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NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES

DISTRIBUTION OF PHYTOPLANKTON
IN WEST VIRGINIA LAKES

WORKING PAPER NO. 693

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
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by

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs. The Survey was designed to develop, in conjunction with State environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and State management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

The Survey collected physical, chemical, and biological data from 815 lakes and reservoirs throughout the contiguous United States. To date, the Survey has yielded more than two million data points. In-depth analyses are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes.

INTRODUCTION

The collection and analysis of phytoplankton data were included in the National Eutrophication Survey in an effort to determine relationships between algal characteristics and trophic status of individual lakes.

During spring, summer, and fall of 1973, the Survey sampled 250 lakes in 17 states. Over 700 algal species and varieties were identified and enumerated from the 743 water samples examined.

This report presents the species and abundance of phytoplankton in the 4 lakes sampled in the State of West Virginia (Table 1). The Nygaard's Trophic State (Nygaard 1949), Palmer's Organic Pollution (Palmer 1969), and species diversity and abundance indices are also included.

Table 1. Lakes Sampled in the State of West Virginia

STORET #	LAKE NAME	COUNTY
5401	Bluestone Reservoir	Summers
5402	Lake Lynn Reservoir (Cheat Lake)	Monongalia
5403	Summersville Reservoir	Nicholas
5404	Tygart Reservoir	Taylor

MATERIALS AND METHODS

LAKE AND SITE SELECTION

Lakes and reservoirs included in the Survey were selected through discussions with State water pollution agency personnel and U.S. Environmental Protection Agency Regional Offices (U.S. EPA 1975). Screening and selection strongly emphasized lakes with actual or potential accelerated eutrophication problems. As a result, the selection was limited to lakes:

(1) Impacted by one or more municipal sewage treatment plant outfalls either directly into the lake or by discharge to an inlet tributary within approximately 40 kilometers of the lake;

(2) 40 hectares or larger in size; and

(3) With a mean hydraulic retention time of at least 30 days.

Specific selection criteria were waived for some lakes of particular State interest.

Sampling sites for a lake were selected based on available information on lake morphometry, potential major sources of nutrient input, and on-site judgment of the field limnologist (U.S. EPA 1975). Primary sampling sites were chosen to reflect the deepest portion of each major basin in a test lake. Where many basins were present, selection was guided by nutrient source information on hand. At each sampling site, a depth-integrated phytoplankton sample was taken. Depth-integrated samples were a uniform mixture of water from the surface to a depth of 15 feet (4.6 meters) or from the surface to the lower limit of the photic zone representing 1 percent of the incident light, whichever was greater. If the depth at the sampling site was less than 15 feet (4.6 meters), the sample was taken from just off the bottom to the surface. Normally, a lake was sampled three times in 1 year, providing information on spring, summer, and fall conditions.

SAMPLE PREPARATION

Four milliliters (ml) of Acid-Lugol's solution (Prescott 1970) were added to each 130-ml sample from each site at the time of collection for preservation. The samples were shipped to the Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, where equal volumes from each site were mixed to form two 130-ml composite samples for a given lake. One composite sample was put into storage and the other was used for the examination.

Prior to examination, the composite samples were concentrated by the settling method. Solids were allowed to settle for at least 24 hours prior to siphoning off the supernatant. The volume of the removed supernatant and the volume of the remaining concentrate were measured and concentrations determined. A small (8 ml) library subsample of the concentrate was then taken. The remaining concentrate was gently agitated to resuspend the plankton and poured into a capped, graduated test tube. If a preliminary examination of a sample indicated the need for a more concentrated sample, the contents of the test tube were further concentrated by repeating the settling method. Final concentrations varied from 15 to 40 times the original.

Permanent slides were prepared from concentrated samples after analysis was complete. A drop of superconcentrate from the bottom of the test tube was placed in a ring of clear Karo Corn Syrup with phenol (a few crystals of phenol were added to each 100 ml of syrup) on a glass slide, thoroughly mixed, and topped with a coverglass. After the syrup at the edges of the coverglass had hardened, the excess was scraped away and the mount was sealed with clear fingernail polish. Permanent diatom slides were prepared by drying sample material on a coverglass, heating in a muffle furnace at 400° C for 45 minutes, and mounting in Hyrax. Finally, the mounts were sealed with clear fingernail polish.

Backup samples, library samples, permanent sample slides, and Hyrax-mounted diatom slides are being stored and maintained at the U.S. EPA's Environmental Monitoring and Support Laboratory-Las Vegas.

EXAMINATION

The phytoplankton samples were examined with the aid of binocular compound microscopes. A preliminary examination was performed to precisely identify and list all forms encountered. The length of this examination varied depending on the complexity of the sample. An attempt was made to find and identify all of the forms present in each sample. Often forms were observed which could not be identified to species or to genus. Abbreviated descriptions were used to keep a record of these forms (e.g., lunate cell, blue-green filament, Navicula #1). Diatom slides were examined using a standard light microscope. If greater resolution was essential to accurately identify the diatoms, a phase-contrast microscope was used.

After the species list was compiled, phytoplankton were enumerated using a Neubauer Counting Chamber with a 40x objective lens and a 10x ocular lens. All forms within each field were counted. The count was continued until a minimum of 100 fields had been viewed, or until the dominant form had been observed a minimum of 100 times.

QUALITY CONTROL

Internal quality control checks on species identifications and counts were performed on a regular basis between project phycologists at the rate of 7 percent. Although an individual had primary responsibility for analyzing a sample, taxonomic problems were discussed among the phycologists.

Additional quality control checks were performed on the Survey samples by Dr. G. W. Prescott of the University of Montana at the rate of 5 percent. Quality control checks were made on 75 percent of these samples to verify species identifications while checks were made on the remaining 25 percent of the samples to verify genus counts. Presently, the agreement between quality control checks for species identification and genus enumerations is satisfactory.

RESULTS

The Appendix summarizes all of the phytoplankton data collected from the State by the Survey. It is organized by lake, including an alphabetical phytoplankton species list with concentrations for individual species given by sampling date. Results from the application of several indices are presented (Nygaard's Trophic State, Palmer's Organic Pollution, and species diversity and abundance). Each lake has been assigned a four-digit STORET number. [STORET (STOrage and RETrieval) is the U.S. EPA's computer system which processes and maintains water quality data.] The first two digits of the STORET number identify the State; the last two digits identify the lake.

NYGAARD'S TROPHIC STATE INDICES

Five indices devised by Nygaard (1949) were proposed under the assumption that certain algal groups are indicative of levels of nutrient enrichment. These indices were calculated in order to aid in determining the surveyed lakes' trophic status. As a general rule, Cyanophyta, Euglenophyta, centric diatoms, and members of the Chlorococcales are found in waters that are eutrophic (rich in nutrients), while desmids and many pennate diatoms generally cannot tolerate high nutrient levels and so are found in oligotrophic waters (poor in nutrients).

In applying the indices to the Survey data, the number of taxa in each major group was determined from the species list for each sample. The ratios of these groups give numerical values which can be used as a biological index of water richness. The five indices and the ranges of values established for Danish lakes by Nygaard for each trophic state are presented in Table 2. The appropriate symbol, (E) eutrophic and (O) oligotrophic, follows each calculated value in the tables in the Appendix. A question mark (?) was entered in these tables when the calculated value was within the range of both classifications.

Table 2. Nygaard's Trophic State Indices adapted from Hutchinson (1967)

Index	Calculation	Oligotrophic	Eutrophic
Myxophycean	Myxophyceae / Desmideae	0.0-0.4	0.1-3.0
Chlorophycean	Chlorococcales / Desmideae	0.0-0.7	0.2-9.0
Diatom	Centric Diatoms / Pennate Diatoms	0.0-0.3	0.0-1.75
Euglenophyte	Euglenophyta / (Myxophyceae + Chlorococcales)	0.0-0.2	0.0-1.0
Compound	(Myxophyceae + Chlorococcales + Centric Diatoms + Euglenophyta) / Desmideae	0.0-1.0	1.2-25

PALMER'S ORGANIC POLLUTION INDICES

Palmer (1969) analyzed reports from 165 authors and developed algal pollution indices for use in rating water samples with high organic pollution. Two lists of organic pollution-tolerant forms were prepared, one containing 20 genera, the other, 20 species (Tables 3 and 4). Each form was assigned a pollution index number ranging from 1 for moderately tolerant forms to 6 for extremely tolerant forms. Palmer based the index numbers on occurrence records and/or where emphasized by the authors as being especially tolerant of organic pollution.

Table 3. Algal Genus Pollution Index (Palmer 1969)

	Pollution Index		Pollution Index
Anacystis	1	*Micractinium*	1
Ankistrodesmus	2	*Navicula*	3
Chlamydomonas	4	*Nitzschia*	3
Chlorella	3	*Oscillatoria*	5
Closterium	1	*Pandorina*	1
Cyclotella	1	*Phacus*	2
Euglena	5	*Phormidium*	1
Gomphonema	1	*Scenedesmus*	4
Lepocinclis	1	*Stigeoclonium*	2
Melosira	1	*Synedra*	2

Table 4. Algal Species Pollution Index (Palmer 1969)

	Pollution Index		Pollution Index
Ankistrodesmus falcatus	3	*Nitzschia palea*	5
Arthrospira jenneri	2	*Oscillatoria chlorina*	2
Chlorella vulgaris	2	*Oscillatoria limosa*	4
Cyclotella meneghiniana	2	*Oscillatoria princeps*	1
Euglena gracilis	1	*Oscillatoria putrida*	1
Euglena viridis	6	*Oscillatoria tenuis*	4
Gomphonema parvulum	1	*Pandorina morum*	3
Melosira varians	2	*Scenedesmus quadricauda*	4
Navicula cryptocephala	1	*Stigeoclonium tenue*	3
Nitzschia acicularis	1	*Synedra ulna*	3

In analyzing a water sample, any of the 20 genera or species of algae present in concentrations of 50 per ml or more are recorded. The pollution index numbers of the algae present are totaled, providing a genus score and a species score. Palmer determined that a score of 20 or more for either index can be taken as evidence of high organic pollution, while a score of 15 to 19 is taken as probable evidence of high organic pollution. Lower figures suggest that the organic pollution of the sample is not high, that the sample is not representative, or that some substance or factor interfering with algal persistence is present and active.

SPECIES DIVERSITY AND ABUNDANCE INDICES

"Information content" of biological samples is being used commonly by biologists as a measure of diversity. Diversity in this connection means the degree of uncertainty attached to the specific identity of any randomly selected individual. The greater the number of taxa and the more equal their proportions, the greater the uncertainty, and hence, the diversity (Pielou 1966). There are several methods of measuring diversity, e.g., the formulas given by Brillouin (1962) and Shannon and Weaver (1962). The method which is appropriate depends on the type of biological sample on hand.

Pielou (1966) classifies the types of biological samples and gives the measure of diversity appropriate for each type. The Survey phytoplankton samples are what she classifies as larger samples (collections in Pielou's terminology) from which random subsamples can be drawn. According to Pielou (1966), the average diversity per individual for these types of samples can be estimated from the Shannon-Wiener formula (Shannon and Weaver 1962):

$$H = -\sum_{i=1}^{S} P_i \log_x P_i,$$

where P is the proportion of the ith taxon in the sample, which is calculated from n_i/N; n_i is the number of individuals per ml of the ith taxon, N is the total number of individuals per ml and S is the total number of taxa.

However, Basharin (1959) and Pielou (1966) have pointed out that H calculated from the subsample is a biased estimator of the sample H, and if this bias is to be accounted for, we must know the total number of taxa present in the sample since the magnitude of this bias depends on it.

Pielou (1966) suggests that if the number of taxa in the subsample falls only slightly short of the number in the larger sample, no appreciable error will result in considering S, estimated from the subsample, as being equal to the sample value. Even though considerable effort was made to find and identify all taxa, the Survey samples undoubtedly contain a fair number of rare phytoplankton taxa which were not encountered.

In the Shannon-Wiener formula, an increase in the number of taxa and/or an increase in the evenness of the distribution of individuals among taxa will increase the average diversity per individual from its minimal value of zero. Sager and Hasler (1969) found that the richness of taxa was of minor importance in determination of average diversity per individual for phytoplankton and they concluded that phytoplankton taxa in excess of the 10 to 15 most abundant ones have little effect on H, which was verified by our own calculations. Our counts are in number per ml and since logarithms to the base 2 were used in our calculations, H is expressed in units of bits per individual. When individuals of a taxon were so rare that they were not counted, a value of 1/130 per ml or 0.008 per ml was used in the calculations since at least one individual of the taxon must have been present in the collection.

A Survey sample for a given lake represents a composite of all phytoplankton collected at different sampling sites on a lake during a given sampling period. Since the number of samples (M) making up a composite is a function of both the complexity of the lake sampled and its size, it should affect the richness of taxa component of the diversity of our phytoplankton collections. The maximum diversity (MaxH) (i.e., when the individuals are distributed among the taxa as evenly as possible) was estimated from $\log_2 S$, the total diversity (D) was calculated from HN, and the evenness component of diversity (J) was estimated from H/MaxH (Pielou 1966). Also given in the Appendix are L (the mean number of individuals per taxa per ml) and K (the number of individuals per ml of the most abundant taxon in the sample).

Zand (1976) suggests that diversity indices be expressed in units of "sits", i.e., in logarithms to base S (where S is the total number of taxa in the sample) instead of in "bits", i.e., in logarithms to base 2. Zand points out that the diversity index in sits per individual is a normalized number ranging from 1 for the most evenly distributed samples to 0 for the least evenly distributed samples. Also, it can be used to compare different samples, independent of the number of taxa in each. The diversity in bits per individual should not be used in direct comparisons involving various samples which have different numbers of species. Since MaxH equals log S, the expression in sits is equal to $\log_S S$ or 1. Therefore diversity in sits per individual is numerically equivalent to J, the evenness component for the Shannon-Wiener formula.

SPECIES OCCURRENCE AND ABUNDANCE

The alphabetic phytoplankton species list for each lake, presented in the Appendix, gives the concentrations of individual species by sampling date. Concentrations are in cells, colonies, or filaments (CEL, COL, FIL) per ml. An "X" after a species name indicates the presence of the species on that date in such a low concentration that it did not show up in the count. A blank space indicates that the organism was not found in the sample collected on that date. Column S is used to designate the examiner's subjective opinion of the five dominant taxa in a sample, based upon relative size and concentration of the organism. The percent column (%C) presents, by abundance, the percentage composition of each taxon.

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APPENDIX

SUMMARY OF PHYTOPLANKTON DATA

The Appendix format was computer generated. Because it was only possible to use upper case letters in the printout, all scientific names are printed in upper case and are not italicized.

The alphabetic phytoplankton lists include taxa without species names (e.g., EUNOTIA, EUNOTIA #1, EUNOTIA ?, FLAGELLATE, FLAGELLATES, MICROSYSTIS INCERTA ?, CHLOROPHYTAN COCCOID CELLED COLONY). When species determinations were not possible, symbols or descriptive phrases were used to separate taxa for enumeration purposes. Each name on a list, however, represents a unique species different from any other name on the same list, unless otherwise noted, for counting purposes.

Numbers were used to separate unidentified species of the same genus. A generic name listed alone is also a unique species. A question mark (?) is placed immediately after the portion of a name which was assigned with uncertainty. Numbered, questioned, or otherwise designated taxa were established on a lake-by-lake basis; therefore NAVICULA #2 from lake A cannot be compared to NAVICULA #2 from lake B. Pluralized categories (e.g., FLAGELLATES, CENTRIC DIATOMS, SPP.) were used for counting purposes when taxa could not be properly differentiated on the counting chamber.

LAKE NAME: BLUESTONE RES.
STORET NUMBER: 5401

NYGAARD TROPHIC STATE INDICES

DATE	07 18 73	09 26 73
MYXOPHYCEAN	01/0 E	2.00 E
CHLOROPHYCEAN	04/0 E	6.00 E
EUGLENOPHYTE	0.20 ?	0/24 ?
DIATOM	0.37 E	0.62 E
COMPOUND	09/0 E	9.67 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	07 18 73	09 26 73
GENUS	05	19
SPECIES	00	02

SPECIES DIVERSITY AND ABUNDANCE INDICES

	DATE	07 18 73	09 26 73
AVERAGE DIVERSITY	H	2.30	3.33
NUMBER OF TAXA	S	18.00	43.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	4.00
MAXIMUM DIVERSITY	MAXH	4.17	5.43
TOTAL DIVERSITY	D	1957.30	24375.60
TOTAL NUMBER OF INDIVIDUALS/ML	N	851.00	7320.00
EVENESS COMPONENT	J	0.55	0.61
MEAN NUMBER OF INDIVIDUALS/TAXA	L	47.28	170.23
NUMBER/ML OF MOST ABUNDANT TAXON	K	409.00	1851.00

LAKE NAME: BLUESTONE RES.
STORET NUMBER: 5401

CONTINUED

TAXA	FORM	07 18 73 S	07 18 73 %C	07 18 73 ALGAL UNITS PER ML	09 26 73 S	09 26 73 %C	09 26 73 ALGAL UNITS PER ML
ACTINASTRUM HANTZSCHII	COL					0.4	29
ANABAENA	FIL					0.4	29
APHANIZOMENON ?	FIL				1	25.3	1851
CLOSTERIOPSIS	CEL		4.0	34			
CLOSTERIUM ?	CEL						X
COCCONEIS PLACENTULA V. EUGLYPTA	CEL						X
COELASTRUM MICROPORUM	COL	4	4.0	34		1.6	116
CRUCIGENIA APICULATA	COL						X
CYCLOTELLA MENEGHINIANA	CEL			X	3	8.7	636
DACTYLOCOCCOPSIS	CEL					4.3	318
DICTYOSPHAERIUM PULCHELLUM	COL					0.4	29
DINOFLAGELLATE	CEL						X
EUGLENA	CEL			X			
FLAGELLATES	CEL	2	20.0	170	5	15.8	1157
FRAGILARIA	CEL			X			
FRAGILARIA CROTONENSIS	CEL	1	48.1	409			X
FRANCEIA	CEL						X
GYROSIGMA SPENCERII	CEL			X		0.4	29
MELOSIRA DISTANS	CEL						X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL			X		2.0	145
MELOSIRA VARIANS	CEL						X
MICROCYSTIS AERUGINOSA	COL						X
MICROCYSTIS INCERTA	COL						X
NAVICULA	CEL					0.8	58
NAVICULA #1	CEL			X			
NAVICULA #2	CEL			X			
NAVICULA #3	CEL						X
NITZSCHIA	CEL		4.0	34		3.2	231
OSCILLATORIA LIMNETICA	FIL	5	8.0	68		1.2	87
PANDORINA MORUM	COL						X

LAKE NAME: BLUESTONE RES. CONTINUED
STORET NUMBER: 5401

TAXA	FORM	07 18 73 S	07 18 73 %C	07 18 73 ALGAL UNITS PER ML	09 26 73 S	09 26 73 %C	09 26 73 ALGAL UNITS PER ML
PEDIASTRUM DUPLEX V. CLATHRATUM	COL						X
PEDIASTRUM SIMPLEX V. DUODENARIUM	COL						X
PEDIASTRUM TETRAS V. TETRAODON	COL						X
SCENEDESMUS #1	COL					1.6	116
SCENEDESMUS #2	COL					2.0	145
SCENEDESMUS #3	COL			X		0.4	29
SCENEDESMUS BIJUGA	COL					0.4	29
SCENEDESMUS DENTICULATUS	COL					1.2	87
SCENEDESMUS DIMORPHUS	COL						X
SCENEDESMUS INTERMEDIUS V. BICAUDATUS	COL					0.4	29
SCENEDESMUS OPOLIENSIS	COL					2.4	174
STAURASTRUM #1	CEL						X
STAURASTRUM #2	CEL						X
STEPHANODISCUS	CEL	3	8.0	68	2	21.3	1562
SURIRELLA	CEL						X
SYNEDRA #1	CEL			X			
SYNEDRA DELICATISSIMA	CEL				4	4.3	318
SYNEDRA ULNA V. RAMESI	CEL			X			
TETRAEDRON MINIMUM	CEL					1.2	87
TETRAEDRON MINIMUM V. SCROBICULATUM	CEL		4.0	34			
TREUBARIA	CEL					0.4	29
TOTAL				851			7320

LAKE NAME: LAKE LYNN RES.
STORET NUMBER: 5402

NYGAARD TROPHIC STATE INDICES

DATE	04 24 73		07 28 73		10 05 73	
MYXOPHYCEAN	0/01	O	0/0	O	0/02	O
CHLOROPHYCEAN	0/01	O	0/0	O	1.00	E
EUGLENOPHYTE	01/0	E	0/0	?	0/02	?
DIATOM	0/04	?	0/01	?	0/01	?
COMPOUND	1.00	O	0/0	O	1.00	O

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 24 73	07 28 73	10 05 73
GENUS	00	00	00
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

	DATE	04 24 73	07 28 73	10 05 73
AVERAGE DIVERSITY	H	1.92	0.00	1.47
NUMBER OF TAXA	S	9.00	2.00	7.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	3.17	1.00	2.81
TOTAL DIVERSITY	D	97.92	0.00	1198.05
TOTAL NUMBER OF INDIVIDUALS/ML	N	51.00	657.00	815.00
EVENESS COMPONENT	J	0.61	0.00	0.52
MEAN NUMBER OF INDIVIDUALS/TAXA	L	5.67	328.50	116.43
NUMBER/ML OF MOST ABUNDANT TAXON	K	21.00	657.00	441.00

LAKE NAME: LAKE LYNN RES. CONTINUED
STORET NUMBER: 5402

TAXA	FORM	04 24 73			07 28 73			10 05 73		
		S	%C	ALGAL UNITS PER ML	S	%C	ALGAL UNITS PER ML	S	%C	ALGAL UNITS PER ML
CLOSTERIUM	CEL		19.6	10						
COSMARIUM	CEL									X
EUGLENA	CEL		19.6	10						
EUNOTIA	CEL			X						
FLAGELLATE	CEL							3	8.1	66
FLAGELLATES	CEL		41.2	21						
GLENODINIUM ?	CEL					100.	657	1	35.1	286
KIRCHNERIELLA	CEL							2	54.1	441
MOUGEOTIA	FIL			X						
NAVICULA	CEL			X				4	1.3	11
PINNULARIA	CEL		19.6	10			X			
SCENEDESMUS	COL									X
STIGEOCLONIUM	FIL			X						
SYNEDRA ULNA	CEL			X						
XANTHIDIUM ?	CEL							5	1.3	11
TOTAL				51			657			815

LAKE NAME: SUMMERSVILLE RES.
STORET NUMBER: 5403

NYGAARD TROPHIC STATE INDICES

DATE	04 03 73	07 18 73	09 28 73
MYXOPHYCEAN	1.00 E	0/0 O	01/0 E
CHLOROPHYCEAN	1.00 E	01/0 E	02/0 E
EUGLENOPHYTE	0.50 E	0/01 ?	0/03 ?
DIATOM	0.37 E	1.00 E	0.60 E
COMPOUND	6.00 E	03/0 E	06/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 03 73	07 18 73	09 28 73
GENUS	03	04	02
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

	DATE	04 03 73	07 18 73	09 28 73
AVERAGE DIVERSITY	H	1.39	1.76	2.37
NUMBER OF TAXA	S	16.00	6.00	20.00
NUMBER OF SAMPLES COMPOSITED	M	4.00	4.00	4.00
MAXIMUM DIVERSITY	MAXH	4.00	2.58	4.32
TOTAL DIVERSITY	D	139.00	1293.60	4057.44
TOTAL NUMBER OF INDIVIDUALS/ML	N	100.00	735.00	1712.00
EVENESS COMPONENT	J	0.35	0.68	0.55
MEAN NUMBER OF INDIVIDUALS/TAXA	L	6.25	122.50	85.60
NUMBER/ML OF MOST ABUNDANT TAXON	K	60.00	317.00	579.00

LAKE NAME: SUMMERSVILLE RES. CONTINUED
STORET NUMBER: 5403

		04 03 73			07 18 73			09 28 73		
TAXA	FORM	S	%C	ALGAL UNITS PER ML	S	%C	ALGAL UNITS PER ML	S	%C	ALGAL UNITS PER ML
ACHNANTHES MICROCEPHALA ?	CEL			X						
CENTRIC DIATOM	CEL							5	33.8	579
CENTRITRACTUS ?	CEL									X
CYANOPHYTAN COCCOID CELLED COLONY	COL									X
CYCLOTELLA STELLIGERA	CEL			X	3	6.8	50	3	14.1	241
CYMBELLA	CEL			X						X
DESMID	CEL			X						
DINOBRYON BAVARICUM	CEL									X
DINOBRYON DIVERGENS	CEL									X
DINOBRYON SERTULARIA	CEL							2	28.2	482
DINOFLAGELLATE #1	CEL								0.7	12
DINOFLAGELLATE #2	CEL								1.4	24
EUNOTIA	CEL									X
FLAGELLATE	CEL							4	7.8	133
FLAGELLATES	CEL		20.0	20	2	43.1	317			
GOMPHONEMA	CEL			X						
GOMPHONEMA ?	CEL									X
MALLOMONAS	CEL								1.4	24
MELOSIRA #2	CEL			X						
MELOSIRA DISTANS	CEL			X						
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL				1	38.6	284	1	12.0	205
NAVICULA SPP.	CEL		60.0	60						
OSCILLATORIA	FIL			X						
PERIDINIUM WISCONSINENSE	CEL									X
SCENEDESMUS DIMORPHUS	COL								0.7	12
SCHROEDERIA SETIGERA	CEL									X
SPHAEROCYSTIS ? SCHROETERI	COL				5	2.3	17			
SYNEDRA #1	CEL				4	9.1	67			X
SYNEDRA #2	CEL			X						
SYNEDRA ULNA V. ?	CEL			X			X			

LAKE NAME: SUMMERSVILLE RES.   CONTINUED
STORET NUMBER: 5403

TAXA	FORM	04 03 73 S	04 03 73 %C	04 03 73 ALGAL UNITS PER ML	07 18 73 S	07 18 73 %C	07 18 73 ALGAL UNITS PER ML	09 28 73 S	09 28 73 %C	09 28 73 ALGAL UNITS PER ML
TABELLARIA FLOCCULOSA	CEL			X						X
TETRAEDRON REGULARE V. INCUS	CEL		20.0	20						
TRACHELOMONAS	CEL			X						
ULOTHRIX ?	FIL			X						
TOTAL				100			735			1712

LAKE NAME: TYGART RES.
STORET NUMBER: 5404

NYGAARD TROPHIC STATE INDICES

DATE	04 23 73	07 28 73	10 05 73
MYXOPHYCEAN	0/0 O	0/0 O	03/0 E
CHLOROPHYCEAN	0/0 O	02/0 E	03/0 E
EUGLENOPHYTE	0/0 ?	0/02 ?	0/06 ?
DIATOM	0.20 ?	01/0 E	1.50 E
COMPOUND	01/0 E	03/0 E	09/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 23 73	07 28 73	10 05 73
GENUS	00	00	09
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

	DATE	04 23 73	07 28 73	10 05 73
AVERAGE DIVERSITY	H	2.51	1.92	2.72
NUMBER OF TAXA	S	10.00	6.00	13.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	5.00
MAXIMUM DIVERSITY	MAXH	3.32	2.58	3.70
TOTAL DIVERSITY	D	529.61	399.36	2662.88
TOTAL NUMBER OF INDIVIDUALS/ML	N	211.00	208.00	979.00
EVENESS COMPONENT	J	0.76	0.74	0.74
MEAN NUMBER OF INDIVIDUALS/TAXA	L	21.10	34.67	75.31
NUMBER/ML OF MOST ABUNDANT TAXON	K	57.00	69.00	287.00

LAKE NAME: TYGART RES.
STORET NUMBER: 5404

CONTINUED

TAXA	FORM	04 23 73 S	04 23 73 %C	04 23 73 ALGAL UNITS PER ML	07 28 73 S	07 28 73 %C	07 28 73 ALGAL UNITS PER ML	10 05 73 S	10 05 73 %C	10 05 73 ALGAL UNITS PER ML
ANKISTRODESMUS	CEL					16.8	35			
CENTRIC DIATOM	CEL					33.2	69		3.5	34
CYCLOTELLA	CEL									X
CYMBELLA	CEL		1.4	3						
DACTYLOCOCCOPSIS	CEL								3.5	34
DINOBRYON SERTULARIA	CEL	1	27.0	57						
DINOFLAGELLATE	CEL								5.2	51
FLAGELLATE #1	CEL	4	23.7	50						
FLAGELLATE #2	CEL	2	25.6	54						
FLAGELLATES	CEL					16.8	35	2	12.1	118
GLENODINIUM	CEL	3	3.3	7						
GLENODINIUM #2	CEL					33.2	69			
GOMPHONEMA	CEL			X						
KIRCHNERIELLA	CEL									X
MELOSIRA DISTANS	CEL			X						
MELOSIRA VARIANS	CEL									X
MICROCYSTIS AERUGINOSA	COL							1	29.3	287
NAVICULA ?	CEL		4.7	10						
NITZSCHIA	CEL	5	6.2	13				5	6.8	67
PENNATE DIATOM	CEL		8.1	17						
PERIDINIUM	CEL						X			
PHORMIDIUM MUCICOLA	COL							3	17.3	169
SCENEDESMUS	COL							4	20.6	202
SCENEDESMUS INTERMEDIUS V. BICAUDATUS	COL						X			
SCHROEDERIA SETIGERA	CEL								1.7	17
SURIRELLA ANGUSTATA	CEL									X
TOTAL				211			208			979