoarhound	W	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lycopus uniflorus	northern bugleweed	N	-	-	3	-	-	-	-	-	-	5	1	5	1	2	-	3	-	4	10	9	-	4	9	3	1	4	3	-	1	-
Lycopus virginicus	Virginia bugleweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	6	1	1
Lysimachia terrestris	swamp loosestrife	W	-	-	4	1	-	-	1	1	-	3	2	5	3	6	-	3	7	5	2	1	2	1	3	1	1	3	6	3	-	1
Melilotus alba	white sweet clover	N	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Microstegium vimineum	stiltgrass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	2	-	2	2	-	-	-	5	-
Mikania scandens	climbing hempweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
Mitchella repens	partridge berry	N	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muhlenbergia uniflora	late-flowering dropseed	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Myriophyllum humile	low water milfoil	W	10	9	2	-	-	-	-	-	5	-	-	2	6	-	10	-	8	3	-	-	-	1	3	1	-	-	1	-	-	-
Najas quadelupensis	southern water-nymph	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Nuphar variegata	bullhead lily	R	-	3	6	9	2	-	-	6	7	-	-	5	-	3	5	-	9	1	-	7	-	8	10	-	5	9	6	7	1	6
Nymphaea odorata	white water lily	W	-	-	5	2	5	-	4	-	2	-	-	-	9	10	4	-	-	-	-	-	9	5	-	6	-	3	-	-	-	-
Nymphoides cordata	floating heart	W	-	-	-	-	-	-	-	-	-	-	3	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Onoclea sensibilis	sensitive fern	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5	-
Orontium aquaticum	golden club	R	-	-	-	-	-	-	-	3	1	-	7	-	4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Osmunda cinnamomea	cinnamon fern	W	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	4	1	1	-	-	-	1	-	1	1	-	1	-	-	-
Oxalis sp.	wood sorrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Oxypolis rigidior	cowbane	R	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Panicum clandestinum	deertongue grass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	4	1	-
Panicum longifolium	long-leaved panic-grass	R	2	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Panicum sp.	panic-grass	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	1	-	-	-	1	1	-	-
Panicum verrucosum	warty panic-grass	W	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	-	-	-	-	-	-
Panicum virgatum	switchgrass	W	3	7	-	-	-	-	-	1	1	1	-	-	-	4	2	1	2	-	1	3	1	3	-	-	-	-	1	-	-	-
Paspalum sp.	bead-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-

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Peltandra virginica	arrow arum	N	-	-	8	4	8	-	3	1	5	-	3	7	1	3	-	-	2	-	2	3	-	3	-	4	-	8	-	6	2	1
Phalaris arundinacea	reed canary grass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Phragmites australis	common reed	N	-	-	-	-	-	-	-	-	-	1	-	4	-	1	-	-	1	1	8	4	1	5	6	7	5	-	7	-	9	2
Pilea pumila	clearweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-
Plantago aristata	bracted plantain	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Pogonia ophioglossoides	rose pogonia	W	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygala brevifolia	short-leaved milkwort	R	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygala cruciata	cross-leaved milkwort	R	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygonum arifolium	halberd-leaved tearthumb	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
Polygonum hydropiperoides	mild water pepper	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	-	-	-	5	5	5	-
Polygonum lapathifolium	dock-leaved smartweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Polygonum pensylvanicum	Pennsylvania smartweed	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Polygonum punctatum	dotted smartweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Polygonum sagittatum	arrow-leaved tearthumb	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-	2	3	9	4	-
Polygonum sp.	smartweed	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Pontederia cordata	pickerel-weed	W	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	3	-	7	-	5
Potamogeton confervoides	alga-like pondweed	R	-	-	5	4	-	7	-	-	10	-	-	-	-	3	3	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Potamogeton diversifolius	hair-like pondweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	6	9	-	4	3	5	-	-	5
Potamogeton epihydrus	Nuttall's pondweed	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Potamogeton oakesianus	Oakes' pondweed	R	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton pusillus	small pondweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	1
Potamogeton sp.	pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Proserpinaca pectinata	cut-leaved mermaid-weed	R	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pteridium aquilinum	bracken	W	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	-	2	2	2	-	-	-	-	-	-	2	-	-	-
Rhexia mariana	Maryland meadow beauty	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Rhexia virginica	Virginia meadow beauty	W	2	1	-	1	-	-	-	-	-	-	-	2	-	2	-	-	1	-	2	1	-	4	-	-	-	-	-	-	-	-
Rhynchospora alba	white beaked-rush	R	-	5	2	-	5	-	7	-	4	-	5	1	4	6	1	-	1	1	-	-	7	1	-	-	-	5	-	-	-	-
Rhynchospora capitellata	small-headed beaked-rush	-	-	1	2	-	2	-	-	-	-	-	-	1	-	7	-	-	-	-	2	1	-	4	-	-	-	-	1	-	-	-
Rhynchospora chalarocephala	loose-headed beaked-rush	R	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	3	1	-	-	-	-	1	-	-	-	-	-	-	-
Rhynchospora macrostachya	horned beaked-rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
Sabatia difformis	lance-leaved sabatia	R	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagittaria engelmanniana	Engelmann's arrowhead	R	-	-	-	2	5	-	-	4	2	-	2	-	4	6	1	-	-	-	-	-	5	1	-	1	-	3	3	-	-	-
Sagittaria latifolia	broad-leaved arrowhead	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	-	-

Species	Common Name		Group I										Group II				Group III				Group IV				Group V							
		Biogeography	Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Sarracenia purpurea	pitcher plant	R	-	3	5	2	5	-	1	-	1	-	3	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Schizachyrium scoparium	little bluestem	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scirpus cyperinus	wool-grass	W	2	4	2	-	-	-	1	-	-	1	-	-	-	-	1	-	4	1	1	1	1	1	1	-	-	3	5	4	-	-
Scirpus pungens	three-square bulrush	W	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	1	-	-	-	-	-	-	-	1	-	-	1	1	-
Scirpus subterminalis	water club-rush	R	-	-	8	8	6	4	5	1	3	-	-	-	4	4	6	-	3	2	1	-	5	3	-	3	1	5	5	-	-	1
Sclerolepis uniflora	pink bogbutton	R	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scutellaria lateriflora	mad-dog skullcap	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	2	1	1	-
Solidago gigantea	late goldenrod	N	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Solidago odora	sweet goldenrod	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Solidago sp.	golden rod	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Sorghastrum nutans	indian grass	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sparganium americanum	slender bur-reed	R	-	4	2	-	-	-	-	1	-	-	-	-	1	2	1	-	-	-	-	-	1	2	1	3	1	3	3	-	-	-
Thelypteris palustris	marsh fern	N	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-
Triadenum virginicum	marsh Saint John's-wort	W	3	5	6	4	6	-	7	3	7	4	4	9	5	8	1	7	8	7	10	6	10	9	7	4	6	8	9	5	2	4
Typha latifolia	broad-leaved cat-tail	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	3	1	1	-
Utricularia cornuta	horned bladderwort	R	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utricularia fibrosa	fibrous bladderwort	R	-	-	-	2	3	1	3	-	-	-	-	-	-	-	5	-	-	-	-	-	-	2	-	-	-	1	9	-	-	-
Utricularia inflata	floating bladderwort	R	-	4	3	-	-	-	-	-	10	-	8	3	7	-	-	8	9	9	6	10	3	8	10	1	-	4	1	-	-	9
Utricularia juncea	rushlike bladderwort	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Utricularia purpurea	purple bladderwort	R	3	-	-	-	1	1	1	-	10	-	-	1	6	4	6	-	9	9	5	1	8	10	-	10	10	9	10	-	-	5
Utricularia subulata	zig-zag bladderwort	R	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Verbena hastata	blue vervain	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vernonia noveboracensis	New York ironweed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Viola lanceolata	lance-leaved violet	W	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-	1	-	4	4	-	-	5	-	-	-	-
Wolffia sp.	water-meal	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
Woodwardia areolata	netted chain fern	W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xerophyllum asphodeloides	turkey-beard	R	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xyris difformis	yellow-eyed grass	R	-	-	1	-	3	-	2	1	-	-	1	-	-	5	-	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-
Xyris smalliana	Small's yellow-eyed grass	R	-	3	-	4	-	2	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Woody plants</u>*:*																																
Acer rubrum	red maple	R	7	8	9	9	5	2	6	5	10	9	7	8	5	5	8	8	9	10	8	10	8	4	3	4	8	8	9	8	-	7
Albizia julibrissin	mimosa	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alnus serrulata	smooth alder	W	-	-	4	-	-	-	-	-	1	-	-	-	3	-	-	-	-	-	2	-	-	-	-	-	-	5	-	1	-	2

Species	Common Name		Group I										Group II				Group III				Group IV				Group V							
		Biogeography	Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Amelanchier canadensis	oblongleaf juneberry	W	-	1	3	-	-	1	-	-	2	1	3	-	1	-	-	1	-	2	-	4	-	-	-	-	1	-	1	1	-	-
Aronia arbutifolia	red chokeberry	W	-	1	2	6	3	3	2	-	6	3	5	1	2	-	5	4	3	6	2	7	1	1	-	3	-	-	4	6	-	8
Betula populifolia	gray birch	R	1	-	1	-	1	-	-	-	1	5	-	-	-	-	-	4	1	2	-	-	-	1	-	-	-	1	-	-	-	-
Cephalanthus occidentalis	buttonbush	W	-	-	-	-	-	-	-	-	1	5	3	1	1	4	-	-	2	2	4	5	-	3	-	1	2	7	-	3	-	1
Chamaecyparis thyoides	Atlantic white cedar	R	-	7	10	8	9	2	9	5	9	5	8	2	4	3	10	-	6	2	4	4	3	-	-	-	-	5	4	-	-	4
Chamaedaphne calyculata	leatherleaf	R	-	9	9	9	6	5	7	6	9	7	6	-	6	8	9	5	7	9	1	4	5	4	-	3	-	5	4	-	-	1
Clematis terniflora	yam-leaved clematis	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Clethra alnifolia	sweet pepperbush	W	2	5	8	5	8	5	6	2	10	7	7	9	2	8	8	5	8	10	8	9	8	7	2	4	5	8	6	10	-	7
Cornus florida	flowering dogwood	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Diospyros virginiana	persimmon	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Eubotrys racemosa	fetterbush	W	9	4	6	3	4	4	5	2	4	4	9	3	3	2	4	3	5	4	5	2	8	1	-	4	2	5	8	2	-	7
Gaultheria procumbens	wintergreen	W	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gaylussacia baccata	black huckleberry	W	-	-	-	3	-	-	-	-	-	1	2	1	-	-	4	1	-	1	2	1	-	-	-	-	-	-	-	-	-	-
Gaylussacia dumosa	dwarf huckleberry	R	-	-	-	1	4	2	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Gaylussacia frondosa	dangleberry	W	-	1	-	7	6	4	5	-	6	-	5	4	3	1	4	4	1	4	-	1	3	-	-	3	-	1	2	-	-	5
Hypericum densiflorum	bushy Saint John's-wort	R	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilex glabra	inkberry	R	3	2	1	6	9	4	3	-	3	1	7	2	3	1	3	1	6	3	2	3	-	-	-	3	1	1	-	-	-	4
Ilex laevigata	smooth winterberry	W	-	-	1	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilex opaca	American holly	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-
Ilex verticillata	winterberry	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
Itea virginica	Virginia willow	R	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Juniperus virginiana	red cedar	N	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kalmia angustifolia	sheep laurel	R	3	5	7	4	3	6	7	1	10	3	6	1	2	5	8	4	2	10	1	-	3	1	-	1	-	1	3	-	-	-
Kalmia latifolia	mountain laurel	W	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	7	1	5	-	-	1	-	-	-	-	-	-	-	-	-
Liquidambar styraciflua	sweet gum	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Lonicera japonica	Japanese honeysuckle	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-
Lyonia ligustrina	maleberry	W	-	1	3	-	1	1	-	-	4	1	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-
Lyonia mariana	staggerbush	R	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnolia virginiana	sweet bay	W	-	2	1	-	-	-	-	-	-	-	4	1	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	1
Myrica pensylvanica	bayberry	W	-	4	2	2	-	2	5	-	2	-	3	1	-	1	4	1	1	2	-	3	-	-	-	-	-	-	-	-	-	1
Nyssa sylvatica	black gum	W	1	2	-	2	1	-	1	-	3	2	4	4	-	-	-	4	5	4	-	4	4	3	-	3	1	-	2	1	-	5
Parthenocissus quinquefolia	Virginia creeper	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1	-	4	1
Pinus echinata	shortleaf pine	W	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-

Species	Common Name	Biogeography	Group I										Group II				Group III				Group IV				Group V							
			Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
Pinus rigida	pitch pine	R	5	3	1	8	8	1	-	1	2	5	7	3	1	2	3	4	7	5	4	8	1	1	-	1	-	1	-	-	-	3
Pinus virginiana	Virginia pine	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Prunus serotina	black cherry	N	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus alba	white oak	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Quercus ilicifolia	scrub oak	R	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus marilandica	black-jack oak	R	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Quercus phellos	willow oak	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Quercus prinus	chestnut oak	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Quercus sp.	oak	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus velutina	black oak	W	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
Rhododendron viscosum	swamp azalea	R	1	4	7	7	5	4	4	-	8	4	7	5	2	2	7	1	2	4	1	1	2	1	-	2	2	2	-	6	-	6
Rhus copallina	winged sumac	N	-	-	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robinia pseudoacacia	black locust	N	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosa multiflora	multiflora rose	N	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosa palustris	swamp rose	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	5	-	-
Rubus hispidus	swamp dewberry	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	3	-	-	1	-	-	1	-	-	-	-	-
Rubus sp.	blackberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-
Salix sp.	willow	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-
Sassafras albidum	sassafras	W	-	1	1	-	-	-	-	-	1	1	-	-	1	-	-	2	-	1	-	-	-	-	-	-	1	-	-	-	-	-
Smilax glauca	glaucous greenbrier	W	2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Smilax rotundifolia	common greenbrier	W	-	2	-	-	2	-	-	-	1	2	2	5	2	-	-	-	-	1	4	1	3	2	-	2	-	1	4	7	-	2
Spiraea sp.	Spiraea	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiraea tomentosa	steeplebush	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	2	-	-	-
Toxicodendron radicans	poison ivy	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	1	-	-	-
Vaccinium corymbosum	highbush blueberry	R	9	5	7	8	6	4	7	3	8	4	5	5	2	6	8	7	10	8	1	7	2	5	-	3	3	6	7	5	-	5
Vaccinium macrocarpon	large cranberry	R	5	8	3	2	5	-	2	1	2	3	1	-	-	6	-	-	-	2	-	1	2	2	1	-	-	-	1	-	-	-
Viburnum dentatum	southern arrowwood	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Viburnum nudum var. *nudum*	naked withe-rod	W	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Appendix 5. The number of diatom cells of each species collected at 20 impoundments in the New Jersey Pinelands in 2006. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group. Slides at Indian Mills Lake were heavily colonized by bryozoa and the diatom cells were largely broken. Refer to Appendix 1 for impoundment-site descriptions.

Species	Group I							Group II		Group III		Group IV			Group V					
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
Achnanthes subatomoides (Hust.) L.-B. & Archb.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Achnanthes sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Achnanthidium exiguum (Grun.) Czarn.	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	6
Achnanthidium minutissimum (Kütz.) Czarn.	-	-	12	-	-	-	-	-	-	-	8	4	2	54	2	10	41	64	52	16
Actinella punctata Lewis	50	6	2	3	6	57	-	17	-	-	2	-	-	-	8	-	-	-	-	-
Amphipleura pellucida (Kütz.) Kütz.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora ovalis (Kütz.) Kütz.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Amphora perpusilla (Grun.) Grun.	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Asterionella ralfsii W. Smith	16	2	27	-	3	-	2	-	52	-	-	-	-	-	-	-	-	-	-	-
Aulacoseira ambigua (Grun.) Simons.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-
Aulacoseira crassipunctata Krammer	-	-	-	-	35	174	5	12	44	6	34	-	2	13	16	2	1	-	1	2
Aulacoseira distans (Ehrenb.) Simons.	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	19	-	-	-
Aulacoseira distans var. *septentrionalis* Camburn and Charles	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aulacoseira granulata (Ehr.) Simons.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
Aulacoseira nygaardii (Camburn) Camburn & Charles	-	-	-	-	66	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aulacoseira paraglabra Camb.	-	-	-	-	-	-	-	18	3	-	-	-	4	-	2	-	-	-	-	-
Brachysira follis (Ehr.) Ross	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-
Brachysira serians (Brébisson ex Kützing) Round & Mann	-	2	2	2	1	-	-	-	-	8	6	-	2	-	-	-	-	1	-	-
Brachysira vitrea (Grun.) R. Ross	-	2	-	-	-	-	-	-	-	34	63	7	5	22	19	8	8	8	1	1
Caloneis lewisii Patr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Cavinula pseudoscutiformis (Hust.) Mann & Stickle	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chamaepinnularia mediocris (Krasske) Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Chamaepinnularia sp.	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Cocconeis pediculus Ehr.	-	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis placentula Ehr.	-	1	20	-	59	-	-	1	1	4	4	-	-	10	-	-	1	2	24	15
Cocconeis cf. *pseudothumensis* Reichardt	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Craticula sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Ctenophora pulchella Breb.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	8

Species	Group I							Group II		Group III		Group IV			Group V					
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
Cyclotella atomus Hust.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cyclotella meneghiniana Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	61
Cyclotella ocellata Pant.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cymbella affinis Kütz.	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbella cf. *aequalis* W. Sm. ex Grev.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Cymbella cuspidata Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Cymbella microcephala Grun.	-	-	-	-	-	-	-	-	-	-	-	-	1	5	-	-	-	-	-	-
Cymbella perpusilla A. Cleve	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Decussata placenta (Ehr.) Lange-Bert. & Metzeltin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Diadesmis confervacea Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	1
Discostella pseudostelligera (Hust.) Houk & Klee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Discostella stelligera (Cleve & Grunow) Houk & Klee	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
Encyonema lunatum (W. Sm.) V.H.	-	-	-	-	-	-	-	-	-	11	34	35	12	3	-	3	9	14	-	-
Encyonema minutum (Hilse in Rabenhorst) Mann	-	-	2	-	-	-	-	-	-	2	-	-	-	2	6	-	2	9	7	2
Entomoneis ornata (J. W. Bail.) Reim.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Eucocconeis flexella (Kütz.) Cl.	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Eunotia bidentula W. Sm.	-	30	-	6	-	1	-	-	1	-	-	-	1	-	-	-	-	-	-	-
Eunotia bigibba var. *pumila* Grun.	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Eunotia bilunaris (Ehrenberg) Mills	3	2	-	-	-	6	167	3	-	4	-	-	2	-	1	-	-	3	27	-
Eunotia carolina Patr.	-	-	2	-	-	16	2	-	-	61	86	-	3	-	6	-	69	4	-	1
Eunotia curvata (Kütz.) Lagerst.	-	-	-	1	-	2	-	-	-	-	-	-	-	3	1	-	20	-	-	-
Eunotia curvata fo. *bergii* Woodhead & Tweed	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia curvata var. *subarcuata* (Naegeli ex Kütz.) Woodhead & Tweed	-	1	1	3	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
Eunotia denticulata (Breb. ex Kütz.) Rabenh.	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia diadon Ehr.	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-
Eunotia exigua (Brébisson ex Kützing) Rabenhorst	-	-	-	-	11	-	157	2	-	-	2	-	-	-	-	-	2	-	-	1
Eunotia fallax A. Cleve	4	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia flexuosa Breb. ex Kutz.	33	6	-	3	1	1	1	-	2	29	48	203	82	78	-	170	3	44	-	-
Eunotia formica Ehr.	-	-	2	-	-	4	-	-	-	-	-	-	-	-	1	-	2	-	-	-
Eunotia incisa W. Sm. ex Greg.	-	-	2	53	1	-	105	2	39	-	-	5	2	17	63	21	-	36	118	3
Eunotia cf. *lapponica* Grun. ex A. Cleve	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Group I							Group II		Group III		Group IV			Group V					
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
Eunotia cf. *maior* (Smith) Rabenhorst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
Eunotia minor (Kütz.) Grun.	-	-	-	-	-	-	-	4	1	-	3	-	-	-	-	-	-	-	-	-
Eunotia naegelii Migula	112	26	19	79	-	7	-	294	2	116	1	28	288	18	6	25	87	43	2	-
Eunotia parallela Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Eunotia pectinalis (O. F. Müll) Rabh.	-	-	2	19	68	55	2	30	44	60	5	9	23	21	88	14	18	52	106	9
Eunotia perpusilla Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia rhomboidea Hust.	-	1	3	-	6	13	10	-	-	6	8	15	-	4	7	13	33	2	1	-
Eunotia serra Ehr.	-	1	-	-	4	1	-	-	1	-	-	-	-	-	-	-	-	1	1	-
Eunotia serra var. *diadema* (Ehr.) Patr.	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	18	-	-	1
Eunotia sp. (coarse, only girdle views)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Eunotia sp. (fine, only girdle views)	-	4	-	-	-	-	-	-	-	-	-	16	8	-	-	-	-	-	-	1
Fragilaria sp.	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Fragilaria vaucheriae (Kütz.) Peterson	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	2	9
Fragilariaforma constricta (Ehr.) Williams & Round	-	-	1	-	-	2	5	-	13	-	-	-	-	-	-	-	-	-	-	3
Fragilariaforma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Frustulia amphipleuroides (Grun.) Cleve-Euler	-	2	2	1	3	13	-	-	6	-	-	12	-	-	-	-	-	-	-	-
Frustulia pseudomagaliesmontana Camburn & Charles	-	4	7	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Frustulia rhomboides (Ehr.) De Toni	3	3	3	5	-	1	1	5	4	1	3	-	2	-	-	-	2	-	1	-
Frustulia crassinervia (Bréb) Lange-Bertalot & Krammer	2	9	13	6	17	2	-	9	5	6	27	43	2	8	1	11	10	13	1	-
Frustulia saxonica Rabh.	-	4	1	9	2	2	-	8	1	3	1	32	-	-	1	3	4	-	-	-
Frustulia sp.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Frustulia vulgaris (Thwaites) De Toni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Gomphonema acuminatum Ehr.	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	10	16	25	-	-
Gomphonema affine Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Gomphonema angustatum (Kütz.) Rabenh.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Gomphonema angustatum var. *sarcophagus* (Greg.) Grun.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema gracile Ehr.	-	-	2	-	-	-	-	-	-	29	2	-	1	2	-	-	1	2	10	-
Gomphonema intricatum Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Gomphonema parvulum (Kütz.) Kütz.	-	-	-	-	-	-	-	-	-	14	17	8	3	8	14	5	5	2	55	13
Gomphonema subclavatum (Grun.) Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1
Gomphonema truncatum Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

Species	Group I							Group II		Group III		Group IV			Group V					
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Gomphonema variostriatum Camburn & Charles	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-
Gomphonema sp.	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	8	1	-
Hantzschia amphioxys Eh.	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hippodonta hungarica (Grunow) Lange-Bert	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
Kobayasiella sp.	-	1	9	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lemnicola hungarica (Grun.) Round & Basson	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43
Melosira arentii (Kolbe) Nagumo & Kobayasi	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira varians Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Meridion circulare (Grev.) C.Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-
Navicula cryptocephala Kütz.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula cryptotenella Lange-Bert. ex Krammer et Lange-Bert.	-	-	1	-	-	-	-	-	-	2	-	1	-	2	-	-	27	-	2	2
Navicula cf. *leptostriata* Jorgensen	-	-	-	1	-	-	-	3	-	-	8	26	-	3	-	2	-	-	-	-
Navicula notha Wallace	-	-	-	2	-	-	-	-	-	-	-	-	-	7	-	-	-	6	-	-
Navicula radiosa var. *parva* Wallace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Navicula sp.	1	-	1	-	2	-	1	-	-	-	-	-	-	-	5	1	-	-	-	7
Neidium affine (Ehr.) Pfitz.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Neidium ampliatum (Ehr.) Krammer	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Neidium ladogense var. *densestriatum* (Østrup) Foged	-	-	-	-	-	8	4	-	3	-	-	-	-	-	-	-	-	-	-	-
Neidium sacoense Reim.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-	-
Neidium sp.	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia acicularis (Kütz.) W. Sm.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Nitzschia amphibia Grun.	-	-	-	-	-	-	6	4	-	-	-	-	-	-	-	-	-	-	3	17
Nitzschia cf. *vitrea* Norman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Nitzschia frustulum (Kütz.) Grun.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Nitzschia cf. *frustulum* var. *bulnheimiana* (Rabenh.) Grunow	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia microcephala Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Nitzschia palea (Kütz.) W. Sm.	-	-	-	-	-	-	24	-	-	6	-	-	-	-	2	-	-	-	4	8
Nitzschia paleacea (Grun. in Cleve & Grun.) Grun.	-	-	-	-	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	-
Nitzschia recta Hantzsch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Nitzschia scalaris (Ehr.)W. Smith	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Nitzschia sp.	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-	-	-	4	5

Species	Group I							Group II		Group III		Group IV			Group V					
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
Nupela sp.	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Opephora sp.	-	-	2	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Peronia heribaudi Brun and Per.	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-
Pinnularia abaujensis (Pant.) R. Ross	-	-	2	-	-	7	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Pinnularia biceps Greg.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia brauniana (Grun.) Mills	-	-	1	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia cf. *divergentissima* (Grun.) Cl.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	-	-	-	-
Pinnularia microstauron (Ehr.) Cl.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia microstauron var. *adirondackensis* Camburn & Charles	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Pinnularia pulchella (Boyer) Krammer	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Pinnularia rupestris Hantz.	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia subanglica Krammer	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia subcapitata Greg.	-	-	-	-	3	12	-	5	3	-	6	-	-	-	-	-	-	2	-	-
Pinnularia sp. (girdle view)	-	-	1	-	-	2	-	2	-	-	-	-	-	-	2	-	-	-	-	-
Placoneis exigua (Greg. ex Grun.) Meresch.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Placoneis gastrum (Ehrenberg) Meresch.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planothidium dubium (Grunow) Round & Bukht.	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planothidium lanceolatum (Bréb.) Lange-Bert.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Pseudostaurosira brevistriata (Grun.) Williams & Round	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	55
Rhoicosphenia curvata (Kütz.) Grunow	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Rossithidium pusillum (Grun.) Round & Bukhtiyarova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-
Sellaphora laevissima (Kütz.) Mann	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sellaphora pupula (Kütz.) Mer.	-	-	2	-	-	-	-	-	-	-	2	-	-	-	13	-	4	-	-	7
Sellaphora rectangularis (W.Greg.) Lange-Bert. & Metzeltin	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cf. *Sellaphora seminulum* (Grun.) D. Mann	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	15
Semiorbis hemicyclus (Ehrenb.) Patr.	-	-	2	-	4	8	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Stauroforma exiguiformis (Lange-Bert.) Flower, Jones & Round	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1	136	-	109	-	2
Stauroforma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Stauroneis anceps Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Stauroneis livingstonii Reim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Stauroneis phoenicenteron (Nitz.) Ehr.	-	-	2	-	-	-	-	-	-	1	1	-	-	-	1	-	2	-	-	-

Species	Group I							Group II		Group III		Group IV			Group V					
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
Stauroneis smithii var. *incisa* Pant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Staurosira construens Ehr.	-	-	85	-	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-
Staurosira construens var. *venter* (Ehr.) Hamilton	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	5	-	-	-
Staurosirella pinnata var. *lancettula* (Schumann) Siver & Hamilton	-	-	75	-	4	-	-	-	-	-	33	-	26	83	33	-	59	-	3	1
Staurosirella pinnata (Ehrenberg) Williams & Round	-	-	27	-	-	-	-	-	-	4	-	-	-	6	-	-	5	-	3	-
Stenopterobia curvula (W. Sm.) Kram.	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	2	-	-	-
Stenopterobia delicatissima (Lewis) Bréb. ex Van H.	-	4	-	-	3	-	-	2	2	2	-	-	-	-	-	-	-	-	-	-
Stenopterobia densestriata (Hust.) Krammer	-	-	-	-	-	-	-	1	-	-	10	18	2	-	-	-	-	-	-	-
Stenopterobia sp.	-	-	-	-	-	-	-	1	4	2	-	-	-	-	-	-	2	-	-	-
Surirella angustata Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Surirella linearis W. Sm.	-	-	2	-	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra cf. *famelica* Kutz.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-
Synedra radians Kutz.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	1	-
Synedra rumpens Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
Synedra rumpens var. *fragilariodes* Grunow in Van Heurck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142
Synedra ulna (Nitzsch) Ehr.	-	-	8	-	-	-	-	-	-	-	-	4	-	-	-	-	-	27	21	-
Tabellaria binalis (Ehr.) Grun. in Van Heurck	-	-	9	1	25	15	-	5	35	1	-	-	-	5	-	-	-	-	-	-
Tabellaria flocculosa (Roth.) Kütz.	-	5	-	1	-	-	-	-	2	22	12	18	4	57	140	45	6	3	-	7
Tabellaria quadriseptata Knudson	276	375	97	264	155	74	-	66	218	24	17	1	14	36	39	16	4	4	-	-
Total number of diatom cells counted	500	500	504	500	500	500	500	500	500	500	500	500	500	500	500	500	500	508	500	506

Appendix 6. Fish-abundance values for individual sample plots at 30 impoundments in the New Jersey Pinelands. Impoundments and species are ordered alphabetically. Refer to Table 11 for fish common names and Appendix 1 for impoundment-site descriptions.

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
Atsion Lake	1	-	1	-	-	-	1	-	-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	-	10
	2	-	1	-	2	-	1	1	-	1	-	-	-	2	-	2	-	2	-	-	-	-	-	-	12
	3	-	-	-	-	-	9	1	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	17
	4	-	-	-	-	-	-	-	-	-	-	1	-	5	-	1	-	-	-	-	-	-	-	-	7
	5	-	2	-	-	1	10	2	-	1	-	-	-	5	-	-	-	-	-	-	-	-	-	-	21
	6	-	1	-	-	-	3	3	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	10
	7	-	-	-	-	-	1	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	6
	8	-	1	-	-	-	-	4	2	1	4	1	-	5	-	-	-	-	-	-	-	-	-	-	18
	9	-	-	-	-	1	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	8
	10	-	1	-	-	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	8
Bamber Lake	1	-	-	-	-	-	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	21
	2	1	2	-	-	-	-	-	9	2	-	1	-	-	-	-	-	-	-	-	-	-	-	21	36
	3	-	1	-	-	1	1	-	10	4	-	1	-	-	-	-	-	-	-	-	-	-	-	4	22
	4	-	-	-	-	-	-	-	4	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	8
	5	-	-	-	-	2	11	-	20	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3	39
	6	-	-	-	-	-	1	-	3	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	8
	7	1	-	-	-	2	5	-	7	4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	22
	8	-	-	-	-	1	2	-	3	2	-	1	-	3	-	-	-	-	-	-	-	-	-	-	12
	9	-	-	-	-	1	-	-	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	5
	10	1	-	-	-	1	1	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	7
Batsto Lake	1	-	-	-	-	-	21	2	3	3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	32
	2	-	-	-	-	-	22	1	-	4	-	-	-	2	-	1	-	-	5	-	-	-	-	-	35
	3	-	-	-	1	-	5	1	-	1	-	4	-	-	-	-	-	-	1	-	-	-	-	-	13
	4	-	-	-	-	-	11	2	-	2	-	1	-	-	-	-	-	-	1	-	-	-	-	-	17
	5	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	8
	6	-	-	-	-	1	30	2	1	1	-	4	-	3	-	-	-	-	-	-	-	-	-	-	42
	7	-	-	-	-	-	14	9	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	25
	8	-	-	-	-	-	25	5	-	2	-	2	-	1	-	-	-	-	1	-	-	-	-	-	36
	9	-	-	-	1	-	25	-	-	2	-	1	-	3	-	-	-	-	1	-	-	-	-	-	33
	10	-	-	-	-	-	11	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13
Chatsworth Lake	1	-	-	-	-	-	1	-	3	1	-	-	-	38	-	-	-	-	-	-	-	-	-	-	43
	2	-	2	-	-	1	21	1	8	16	-	-	-	6	-	-	-	-	-	-	-	-	-	-	55
	3	-	-	-	-	-	6	-	7	2	-	-	-	10	-	-	-	-	-	-	-	-	-	-	25
	4	-	-	-	-	-	13	-	9	5	-	-	-	27	-	-	-	-	-	-	-	-	-	-	54
	5	-	-	-	-	-	19	2	14	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	41
	6	-	-	-	-	-	7	-	1	-	-	1	-	4	-	-	-	-	-	-	-	-	-	-	13
	7	-	-	-	-	1	34	5	9	7	-	1	-	1	-	-	-	-	-	-	-	-	-	-	58
	8	-	-	-	-	-	5	-	-	1	-	-	-	14	-	-	-	-	-	-	-	-	-	-	20
	9	-	-	-	-	-	2	-	-	2	-	-	-	5	-	-	-	-	-	-	-	-	-	-	9
	10	-	1	-	-	-	11	1	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	18
Country Lake	1	-	-	-	-	-	6	-	-	-	-	-	-	9	-	-	-	-	1	-	-	-	-	-	16
	2	1	-	-	-	-	2	-	1	2	-	-	-	8	-	-	-	1	-	-	-	-	-	-	15
	3	2	3	1	-	-	3	-	10	11	-	-	-	6	-	-	-	1	-	-	-	-	-	-	37
	4	-	-	-	-	-	-	-	-	5	-	-	-	4	-	-	-	-	-	-	-	-	-	-	9
	5	-	1	1	-	-	4	-	-	4	-	1	-	3	-	-	-	-	-	-	-	1	-	-	15
	6	-	-	1	-	-	-	-	1	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	7
	7	8	5	-	-	2	5	-	16	87	-	-	-	1	-	-	-	-	-	-	-	-	-	-	124
	8	1	8	12	-	4	-	-	14	85	-	-	-	3	-	-	-	-	-	-	-	-	-	-	127

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
	9	7	4	2	-	-	5	-	12	24	-	1	-	-	-	3	-	-	-	-	-	-	-	-	58
	10	4	4	102	-	-	-	-	3	4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	118
Crane Lake	1	-	-	4	-	-	-	5	-	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	13
	2	-	-	1	-	-	-	9	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	11
	3	-	1	4	-	-	-	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	10
	4	1	1	3	-	-	-	9	-	-	-	3	-	-	-	-	-	-	1	-	-	-	-	-	18
	5	-	-	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	1	-	-	-	-	-	5
	6	-	-	2	-	-	-	2	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	7
	7	-	-	-	-	-	-	15	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	18
	8	-	-	1	-	1	-	3	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	7
	9	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	1	-	2	-	-	-	-	-	6
	10	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	5	-	-	-	-	-	7
Davenport Imp.	1	-	3	-	-	-	-	-	24	5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	33
	2	-	1	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	15
	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3
	4	-	-	-	-	-	-	-	1	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	8
	5	-	1	-	-	-	-	-	10	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	15
	6	-	-	-	-	-	-	-	1	-	-	-	-	-	-	4	1	1	1	-	-	-	-	-	8
	7	-	-	-	-	-	-	-	-	2	1	-	-	-	-	2	4	1	1	-	-	-	-	-	11
	8	-	-	-	-	-	-	-	2	9	-	-	-	-	-	-	1	-	-	-	-	-	-	-	12
	9	-	-	-	-	-	-	-	2	4	1	1	-	-	-	-	2	-	2	-	-	-	-	-	12
	10	-	2	-	-	1	-	-	2	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-	9
Egg Harbor City Lake	1	1	6	-	-	-	1	-	6	7	-	1	-	2	-	-	-	-	-	-	-	-	-	-	24
	2	-	-	-	-	1	11	1	4	2	-	1	-	1	-	-	-	-	-	-	-	-	-	-	21
	3	-	2	-	-	1	5	-	5	4	-	1	-	2	-	-	-	-	-	-	-	-	-	-	20
	4	1	-	-	-	-	3	-	-	4	-	-	-	4	-	-	-	-	-	-	-	-	-	-	12
	5	-	1	-	-	-	5	-	6	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	17
	6	3	-	-	-	-	19	-	6	4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	37
	7	-	-	-	-	-	14	1	3	1	-	2	-	1	-	-	-	-	-	-	-	-	-	-	22
	8	1	1	-	-	1	5	1	6	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	20
	9	-	2	-	-	2	7	-	11	4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	29
	10	-	1	-	-	1	1	-	7	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	12
Hammonton Lake	1	-	-	-	-	-	-	1	-	1	-	-	-	3	-	-	2	44	3	18	-	2	-	-	74
	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	2	45	-	30	-	-	-	-	80
	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	5	1	27	-	-	-	-	-	-	35
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	37	3	1	-	-	-	-	43
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	25	1	-	-	-	-	-	27
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	27	-	20	-	1	1	-	50
	8	-	-	-	-	-	-	5	-	1	-	1	-	4	-	-	-	27	1	6	-	1	-	-	46
	9	-	-	-	-	-	-	2	-	-	-	-	-	-	-	20	10	5	3	-	-	-	-	-	40
	10	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	23	1	3	-	-	1	-	29
Horicon Lake	1	-	-	-	-	-	2	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
	2	-	-	-	-	-	7	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	3	-	-	-	-	-	17	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
	4	-	1	-	-	2	22	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
	5	-	1	-	-	9	12	-	10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
	6	-	-	-	-	-	7	-	5	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	16
	7	1	1	-	-	2	17	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
	8	-	-	-	-	6	5	-	17	2	3	1	-	19	-	-	-	-	-	-	-	-	-	5	58
	9	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	4

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
	10	-	-	-	-	1	14	-	11	4	-	1	-	1	-	-	-	-	-	-	-	-	-	-	32
Howardsville Imp.	1	-	-	-	-	-	-	-	26	-	-	-	-	41	-	-	-	-	-	-	-	-	-	-	67
	2	-	-	-	-	-	5	-	21	1	-	-	-	14	-	-	-	-	-	-	-	-	-	11	52
	3	-	-	-	-	-	2	-	28	3	-	1	-	3	-	-	-	-	-	-	-	-	-	1	38
	4	-	-	-	-	-	-	-	6	-	-	-	-	3	-	-	-	-	-	-	-	-	-	2	11
	5	-	-	-	-	-	-	-	14	-	-	-	-	6	-	-	-	-	-	-	-	-	-	1	21
	6	-	-	-	-	-	-	-	4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	5
	7	-	-	-	-	-	7	-	28	3	-	-	-	6	-	-	-	-	-	-	-	-	-	1	45
	8	-	-	-	-	-	2	-	18	1	-	1	-	7	-	-	-	-	-	-	-	-	-	2	31
	9	-	-	-	-	-	4	-	36	4	-	-	1	1	-	-	-	-	-	-	-	-	-	1	47
	10	-	-	-	-	-	1	-	21	-	-	-	-	4	-	-	-	-	-	-	-	-	-	7	33
Indian Mills Lake	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	6	-	-	-	-	-	-	10
	2	-	-	-	1	-	-	-	-	-	1	-	-	3	-	2	1	12	-	-	-	-	-	-	20
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	10	58	-	-	-	-	-	-	75
	4	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	2	13	-	-	-	-	-	-	19
	5	-	-	-	-	-	-	-	-	-	-	-	-	6	-	3	2	1	-	-	-	-	-	-	12
	6	-	-	-	-	-	-	-	-	-	-	-	-	1	-	9	5	26	-	-	-	-	-	1	42
	7	-	-	-	-	3	-	-	-	-	1	-	-	5	-	5	38	67	-	-	-	-	-	2	121
	8	-	-	1	-	3	-	-	-	-	-	-	-	10	-	-	25	116	-	-	-	-	-	-	155
	9	-	-	-	-	2	-	-	-	-	-	-	-	7	-	1	28	33	5	-	-	-	-	-	76
	10	-	-	1	-	1	-	-	-	-	-	-	-	16	-	1	9	65	1	-	-	-	-	-	94
Cushman Lake	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	7	31	-	-	-	-	1	-	43
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	8	-	-	-	-	-	-	21
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	24	41	-	-	1	-	-	-	72
	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	9	63	24	1	-	-	1	-	-	100
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	56	77	-	-	1	-	-	-	143
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	15	20	-	-	-	-	-	-	37
	7	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	10	23	-	-	-	-	-	-	37
	8	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	8	25	2	2	-	-	-	-	39
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	5	16	-	-	-	-	-	-	-	-	21
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	4	-	-	-	-	1	-	7
Jennings Lake	1	-	-	-	-	-	-	24	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	27
	2	-	-	-	-	-	-	19	-	-	-	3	-	-	-	-	-	-	1	-	-	-	-	-	23
	3	-	-	-	-	-	-	6	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	8
	4	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	6
	5	-	-	-	-	1	-	7	-	2	-	2	1	-	-	-	-	-	-	-	1	-	-	3	17
	6	-	-	-	-	-	-	24	-	-	1	1	-	-	-	-	3	-	3	-	-	-	-	-	32
	7	-	-	1	-	-	-	33	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	2	39
	8	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5
	9	-	-	-	-	-	-	11	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	14
	10	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4
Kettle Run Imp.	1	-	-	-	-	-	6	-	6	-	-	-	-	3	-	-	5	-	1	-	-	-	-	3	24
	2	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	6
	3	-	-	-	-	-	2	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	9
	4	-	-	-	-	-	3	-	1	1	-	-	-	7	-	1	3	-	-	-	-	-	-	1	17
	5	1	-	-	-	-	18	-	-	3	-	-	-	2	-	-	1	-	-	-	-	-	-	-	25
	6	-	-	-	-	-	1	-	-	3	-	-	-	3	-	-	1	-	1	-	-	-	1	-	10
	7	-	1	-	-	-	-	-	8	5	-	-	-	4	-	-	-	-	-	-	-	-	-	1	19
	8	-	-	-	-	-	1	-	-	-	-	-	-	4	-	2	-	-	-	-	-	-	-	-	7
	9	-	-	-	-	-	16	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1	20
	10	-	-	-	-	-	17	-	3	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	24

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
Lady's Lake	1	-	-	-	-	-	22	-	4	4	-	1	-	-	-	1	-	-	1	-	-	-	-	-	33
	2	-	1	-	-	-	15	-	5	2	1	1	-	-	-	-	-	-	5	4	-	-	-	1	35
	3	-	-	-	-	-	16	-	5	1	-	1	-	-	-	-	-	-	3	-	-	-	-	-	26
	4	-	-	-	-	-	21	-	8	3	-	4	-	2	-	-	-	-	1	-	-	-	-	-	39
	5	-	-	-	-	-	5	-	1	2	-	3	-	2	-	-	3	-	-	-	-	-	-	-	16
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7	2	-	-	-	-	-	11
	7	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	1	3	3	-	-	-	-	-	11
	8	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	9
	9	-	-	-	-	-	23	-	5	1	1	1	-	-	-	-	2	-	-	-	-	-	-	-	33
	10	-	-	-	-	-	6	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	12
Lake Absegami	1	-	-	-	-	-	-	-	10	6	-	3	-	-	-	-	-	-	-	-	-	-	-	-	19
	2	-	-	-	-	-	-	-	12	15	1	-	-	7	-	-	-	-	-	-	-	-	-	-	35
	3	-	-	-	-	-	-	-	2	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	6
	4	-	-	-	-	-	-	-	1	-	-	1	-	15	-	-	-	-	-	-	-	-	-	-	17
	5	-	-	-	-	-	-	-	-	-	-	1	-	14	-	-	-	-	-	-	-	-	-	-	15
	6	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	5
	7	-	-	-	-	-	-	-	15	8	-	-	-	13	-	-	-	-	-	-	-	-	-	-	36
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	20
	10	-	-	-	-	-	-	-	1	-	-	-	-	26	-	-	-	-	-	-	-	-	-	1	28
Lake Albert	1	-	-	-	-	-	1	1	1	-	-	-	-	17	-	14	3	40	-	-	-	-	-	-	77
	2	-	-	-	-	-	1	-	-	-	-	1	-	7	-	2	3	11	-	-	-	-	-	-	25
	3	-	-	-	-	1	1	2	-	-	-	3	-	-	-	1	23	26	-	-	-	-	-	-	57
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	-	-	-	-	-	-	6
	5	-	-	-	-	-	2	3	-	-	-	-	-	1	-	9	20	41	-	-	-	-	-	-	76
	6	-	-	-	-	-	1	-	-	-	-	-	-	4	-	7	22	7	-	-	-	-	-	-	41
	7	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	6	135	1	-	-	-	-	-	144
	8	-	-	-	-	-	1	-	-	-	-	-	-	2	-	20	25	8	-	-	-	-	-	-	56
	9	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	24	289	-	-	-	-	-	-	314
	10	1	-	-	-	-	13	1	-	-	-	-	-	8	-	-	-	25	-	-	-	-	-	-	48
Lake Fred	1	-	-	3	-	-	1	-	38	1	-	1	-	-	-	-	-	-	1	-	-	-	-	4	49
	2	-	1	-	-	-	29	-	11	4	-	-	-	1	-	-	-	-	1	-	-	-	-	3	50
	3	-	-	1	-	-	-	-	8	7	-	-	-	-	-	-	-	-	2	-	-	-	-	6	24
	4	-	-	-	-	-	-	-	5	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
	5	-	-	-	-	-	2	-	2	-	-	-	-	-	-	1	-	-	17	-	-	-	-	-	22
	6	-	-	-	-	-	17	-	13	5	-	-	-	4	-	-	-	-	4	-	-	-	-	-	43
	7	-	6	2	-	-	148	-	26	1	-	1	-	2	-	1	1	-	-	-	-	-	-	9	197
	8	-	-	-	-	-	1	-	5	-	-	3	-	3	-	1	-	-	2	-	-	-	-	-	15
	9	-	-	-	-	-	14	-	14	10	-	-	-	1	-	-	-	-	1	-	-	-	-	3	43
	10	-	1	-	-	-	32	-	12	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	48
Maple Lake	1	-	-	-	-	-	-	7	-	2	-	-	-	-	-	-	4	31	-	-	-	-	-	4	48
	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	17	1	-	-	-	-	3	24
	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	4	18	-	-	-	-	-	-	23
	4	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	6	27	1	-	-	-	-	2	38
	5	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	102	33	2	-	-	-	-	2	142
	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	10	1	1	-	-	-	-	-	13
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	8	2	-	-	-	-	-	14
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	16	-	-	-	-	-	-	24
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-	24
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	9	-	-	-	-	-	-	12
Mimosa Lake	1	-	1	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	5

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
	2	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	6	-	-	-	-	-	8
	3	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	6
	4	-	-	-	-	-	2	-	-	-	-	-	-	1	-	1	2	-	3	-	-	-	-	-	9
	5	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	7
	6	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	7	-	-	-	-	-	10
	7	-	-	-	-	-	-	-	2	-	-	-	-	14	-	-	-	-	2	-	-	-	-	-	18
	8	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	5
	9	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	5
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	5	-	-	-	1	-	9
Oswego Lake	1	-	-	-	-	-	3	-	-	1	3	-	-	7	-	-	-	-	-	-	-	-	-	-	14
	2	-	1	-	-	-	1	-	1	-	27	-	-	3	-	-	-	-	-	-	-	-	-	-	33
	3	-	4	-	-	-	-	-	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	4	-	-	-	-	-	2	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	4
	5	-	1	-	-	-	2	-	2	2	17	1	-	4	-	-	-	-	-	-	-	-	-	-	29
	6	-	-	-	-	-	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
	7	-	-	-	-	-	5	9	3	3	32	-	-	17	-	-	-	-	-	-	-	-	-	-	69
	8	-	-	-	-	-	13	13	5	3	6	1	-	3	-	-	-	-	-	-	-	-	-	-	44
	9	-	1	-	-	-	10	4	5	2	4	-	-	1	-	-	-	-	-	-	-	-	-	1	28
	10	-	-	-	-	-	3	2	2	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	10
Pakim Pond	1	-	-	-	-	-	-	-	15	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	20
	2	-	-	-	-	-	-	-	7	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
	3	-	-	-	-	-	-	-	5	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
	4	-	-	-	-	-	-	-	13	5	-	1	-	-	-	-	-	-	-	-	-	-	-	2	21
	5	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	6	-	-	-	-	-	-	-	9	13	-	1	-	-	-	-	-	-	-	-	-	-	-	-	23
	7	-	-	-	-	-	-	-	7	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13
	8	-	-	-	-	-	-	-	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
	9	-	-	-	-	-	-	-	4	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	8
	10	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Paradise Lake	1	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	1	-	1	-	-	-	-	-	5
	2	-	-	-	-	-	-	-	-	-	16	3	-	-	-	-	-	1	-	-	-	-	-	-	20
	3	-	-	-	-	-	2	1	-	1	5	1	-	-	-	-	-	15	-	2	-	-	-	-	27
	4	-	-	-	-	-	6	3	1	-	5	1	-	-	-	-	-	7	-	1	-	-	-	-	24
	5	-	-	-	-	-	5	1	-	-	9	3	-	-	-	-	2	-	-	-	-	-	-	-	20
	6	-	-	-	-	1	7	-	-	-	2	5	-	3	-	-	1	-	-	-	-	-	-	-	19
	7	-	-	-	-	-	23	-	4	-	2	2	-	-	-	-	-	-	-	-	1	-	-	4	36
	8	-	-	-	-	-	12	1	6	-	10	4	-	-	-	-	-	-	-	-	-	-	-	-	33
	9	-	-	-	-	-	2	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	6
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pilgrim Lake	1	-	1	-	-	-	7	3	7	-	16	-	-	4	-	-	-	-	-	-	-	-	-	1	39
	2	-	-	-	-	-	8	1	8	4	21	-	-	1	-	-	-	-	-	-	-	-	-	2	45
	3	-	1	-	-	-	11	1	10	5	2	1	-	-	-	-	-	-	-	-	-	-	-	4	35
	4	-	2	-	1	-	11	-	6	7	2	-	-	-	-	-	-	-	-	-	-	-	-	5	34
	5	-	1	-	-	-	5	-	4	6	5	1	-	1	-	-	-	-	-	-	-	-	-	4	27
	6	-	2	-	-	-	6	2	7	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	23
	7	-	1	-	-	-	12	1	3	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	22
	8	-	1	-	-	-	1	2	6	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	13
	9	-	1	-	1	-	1	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	7
	10	-	2	-	-	-	2	3	3	9	-	1	-	-	-	-	-	-	-	-	-	-	-	1	21
Shadow Lake	1	1	2	-	-	1	-	-	3	3	1	-	-	4	-	1	-	-	-	-	-	-	-	-	16
	2	-	-	-	-	-	-	-	17	3	3	-	-	6	-	-	1	-	-	-	-	-	-	4	34

Impoundment	Plot	*Acantharchus pomotis*	*Ameiurus natalis*	*Ameiurus nebulosus*	*Anguilla rostrata*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus gloriosus*	*Enneacanthus obesus*	*Enneacanthus species*	*Erimyzon oblongus*	*Esox niger*	*Esox species*	*Etheostoma fusiforme*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Lepomis species*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Noturus gyrinus*	*Perca flavescens*	*Pomoxis nigromaculatus*	*Umbra pygmaea*	Total
	3	1	-	-	-	4	-	-	3	3	-	1	-	-	-	-	1	-	-	-	-	-	-	-	13
	4	-	-	-	-	-	-	-	-	5	1	-	-	10	-	-	-	-	-	-	-	-	-	-	16
	5	1	-	-	-	1	-	-	10	1	7	1	-	17	-	-	-	-	-	-	-	-	-	-	38
	6	1	-	-	-	2	-	-	6	4	1	1	-	8	-	-	-	-	-	-	-	-	-	-	23
	7	-	-	-	-	2	-	-	6	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	13
	8	1	-	-	-	-	-	-	3	-	3	1	-	6	-	-	1	-	-	-	-	-	-	-	15
	9	-	-	-	-	-	-	-	5	3	-	1	-	-	-	1	1	-	-	-	-	-	-	-	11
	10	-	-	-	-	2	-	-	7	8	1	2	-	2	-	-	-	-	-	-	-	-	-	-	22
Success Lake	1	-	2	-	-	2	-	10	10	8	-	1	-	-	-	-	-	-	-	-	-	-	-	-	33
	2	-	1	-	-	1	-	4	3	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	12
	3	-	1	-	-	9	-	5	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
	4	-	5	-	-	3	-	9	25	11	-	-	-	3	-	-	-	-	-	-	-	-	-	3	59
	5	-	2	-	-	-	-	1	3	4	-	1	-	7	-	-	-	-	-	-	-	-	-	-	18
	6	1	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	17
	7	-	1	-	-	3	-	18	19	1	-	2	-	6	-	-	-	-	-	-	-	-	-	3	53
	8	-	2	-	-	1	-	3	6	7	-	-	-	4	-	-	-	-	-	-	-	-	-	-	23
	9	-	-	-	-	1	-	5	9	6	-	-	-	1	-	-	-	-	-	-	-	-	-	-	22
	10	-	2	-	-	-	-	4	22	20	-	1	-	1	-	-	-	-	-	-	-	-	-	-	50
Sunset Lake	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	1	-	-	-	-	-	4
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	3	-	-	-	-	-	5
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	8
	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
	5	-	-	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-	4	2	-	-	-	-	10
	6	-	-	-	-	2	-	-	4	1	-	-	-	-	-	-	-	-	1	-	-	-	-	3	11
	7	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-	-	-	6
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6	-	-	-	-	-	7
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	3
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	6	-	-	-	-	-	7
Turn Mill Pond	1	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	3	13	-	-	-	-	-	-	19
	2	-	-	-	-	-	-	-	-	7	-	-	-	4	1	-	-	3	2	-	1	-	-	-	18
	3	-	-	-	-	-	-	-	-	4	-	-	-	10	1	-	-	18	1	-	-	-	-	-	34
	4	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	16	-	-	-	-	-	-	19
	5	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	9	-	-	-	-	-	-	11
	6	-	-	-	-	-	-	6	-	1	-	1	-	2	1	-	1	4	2	-	1	-	-	-	19
	7	-	-	-	-	-	-	-	-	3	-	1	-	1	-	-	-	14	2	-	-	-	-	-	21
	8	-	1	-	-	-	-	-	-	1	-	1	-	1	3	-	2	3	-	-	-	-	-	-	12
	9	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	10	1	-	-	-	-	-	15
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	11	-	-	-	-	-	-	13
Wells Mills Lake	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3
	2	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	3	3	-	-	-	1	-	-	9	9	-	1	-	-	-	-	-	-	-	-	-	-	-	6	29
	4	1	-	-	-	-	-	-	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	5	-	1	-	-	-	-	-	4	10	-	4	-	-	-	-	-	-	-	-	-	-	-	1	20
	6	-	3	-	-	1	-	-	2	10	6	-	-	-	-	-	-	-	-	-	-	-	-	1	23
	7	1	4	-	-	-	-	-	5	1	2	1	-	-	-	-	-	-	3	-	-	-	-	-	17
	8	-	1	-	-	1	-	-	3	5	6	1	-	-	-	-	-	-	1	-	-	-	-	-	18
	9	-	-	-	-	-	-	-	5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	1	9
	10	-	-	-	-	-	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7

Appendix 7. Frequency of occurrence values for fish species collected from 30 impoundments in the New Jersey Pinelands. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, Table 11 for fish common names, and Appendix 1 for site descriptions.

			Restricted-native Species						Widespread-native Species						Nonnative Species							
Impoundment	Survey Date	Land-use Group	*Acantharchus pomotis*	*Ameiurus natalis*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus obesus*	*Etheostoma fusiforme*	*Anguilla rostrata*	*Enneacanthus gloriosus*	*Erimyzon oblongus*	*Esox niger*	*Noturus gyrinus*	*Umbra pygmaea*	*Ameiurus nebulosus*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Perca flavescens*	*Pomoxis nigromaculatus*
Howardsville Imp.	07/08/04	I	-	-	-	6	10	10	-	-	-	2	-	8	-	-	-	-	-	-	-	-
Pilgrim Lake	08/03/05	I	-	9	-	10	10	4	2	7	5	7	-	7	-	-	-	-	-	-	-	-
Bamber Lake	10/02/03	I	3	2	6	7	10	5	-	-	1	7	-	5	-	-	-	-	-	-	-	-
Oswego Lake	07/21/04	I	-	4	-	9	8	8	-	4	7	3	-	1	-	-	-	-	-	-	-	-
Pakim Pond	08/11/04	I	-	-	-	-	10	-	-	-	-	5	-	1	-	-	-	-	-	-	-	-
Lake Absegami	09/30/04	I	-	-	-	-	7	8	-	-	1	4	-	1	-	-	-	-	-	-	-	-
Wells Mills Lake	09/07/05	I	3	4	4	-	9	-	-	-	3	5	-	5	-	-	-	-	2	-	-	-
Chatsworth Lake	09/09/04	I	-	2	2	10	7	9	-	4	-	3	-	-	-	-	-	-	-	-	-	-
Horicon Lake	10/03/03	I	1	3	5	9	9	4	-	1	1	3	-	1	-	-	-	-	-	-	-	-
Country Lake	07/13/05	I	6	6	2	6	7	9	-	-	-	2	-	-	6	-	1	-	1	-	1	-
Atsion Lake	08/12/04	II	-	6	2	7	2	8	1	5	4	4	-	-	-	-	2	-	-	-	-	-
Maple Lake	09/21/05	II	-	-	-	-	-	-	-	6	-	-	-	4	-	-	-	9	5	-	-	-
Batsto Lake	08/24/05	II	-	-	1	10	2	5	2	7	1	8	-	-	-	-	1	-	7	-	-	-
Success Lake	09/05/03	II	1	8	7	-	10	6	-	9	-	4	-	3	-	-	-	-	1	-	-	-
Egg Harbor City Lake	09/14/05	III	4	6	5	10	9	8	-	3	-	9	-	-	-	-	-	-	-	-	-	-
Mimosa Lake	08/19/05	III	-	4	-	3	1	9	-	-	-	-	-	-	-	-	2	2	8	-	-	1
Lake Fred	07/22/04	III	-	3	-	8	10	5	-	-	-	3	-	6	3	-	3	1	7	-	-	-
Kettle Run Imp.	09/15/04	III	1	1	-	9	6	10	-	-	-	-	-	6	-	-	2	4	3	-	-	1
Lake Albert	09/16/04	IV	1	-	1	7	1	8	-	4	-	2	-	-	-	-	7	9	1	-	-	-
Cushman Lake	08/26/04	IV	-	-	-	-	-	1	-	4	-	-	2	-	-	1	8	9	2	1	1	2
Davenport Imp.	08/17/05	IV	-	4	1	-	9	2	-	-	3	1	-	2	-	-	2	5	6	-	-	-
Turn Mill Pond	09/11/03	IV	-	1	-	-	-	9	-	2	-	4	2	-	-	4	-	6	5	-	-	-
Shadow Lake	09/22/04	V	5	1	6	-	9	8	-	-	7	6	-	1	-	-	2	4	-	-	-	-
Paradise Lake	09/02/04	V	-	-	1	7	4	1	-	4	8	9	1	1	-	-	-	3	1	2	-	-
Sunset Lake	07/20/05	V	-	-	1	-	2	1	-	-	-	3	-	1	-	-	3	2	9	1	-	-
Crane Lake	07/21/05	V	1	2	1	-	-	1	-	9	1	6	-	-	6	-	3	3	8	-	-	-
Lady's Lake	08/04/04	V	-	1	-	9	8	2	-	-	2	7	-	1	-	-	1	5	6	1	-	-
Jennings Lake	08/05/04	V	-	-	1	-	-	-	-	10	1	8	3	3	1	-	-	3	2	-	-	-
Indian Mills Lake	07/28/04	V	-	-	4	-	-	8	1	-	3	-	-	2	2	-	9	10	2	-	-	-
Hammonton Lake	07/29/04	V	-	-	-	-	-	3	-	5	-	2	-	-	-	-	3	8	6	6	3	2
Overall			10	18	17	16	23	26	4	16	15	25	4	19	5	2	15	16	19	5	3	4

Appendix 8. Mean relative-abundance values for fish species collected from 30 stream impoundments in the New Jersey Pinelands. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, Table 11 for fish common names, and Appendix 1 for site descriptions.

			Restricted-native Species						Widespread-native Species						Nonnative Species							
Impoundment	Survey Date	Land-use Group	*Acantharchus pomotis*	*Ameiurus natalis*	*Aphredoderus sayanus*	*Enneacanthus chaetodon*	*Enneacanthus obesus*	*Etheostoma fusiforme*	*Anguilla rostrata*	*Enneacanthus gloriosus*	*Erimyzon oblongus*	*Esox niger*	*Noturus gyrinus*	*Umbra pygmaea*	*Ameiurus nebulosus*	*Fundulus diaphanus*	*Lepomis gibbosus*	*Lepomis macrochirus*	*Micropterus salmoides*	*Notemigonus chrysoleucas*	*Perca flavescens*	*Pomoxis nigromaculatus*
Howardsville Imp.	07/08/04	I	-	-	-	5.1	63.7	22.5	-	-	-	0.6	-	8.0	-	-	-	-	-	-	-	-
Pilgrim Lake	08/03/05	I	-	7.6	-	27.7	27.5	2.3	2.0	7.2	13.0	5.2	-	7.5	-	-	-	-	-	-	-	-
Bamber Lake	10/02/03	I	2.3	1.1	6.6	11.8	38.6	16.2	-	-	0.5	6.8	-	16.1	-	-	-	-	-	-	-	-
Oswego Lake	07/21/04	I	-	6.1	-	27.5	13.3	16.0	-	8.1	27.1	1.6	-	0.4	-	-	-	-	-	-	-	-
Pakim Pond	08/11/04	I	-	-	-	-	93.3	-	-	-	-	5.5	-	1.3	-	-	-	-	-	-	-	-
Lake Absegami	09/30/04	I	-	-	-	-	28.1	65.1	-	-	0.6	5.8	-	0.4	-	-	-	-	-	-	-	-
Wells Mills Lake	09/07/05	I	5.5	6.6	7.0	-	49.3	-	-	-	10.5	7.3	-	11.2	-	-	-	-	2.6	-	-	-
Chatsworth Lake	09/09/04	I	-	1.2	0.5	41.3	13.9	39.0	-	2.5	-	1.7	-	-	-	-	-	-	-	-	-	-
Horicon Lake	10/03/03	I	0.4	1.0	5.7	45.6	28.0	15.0	-	1.0	0.5	1.8	-	0.9	-	-	-	-	-	-	-	-
Country Lake	07/13/05	I	6.4	6.9	1.5	13.1	17.7	35.6	-	-	-	1.2	-	-	15.1	-	0.9	-	0.6	-	0.9	-
Atsion Lake	08/12/04	II	-	5.9	1.8	24.6	2.2	29.2	2.2	8.1	16.1	6.4	-	-	-	-	3.7	-	-	-	-	-
Maple Lake	09/21/05	II	-	-	-	-	-	-	-	11.3	-	-	-	10.2	-	-	-	71.0	7.5	-	-	-
Batsto Lake	08/24/05	II	-	-	0.2	70.8	1.3	3.3	1.2	8.7	0.4	8.4	-	-	-	-	0.3	-	5.3	-	-	-
Success Lake	09/05/03	II	0.6	7.0	9.9	-	41.2	10.2	-	23.5	-	1.8	-	4.7	-	-	-	-	1.0	-	-	-
Egg Harbor City Lake	09/14/05	III	3.3	7.7	3.4	35.6	29.8	10.8	-	1.6	-	7.9	-	-	-	-	-	-	-	-	-	-
Mimosa Lake	08/19/05	III	-	8.9	-	11.9	1.1	30.2	-	-	-	-	-	-	-	-	3.1	5.6	38.0	-	-	1.1
Lake Fred	07/22/04	III	-	0.7	-	31.3	40.9	3.7	-	-	-	2.3	-	6.6	1.3	-	1.2	0.1	12.0	-	-	-
Kettle Run Imp.	09/15/04	III	0.5	0.7	-	39.4	13.9	25.5	-	-	-	-	-	7.0	-	-	3.5	5.8	2.3	-	-	1.4
Lake Albert	09/16/04	IV	0.4	-	0.3	8.0	0.3	17.6	-	2.2	-	1.7	-	-	-	-	17.7	50.7	1.1	-	-	-
Cushman Lake	08/26/04	IV	-	-	-	-	-	0.7	-	3.2	-	-	0.5	-	-	2.4	20.5	65.4	1.6	1.4	0.1	4.2
Davenport Imp.	08/17/05	IV	-	5.7	1.7	-	42.1	8.8	-	-	3.8	1.3	-	1.0	-	-	8.2	17.3	10.1	-	-	-
Turn Mill Pond	09/11/03	IV	-	1.3	-	-	-	31.3	-	7.6	-	9.5	2.0	-	-	6.5	-	30.0	11.8	-	-	-
Shadow Lake	09/22/04	V	3.2	1.5	9.1	-	34.5	32.2	-	-	7.8	5.1	-	1.3	-	-	2.0	3.2	-	-	-	-
Paradise Lake	09/02/04	V	-	-	0.6	27.7	6.1	1.8	-	3.9	29.7	20.0	0.3	1.2	-	-	-	3.9	2.2	2.7	-	-
Sunset Lake	07/20/05	V	-	-	2.0	-	6.2	6.7	-	-	-	16.1	-	3.0	-	-	5.9	7.0	50.8	2.2	-	-
Crane Lake	07/21/05	V	0.6	1.6	1.4	-	-	2.9	-	40.2	0.6	7.8	-	-	13.9	-	8.8	3.7	18.7	-	-	-
Lady's Lake	08/04/04	V	-	0.3	-	49.3	12.5	2.0	-	-	0.6	7.3	-	0.3	-	-	0.3	14.0	12.1	1.2	-	-
Jennings Lake	08/05/04	V	-	-	0.7	-	-	-	-	75.6	0.3	11.6	3.7	3.0	0.3	-	-	3.3	1.4	-	-	-
Indian Mills Lake	07/28/04	V	-	-	2.1	-	-	23.8	1.3	-	3.9	-	-	1.0	0.6	-	22.3	43.5	1.5	-	-	-
Hammonton Lake	07/29/04	V	-	-	-	-	-	5.8	-	5.6	-	0.8	-	-	-	-	12.3	24.1	14.1	33.5	1.7	2.1

Appendix 9. Anuran-abundance values for 30 impoundments in the New Jersey Pinelands. Abundance values represent the number of vocalizing adults up to a maximum of ten individuals. For carpenter frogs and bullfrogs, shaded values indicate that larvae were present. Weather codes are 0 = clear, 1 = cloudy, 2 = overcast, 3 = fog/haze, 4 = breezy, 5 = drizzle, 6 = constant rain, 7 = showers, 8 = thunder storm occurred within one hour, and 9 = thunderstorm. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, and Appendix 1 for impoundment-site descriptions.

							Restricted-native Species		Widespread-native Species			Nonnative Species	
Impoundment	Land-use Group	Survey Date	Time	Weather	Air Temp. (deg. C)	Relative Humidity (%)	*Hyla andersonii* (Pine Barrens treefrog)	*Rana virgatipes* (carpenter frog)	*Bufo woodhousii fowleri* (Fowler's toad)	*Rana clamitans melanota* (green frog)	*Rana utricularia* (southern leopard frog)	*Acris c. crepitans* (northern cricket frog)	*Rana catesbeiana* (bullfrog)
Howardsville Imp.	I	06/14/05	11:10 PM	0	23.5	86.5	3	10	-	10	1	-	1
Pilgrim Lake	I	06/05/05	11:23 PM	0	21.0	90.0	-	10	2	2	-	-	-
Bamber Lake	I	06/14/05	10:33 PM	0	26.0	76.5	3	10	5	3	-	-	1
Oswego Lake	I	06/05/05	9:32 PM	0	22.5	82.5	-	10	3	-	-	-	-
Pakim Pond	I	06/05/05	9:30 PM	0	22.5	82.5	-	10	7	1	-	-	-
Lake Absegami	I	06/05/05	11:40 PM	0	20.5	90.0	4	6	4	1	3	-	-
Wells Mills Lake	I	06/14/05	11:40 PM	0,4	27.0	78.0	-	-	2	10	-	-	-
Chatsworth Lake	I	06/05/05	9:53 PM	0	22.0	82.5	-	6	3	2	-	-	-
Horicon Lake	I	06/14/05	9:55 PM	0	27.5	70.5	-	10	5	-	-	-	1
Country Lake	I	06/05/05	8:43 PM	0	25.0	76.5	-	-	2	-	-	-	-
Atsion Lake	II	06/09/05	9:05 PM	1,4	24.5	84.0	-	3	4	3	-	-	-
Maple Lake	II	06/07/05	10:25 PM	0	22.0	90.5	-	-	2	8	-	-	8
Batsto Lake	II	06/05/05	12:10 AM	0	20.5	90.0	-	10	2	1	-	-	1
Success Lake	II	06/14/05	9:25 PM	0	27.0	70.5	-	10	6	2	-	-	-
Egg Harbor City Lake	III	06/07/05	9:25 PM	0,4	25.5	74.0	-	10	2	4	2	-	1
Mimosa Lake	III	06/28/05	9:07 PM	2,4	24.5	84.0	-	-	1	5	-	-	2
Lake Fred	III	06/07/05	9:40 PM	0	25.5	76.5	-	-	5	-	1	-	4
Kettle Run Imp.	III	06/09/05	11:15 PM	0,4	24.0	84.0	-	8	-	10	1	-	-
Lake Albert	IV	06/07/05	11:25 PM	0,4	24.0	80.0	-	-	-	3	-	-	3
Cushman Lake	IV	06/07/05	11:40 PM	0,4	24.5	76.5	-	-	5	1	-	-	2
Davenport Imp.	IV	06/14/05	10:20 PM	0	28.0	71.0	-	10	-	-	-	-	3
Turn Mill Pond	IV	06/14/05	9:00 PM	0	27.0	70.5	-	-	6	5	-	-	3
Shadow Lake	V	06/09/05	9:35 PM	1,4	24.0	84.0	-	-	-	6	-	-	2
Paradise Lake	V	06/05/05	12:50 AM	0	20.0	90.0	-	4	2	4	-	-	7
Sunset Lake	V	06/07/05	12:25 AM	0	23.0	86.5	-	-	1	-	-	-	5
Crane Lake	V	06/07/05	12:10 AM	0	23.0	86.5	-	4	2	4	-	10	6
Lady's Lake	V	06/09/05	10:10 PM	1	23.5	84.0	-	-	3	4	-	-	4
Jennings Lake	V	06/09/05	11:40 PM	0,4	23.5	86.5	-	-	-	10	-	-	9
Indian Mills Lake	V	06/09/05	9:18 PM	1,4	24.5	80.0	-	-	-	3	-	-	4
Hammonton Lake	V	06/07/05	1:05 AM	0	23.0	88.0	-	-	-	-	-	2	4