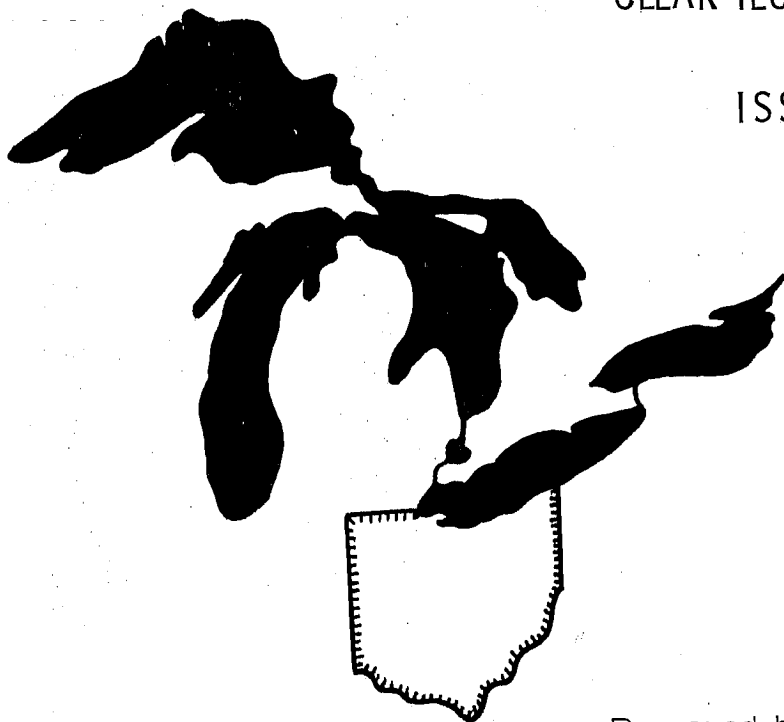


CLEAR TECHNICAL REPORT NO. 169

ISSUED FOR COMMENT

PHYTOPLANKTON BIOMASS
DATA SYSTEM FOR
LAKE ERIE



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Prepared for

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Introduction to the Phytoplankton Biomass Data System

Purpose:

While phytoplankton was being enumerated during the USEPA Nutrient Control Study, we became concerned over comparison of our results with other parameters being monitored. We could not make meaningful comparisons between number of algal cells /ml and concentrations in μg or mg of other chemical and biological parameters within our own study, and it was not possible to compare our results to other Lake Erie surveys (Curl, 1951; Munawar and Munawar, 1976; Munawar and Burns, 1976). In an attempt to solve this problem, a system was generated for specifically coding organisms, as well as making it possible to calculate cell numbers and biomass from raw count data.

Keeping track of a large number of phytoplankton species presents many problems. Numbers of organisms must be taken from a count sheet and accurately entered into the computer for further analysis. Genus, species and variety of the organism are essential taxonomic facts which must be recorded, and in some cases, the size of individual cells is just important. A classification scheme must be large enough to allow the addition of new taxa. Our data system has space for 5,000 taxa or size classifications, which should be ample for the Great Lakes. To date, approximately one tenth of the code numbers available are in use.

The practice of assigning a geometric configuration to an algal cell, determining its volume based on observed measurements, assuming an approximate specific gravity of 1.0, and equating said cell volume to wet weight has been accepted by phytoplankton enumerators world wide. Curl (1951), Munawar and Munawar (1976), the Great Lakes Laboratory, State University College at Buffalo, and the Center for Lake Erie Area Research (Rathke, 1979) have all expressed phytoplankton data in terms of algal biomass, but even these Lake Erie studies have not been coordinated at this time. Several species lists with algal biomass numbers have appeared in the literature (Kling and Holmgren, 1972, Willén, 1976) but they are not broad enough in scope for our purposes. In spite of the fact that biomass is considered to be a useful way of expressing algal concentration, and that the techniques used to compute biomass are widely accepted (S.A.P.H.A.M., 1976; Weber, 1973) there have been few efforts to standardize procedures or to pool knowledge, even for one body of water. Hopefully the material in this technical report will prove useful to those wishing to convert cell numbers/ml to the more meaningful, useable measurement, algal biomass.

Methods:

Our computer programs are designed to convert raw count data obtained by the Utermohl technique (Utermohl, 1958) to cells/ml and biomass in $\mu\text{g}/\text{l}$ (Appendix 1). The programs could be modified for use with any counting technique, provided:

1. The sample concentration is known.
2. The amount of sample viewed by the enumerator is known.
3. Individual cells are counted or estimated. These data are not applicable in cases where colonies or filaments are enumerated as single units.

Each taxon is placed in order alphabetically within its Division (or, in the case of the Pyrrophyta, within its Class), and assigned two codes. These codes in combination are specific for that taxon. The six letter alphabetic code is based upon the first letters of its scientific name:

Fragilaria crotonensis = FRACRO, or

Scenedesmus intermedius var. baltonica = SCEIBA

Sometimes this is a problem, as in the case of:

Cosmarium subcostatum = COSSBC and

Cosmarium subraciborskii = COSSBR

To code both of these species COSSUB would cause confusion for the person entering the data. As they are coded above, each is distinct from every other taxon in the species list. The alphabetical code makes it easy to identify a specific taxon when entering data, and to assign it its own numerical code. The numerical code alone is actually entered as data, along with the raw count information (Appendix 2). Resultant print-outs may list cell numbers and biomass along with the entire name of the organism, or just with the six letter alphabetical code, depending upon space limitations.

Whitton, Diaz and Holmes (1979) describe a system which uses six numbers to categorize plankton organisms. The first two place the organism within its proper phylum, the second two within its genus, and the third two within its species, variety or size classification. This is a logical, flexible system, but lacks the convenience of the accompanying alphabetic code as a recognition device.

The four digit numerical code assigned to each organism is determined by where it fits into alphabetical order within Division, Class, Genus, Species and Varietal classifications.

5000=Blue-green algae (Cyanophyta)
6000-6899=Green algae (Chlorophyta)
6900=Euglenoids (Euglenophyta)
7000=Diatoms (Bacillariophyta)
8000=Dinoflagellates (Pyrrophyta, Dinophyceae)
9000=Chrysophytes (Chrysophyta)
9500=Cryptophytes (Pyrrophyta, Cryptophyceae)

Organisms are identified under the inverted microscope using standard taxonomic references (Table 1). Measurements made throughout the season are used to obtain an average cell size for a taxon. Standard Methods and EPA's Biological Field and Laboratory Methods manual recommend measuring at least 20 representative individuals of each major species for biomass determination, and this recommendation was followed. Gelatinous envelopes and Chrysophyte loricae were not measured as part of the organism (Willen, 1976). For taxa occurring over a wide size range, up to four size categories have been assigned to one organism (i.e. Pediastrum simplex, Sphaerocystis shroeteri). Use of these size categories ensures greater accuracy in computing biomass for highly variable taxa because biomass values are calculated for cells in each size range and then summed.

Cell numbers are obtained by counting individual cells whenever possible. In the case of long filaments or large colonies, several procedures for estimating cell numbers may be followed. These

1. For very common colonies, the procedure described by Reynolds (Reynolds and Jaworski, 1978) may be followed. A regression was plotted which related actual cell numbers in Microcystis colonies disrupted with potassium hydroxide to linear dimensions of the colonies. This method proved very accurate statistically.
2. Count cells in a portion of a colony and estimate cell numbers based upon the percentage that portion represents of the entire colony.
3. Count cells in a colony and assume that any colonies of that species which are the same size have the same number of cells.
4. Measure trichome or filament length and divide by known cell length (or enter trichome or filament length and have the computer perform this division).
4. Make an intelligent guess. (Emphasis is on "intelligent" rather than "guess".)

Use of these procedures can result in relatively accurate cell number and biomass estimates for genera such as Microcystis and Oscillatoria. Even such rough estimates are preferable to enumeration of an entire colony or filament as one unit.

Cell volumes were computed for each taxon based on measurements made during routine counting. A geometric configuration most closely resembling the shape of the cells of the taxon was selected, and a volume computed using standard formulas (Table 2). At times a combination of several shapes was used to approximate the volume of the organism. The shapes used, and the codes describing them, also appear in Table 2.

Biomass data appearing in Table 3 were obtained from observations of samples from the Lake Erie central basin and the Lake Erie western basin nearshore area. While volumes for cells of some algal taxa are quite consistent, volumes of cells of other taxa will vary greatly with season and location. These data must therefore be revised to meet the needs of a given user.

We look upon this biomass data system as a start towards solving an extremely complex set of problems. The system was designed to be flexible; in order to be a useful tool, additions and modifications will routinely be made to the data file. Once appropriate additions and modifications are made to the system by the user, the system should prove to be valuable and time-saving. Hopefully it will ease comparison of phytoplankton data with other parameters measured, and make comparisons between different phytoplankton studies more meaningful.

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TABLE 1

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TABLE 1 (Continued)

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TABLE 2 - SHAPES AND FORMULAS FOR ALGAL BIOMASS DETERMINATIONS

<u>Shape Code</u>	<u>Shape</u>	<u>Representative Organism</u>
REC	Rectangular solid	<u>Tabellaria fenestrata</u>
SPH	Sphere	<u>Sphaerocystis shroeteri</u>
CYL	Cylinder	<u>Melosira granulata</u>
CON	Cone	<u>Rhodomonas minuta</u>
DUBCON	Double cone	<u>Closterium aciculare</u>
TRI	Triangular solid	<u>Tetraedron muticum</u>
DUBTRI	Double triangular solid	<u>Navicula cryptocephala</u>
FRU	Frustrum	<u>Cryptomonas erosa</u>
DUBFRU	Double frustrum	<u>Cosmarium bipunctatum</u>
PROSPH	Prolate spheroid	<u>Oocystis lacustris</u>
DUBPRO	Double prolate spheroid	<u>Cosmarium depressum</u>
OBLSPH	Oblate spheroid	<u>Peridinium penardiforme</u>
DUBOBL	Double oblate spheroid	<u>Cosmarium variolatum var.</u> <u>cataractarum</u>
ELISOL	Elliptical solid	<u>Stauroneis anceps</u>
ELIREC	Elliptical solid + Rectangular solid	<u>Fragilaria crotonensis</u>
CONFRU	Cone + frustrum	<u>Gymnodinium helveticum</u>

TABLE 2 (Continued)

Triangle = area = $1/2 bh$ Volume of triangular solid = $1/2 bh \times (\text{depth})$

Ellipse area = $(\frac{ab}{4})\pi$
 volume of an elliptical solid = $[\pi(\frac{ab}{4})]h$

Rectangular solid volume = lwh

Cylinder volume = $\pi r^2 h$

Cone volume = $\pi/3 [r^2 h]$

Sphere volume = $4/3\pi r^3$

Prolate spheroid volume = $4/3\pi(ab^2)$

(where a=the major semi-axis and b = the minor semi-axis)

Oblate spheroid volume = $4/3\pi(a^2b)$

Frustrum volume = $h/3(r_1^2 + r_1r_2 + r_2^2)\pi$

where r_1 = base radius
 r_2 = top radius

TABLE 3

CLEAR Phytoplankton Species List

Explanation of Codes in Table 3

NUM CODE = Numerical code assigned to each organism.

ALPHA CODE = Alphabetical code assigned to each organism.

SPECIES NAME = Complete name of the organism.

SOURCE = The text in which a description of the organism can be found.
(See Table 1.) "OB" means an organism observed and not identified.

SHAPE = The geometric configuration assigned to each organism. (See
Table 2.)

LIT DIAM = Diameter cited in the source description.

OBS DIAM = The diameter we have observed.

LIT LENGTH = Length cited in the source description.

OBS LENGTH = The average cell length we have observed.

LIT WIDTH = Width cited in the source description.

OBS WIDTH = The average cell width we have observed.

VOLUME = The volume of a cell of the organism in cubic microns.

Table 3 was compiled from two separate card decks, one being a listing of organism names, and the other a deck containing size information on each taxon. The two sources of information were combined to produce Table 3.

TABLE 3 - CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT		OBS		LIT		OBS		VOLUME
				DIAM	SHAPE	DIAM	SHAPE	LENGTH	WIDTH	LENGTH	WIDTH	
5000		BLUGRN BLUE-GREEN ALGAE (CYANOPHYTA)										382
5005		AWACIR ANABAENA CIRCINALIS RABENHORST										102
5015		AWAPLO ANABAENA FLOS-AQUAE (LYNGB.) DE BREBISSON										435
5040		AWAPLA ANABAENA PLANKTONICA BRUNTHALER										796
5050		ANASCE ANABAENA SPIROIDES VAR. CRASSA LEMMERMANN										40.6
5060		ANAVIS ANABAENA WISCONSINENSE PRESCOTT										22
5061		ANAVAR ANABAENA VARIABILIS KUETZING										48
5070		ANASPA ANABAENA SPECIES A										66
5074		ANABELL ANABENOPSIS ELLERKINII MILLER										58.9
5075		ANBRAC ANABENOPSIS RACIBORSKII WOLOSZYNSKA										65.5
5076		ANBSPP ANABENOPSIS SPECIES										1.4
5080		APHECO APHANOCAPSA ELACHISTA VAR. CONFERTA WEST & WEST										4.2
5081		APHEPL APHANOCAPSA ELACHISTA VAR. ELANKTONICA G.M. SMITH										52
5083		APHEPL APHANOCAPSA DELICATISSIMA WEST & WEST										34
5084		APHEPL APHANOCAPSA DELICATISSIMA WEST & WEST										34
5084		APHEPL APHANOCAPSA PULCHRA (KUETZ.) RABENHORST										65.5
5087		APHRIV APHANOCAPSA RIVULARIS (CARM.) RABENHORST										3.8
5101		APHCLA APHANOTHECE CLATHRATA W. G. S. WEST										34.4
5124		APHIC APHANOTHECE CLATHRATA W. G. S. WEST										3.5
5125		APHID APHANOTHECE CLATHRATA W. G. S. WEST										96
5151		APZFIO APHANIZOENON HOLSATIUM RICHTER										100.5
5152		APZHO APHANIZOENON HOLSATIUM RICHTER										905
5225		CHRLM CHROOCOCCUS LIMNETICUS LEMMERMANN										41.6
5226		CHRDJ CHROOCOCCUS DISPERSUS (KESSL.) LEMMERMANN										14.1
5230		CHRDJ CHROOCOCCUS DISPERSUS VAR. MINOR G.M. SMITH										24
5241		CYLSTA CYLINDROSPERMUM STAGNALE (KUETZ.) BORNET & FLAHAULT										113
5251		COEDUB COELOSPHAERIUM DUBIUM GRUNOW										14.1
5260		COEKUE COELOSPHAERIUM KUETZINGIANUM NAEGLI										41
5275		COENAE COELOSPHAERIUM NAEGLIANUM UNGER										5.2
5276		COEPL COELOSPHAERIUM PALLIDUM LEMMERMANN										78.5
5280		GLORUP GLEOTHECE RUPESTRIS (LYNG.) BORNET										4.2
5295		GLORUP GLEOTHECE RUPESTRIS (LYNG.) BORNET										905
5296		GLORUP GLEOTHECE RUPESTRIS (LYNG.) BORNET										6.8
5300		GOMADE GOMPHOSPHAERIA APONINA VAR. DELICATULA VIRIEUX										126
5301		GOMAPO GOMPHOSPHAERIA APONINA KUETZING										4.2
5302		GOMLAC GOMPHOSPHAERIA LACUSTRIS CHODAT										1257
5315		HYEFON HYELLA FONTANA HUBER ET JADIN										15.7
5320		LYNGON LYNGBIA CONTORTA LEMMERMANN										42.6
5321		LYNSPP LYNGBIA SPECIES										8.2
5351		MARELE MARSONIELLA ELEGANS LEMMERMANN										6.8
5400		MERCON MERISMOPEDIA CONVOLUTA DE BREBISSON IN KUETZING										16.5
5401		MESLE MERISMOPEDIA ELEGANS A. BRAUN										91.6
5410		MESGLA MERISMOPEDIA GLAUCA (EHRENW.) NAEGLI										0.5
5425		MESIM MERISMOPEDIA HINNA BECK										14.1
5430		MERPUN MERISMOPEDIA PUNCTATA HEYEN										48
5451		HICABA MICROCYSTIS AERUGINOSA KUETZING										65.5
5452		HICABA MICROCYSTIS AERUGINOSA VAR. MAJOR (WITTR.) G. M. SMITH										65
5460		MICPYLO MICROCYSTIS FLOS-AQUAE (WITTR.) KIRCHNER										1.8
5465		MICINC MICROCYSTIS INCERTA LEMMERMANN										1.8
5475		MICMIN MICROCYSTIS MINUTISSIMA WEST										1.8

CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LNPTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
5501	OSGAGA	OSCILLATORIA AGARDHII GOMONT	T CYL	4-6	4-6	2.5-4	3			50	
5515	OSCGEM	OSCILLATORIA GEMMINATA MEREGRINI	G CYL	2.3-4	3	2.3-16	5.5			38.9	
5535	OSCLIM	OSCILLATORIA LIMNETICA LENNERMANN	P CYL	1.5	1.5	4-12	10			18	
5539	OSCLHO	OSCILLATORIA LIMOSA (ROTH) C. A. AGARDH	T CYL	11-20	11	2-5	2.5			238	
5550	OSCPHA	OSCILLATORIA PLANKTONICA HOLLE	G CYL	2-3	2.5	6-8	5.8			229	
5555	OSCPHO	OSCILLATORIA PROLIFICA (GREV.) GOMONT	T CYL	2-2.5	2.5	4-6	4			19.6	
5556	OSCSUB	OSCILLATORIA SUBBREVIS SCHMIDLE	P CYL	5-6	5	1-2	1.5			30	
5570	OSCTEN	OSCILLATORIA TENUIS AGARDH	T CYL	4-10	8	2.6-5	3			56.6	
5625	PHOSPA	PHORMIDIUM SPECIES A	OB CYL	1.5	1.5	4	4			7.1	
5699	RHALIN	RHABDODERMA LINEARE SCHMIDLE & LAUTERBORN	P CYL	2-3	2	6-12	6			18.9	
5700	RHACUR	RHAPHIDIOPSIS CURVATA FRITSCH & RICH	R CYL	4.5	4.5	7-9	7			111.3	
5701	RHAMED	RHAPHIDIOPSIS MEDITERRANEA SKUJA	G CYL	1-2.5	3		5.8			41	
5705	SEIMAJ	SPIRULLINA MAJOR KUETZING	T EST	1.2-1.7	1.5	150				265	
5800	BLGSPA	BLUE GREEN SPECIES A (SC)	OB SPH							14	
5801	BLGSPB	BLUE GREEN SPECIES B (SC)	OB SPH							180	
5802	COENAE	COELOSPHAERIUM NAEGELIANUM UNGER (SC)	T CYL	3	3		5.8			41	
5803	GOMAPO	GOMPHOSPHERIA APONINA KUETZING (SC)	T CYL	4	4		10			125	
5804	MICAEK	MICROCYSTIS AERUGINOSA KUETZING (SC)	T SPH	4-5	4-5					48	
5805	APHCIA	APHANOTHECE CLATHRATA W. & G. S. WEST (SC)	T CYL	1.4	1.4		2.5			3.8	
5806	COEKUE	COELOSPHAERIUM KUETZINGIANUM NAEGELI (SC)	T SPH	3	3					14.3	

CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE	SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LNKTH	LIT WIDTH	OBS WIDTH	VOLUME
6000		GREENS GREEN ALGAE (CHLOROPHYTA)									
6001	ACTGRA	ACTINASTRUM GRACILLIUM G. M. SMITH		P CON	1-7-3	2-5	14-21	16			26-2
6002	ACTHNA	ACTINASTRUM HANTZSCHII LAGERHEIM		T DUBCON	3-5-5	3-5	12-22	21-5			69
6003	ACTHEL	ACTINASTRUM HANTZSCHII VAR. ELONGATUM G. M. SMITH		P DUBCON	4-5	4	30-35	30			126
6004	ACTHYL	ACTINASTRUM HANTZSCHII VAR. FLUVIATILE SCHROEDER		T DUBCON	3-3-5	3	39-42	15			35
6013	ANKCON	ANKISTRODESMUS CONVOLUTUS CORDA		T DUBCON	3-4-5	2	15-25	23			24
6015	ANKFAL	ANKISTRODESMUS FALCATUS (CORDA) RALFS		T DUBCON	2-6	2	25-100	37-5			39
6016	ANKFTU	ANKISTRODESMUS FALCATUS VAR. MIRABILIS (WEST & WEST) G. S. WEST		T DUBCON	2-3	4-4	150	30			177
6017	ANKFTU	ANKISTRODESMUS FALCATUS VAR. TUNDIDUS (WEST & WEST) G. S. WEST		KL DUBCON	0-5-3-5	1-5	20-44	30			152
6018	ANKGRA	ANKISTRODESMUS GRACILIS (REITSCH.) KORSIKOV		T DUBCON	2-3	2	25-35	25			26-2
6025	ANKSTI	ANKISTRODESMUS SPIRALIS (TURN.) LEMMERMANN		KL DUBCON	1-4-4-5	2	43-105	45			47-1
6026	ANKSTI	ANKISTRODESMUS STIPITATUS CHODAT		HP PROSPH		12		20			1507-9
6027	AULSUB	AULACOMONAS SUBMARINA SNUJA		T CYL	2-3	5-2	8-20	15-5			330
6031	BINERI	BINUCLEARIA ERIENSIS TIFFANY		P PROSPH	3-6	4	6-12	7			58-6
6034	BORERA	BOTRYOCOCCUS BRAUNII KUEZING		P SPH	16	15-7	12-20				2026
6036	CARCOR	CARTERIA CORDIFORMIS (CARTER) DIESING		OB SPH		4-3					41-6
6042	CARSPA	CARTERIA SPECIES A		OB SPH		8-6					333
6043	CARSPB	CARTERIA SPECIES B		OB SPH		8-6					333
6045	CENBEL	CENTRITRACTUS BELANOPHORUS LEMMERMANN		T DUBCON	5-9	8	8-16	14			235
6047	CLOPHI	CLOSTERIUM FRITCHARDIA NUH ARCHER		T DUBCON	21-37	21	334-530	409			47221
6048	CLOVIN	CLOSTERIUM VENUS VAR. INCURVUM (DE BREB.) KRIEGER		T DUBCON	7-12	10	39-66	60			1571
6058	CHASAC	CHASACIUM SPECIES A		OB DUBCON		4-3		25			121
6059	CHACU	CHARACIUM ACUMINATUM A. BRAUN		P PROSPH	15-20	15	35-40	35			4123
6061	CHLANG	CHLAMYDOMONAS ANGLICA PASCHER		HP SPH	2-7	5-8	7-5-11	102			102
6064	CHLGLO	CHLAMYDOMONAS GLOBOSA SNOW		T SPH	5-7	8-6	10-19	333			333
6065	CHLEPI	CHLAMYDOMONAS EPIPHYTICA G.M. SMITH		P SPH	7-8	5-7		97			97
6071	CHLSPA	CHLAMYDOMONAS SPECIES A		OB SPH		5		65			65
6072	CHLSPB	CHLAMYDOMONAS SPECIES B		OB SPH	10			524			524
6073	CHLSPC	CHLAMYDOMONAS SPECIES C		OB SPH		15		1767			1767
6074	CHLSPD	CHLAMYDOMONAS SPECIES D		OB SPH		20		4189			4189
6075	CHLSP E	CHLAMYDOMONAS SPECIES E		OB SPH		25		8185			8185
6077	CHLORA	CHLORELLA SPECIES A		OB SPH		6		173			173
6080	ENCCEL	ENCISTED CHLAMYDOMONAS		OB PROSPH		4-6		10-4			115
6081	CHOBAL	CHODOTELLA BALATONICA SCHERFFEL		FO CYL	3-4	3	5-8-8	5-5			38-9
6082	CLOON	CLOSTERIOPSIS LONGISSIMA LEMMERMANN		T DUBCON	3-5-6	4	190-240	200			838
6083	CIRELO	CHLOROGONIUM ELONGATUM (DANG.) FRANZ		SA DUBCON		3-3		33			94
6084	CIRSPA	CHLOROGONIUM SPECIES A		OB DUBCON		8		27			452
6085	CLOACE	CLOSTERIUM ACEROSUM (SCHRANK) EHRENBERG		T DUBFRU		25		460			8 107125
6086	CLOACT	CLOSTERIUM ACICULARE T. WEST		SW DUBFRU	5	5-2	500	570			2-9 7149
6087	CLOBRE	CLOSTERIUM BREISSONII DELPONT		T DUBCON	23	23	644	600			98456.
6088	CLOACU	CLOSTERIUM ACUTUM (LYNG.) DE BREISSON		SW DUBCON	4-6	4	132-146	150			628
6089	CLODIA	CLOSTERIUM DIANA EHNBERG		T DUBFRU		11-5		166			5 29074
6091	CLOGRA	CLOSTERIUM GRACILE DE BREISSON		T DUBCON	3-5-6		130-1	90			628
6092	CLOIDI	CLOSTERIUM IDIOSPORUM W. & G.S. WEST		T DBLCON	9-10	9	197-232	210			4452-4
6093	CLOPER	CLOSTERIUM PERACEROSUM GAY		W1 DUBCON	12-17-5	15	180-303	210			12368
6094	CLOPAN	CLOSTERIUM PARVULUM VAR. ANGUSTATUM WEST & WEST		T DUBFRU		4-3		127			2 1037
6095	CLOPOT	CLOSTERIUM TURIDUM JOHNSON		W DUBFRU		14		120			3 7508
6096	CLOSPA	CLOSTERIUM SPECIES A		OB EST							6116
6097	CLOSPB	CLOSTERIUM SPECIES B		OB DUBCON		13		92			4069-7

CLEAR PHYTOPLANKTON LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
6098	CLOSPC	CLOSTERIUM SPECIES C	OB DBLCON	9-14	6	76-85	215					1350.6	
6099	CLOVEN	CLOSTERIUM VENUS KUETZING	T DUBCON	12			80					3016	
6101	COECIN	COELASTRUM CAMBRICUM VAR. INTERMEDIUM (BOHLIN) G. S. WEST	BG SPH	7-2								195	
6102	COECHS	COELASTRUM CAMBRICUM ARCHER (SM)	T SPH	10-20								179.6	
6103	COECL	COELASTRUM CAMBRICUM ARCHER (LG)	T SPH	10-20	12							905	
6104	COECL	COELASTRUM MICROPORUM NAEGELI (SM)	T SPH	8-20	7.4							212	
6105	COECL	COELASTRUM MICROPORUM NAEGELI (LG)	T SPH	8-20	18							3054	
6106	COERTS	COELASTRUM RETICULATUM (DANG.) SENN (SM)	T T	8-24	6							113	
6107	COERTL	COELASTRUM RETICULATUM (DANG.) SENN (LG)	T T	8-24	16							2145	
6108	COESP	COELASTRUM SPHAERICUM NAEGELI	T T	8-25								905	
6112	COSAPH	COSMARIUM APHANICHONDRUM NORDSTEDT	T DUBPRO	39-40	39		32					83640	
6115	COSBIR	COSMARIUM BIRETUM DE BREBISSE	T DUBPRO	60-64	64		64-65					86628	
6116	COSBHI	COSMARIUM BIRETUM VAR. MINUS HANSEIRG	T DUBPRO	36-38	36		39-41					15079	
6117	COSBIP	COSMARIUM BIPUNCTATUM BOERGENSE	T DUBPRO	25-30	25		27-31			14		8277	
6120	COSDIP	COSMARIUM DEPRESSUM (NAEG.) LUNDELL	T DUBPRO	40-50	27		37-43					5153	
6121	COSDIP	COSMARIUM DEPRESSUM VAR. ACHONDRUM (BOLDT) W. & G. S. WEST	T DUBPRO	43-46	43		33-43					15411	
6122	COSDIP	COSMARIUM FORFUSULOSUM HOFF	T DUBPRO	40-50	45		34-40			22-25	23	54726	
6123	COSGEO	COSMARIUM GEOMETRICUM W. & G. S. WEST VAR. SUEVICUM BORGES	T DUBPRO	12	12		11					760	
6124	COSGEO	COSMARIUM CONTRACTUM KIRCHNER	SW DUBOBL	22-24	22		29-37			15	10	8615	
6125	COSKGR	COSMARIUM KJELLMANI WILLE VAR. GRANDE WILLE	T DUBFRU	37-39	20		46-50					6230	
6129	COSPSE	COSMARIUM PSEUDARCTIUM NORDSTEDT	T DUBSPH	14	14		19-20					1437	
6130	COSMPU	COSMARIUM HONILIFORME (TURP.) RALES VAR. PUNCTATA LAGERHEIM	T DUBPRO	25-28	19		22-24					8695	
6131	COSMBC	COSMARIUM INCURVUM SKUJA N. SP.	T DUBPRO	27	27		32					3619	
6132	COSMBC	COSMARIUM INCURVUM SKUJA N. SP.	SK DUBPRO	11.5	11.5		11.5					391	
6133	COSPRR	COSMARIUM PSEUDOPROTUBERANS KIRCHNER	T DUBPRO	23-24	23		25-27					4070	
6134	COSGSO	COSMARIUM TURPINII DE BREBISSE VAR. POPOLICUM GUTWINSKII	T DUBFRU	20	20		35					6414	
6135	COSGSO	COSMARIUM TURPINII DE BREBISSE VAR. POPOLICUM GUTWINSKII	T DUBFRU	50-53	50		57-64			25	25	67577	
6136	COSREN	COSMARIUM RENIFORME (RALES) ARCHER	T DUBPRO	44	44		48					13270	
6137	COSKSL	COSMARIUM SUBTUMIDUM NORDSTEDT VAR. KLEBSII (GUTW.) W. & G. S. WEST	T PROSPH	16-18	17		32-41			29-35	30	5296	
6138	COSVCO	COSMARIUM VIRIDE (CORDA) JOSHUA VAR. COMPRESSUM TAFT	T DUBOBL	18-22	20		30-33					6702	
6139	COSDIN	COSMARIUM OCELLATUM VAR. INCRASSUM WEST & G. S. WEST	W2 DUBPRO	24-26	25		28-30					2752	
6140	COSSPA	COSMARIUM SPECIES A	OB DUBOBL		22.9		32.8					9006	
6141	COSPEB	COSMARIUM SPECIES B	OB DUBFRU		26		37.2					13128	
6142	COSSEB	COSMARIUM SPECIES C	OB DUBFRU		37.2		38.6					20	25545
6143	COSSPD	COSMARIUM SPECIES D	OB DUBFRU		31		44					6	13627
6144	COSSEF	COSMARIUM SPECIES E	OB DUBOBL		36		41					27946	
6145	COSSEF	COSMARIUM SPECIES F	OB DUBOBL		38.6		43					299302	
6146	COSSEF	COSMARIUM SPECIES G	OB DUBRO		20.2		21.6					4613	
6147	COSQUA	COSMARIUM QUADRUM LUNDELL VAR. MINUS NORDSTEDT	T DUBREC	60-83	70		54-74					30	243600
6148	COSCCR	COSMARIUM SUBCRETATUM HANTZSCH	T DUBPRO	23-37	25		18-30					14	12671
6149	COSPMI	COSMARIUM PHASEOLUS DE BREB. FORMA MINOR BOLDT	T DUBPRO	20.4-21	20		18					12	7540
6150	COSVAR	COSMARIUM VARIOLATUM LUNDELL VAR. CATARACTARUM RACIBORSKI	T DUBPRO	25-30	27		37-43					30536	
6151	COSBRP	COSMARIUM SUBRACIBORSKII TAFT	T DUBPRO	25-30	25		23-27					4091	
6152	CRUAPT	CRUCIGENIA APICULATA (LEH.) SCHMIDLE	P CYL	3-7	5		5-10					176.7	
6153	CRUFRN	CRUCIGENIA FENESTRATA SCHMIDLE	T PROSPH	3-5	4		5-13					84	
6154	CRULAU	CRUCIGENIA LAUTERBORNEI SCHMIDLE	T PROSPH	5.4-9	7.2		8-15					233	
6155	CRUQUA	CRUCIGENIA QUADRATA MORREN	T QUACIL	4-7	6.2		5-10					10.8	
6156	CRUREC	CRUCIGENIA RECTANGULARIS (A. BRAUN) GAY	T T	4-5-9	4.6		8-14					217	
6157	CRUTET	CRUCIGENIA TETRAPEDIA (KIRCH.) W. & G. S. WEST	T T	5-9	7		8-14					52	
6158	CRUIRR	CRUCIGENIA IRREGULARIS WILLE	P PROSPH	5-9	7		8-14					256.6	

CLEAR PHYTOPLANKTON SPECIES LIST

NUM ALPHA CODE	SPECIES NAME	SOURCE	SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
6159	CRUTRU CRUCIGENIA TRUNCATA G. M. SMITH	P	SPH	4-6	5					65.5	
6163	DICTYOSPHAERIUM PULCHELLUM WOOD	T	SPH	3-10	6.2					125	
6164	DICTYOSPHAERIUM PLANKTONICUM TIFFANY AND AHLSTROM	P	OBLSPH	8-9	8	12-16	14			821.0	
6167	ELAGEL ELAKTOTHRIX GELATINOSA WILLE	P	DUBCON	3-6		15-25				382	
6168	ELAVIR ELAKTOTHRIX VIRIDIS (SNOW) PRINTZ	T	DUBCON	6-15		35				654	
6171	ERRBOR ERRERELLA BORNHEIMIENSIS CONRAD	T	SPH	3-6	5					524	
6174	EUDORNA ELEGANS EHRENBERG	T	PROSPH	10-20	12					905	
6178	FOUR-SQUARES RICKLE	OB	SPH		6					113.1	
6181	FRADRO FRANCEIA OVALIS (LEMM.) G. M. SMITH	T	PROSPH	5-12		9-16				402	
6182	FRANCEIA OVALIS (FRANCE) LEMMERMANN	P	PROSPH	7-10	8	13-17	15			502.6	
6193	GLOGIC GLOGOCYSTIS GIGAS (KUETZ.) LAGERHEIM	T	SPH	9-12	11					697	
6197	GLOMIR GLOBOTRYS LINNETICUS (G. M. SMITH) PASCHER	P	SPH	5-8	6					113.1	
6204	GOERAD GOLEKINIA RADIATA (CHOD.) WILLE	T	SPH	7-15	9.7					478	
6205	GOERBR GOLEKINIA RADIATA (CHOD.) WILLE VAR. BREVISPINA TIFFANY & AHLSTROM	T	SPH	1-2	18	5.8-10	11.2			3054	
6211	KIRCON KIRCHNERIELLA CONTORTA (SCHMIDLE) BOHLEN	T	DUBCON	3-8	4	6.5-13	10			47	
6215	KIRLUN KIRCHNERIELLA LUNARIS (KIRCH.) MOEBIUS	T	DUBCON		5	10-14	10			20.8	
6216	KIRLIR KIRCHNERIELLA LUNARIS VAR. IRREGULARIS G. M. SMITH	T	DUBCON	3-4.5		10-21				42	
6220	KIRSUB KIRCHNERIELLA SUBSOLITARIA G. S. WEST	FO	PROSPH	6-18		10-21				1206	
6227	LACIT LAGERHEIMIA CITRIFORMIS (SNOW) G. M. SMITH	T	PROSPH	8-20	13.1	13-23	18.9			1698	
6229	CHOBAL CHODATELLA CILIATA (LAGER.) LEMMERMANN	FO	PROSPH	2-4	3	4-10	8.7			41	
6230	LAGEN LAGERHEIMIA GENEVENSIS CHODAT	FO	PROSPH	2-4	3	4-10	8.7			41	
6231	CHOLON CHODATELLA LONGISETA LEMMERMANN	FO	PROSPH	5-8	5	9-13	9			117.8	
6233	CHOQUA CHODATELLA QUADRISETA LEMMERMANN	FO	PROSPH	4-7	5	7-12	11			131	
6234	CHOSUB CHODATELLA SUBSALSATA LEMMERMANN	FO	PROSPH	2-8	4	5-12	11			92	
6235	LAGRA LAGERHEIMIA WRATISLAVIENSIS SCHROEDER	FO	PROSPH	5-10	6	8-14	10			282.7	
6241	MICRHI MICRACTINIUM ERIENSE TIFFANY & AHLSTROM	FO	CYL	7-10	4.3					41.6	
6242	MICRUS MICRACTINIUM PUSILLUM FRESENIUS	T	SPH	3-7						134	
6253	MCSRAG MICROSPORA STAGNORUM (KUETZ.) LAGERHEIM	T	CYL	5-10	9	8-30	16			1018	
6262	MONBRA MONORAPHIDIUM BRAUNII (WAEG.) KOMAROVA-LEGNEROVA N. C.	KL	DUBCON	1-7.8	4	13-52	35			147	
6264	MONCON MONORAPHIDIUM CONTORTUM (THUR.) N. C.	KL	DUBCON	1-5	1.4	7-40	28.5			14.6	
6268	MONIR MONORAPHIDIUM IRREGULARE (G. M. SMITH) N. C.	KL	DUBCON	1-3.5		40-72				27	
6272	MONIR MONORAPHIDIUM MINIMUM (WAEG.) KOMAROVA-LEGNEROVA N. C.	KL	DUBCON	2-7		6-17				12.5	
6274	MONST MONORAPHIDIUM SETIFORME (NYGARD) N. C.	KL	DUBCON	1.4-3	1.3	70-182	35			15.5	
6276	MONOR MONORAPHIDIUM TORTILE (N. & G. S. WEST) N. C.	KL	DUBCON	0.5-1.6	4.3	12-28	20			5.2	
6281	MOUSPA MOUGEOTIA SPECIES A	OB	CYL	2-7	6.9	8-18	20.4			822	
6291	NEPAGA NEPHROCITIUM AGARDHIANUM NAEGLI	T	CYL	14-17	4	30-33	20.4			256	
6293	NEPLIM NEPHROCITIUM LIMNETICUM (G. M. SMITH) G. M. SMITH	T	CYL		4					5301	
6294	NEPOBE NEPHROCITIUM OBESUM WEST & WEST	T	CYL		4.6					715	
6296	ODSPA ODOGONIUM SPECIES A	OB	CYL		4.6					159	
6301	OOCBES OOCYSTIS BORGEI SNOW (SM)	T	PROSPH	9-13	5.4	10-19	10.4			552	
6302	OOCBRL OOCYSTIS BORGEI SNOW (LG)	T	PROSPH	8-3	8.3	15.3	23			2360	
6303	OOCCHA OOCYSTIS CRASSA WITTROCK	T	PROSPH	10-20	14	14-26	23			146	
6305	OOCCLS OOCYSTIS LACUSTRIS CHODOT (SM)	T	PROSPH	12-15	5.7	16-20	18.8			1465	
6306	OOCCLC OOCYSTIS LACUSTRIS CHODOT (HD)	T	PROSPH	16-20	12.2	21-28	23			3480	
6307	OOCCLC OOCYSTIS LACUSTRIS CHODOT (LG)	T	PROSPH		17					51	
6308	OOCPRS OOCYSTIS PARVA WEST & WEST (SM)	T	PROSPH	4-5	4.3	6-10	7.2			70	
6309	OOCPHL OOCYSTIS PARVA WEST & WEST (LG)	T	PROSPH	6-8	6	11-16	11			207	
6311	OOCPLS OOCYSTIS PUSILLA HANSGRING	T	PROSPH	4-8	6	6-12	11			3026	
6313	OOCPSOL OOCYSTIS SOLITARIA WITTROCK	T	PROSPH	3-9	17	7-20	20				

CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
6315	OCSUB	OOCYSTIS SUBMARINA LAGERHEIM	T PROSPH	3-9	5.7	7-20	13.8			235	
6321	PANDOR	NA MORUM	MU PROSPH		5.7		7.8			133	
6324	PARMUL	PARMODOXIA MULTISETA SWIRENKO	EG PROSPH		5.8		13			229	
6326	PLASPA	PLATYDORINA SPECIES A	OB SPH	10-20	10					524	
6330	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN	P EST	10-20	16					12.11	
6331	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN	T EST		10.5		9		3	12.5	
6332	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN (TURP.)	T EST		13		13		5.8	95.0	
6332	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN (TURP.)	T EST		14		14		5.8	102.3	
6333	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN (TURP.)	T EST		11.5		11.5		3	342	
6335	PEDBIR	PEDIASTRUM BIRADIATUM MEYEN (SM)	T EST		14.5		8.7		5.8	980	
6336	PEDDPL	PEDIASTRUM DUPLEX MEYEN (MD)	T EST		20.4		14.6		5.8	1597	
6336	PEDDPL	PEDIASTRUM DUPLEX MEYEN (MD)	T EST		11.5		14.5		5.8	870	
6337	PEDDPL	PEDIASTRUM DUPLEX MEYEN (LG)	P EST		14.5		16		5.8	1211	
6338	PEDDPL	PEDIASTRUM DUPLEX VAR. CLATHRATUM (A. BRAUN) LAGERHEIM	T EST		9		9		4	282	
6339	PEDDGR	PEDIASTRUM DUPLEX VAR. GRACILLITUM WEST & WEST	T EST		14.5		14.5		5.8	830	
6340	PEDSMH	PEDIASTRUM SIMPLEX (MEYEN) LEMMERMANN (SM)	T EST		17.5		17.5		8.7	2003	
6341	PEDSMH	PEDIASTRUM SIMPLEX (MEYEN) LEMMERMANN (MD)	T EST		24		24		5.8	2506	
6342	PEDSHL	PEDIASTRUM SIMPLEX (MEYEN) LEMMERMANN (LG)	T EST		24		24		5.8	731	
6343	PEDSMX	PEDIASTRUM SIMPLEX (MEYEN) LEMMERMANN (XL)	T EST		10		14		5.8	731	
6345	PEDTET	PEDIASTRUM TETRAS (EHR.) RALFS	T EST	8-15	10		14		5.8	731	
6346	PEDTTE	PEDIASTRUM TETRAS VAR. TETRAODON (CORDA) RABENHORST	T EST		10		14		5.8	731	
6347	PHALEN	PHACOTUS LENTICULARIS (EHRENB.) STEIN	T ELSOL	13-20	13	13-20	16		6	980	
6348	PLAGEL	PLANKTOSPHAERIA GELATINOSA G. M. SMITH	P SPH	20-25	20					4188-7	
6349	PTANG	PTEROMONAS ANGULOSA (CARTER) LEMMERMANN	P CIL	9-20	13	13-17	17			2256-5	
6350	PLECAL	PLEODORINA CALIFORNICA SHAW	P SPH	6-34	12					904.8	
6351	QUACHO	QUADRIGULA CHODATI (VAN-PUL.) G. M. SMITH	T DURCON	3-7		30-80				295	
6352	QUAPFI	QUADRIGULA PFITZERI (SCHROEDER) G. M. SMITH	SW CIL		3		25			177	
6353	QUACLO	QUADRIGULA CLOSTERIODES (BOHLIN) PRINZ	P DURFRU	4-6	4	22-35	25		3	242	
6354	QUALAC	QUADRIGULA LACUSTRIS (CHOD.) G. M. SMITH	P DURCON	3-5		20-25				117	
6354	QUALAC	QUADRIGULA LACUSTRIS (CHOD.) G. M. SMITH	T CIL	4-7	2.2	7-12	7.3			28	
6360	SCABU	SCENEDESMUS ABUNDANS (KIRCH.) CHODAT	UH CIL		5.1	14.6				298	
6361	SCAAL	SCENEDESMUS ACUTUS VAR. ALTERNANS HORTOBAGII	UH CIL	3-7	5.8	30-40	25.6			676	
6364	SCACU	SCENEDESMUS ACUMINATUS (LAG.) CHODAT	UH EST							676	
6365	SCAEL	SCENEDESMUS ACUMINATUS VAR. ELONGATUS G. M. SMITH	UH CIL		2		3			9.4	
6366	SCEBIS	SCENEDESMUS BICAUDATUS (HANSG.) CHODAT (SM)	UH CIL		3		9			113	
6367	SCEBIL	SCENEDESMUS BICAUDATUS (HANSG.) CHODAT (LG)	UH CIL		4		7.9			56	
6368	SCEARC	SCENEDESMUS ARCUATUS VAR. PLATYDISCA G. M. SMITH	T CIL	4-8	5	10-15	10			131	
6369	SCEAPL	SCENEDESMUS ARATUS (CHOD.) G. M. SMITH	P' PROSPH	4.5-7.5		8-17	10			37	
6370	SCEARH	SCENEDESMUS ARATUS (CHOD.) G. M. SMITH	T CIL	6-8		9-15				135	
6372	SCBJL	SCENEDESMUS BIJUGA (TURP.) LAGERHEIM VAR. FLEXOSUS (LEHM.) COLLI	T CIL	4-5	3.8	8-11	11.9			1041	
6373	SCBJL	SCENEDESMUS BIJUGA (TURP.) LAGERHEIM VAR. FLEXOSUS (LEHM.) COLLI	T CIL	6-8	8	12-16	20.7			283	
6374	SCERBAL	SCENEDESMUS BIJUGA VAR. ALTERNANS (REINSCH) BORGE	T CIL	4-8	6	7-16	10			397	
6375	SCEDEN	SCENEDESMUS DENTICULATUS LAGERHEIM	T CIL	6-10	6.6	8-15	11.6			282.7	
6376	SCEDLI	SCENEDESMUS DENTICULATUS VAR. LINEARIS HANSGIRG	P CIL	4	6	11	10			226	
6377	SCEDIM	SCENEDESMUS DIMORPHUS (TURP.) KUETZING	T CIL	3-6		16-22				196.4	
6378	SCEGRA	SCENEDESMUS GRANULATUS W. & G. S. WEST	UH CIL		5		10			35.3	
6379	SCELNT	SCENEDESMUS INTERMEDIUS CHODOT	UH CIL		3		5			42	
6380	SCELBA	SCENEDESMUS INTERMEDIUS VAR. BALTONICUS HORTOBAGII	UH CIL		3		6			130.9	
6381	SCESCO	SCENEDESMUS ECOMNIS (RALES) CHODOT	UH PROSPH		5		10			42.4	
6382	SCETBI	SCENEDESMUS INTERMEDIUS VAR. BICAUDATUS HORTOBAGII	UH PROSPH		3		9			191	
6391	SCBOBL	SCENEDESMUS OBLIQUUS (TURPIN) KUETZING	T CIL		4.6		11.5			396	
6392	SCPOPO	SCENEDESMUS OPLIENSIS P. RICHTER	T CIL	6-8	6	14-26	14			196.4	
6394	SCSEPI	SCENEDESMUS SPINOSUS CHODOT	UH CIL		5		10				

CLEAR PHYTOPLANKTON SPECIES LIST

NUM ALPHA CODE	SPECIES NAME	SOURCE	SHAPE	LIT DIAH	OBS DIAH	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	OBS VOLUME
6396	SCENEDESMUS QUADRICAUDA (TURP.) DE BREILSSON	T	CYL	3-8	2-8	9-16	4-3			26
6397	SCENEDESMUS QUADRICAUDA (TURP.) DE BREILSSON	T	CYL	9-18	4	17-35	11-8			148
6398	SCENEDESMUS QUADRICAUDA VAR. LONGISPINA (CHOD.) G. M. SMITH	T	CYL	3.5-5		8-11				126
6399	SCENEDESMUS QUADRICAUDA VAR. MAXIMUS WEST & WEST	T	CYL	9-11	8.7	27-36	23			1367
6400	SCENEDESMUS SPECIES A	OB	PROSPH	2-2	2-2	5-2	6			20
6401	SCENEDESMUS CELLS	OB	CYL	3	3					42-4
6402	SCENEDESMUS SERRATUS (CORDA) BOHLIN	P	PROSPH	4.5-7	6	15-20	16			301-6
6403	SCENEDESMUS RACIBORSKII WOLOZYNSKA	UH	CYL	4-5	3	12	12			84-8
6404	SHRETS SHROEDERIA SETIGERA (SHROEDER) LEHMERMANN	P	DUBCON	4-5-7	1-5	60-85	14			70-7
6407	SHRETS SHROEDERIA SETIGERA (SHROEDER) LEHMERMANN	P	DUBCON	4-5-7	3	60-85	30			307-9
6408	SHRETS SHROEDERIA SETIGERA (SHROEDER) LEHMERMANN	P	DUBCON	4-5-7	7	60-85	24			91
6411	SELENASTRUM BIBRAIANUM REINSCH	T	DUBCON	5-8	7.2	20-38	24			92
6413	SELENASTRUM GRACILE REINSCH	P	DUBCON	3-6	4	19-28	22			15-7
6415	SELENASTRUM WESTII G. M. SMITH	P	DUBCON	1.5-2.5	2	15-18	16			4 804-2
6416	SORAPA SORASTRUM SPECIES A	OB	OBLSPH	6	6					5 1533
6417	SORAPA SORASTRUM SPINULOSUM MAEGELI	T	FRU	8-20	10	6-18	8			65-5
6420	SPHSHS SPHAEROCYSTIS SCHROETERI CHODAT (SM)	T	SPH	5	5					187
6421	SPHSHS SPHAEROCYSTIS SCHROETERI CHODAT (MD)	T	SPH	7-1	7-1					2352
6422	SPHSHS SPHAEROCYSTIS SCHROETERI CHODAT (LG)	T	SPH	16-5	16-5					4189
6423	SPHSHS SPHAEROCYSTIS SCHROETERI CHODAT (KL)	T	SPH	20	20					25446
6426	SPOMON SPONDILIOSIUM MONILLIFORNE LUND	SW	DUBOBL	30	30	27	27			9 4994
6433	STABUL STAURASTRUM BULLARDII G. M. SMITH	SW	DUBFRU	22	22	12-5	12-5			12 22389
6435	STACHA STAURASTRUM CHAETOCERUS (SCHROEDER) G. M. SMITH	T	DUBFRU	23-39	25	33-60	40			12 38218
6436	STADMA STAURASTRUM DICKIEI VAR. MAXIMUM W. & G. S. WEST	SW	DUBFRU	45-53	50	44-47-5	45			7-5 4761
6438	STAFLO STAURASTRUM FLORIFERUM W. & G. S. WEST	SW	DUBFRU	37	37	24	24			10 11555
6440	STAGRA STAURASTRUM GRACILE RALFS	SW	DUBFRU	23-5	23-5	26-5	26-5			14-1 15019
6448	STAREG STAURASTRUM MEGACANTHUM VAR. SCOTICUM W. & G. S. WEST	SW	DUBFRU	40-46	43	36-38	37			17-5 13018
6450	STAPAR STAURASTRUM PARADOXUM MEYER	T	DUBFRU	22-7	22-7	20-4	20-4			14 8774
6455	STASOR STAURASTRUM SEBALDI REINSCH VAR. ORNATUM NORDSTEDT	T	DUBFRU	39-46	42	35-39	37			11 28862
6456	STASET STAURASTRUM SETIGERUM CLEVE	OB	DUBFRU	55	55					15 85347
6459	STASPA STAURASTRUM SPECIES A	OB	DUBFRU	7-10	8	18-30	20			2 1320
6461	STATET STAURASTRUM TETRACERUM HALFS.	OB	EST	3.7-4	23-5	27-29	27			14-1 39-3
6466	STEND STAURASTRUM ON END	P	CYL	56	25	50	50			31250
6467	TETART TETRADESMUS SMITHII PRESCOTT	P	EST	25	25					254
6469	TETCAU TETRAEDRON ARTHRODESMIFORME (G. S. WEST) WOLOZYNSKA	P	EST	8-18	9-2					254
6470	TETCLO TETRAEDRON CAUDATUM (CORDA) HANSGIRG	T	CUB	28-36	30	36	36			6480
6475	TETLIM TETRAEDRON HASTATUM (REINSCH) HANSGIRG	T	PYR	11-12	10	25-30	25			1171
6476	TETLUN TETRAEDRON LUNULA (REINSCH) WILLE	P	DELCON	12-0	12-0	12-0	12-0			654-4
6480	TETHIN TETRAEDRON MUMUM (A. BRAUN) HANSGIRG	T	TRI	6-18	12	14	14			504
6482	TETPEM TETRAEDRON MUTICUM (A. BRAUN) HANSGIRG	T	REC	18-21	18	18-21	18			5832
6483	TETTRM TETRAEDRON PENTAEDETRICUM WEST & WEST	P	PYR	15-20	16	23	23			893
6485	TETTRI TETRAEDRON REGULARE VAR. INCUS TELLING	T	PYR	20-30	20	23	23			1533
6490	TIALAG TETRAEDRON TRIGONUM (NAEG.) HANSGIRG	P	DUBCON	4-8	6	10-13	12			113
6493	TIRGAL TETRAEDRON LAGERHEIMII TELLING	T	SPH	4-5	4-5					48
6494	TIRHET TETRAEDRON GLABRUM (ROLL) AHLSTROM & TIFFANY	T	SPH	4-3	4-3					42
6496	TIRSTA TETRAEDRON HETERACANTHUM (NORDST.) CHODAT	T	PROSPH	2-9	2-9					19

CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT		OBS		LIT		OBS		VOLUME
				DIAM	DIAM	DIAM	DIAM	LENGTH	LENGTH	WIDTH	WIDTH	
6497		TETHAS TETRAEDRON HASTATUM (REINSCH) HANGIRG	P EST	28-36	7.14							576
6501		TREUBARIA SETIGERUM (ARCHER) G. H. SMITH	P CUB		12							364
6503		TROSPA TROCHISCIA SPECIES A	OB SPH	3-9	6							904.8
6511		WESTELLA BOTRYOIDES (W. WEST) DE WILDEMANN	T SPH		4.3				11.5			113
6520		ULOSPA ULOTHRIX SPECIES A	OB CYL		4							33.5
6550		GREEN CELL A	OB SPH		8							268
6551		GREEN CELL B	OB SPH		12							905
6552		GREEN CELL C	OB SPH		18							3054
6553		GREEN CELL D	OB SPH		10							524
6555		GREBLO GREEN BLOB	OB SPH		5							65.5
6556		GRECOS GREEN COCCOID WITH SHEATH	OB SPH									
6900		EUGLEN EUGLENOIDS (EUGLENOPHYTA)	OB CYL		15							7069
6901		EUGSPA EUGLENA SPECIES A	P CYL	10-14	12	140-180				40		13572
6902		EUGACU EUGLENA ACUS EHRENBURG	OB CYL		16					120		11662
6903		EUGSPB EUGLENA SPECIES B	P CYL	9.5-11	10	76-100				58		6283
6904		EUGERA EUGLENA GRACILIS KLEBS	P CYL	8-15	12	37-50				40		4525
6905		EUGELA EUGLENE ELASTICA PRESCOTT	P CYL	11-13	11	30-34				30		5184
6907		LEPACU LEPOCINCLIS ACUTA PRESCOTT	P OBLSPH		18					28		7389
6925		PHASPA PHACUS SPECIES A	OB OBLSPH		24	25-30				25		7854
6926		PHACUR PHACUS CHRYSICAUDA SWIRENKO	P OBLSPH	24-26	20	29-31				29		6833
6927		PHACHL PHACUS CHLOROPLASTES PRESCOTT	P ELISOL	20-22	45	85-170				90		63617
6929		PHALON PHACUS LONGICAUDA (EHRENB.) DUJARDIN	P ELISOL	45-70	18	36				36		4580
6930		PHANOR PHACUS NORDSTEDTII LEMMERMANN	P ELISOL	18.5	20					26		5445
6931		PHASEP PHACUS SPECIES B	OB PROSPH		40	60-100				60		75397
6932		PHAOBB PHACUS ORBICULARIS HUEBNER	P OBLSPH	39-45	28	46-48				46		31022
6933		LEPPYA LEPOCINCLIS PLAFAIRIANA DELANDRE	OB OBLSPH	28-30	18	27-30				27		6871
6935		PHAPPY PHACUS PYRUM (EHRENB.) STEIN	OB OBLSPH	15.6-21	25	40				40		19635
6940		PHASEP COMBINED PHACUS SPECIES	OB ELISOL	25	15	30-36				30		3534
6998		TRAHX TRACHELOMONAS HEXANGULATA SWIRENKO	P PROSPH	14-16	15					20		4021
6999		TRASPP TRACHELOMONAS SPECIES	OB PROSPH		16					20		

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT		OBS DIAM	LIT		OBS LENGTH	LIT		OBS WIDTH	LIT		OBS WIDTH	VOLUME
				DIAM	DIAM		LENGTH	LENGTH		WIDTH	WIDTH					
7000		DIATOMS (BACILLARIOPHYTA)														10093
7001		ACTINOCYCLUS NORMANNI P. SUBSALSZA (JUHL.-DANNF.) HUSTEDT														7
7003		ACHLAW ACHNATHES LANGOLATA (BREB.) GRUNOW														62832
7004		ATTZAC ATTHEYA ZACHARIASI J. BRUN														3015
7005		AMPEL AMPHILEURA PELLUCIDA KUTZING														7
7006		AMPSA AMPHORA SPECIES A														2282
7007		AMPSA AMPHORA SPECIES B														6457.5
7016		AMPOVA AMPHORA OVALIS (KUETZ.) KUETZING														10
7021		ASPORA ASPERIONELLA FORMOSA HASSALL														2.7
7022		ASPORA ASPERIONELLA FORMOSA HASSALL														2.7
7028		CALSPA CALONEIS SPECIES A														37500
7030		BIDSPB BIDDULPHIA SPECIES														7854
7035		COCRUG COCCONEIS RUGOSA SOVEREIGN														16
7042		COSLAC COSCINODISCUS LACUSTRIS GRUNOW														4423
7055		CYBOD CYCLOTELLA BODANICA EULENSTEIN														7069
7056		CMBIN CYMBELLA MINUTA HILSE EX RABENHORST														6283
7057		CBTR CYMBELLA TURCIDA (GREGORY) CLEVE														198
7059		CBSPA CYMBELLA SPECIES A														4
7060		CYCOM CYCOTELLA COMTA (EHR.) KUETZING														16
7061		CYCOM CYCOTELLA COHENSI GRUNOW														2554
7065		CYKUT CYCLOTELLA KUTZINGIANA THWAITES														196
7070		CYHEN CYCLOTELLA MENESIMIANA KUETZING														2199
7075		CYCFSE CYCLOTELLA PSEUDOSTELLIGERA HUSTEDT														2093
7080		CYCFSE CYCLOTELLA STELLIGERA CLEVE & GRUNOW														1357
7082		CYCFTR CYCLOTELLA STRIATA (KUETZ.) GRUNOW														785
7095		CBSPA CENTRIC SPECIES A														98
7096		CBSPA CENTRIC SPECIES B														628
7097		CBSPA CENTRIC SPECIES C														1856
7098		CBSPA CENTRIC SPECIES D														3770
7099		CBSPA CENTRIC SPECIES E														7363
7100		CBSPA CENTRIC SPECIES F														12723
7102		DIASPA DIATOM SPECIES A														353.4
7103		NAVSPA NAVICULOID SPECIES A														23.6
7105		CBSPA CYNAMOPELEURA SOLEA (BREB.) W. SMITH														70686
7106		CBSPA CYNAMOPELEURA SOLEA (BREB.) W. SMITH														5630
7107		DIATEL DIATOMA TENUE VAR. ELONGATUM LYNGBYE														1496
7108		DIATEL DIATOMA TENUE VAR. ELONGATUM LYNGBYE														5760
7109		CHAEI CYNAMOPELEURA ELIPTICA (BREB.) W. SMITH														51051
7110		DIANAC DIATOMA ANCEPS (EHR.) KIRCHNER														503
7121		FRABIN FRAGILARIA BREVISTRATA VAR. INFLATA (PANT) HUSTEDT														1571
7122		FRAGIL RIA CAPUCINA DESHAZIERES														800
7123		FRACRO FRAGILARIA CROTONENSIS KITTON														387
7124		FRACRO FRAGILARIA CROTONENSIS KITTON														516
7125		FRACV FRAGILARIA CONSTRUPERS VAR. VENTER (EHR.) GRUNOW														113
7127		FRAPIN FRAGILARIA PINNATA EHREBERG														180
7129		FRAVIR FRAGILARIA VAUCHERIAE (KUETZ.) PETERS														135
7133		FRAVIR FRAGILARIA VIRESCENTIS RALFS														1000
7140		FRASPA FRAGILARIA SPECIES A														684
7141		FRASPB FRAGILARIA SPECIES B														432

CLEAR PHYTOPLANKTON SPECIES LIST

NUM ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
7142	DIAMES DIATOM MESSED UP	OB DUBCON		3		45			106	
7145	GOMSPA GOMPHONEMA SPECIES A	OB ELISOL		10		50			5000	
7146	GOMTRU GOMPHONEMA TRUNCATUM EHRENBERG	PR ELISOL	6-14	14	26-65	50	14	14	21420	
7148	GYRSPA GYROSIGMA SPECIES A	PR DUBTRI	13-17	15	75-115	170	15	15	424	
7149	GYROR GYROSIGMA WOHLEI (SULLIV.) BOYER	H CYL	4-15	6	3.5-13	15			1255	
7150	MELAMS MELOSIRA AMBIGUA (GRUN.) D. MUELLER (SM)	H CYL	4-15	8-7	3.5-13	21.1			2119	
7151	MELAMM MELOSIRA AMBIGUA (GRUN.) D. MUELLER (M)	H CYL	4-15	11	3.5-13	22.3			4102	
7152	MELAMB MELOSIRA AMBIGUA (GRUN.) D. MUELLER (L)	H CYL	5-21	16.2	5-18	19.9			295	
7160	MELGRA MELOSIRA GRANULATA (EHR.) RALFS	H CYL	3-5	3.6	4-21	20.1			818	
7161	MELGAN MELOSIRA GRANULATA VAR. ANGUSTISSIMA D. MUELLER	H CYL	7-27	7.2	8-21	20			528	
7165	MELIHE MELOSIRA ITALICA (EHR.) RALFS	H CYL	5-28	5.8	9-13	10			2011	
7170	MELIAR MELOSIRA VARIANS C. A. AGARDH	H CYL	8-35	16	9-13	24			1207	
7180	MELVAR MELOSIRA VARIANS C. A. AGARDH	PR FRU	4-8	6	12-80	40			779	
7181	MELSIRA MELOSIRA SPECIES A	OB ELISOL		4		62			2117	
7190	MERCIR MERIDION CIRCULARE (GREV.) AGARDH	OB ELISOL		7		55			226.2	
7224	NAVIA NAVICULOID DIATOM	OB ELISOL		3		64			8495	
7227	NAVSPA NAVICULOID SPECIES A	OB ELISOL		13		72			18322	
7228	NAVSPB NAVICULOID SPECIES B	OB ELISOL		18		120			3393	
7229	NAVSPC NAVICULOID SPECIES C	OB ELISOL		20		46			14451	
7230	NAVSPD NAVICULOID SPECIES D	OB ELISOL		10		35			10	2745
7231	NAVSPF NAVICULOID SPECIES E	OB ELISOL		6		30			3	540
7232	NAVSPG NAVICULOID SPECIES F	OB ELISOL		3		20			3	141
7233	NAVSPH NAVICULOID SPECIES G	OB ELISOL		15		45			15	7952
7234	NAVSPJ NAVICULOID SPECIES H	OB DUBTRI	5-7	6	20-40	30			5	314
7235	NAVSPK NAVICULOID SPECIES J	PR ELISOL	2-5-5	5	6-17	16			5	249
7240	NAVSPQ NAVICULA SPECIES Q	PR ELISOL	7-11	4.6	20-40	15			4.6	768
7241	NAVSPR NAVICULA SPECIES R	PR DUBTRI	8-12	8	23-41	24			10	3927
7242	NAVSH NAVICULA MINIMA GRUNOW	PR ELISOL	6-10	2.5	33-60	50			10	98
7243	NAVSL NAVICULA SALINARUM GRUNOW	OB DUBCON		13	50-140	60			13	7964
7244	NAVSM NAVICULA MURICATA (O. F. MUELL.) BORY	H ELISOL	10-20	13	20-50	77			7	1347
7245	NAVSN NAVICULA NITIDA (O. F. MUELL.) BORY	H ELISOL	5-8	7	20-50	35			7	170
7246	NAVSO NAVICULA OBLONGATA (O. F. MUELL.) BORY	H DUBCON	3-4	2.9	50-150	120			636	
7248	NEEDIA NEEDLE DIATOM	H DUBCON	4.5	4.5		100			236	
7249	NAVUL NAVICULA VULPINA KUEZZING	H DUBCON	3-4	3	50-150	100			5	1924
7250	NITAPI NITZSCHIA APICULATA (GREGORY) GRUNOW	H DUBCON	4-6	5	20-100	70			7	2309
7251	NITACI NITZSCHIA ACICULARIS W. SMITH	H ELISOL	6-9	7	20-110	60			2	3369
7252	NITCLO NITZSCHIA CLOSTERIUM (EHR.) W. SMITH	H DUBTRI	5-6	5	70-180	110			3	297
7255	NITDIS NITZSCHIA DISSIPATA (KUEZZ.) GRUNOW	H DUBTRI	2.5-5	4.3	20-65	23			1352	
7257	NITFIL NITZSCHIA FILIFORMIS (W. SMITH) HUSTEDT	H DUBCON	4-6	5.7	40-75	50			654.4	
7260	NITFUN NITZSCHIA FUNGICATA GRUNOW	H DUBCON	6-10	9	30-60	47			209.4	
7265	NITLIN NITZSCHIA LINEARIS W. SMITH	H DUBCON	2-4	5.8	40-150	18.2			480	
7270	NITPAL NITZSCHIA PALEA (KUEZZ.) W. SMITH	H CYL	3-6	4.2	12-75	15			294.5	
7275	NITSIG NITZSCHIA SIGMOIDEA (EHR.) W. SMITH	H CYL	4-8	3.6	5	15			114	
7276	NITSUB NITZSCHIA SUBLINEARIS HUSTEDT	H CYL	9-15	12	24-75	40			1524	
7277	NITSTA NITZSCHIA STAGNORUM RABENHORST	PR ELISOL	30-70	36.4		20			20812	
7280	NITSPA NITZSCHIA SPECIES A	H CYL								
7301	RHIERI RHIZOLENIA ERIENISIS H. I. SMITH	H CYL								
7302	RHOEUR RHIZOLENIA CURVATA (KUTZ.) GRUNOW	H CYL								
7305	SCEGUB SCELETONEMA SUBSALSUS A. CLEVES	H CYL								
7308	STANWC STAUROWNEIS ANCEPS EHRENBERG	H CYL								
7311	STEARST STEPHANODISCUS ASTRAEA (EHR.) GRUNOW	H CYL								

CLEAR PHYTOPLANKTON SPECIES LIST

NUM CODE	ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LNETH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
7312	STEAMI	STEPHANODISCUS ASTREA VAR. MINUTULA (KUETZ.-) KRIEGER	H CYL	8-30	16		16			3217	462
7314	STERIN	STEPHANODISCUS BENDERANUS (KUETZ.-) KRIEGER	H CYL	4-25	12.6	3-7	16.9			2107	2199
7315	STERIN	STEPHANODISCUS BENDERANUS (KUETZ.-) KRIEGER	H CYL	10-25	20		7			8107	50697
7318	STEDUB	STEPHANODISCUS DUBIUS (FRICKS) HUSTEDT	H CYL	8-20	25.4		16			10	4712
7320	STEHAN	STEPHANODISCUS HANTZSCHII GRUNOW	HP CYL	30-100	48.1		27.9			15	24103
7330	STEHAN	STEPHANODISCUS NIAGARA EHRENBERG	H ELISOL	6-15	10	18-70	60			7068.6	7068
7351	SURANG	SURIARELLA ANGUSTATA KUETZING	H ELISOL	30	30	15-70	60			10	9796
7380	SUROVA	SURIARELLA OVALIS DE BREISSON	H ELISOL	8-23	15		40			20	97625
7381	SUROVA	SURIARELLA OVATA KUTZING	OB EST				41			2	7877
7384	SURGIR	SURIARELLA GIRDLE VIEW	OB ELISOL				41			2.9	350
7385	SURSPA	SURIARELLA SPECIES A	OB ELISOL				460				90
7386	SURSPB	SURIARELLA SPECIES B	PR DUBFRU				34				552
7402	SYNACU	SYNEDRA ACUS KUETZING	H DUBFRU	2-5-4	3	20-75	60			3	3299
7405	SYNACT	SYNEDRA ACTINASTROIDES LEMMERHANN	PR DUBFRU	3-5	50	20-30	43			1.5	618
7406	SYNAP	SYNEDRA AEPHICEPHALA KUETZING	PR DUBFRU	2-7.6	4	100-230	150			2	660
7407	SYNDEL	SYNEDRA DELICATISSIMA W. SMITH	PR DUBFRU	2-4	3	40-120	50			2	2450
7430	SYNRAD	SYNEDRA RADIANUS KUETZING	PR DUBFRU	2-4	4	27-70	30			2	1984
7435	SYNRUL	SYNEDRA RUMPENS KUETZING	PR DUBFRU	5-9	5	70-100	80			2.6	127
7440	SYNUCH	SYNEDRA ULNA (WITZ.) EHRENBERG	PR DUBFRU	3-5	4.6	400-700	190				91.9
7441	SYNUCH	SYNEDRA ULNA VAR. CHASEANA THOMAS	PR DUBFRU		2		69			9	1438
7442	SYNSPA	SYNEDRA SPECIES A	OB DUBFRU		5	40-75	56			9	1438
7443	SYNSPB	SYNEDRA SPECIES B	PR CYLREC	5-10	7-2	12-50	30			20	1526
7451	TAFEN	TABELLARIA FENESTRATA (LYNGB.) KUETZING	PR CYLREC	5-16	6						
7460	TAFLO	TABELLARIA FLOCCULOSA (ROTH) KUETZING	PR CYLREC								

8000	DINFLA	DINOFLAGELLATES (PYROPHITA, DINOPHYCEAE)	HP EST							23000	
8051	CERHIR	CERATIUM HIRUNDINELLA (O. MUELL.) SCHRANK	OB EST							40000	
8052	CERHIR	CERATIUM HIRUNDINELLA (O. MUELL.) SCHRANK	OB EST							23000	
8053	CERCYS	CERATIUM CYST	HP PROSPH	42-49	40.6	44-49	46.4			40047	
8101	DIPACU	DIPLOSALIS ACUTA ENTZ	OB PROSPH				20.4			3676	
8175	GLESFA	GLENODINIUM EDAX SCHILLING	HP PROSPH	33	33	34	34			13521	10
8201	GYMAER	GYMNODINIUM AERUGINOSUM STEIN	HP PROSPH	21-22	22.5	33-34	32			8482	
8210	GYMOR	GYMNODINIUM CORONATUM WOLLE	HP PROSPH	25	27	30	30			11451	
8220	GYMHEL	GYMNODINIUM HELVETICUM PENARD	HP CONFRU	30	30	50	50			12117	
8230	GYMILN	GYMNODINIUM INVERSUM NYGAARD	HP PROSPH	22-29	24	27-36	35.5			10707	
8231	GYMIEL	GYMNODINIUM INVERSUM VAR. ELONGATUM NYGAARD	HP PROSPH	22-34	26.0	39-50	46.0			16282	
8232	GYMLIH	GYMNODINIUM LIMNETICUM WOLOZYNSKA	HP PROSPH	30	30	30-40	35			16943	
8240	GYMNEG	GYMNODINIUM NEGLECTUM (SCHILLING) LINDEMANN	HP PROSPH	22	22	32-35	32			8110	
8250	GYMORD	GYMNODINIUM ORDINATUM SKUGA	HP PROSPH	11-13	11.2	12-15	11.6			762	
8275	GYMSPA	GYMNODINIUM SPECIES A	OB PROSPH		14.3		15.7			1681	
8301	PERACT	PERIDINIUM ACICULIFERUM (LEMM.) LEMMERHANN	HP EST	29-42	40	35-51	8500			8500	
8310	PERCIN	PERIDINIUM CINCTUM (MUELL.) EHRENBERG	HP EST	35-55	50	45-60	50			41888	
8327	PERPAL	PERIDINIUM PALUSTRE (LINDEMANN) LEFEBVRE	HP OBLSPH	45-80	50	55-80	65			10608	
8328	PERPER	PERIDINIUM PENARDIFORME WOLLE	P OBLSPH	26-30	26	30-34	30			12252	
8330	PERPOL	PERIDINIUM POLONICUM WOLLE	HP PROSPH	35	36.7	40	43.6			30748	
8333	PERPYG	PERIDINIUM PYGMAEUM LINDEMANN	HP OBLSPH	20-24	20	22-25	22			5068	
8350	PERWIL	PERIDINIUM WILLEI HULTF-KAAS	HP OBLSPH	47-50	48	40-60	50			615188	
8375	PERSPA	PERIDINIUM SPECIES A	OB PROSPH	30	30		33			15551	
8376	PERSPB	PERIDINIUM SPECIES B	OB SPH	30	30		30			14137	
8377	PERSPC	PERIDINIUM SPECIES C	OB PROSPH	34	34		38			23000	
8378	PERSPD	PERIDINIUM SPECIES D	OB PROSPH	29	29		36			15853	
8500	GDISEA	G-DINIUM SPECIES A	OB PROSPH	18	18		23			3902	

CLEAR PHYTOPLANKTON SPECIES LIST

NUM ALPHA CODE	SPECIES NAME	SOURCE SHAPE	LIT DIAM	OBS DIAM	LIT LENGTH	OBS LENGTH	LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
9000	CHRYSOPHYTES (CHRYSOPHYTA)	HP PROSPH		5.8		7.3			129	
9005	ASTROSIGA RADIATA ZACHARIAS	HP PROSPH		4		7			58.6	
9010	BICOSA BICOECA SOCIALIS LAUTERBORN	OB SPH	5.8						102	
9015	BICOSA BICOECA SPECIES A	SPH		4.3	2-3-5				42	
9016	BICAIN BICOSOCCA AINIKKIAE	PROSPH	1-7-3						9.8	
9026	BODSPO BODO SPORA SKUJA	PROSPH	3-4		8-10				58	
9060	CHREGLA CHROMULINA GLACIALIS SKUJA	PROSPH	2		2-4				6.3	
9065	CHREGLA CHROMULINA MIKROPLANKTON PASCHER	HP PROSPH	3						14	
9070	CHRSPA CHROMULINA SPECIES A	OB SPH	5.7						97	
9071	CHRSPB CHROMULINA SPECIES B	OB SPH	12-17						382	
9080	CHRSAD CHYSAMOREBA RADIANS KLEBS	HP SPH	2-3						14	
9110	CRYPF CHRYSOCOCCUS PUNCTIFORMIS PASCHER	HP SPH	8-12						52.4	
9115	CRYPF CHRYSOCOCCUS RUFESCENS KLEBS	HP SPH	7-15						83	
9116	CHRYAD CHRYSOCOCCUS RADIANS CONRAD	OB SPH	5.4						14	
9120	CHRSQA CHRYSOCOCCUS SPECIES A	OB SPH	5.8						102	
9121	CHRSPB CHRYSOCOCCUS SPECIES B	OB SPH	5.7						97	
9130	CROPAR CHRYSOCHROMULINA PARVA LACKEY	SA SPH	6						113	
9155	DESHON DESHARELLA MONILIFORMIS S. KENT	HP SPH			16.5				526	
9176	DINBAV DINOBRYON BAVARICUM IMHOF	HP PROSPH	7.7		10				366.5	
9178	DINCLV DINOBRYON CYLINDRICUM IMHOF	P PROSPH	7		12.7				326	
9185	DINDIV DINOBRYON DIVERGENS IMHOF	HP PROSPH	8		14.6				488	
9190	DINSOC DINOBRYON SOCIALE EHRENBERG	OB EST							326	
9195	DINSPA DINOBRYON SPECIES A	HP SPH	10						524	
9196	DINSTA DINOBRYON STATOBLAST	OB SPH	5						65.5	
9197	DINSEB DINOBRYON SPECIES B	OB SPH	5						111	
9210	ERKSUB ERKENIA SUBAEQUICILIATA SKUJA	PROSPH	5-8		5-9				484	
9220	CENBEL CENTRITRACTUS BELANOPHORUS LEMMERMANN	T DUBCON	5-9		8-16				14	
9235	KEPMAS KEPHYTRION MASTIGOPHORUM GERL. SCHMID	HP SPH	6						28	
9236	KEPSEI KEPHYTRION SPIRALE (LACK.) CONRAD	HP PROSPH	3						113	
9260	LAGGLO LAGNEDECA GLOBULOSA FRANCE	HP SPH	6						953	
9286	MALTAL MALLONAS TONSURATA VAR. ALPINA (PASCH. & RUTIN.) KRIEGER	HP PROSPH	9-15	10.2	13-35	17.5			14	
9314	OCHNAN OCHROMONAS NANA DOFLEIN	HP SPH	2-3						170	
9315	OCHVAL OCHROMONAS VALLESIIACA CHODAT	HP PROSPH	6						132	
9316	OCHVAR OCHROMONAS VARIABILIS MEYER	HP PROSPH	6						22.5	
9320	OCHSPA OCHROMONAS SPECIES A	OB SPH	3.5						102	
9321	OCHSPB OCHROMONAS SPECIES B	OB SPH	5.8						33	
9322	OCHSPC OCHROMONAS SPECIES C	OB SPH	3						2309	
9326	ORHCAP ORHOCYTIUM CAPITATUM WOLLE	OB PROSPH	5-10		7				1669	
9327	ORHCLO ORHOCYTIUM CAPITATUM VAR. LONGISPINUM (MOEBIUS) LEMMERMANN	T CYL	5-10		85	60			45	
9356	PSEPOC PSEUDOKEPHYTRION POCULUM CONRAD	HP SPH	4.4		85	85			45	
9365	PSESPA PSEUDOKEPHYTRION SPECIES A	OB SPH	4.4						69.7	
9370	SALFRE SALPINGOCCA FREQUENTISSIMA (ZACH.) LEMMERMANN	HP PROSPH	4.3			7.2			22.5	
9375	STEDIC STELEXOMONAS DICHOTOMA LACKEY	SPH	3.5						58.6	
9380	URGAHE URGLENOPSIS AMERICANA (CALKINS) LEMMERMANN	T PROSPH	4		5-10				6.3	
9401	FLASPC FLAGELLATE SPECIES C	OB SPH	3							

CLEAR PHYTOPLANKTON S

NUM ALPHA CODE	SPECIES NAME	SHAPE	LIT		OBS		LIT		OBS		LIT WIDTH	OBS WIDTH	LIT VOLUME	OBS VOLUME
			DIAM	DIAM	LENGTH	LENGTH	LNCTH	LNCTH						
9500	CRYPTO CRYPTOPHYTES (PYROPHYTA, CRYPTOPHYCEAE)													
9505	CRYPTUR CRYPTOMONAS CURVATA EHRENBURG	HP PROSPH	9-13	20	18-27	40	4-5	2256	8377					
9515	CRYERO CRYPTOMONAS EROSA EHRENBURG	HP FRU	8-14	13-4	16-20	24	3-4	490	2256					
9516	CRYERE CRYPTOMONAS EROSA VAR. REFLEXA MARSSON	HP PROSPH	12	8-7		16		2111	2111					
9535	CRYMAR CRYPTOMONAS MARSSONII SKUJA	HP PROSPH	6-20	18	20-80	23	5-8	3902	3902					
9545	CRYOVA CRYPTOMONAS OVATA EHRENBURG	HP FRU	14-19	16	30-46	35	10-16	3078	3078					
9555	CRYREF CRYPTOMONAS REFLEXA SKUJA	HP PROSPH	18-28	22	48-58	48	5	19792	19792					
9560	CRYROP CRYPTOMONAS ROSTRIFORMIS SKUJA	HP FRU	3-8	4-4	8-14	7		71	71					
9561	CRYROS CRYPTOMONAS ROSTRATA TROITZK	HP PROSPH	2	2	3-3.5	3		9-4	9-4					
9610	KATOVA KATABLEPHARIS OVALIS SKUJA	HP PROSPH	5-8	5	10-13	10	2	306	306					
9615	MOMPAC MONOCHRYISIS PARVA SKUJA	HP FRU	9-11	9	12-17	12	2	971	971					
9710	RHOLAC RHODOMONAS LACUSTRIS PASCHER-RUTTNER	HP CON	4-7	7.5	9-14	12.9		190	190					
9715	RHOLEN RHODOMONAS LENS PASCHER-RUTTNER	HP CON	5-6	9	8-9			47	47					
9720	RHOMIN RHODOMONAS MINUTA SKUJA	OB SPH						382	382					
9721	RHOMNA RHODOMONAS MINUTA VAR. NANNOPLANCTICA SKUJA	OB SPH						66	66					
9731	FLASPE FLAGELLATE SPECIES E													
9732	FLASPD FLAGELLATE SPECIES D													

APPENDIX 1

Programs for Conversion of Raw Count Data into Cells/ml and Biomass

These programs are in the process of being updated and documented, and will be forthcoming.

APPENDIX 2

Coding Form Used for Keypunching Phytoplankton Data

The three-page phytoplankton coding form is used by the enumerator to prepare raw count data for the keypuncher. The coding form follows the format outlined on the following format page. The coding sheets contain some of the most common organisms encountered, plus have blank spaces where the less common taxa may be entered.

Information about which microscope was used, which magnification, and the diameter of the settling chamber is entered on the header cards. The volume of water settled and the number of fields or strips examined are also entered. These pieces of information make it possible to convert raw count data to cell numbers per ml and phytoplankton biomass in $\mu\text{g}/\text{l}$.

Our usual counting procedure is to count a number of fields (ordinarily 50) at low magnification (20x or 25x objective) and record all but the very small organisms (under 10μ). The small organisms are counted at a higher magnification (40x objective). If there are many large organisms in the sample (i.e. Dinoflagellates), a third type of count may be made, where the contents of half the settling chamber is examined, and just the very large biomass contributors enumerated. These procedures are satisfactory for our Lake Erie work, but might be modified for other areas with sparse phytoplankton populations. Modifications could be made by any given user of the system to suit the needs of that user.

The phytoplankton enumerator uses the alphabetical codes to locate a specific organism on the coding sheet. Coding of raw count data is usually done in red. The keypuncher ignores the alphabetical codes, and just punches in the numerical code and the raw count data which has been entered in a visible color. The computer programs deal only with the numerical codes and raw data when performing computations.

PHYTOPLANKTON FORMAT

HEADER CARD

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
N	S										1				1									

STUDY CODE (PROJECT)	STATION	DATE	CARD NUMBER	CHAMBER TYPE 1 = 25.0 2 = 26.1	SCOPE CODE	COUNT TYPE 1 = PHYTOPLANKTON 2 = ZOOPLANKTON	D	E	P	T	H
----------------------	---------	------	-------------	--------------------------------------	------------	--	---	---	---	---	---

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S										2							

DATA →

9999 995
END OF COUNT # 1

REPEAT

CARD NUMBER	ENTER # OF FIELDS OR 950 = STRIP	MAGNIFICATION	VOLUME OF WATER SETTLED
-------------	----------------------------------	---------------	-------------------------

1 = 10x
2 = 20x
3 = 25x
4 = 40x
5 = 100x
MAGNIFICATION CODES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S																	

DATA →

9999 996
END OF COUNT # 2

REPEAT

CARD NUMBER	ENTER # OF FIELDS OR 950 = STRIP	MAGNIFICATION	VOLUME SETTLED
-------------	----------------------------------	---------------	----------------

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S											9	7	5				

DATA → 9999 997
END OF STATION

975 =
HALF CHAMBER

REPEAT

CARD NUMBER	CODE FOR HALF CHAMBER IS 975	MAGNIFICATION	VOLUME SETTLED
-------------	------------------------------	---------------	----------------

SCOPE CODES - NS
1. = RICK LEITZ
2. = RICK WILD
3. = DONNA LEITZ 12.5
4. = MARTHA WILD 10.5
5. = MARTHA WILD 12.5

STATION, CRUISE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
N	S										1									

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S										2							

5005	ANACIR		7001	ACTNDS		9515	CRYERD		6163	DICPUL
5015	ANAFLO		7021	ASTFOR		9535	CRYMAR		6168	ELAVIA
5050	ANASCR		7042	COSLAC		9545	CRYOVA		6181	FRADRO
5060	ANAWIS					9555	CRYREF		6193	GLOGIG
5070	ANASPA		7055	CYCBDD		9560	CRYRDF		6204	GOLRAD
5080	APHECO		7060	CYCCOM		9130	CROPAR		6215	KIRLUN
5101	APHCLA		7070	CYCMEN		9610	KATOVA		6220	KIRSUB
5125	APANID		7107	DIATEL		9720	RHOMIN		6227	LAGEIT
5151	APZFLD		7108	DIAVUL		9721	RHOMNA		6230	LAGEEN
5225	CHRZIM		7123	FRACRO					6234	LAGESUB
5251	COEDUB		7129	FRAVAU					6241	MICERI
5260	COEKUE		7160	MELGRA		6002	ACTHAN		6264	MONCON
5275	COENAE		7161	MELGAN		6004	ACTHAF		6268	MONIRR
5301	GOMAPO		7165	MELJSL		6015	ANKFAL		6272	MONMIN
5351	MARELE		7225	NAVSPA		6031	BINERI		6274	MONSET
5401	MESELE		7301	RHIERI		6042	CARSPA		6276	MONTOR
5425	MESHIM		7305	SCESUB		6064	CHLGLD		6281	MOUSPA
5451	MICAER		7312	STEAMI		6082	CLDLON		6291	NEPAGA
5475	MICMIN		7315	STEBIN		6086	CLDACL		6293	NEPLIM
5501	OSCAGA		7320	STEHAN		6089	CLDDIA		6294	NEPDBE
5535	OSCLIM		7330	STENIA		6091	CLDGRA		6296	OEDSPA
5550	OSCPA		7451	TABFEN		6104	COEMIC		6301	OOCBOR
5555	OSCPRO		7095	CENSPA(5)		6105	COEMIL		6302	OOCBOR
5625	PHOSPA		7096	CENSPB(10)		6106	COERET		6305	OOCCLAC
5701	RHAMED		7097	CENSPL(15)		6107	COERET		6306	OOCCLAC
			7098	CENSPD(20)		6120	COSDEP		6308	OOCPAR
5276	COEPAL		7099	CENSPE(25)		6135	COSTEP		6313	OOCSDL
5465	MICINC		7100	CENSPF(30)		6153	CRUFEN		6315	OOCSUB
			7170	MELITA		6154	CRULLAU		6321	PANMDR
						6156	CRUREC		6324	PARMUL
						6157	CRUTET			
						6155	CRUQUA			

6331	PEDB			9176	DINBAV		6901	EU6SPA
6332	PEDB			9185	DINDIV			
6335	PEDD	6411	SELBIB	9190	DINSOC			
6336	PEDD	6413	SELGRA	9178	DINCYL			
6337	PEDD	6417	SORSPI					
6338	PEDDCL	6420	SPHSCH	9285	MALTAL			
6339	PEDDGR	6421	SPHSCH	9290	MA1SPA			
6340	PEDSMS	6422	SPHSCA	9291	MA1SPB			
6341	PEDSMH	6433	STABUL					
6342	PEDSML	6440	STAGRA	8051	CERHIR			
6343	PEDSMX	6446	STALDN	8052	CERHIR	6925	PHASPA	
6345	PEDTET	6450	STAPAR	8101	DIPACU			
6346	PEDTTE	6470	TETCLO					
6350	PTEANG	6475	TETLIM					
6351	QUACHO	6480	TETMIN					
6354	QUALAC	6480	TETMUT					
6356	SCEABU	6483	TETRIN	8220	GYMHEL			
6364	SCEACU	6485	TETTRI	8230	GYMINV			
6368	SCEARC	6493	TTRGLA	8231	GYMIEL			
6370	SCEARM	6494	TTRHET	8240	GYMNGG			
6372	SCEBITJ	6496	TTRSTA	8250	GYMDRD			
6373	SCEBITJ	6501	TRESET	8275	GYMSPA			
6365	SCEBIC	6520	ULDSPA					
6366	SCEBIC			8301	PERACI			
6375	SCEDEN	6975	GRNSPA(4)					
6377	SCEDIM	6976	GRNSPB(8)	8330	PERPOL			
6392	SCEOPD	6977	GRNSPC(12)					
6393	SCEEIC	6978	GRNSPD(18)	8375	PERSPA			
6396	SCEQUA			8376	PERSPB			
6397	SCEQUA							
6398	SCEQLD							
6399	SCEQMA							
6400	SCESPA							
6406	SCHSTS							
6407	SCHSTM							
6408	SCHSTL							
							9999	995

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S																	

CENTRICS

9010	BICSOC			9185	DINDIV			9610	KATOVA			7095	CENSPA(5)
9026	BODSPO			9190	DINSOC			9720	RHOMIN			7096	CENSPB(10)
9060	CHRGLA			9210	ERKSUB			9721	RHOMNA			7097	CENSPC(15)
9065	CHRMIR			9235	KEPMAS							7098	CENSPD(20)
9070	CHRSPA			9260	LAGLOB			BG	CELLS			7099	CENSPE(25)
9071	CHRSPB			9285	MAJAL			5800	BLGSPA(3)			GREEN CELLS	
9080	CRSRAD							5801	BKSPB(7)			6975	GRESPI(4)
9110	CRYPUN			9314	OCHNAN			5802	COENAE			6976	GRESPIB(8)
9116	CRYRAD			9315	OCHVAL			5803	GOMAPO			6977	GRESPI(12)
9120	CRYSPI(3)			9316	OCHVAR			5804	MICAER			6978	GRESPI(18)
9121	CRYSPI(5.8)			9320	OCHSPA(3.5)			5805	APHCLA				
9130	CRDPAR			9321	OCHSPB(6.8)			5806	COEKUE				
9155	DESMON			9322	OCHSPC(2)								
9176	DINBAV			9326	DPHCAP								
9178	DINCLY			9615	HONPAR								
				9356	PSEPOC								
				9365	PSESPA							9999	996
				9375	STEDIC								
				9370	SALFRE								

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
N	S											9	7	5				

				8220	GYMHEL			8330	PERPOL			4005	CILSPA
				8230	GYMINV							4006	CILSPB
				8231	GYMIEL							4007	CILSPC
8051	CERHIR			8240	GYMNEG								
8052	CERHIR			8250	GYMORD							4052	STRSPA
8101	DIPACU			8275	GYMSPA								
8175	GLSPA							6120	COSDEP				
								6122	COSFOR				
				8301	PERACI			6150	COSVAR			9999	997
				8328	PERPEN			6450	STAPAR				