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PHYTOPLANKTON AND PRIMARY PRODUCTIVITY STUDIES IN LAKE OKEECHOBEE DURING 1974

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

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Phytoplankton and Primary Productivity Studies in Lake Okeechobee During 1974

by

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SUMMARY AND CONCLUSIONS

1. In Lake Okeechobee, two periods of maximum gross primary productivity were observed in 1974. The productivities were 1705 mg C/m^3/day in May and 2216 mg C/m^3/day in September.

2. The average gross primary productivity for 1974 was 1349 mg C/m^3/day. The average productivities for each station were as follows:

Station 1 (north end of the Lake)	1673 mg C/m^3/day
Station 4 (east-central portion of the Lake)	1419 mg C/m^3/day
Station 5 (mouth of Fisheating Creek)	1278 mg C/m^3/day
Station 6 (south-central portion of the Lake)	1027 mg C/m^3/day

3. The highest productivity, 3454 mg C/m^3/day, was observed at Station 5 in September.

4. Most of the productivity in Lake Okeechobee was net productivity. Respiration generally accounted for less than 10% and rarely exceeded 20% of the gross primary productivity.

5. The periodicity in primary productivity remained relatively constant from 1973 to 1974.

6. Average gross primary productivity was higher in 1974 than in 1973. Stations near inflows (Stations 1 and 5) had higher average productivities in 1974 than in 1973. Centrally located Stations (4 and 6) showed essentially no differences in average productivity from 1973 to 1974. The largest increase in average productivity (33%) was observed at Station 5. Although some averages were higher, no significant differences were observed between the 1973 and 1974 average productivity means for individual as well as collective stations groupings.

7. A total of 233 species of algae were identified from Lake Okeechobee. A breakdown by algal group is as follows: Blue-green algae (Cyanophyta) 38 species: Green algae (Chlorophyta) 79 species; Diatoms (Chrysophyta, Class Bacillariophyceae) 67 species; Euglenoids (Euglenophyta) 29 species; Cryptomonads

(Pyrrhophyta, Class Cryptophyceae) 8 species; and Dinoflagellates (Pyrrhophyta, Class Dinophyceae) 12 species.

8. Two peaks in phytoplankton densities and biovolume were observed in 1974. The largest peak in densities (222,061 and 221,760 units/ml) were observed in April and May, respectively). A smaller peak (135,362 units/ml) was observed in August. In terms of biovolume, the August peak (22,598,359 μ^3/ml)was much larger than the April peak (12,679,851 μ^3/ml).

9. When phytoplankton populations were analyzed in terms of density, the phytoplankton were dominated by blue-green algae (59%) followed by diatoms (20%), green algae (14%) and cryptomonads (7%).

10. When populations were analyzed on the basis of biovolume, the phytoplankton were dominated by diatoms (41%) followed by blue-green algae (34%), green algae (12%), cryptomonads (10%), euglenoids (2%) and dinoflagellates (2%).

11. In terms of densities, the spring peak was dominated by diatoms and blue-green algae, whereas, on the basis of biovolume, the spring peak was dominated by diatoms.

12. The fall peak in densities was caused by increases in blue-green algae, green algae, and diatoms. The fall peak in biovolume was caused primarily by blue-green algae.

13. Stations 1, 3, and 5, near inflows, had higher average phytoplankton densities and up to 50% more biovolume than other stations. Stations 6 and 7 at the south end of the Lake averaged about 1/3 of the density and 1/2 of the biovolume of the rest of the Lake stations. Stations near inflows also had higher percentages of blue-green algae (both in density and biovolume) than did other Lake stations. Stations 2,4,6,7 and 8 in the central and southern portions of the Lake had higher percentages of diatoms.

14. The largest algal bloom (189,545 units/ml and 98,979,125 μ^3/ml) was composed of a blue-green alga, Rhaphidiopsis curvata. Smaller blooms were

caused by diatoms (Fragilaria pinnata, Fragilaria construens, and Coscinodiscus rothii) at most stations in the spring and fall. A bloom of the green alga, Chlorella sp., was observed at Station 5 in August.

15. Based on the size ranges, the phytoplankton community is composed mainly (estimated 95%) of nannoplankton (10-50μ) with most of the nannoplankton (estimated 85-90%) in the ultraplankton range (0.5-10μ).

16. Peaks in algal densities and biovolume were generally out of phase with those of gross primary productivity.

17. Significant regressions were observed between gross primary productivity and phytoplankton density and biovolume parameters. The strengths of the relationships (as determined by coefficients of determination) were very low for collective stations groupings but moderately high for some individual stations.

18. Significant regressions were observed between certain algal groups (blue-green algae, green algae, and diatoms) and gross primary productivity, but no group showed consistent relationships for each station.

19. The species list presented in this report differs from that presented from the 1973 report (Davis and Marshall, 1975). These differences may be explained by improvements in identification techniques.

20. The periodicity in phytoplankton populations remained relatively constant from 1973 to 1974. The same general pattern in dominance and seasonal succession was observed for both years.

21. Lake Okeechobee exhibits the seasonal patterns and periodicity typical of temperate lakes although the seasonal variation in densities is typical of a tropical lake. Considering primary productivity with these factors, the author concludes that Lake Okeechobee phytoplankton dynamics most closely resemble those of a temperate lake.

INTRODUCTION

Lake Okeechobee is the major storage basin for surface water in southern Florida and hence is highly significant in terms of future water management programs. Since 1973, the South Florida Water Management District (formerly Central and Southern Florida Flood Control District) has actively been engaged in limnological studies of Lake Okeechobee. A report published by the District (Davis and Marshall, 1975) produced the first in depth study of the biological and chemical factors affecting the Lake. The present report focuses on phytoplankton dynamics and primary productivity in the Lake during 1974. Seasonal and areal variations in phytoplankton and primary productivity are examined, and an attempt is made to categorize Lake Okeechobee as temperate or tropical in terms of phytoplankton populations and primary productivity.

MATERIALS AND METHODS

Sampling Locations and Frequencies

Figure 1 shows the locations of all stations at which biological data were collected. Phytoplankton samples were taken at Stations 1 through 8 at approximately monthly intervals from January through December 1974. Primary productivity measurements were made at the same frequency at Stations 1, 4, 5, and 6.

Biology Methods

Primary productivity was estimated by the light and dark bottle method (Strickland and Parsons, 1968). Oxygen concentrations were determined in the field by the Azide modification of the Winkler titration (USPHA 13th Ed). Duplicate bottles were suspended vertically from floats, and incubated *in situ* for six hours at a depth of 0.22 m. This depth was the minimum depth at which bottles could be placed and not have them break the surface during periods of rough water. Bottles were placed in the water between 0900 and 1100 hours. Daily productivities were calculated by multiplication of the observed productivity rate (six hour average) by the day length.

Gross and net primary productivity and respiration were calculated from light and dark bottle data. Gross primary productivity is the total rate at which organic compounds are being produced by cells. Net primary productivity is the rate at which organic compounds are being produced minus losses due to respiration and certain other cellular processes. Respiration is the rate at which organic compounds are being utilized by the cells. A PQ (photosynthetic quotient) value of 1.2 and RQ (respiratory quotient) of 1.0 were used in the productivity calculations. Since estimates of gross productivity by the oxygen method are considered to be more reliable than net productivity estimates

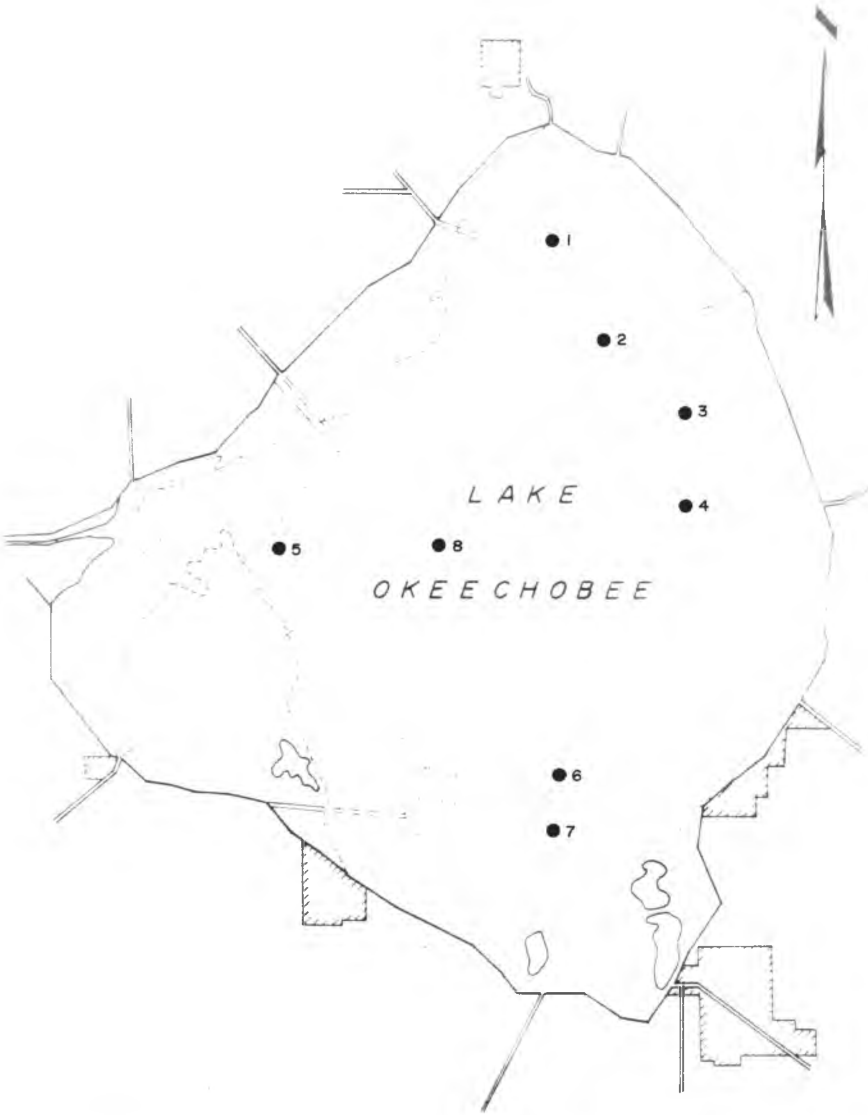

Figure I LAKE OKEECHOBEE 1974 WATER QUALITY AND BIOLOGICAL SAMPLING STATIONS

(Strickland, 1966; Vollenweider, 1969) more emphasis is placed on gross primary productivity in the results and discussion sections.

Phytoplankton samples, 250-300 ml aliquots, were taken from a depth of 0.5 m and preserved in Lugol's solution. Preserved samples were thoroughly shaken and pipetted into 50 ml Wild settling chambers (Wild Heerbrugg Instruments Inc., Farmingdale, L.I., N.Y.). Algae in the samples were allowed to settle overnight and counted by observation with a Wild M40 inverted microscope (Wild Heerbrugg Instruments, Inc. Farmingdale, L.I. N.Y.) at 1875X. At least 100 organisms were counted per sample. Algal concentrations or densities were determined as number of units per milliter (ml). In counting, a colony or filament was considered as one "unit". Cell volumes were calculated using the measurements of individual cells and the appropriate shapes which most closely resembled the alga. The formulae for the following shapes were used in these determinations: cylinder, sphere, cone, oblate spheroid, and prolate spheroid. The volume of each unit was multiplied by the density to determine the biovolume per ml. Diatoms were prepared according to Patrick and Reimer (1966) and mounted in Hyrax.

The following taxonomic keys were used in species determinations: Prescott, 1970; Smith, 1950; Huber-Pestalozzi, 1938-1961; Hustedt, 1930; Drouet, 1968; Drouet and Daily, 1956; Tiffany and Britton, 1971; Patrick and Reimer, 1966; Edmondson, 1959; and Whitford and Schumacher, 1973.

The following persons were instrumental in the identification of various algae: Dr. James B. Lackey for cryptomonads and dinoflagellates; Dr. Francis Drouet for the identification of _Rhaphidiopsis curvata_; and Mr. David Swift for diatom identification.

RESULTS

Primary Productivity

Monthly average gross primary productivities for January 1974 through December 1974 are shown in Figure 2. Two peaks in average primary productivity were recorded in 1974. The peak in May was smaller in magnitude (1705 mg C/m^3/day) but of longer duration than the September peak (2216 mg C/m^3/day).

The average productivities for 1974 by station were 1673 mg C/m^3/day at Station 1, 1419 mg C/m^3/day at Station 4, 1278 mg C/m^3/day at Station 5, and 1027 mg C/m^3/day at Station 6. The average primary productivity for all stations in 1974 was 1349 mg C/m^3/day.

Primary productivity values for individual stations are shown in Figure 3 and listed in Table 1. In 1974, the spring peak (April) of productivity (2691 mg C/m^3/day) at Station 1 showed a smaller increase in magnitude than other stations due to the generally elevated productivity values. The fall peak of productivity (August) was relatively low (2017 mg C/m^3/day).

At Station 4 the spring peak of productivity (May) had a value of 2457 mg C/m^3/day. The data collected in the fall was incomplete so that the maximum productivity value could not be ascertained.

At Station 5 in 1974, the spring peak of productivity occurred in March and April. Productivities during these months were 1519 and 1477 mg C/m^3/day, respectively. The highest productivity (3578 mg C/m^3/day) thus far recorded for the Lake was observed in September 1974 at Station 5.

Productivity data for Station 6 remained relatively consistent throughout the year. The peaks were indistinct with values of 1410 and 1674 mg C/m^3/day occurring in the late spring (May) and fall (September) respectively.

Most of the productivity in Lake Okeechobee was net productivity. Net productivity closely approximated the gross productivity and sometimes exceeded

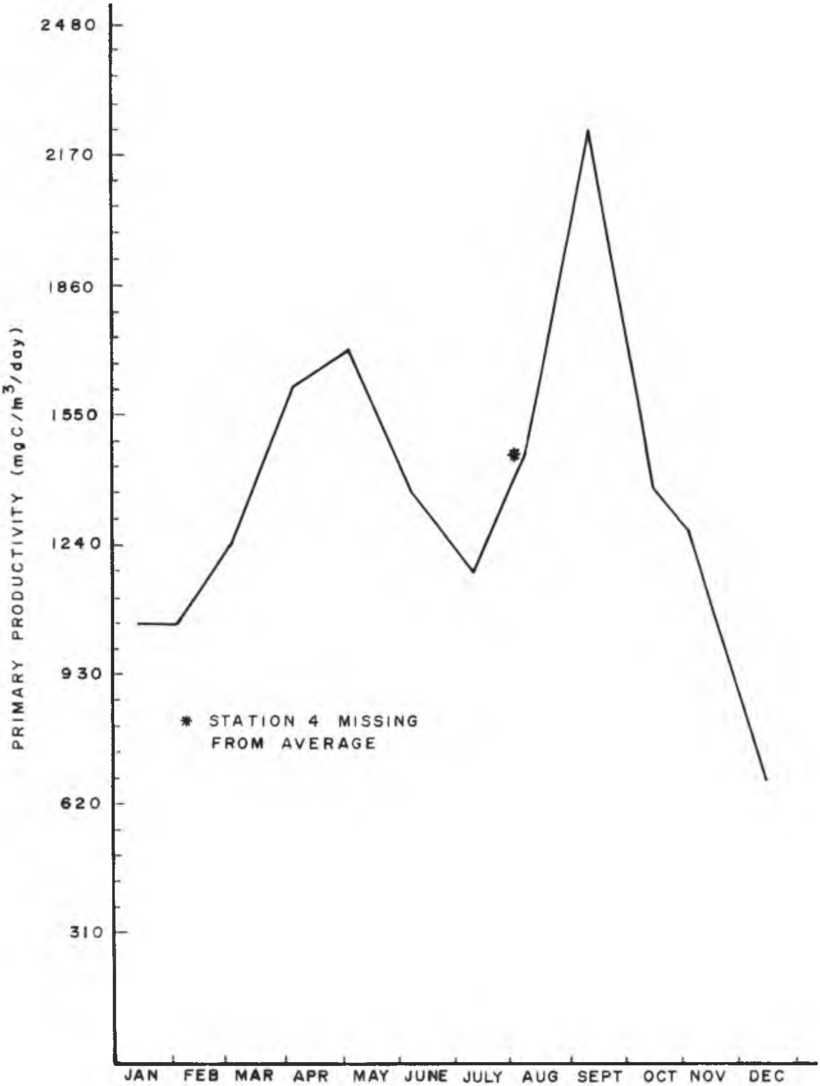

Figure 2 LAKE OKEECHOBEE AVERAGE PRIMARY PRODUCTIVITIES FOR JAN.— DEC. 1974

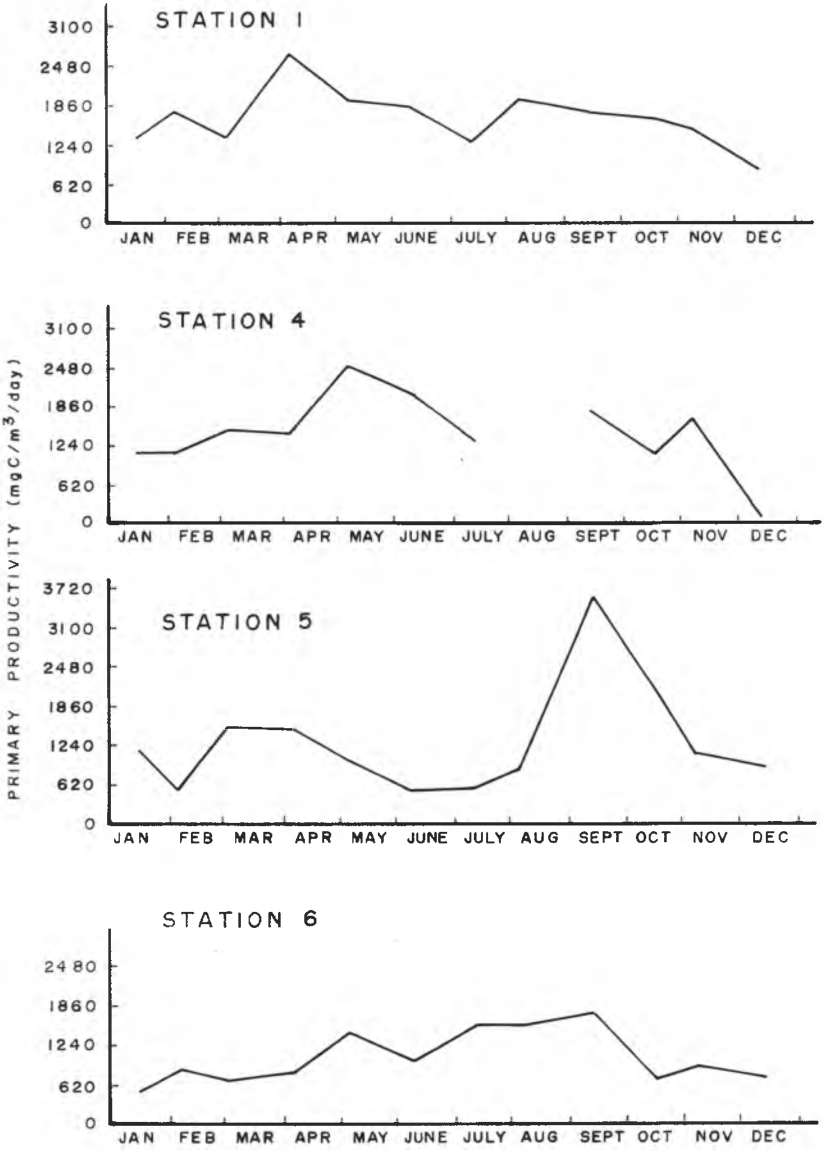

Figure 3 LAKE OKEECHOBEE PRIMARY PRODUCTIVITY BY STATION FOR JANUARY-DECEMBER 1974

TABLE 1 Lake Okeechobee 1974

In Situ Primary Productivities (Light and Dark Bottle Oxygen Method) Incubated for Six Hours at 0.22 m.

		Primary Productivity (mg C/m^3/day)		
		Corrected for Day Length		
Date	Station	Gross	Net	Respiration
1/16/74	1	1346	1231	138
1/16/74	4	1107	937	205
1/17/74	5	1193	1022	205
1/17/74	6	539	539	0
2/6/74	1	1764	1793	0
2/6/74	4	1099	1157	0
2/13/74	5	554	467	105
2/13/74	6	817	613	245
3/5/74	1	1395	1488	0
3/6/74	4	1457	1364	112
3/7/74	5	1519	1240	335
3/7/74	6	682	713	0
4/3/74	1	2691	2691	0
4/3/74	4	1444	1543	0
4/4/74	5	1477	1444	40
4/4/74	6	788	821	0
5/8/74	1	1911	1945	0
5/8/74	4	2457	2423	41
5/10/74	5	997	825	206
5/10/74	6	1410	1341	82
6/6/74	1	1885	1815	84
6/6/74	4	2060	2025	42
6/7/74	5	489	489	0
6/7/74	6	977	1047	0
7/9/74	1	1291	1257	42
7/9/74	4	1291	1222	84
7/10/74	5	559	523	42
7/10/74	6	1536	1431	126
8/7/74	1	2017	2017	0
8/8/74	5	853	750	123
8/8/74	6	1536	1604	0

TABLE 1 Lake Okeechobee 1974 (CONTINUED)

		Primary Productivity (mg C/m^3/day)		
		Corrected for Day Length		
Date	Station	Gross	Net	Respiration
9/11/74	1	1773	1674	118
9/11/74	4	1805	1608	236
9/12/74	5	3578	3282	355
9/12/74	6	1674	1510	197
10/15/74	1	1598	1598	0
10/15/74	4	1137	1199	0
10/16/74	5	2060	1998	74
10/16/74	6	769	799	0
11/6/74	1	1533	1420	136
11/6/74	4	1618	1590	34
11/5/74	5	1107	937	205
11/5/74	6	852	852	0
12/12/74	1	875	821	66
12/12/74	4	137	137	0
12/11/74	5	957	957	0
12/11/74	6	738	766	0

it (due to empirical derivation).

Respiration generally accounted for less than 10% and rarely exceeded 20% of the gross primary productivity. The highest respiration, 355 mg C/ m^3/day, was observed at Station 5 in September.

Phytoplankton Populations

A listing of the 233 species of phytoplankton found in Lake Okeechobee appears in Table 2. During the study, 38 species of blue-green algae (Cyanophyta), 79 species of green algae (Chlorophyta), 67 species of diatoms (Chrysophyta, Class Bacillariophyceae), 29 species of euglenoids (Euglenophyta), 8 species of cryptomonads (Pyrrhophyta, Class Cryptophyceae), and 12 species of dinoflagellates (Pyrrhophyta, Class Dinophyceae) were observed.

The most frequently occurring blue-green algae were Lyngbya limnetica, Aphanocapsa delicatissima, Lyngbya contorta, Raphidiopsis curvata and Merismopedia tenuissima. Lyngbya limnetica was the most common species. This blue-green alga was often found in large numbers, but because of its small size was not extremely important in terms of biovolume. Raphidiopsis curvata formed the most significant "blooms" both in terms of densities and biovolumes.

Green algae were common but rarely in great abundance. Few species occurred often in the samples. The most often observed green algae were Scenedsemus quadricauda, Tetrastrum staurogeniaeforme, Kirchneriella sp. and Chlorella sp. Green algae blooms were never observed except for one localized bloom of Chlorella sp.

The most commonly observed diatoms were Fragilaria pinnata, Fragilaria construens, Melosira granulata v. augustissima fo. spiralis, Fragilaria capucina, and Nitzschia lorenziana. Fragilaria pinnata was the only diatom observed to form significant blooms. Diatoms dominated the other algal groups in terms of biovolume and occasionally in terms of densities.

TABLE 2

LAKE OKEECHOBEE PHYTOPLANKTON OBSERVED JANUARY 1973-1974

Cyanophyta (Blue--green Algae)

Anabaena bornitiana
Anabaena sphaerica
Anabaena spiroides
Anacystis sp. (Gloeothece)
Aphanizomenon flos-aquae
Aphanocapsa delicatissima
Aphanocapsa pulchra
Aphanothece stagnina
Aphanothece prasina
Arthrospira gomontiana
Aulosira infuxa
Chroococcus planctonica
Chroococcus turgidus
Coccochloris sp.
Coelosphaerium naegelianum
Coelosphaerium sp.
Eucapsis alpina
Gomphosphaeria aporina
Gomphosphaeria lacustris
Holopedium irregulare
Lyngbya contorta
Lyngbya limnetica
Lyngbya tenuis
Merismopedia elegans
Merismopedia glauca
Merismopedia punctata
Microcoleus lyngbyaceus
Microcystis aeruginosa
Microcystis flos-aquae
Microcystis incerta
Nodularia spumigena
Oscillatoria tenuis
Oscillatoria terebriformis
Phormidium autumnole
Raphidiopsis curvata
Schizothrix calciola
Spirulina laxissima
Spirulina subsalsa

Table 2 (Continued)

Chlorophyta (Green Algae)

Ankistrodesmus falcatus
Ankistrodesmus spiralis
Arthrodesmus sp.
Asterococcus spinulosa
Carteria cordiformis
Chlamydomonas polypyrenoideum
Chlamydomonas sp.
Chlorella sp.
Chlorococcum sp.
Chlorogonium sp.
Closteridium lunula
Closteriopsis longissima
Closterium curvaceum
Closterium gracile
Closterium kutzingii f. sigmoides
Closterium setaceum
Closterium venus
Coelastrum cambricum
Coelastrum microporum
Cosmarium circulare
Cosmarium sp.
Crucigenia apiculata
Crucigenia quadrata
Dictyosphaerium ehrenbergianum
Dictyosphaerium pulchellum
Elakatothrix gelatinosa
Euastrum sp.
Eudorina elegans
Geminella interrupta
Golenkinia radiata
Gonium pectorale
Heteromastix angulata
Kirchneriella contorta
Kirchneriella obesa
Kirchneriella sp.
Lagerhemia citriformis
Lagerhemia subsalsa
Mougeotia sp.
Oocystis sp.
Ourococcus bicaudatus
Pandorina morum
Pediastrum biradiatum
Pediastrum boryanum
Pediastrum duplex v. gracilimum
Pediastrum duplex v. reticulatum
Pediastrum simplex
Pediastrum simplex v. duodenarium
Pediastrum tetras
Pedinomonas minor
Phacotus lenticularis
Platydorina caudata
Polyedriopsis spinulosa
Pseudotetraedron neglectum

Table 2 (Continued)

Pteromonas aculeata
Quadrigula closteroides
Scenedesmus abundans
Scenedesmus acuminatus
Scenedesmus arcuatus v. platydisca
Scenedesmus bijuga
Scenedesmus denticulatus
Scenedesmus dimorphus
Scenedesmus opoliensis
Scenedesmus quadricauda
Schroderia setigera
Spermatozopsis exultans
Staurastrum cuspidatum
Staurastrum limneticum
Staurastrum sp.
Tetraedron caudatum
Tetraedron gracile
Teraedron limneticum
Tetraedron lobulatum
Tetraedron minimum
Tetraedron muticum
Tetraedron trigonum
Tetrastrum staurogeniaeforme
Treubaria crassispina
Volvulina steinii
Westella botryoides

Chrysophyta
Class Bacillariophyceae (Diatoms)
Achnanthes exigua v. heterovalve
Achnanthes sp.
Amphora ovalis v. libyca
Biddulphia laevis
Caloneis amphisbaena
Cocconeis diminuta
*Cocconeis hustedtii**
Cocconeis placentula
Coscinodiscus rothii
Cyclotella glomerata
Cyclotella kutzingiana
Cyclotella menghiniana
Cyclotella stelligera
Cymatopleura solea
Cymbella ventricosa
Diploneis oblongella
Fragilaria brevistriata
Fragilaria capucina
Fragilaria construens
Fragilaria construens v. subsalina
Fragilaria construens v. venter
Fragilaria crotonensis
Fragilaria pinnata
Fragilaria vaucheriae
Gomphonema gracile
*Gyrosigma (near) nodiferum**

*tentative identification

Table 2 (Continued)

Melosira ambigua
Melosira granulata
Melosira granulata v. augustissima fo. spiralis
Melosira granulata muzzanensis
Melosira italica
*Navicula accomoda**
*Navicula (near) cincta**
Navicula cryptocephala
Navicula exigua
Navicula pupula
Navicula rhyncocephala v. germanii
Nitzschia acicularis
Nitzschia amphibia
Nitzschia apiculata
Nitzschia augustata
Nitzschia constricta
Nitzschia dissipata
Nitzschia (near) filiforms
Nitzschia frustulum
*Nitzschia (near) holostica**
Nitzschia hungarica
*Nitzschia lanceolata v. minima**
Nitzschia linearis
Nitzschia lorenziana
Nitzschia paradoxa
Nitzschia punctuata v. coarctata
Nitzschia tryblionella v. victoriae
Opephora martyi
Pinnularia (near) major
Pleurosigma (near) salinarium v. boyeri
Rhopalodia gibba
Skeletonema costatum
Stauroneis sp.
Stephanodiscus astrae v. minutula
Stephanodiscus invisitatus
Surirella robusta v. splendida
Synedra actinastroides
Synedra ulna
Tabellaria sp.
Tetracyclus lacustris
Thalassiosira sp.

Euglenophyta
Astasia klebesii
Euglena acus
Euglena deses
Euglena gracilis
Euglena hematodes
Euglena minuta
Euglena oxyuris
Euglena polymorpha

*tentative identification

Table 2 (Continued)

Euglena subehrenbergii
Euglena tripteris
Euglena viridis
Euglena sp.
Lepocinclis ovum
Lepocinclis texta
Petalomonas sp.
Phacus curvicauda
Phacus longicauda
Phacus pleuronectes
Phacus pyrum
Phacus torta
Phacus triqueter
Phacus sp.
Strombomonas giardiana
Strombomonas giardiana v. glabra
Strombomonas tambowika
Strombomonas sp.
Trachelomonas crebea
Trachelomonas cylindrica
Trachelomonas volvocina

Pyrrhophyta
Class Cryptophyceae
Chilomonas paramecium
Chroomonas acuta
Cryptomonas erosa
Cryptomonas marssoni
Cryptomonas ovata
*Hillea sp.**
Rhodomonas lucustris
Rhodomonas sp.

Class Dinophyceae
Ceratium brachyceros
Ceratium hirundinella fa. furcoides
Diplopsalis lenticula †
Glenodinium gymnodinium
Gonyaulax sp.
Gymnodinium aeruginosum
Gymnodinium neglectum
Peridinium inconspicuum
Peridinium umbonatum
Peridinium wisconsinense
Peridinium sp.
Prorocentrum micans

† may be *Peridiniopsis acuta*
* tentative identification

Euglena sp. and Euglena subehrenbergii were the most common euglenoids. No single species was found in great abundance and the group was found only at certain times of the year.

The most abundant species of cryptomonads were Chroomonas acuta, Crypotomonas erosa, Cryptomonas ovata, and Rhodomonas lacustris. Cryptomonads were common but only abundant certain times of the year.

The most commonly observed species of dinoflagellates were Ceratium hirundinella fa. furcoides, Glenodinium gymodinium, and Gymnodinium aeruginosum. Dinoflagellates were never found in abundance and were found only at certain times of the year.

Seasonal Phytoplankton Variation

Seasonal variations in average density and biovolume of phytoplankton populations are shown by month in Figures 4 and 5, respectively, and listed in Tables 3 and 4. Total phytoplankton densities and biovolumes are listed in Appendices A and B respectively, for each month and each station. The category listed as "unknown" represents those entities observed which were of uncertain taxonomic status. The "unknown" organisms were not included in the overall totals.

In 1974 two peaks were observed in algal densities (Figure 4). The highest algal densities were observed in April, 222,061 units/ml, and May, 221,760 units/ml. A smaller peak of algal density (135,362 units/ml) occurred in August. Low densities were observed in July (102,101 units/ml) and November (56,489 units/ml).

A succession of various algal groups accounted for the peak in densities in April and May (Table 3). This "spring" peak was preceded by small peaks in concentration of diatoms, cryptomonads and green algae. In April, a large

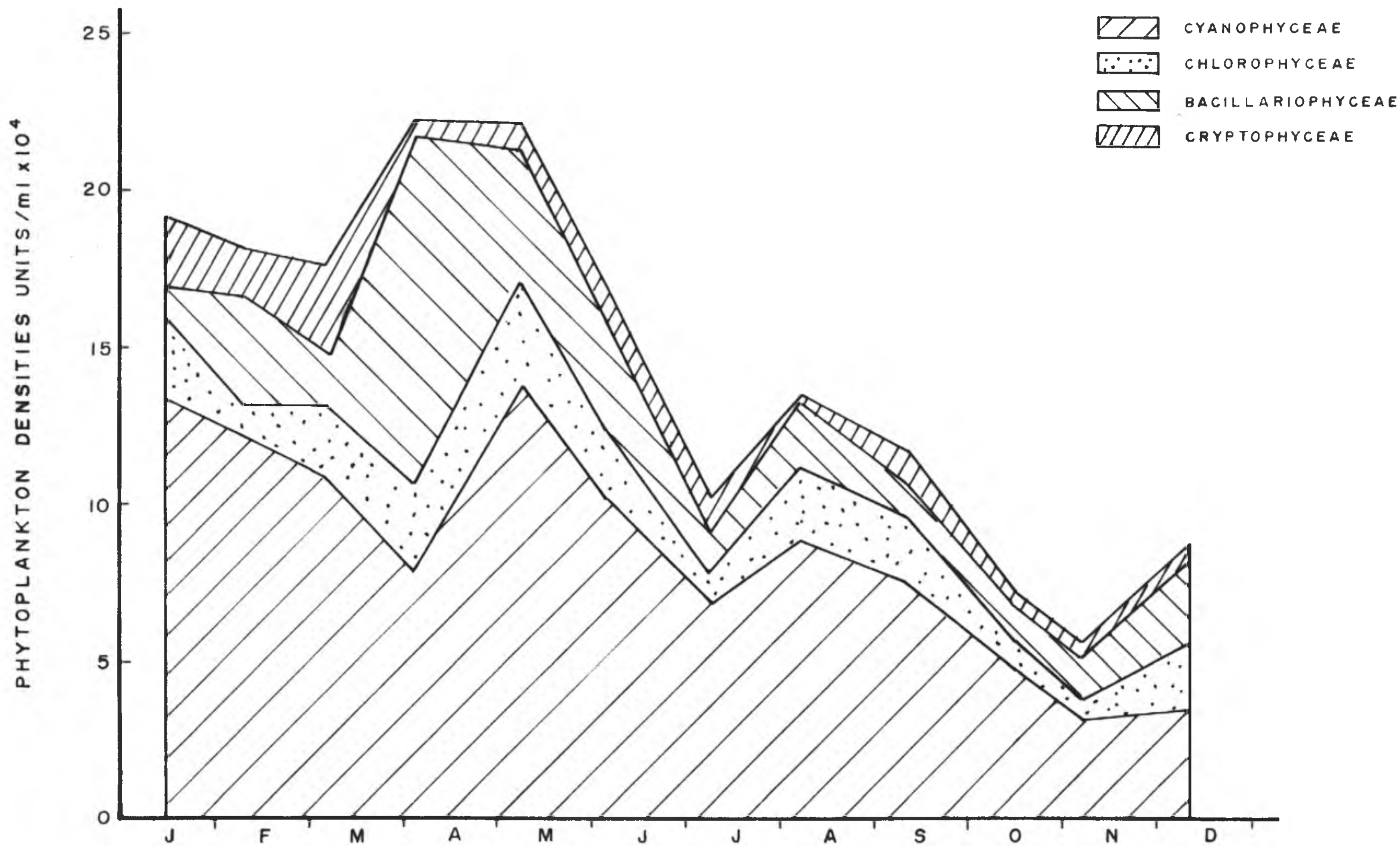

Figure 4 LAKE OKEECHOBEE JANUARY — DECEMBER 1974
AVERAGE PHYTOPLANKTON DENSITIES BY CLASS

TABLE 3 Lake Okeechobee, Phytoplankton Densities (units/ml) and Percentage Composition by Class for 1974.

Month	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Total
J*	134,039(70)	23,943(13)	12,054(6)	20,390(11)	742(0)	137(0)	191,305
F	121,225(67)	11,500(6)	34,541(19)	14,916(8)	61(0)		182,153
M	109,608(62)	21,897(12)	15,889(9)	28,821(16)	379(0)	281(0)	176,875
A	79,637(36)	26,356(12)	110,978(50)	4,546(2)		544(0)	222,061
M	138,560(62)	34,172(15)	40,700(18)	7,282(3)	361(0)	685(0)	221,760
J	102,789(60)	20,658(12)	35,280(21)	8,100(5)	324(0)	2,818(2)	169,969
J	69,474(68)	9,727(10)	13,084(13)	8,709(9)	163(0)	944(1)	102,101
A	85,245(63)	27,252(20)	22,055(16)	371(0)	106(0)	333(0)	135,362
S	75,515(65)	21,254(18)	10,460(9)	7,428(6)	509(0)	894(1)	116,060
O	47,479(66)	10,319(14)	11,040(15)	3,291(5)			72,129
N	30,643(54)	8,654(15)	11,406(20)	5,786(10)			56,489
D	35,035(40)	21,026(24)	28,366(32)	4,044(5)		108(0)	88,579
Avg.	85,771(59)	19,730(14)	28,814(20)	9,474(7)	220(0)	562(0)	144,570

( ) Percentage Composition

*Average based on seven stations

increase in diatoms accounted for the initial increase in phytoplankton densities. Diatom densities declined in May and there was an increase in blue-green algae density. Hence, the densities for April and May were essentially the same but the phytoplankton was drastically different in composition. All algal groups declined in density through July. The peak of algal concentration in August was due primarily to an increase in diatoms, green and blue-green algae. Although concentrations of all algal groups declined from August through November, declines in blue-green algae accounted for most of the decrease in algal densities. The small increase in density in December was due mainly to increases in green algae and diatoms.

Blue-green algae were dominant in the phytoplankton in every month except April. The percentage of blue-green algae generally exceeded 60% throughout most of the year (Table 3). Diatoms were next in abundance with blooms occurring in April and December. Green algae showed little variation in density throughout the year. Cryptomonads were most abundant in the spring and winter. Euglenoids were very low in abundance with the highest percentage occurring in June and July. Dinoflagellates were the least abundant algal group with highest densities in January and September.

In terms of phytoplankton densities, the average overall percentage composition by class for 1974 was as follows: Blue-green algae (Cyanophyceae), 59%, Diatoms (Bacillariophyceae), 20%; Green algae (Chlorophyceae), 14%; Cryptomonads (Cryptophyceae), 7%; Euglenoids (Euglenophyceae), 0%; and Dinoflagellates (Dinophyceae), 0%.

When biovolumes of the various algal groups were compared, the seasonal predominance was changed (Figure 5). The most obvious change occurred in August. The fall (August) peak (22,598,359 μ^3/ml) was much larger than the

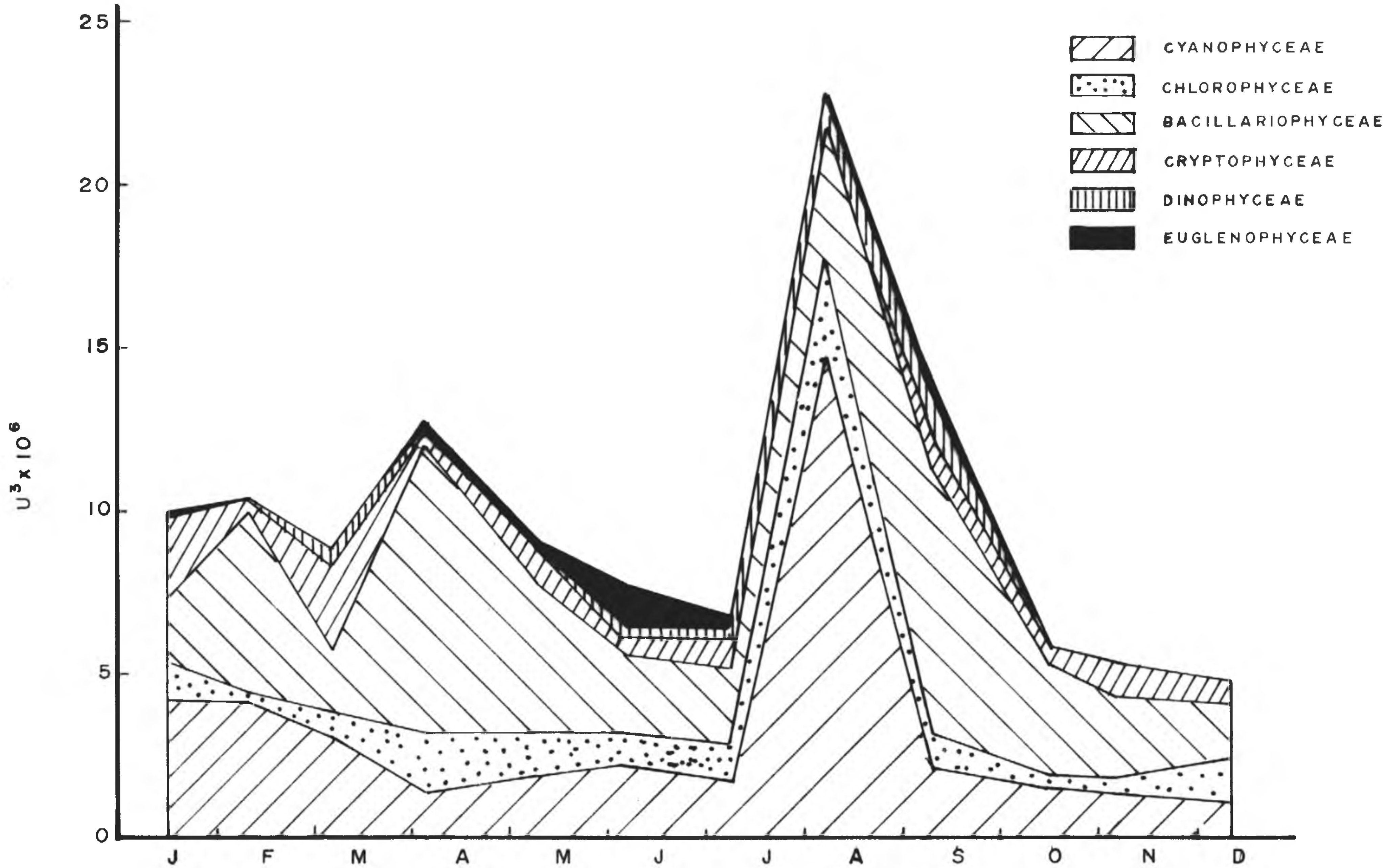

Figure 5 LAKE OKEECHOBEE JANUARY — DECEMBER 1974
AVERAGE PHYTOPLANKTON BIOVOLUMES BY CLASS

TABLE 4 Lake Okeechobee, Phytoplankton Biovolumes (μ^3/ml) and Percentage Composition by Class for 1974.

Month	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Total
J*	4,254,294(43)	1,022,608(10)	2,127,207(21)	2,498,763(25)	20,772(0)	51,520(1)	9,975,164
F	4,119,252(40)	371,952(4)	5,461,414(53)	419,357(4)	969(0)		10,372,944
M	3,061,491(35)	870,729(10)	1,800,060(20)	2,758,385(31)	237,987(3)	96,274(1)	8,824,926
A	1,461,446(12)	1,799,963(14)	8,789,338(69)	477,757(4)		151,347(1)	12,679,851
M	1,959,273(21)	1,329,198(15)	4,676,199(51)	1,011,452(11)	8,655(0)	173,989(2)	9,158,766
J	2,347,375(30)	906,156(12)	2,356,982(30)	564,602(7)	174,616(2)	1,489,000(19)	7,838,731
J	1,760,186(26)	1,111,637(16)	2,357,704(35)	959,590(14)	184,503(3)	411,204(6)	6,784,824
A	14,624,140(65)	2,939,386(13)	4,481,596(20)	58,032(0)	403,698(2)	91,507(0)	22,598,359
S	2,128,401(16)	1,071,419(8)	8,083,599(60)	1,042,060(8)	955,191(7)	153,206(1)	13,433,876
O	1,504,542(26)	468,004(8)	3,289,572(56)	622,178(11)			5,884,296
N	1,422,947(27)	377,716(7)	2,665,279(50)	823,723(16)			5,289,665
D	1,027,272(21)	1,426,364(29)	1,687,391(34)	743,717(15)		47,241(1)	4,941,985
Avg.	3,305,885(34)	1,141,261(12)	3,981,362(41)	998,301(10)	165,533(2)	222,107(2)	9,815,282

*Average based on seven stations

spring (April) peak (12,679,851 μ^3/ml). Low in biovolumes occurred in December (4,931,985μ^3/ml) and July (6,784,824 μ^3/ml).

The relative importance of the various algal groups is also different when biovolumes are considered. Peak algal biovolumes of 10,372,944 and 12,679,851 μ^3/ml, were observed in February and April, respectively, and were due mainly to increases in the biovolumes of the diatom populations. The peak in blue-green densities in May was not significant in terms of biovolumes. The peak in biovolume in August was due to a drastic increase in biovolume of blue-green algae. This bloom was short-lived and the biovolumes of the various algal groups, except diatoms, in September returned to the same relative proportions as in July.

The average percentage composition by class on the basis of biovolumes is as follows: Diatoms (41%), Blue-green algae (34%), Green algae (12%), Cryptomonads (10%), Euglenoids (2%), and Dinoflagellates (2%). Blue-green algae were much less important in terms of biovolumes, accounting for more than 50% of the biovolume only in August. Diatoms were the dominant algae on the basis of biovolumes throughout most of the year. The relative importance of other algal groups (cryptomonads, dinoflagellates and euglenoids) increased by 2 to 3%, whereas green algae decreased by 2%.

Table 5 shows the average density and percentage composition of the various classes of phytoplankton at each station. Stations influenced by inflows (5,3, and 1) had the highest average densities (195,532, 184,815 and 180,392 units/ml, respectively). Stations 7 and 6 had the lowest densities (41,171 and 64,173 units/ml, respectively).

Stations near inflows (Stations 5, 1 and 3) had generally higher percentages of blue-green algae (68%, 66%, and 62%, respectively) (Figure 6). The southernmost stations (7 and 6) had the lowest densities of blue-

TABLE 5 . LAKE OKEECHOBEE AVERAGE COMPOSITION AND PERCENTAGE OF PHYTOPLANKTON DENSITIES BY STATION BY CLASS FOR 1974.

Station	Densities (Units/ml)				( ) Percentage		
	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Total
1	118,981(66)	21,460(12)	26,840(15)	12,457(7)	253(0)	401(0)	180,392
2	97,676(59)	19,517(12)	36,144(22)	6,983(4)	184(0)	945(1)	161,449
3	115,639(62)	23,814(13)	29,277(16)	14,789(8)	252(0)	1044(1)	184,815
4	94,765(54)	23,256(13)	48,032(28)	7,662(4)	0	528(0)	174,243
5	132,466(68)	32,158(16)	24,533(13)	5,642(3)	240(0)	493(0)	195,532
6	29,365(46)	10,879(17)	15,607(24)	7,934(12)	40(0)	347(0)	64,173
7	11,425(28)	8,274(20)	14,572(35)	6,554(16)	227(1)	119(0)	41,171
8	82,576(54)	18,341(12)	38,504(25)	12,706(8)	504(0)	438(0)	153,069

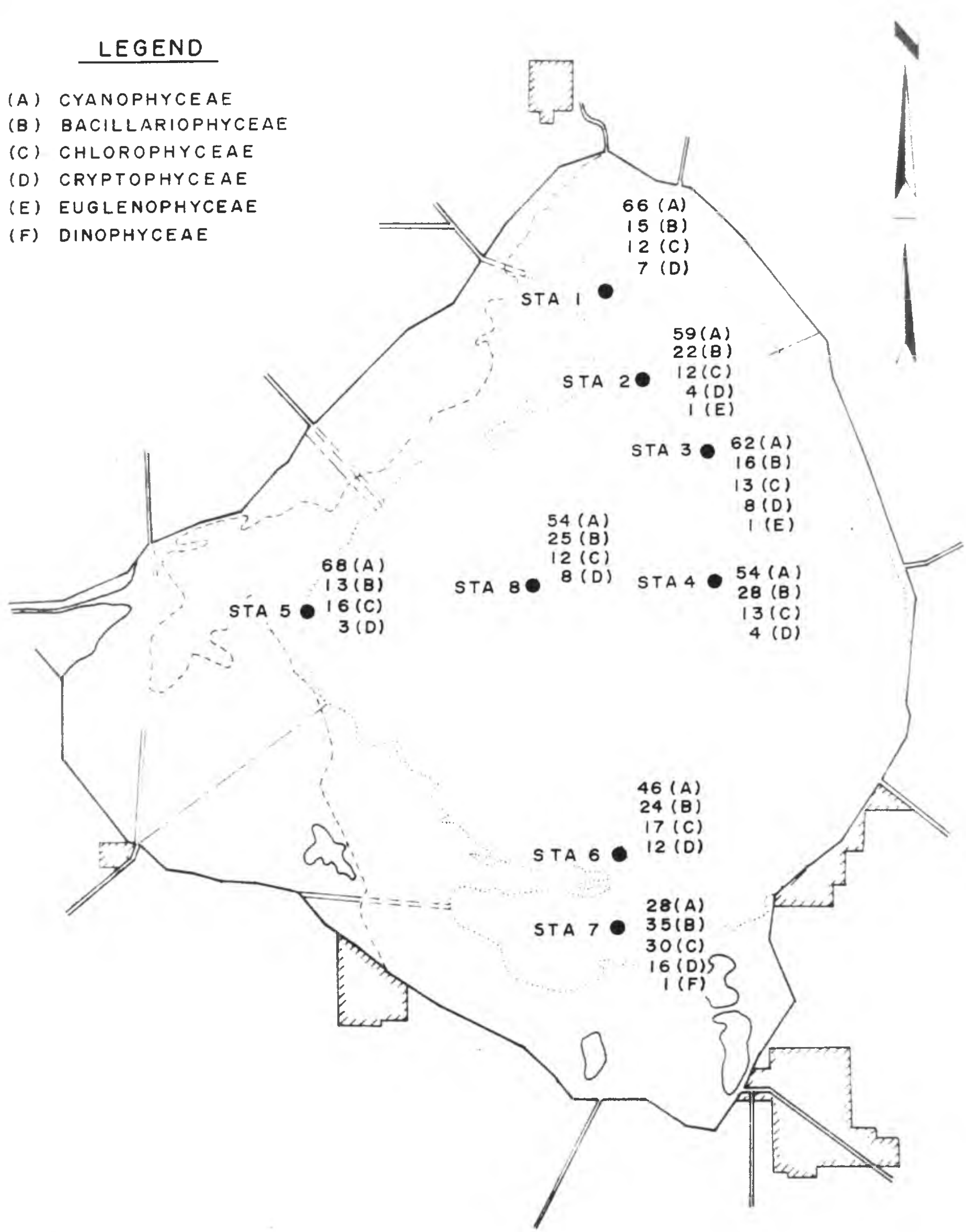

Figure 6 LAKE OKEECHOBEE 1974 AVERAGE PERCENTAGE COMPOSITION OF PHYTOPLANKTON BY DENSITY BY STATION

green algae (28% and 46%, respectively). The highest average percentage of diatoms was at Station 7 (35%) followed by Stations 4 (28%), 8 (25%), and 6 (24%). The lowest percentages of diatoms were observed near inflows at Stations 5, (13%), 1 (15%), and 3 (16%). Stations 7, (20%), 6 (17%), 5 (16%) had the highest percentage of green algae. All other stations had 12% to 13% of green algae. The highest percentages of cryptomonads were recorded at Stations 7 (16%), and 6 (12%). The lowest percentages of cryptomonads were at Stations 5 (3%), 2 (4%), and 4 (4%). The highest percentages of euglenoids (1%) were observed at Stations 2 and 3. Percentages of euglenoids at all other stations were less than 1%. The highest percentage of dinoflagellates (1%) occurred at Station 7. All other stations had less than 1% and no dinoflagellates were observed at Station 4.

Table 6 shows the average biovolume and percentage composition by biovolume of the various classes of phytoplankton at each station. Stations influenced by inflows (Stations 1, 3 and 5) had an average of about 50% more biovolume than did other stations. Station 3 had the highest biovolume (17,073,112 μ^3/ml), followed by Station 1 (12,662,101 μ^3/ml) and Station 5 (11,621,408 μ^3/ml). Stations 6 (6,233,563 μ^3/ml) and 7 (5,323,654 μ^3/ml) had the lowest biovolumes. Stations 2 (8,815,751 μ^3/ml), 4 (8,609,755 μ^3/ml) and 8 (8,062,717 μ^3/ml) had approximately equal biovolumes.

Figure 7 shows the average percentage composition by biovolume of phytoplankton at each station. In terms of biovolume, diatoms were most important in Lake Okeechobee. Station 6 had the highest percentage (64%) of diatoms, followed by Stations 4 (61%) and 7 (59%). Station 3 had the lowest percentage (23%) of diatoms. Station 3 had the highest percentage (61%) of blue-green algae followed by Station 5 (50%). Stations 7 (3%)

TABLE 6 Lake Okeechobee Average Composition and Percentage of Phytoplankton Biovolume by Station by Class for 1974.

Station	Biovolume [μ^3/ml]					( ) Percentage
	Cyano	Chloro	Bacillario	Crypto	Dino	Eugleno	Total
1	3,163,753(25)	2,861,147(23)	4,966,160(39)	709,750(6)	135,768(1)	825,523(6)	12,662,101
2	2,258,697(26)	1,125,473(13)	4,291,447(49)	707,869(8)	264,868(3)	167,397(2)	8,815,751
3	10,330,501(61)	1,121,341(7)	3,871,226(23)	1,388,841(8)	158,658(1)	202,545(1)	17,073,112
4	1,603,580(19)	686,996(8)	5,226,895(61)	932,972(11)		159,312(2)	8,609,755
5	5,804,591(50)	1,222,112(11)	3,723,159(32)	783,706(7)	5,770(0)	82,070(1)	11,621,408
6	360,368(6)	661,712(11)	4,006,290(64)	1,071,750(17)	646(0)	132,797(2)	6,233,563
7	164,632(3)	782,250(15)	3,154,073(59)	712,656(13)	475,570(9)	34,497(1)	5,323,654
8	2,540,063(32)	641,114(8)	2,869,951(36)	1,548,391(19)	281,248(3)	181,950(2)	8,062,717

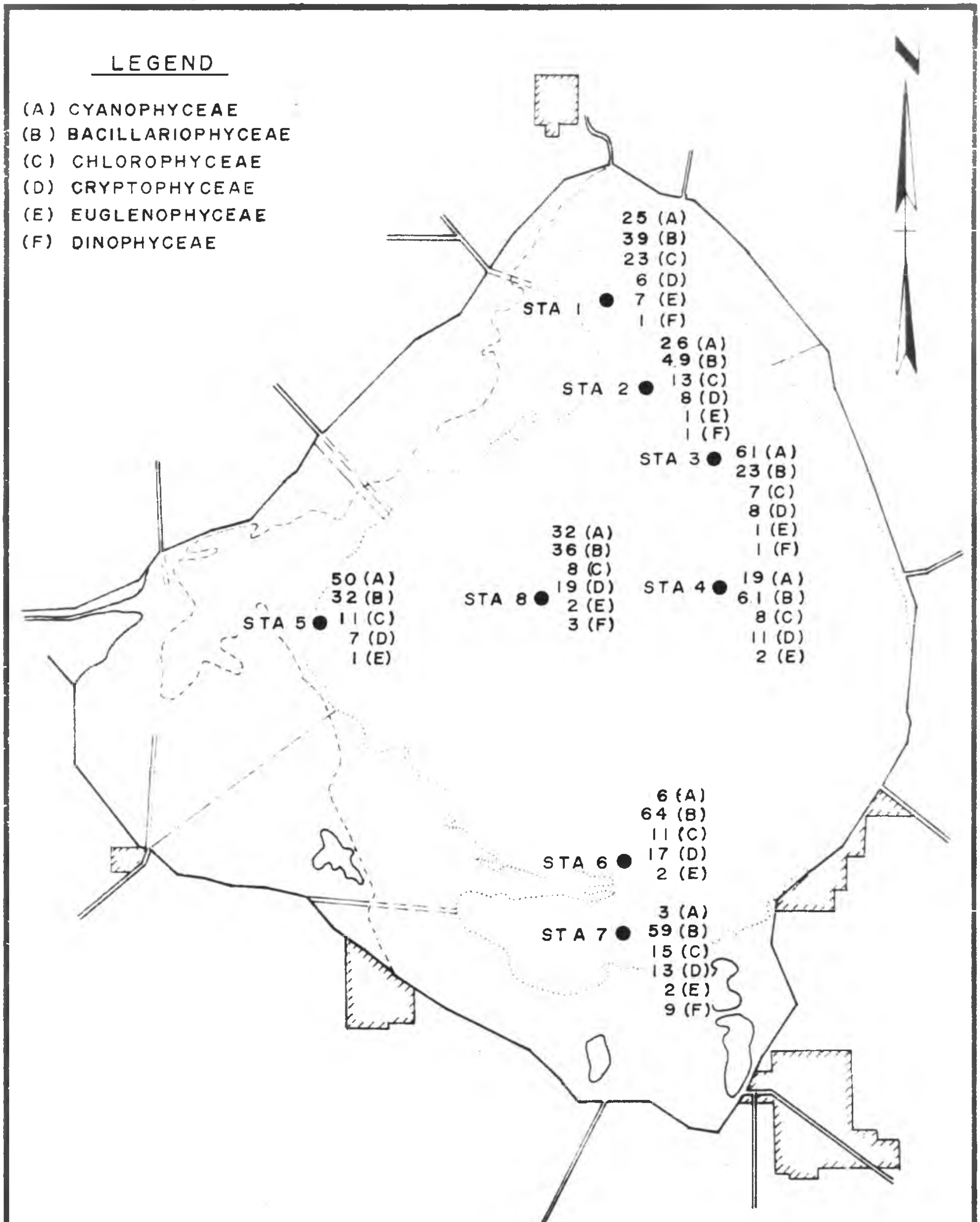

Figure 7 LAKE OKEECHOBEE 1974 AVERAGE PERCENTAGE COMPOSITION OF PHYTOPLANKTON BY BIOVOLUME BY STATION

and 6 (6%) had the lowest percentage of blue-green algae. The green algae percentage was highest at Station 1 (23%) and lowest at Station 3 (7%), 4 (8%), and 8 (8%). Cryptomonad percentages were highest at Station 8 (19%), and 6 (17%) with lowest percentages at Station 1 (6%), 5 (7%), 2 (8%), and 3 (8%). The highest percentage of euglenoid biovolume was observed at Station 1 (7%) with only 1 or 2% observed at other stations. The dinoflagellate percentage was highest at Station 7 (9%) with very low percentages (0-3%) at all other stations.

Algae Blooms

Figures 8 through 14 show the phytoplankton densities by station, whereas Figures 15 through 22 show the phytoplankton biovolume by station for 1974. Considerable variation, both in terms of density and biovolume, was observed from station to station.

An algae "bloom", as defined by this author, is a concentration of algae dominated by one or two species of algae with concentrations well above (at least two times greater than) seasonal background levels. Exact threshold density and biovolume concentrations varied due to the wide seasonal variation in algal concentrations. Blooms of algae occurred at most stations.

The most significant algae blooms in terms of densities and biovolumes occurred near inflows in the summer. *Raphidiopsis curvata*, a blue-green alga, was responsible for the most significant blooms on the Lake. The largest such bloom, 189,545 units/ml and 98,979,125 μ^3/ml, was observed at Station 3 in August. During a bloom, this alga dominates almost to the exclusion of other algal groups. *R. curvata* was responsible for most of the other minor peaks in blue-green algae concentrations.

Diatom blooms occurred in the spring and were caused by *Fragilaria pinnata*. Blooms due to *F. pinnata* in April occurred at Station 2

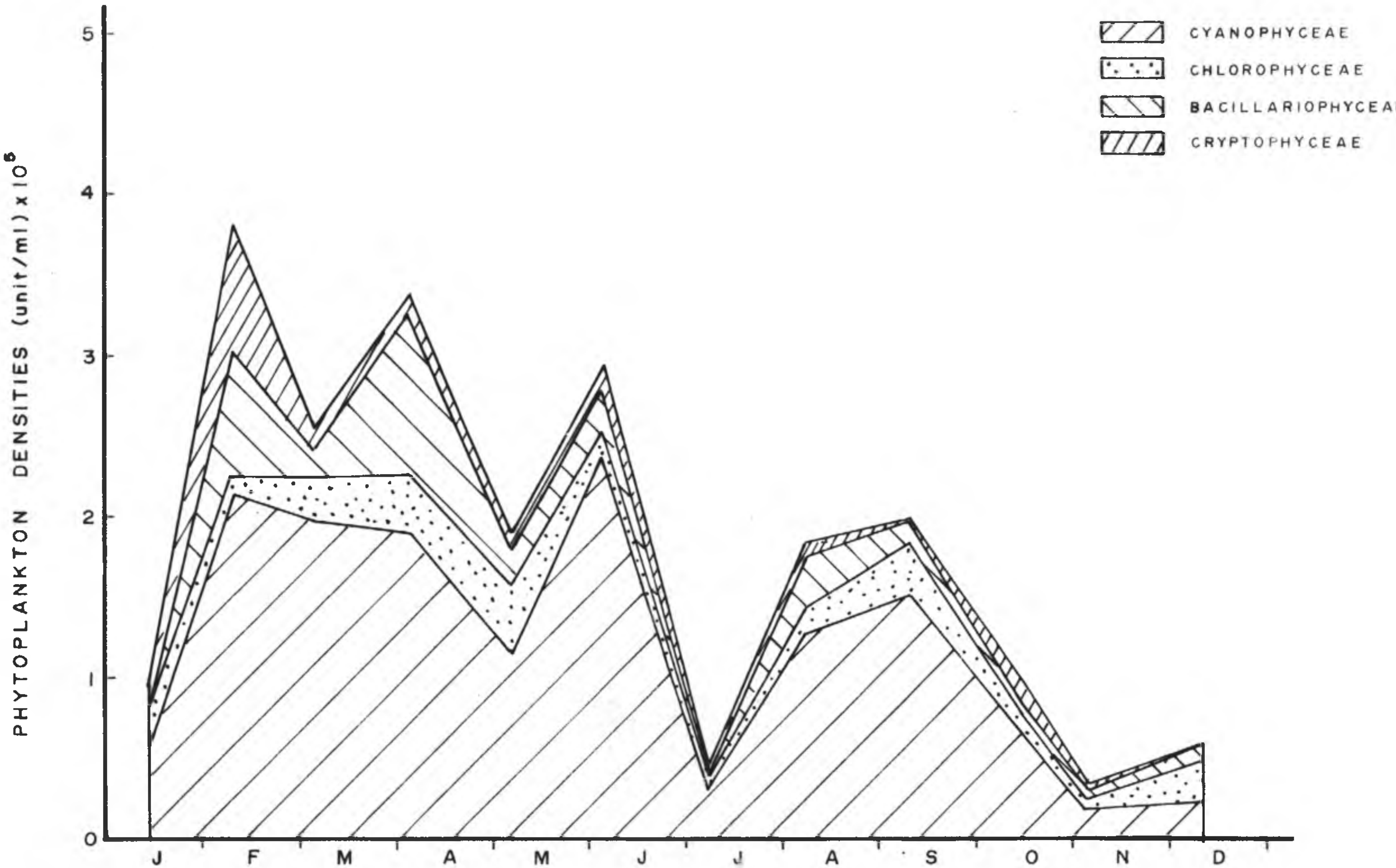

Figure 8 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION I IN 1974

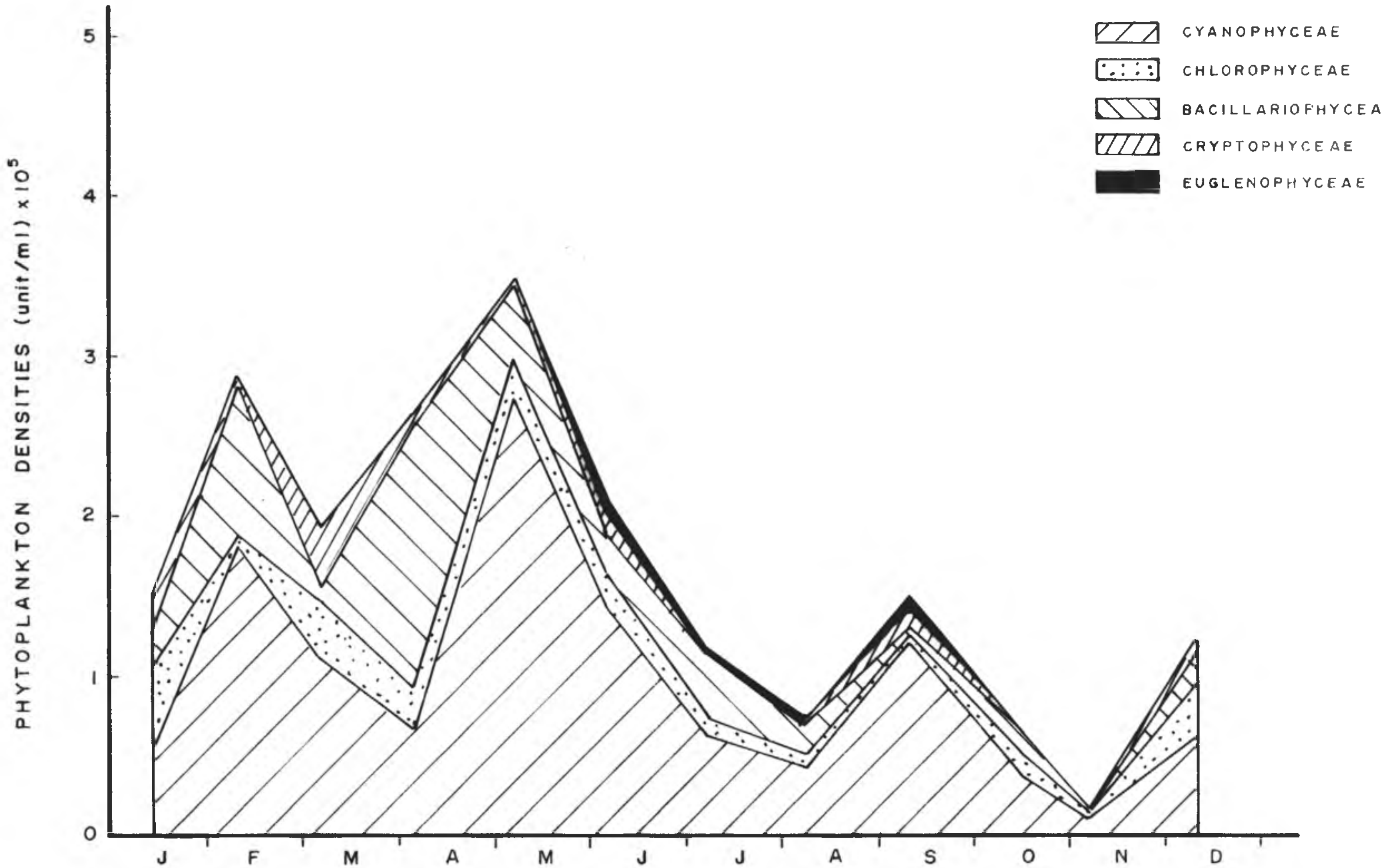

Figure 9 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 2 IN 1974

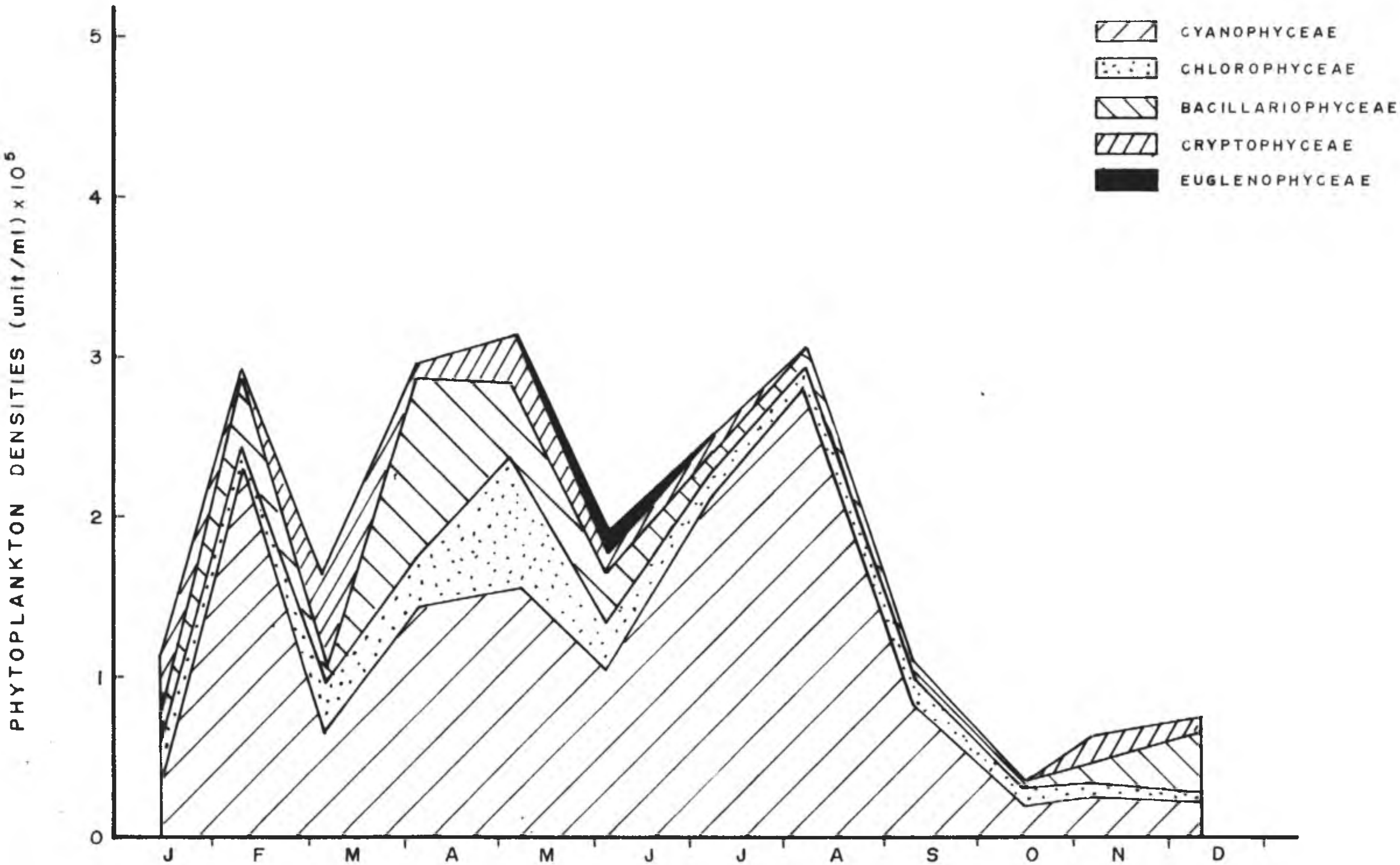

Figure 10 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 3 IN 1974

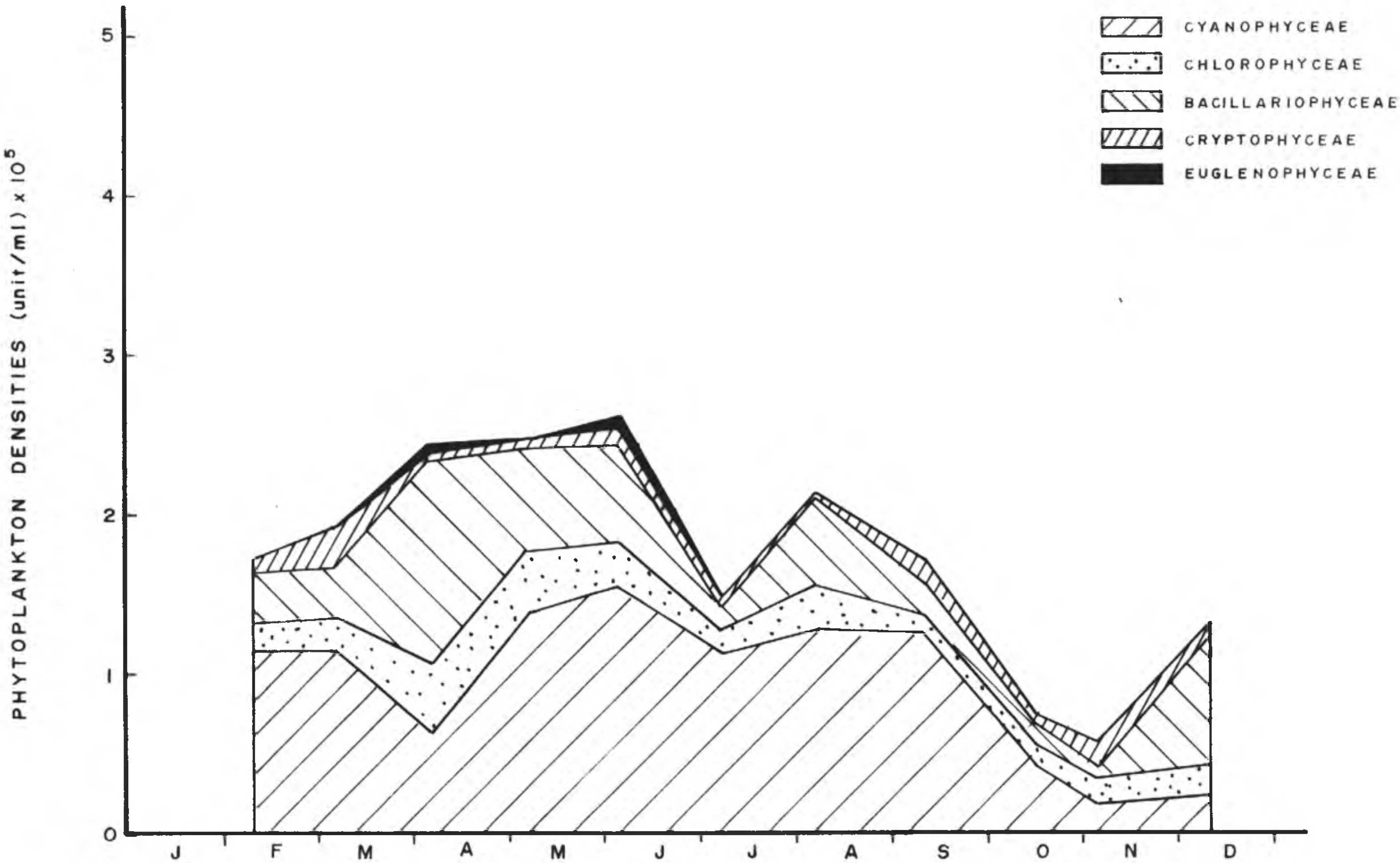

Figure 11 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 4 IN 1974

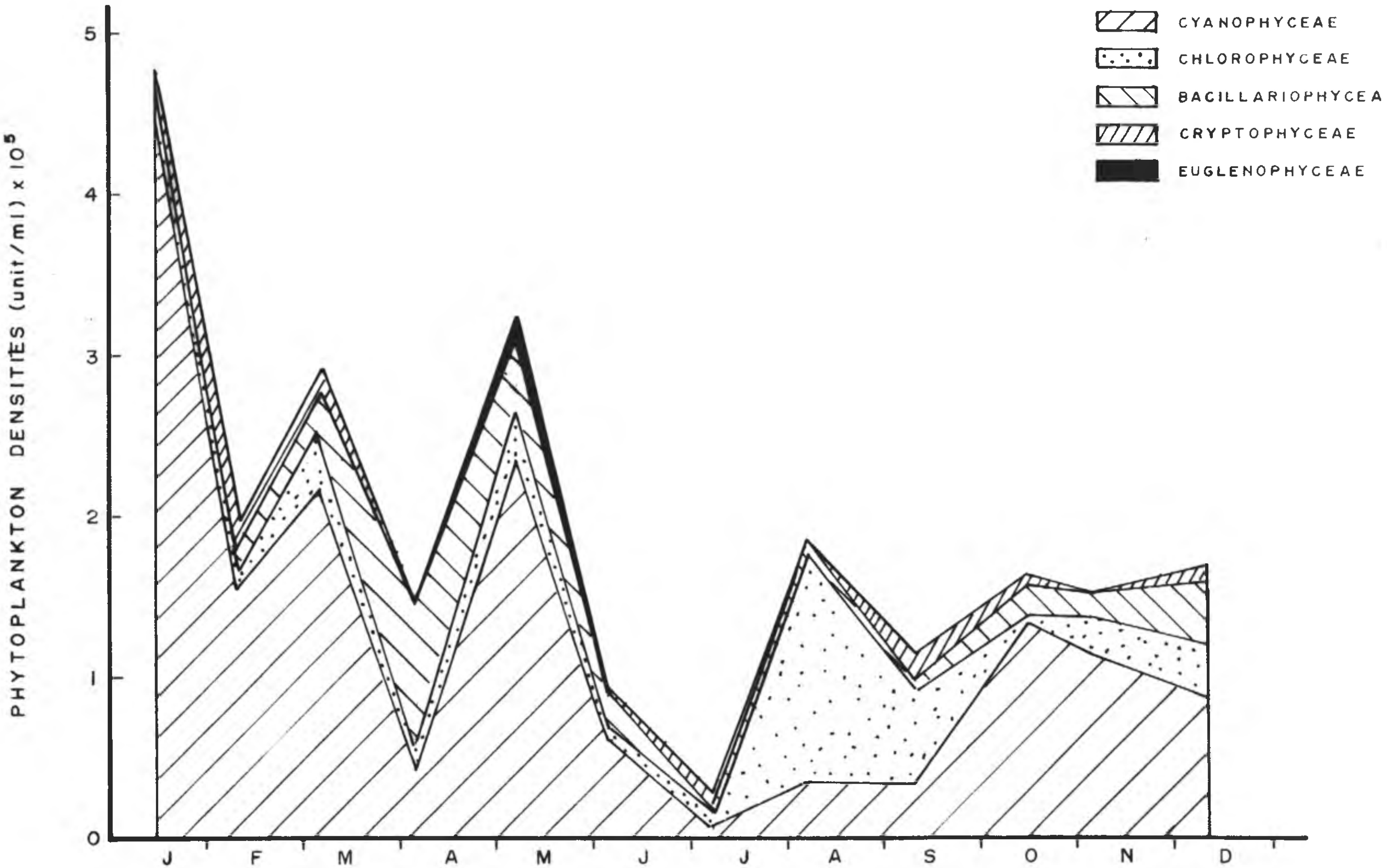

Figure 12 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 5 IN 1974

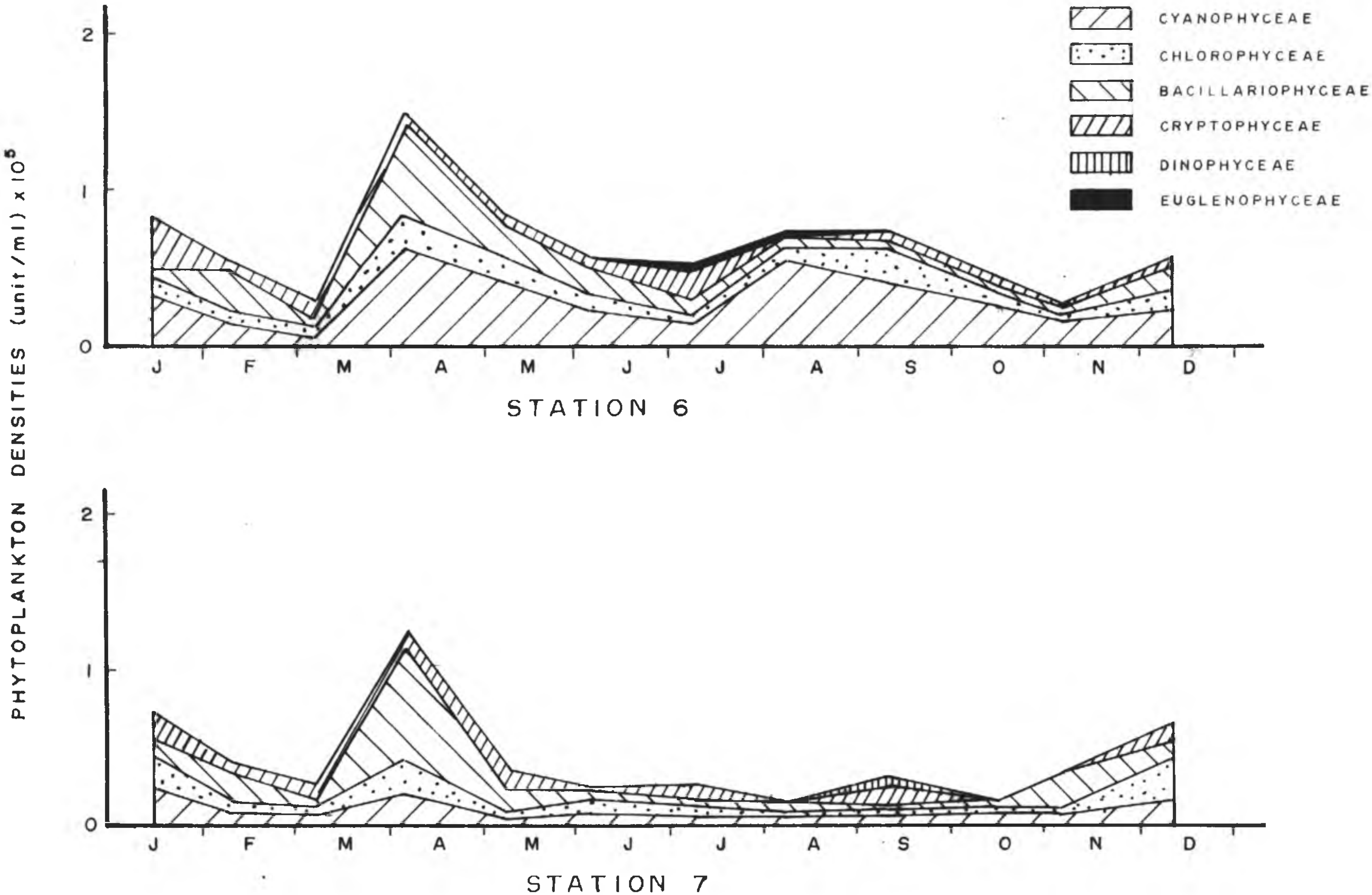

Figure 13 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 6 AND STATION 7 IN 1974

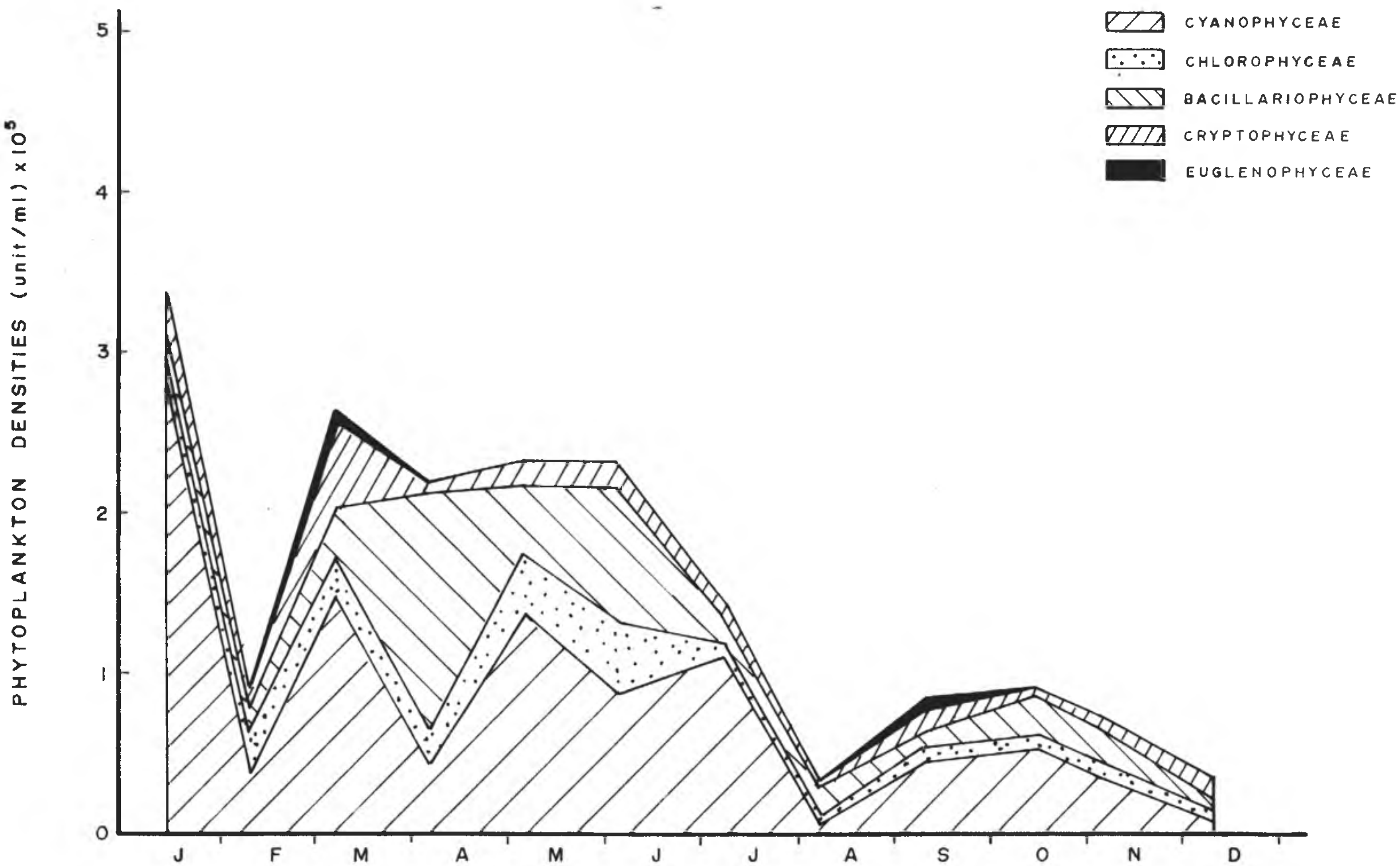

Figure 14 LAKE OKEECHOBEE PHYTOPLANKTON DENSITIES BY CLASS AT STATION 8 IN 1974

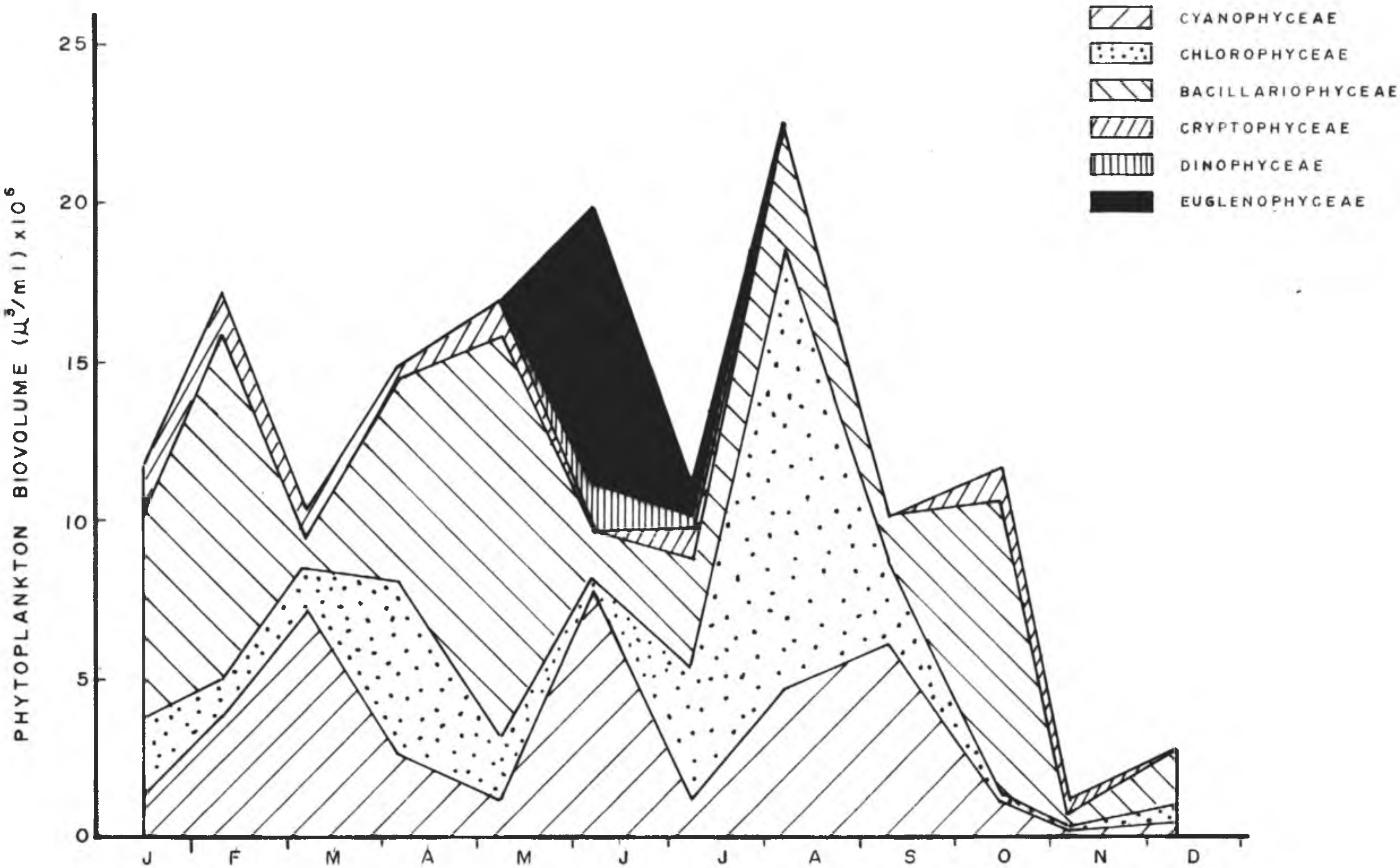

Figure 15 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 1 IN 1974

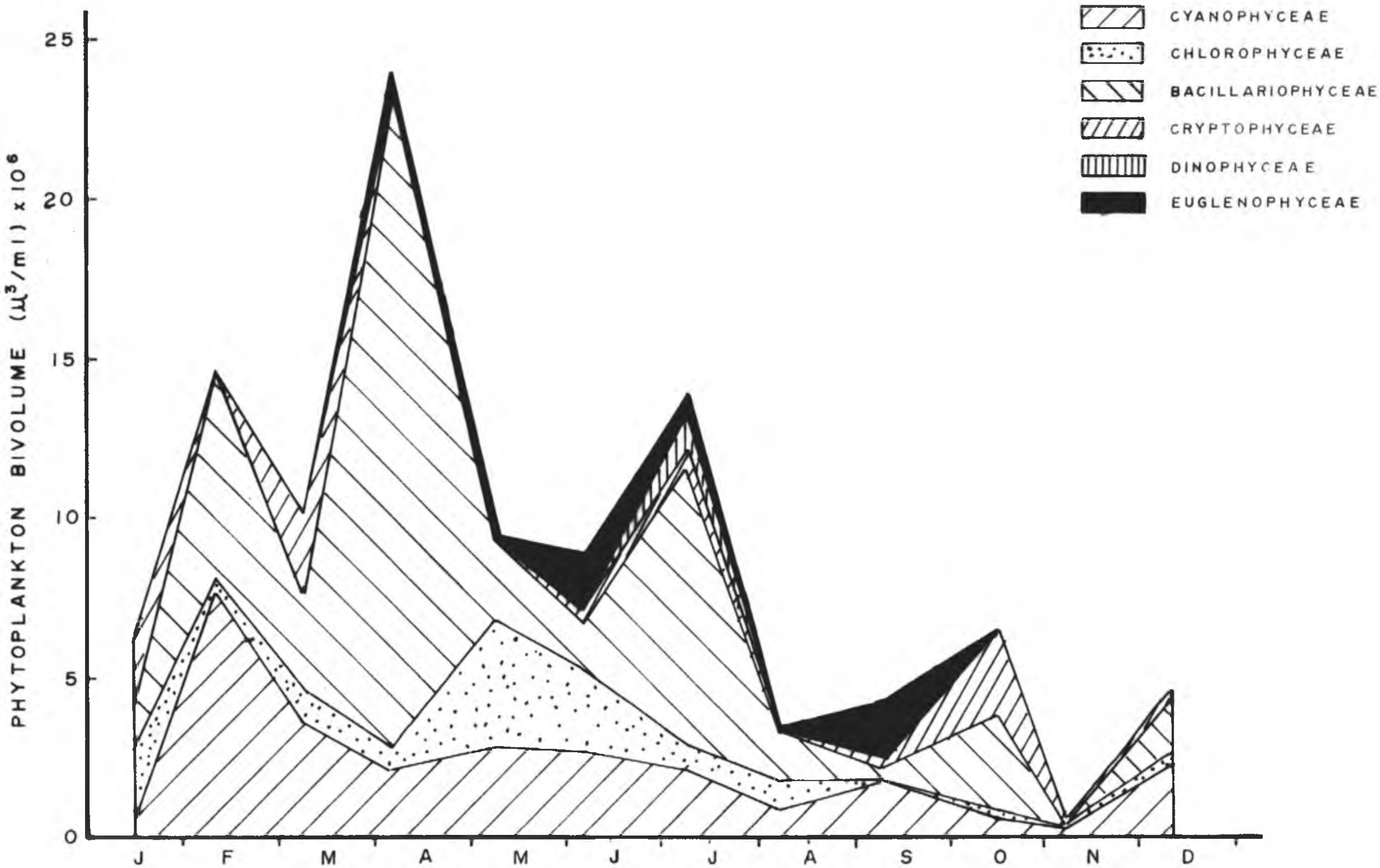

Figure 16 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 2 IN 1974

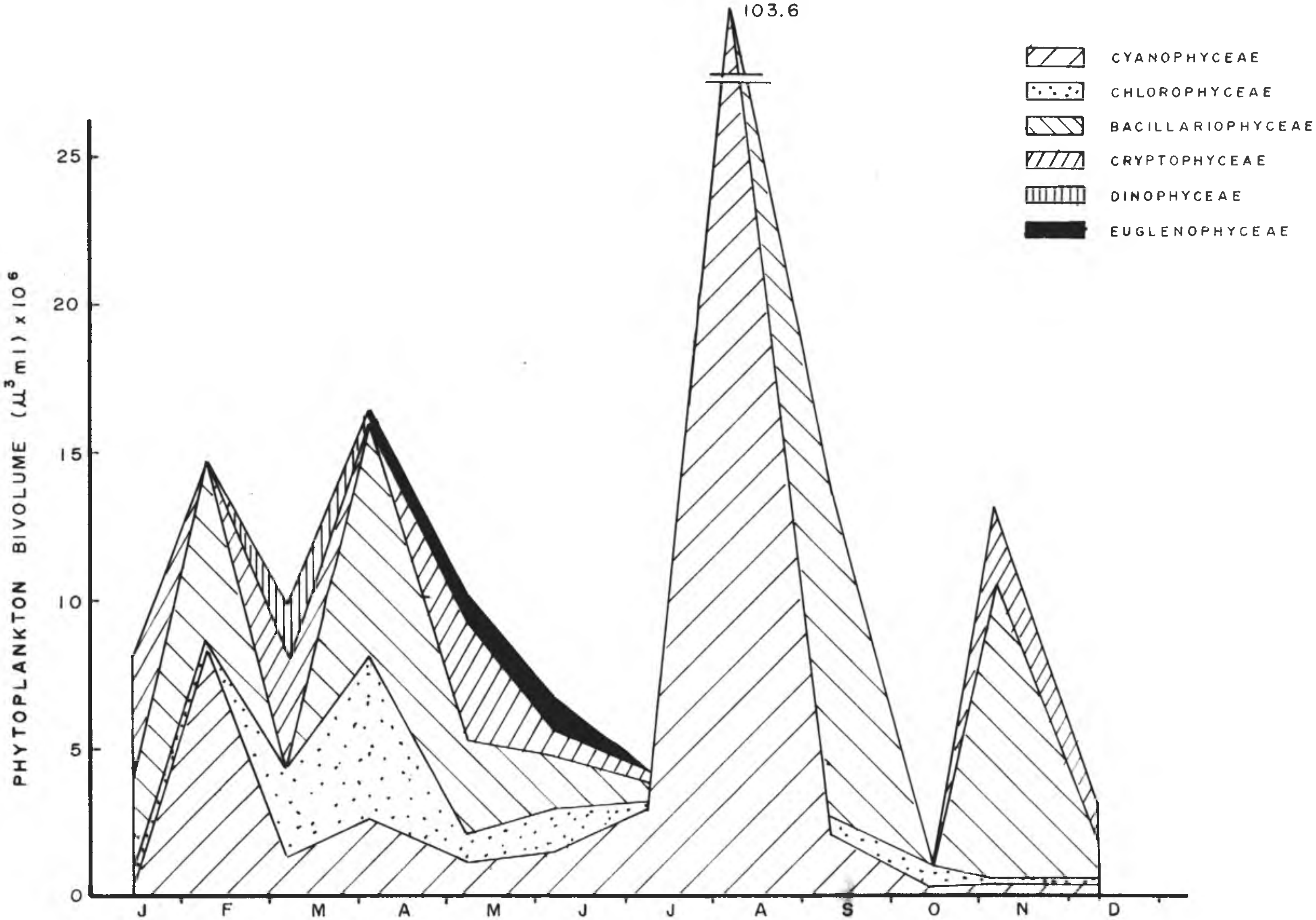

Figure 17 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 3 IN 1974

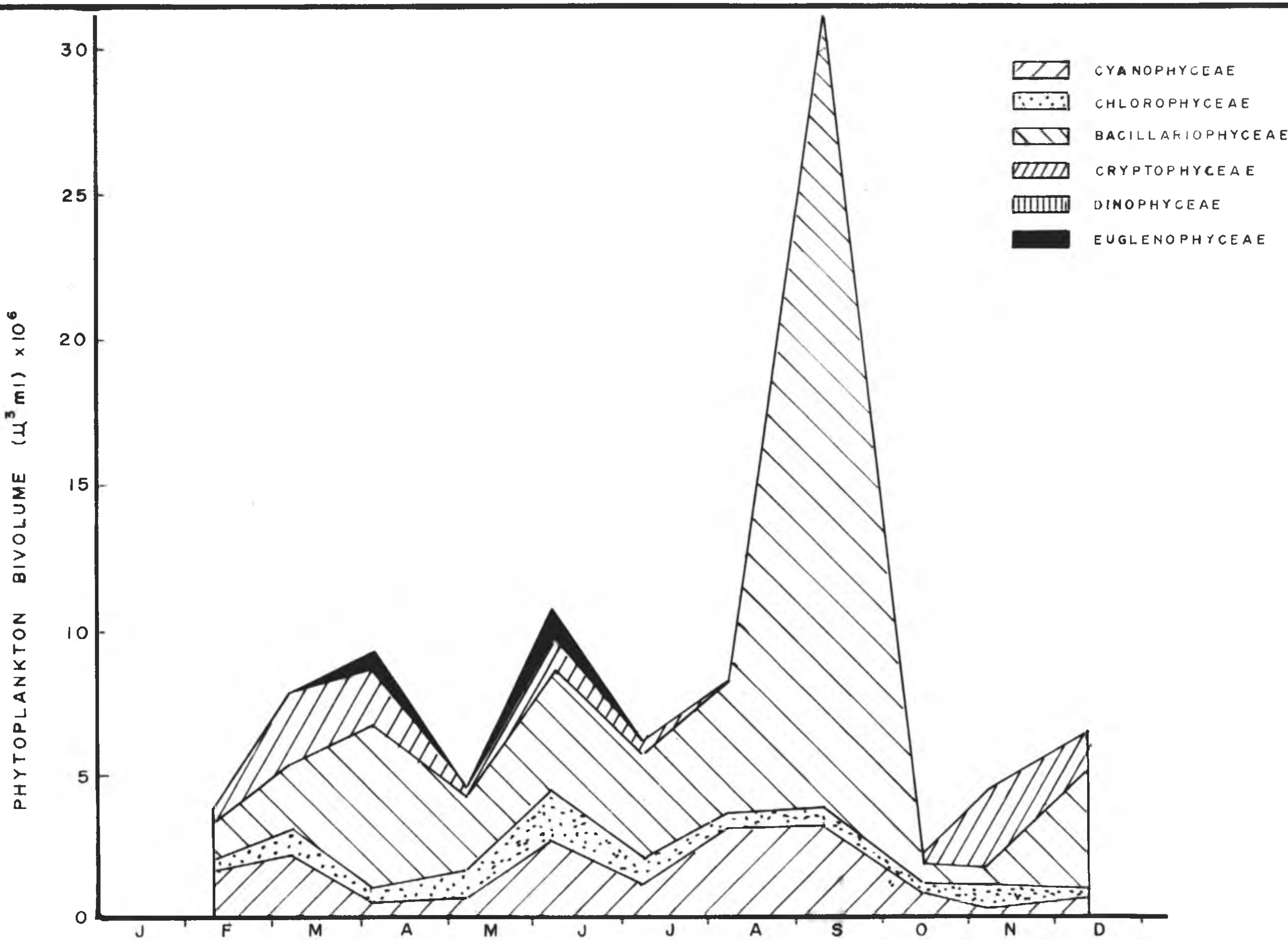

Figure 18 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 4 IN 1974

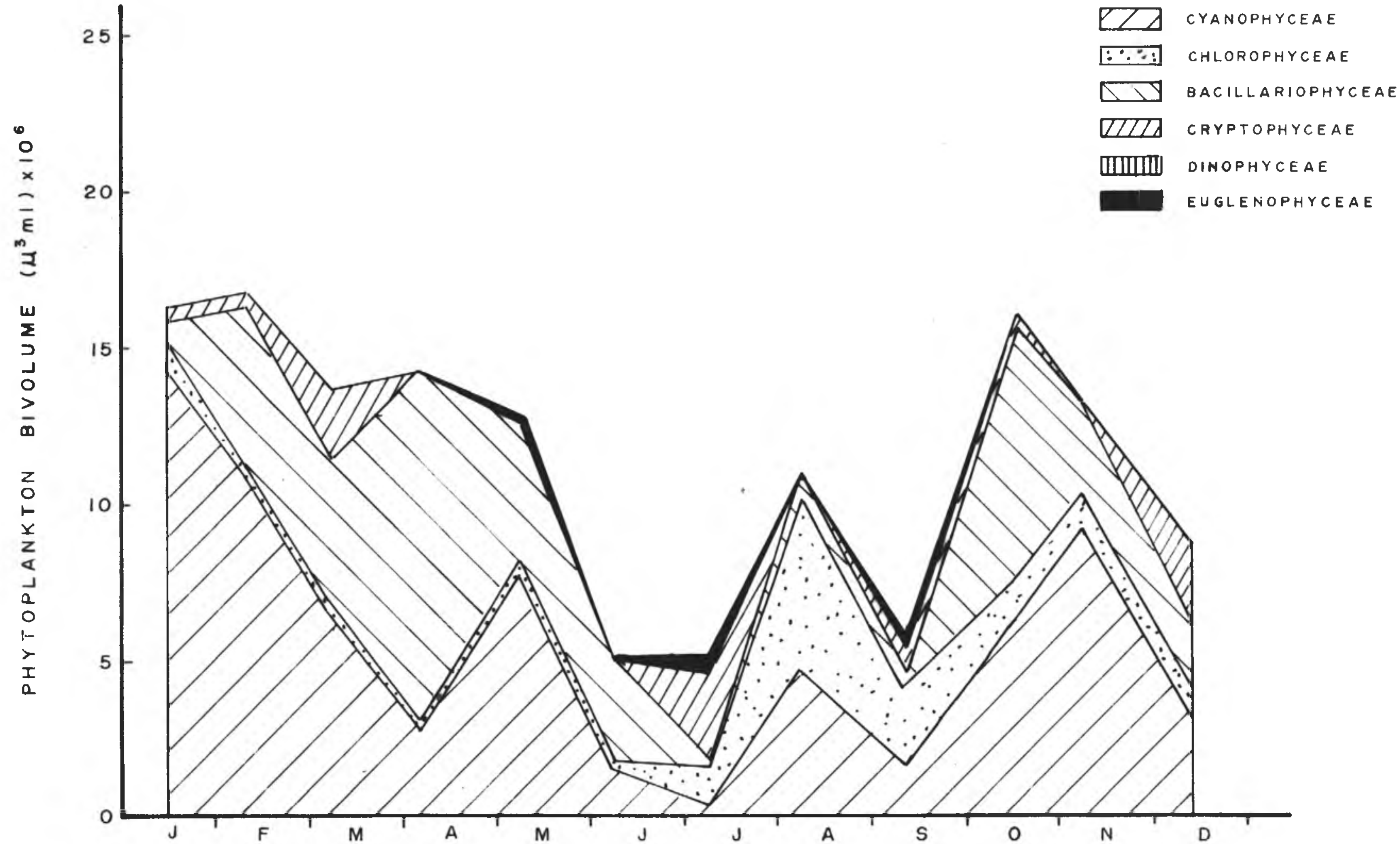

Figure 19 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 5 IN 1974

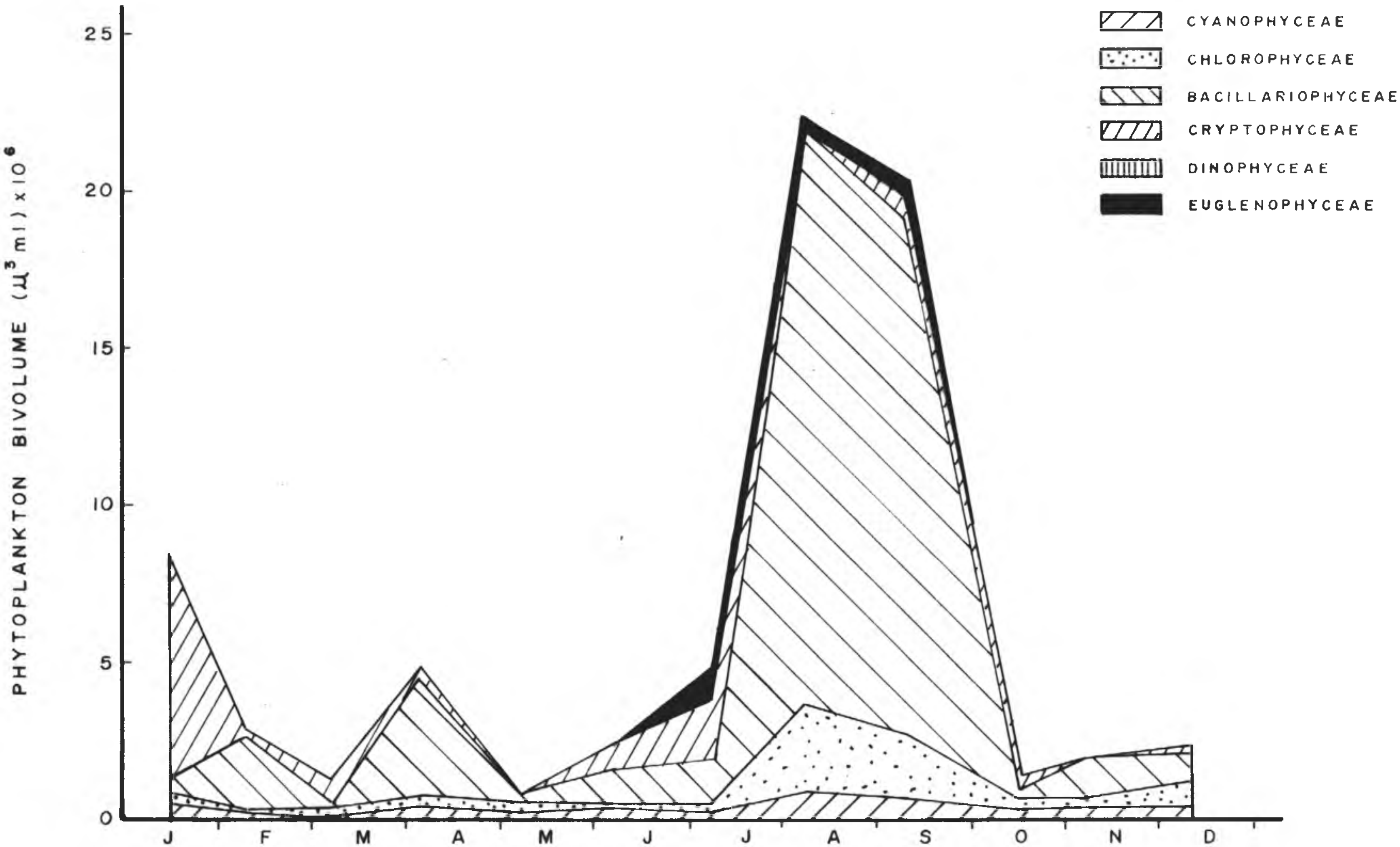

Figure 20 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 6 IN 1974

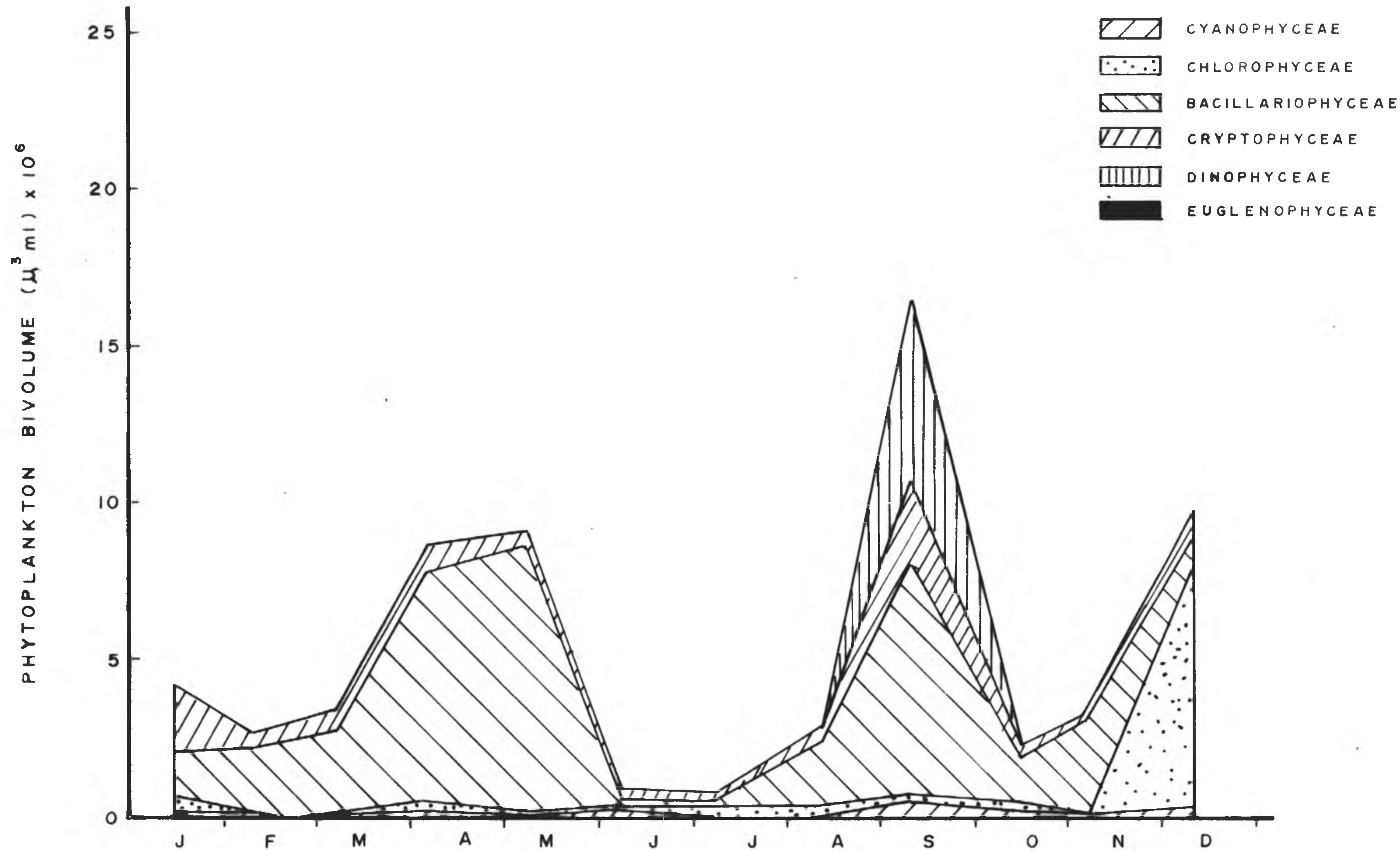

Figure 21 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 7 IN 1974

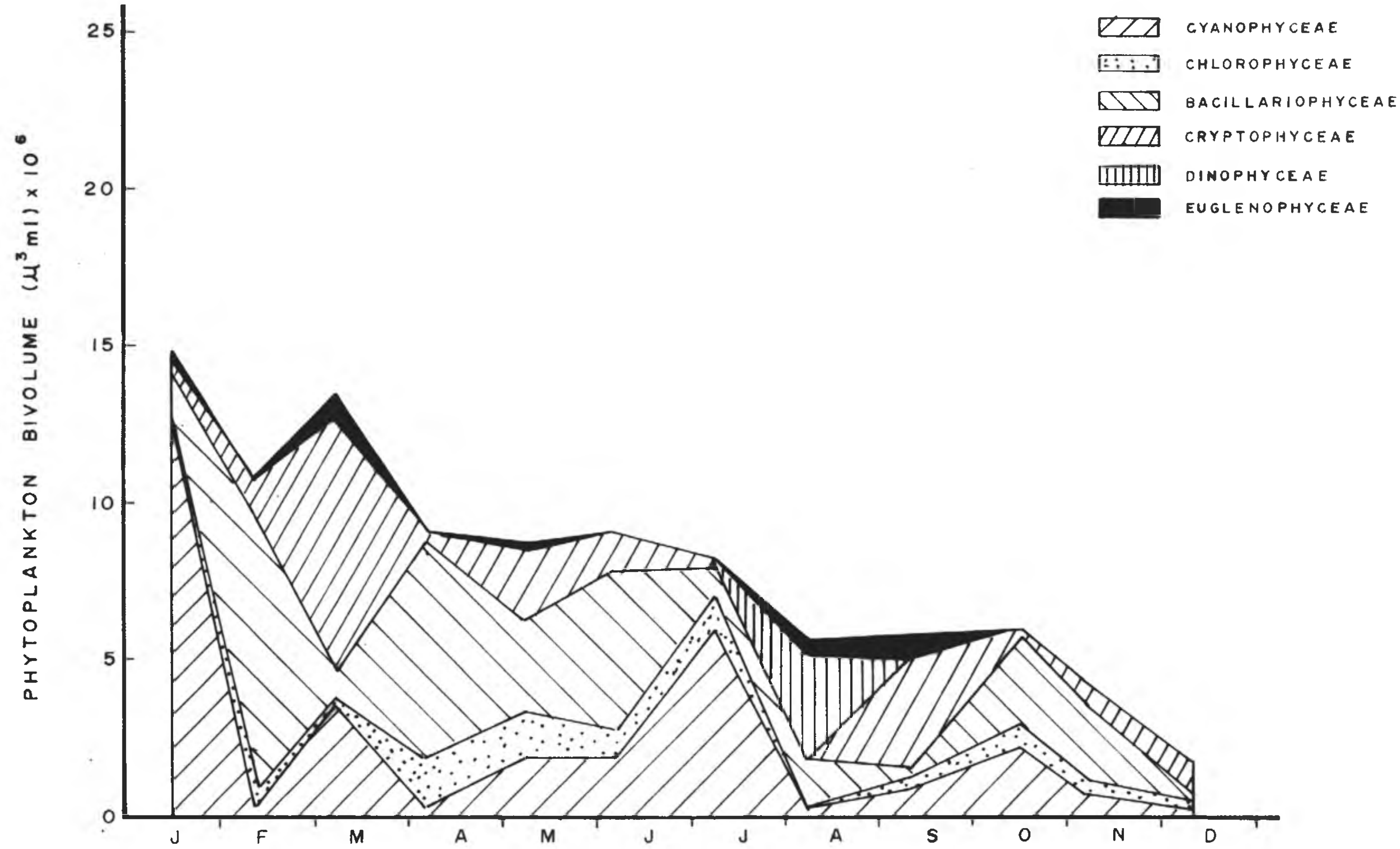

Figure 22 LAKE OKEECHOBEE PHYTOPLANKTON BIVOLUME BY CLASS AT STATION 8 IN 1974

(142,142 units/ml and 7,368,109 μ^3/ml) and Station 8 (133,288 units/ml and 7,098,582 μ^3/ml). In April most of the total biovolume (5,759,646 μ^3/ml) at Station 3 was due to F. construens (5,306,724 μ^3/ml).

The large diatom biovolumes at Station 4 (23,791,860 μ^3/ml) and 6 (5,968,867 μ^3/ml) in September and Station 7 (7,443,721 μ^3/ml) in May were due to the presence of the large centric diatom, Coscinodiscus rothii.

The only green algae bloom of any significance took place at Station 5 in August. Concentrations of Chlorella sp. reached 141,315 units/ml and 5,040,093 μ^3/ml.

Phytoplankton Size Distribution

A survey of the raw data indicates that approximately 95% of the measured algae were less than 50μ in length along the longest axis. Most of the algae in this size range were blue-green algae filaments and pennate diatoms with diameters ranging from 0.3μ to 3 μ. An estimated 85-90% were less than 10μ along the longest axis. Generally, the size range of the species of algae that were identified and measured from Lake Okeechobee were smaller than those reported in the reference keys.

Algae Populations and Primary Productivity

The results of regression analyses for gross primary productivity and phytoplankton parameters (density and biovolume) at Stations 1, 4, 5, and 6 are presented in Table 7. Stations were tested both individually and collectively. Diatoms, blue-green, green and cryptomonad components were tested in addition to collective groupings (totals). The assumed dependent variable was gross primary productivity. The symbol "*" indicates that the slope was significantly different from zero at the 95% confidence level

TABLE 7 Lake Okeechobee 1974 Regression of Gross Primary Productivity versus Phytoplankton Parameters.

* $t_{.05}$ ** $t_{.01}$ (r^2)

Gross Primary Productivity vs	STATIONS All	1	4	5	6
Density					
Total	*(.10)	*(.41)	*(.31)		
Diatom	*(.06)	**(.55)			
Bluegreen	*(.06)	*(.36)	*(.35)		
Green					
Cryptomonad					
Biovolume					
Total	**(.12)				*(.36)
Diatom	*(.07)				**(.45)
Bluegreen					
Green	**(.12)		**(.50)		*(.41)
Cryptomonad					

(t.05) in a one-tailed test; while "**" denotes significance at the 99% confidence level (t.01). The coefficient of determination (r^2) for each significant regression is also shown.

Significant regressions were observed for total, diatom, and blue-green densities. No significant regressions were observed with green algae or cryptomonad densities. The coefficients of determination were very low for all regressions in the collective station grouping.

Coefficients of determination were high at individual stations. Stations 1 and 4 had significant regressions with density parameters. A highly significant regression with the highest coefficients of determination observed in the study was observed between gross primary productivity and diatom density at Station 1. Lower coefficients of determination were observed with total blue-green densities at Stations 1 and 4.

Significant regressions were observed with total, diatom, and green algae biovolumes. No significant regressions were observed with blue-green algae or cryptomonads biovolumes. The coefficients of determination were slightly higher with biovolume components than with density components.

Stations 4 and 6 had significant regressions with biovolume parameters. A highly significant regression with a moderately high coefficient of determination was observed between gross primary productivity and green algal biovolume at Stations 4 and 6 and between primary productivity and diatom biovolume at Station 6. Less significant regressions were observed between primary productivity and total and green algae biovolumes at Station 6. No significant regressions with either density or biovolume were observed at Station 5.

DISCUSSION

Primary Productivity

Monthly average primary productivities for 1973 (Davis and Marshall, 1975) and 1974 are plotted in Figure 23. Comparison of the 1973 and 1974 productivity data is difficult, since the data record for 1973 is relatively incomplete. In both years, the fall peak (September) was of greater magnitude than the spring peak (March 1973, May 1974) and low productivity occurred in the winter months (November through February) and late summer (July). Since the 1974 data are more complete these data may provide a better picture of primary productivity on Lake Okeechobee than the 1973 data.

Monthly average primary productivities by station for January 1973 through December 1974 are plotted in Figure 24. At Station 1 a spring peak in productivity was not observed in 1973 but was observed in 1974. The fall peak in productivity in 1973 occurred in the same month (August) as in 1974 and was slightly greater in magnitude.

Data for 1973 were incomplete and were not comparable with the 1974 data for Station 4.

The 1974 productivity data for Station 5 generally followed the same pattern as the data for 1973. The fall peak in productivity in 1974 was of much greater magnitude and occurred a month earlier (September) than that of 1973 (October).

Productivity data at Station 6 for 1974 followed much the same pattern as those for 1973 and were in the same general range. The fall peak (September) in productivity in 1974 was slightly more compressed than that from 1973.

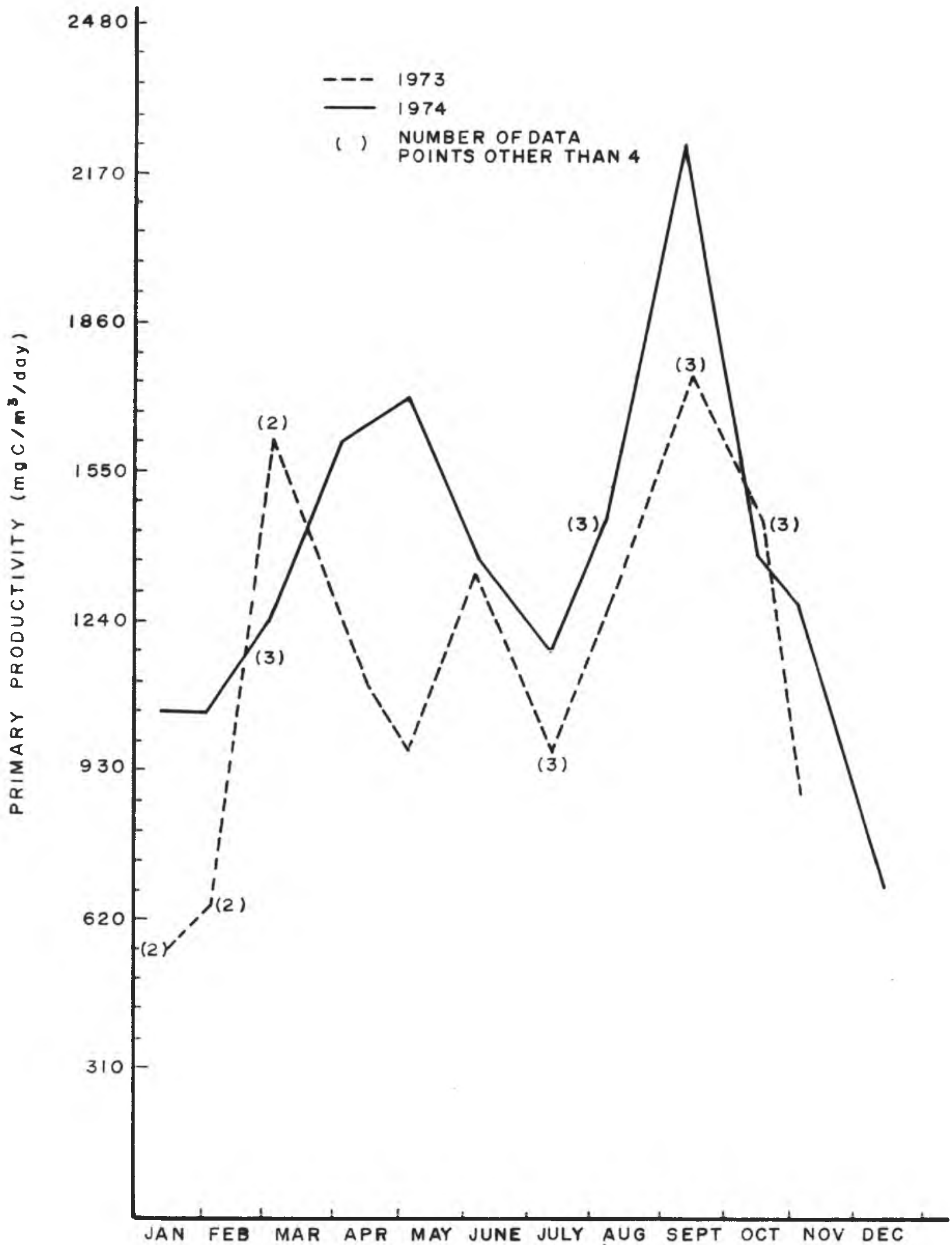

Figure 23 LAKE OKEECHOBEE AVERAGE PRIMARY PRODUCTIVITIES FOR 1973 AND 1974

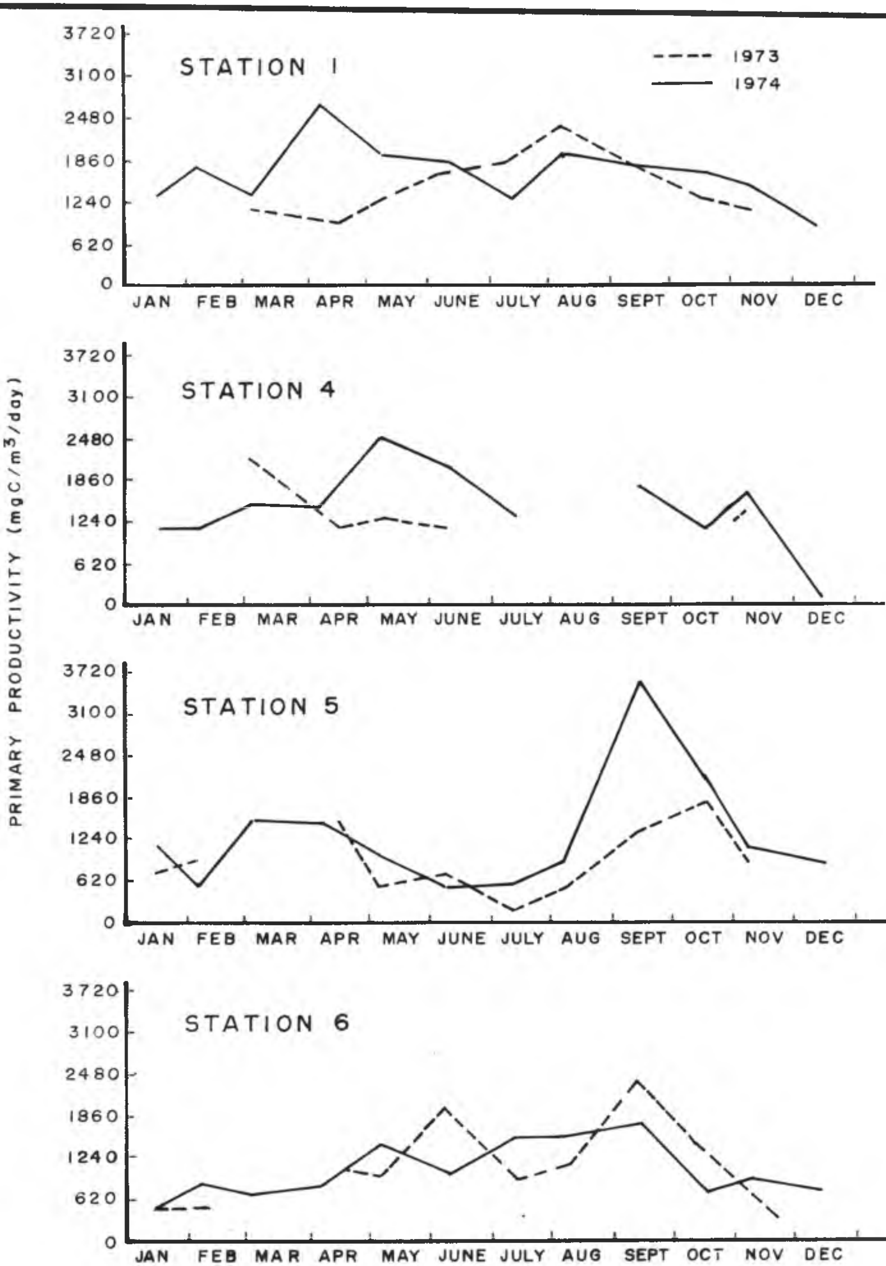

Figure 24 LAKE OKEECHOBEE PRIMARY PRODUCTIVITY BY STATION FOR 1973 AND 1974

Primary productivities for 1973 and 1974 can be summarized as follows:

	Gross Primary Productivity (mg C/m^3/day)	
Station	1973	1974
1	1440	1673
4	1376	1419
5	874	1278
6	1073	1027
Average	1156	1349

Station 1 had a slightly higher average productivity in 1974 than in 1973. Average productivities at Stations 4 and 6 were essentially the same in 1974 as in 1973. The average productivity for Station 5 increased by one-third from 1973 to 1974. This increase in the average at Station 5 was due to the extremely high productivity observed in September of 1974 and probably reflects a higher nutrient loading rate. The stations near inflows (Stations 1 and 5) changed in average productivity from year to year, but those in the open Lake (Stations 4 and 6) did not. The data suggest that those stations near inflows are more strongly influenced by loadings. Changes in productivities at Stations 1 and 5 accounted for most of the increase in average productivity of the Lake from 1973 to 1974.

A two-tailed Student's t-test for equality of means, assuming equal variances, was used to test the means of the 1973-1974 productivities. No significant differences (90% confidence level) were observed between the means of individual or grouped stations.

Recent studies by Marshall, (unpublished 1977) have shown that the 0.22 m depth of incubation generally is the depth at which maximum productivity is reached in Lake Okeechobee. Productivity bottles incubated at 0.0, 0.5, 1.0, and 2.0 m generally had less production than those incubated at 0.22 m. The reported productivities in 1973 and 1974 probably are good estimates of maximum productivities.

Algae Populations

The first published phytoplankton study on Lake Okeechobee was conducted by Joyner (1974). Phytoplankton samples were collected on nine dates between January 1969 and April 1971 and 17 species were reported.

Davis and Marshall (1975) collected monthly phytoplankton samples during 1973 and identified 83 species of algae. Seasonal and areal variations in populations were described.

The present study was a continuation of the 1973 study with improvements in identification and counting techniques. The 233 species of algae that were identified in the present study indicated considerable differences between reported dominant species in 1973 and 1974.

The *Oscillatoria sp*. which was reported as the dominant bloom producing blue-green alga in 1973 was in fact *Raphidiopsis curvata*. These species are distinguished on the basis of akinetes. None of the 1973 samples were observed to have akinetes, but three akinetes were observed in the 1974 samples. According to Dr. F. Drouet (personal communication), the akinetes develop only under certain conditions which obviously were not present in the Lake during the study periods. *Lyngbya limnetica* (1974) was misidentified as an *Oscillatoria* (1973). Observations at higher magnification permitted the detection of the sheath of *L. limnetica* which separates it taxonomically from *Oscillatoria*. The change in magnification (from 400X to 1875X) accounted for the reported differences in diatoms. This higher magnification was also responsible for the separation of cryptomonads from the group of "green flagellates" reported in the 1973 data.

An improvement in counting techniques is responsible for the apparent difference in phytoplankton densities between 1973 and 1974. The relative high densities and low densities of phytoplankton were the same for the two study periods. Peaks in phytoplankton densities in the spring and fall were observed in both studies and were roughly of the same magnitude (that is a higher density in the spring peak as opposed to the fall peak). The same succession in algal groups (cryptomonads (1974), green flagellates (1973)--diatoms--blue-green algae) was observed in both study periods.

Dominance in densities by blue-green algae was evident in both study periods. The improvement in counting techniques is felt to be responsible for the increase in reported diatoms for the 1974 period.

Both density and biovolume analyses are presented in this report since each method has inherent biases that favor one group of algae over another. Densities do not give a true evaluation of the importance of an alga since algae differ greatly in size (Vollenweider, 1969). Density data tend to overestimate the smaller algae, such as small filamentous and colonial blue-green algae and flagellates, which may be numerous but account for very little biovolume. Biovolume data tend to overestimate the larger algae, such as large diatoms, which may be uncommon but are very large. It is generally accepted that biomass (biovolume times density of water) data gives the best estimate of standing crop (Wetzel, 1975). Density data, however, may be important in terms of productivity since smaller algae are generally more productive per unit biomass (Findenegg, 1966). The inclusion of both density and biovolume data provides the broadest base from which characterizations can be made.

The calculation of biovolumes was felt to be useful in gaining perspective as to the relative importance of the various algal groups to the Lake. Diatoms were generally more important in terms of biovolume than blue-green algae, except during summer blue-green algae blooms.

The Summer Blue-green Algal Bloom

The bloom-forming blue-green alga, Rhapidiopsis curvata, has at least 21 synonymous species including Anabaenopsis philippinensis, Aphanizomenon americanum, Anabaenopsis seriata and Anabaenopsis wustericum (Drouet, 1973), R. curvata has been found in temperate and tropical regions throughout most of the world and develops in regions where water becomes very warm during the summer. In Florida, R. curvata has been identified in Lake Warren (Orange County), Lake Mulberry (Polk County), Gainesville, and the St. Johns River at Welaka (Drouet, 1973). The large bloom observed in this study was first detected at Station 3 in August. More recent studies (Marshall, unpublished 1977) showed that in 1975 and 1976 these blooms of R. curvata originated at Nubbins Slough.

Classification of Algae by Size

Lake Okeechobee phytoplankton consists mainly of very small organisms. Generally accepted size ranges for the classification of plankton (Strickland, 1960) are:

Macroplankton	500 μ
Microplankton (net plankton)	ca 50 to 500 μ
Nannoplankton	10 to ca 50 μ
Ultraplankton	0.5 to 10 μ

Using this classification system, the major component of Lake Okeechobee phytoplankton is the ultraplankton.

Primary Productivity and Algal Populations

In Lake Okeechobee the observed maxima and minima algal densities and biovolume are out of phase with the periodicity of the primary productivity. The low coefficients of determination between gross primary productivity and phytoplankton parameters for the collective station grouping reflect this phenomenon. This lack of synchrony between density and primary productivity generally occurs in most lakes (Wetzel, 1975). Moderately strong relationships (higher coefficients of determination) were observed for individual stations. The explanation for the stronger relationships at various stations with different algal classes is not apparent.

Lake Okeechobee: Temperate or Tropical?

The following discussion addresses the temperate-tropical nature of Lake Okeechobee phytoplankton and primary productivity.

Lake Okeechobee phytoplankton exhibits seasonal patterns and periodicity that are typical of temperate lakes. A summary of temperate phytoplankton characteristics by Wetzel (1975) describes many of the occurrences observed in Lake Okeechobee:

a. Spring maximum of phytoplankton (usually diatoms) usually less than 3 months in durations.
b. Spring maximum followed by brief period of low numbers and biomass (summer minimum) which phases into a later summer profusion of blue-green algae (in eutrophic lakes).
c. Second maximum generally not as strongly developed as that of the spring period.
d. Decline in populations to a winter minimum.

In contrast, a single maximum in phytoplankton concentrations often is observed in the winter in tropical lakes (Wetzel, 1975).

Lake Okeechobee does not exhibit the wide fluctuations in numbers and biomass that are characteristic of temperate lakes. In temperate lakes the seasonal amplitude in phytoplankton numbers is great, of the order of a thousandfold. By contrast, in tropical waters the seasonal variation may be as little as fivefold (Fogg, 1975). The winter minimum occurs with ice coverage in temperate lakes. Since Lake Okeechobee never freezes over, the drastic reduction in phytoplankton numbers and biomass due to light and temperate reduction does not occur. The seasonal variation in numbers and biovolume in Lake Okeechobee approximates those of a tropical lake.

Comparison of Lake Okeechobee With A Tropical Lake

A survey of the literature was made in an attempt to find a tropical lake which limnologically resembled Lake Okeechobee. The lake which most closely resembles Lake Okeechobee (that this author could find) is Lake George, Uganda. Lake George is a shallow (average depth of 2.5 m) eutrophic tropical lake with no permanent stratification. The species composition includes *Microscystis aeruginosa*, *M. flosaquae*, *Anabaenopisis sp.*, *Lyngbya sp.*, *Aphanocapsa sp.*, *Chroococcus sp.*, *Pediastrum sp.*, *Scenedesmus sp.*, *Kirchneriella sp.*, *Synedra sp.*, *Nitzschia sp.*, and *Melosira sp.* (Burgis et al, 1973).

Lake George differs from Lake Okeechobee in terms of phytoplankton in several aspects. The Lake George phytoplankton community is dominated throughout the year by blue-green algae (70-80% of the phytoplankton biomass) (Ganf, 1969; Buris et al, 1973). Seasonal fluctuations of species composition and density are small (Burgis et al, 1973). The concentrations of phytoplankton (using chlorophyll $\bar{a}$ as an index) range from 150 to 350 mg/m^3 (Burgis et al, 1973) as opposed to 14 to 38 mg/m^3 in Lake Okeechobee (Marshall, unpublished).

Gross primary productivity in Lake George is much higher than in Lake Okeechobee. Gant (1969) reported a productivity of 5.4 g C/m^2/day for Lake George. Assuming a euphotic zone of 1.2 m, Lake Okeechobee has a maximum productivity of 1.6 g C/m^2/day.

The primary production in Lake George is relatively uniform throughout the year (Talling, 1965; Ganf, 1974), whereas wide fluctuations in productivity occur in Lake Okeechobee.

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APPENDIX A LAKE OKEECHOBEE, JANUARY - DECEMBER 1974 PHYTOPLANKTON TOTAL DENSITIES (UNITS/ML)

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
1/16/74	1	55,825	20,772	1,298	18,176				96,071
1/16/74	2	54,527	50,632	27,263	23,369				155,791
1/16/74	3	32,525	26,785	16,262	38,264		957		114,793
1/17/74	5	454,390	14,540	3,635	7,270				479,835
1/17/74	6	32,716	12,117	3,635	34,534				83,002
1/17/74	7	27,869	19,388	11,511	13,328				72,096
1/17/74	8	280,423	23,368	20,772	7,789	5,193			337,545
	Ave.	134,039	23,943	12,054	20,390	742	137		191,305
2/6/74	1	215,078	12,117	75,732	81,790			6,058	384,717
2/6/74	2	181,756	8,078	38,371					228,205
2/6/74	3	236,282	7,789	51,930					296,001
2/6/74	4	115,112	18,176	33,322	6,058				172,668
2/13/74	5	158,128	8,088	14,540	12,723				193,479
2/13/74	6	14,540	7,270	26,173	3,877	485			52,345
2/13/74	7	9,088	8,709	14,768	7,952				40,517
2/13/74	8	39,813	20,772	20,772	6,924				88,281
	Ave.	121,225	11,375	34,451	14,916	61			182,028
3/6/74	1	199,932	24,991	15,904	15,904				256,731
3/6/74	2	112,358	31,394	11,566	36,351				191,669
3/6/74	3	68,158	28,778	9,088	57,556	3,029			166,609
3/6/74	4	116,324	21,811	29,081	23,628			1,817	190,844
3/7/74	5	218,107	33,755	28,562	10,386				290,810
3/7/74	6	5,049	7,068	1,515	15,146				28,778
3/7/74	7	6,991	4,660	1,864	10,253			699	23,768
3/7/74	8	149,949	22,719	29,535	61,343		2,272		265,818
	Ave.	109,608	21,897	15,889	28,821	379	284		176,878

Appendix A (Continued)

Date	Sta.	Cyano	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
4/3/74	1	190,843	36,351	102,995	6,058				336,247
4/3/74	2	67,576	25,632	167,775			2,330		263,313
4/3/74	3	143,202	30,293	112,909	8,262			5,508	294,666
4/3/74	4	64,624	44,429	127,229	6,058		2,019		244,359
4/4/74	5	45,439	13,769	89,501					148,709
4/4/74	6	62,915	18,176	64,314	4,194				149,599
4/4/74	7	20,089	22,002	73,659	5,740			2,870	121,490
4/4/74	8	42,410	20,195	149,444	6,058			2,019	218,107
	Ave.	79,637	26,356	110,978	4,546		544		222,061
5/8/74	1	117,315	42,960	21,480	6,609				188,364
5/8/74	2	272,634	27,263	48,468					348,365
5/8/74	3	158,387	80,492	46,737	25,965			2,596	311,581
5/8/74	4	139,346	40,390	66,644	2,019			4,039	248,399
5/9/74	5	239,456	25,965	51,930		2,885	2,885	2,885	323,121
5/9/74	6	40,390	17,502	20,868	1,346			2,019	80,106
5/9/74	7	2,364	4,729	26,303	4,137			591	37,533
5/9/74	8	138,589	34,079	43,167	18,176			4,544	234,011
	Ave.	138,560	34,172	40,700	7,282	361	361		221,436
6/6/74	1	238,879	15,579	28,562	2,596	2,596	2,596		290,808
6/6/74	2	141,770	23,628	29,081	7,270		5,453		207,202
6/6/74	3	105,749	28,089	33,046	13,219		11,566		191,669
6/6/74	4	154,493	27,263	63,615	13,632		2,272		261,275
6/7/74	5	61,451	5,193	25,100	865			5,193	92,609
6/7/74	6	23,657	9,809	16,733	7,501			577	57,700
6/7/74	7	9,473	9,253	3,305	1,542		661		24,234
6/7/74	8	86,839	46,449	82,800	18,176			8,078	234,264
	Ave.	102,789	20,658	35,280	8,100	324	2,818		169,969

Appendix A (Continued)

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
7/9/74	1	30,145	7,979	2,660	1,773	443	2,216	1,773	45,216
7/9/74	2	62,316	8,655	39,813	6,924	865	865		119,438
7/9/74	3	212,654	16,358	12,723	10,905				252,640
7/9/74	4	112,689	15,752	13,329	6,058				147,828
7/10/74	5	7,501	9,232	1,154	11,540		2,308		31,735
7/10/74	6	14,281	2,596	12,982	19,474		2,164		51,497
7/10/74	7	5,852	8,157	1,241	7,802			177	23,052
7/10/74	8	110,352	9,088	20,772	5,193				145,405
	Ave.	69,474	9,727	13,084	8,709	163	944		102,101
8/7/74	1	127,229	16,523	36,351	1,652				181,755
8/7/74	2	43,872	6,267	21,309	627				72,075
8/7/74	3	280,423	12,982	15,579					308,984
8/7/74	4	129,047	27,263	59,979					216,289
8/8/74	5	35,442	144,042	4,544					184,028
8/8/74	6	55,176	6,491	8,439			1,298		71,404
8/8/74	7	5,373	2,172	4,115	686		229	457	12,575
8/8/74	8	5,396	2,272	26,127		852	1,136		35,783
	Ave.	85,245	27,252	22,055	371	106	333		135,362
9/11/74	1	150,857	34,534	12,723					198,114
9/11/74	2	121,171	6,732	13,463	4,039	1,346	2,693		149,444
9/11/74	3	81,312	22,002	7,653					110,967
9/11/74	4	127,229	12,117	30,293			1,515		171,154
9/12/74	5	31,262	60,343	7,270	14,540		727		114,142
9/12/74	6	41,245	20,972	3,495	4,194		699		70,605
9/12/74	7	6,361	1,212	2,726	18,478	2,726		303	31,503
9/12/74	8	44,682	12,117	6,058	18,176		1,515	4,544	82,548
	Ave.	75,515	21,254	10,460	7,428	509	894		116,060

Appendix A (Continued)

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto	Dino.	Eugleno.	Unknown	Total
10/15/74	1	61,393	14,540	7,270	12,925				96,128
10/15/74	2	38,659	11,540	9,232	2,885				62,316
10/15/74	3	20,089	10,842	2,870	319			319	34,120
10/15/74	4	40,967	14,425	14,425	1,731			577	71,548
10/16/74	5	133,720	5,193	23,369	2,596			5,193	164,878
10/16/74	6	26,473	9,088	4,346	2,371			790	42,278
10/16/74	7	8,330	3,938	2,575	909				15,752
10/16/74	8	50,199	12,983	24,234	2,596			865	90,012
	Ave.	47,479	10,319	11,040	3,291				72,129
11/7/74	1	18,359	5,508	5,875	1,469				31,211
11/7/74	2	10,229	3,619	3,147	472				17,467
11/7/74	3	25,815	7,376	11,063	17,385				61,639
11/7/74	4	19,277	13,219	7,711	19,277				59,484
11/7/74	5	115,112	24,234	13,632				1,515	152,978
11/7/74	6	15,042	4,011	7,521	752				27,326
11/7/74	7	6,979	1,163	22,101	872				31,115
11/7/74	8	34,332	10,098	20,195	6,058				70,683
	Ave.	30,643	8,654	11,406	5,786				56,489
12/11/74	1	21,918	25,660	11,226	535				59,339
12/11/74	2	65,246	30,759	24,234	1,864				122,103
12/11/74	3	23,069	13,981	31,458	5,592			3,495	74,100
12/11/74	4	23,302	20,972	82,722	5,825				132,821
12/12/74	5	89,580	41,544	31,158	7,789				170,071
12/12/74	6	20,902	15,449	17,267	1,818			454	55,436
12/12/74	7	28,332	13,899	10,691	6,949		535		60,406
12/12/74	8	7,931	5,948	18,176	1,983		330		34,368
	Ave.	35,035	21,026	28,366	4,044		108		88,579

APPENDIX B LAKE OKEECHOBEE, JANUARY - DECEMBER 1974 PHYTOPLANKTON BIOVOLUME (μ^3/ml)

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
1/16/74	1	1,354,731	2,336,214	6,422,478	1,607,891				11,721,314
1/16/74	2	592,005	2,068,124	1,564,400	2,113,563				6,338,092
1/16/74	3	360,642	539,528	3,117,594	3,792,004		360,642		8,170,410
1/17/74	5	14,318,738	926,956	708,848	334,431				16,288,973
1/17/74	6	521,034	372,600	397,440	7,126.047				8,417,121
1/17/74	7	205,990	351,395	1,461,924	2,125,333				4,144.642
1/17/74	8	12,426,917	563,444	1,217,765	392,074	145,405			14,745,605
	Ave.	4,254,294	1,022,609	2,127,207	2,498,763	20,772	51,520		9,975,164
2/6/74	1	3,828,993	1,251,087	10,841,745	1,290,468			145,405	17,212,293
2/6/74	2	7,746,845	393,805	6,444,260					14,584,910
2/6/74	3	8,381,548	244,072	6,130,370					14,755,990
2/6/74	4	1,593,394	421,068	1,413,153	292,324				3,719,939
2/13/74	5	10,943,529	232,648	5,196,404	314,438				16,687,019
2/13/74	6	105,661	85,789	2,439,893	142,981	7,755			2,782,079
2/13/74	7	45,060	51,498	2,109,127	360,861				2,566,546
2/13/74	8	308,985	295,651	9,116,362	953,786				10,674,784
	Ave.	4,119,252	371,952	5,461,414	419,357	969			10,372,944
3/6/74	1	7,011,238	1,501,759	981,482	933,771				10,428,250
3/6/74	2	3,611,987	993,049	3,030,368	2,569,369				10,204,773
3/6/74	3	1,408,609	2,774,808	269,605	3,619,974	1,903,894			9,976,890
3/6/74	4	2,346,470	674,315	2,342,835	2,564,577			59,979	7,928,197
3/7/74	5	6,574,374	329,757	4,253,090	2,318,687				13,475,908
3/7/74	6	24,487	366,036	35,594	1,244,776				1,670,893
3/7/74	7	56,857	39,847	2,646,880	702,790			932	3,446,374
3/7/74	8	3,457,908	286,266	840,622	8,113,133		770,191		13,468,120
	Ave.	3,061,491	870,729	1,800,060	2,758,385	237,987	96,274		8,824,926

Appendix B CONTINUED

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
4/3/74	1	2,647,579	5,482,973	6,391,753	357,453				14,879,758
4/3/74	2	2,050,581	659,448	20,608,334			538,277		23,856,640
4/3/74	3	2,541,830	5,538,050	8,093,650	275,388			77,109	16,448,918
4/3/74	4	587,678	472,566	5,759,646	1,861,989		672,497		9,354,376
4/4/74	5	2,963,174	115,663	11,246,841					14,325,678
4/4/74	6	447,399	317,374	3,969,271	198,533				4,932,577
4/4/74	7	110,010	270,721	7,550,527	639,972			78,442	8,571,230
4/4/74	8	343,317	1,542,906	6,694,679	488,722			286,771	9,069,624
	Ave.	1,461,446	1,799,963	8,789,338	477,757		151,347		12,679,851
5/8/74	1	1,257,421	2,116,631	12,344,537	1,273,944				16,992,533
5/8/74	2	2,683,930	4,068,305	2,656,667					9,408,902
5/8/74	3	1,217,765	1,002,255	2,975,605	3,923,333		934,745		10,053,703
5/8/74	4	688,653	1,015,814	2,692,008	119,151			331,200	4,515,626
5/9/74	5	7,720,302	490,453	4,515,050		69,240	141,366	40,390	12,936,411
5/9/74	6	190,507	321,775	1,046,107	79,434			50,488	1,637,823
5/9/74	7	16,255	134,765	8,416,928	496,504			19,210	9,064,452
5/9/74	8	1,899,350	1,483,583	2,762,691	2,199,248		315,801		8,660,673
	Ave.	1,959,273	1,329,198	4,676,199	1,011,452	8,655	173,989		9,158,766
6/6/74	1	7,919,369	233,686	1,467,031	85,685	1,396,925	8,882,675		19,985,371
6/6/74	2	2,537,314	2,726,340	1,595,818	232,648		890,604		7,982,724
6/6/74	3	1,543,274	1,368,127	1,870,434	779,898		1,135,149		6,696,882
6/6/74	4	2,801,314	1,697,147	4,134,949	1,097,352		990,570	43,167	10,721,332
6/7/74	5	1,525,019	128,095	3,405,761	57,123			91,744	5,115,998
6/7/74	6	285,040	162,138	1,078,996	841,271			8,078	2,367,445
6/7/74	7	202,685	144,083	359,106	73,804		12,998		792,676
6/7/74	8	1,964,984	789,629	4,943,763	1,349,033				9,047,409
	Ave.	2,347,375	906,156	2,356,982	564,602	174,616	1,489,000		7,838,731

Appendix B CONTINUED

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
7/9/74	1	1,305,983	4,152,460	3,302,196	1,127,331	232,293	1,023,597	290,810	11,143,860
7/9/74	2	2,065,960	849,926	8,711,305	490,741	1,243,730	579,888		13,941,550
7/9/74	3	2,933,542	258,094	552,538	498,011				4,242,185
7/9/74	4	1,176,567	920,897	3,449,729	547,691				6,094,884
7/10/74	5	466,796	1,202,186	260,805	2,687,969		656,630		5,274,386
7/10/74	6	128,527	358,319	1,487,370	1,731,875		1,029,518		4,735,609
7/10/74	7	87,952	116,501	78,554	347,730			67,737	630,737
7/10/74	8	5,916,158	1,034,711	1,019,132	245,371				8,215,372
	Ave.	1,760,186	1,111,637	2,357,704	764,754	184,503	411,204		6,589,988
8/7/74	1	4,682,695	13,858,069	5,049,512	152,014				23,742,290
8/7/74	2	898,752	779,671	1,771,808	36,978				3,487,209
8/7/74	3	102,377,962	207,721	971,096					103,556,779
8/7/74	4	3,077,129	519,822	4,745,649					8,342,600
8/8/74	5	4,756,100	5,313,637	981,482					11,051,219
8/8/74	6	962,009	2,578,339	18,572,218			197,736		22,310,302
8/8/74	7	68,930	166,667	2,210,679	275,263		36,923	46,525	2,758,462
8/8/74	8	169,544	91,162	1,550,322		3,229,577	500,397		5,541,002
	Ave.	14,624,140	2,939,386	4,481,596	58,032	403,698	91,507		22,598,359
9/11/74	1	6,108,819	2,655,455	1,335,907					10,100,181
9/11/74	2	1,756,975	35,005	390,439	238,302	1,934,692		483,336	4,355,413
9/11/74	3	2,141,851	484,045	10,906,317					13,532,213
9/11/74	4	3,250,403	580,105	27,248,254			89,363		31,168,125
9/12/74	5	1,638,712	2,551,127	520,549	1,001,839		186,845		5,899,072
9/12/74	6	634,748	1,960,868	16,528,611	838,175		366,308		20,328,710
9/12/74	7	549,812	103,298	7,372,932	2,769,961	5,706,835		272,634	16,502,838
9/12/74	8	945,889	201,446	365,784	3,488,201		583,134	112,083	5,584,454
	Ave.	2,128,401	1,071,419	8,083,599	1,042,060	955,191	153,206		13,433,876

Appendix B CONTINUED

Date	Sta.	Cyano.	Chloro.	Bacillario.	Crypto.	Dino.	Eugleno.	Unknown	Total
10/15/74	1	1,139,004	168,023	9,359,222	1,055,800				11,722,049
10/15/74	2	507,763	124,056	3,279,686	2,643,829				6,555,334
10/15/74	3	361,599	686,846	132,331	106,503			751,258	1,287,279
10/15/74	4	949,747	267,152	761,644	103,284			148,290	2,081,827
10/16/74	5	6,344,583	1,178,817	8,421,794	153,194			934,745	16,098,388
10/16/74	6	312,541	313,727	181,361	519,585			790	1,327,214
10/16/74	7	202,809	248,097	1,508,726	242,038				2,201,670
10/16/74	8	2,218,289	757,317	2,671,813	153,194			231,955	5,800,613
	Ave.	1,504,542	468,004	3,289,572	622,178				5,884,296
11/7/74	1	157,522	38,554	467,058	593,002				1,256,136
11/7/74	2	219,523	132,186	146,821	59,012				557,542
11/7/74	3	379,317	155,415	10,016,073	2,516,135				13,066,940
11/7/74	4	464,304	725,922	649,915	2,607,923				4,448,064
11/7/74	5	9,134,754	1,240,485	3,064,103				177,212	13,439,342
11/7/74	6	307,606	238,414	1,377,585	31,087				1,954,692
11/7/74	7	68,922	25,591	3,197,452	38,096				3,330,061
11/7/74	8	651,629	465,161	2,403,218	744,526				4,264,534
	Ave.	1,422,947	377,716	2,665,279	823,723				5,289,665
12/11/74	1	551,683	538,853	1,630,993	39,559				2,761,088
12/11/74	2	2,432,734	675,759	1,297,458	109,986				4,515,937
12/11/74	3	318,073	197,135	1,419,095	1,154,850			139,113	3,089,153
12/11/74	4	703,722	262,148	4,298,063	1,068,399				6,332,332
12/12/74	5	3,269,011	955,517	2,103,177	2,536,794			233,686	8,864,499
12/12/74	6	404,861	865,159	961,035	107,236			59,979	2,338,291
12/12/74	7	360,305	7,734,252	936,043	479,515		364,047		9,874,162
12/12/74	8	177,790	182,086	853,262	453,399		13,880		1,680,417
	Ave.	1,027,272	1,426,364	1,687,391	753,717		47,241		4,931,985

ADDENDUM

In Davis and Marshall (1975), Table 7 listed the primary productivity values that were measured on Lake Okeechobee during 1973. Since the publication of that report, an error has been discovered in the calculation procedure for primary productivity. Table 7 is reproduced in the present report with the corrected values. The average gross primary productivity for 1973 was 1156 mgC/m^3/day rather than 1864 mgC/m^3/day as reported in Davis and Marshall (1975).

Appendix E (Davis and Marshall, 1975) is reproduced in the present report with the corrected rate, 100 mgC/m^3/hr.

A comparison of productivity rates with those of other lakes classified by Brezonik, et al (1969) leads this author to conclude that Lake Okeechobee may be classified as either mesotrophic or eutrophic.

TABLE 7 LAKE OKEECHOBEE 1973

IN SITU PRIMARY PRODUCTIVITIES (LIGHT AND DARK BOTTLE OXYGEN METHOD)

Date	Station	Primary Productivity ($mgC/m^3/day$) Corrected for day length		Respiration
		Gross	Net	
1/16/73	5	682	496	186
1/16/73	6	434	434	0
2/6/73	5	868	806	62
2/6/73	6	434	496	0
3/5/73	1	1054	1240	0
3/5/73	4	2170	2294	0
4/19/73	1	930	930	0
4/19/73	4	1054	558	620
4/12/73	5	1488	1550	0
4/12/73	6	992	1054	0
5/3/73	1	1240	1302	0
5/2/73	4	1240	1302	0
5/9/73	5	496	434	62
5/9/73	6	930	806	124
6/4/73	1	1612	1116	558
6/4/73	4	1054	930	124
6/5/73	5	744	744	0
6/5/73	6	1984	1984	0
7/12/73	1	1860	1860	0
7/10/73	5	186	310	0
7/10/73	6	868	806	62
8/9/73	1	2294	2418	0
8/10/73	5	434	372	62
8/10/73	6	1116	1054	62
9/12/73	1	1674	1674	62
9/13/73	5	1302	1178	186
9/13/73	6	2294	2108	186
10/11/73	1	1240	1302	0
10/12/73	5	1674	1488	248
10/12/73	6	1426	1426	62
11/15/73	1	1054	992	124
11/15/73	4	1364	1240	186
11/20/73	5	868	806	62
11/20/73	6	248	310	0

APPENDIX E

GROSS PRIMARY PRODUCTIVITY VALUES OF VARIOUS FLORIDA LAKES (Brezonik, *et al.*, 1969)

(Lake Okeechobee, gross primary productivity values: 100 mg C/m^3/hr)

Location	mg C/m^3/hr
Lake Apopka	386.0
Lake Dora	1020.0
Lake Harris	37.0
Lake Eustis	274.0
Lake Griffin	183.0
Lake Weir	11.0
Lake Santa Fe	13.5
Lake Newman	53.6
Lake Orange	43.0
Lake Lochloosa	35.6
Lake Altho	10.3
Lake Cooter	87.0
Lake Little Santa Fe	6.6
Lake Little Orange	12.7
Lake Tuscawilla	12.2
Lake Watermelon	5.3
Lake Wauberg	124.3
Lake Bivens Arm	77.5
Lake Burnt	54.4
Lake Elizabeth	0.58
Lake Hawthorn	55.5
Lake Hickory	7.52
Lake Jeggord	4.26
Lake Kanapaha	26.9
Lake Long	1.42
Lake Moss Lee	12.9
Lake Palatka	3.36
Lake Trout	10.5
Lake Clear	69.1
Lake Clearwater	0.33
Lake Meta	3.59
Lake Mize	7.46