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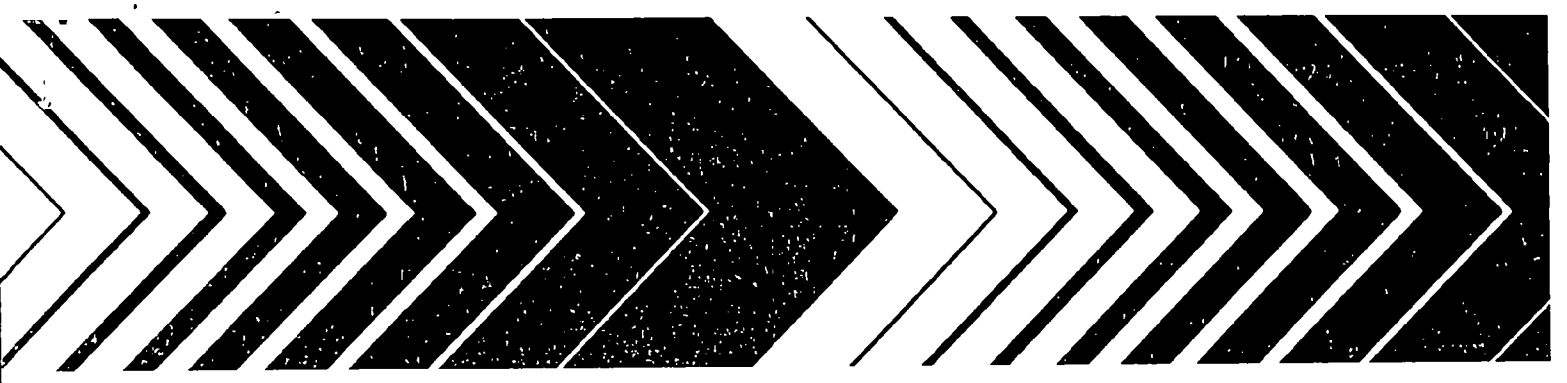
Distribution of Phytoplankton in Nebraska Lakes

Working Paper 699



DISTRIBUTION OF PHYTOPLANKTON IN NEBRASKA LAKES

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 watershed.

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.

CONTENTS

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 1974, the Survey sampled 179 lakes in 10 States. Over 700 algal species and varieties were identified and enumerated from the 573 water samples examined.

This report presents the species and abundance of phytoplankton in the 9 lakes sampled in the State of Nebraska (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 NEBRASKA

STORET No.	Lake Name	County
3101	Branched Oak	Lancaster
3102	Harlan County Reservoir	Harlan
3103	Harry D. Strunk (Medicine Creek)	Frontier
3104	Hugh Butler (Red Willow)	Frontier, Red Willow
3105	Johnson Reservoir	Dawson, Gosper
3106	Lake McConaughy	Keith
3107	Pawnee Lake	Lancaster
3108	Sherman County Reservoir	Sherman
3110	Swanson Reservoir	Hitchcock

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. Environmental Protection Agency 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. Environmental Protection Agency 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 uniform mixtures 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

To preserve the sample 4 milliliters (ml) of Acid-Lugol's solution (Prescott 1970) were added to each 130-ml sample from each site at the time of collection. 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 supernate. The volume of the removed supernate 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 ring of clear Karo® corn syrup with phenol (a few crystals of phenol were added to each 100 ml of syrup) was placed on a glass slide. A drop of superconcentrate from the bottom of the test tube was placed in the ring. This solution was 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 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.

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QUALITY CONTROL

Project phycologists performed internal quality control intercomparisons regularly on 7 percent of the species identification and counts. 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

A phytoplankton species list for the State is presented in Appendix A. Appendix B summarizes all of the phytoplankton data collected from the State by the Survey. The latter is organized by lake, and includes 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. Environmental Protection Agency'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 Appendix B. A question mark (?) following a calculated value in these tables was entered when that value was within the range of both classifications.

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

TABLE 2. NYGAARD'S TROPHIC STATE INDICES ADAPTED FROM HUTCHINSON (1967)

Index	Calculation	Oligotrophic	Eutrophic
Myxophycean	$\frac{\text{Myxophyceae}}{\text{Desmideae}}$	0.0-0.4	0.1-3.0
Chlorophycean	$\frac{\text{Chlorococcales}}{\text{Desmideae}}$	0.0-0.7	0.2-9.0
Diatom	$\frac{\text{Centric Diatoms}}{\text{Pennate Diatoms}}$	0.0-0.3	0.0-1.75
Euglenophyte	$\frac{\text{Euglenophyta}}{\text{Myxophyceae + Chlorococcales}}$	0.0-0.2	0.0-1.0
Compound	$\frac{\text{Myxophyceae + Chlorococcales + Centric Diatoms + Euglenophyta}}{\text{Desmideae}}$	0.0-1.0	1.2-25

TABLE 3. ALGAL GENUS POLLUTION INDEX (Palmer 1969)

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

TABLE 4. ALGAL SPECIES POLLUTION INDEX (Palmer 1969)

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

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.

In analyzing a water sample, any of the 20 genera or species of algae present in concentrations of 50 per milliliter 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 (1963). 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, the average diversity per individual (H) for these types of samples can be estimated from the Shannon-Wiener formula (Shannon and Weaver 1963):

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

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 milliliter 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. This was verified by our own calculations. Our counts are in number per milliliter 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 milliliter or 0.008 per milliliter 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 the 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 $\log_2 S$ (Pielou 1966), while the minimum diversity (MinH), was estimated from the formula:

$$\text{MinH} = -\frac{S-1}{N}\log_2\frac{1}{N} - \left[\frac{N-(S-1)}{N}\right]\log_2\left[\frac{N-(S-1)}{N}\right]$$

given by Zand (1976). The total diversity (D) was calculated from HN (Pielou 1966). Also given in Appendix B are L (the mean number of individuals per taxa per milliliter) and K (the number of individuals per milliliter of the most abundant taxon in the sample).

The evenness component of diversity (J) was estimated from H/MaxH (Pielou 1966). Relative evenness (RJ) was calculated from the formula:

$$\text{RJ} = \frac{\text{H-MinH}}{\text{MaxH-MinH}}$$

given by Zand (1976). Zand suggests that RJ be used as a substitute for both J and the redundancy expression given by Wilhm and Dorris (1968). As pointed out by Zand, the redundancy expression given by Wilhm and Dorris does not properly express what it is intended to show, i.e., the position of H in the range between MaxH and MinH. RJ may range from 0 to 1; being 1 for the most even samples and 0 for the least even samples.

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 taxa. 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 Appendix B, gives the concentrations of individual species by sampling date. Concentrations are in cells, colonies, or filaments (CEL, COL, FIL) per milliliter. An "X" after a species name indicates that the species identified in the preliminary examination was in such a low concentration that it did not appear 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 A

PHYTOPLANKTON SPECIES FOR THE STATE OF NEBRASKA

Achnanthes sp.
Actinastrum hantzschii
v. *fluviatile*
Anabaena sp.
Ankistrodesmus falcatus
Ankistrodesmus falcatus
v. *acicularis*
Ankistrodesmus falcatus
v. *mirabilis*
Aphanizomenon flos-aquae
Asterionella formosa
Caloneis lewisii
Carteria klebsii
Ceratium hirundinella
Ceratium hirundinella
f. *furcoides*
Ceratium hirundinella
f. *scotticum*
Chlamydomonas sp.
Chlorogonium sp.
Closterium sp.
Cocconeis placentula
Coelastrum cambricum
Coelastrum cambricum
v. *intermedium*
Coelastrum reticulatum
Coelosphaerium naegelianum
Cosmarium sp.
Crucigenia apiculata
Crucigenia rectangularis ?
Crucigenia tetrapedia
Cryptomonas erosa
Cryptomonas erosa
v. *reflexa*
Cryptomonas marssonii
Cryptomonas ovata
Cryptomonas reflexa
Cyclotella meneghiniana
Cyclotella stelligera
Cymatopleura elliptica
f. *spiralis*
Cymatopleura solea
Cymbella affinis
Cymbella tumida
Cymbella turgida
Dactylococcopsis irregularis
Denticula sp.
Diatoma elongatum
Diatoma vulgare
Dictyosphaerium pulchellum
Dinobryon divergens
Dinobyron sociale
v. *americanum*
Elakotothrix sp.
Epithemia sp.
Errerella bornhemiensis
Eudorina elegans
Euglena sp.
Fragilaria capucina
Fragilaria construens ?
Fragilaria crotonensis
Fragilaria intermedia ?
Fragilaria leptostauron
Franceia sp.
Glenodinium gymnodinium
Glenodinium gymnodinium
v. *biscutelliforme*
Glenodinium oculatum
Gloeocystis ampla ?
Gomphonema olivaceum
Gymnodinium albulum
Gymnodinium ordinatum
Gyrosigma sp.
Hantzschia amphioxys
f. *capitata*
Kirchneriella sp.
Lagerheimia quadriseta
Lepocinclis sp.
Lyngbya sp.
Mallomonas caudata
Melosira distans
Melosira granulata
Melosira granulata
v. *angustissima*
Melosira italica
Melosira varians
Merismopedia minima
Merismopedia tenuissima
Mesostigma viridis
Micractinium pusillum
Microcystis aeruginosa
Microcystis incerta
Mougeotia sp.
Navicula latens ?
Navicula radiosa
Neidium ? sp.
Nitzschia filiformis
Nitzschia palea
Nitzschia sigmoidea
Qocystis sp.

Ophiocytium capitatum
Oscillatoria limnetica
Oscillatoria tenuis
Pandorina morum
Pandorina protuberans
Pediastrum boryanum
Pediastrum duplex
Pediastrum duplex
v. *clathratum*
Pediastrum duplex
v. *reticulatum*
Pediastrum duplex
v. *rotundatum*
Pediastrum simplex
v. *duodenarium*
Pediastrum tetras
Pediastrum tetras
v. *tetraodon*
Peridinium inconspicuum
Phacus acuminatus
Phacus longicauda
Phacus megalopsis
Pinnularia sp.
Raphidiopsis curvata
Rhoicosphenia sp.
Rhopalodia gibba
Scenedesmus abundans
Scenedesmus acuminatus
Scenedesmus arcuatus
Scenedesmus balatonicus ?
Scenedesmus bicaudatus
Scenedesmus bijuga
Scenedesmus bijuga
v. *flexuosus*
Scenedesmus dimorphus
Scenedesmus intermedius
Scenedesmus obliquus
Scenedesmus opoliensis
Scenedesmus protuberans
Scenedesmus quadricauda
Scenedesmus raciborskii
f. *granulatas*
Schroederia setigera
Sphaerocystis schroeteri
Staurastrum chaetocerus
Stephanodiscus astraea
Stephanodiscus niagarae
Surirella angustata
Surirella ovata
Synedra acus
Synedra rumpens
Synedra ulna
Tetraedron caudatum
Tetraedron caudatum
v. *longecornutum*
Tetraedron hastatum
Tetraedron minimum
Tetraedron muticum
Tetraedron trigonum
v. *gracile*
Tetrastrum ? glabrum
Tetrastrum elegans
Tetrastrum heteracanthum
Tetrastrum staurogeniaeforme
Trachelomonas abrupta ?
Trachelomonas ensifera
Trachelomonas fluviatilis
Trachelomonas intermedia
Trachelomonas planctonica
Trachelomonas schauinslandii
Trachelomonas verrucosa
Trachelomonas volvocina
Wislouchiella sp.

APPENDIX B. SUMMARY OF PHYTOPLANKTON DATA

This appendix was generated by computer. 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, FLAGELLATE, FLAGELLATES, MICROCYSTIS 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: BRANCHED OAK
STORET NUMBER: 3101

NYGAARD TROPHIC STATE INDICES

DATE	04 17 74	07 02 74	09 26 74
MYXOPHYCEAN	03/0 E	04/0 E	4.00 E
CHLOROPHYCEAN	07/0 E	12/0 E	8.00 E
EUGLENOPHYTE	0.10 ?	0.12 ?	0/12 ?
DIATOM	0.17 ?	0.67 E	1.50 E
COMPOUND	12/0 E	20/0 E	15.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 17 74	07 02 74	09 26 74
GENUS	02	03	10
SPECIES	03	03	02

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 17 74	07 02 74	09 26 74
AVERAGE DIVERSITY	H	1.34	2.93	2.85
NUMBER OF TAXA	S	23.00	30.00	21.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.52	4.91	4.39
MINIMUM DIVERSITY	MINH	0.02	0.10	0.04
TOTAL DIVERSITY	D	27333.32	11605.73	22942.50
TOTAL NUMBER OF INDIVIDUALS/ML	N	20398.00	3961.00	8050.00
EVENESS COMPONENT	J	0.30	0.60	0.65
RELATIVE EVENESS	RJ	0.30	0.59	0.65
MEAN NUMBER OF INDIVIDUALS/TAXA	L	886.87	132.03	383.33
NUMBER/ML OF MOST ABUNDANT TAXON	K	15728.00	1541.00	2641.00

LAKE NAME: BRANCHED OAK
STORET NUMBER: 3101

CONTINUED

TAXA	FORM	04 17 74 IS	04 17 74 CC	04 17 74 ALGAL UNITS PER ML	07 02 74 IS	07 02 74 CC	07 02 74 ALGAL UNITS PER ML	09 26 74 IS	09 26 74 CC	09 26 74 ALGAL UNITS PER ML
ACTINASTRUM	CEL					4.4	176			X
ANABAENA	FIL									
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL		0.9	191						
ANKISTRODESMUS FALCATUS V. RIPARIUS	CEL					2.2	88			
APHANIZOMENON FLOS-AQUAE	FIL				15	5.6	220	11	6.4	513
ASTERIONELLA FORMOSA	CEL	11	77.1	15728						
CALONEIS ?	CEL						X			
CARTERIA	CEL				11	38.9	1541			
CHLAMYDOMONAS ?	CEL								1.6	129
COCCONEIS	CEL									X
COELASTRUM CAMBRICUM	COL						X			X
COELASTRUM RETICULATUM	COL									X
COELOSPHAERIUM NAEGELIANUM	COL						X	12	3.2	258
COSMARIUM	CEL								0.8	64
CRUCIGENIA TETRAPEDIA	COL								0.8	64
CRYPTOMONAS	CEL				12	10.3	396			
CRYPTOMONAS EROSA	CEL	12	2.8	572				14	7.2	580
CYMBELLA	CEL			X						
CYST	CEL				13	7.4	308			
DACTYLOCOCCOPSIS	CEL			X						
DICTYOSPHAERIUM	COL					2.2	88			
DICTYOSPHAERIUM PULCHELLUM	COL			X					2.4	193
DINOBRYON SOCIALE V. AMERICANUM	CEL	14	6.5	1334						
ELAKATOTHRIX	CEL						X			
FLAGELLATE #1	CEL	13	6.5	1334			X		4.0	322
FLAGELLATE #2	CEL	19	4.2	858						
FLAGELLATES	CEL					14.4	572			
FRAGILARIA	CEL									X
FRAGILARIA #1	CEL			X						
FRAGILARIA #2	CEL			X						
GLENODINIUM OCULATUM	CEL				14	3.3	132			
GYMNODINIUM ORDINATUM	CEL			X						
LAGERHEIMIA QUADRISETA	CEL		0.5	95						
LEPOCINCLIS	CEL			X			X			
MELOSIRA	CEL						X			
MELOSIRA DISTANS	CEL								32.8	2641
MELOSIRA GRANULATA	CEL			X					14.4	1159
MELOSIRA VARIANS ?	CEL							15	22.4	1803
MICRACTINIUM	COL						X			
MICROCYSTIS AERUGINOSA	COL			X		4.4	176	11	2.4	193
NITZSCHIA PALEA	CEL			X						
NITZSCHIA SIGMOIDEA	CEL			X						
OOCYSTIS	CEL						X			X
OSCILLATORIA	CEL			X		1.1	44			
PANDORINA MORUM	COL						X			
PEDIASTRUM DUPLEX	COL									
V. CLATHRATUM	COL			X			X			X
PENNATE DIATOM	CEL					4.4	176			
PHACUS	CEL						X			
PHOTOSPHENIA	CEL						X			
SCENEDESMUS BIJUGA	COL								1.6	129
SCENEDESMUS BIJUGA V. FLEXUOSUS	COL						X			
SCENEDESMUS QUADRICAUDA	COL			X						
SCENEDESMUS RACIBORSKII F. GRANULATAS	COL						X			
SCHROEDERIA SETIGERA	CEL		0.9	191		1.1	44			X
STEPHANODISCUS	CEL						X			
TETRAEDRON HASTATUM	CEL						X			
TETRASTRUM STAUROGENIAEFORME	COL		0.5	95						
TOTAL				20198			3961			8050

LAKE NAME: HARLAN
STORET NUMBER: 3102

NYGAARD TROPHIC STATE INDICES

DATE	04 16 74	06 28 74	09 30 74
MYXOPHYCEAN	01/0 E	04/0 E	03/0 E
CHLOROPHYCEAN	01/0 E	12/0 E	13/0 E
EUGLENOPHYTE	0.50 E	0.31 E	0.12 ?
DIATOM	0.21 ?	0.67 E	0.57 E
COMPOUND	06/0 E	25/0 E	22/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 16 74	06 28 74	09 30 74
GENUS	03	09	11
SPECIES	00	00	07

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 16 74	06 28 74	09 30 74
AVERAGE DIVERSITY	H	1.64	3.37	2.23
NUMBER OF TAXA	S	25.00	37.00	33.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.64	5.21	5.04
MINUMUM DIVERSITY	MINH	0.01	0.09	0.06
TOTAL DIVERSITY	D	43199.24	19188.78	15980.18
TOTAL NUMBER OF INDIVIDUALS/ML	N	26341.00	5694.00	7166.00
EVENESS COMPONENT	J	0.35	0.65	0.44
RELATIVE EVENESS	RJ	0.36	0.65	0.44
MEAN NUMBER OF INDIVIDUALS/TAXA	L	1053.64	153.89	217.15
NUMBER/ML OF MOST ABUNDANT TAXON	K	17479.00	1466.00	3555.00

LAKE NAME: HARLAN
STORET NUMBER: 3102

CONTINUED

TAXA	FORM	09 16 74 IS	09 16 74 ZC	09 16 74 ALGAL UNITS PER ML	06 28 74 IS	06 28 74 ZC	06 28 74 ALGAL UNITS PER ML	09 30 74 IS	09 30 74 ZC	09 30 74 ALGAL UNITS PER ML
ACTINASTRUM HANTZSCHII										
V. FLUVIATILE	CEL						X			
ANABAENA	FIL						X			
ANKISTRODESMUS FALCATUS	CEL								0.8	54
APHANIZOMENON FLOS-AQUAE	FIL				12	14.7	837			
ASTERIONELLA FORMOSA	CEL	12	10.0	4211			X			X
CARTERIA	CEL									X
CARTERIA KLEBSII	CEL				13	15.4	879			
CERATIUM HIRUNDINELLA	CEL						X			
COELASTRUM CAMBRICUM	CGL									X
COELASTRUM CAMBRICUM ?	COL						X			
CRYPTOMONAS EROSA	CEL	15	1.5	392		4.4	251			
CRYPTOMONAS REFLEXA	CEL			X						
CRYPTOMONAS SPP.	CEL							15	1.5	108
CYCLOTELLA	CEL	11	100.4	17479		2.9	167	12	22.6	1616
CYMATOPLEURA SOLEA	CEL			X						
CYMBELLA	CFL						X			
DACTYLOCOCCOPSIS IRREGULARIS	CEL		3.7	979			X		2.3	162
DIATOMA VULGARE	CFL									X
DICTYOSPHAERIUM PULCHELLUM	COL									X
EREMOSPHAERA BOHEMIENSIS	CGL						X			
EUGLENA	CEL			X		0.7	42			X
FLAGELLATE #1	CEL	13	8.0	2105		2.9	167			
FLAGELLATE #3	CEL							13	14.7	1050
FRAGILARIA	CFL			X						
FRAGILARIA CROTONENSIS	CEL			X		7.4	419			
GYMNODINIUM ALBULUM	CEL		0.2	49		0.7	42			
GYROSIGMA	CEL						X			
LUNATE CELL	CFL		0.2	49						
MELOSIRA	CEL			X						
MELOSIRA GRANULATA	CEL				11	25.7	1466		0.4	27
MELOSIRA GRANULATA										
V. ANGUSTISSIMA	CEL				5	5.1	293			X
MERISMOPEDIA MINIMA	COL								1.5	108
MESOSTIGMA VIRIDIS	CEL								0.8	54
MICRACTINIUM PUSILLUM	COL						X			
MICROCYSTIS AERUGINOSA	COL					1.5	84			
MICROCYSTIS INCERTA	COL								1.1	81
NAVICULA	CEL									X
NAVICULA #1	CEL		0.2	49						
NAVICULA #2	CFL			X						
NEIDIUM ?	CEL			X						
NITZSCHIA #1	CEL			X						
NITZSCHIA #2	CEL			X						
NITZSCHIA #3	CEL			X						X
NITZSCHIA #4	CEL									X
NITZSCHIA #5	CEL								1.1	81
NITZSCHIA #6	CFL					0.7	42			
OOCYSTIS	CEL						X			X
PEDIASTRUM BORYANUM	CGL						X			
PEDIASTRUM DUPLEX										
V. RETICULATUM	COL						X			X
PEDIASTRUM TETRAS	CEL									X
PHACUS ACUMINATUS	CEL						X			
PHACUS LONGICAUDA	CEL						X			
PHACUS MEGALOPSIS	CEL						X			X
SCENEDESMUS ABUNDANS	CCL								2.2	54
SCENEDESMUS ACUMINATUS	COL					1.5	84			
SCENEDESMUS DIMORPHUS	CGL									X
SCENEDESMUS INTERMEDIUS	COL									X
SCENEDESMUS QUADRICAUDA	COL		0.2	49		0.7	42	1	1.5	108
SCHROEDERIA SETIGERA	CEL					3.7	209		0.4	27
SPHAEROCYSTIS SCHROETERI	COL						X			
STEPHANODISCUS	CEL	14	3.2	832	14	8.8	502	11	49.6	3555
SURIRELLA	CEL			X						
SURIRELLA ANGUSTATA	CEL			X						
SURIRELLA OVATA	CEL									X
SYNEDRA #1	CEL									
SYNEDRA ULNA	CEL		0.6	147		1.5	84			
TETRAEDRON MUTICUM	CEL			X						
TETRASTRUM HETERACANTHUM	CEL									X
TETRASTRUM STAUROGENIAEFORME	COL					1.5	84			
TRACHELOMONAS SCHAUINSLANDII	COL								1.1	81
WISLOUCHIELLA	CEL						X			
	CEL						X			
TOTAL				26341			5694			7166

LAKE NAME: HARRY D. STRUNK
STORET NUMBER: 3103

NYGAARD TROPHIC STATE INDICES

DATE	04 16 74	07 01 74	09 27 74
MYXOPHYCEAN	0.50 E	03/0 E	0/0 D
CHLOROPHYCEAN	0.50 ?	02/0 E	09/0 E
EUGLENOPHYTE	0/02 ?	0/05 ?	0.22 E
DIATOM	0.57 E	0.75 E	0.71 E
COMPOUND	3.00 E	08/0 E	16/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 16 74	07 01 74	09 27 74
GENUS	00	02	07
SPECIES	00	00	04

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 16 74	07 01 74	09 27 74
AVERAGE DIVERSITY	H	3.88	2.38	2.41
NUMBER OF TAXA	S	19.00	16.00	24.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	2.00	2.00
MAXIMUM DIVERSITY	MAXH	4.25	4.00	4.58
MINIMUM DIVERSITY	MINH	0.00	0.05	0.05
TOTAL DIVERSITY	D	64311.28	8632.26	15472.20
TOTAL NUMBER OF INDIVIDUALS/ML	N	73081.00	3627.00	6420.00
EVENESS COMPONENT	J	0.21	0.60	0.53
RELATIVE EVENESS	RJ	0.21	0.59	0.53
MEAN NUMBER OF INDIVIDUALS/TAXA	L	3846.37	226.69	267.50
NUMBER/ML OF MOST ABUNDANT TAXON	K	62062.00	1596.00	3488.00

LAKE NAME: HARRY D. STRUNK
STORET NUMBER: 3103

CONTINUED

TAXA	FORM	04 16 74 IS	04 16 74 %C	04 16 74 ALGAL UNITS PER ML	07 01 74 IS	07 01 74 %C	07 01 74 ALGAL UNITS PER ML	09 27 74 IS	09 27 74 %C	09 27 74 ALGAL UNITS PER ML
ACHNANTHES	CEL									X
ANABAENA	FIL						X			
ANKISTRODESMUS FALCATUS V. MIRABILIS	CEL			X						
APHANIZOMENON FLOS-AQUAE	FIL				11	49.2	1596			
ASTERIONELLA FORMOSA	CEL	121	84.91	62.62			X			X
CENTRIC DIATOM	CEL	121	5.66	4124						
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL						X			
CLOSTERIUM	CEL			X						
CLOSTERIUM #2	CEL			X						
COELASTRUM CAMBRICUM	COL									X
CRUCIGENIA TETRAPEDIA	COL							1	10.38	664
CRYPTOMONAS	CEL				12	19.49	522	11	4.31	277
CRYPTOMONAS EROSA	CEL			X						
CRYPTOMONAS REFLEXA	CEL	1	0.49	270						
CYCLOTELLA	CEL					1.00	58			
CYMATOPLEURA SOLEA	CEL			X						
CYMBELLA	CEL					0.83	29			
CYMBELLA #1	CEL			X						
CYMBELLA #2	CEL			X						
CYMBELLA AFFINIS	CEL									X
DACTYLOCOCCOPSIS IRREGULARIS	CEL	131	5.41	3921						X
EUGLENA	CEL	1								
FLAGELLATE #1	CEL	141	3.31	2434	1	2.49	87			
FRAGILARIA CROTONENSIS	CEL			X	14	8.83	319			
KIRCHNERIELLA	CEL							15	12.11	775
MELOSIRA DISTANS	CEL									X
MELOSIRA GRANULATA	CEL			X						X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL				13	20.08	726	13	3.49	221
MICROCYSTIS AERUGINOSA	COL					0.83	29			
NAVICULA	CEL			X						X
NITZSCHIA	CEL									X
PANDORINA MORUM	COL					0.83	29			
PEDIASTRUM DUPLEX V. CLATHRATUM	COL						X			
PENNATE DIATOM	CEL							1	0.91	55
PHACUS	CEL									X
SCENEDESMUS DIMORPHUS	COL							1	0.91	55
SCENEDESMUS INTERMEDIUS	COL							2	1.78	111
SCENEDESMUS QUADRICAUDA	COL							1	0.91	55
SCHROEDERIA SETIGERA	CEL				15	5.81	203			
STEPHANODISCUS	CEL					0.83	29	12	54.31	3488
STEPHANODISCUS #1	CEL			X						
STEPHANODISCUS ASTRAEA	CEL			X				14	2.66	166
STEPHANODISCUS SPP.	CEL	15	0.41	270						
SYNEDRA	CEL			X					4.31	277
SYNEDRA ULNA	CEL						X			
TETRAEDRON CAUDATUM V. LONGECAUDATUM	CEL							1	0.91	55
TETRAEDRON MUTICUM	CEL							1	0.91	55
TETRASTRUM ELEGANS	COL							2	2.66	166
TOTAL				7308			3627			6420

LAKE NAME: HUGH BUTLER
STORET NUMBER: 3104

NYGAARD TROPHIC STATE INDICES

DATE	04 16 74	07 01 74	09 27 74
MYXOPHYCEAN	01/0 E	03/0 E	1.00 E
CHLOROPHYCEAN	06/0 E	09/0 E	3.00 E
EUGLENOPHYTE	0.43 E	0.33 E	0.25 E
DIATOM	0.43 E	0.67 E	0.42 E
COMPOUND	13/0 E	18/0 E	7.50 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 16 74	07 01 74	09 27 74
GENUS	05	15	05
SPECIES	03	07	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 16 74	07 01 74	09 27 74
AVERAGE DIVERSITY	H	2.06	3.54	2.75
NUMBER OF TAXA	S	25.00	28.00	34.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.64	4.81	5.09
MINUMUM DIVERSITY	MINH	0.01	0.06	0.15
TOTAL DIVERSITY	D	63664.30	16542.42	7669.75
TOTAL NUMBER OF INDIVIDUALS/ML	N	30905.00	4673.00	2789.00
EVENESS COMPONENT	J	0.44	0.74	0.54
RELATIVE EVENESS	RJ	0.45	0.74	0.53
MEAN NUMBER OF INDIVIDUALS/TAXA	L	1236.20	166.89	82.03
NUMBER/ML OF MOST ABUNDANT TAXON	K	14842.00	805.00	1280.00

LAKE NAME: HUGH BUTLER
STORET NUMBER: 3104

CONTINUED

TAXA	FORM	04 16 74 IS	04 16 74 %C	04 16 74 ALGAL UNITS PER ML	07 31 74 IS	07 31 74 %C	07 31 74 ALGAL UNITS PER ML	09 27 74 IS	09 27 74 %C	09 27 74 ALGAL UNITS PER ML
ANKISTRODESMUS FALCATUS	CEL						X			X
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL					17.21	805			
ANKISTRODESMUS FALCATUS V. MIRABILIS	CEL	141	9.31	2871						
ASTERIONELLA FORMOSA	CEL	111	46.01	14842			X			X
CARTERIA	CEL				111	15.51	725			
CENTRIC DIATOM	CEL	121	24.51	7574				111	45.91	1280
CHLOROGONIUM	CEL						X			
CLOSTERIUM #1	CEL									X
CLUSTERIUM #2	CEL									X
COCCONEIS	CEL			X						X
COELASTRUM SPHAERICUM	COL			X					1.61	46
CRUCIGENIA TETRAPEDIA	COL		0.61	183			X			
CRYPTOMONAS EROSA	CEL				121	17.21	805	131	8.21	228
CRYPTOMONAS MARSSONII	CEL		1.21	366						
CRYPTOMONAS REFLEXA	CEL			X						X
CYMBELLA	CEL									X
CYMBELLA #2	CEL									X
CYMBELLA TURGIDA	CEL			X						
DACTYLOCOCCOPSIS	FIL					6.91	322			
DACTYLOCOCCOPSIS IRREGULARIS	CEL		1.41	428					4.91	137
EPITHEMIA	CEL						X			
EUGLENA #1	CEL			X		1.71	81			
FLAGELLATE #1	CEL	131	13.01	4031		6.91	322	151	14.71	411
FLAGELLATE #2	CEL						X			
FRAGILARIA	CEL			X						X
FRAGILARIA CROTONENSIS	CEL									X
FRANCEIA	CEL						X			
GLOEOCYSTIS AMPLA ?	COL			X						
GOMPHONEMA	CEL									X
MELOSIRA #4	CEL								3.31	91
MELOSIRA DISTANS	CEL						X			
MELOSIRA GRANULATA	CEL			X						X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL									X
MERISMOPEDIA MINIMA	COL								1.61	46
MERISMOPEDIA TENUISSIMA	COL					0.41	322			
MICROCYSTIS INCERTA	COL					3.21	242			
NOUGEOTIA	FIL									X
NAVICULA	CEL									X
NITZSCHIA	CEL		0.61	183						
NITZSCHIA #1	CEL								1.61	46
NITZSCHIA #2	CEL			X						
NITZSCHIA #3	CEL					3.41	161			
OOCYSTIS	COL		0.21	61				141	4.91	137
PALMELLOID CELLS	CEL								1.61	46
PEDIASTRUM DUPLEX V. CLATHRATUM	COL									X
PERIDINIUM INCONSPICUUM	CEL				141	1.71	81			X
PHACUS ACUMINATUS	CEL									
PHACUS MEGALOPSIS	CEL			X						
SCENEDESMUS BICAUDATUS	COL					1.71	81			
SCENEDESMUS BIJUGA	COL					1.71	81		1.61	46
SCENEDESMUS QUADRICAUDA	COL			X	151	3.41	161		1.61	46
SCHROEDERIA SETIGERA	CEL					1.71	81			
STAUROSPORE	CEL			X						
STEPHANODISCUS	CEL					3.41	161			
STEPHANODISCUS ASTRAEA	CEL							121	8.81	183
STEPHANODISCUS NIAGARAE	CFL	151	1.01	305						
SURIRELLA ANGUSTATA	CEL									X
SYNEDRA	CEL								1.61	46
SYNEDRA RUMPENS	CFL			X						X
TETRAEDRON TRIGONUM V. GRACILE	CEL		0.21	61						
TETRASTRUM HETERACANTHUM	COL						X			
TRACHELOMONAS	CEL			X						
TRACHELOMONAS ABRUPTA ?	CEL									X
TRACHELOMONAS ENSIFERA	CEL						X			
TRACHELOMONAS INTERMEDIA	CEL						X			
TRACHELOMONAS PLANCTONICA	CEL						X			
TRACHELOMONAS SPP.	CEL				131	5.21	242			
TOTAL				30969			4673			2789

LAKE NAME: JOHNSON
STORET NUMBER: 3105

NYGAARD TROPHIC STATE INDICES

DATE	04 16 74	07 01 74	09 30 74
MYXOPHYCEAN	1.50 E	03/0 E	3.00 E
CHLOROPHYCEAN	6.00 E	10/0 E	6.00 E
EUGLENOPHYTE	0.07 ?	0.08 ?	0.11 ?
DIATOM	0.30 ?	0.25 ?	1.00 E
COMPOUND	9.50 E	16/0 E	12.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 16 74	07 01 74	09 30 74
GENUS	17	06	11
SPECIES	09	04	04

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 16 74	07 01 74	09 30 74
AVERAGE DIVERSITY	H	1.28	2.98	3.06
NUMBER OF TAXA	S	40.00	30.00	34.00
NUMBER OF SAMPLES COMPOSITED	M	1.00	1.00	1.00
MAXIMUM DIVERSITY	MAXH	5.32	4.91	5.09
MINIMUM DIVERSITY	MINH	0.02	0.09	0.09
TOTAL DIVERSITY	D	36403.20	13457.66	15483.60
TOTAL NUMBER OF INDIVIDUALS/ML	N	28440.00	4516.00	5060.00
EVENESS COMPONENT	J	0.24	0.61	0.60
RELATIVE EVENESS	RJ	0.24	0.60	0.60
MEAN NUMBER OF INDIVIDUALS/TAXA	L	711.00	150.53	148.82
NUMBER/ML OF MOST ABUNDANT TAXON	K	23760.00	1607.00	2232.00

LAKE NAME: JOHNSON
STREET NUMBER: 3105

(CONTINUED

TAXA	FORM	04 16 74 IS	04 16 74 %C	04 16 74 ALGAL UNITS PER ML	07 01 74 IS	07 01 74 %C	07 01 74 ALGAL UNITS PER ML	09 30 74 IS	09 30 74 %C	09 30 74 ALGAL UNITS PER ML
ACTINASTRUM	COL		0.1	38					0.6	30
ANABAENA	FIL							14	4.3	208
ANKISTRODESMUS FALCATUS	CEL		0.4	115						
APHANIZOMENON FLOS-AQUAE	FIL				15	5.8	261	12	9.4	476
ASTERIONELLA FORMOSA	CEL	12	3.2	921		1.0	43			X
CARTERIA	CEL		0.1	38						
CERATIUM HIRUNDINELLA										
F. SCOTTICUM	CEL						X			
CHLAMYDOMONAS	CEL		1.9	537						
CLOSTERIUM	CEL			X					0.6	30
COELASTRUM CAMBRICUM	COL		0.1	38						
CRUCIGENIA TETRAPEDIA	COL								0.6	30
CRYPTOMONAS EROSA	CEL		0.8	230					1.8	89
CRYPTOMONAS MARSSONII	CEL						X			
CRYPTOMONAS REFLEXA	CEL	15	0.7	192		1.9	87			
CYCLOTELLA	CEL								4.1	208
CYMBELLA TUMIDA	CEL									X
DACTYLOCOCCOPSIS IRREGULARIS	CEL		0.4	115		1.0	43		1.8	89
DIATOMA ELONGATUM	CEL	14	2.2	614						
DICTYOSPHAERIUM PULCHELLUM	COL								0.6	30
EUGLENA	CEL			X			X			
EUGLENA #1	CEL									X
FLAGELLATE #1	CEL		1.1	307					4.1	208
FRAGILARIA	CEL				13	16.4	739			
FRAGILARIA CROTONENSIS	CEL			X	11	35.6	1607			X
GOMPHONEMA	CEL			X						
GYMNODINIUM ALBULUM	CEL					1.0	43			
GYMNODINIUM ORDINATUM ?	CEL		0.5	154						
MELOSIRA GRANULATA	CEL		0.4	115		6.7	304	11	44.1	2232
MELOSIRA GRANULATA										
V. ANGUSTISSIMA	CEL									X
MELOSIRA VARIANS	CEL		0.3	77					0.6	30
MESOSTIGMA	CEL									
MICRACTINIUM PUSILLUM	COL			X						
MICROCYSTIS AERUGINOSA	COL					1.9	87			
MICROCYSTIS INCERTA	CUL			X						
NAVICULA	CEL						X			
NAVICULA #2	CEL			X		1.0	43			
NAVICULA #3	CEL		0.3	77						
NITZSCHIA #1	CEL		0.1	38		1.0	43			
NITZSCHIA #2	CEL		0.1	38					0.6	30
OOCYSTIS	CEL					1.9	87	15	4.7	238
OSCILLATORIA	FIL								1.8	89
OSCILLATORIA LIMNETICA	FIL			X					5.3	268
PANDORINA MORUM	COL			X			X			
PEDIASTRUM BORYANUM	COL		0.1	38		1.0	43			X
PEDIASTRUM DUPLEX	COL						X			
PEDIASTRUM DUPLEX										
V. CLATHRATUM	COL						X			
PEDIASTRUM DUPLEX										
V. RETICULATUM	COL									X
PEDIASTRUM TETRAS										
V. TETRADON	COL						X			
PERIDINIUM	CEL		0.3	77			X			X
PERIDINIUM #1	CEL			X						
RAPHIDIOPSIS CURVATA	FIL								0.6	30
SCENEDESMUS ABUNDANS	COL		0.3	77						
SCENEDESMUS ACUMINATUS	COL		0.1	38						
SCENEDESMUS ARCUATUS	COL									X
SCENEDESMUS BIJUGA	COL					1.0	43			
SCENEDESMUS DIMORPHUS	COL			X			X		0.6	30
SCENEDESMUS INTERMEDIUS	COL			X					0.6	30
SCENEDESMUS QUADRICAUDA	COL		0.9	269		1.9	87		2.4	119
SCHROEDERIA SETIGERA	CEL						X			X
SPHAEROCYSTIS SCHROETERI	COL						X			X
STAURASTRUM CHAETOCERUS	CEL			X					0.6	30
STEPHANODISCUS	CEL	11	83.5	23760	12	16.4	739	13	10.6	536
SURIRELLA OVATA	CYL	13	1.8	499			X			
SYNEDRA	CEL			X	14	4.8	217			
TETRAEDRON MINIMUM	CEL			X						
TETRASTRUM STAUROGENIAEFORME	COL		0.1	38						X
TRACHELOMONAS	CEL									
TOTAL				28440			4516			5060

LAKE NAME: MCCONAUGHY
STORET NUMBER: 3106

NYGAARD TROPHIC STATE INDICES

DATE	04 15 74	07 01 74	09 27 74
MYXOPHYCEAN	01/0 E	03/0 E	2.00 E
CHLOROPHYCEAN	05/0 E	07/0 E	7.00 E
EUGLENOPHYTE	0/06 ?	0/10 ?	0.06 ?
DIATOM	0.33 E	0.33 E	0.36 E
COMPOUND	09/0 E	12/0 E	12.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 15 74	07 01 74	09 27 74
GENUS	05	01	10
SPECIES	02	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 15 74	07 01 74	09 27 74
AVERAGE DIVERSITY	H	2.23	3.17	3.37
NUMBER OF TAXA	S	23.00	21.00	46.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.52	4.39	5.52
MINIMUM DIVERSITY	MINH	0.03	0.08	0.13
TOTAL DIVERSITY	D	27292.97	10495.87	16624.21
TOTAL NUMBER OF INDIVIDUALS/ML	N	12239.00	3311.00	4933.00
EVENESS COMPONENT	J	0.49	0.72	0.61
RELATIVE EVENESS	RJ	0.49	0.72	0.61
MEAN NUMBER OF INDIVIDUALS/TAXA	L	532.13	157.67	107.24
NUMBER/ML OF MOST ABUNDANT TAXON	K	5173.00	602.00	1023.00

LAKE NAME: MCCONAUGHY
STORET NUMBER: 3106

CONTINUED

TAXA	FORM	04 15 74 IS	04 15 74 %C	04 15 74 ALGAL UNITS PER ML	07 01 74 IS	07 01 74 %C	07 01 74 ALGAL UNITS PER ML	09 27 74 IS	09 27 74 %C	09 27 74 ALGAL UNITS PER ML
ACTINASTRUM	CEL		1.3	154						X
ANKISTRODESMUS FALCATUS V. MIRABILIS	CEL		0.3	39						X
APHANIZOMENON FLOS-AQUAE	FIL				12	7.8	258			
ASTERIONELLA FORMOSA	CEL	11	42.3	5173	15	14.3	473		1.0	47
CARTERIA	CEL		0.3	39						
COCCONEIS	CEL			X						X
CYCLOTELLA MENEGHINIANA	COL					1.3	43			
COSMARIUM	CEL									X
CRUCIGENIA TETRAPEDIA	COL									X
CRYPTOMONAS	CEL	13	6.0	734				11	20.7	1023
CRYPTOMONAS ERUSA	CEL				11	13.0	430			
CRYPTOMONAS EROSA V. RIFFLRA	CEL				13	13.0	430			
CYCLOTELLA MENEGHINIANA	CEL									X
CYMBELLA	CEL						X			X
DACTYLOCOCCOPSIS	CEL		3.2	386		2.6	86	14	13.2	651
DICTYOSPHAERIUM PULCHELLUM	COL								1.9	93
FLAGELLATE #1	CEL	12	35.6	4362		10.4	344	13	17.9	884
FRAGILARIA #1	CEL						X			
FRAGILARIA CAPUCINA	CEL			X						X
FRAGILARIA CROTONENSIS	CEL		0.9	116	14	18.2	602			X
FRAGILARIA LEPTOSTAURON	CEL			X						
GOMPHOSPHAERIA OLIVACEUM	CEL						X			
GYMNODINIUM ORDINATUM	CEL	15	1.9	232					1.0	47
KIRCHNERIELLA	CEL					1.3	43			
LEPOCINCLIS	CEL									X
LYNGBYA	FIL						X			
MELOSIRA #4	CEL								1.9	93
MELOSIRA GRANULATA	CEL					7.8	258	12	8.5	419
MELOSIRA ITALICA	CEL		1.9	232						
MELOSIRA VARIANS	CEL		0.6	77						X
MERISMOPEDIA MINIMA	COL								8.5	419
MESOSTIGMA VIRIDIS	CEL									X
MICRACTINIUM	CEL						X			
MICROCYSTIS AERUGINOSA	COL									X
NOUGLUTIA	FIL									X
NAVICULA	CEL						X			
NAVICULA #1	CEL									X
NAVICULA #2	CEL			X						
NAVICULA #3	CEL									X
NITZSCHIA	CEL									X
OOCYSTIS	CEL								3.8	186
OSCILLATORIA	FIL								3.8	186
PEDIASTRUM BORYANUM	COL									X
PENNATE DIATOMS	CEL		0.9	116					4.7	233
RHOICOSPHENIA	CEL			X						X
RHOPALODIA GIBBA	CEL									X
SCENEDESMUS ACUMINATUS	COL									X
SCENEDESMUS ARCUATUS	COL									X
SCENEDESMUS OBLIQUUS	COL									X
SCENEDESMUS OPOLIENSIS	COL			X						
SCENEDESMUS PROTUBERANS	COL						X			X
SCENEDESMUS QUADRICAUDA	COL			X			X			X
SCENEDESMUS SPP.	COL		0.6	77				15	7.5	372
SCHROEDERIA SETIGERA	CEL					10.4	344			
STAURASTRUM	CEL									X
STEPHANODISCUS	CEL	14	3.8	463			X			X
SURIRELLA #1	CEL									X
SURIRELLA #2	CEL									X
SYNEDRA ACUS	CEL		0.3	39						
SYNEDRA ULNA	CEL									X
TETRAEDRON CAUDATUM	CEL			X					1.0	47
TETRAEDRON MINIMUM	CEL									X
TETRASTRUM 3 GLABRUM	COL								4.7	233
TETRASTRUM STAURODENIALEFORME	COL						X			
TOTAL				12239			3311			4933

LAKE NAME: PAWNEE LAKE
STORET NUMBER: 3107

NYGAARD TROPHIC STATE INDICES

DATE	04 17 74	07 02 74	09 26 74
MYXOPHYCEAN	1.00 E	1.67 E	4.00 E
CHLOROPHYCEAN	0/01 D	3.00 E	9.00 E
EUGLENOPHYTE	1.00 E	0.14 ?	0.08 ?
DIATOM	0.80 E	3.00 E	5.00 E
COMPOUND	6.00 E	6.33 E	19.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 17 74	07 02 74	09 26 74
GENUS	01	02	02
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 17 74	07 02 74	09 26 74
AVERAGE DIVERSITY	H	2.13	3.52	2.71
NUMBER OF TAXA	S	21.00	33.00	27.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	2.00	2.00
MAXIMUM DIVERSITY	MAXH	4.39	5.04	4.75
MINIMUM DIVERSITY	MINH	0.14	0.15	0.16
TOTAL DIVERSITY	D	3616.74	9817.28	5574.47
TOTAL NUMBER OF INDIVIDUALS/ML	N	1698.00	2789.00	2057.00
EVENESS COMPONENT	J	0.49	0.70	0.57
RELATIVE EVENESS	RJ	0.47	0.69	0.56
MEAN NUMBER OF INDIVIDUALS/TAXA	L	80.86	84.52	76.19
NUMBER/ML OF MOST ABUNDANT TAXON	K	849.00	634.00	765.00

LAKE NAME: PARMEE LAKE
STORET NUMBER: 3107

CONTINUED

TAXA	FORM	04 17 74 IS	04 17 74 %C	04 17 74 ALGAL UNITS PER ML	07 02 74 IS	07 02 74 %C	07 02 74 ALGAL UNITS PER ML	09 26 74 IS	09 26 74 %C	09 26 74 ALGAL UNITS PER ML
ANABAENA	FIL				12	10.81	296		0.81	16
APHANIZOMENON FLOS-AQUAE	FIL				6	3.01	85	13	18.61	382
ASTERIONELLA FORMOSA	CEL	14	12.51	212						X
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL			X						
CHLAMYDOMONAS	CEL								0.81	16
CHLOROPHYTAN COCCOID CELLED COLONY	CEL			X						
CLOSTERIUM	CEL									X
CLUSTERIUM #1	CEL					1.51	42			
CLOSTERIUM #2	CEL						X			
CLUSTERIUM #3	CEL			X						
COCCOID COLONY	CEL						X			
COELASTRUM CAMBRICUM	COL					1.51	42		0.81	16
COELASTRUM RETICULATUM	COL						X			
COELOSPHAERIUM NAEGELIANUM	COL					1.51	42		2.31	48
COSMARIUM	CEL						X			
CRUCIGENIA RECTANGULARIS ?	COL						X			
CRYPTOMONAS EROSA	CEL				11	22.71	634	14	13.21	271
CRYPTOMONAS MARSSONII	CEL			X						
CRYPTOMONAS REFLEXA	CEL	12	18.31	313			X			
CYCLOTELLA MENEGHINIANA	CEL								1.61	32
CYCLOTELLA STELLIGERA	CEL									X
DACTYLOCOCCOPSIS IRREGULARIS	CEL		1.91	33						
DICTYOSPHAERIUM	COL								0.81	16
DICTYOSPHAERIUM PULCHELLUM	COL					3.01	85			
DINOBRYON DIVERGENS	CEL			X						
DINOBRYON W/O LORICA	CEL	11	50.01	849						
ELAKATOTHRIX	CEL									X
EUDORINA ELEGANS	CEL			X						X
EUGLENA	CEL						X			
FLAGELLATE #3	CEL		4.84	82		13.61	380			
FLAGELLATE #9	CEL					1.51	42			
FRAGILARIA	CEL			X						
GLENODINIUM GYMNODINIUM	CEL						X		1.61	32
GLENODINIUM GYMNODINIUM V. BISCUFELLIFORME	CEL						X			
HALLOMONAS CAUDATA	CEL						X			
MELOSIRA	CEL	15	3.81	65						
MELOSIRA #1	CEL									X
MELOSIRA GRANULATA	CEL				13	10.61	296			X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL			X		6.11	169			
MELOSIRA SPP.	CEL							12	37.21	765
MICROCYSTIS AERUGINOSA	COL					3.01	85	11	14.01	287
NAVICULA	CEL			X						
NAVICULA RADIOSA	CEL						X			
NITZSCHIA	CEL			X						
OOCYSTIS	CEL					1.51	42		3.11	64
OPHIOCYTIUM CAPITATUM	CEL					1.51	42			
OSCILLATORIA TENUIS	FIL						X			
PEDIASTRUM DUPLEX	COL									X
PEDIASTRUM DUPLEX V. CLATHRATUM	COL				15	1.51	42			X
PEDIASTRUM DUPLEX V. RETUNDATUM	COL						X			
PEDIASTRUM SIMPLEX V. DUODENARIUM	COL						X			X
PERIDINIUM	CEL									X
PHACUS	CEL									X
SCHROEDERIA SETIGERA	CEL					12.11	338		0.81	16
SPHAEROCYSTIS SCHROETERI	COL									X
STAURASPORE							X			
STEPHANODISCUS #3	CEL			X						
STEPHANODISCUS ASTRAEA	CEL			X	14	5.01	89	13	4.71	96
STEPHANODISCUS SPP.	CEL	13	8.71	147						
SYNEDRA	CEL			X						
TRACHELOMONAS	CEL					1.51	42			
TRACHELOMONAS VOLVOCINA	CEL			X						
TOTAL				1698			2789			2057

LAKE NAME: SHERMAN COUNTY RLS.
STORET NUMBER: 3108

NYGAARD TROPHIC STATE INDICES

DATE	04 17 74	07 01 74	09 27 74
MYXOPHYCEAN	03/0 E	02/0 E	2.00 E
CHLOROPHYCEAN	02/0 E	02/0 E	1.00 E
EUGLENOPHYTE	0/05 ?	0/04 ?	0/06 ?
DIATOM	0.50 E	1.00 E	0.40 E
COMPOUND	07/0 E	06/0 E	5.00 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 17 74	07 01 74	09 27 74
GENUS	04	01	02
SPECIES	00	00	02

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 17 74	07 01 74	09 27 74
AVERAGE DIVERSITY	H	2.83	2.35	1.69
NUMBER OF TAXA	S	14.00	12.00	25.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	2.00	2.00
MAXIMUM DIVERSITY	MAXH	3.81	3.58	4.64
MINUMUM DIVERSITY	MINH	0.10	0.09	0.13
TOTAL DIVERSITY	D	4525.17	3614.30	5213.65
TOTAL NUMBER OF INDIVIDUALS/ML	N	1599.00	1538.00	3085.00
EVENESS COMPONENT	J	0.74	0.66	0.36
RELATIVE EVENESS	RJ	0.74	0.65	0.36
MEAN NUMBER OF INDIVIDUALS/TAXA	L	114.21	128.17	123.40
NUMBER/ML OF MOST ABUNDANT TAXON	K	503.00	461.00	2198.00

LAKE NAME: SHERMAN COUNTY RES. CONTINUED
STORET NUMBER: 3108

TAXA	FORM	06 17 74			07 01 74			08 27 74		
		IS	%C	ALGAL UNITS PER ML	IS	%C	ALGAL UNITS PER ML	IS	%C	ALGAL UNITS PER ML
ANABAENA	FIL			X						
APHANIZOMENON FLOS-AQUAE	FIL							121	3.01	92
ASTERIONELLA FORMOSA	CEL	111	31.5	503						
CALONEIS LEWISII	CEL						X			
CERATIUM HIRUNDINELLA	CEL						X			
CLOSTERIUM	CEL									X
COCCONEIS	CEL									X
CRYPTOMONAS	CEL						X			X
CRYPTOMONAS EROSA	CEL	131	2.9	46	111	17.5	269			
CYANOPHYTAN FILAMENT	FIL							1	1.0	31
CYCLOTELLA MENEGHINIANA	CEL							151	4.0	122
CYMATOPLEURA ELLIPTICA F. SPIRALIS	CEL									X
CYMBELLA	CEL							1	1.0	31
DACTYLOCOCCOPSIS	CEL			X						
EUGLENA ELEGANS	CEL									X
FLAGELLATE #1	CEL	141	17.1	274	141	27.5	423	1	5.0	153
FLAGELLATE #2	CEL	151	11.4	183						
FRAGILARIA CONSTRUENS ?	CEL									X
FRAGILARIA CROTONENSIS	CEL						X	141	7.9	244
FRAGILARIA INTERMEDIA ?	CEL	1	11.4	183						
HANTZSCHIA AMPHIOXYS F. CAPITATA	CEL									X
KIRCHNERIELLA	CEL			X						
MELOSIRA GRANULATA	CEL									X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL			X			X	131	4.0	122
MERISMOPEDIA MINIMA	COL				131	3....	461	1	2.0	61
MICROCYSTIS AERUGINOSA	COL									X
MICROCYSTIS INCERTA	COL				1	5.0	77			
MICROCYSTIS INCERTA ?	COL	1	5.7	91						
NAVICULA	CEL									X
NAVICULA #1	CEL									X
NAVICULA LATENS ?	CEL									X
NITZSCHIA	CEL									X
NITZSCHIA FILIFORMIS	CEL	1	5.7	91						
PEDIASTRUM DUPLEX	COL									X
SCENEDESMUS BICAUDATUS	COL			X						
SCENEDESMUS BIJUGA	COL						X			
SCHROEDERIA SETIGERA	CEL				151	10.0	154	1	1.0	31
STAURASTRUM	CEL									X
STEPHANODISCUS ASTRAEA	CEL	121	8.6	137	121	10.0	154	111	71.2	2198
TOTAL				1599			1538			3085

LAKE NAME: SWANSON
STORET NUMBER: 3110

NYGAARD TROPHIC STATE INDICES

DATE	04 15 74	06 28 74	09 27 74
MYXOPHYCEAN	0/02 D	3.00 E	1.50 E
CHLOROPHYCEAN	1.00 E	4.00 E	4.50 E
EUGLENOPHYTE	0/02 ?	0.14 ?	0.42 E
DIATOM	0.12 ?	0.50 E	0.33 E
COMPOUND	1.50 E	9.00 E	9.50 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	04 15 74	06 28 74	09 27 74
GENUS	01	00	11
SPECIES	02	00	03

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		04 15 74	06 28 74	09 27 74
AVERAGE DIVERSITY	H	0.37	2.90	3.00
NUMBER OF TAXA	S	16.00	18.00	32.00
NUMBER OF SAMPLES COMPOSITED	M	2.00	2.00	2.00
MAXIMUM DIVERSITY	MAXH	4.00	4.17	5.00
MINUMUM DIVERSITY	MINH	0.01	0.11	0.14
TOTAL DIVERSITY	D	5968.47	5779.70	8256.00
TOTAL NUMBER OF INDIVIDUALS/ML	N	16131.00	1993.00	2752.00
EVENESS COMPONENT	J	0.09	0.70	0.80
RELATIVE EVENESS	RJ	0.10	0.69	0.59
MEAN NUMBER OF INDIVIDUALS/TAXA	L	1008.19	110.72	86.00
NUMBER/ML OF MOST ABUNDANT TAXON	K	15214.00	413.00	912.00

LAKE NAME: SWANSON
STORET NUMBER: 3110

CONTINUED

TAXA	FORM	04 15 74 IS	04 15 74 %C	04 15 74 ALGAL UNITS PER ML	06 20 74 IS	06 20 74 %C	06 20 74 ALGAL UNITS PER ML	09 27 74 IS	09 27 74 %C	09 27 74 ALGAL UNITS PER ML
ANABAENA	FIL					1.9	38			X
ANKISTRODESMUS FALCATUS V. ACICULARIS	CEL								3.7	103
APHANIZOMENON FLOS-AQUAE	FIL					1.9	38			
ASTERIONELLA FORMOSA	CEL	11	94.3	15214		1.9	38			X
CERATIUM HIRUNDINELLA	CEL						X			
CERATIUM HIRUNDINELLA F. FURCOIDES	CEL									X
CHLAMYDOMONAS ?	CEL								4.4	120
CLOSTERIUM	CEL							13	5.6	155
CLUSTERIUM #1	CEL			X						X
COCCONEIS PLACENTULA	CEL									X
COELASTRUM CAMBRICUM	CCL			X			X			
CUSMARIUM	CEL						X			
CRUCIGENIA APICULATA	CEL									X
CRYPTOMONAS EROSA	CEL							12	20.6	568
CRYPTOMONAS OVATA	CEL				12	17.7	338			
CRYPTOMONAS REFLEXA	CEL			X						
CYCLOTELLA MENEGHINIANA	CEL	12	4.4	769						
CYMBELLA	CEL			X						
DENTICULA	CEL			X						X
DICTYOSPHAERIUM PULCHELLUM	COL						X			
DINOBRYON DIVERGENS	CEL						X			
ELAKATOTHRIX	CEL					1.9	38			
EUDORINA ELEGANS	COL									X
EUGLENA	CEL						X			
FLAGELLATE #1	CEL	14	0.8	125	19	26.7	513			
FLAGELLATES	CEL				13	17.7	338			
FRAGILARIA CROTONENSIS	CEL	13	0.9	83						X
GLENODINIUM GOCLATUM	CEL					1.9	38			
LEPOCINCLIS										X
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL						X			
MICROCYSTIS AERUGINOSA	COL								6.9	189
MICROCYSTIS INCERTA	COL									X
NAVICULA	CEL									X
NAVICULA #1	CEL			X			-		3.1	86
NITZSCHIA #1	CEL			X						
NITZSCHIA #2	CEL			X					2.9	69
NITZSCHIA #3	CEL							14	10.6	293
OOCYSTIS	CEL					3.8	75			X
OSCILLATORIA	FIL									
PEDIASTRUM DUPLEX V. RETICULATUM										X
PERIDINIUM	COL									X
PHACUS MEGALOPSIS	CEL									X
PINNULARIA	CEL									
SCENEDESMUS ACUMINATUS	CEL			X						
SCENEDESMUS BALATONICUS ?	COL			X					0.6	17
SCENEDESMUS DIMORPHUS	COL								0.6	17
SCHROEDERIA SETIGERA	COL								0.6	17
STAURASTRUM CHAETOCERAS	CEL				14	16.9	376			X
STEPHANODISCUS NIAGARAE	CEL			X						
SURIRELLA OVATA	CEL				11	13.2	263	11	33.1	912
TRACHELOMONAS FLUVIATILIS	CEL									X
TRACHELOMONAS INTERMEDIA ?	CEL							15	4.4	120
TRACHELOMONAS VERRUCOSA	CEL								3.1	86
TOTAL				16131			1493			2752