THE PHYTOPLANKTON OF THE COOK PLANT MONTHLY MINIMAL SURVEYS DURING THE PREOPERATIONAL YEARS 1972, 1973, AND 1974

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ABSTRACT

The nine-station monthly minimal surveys (exclusive of reference stations) at Cook Plant in 1974 are reported and compared to similar surveys of 1972 and 1973. In 1974, 256 phytoplanktonic forms were taken in the nine-station grid and an additional 49 were collected at the reference stations. In 1974, 66 forms attained to an arbitrary "abundant" status, compared to 50 in 1973 and 32 in 1972. The increase in abundant forms is attributed to more forms being recognized to the species level, not to a progressive increase in the numbers of phytoplankton.

Inshore stations in front of the plant, where the thermal plume will be present most or all of the time, had a grand mean number of cells per ml of 1631 over the period 1972 through 1974. Postoperational numbers can be compared to this as a measure of plant effect.

In total numbers of forms collected, inshore and offshore stations have similar numbers of forms in April and May and again in late fall; fewer forms are taken in the intervening months. The summer and early fall reduction in numbers of forms is more pronounced in the offshore stations.

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INTRODUCTION

The Donald C. Cook Nuclear Plant became operational during the winter of 1974-75, making the monthly minimum (short) surveys of 1974 the last of the preoperational short surveys. Plant operation during 1975 has been intermittent and at different levels of power generation, but thermal plumes have been produced, and surveys in 1975 and following years must be and are classed as postoperational.

This report deals only with the monthly short surveys. It presents the results obtained in 1974 and compares them to results obtained in 1972 and 1973.

Because 1974 was the last preoperational year, every effort has been made to present the three years of preoperational phytoplankton results as completely as possible and to indicate by example several parameters by which it is envisioned that pre- and postoperational comparisons can be made.

Some of these parameters are unconventional and some may be only marginally defensible, but at this point in time it is considered that they represent aspects of the phytoplankton community in which changes could be detected when and if plant operation brings them into existence.

During the field season of 1974, phytoplankton were collected monthly at 8 or 9 sampling stations in the vicinity of the Cook Plant and at two reference stations, one 7 miles north and one 7 miles south of the plant. Spring, summer, and fall seasonal collections were made at 36 sampling stations in a grid ranging 7 miles south and 7 miles north as well as 7 miles offshore. The minimal monthly surveys were designed to give information on the temporal succession of species or groups (forms), while the large seasonal surveys were designed to provide seasonal spatial distribution information and to be massive enough to capture rare forms that might not be taken in the limited monthly surveys, but which might be of value in assessing whether new forms were being added to the population.

This paper addresses only the minimal monthly surveys; the large seasonal surveys will be reported separately.

METHODS

Figure 1 shows the collection stations used in the minimal monthly surveys during 1974. It was not possible to occupy all stations in all months of the field season, because on some sampling days heavy construction equipment was working on some of the station positions. Unexpectedly, station DC-0 was unsamplable in April and September because of the temporary (but real) presence of dredging barges anchoring there. Collections of phytoplankton were not made in November because bad weather (requiring staying in harbor) had exhausted the available time of the R/V MYSIS.

At all stations other than DC-0, collections were made by Niskin bottle at one meter of depth; at station DC-0 a liter brown polyethylene bottle was held by hand below the water surface until filled. All samples were of one-liter volume and preserved with Utermöhl's iodine solution with 25 ml of glacial acetic acid per liter added.

The samples from station collections of April through June of 1972 were counted and identified by the Utermöhl settling chamber and inverted microscope method.

In the laboratory, each sample was concentrated to 100 ml by settling in a 1000-ml graduate cylinder and siphoning off 900 ml of fluid. The concentrated sample was stored in a 100-ml opaque bottle.

Samples were prepared for counting by placing an aliquot of the concentrated sample in a tubular combination settling and counting chamber and allowing the aliquot to settle overnight. The counting chamber containing the settled cells was then separated from the settling chamber, covered, and placed on the microscope. The samples were counted on a binocular inverted microscope at 1000X magnification.

Solitary species, green and blue-green algae colonies, and the filaments of filamentous forms were each counted as one cell. Each colonial diatom cell was counted except when the size of the filaments or colonies prohibited counting the individual cells; in this case, the number of individual cells was estimated.

Beginning with July of 1972 (erroneously reported as 1973 in Seibel and Ayers 1974) and continuing since, the samples were prepared for examination by

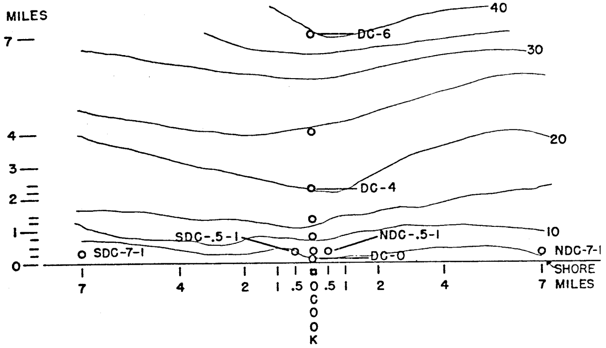

FIG. 1. The Cook Plant minimal survey grid used in months between seasonal surveys. The reference stations, SDC-7-1 and NDC-7-1, were not used in 1972 or 1973. Contours off shore are depths in meters.

using the Settle-Freeze method of Sanford, Sands, and Goldman (1969). After preliminary settling of the one-liter samples, 900 ml of the supernatant liquid was siphoned off, and the remaining 100 ml swirled to resuspend the settled material. Of the latter, 18 ml were placed in a settling chamber mechanically held to a microscope slide and settled for two days. The chamber was then very gently moved to set upon a block of dry ice until the bottom 2 or 3 ml of the liquid column were frozen. The supernatant was decanted. The chamber was then removed from the dry ice and allowed to thaw until it could be removed--leaving a wafer of ice and water on the slide. Dehydration was accomplished by placing the slide in a chamber of anhydrous alcohol vapor followed by a toluene vapor chamber. Cover glasses were attached with Permount.

In examination, a horizontal and a vertical row across the slide were counted and identified at 1000X under oil immersion on a Leitz Ortholux micro scope. Counting methodology was the same as with the Utermöhl technique.

RESULTS AND DISCUSSION

THE PHYTOPLANKTON COLLECTIONS OF 1974

In 1974 two reference (control) stations were added to the monthly minimal surveys. These were a north reference, NDC-7-1, and a south reference, SDC-7-1. Their functions are to provide species lists from inshore points seven miles north and south of the plant for comparison to the lists from inshore stations (NDC-.5-1, SDC-.5-1, DC-0, and DC-1) directly in front of the plant.

No reference stations were used in the monthly minimal surveys of 1972 or 1973; for comparability to those surveys, the master species list of 1974 is restricted to forms taken at the main group of stations directly in front of the plant. Collections from inshore stations at the plant are compared to species lists from the reference stations in Table 9.

The 1974 master list of 256 phytoplanktonic forms from the main group of stations is presented alphabetically in Table 1 and is annotated to indicate "abundant," "rare" and "riverine" (characteristic of rivers) forms. The break-point between "abundant" and "rare" has been arbitrarily set at a total of 100 cells accumulated from all the stations during the entire seven months of collections. This corresponds to a mean of 1587 cells per liter. No special defense of "abundant," as used here, is offered; it is solely a means of making year to year comparisons. Table 1 also gives the total numbers and months of occurrence of the rare forms (the right-hand column of Table 1 is not dates).

Species and groups (forms) are presented in the way in which they are recognized and counted. As examples: *Glenodinium*, a dinoflagellate, is recognized and counted separately from unidentified dinoflagellates which are given as "Dinoflagellates"; the flagellate *Cryptomonas* is recognized and counted separately from unidentified "Flagellates"; and *Anacystis* and *Chroococcus* are recognized as separate entities, rather than as species of *Anacystis*.

In the collections from the main group of stations during the minimal surveys in 1974 there were 66 forms which attained to the arbitrary "abundant" rating. These are presented by stations and months in Table 2. Comparable tables for the collections of 1972 and 1973 are given in Ayers and Seibel (1973, p. 35-40) and Seibel and Ayers (1974, p. 149-152).

TABLE 1. Master species list, 1974, indicating "Abundant," "Rare," and "riverine" by A, R, and r on the left.

	Species	Total monthly collections of rare forms at all stations (Month and cells, unless otherwise indicated)
R	*Achnanthes clevei*	Sep 2
R	*A. clevei* v. *rostrata*	Sep 3, Oct 4
R	*A. lanceolata*	May 9
R	*A. lanceolata* v. *dubia*	Oct 2
R	*A. linearis*	Aug 2
R	*A. minutissima*	May 2, Aug 2, Sep 2
R	*Achnanthes* spp.	Apr 2, May 2, Aug 2
R	*Amphipleura pellucida*	Apr 16, May 12, Jun 26, Jul 8, Aug 2, Oct 31
R	*Amphora neglecta*	Sep 2
R(r)	*A. ovalis*	Aug 2, Oct 6
R(r)	*A. ovalis* v. *constricta*	May, 4, Jun 6, Aug 4, Sep 2
R(r)	*A. ovalis* v. *gracilis*	Aug 2
R(r)	*A. ovalis* v. *libyca*	May 2, Aug 7, Oct 2
R(r)	*A. ovalis* v. *pediculus*	Apr 4, May 2, Jun 6, Jul 4, Aug 6, Oct 6
R	*A. rotunda*	Sep 2
R	*A. sibirica*	Oct 6
R(r)	*Amphora* spp.	Jun 2, Oct 21
A	*Anabaena flos-aquae* (chains or masses)	
A	*Anabaena flos-aquae* (resting cells)	
R	*Anabaena* sp.	Jul 4
A	*Anacystis incerta*	
A	*A. thermalis*	
A	*Anacystis* spp.	
R	*Ankistrodesmus braunii*	Apr 2, May 2, Sep 2
R	*A. falcatus*	May 12, Aug 9, Sep 1

TABLE 1 continued.

R	*A. gelifactum*	Apr 6, Jul 17, Sep 22, Oct 6
R	*Ankistrodesmus* sp. #1	Apr 4, May 35, Jun 12, Jul 4, Aug 21, Sep 5
R	*Ankistrodesmus* sp. #2	Aug 4
A	*Ankistrodesmus* sp. #3	
R	*Ankistrodesmus* sp. #4	Sep 3
R	*Ankistrodesmus* sp. #5	Jul 4
R	*Ankistrodesmus* spp.	Apr 2, May 4, Jun 4, Jul 4, Sep 15
R	*Ankyra* sp.	May 2
R	*Aphanocapsa* sp.	Sep 48
R	*Aphanothece* sp.	Sep 3
A	*Asterionella formosa*	
R	Blue-green filaments	Apr 2, Sep 1
R	*Bottryococcus braunii*	Oct 83
R	*Caloneis* sp.	Oct 2
R	*Ceratium hirundinella*	Jun 4, Aug 21, Sep 8
A	*Chroococcus prescottii*	
R	*Chroococcus* spp.	Apr 4, Jun 11, Jul 7
R	*Closteriopsis* sp.	Oct 2
R	Coccoid blue-greens	May 13
A	Coccoid greens	
R	*Cocconeis diminuta*	Oct 2
R	*C. placentula*	Jun 4
R	*C. placentula* v. *euglypta*	May 4
R	*Coelastrum microporum*	Oct 186 (see text)
R	*C. reticulatum*	Aug 30
R	*Coelosphaerium kuetzingianum*	Sep 84
R	*Coelosphaerium* spp. (colonies)	Apr 2, Jul 2, Aug 12
R	*Cosmarium* sp. #1	May 13, Jun 21, Jul 27, Sep 9, Oct 2
R	*Cosmarium* spp.	Apr 10, May 2, Jun 6, Aug 2
R	*Crucigenia apiculata*	Sep 7

TABLE 1 continued.

A	*C. quadrata*	
R	*C. rectangularis*	Sep 7
A	*C. tetrapedia*	
A	*Cryptomonas* spp.	
R	*Cyclotella atomus*	Aug 2
R	*C. comta*	Jul 10, Aug 3, Sep 5, Oct 28
R	*C. cryptica*	Apr 10, May 20, Jun 4, Jul 11, Aug 6, Sep 6, Oct 20
R	*C. kuetzingiana*	Jun 4, Aug 5 Sep 9
R	*C. kuetzingiana* v. *planetophora*	Sep 14
R	*C. kuetzingiana* v. *radiosa*	Aug 2, Sep 6
R(r)	*C. meneghiniana*	May 18, Jun 10, Jul 15, Aug 6, Oct 11
R(r)	*C. meneghiniana* v. *plana*	Jul 7
A	*C. michiganiana*	
A	*C. ocellata*	
R	*C. operculata*	May 4, Oct 2
R	*C. pseudostelligera*	Jul 1, Sep 9
A	*C. stelligera*	
R	*Cyclotella* sp. #5	Sep 1
A	*Cyclotella* spp.	
R	*Cymatopleura solea*	Apr 2
R	*C. solea* v. *apiculata*	Apr 2, May 6
R	*Cymbella amphicephala*	Jul 4
R	*C. obtusiuscula*	May 2
R	Cysts, unknown	Sep 7
R	*Dactylococcopsis fascicularis*	Jul 4
R	*Dactylococcopsis* spp.	Apr 67, May 8, Jun 8, Jul 1, Aug 3, Sep 4
R	*Desmidium schwartzii*	Jul 111 (see text)
R	*Diatoma tenue*	May 2, Jul 1
R	*D. tenue* v. *breve*	May 4
A	*D. tenue* v. *elongatum*	

TABLE 1 continued.

R	*D. vulgare*	May 2
R	*Dictyosphaerium* spp.	Jun 30, Oct 32
A	*Dinobryon divergens*	
A	*D. sociale*	
R	Dinoflagellates	May 6, Jun 11, Aug 22, Sep 50
R	*Diploneis boldtiana*	Oct 2
R	*D. oculata*	Jun 2
R	*D. parma*	Apr 2
A	Flagellates	
R	*Fragilaria brevistriata*	Oct 4
A	*F. capucina*	
R	*F. construens*	Sep 4, Oct 37
R	*F. construens* v. *minuta*	Sep 7, Oct 2
R	*F. construens* v. *pumila*	Jul 2, Oct 15
R	*F. construens* v. *venter*	Oct 15
A	*F. crotonensis*	
R	*F. crotonensis* v. *intermedia*	Jul 28
A	*F. intermedia*	
R	*F. intermedia* v. *fallax*	May 104, Oct 2 (see text)
R	*F. leptostauron*	Jun 2
R	*F. pinnata*	Oct 36
R	*F. pinnata* v. *lancettula*	Jul 1, Oct 11
R	*Fragilaria* spp.	Oct 10
A	*Glenodinium* spp.	
A	*Gloeocystis planctonica*	
A	*Gloeocystis* spp.	
R	*Gomphonema olivaceum*	Apr 2, May 2
R	*Gomphosphaeria aponina*	Jun 6
A	*G. lacustris*	
R	*G. wichure* (colonies)	Jul 2

TABLE 1 continued.

R	Green colonies, unidentifiable	Oct 87
R	Green filaments	Apr 8, May 4, Jun 13, Jul 34, Sep 2, Oct 6
R	*Gymnodinium* spp.	Jun 2, Aug 3
R	*Kirchneriella* spp.	May 2, Aug 2, Sep 7
R	*Mallomonas pseudocoronata*	Aug 5
R	*Marsoniella elegans*	Jul 45
R	*Melosira distans* v. *alpigena*	Jul 1, Aug 2, Sep 4
A(r)	*M. granulata*	
A(r)	*M. granulata* v. *angustissima*	
A	*M. islandica*	
A	*M. italica*	
R	*M. varians*	May 22
R	*Melosira* sp.	Oct 8
R	*Meridion circulare*	May 8
R	*Mougeotia* spp.	May 4, Jun 4, Jul 5
R	*Navicula bacillum*	Jun 2
R(r)	*N. capitata*	Apr 4, Oct 12
R(r)	*N. capitata* v. *luneburgensis*	Jun 9, Aug 4, Oct 2
R(r)	*N. costulata*	May 2
R	*N. cryptocephala*	May 4
R	*N. cryptocephala* v. *veneta*	May 4, Aug 2, Oct 2
R	*N. cuspidata*	Jul 2
R(r)	*N. decussis*	Apr 2, Jun 2, Aug 5, Oct 8
R	*N. exigua* v. *capitata*	Oct 4
R(r)	*N. gastrum*	Jun 2, Aug 2, Oct 2
R	*N. gregaria*	May 13, Jun 2, Oct 8
R	*N. hambergii*	Jun 7, Aug 2
R	*N. lanceolata*	Aug 4, Oct 2
R	*N. latens*	May 23, Jun 8, Jul 2, Aug 19, Oct 14
R	*N. menisculus*	Aug 2

TABLE 1 continued.

R	*N. menisculus* v. *obtusa*	Jun 2, Jul 2
R	*N. menisculus* v. *upsaliensis*	Aug 5, Sep 2, Oct 2
R	*N. micropupula*	Oct 2
R	*N. pupula*	Jun 4, Jul 2
R	*N. radiosa*	May 2
R	*N. radiosa* v. *tenella*	May 2
R	*N. rhynchocephala*	May 2, Oct 2
R	*N. tripunctata*	Apr 4, May 6, Jul 1
R	*N. viridula*	Oct 2
R	*Navicula* sp. #78	May 4
R(r)	*Navicula* spp.	May 4, Sep 2, Oct 48
R	*Nephrocytium agardhianum*	Jul 37
R	*Nephrocytium* sp.	Sep 3
A(r)	*Nitzschia acicularis*	
R	*N. acuta*	Apr 2, May 17, Jun 2, Oct 4
R	*N. angustata*	Oct 2
A	*N. bacata*	
R	*N. capitellata*	Sep 2
A	*N. confinis*	
R	*N. denticulata*	May 4
A	*N. dissipata*	
R	*N. fonticola*	Apr 2, May 4, Sep 2, Oct 79
R	*N. fonticola* v. *pelagica*	Oct 2
R	*N. frustulum*	Oct 15
R	*N. holsatica*	Apr 6
A	*N. kuetzingiana*	
R	*N. palea*	Apr 2, Jun 11, Jul 25, Sep 3, Oct 53
R	*N. paleacea*	Jun 4, Jul 2, Oct 2
R	*N. recta*	Apr 2, May 2, Jun 2
R	*N. sigma*	May 4

TABLE 1 continued.

R	*N. spiculoides*	May 17, Jun 35, Jul 6
R	*Nitzschia* sp. #1	Apr 6, May 2, Jun 2, Jul 2, Oct 46
A	*Nitzschia* sp. #2	
R	*Nitzschia* sp. #7	Oct 2
R	*Nitzschia* sp. #8	Oct 10
R	*Nitzschia* sp. #9	Oct 47
R	*Nitzschia* sp. #10	Jul 2, Aug 2, Oct 29
R	*Nitzschia* sp. #18	Apr 2
A(r)	*Nitzschia* spp.	
R	*Oestrupia zachariasi*	Oct 2
A	*Oocystis* spp.	
R	*Oscillatoria limnetica*	Aug 15, Sep 2, Oct 6
R	*O. retzii*	Oct 2
A	*Oscillatoria* spp.	
R	*Pandorina morum*	Jul 74, Sep 20
R	*Pediastrum boryanum*	Oct 2
R	*P. duplex* v. *reticulatum*	Jul 2, Aug 37
R	*P. sculptalum* (colonies)	Jul 2
R	*Pediastrum* sp. (colonies)	Jul 1
A	*Peridinium* spp.	
R	*Pinnularia* sp.	Jun 2
A	*Rhizosolenia eriensis*	
A	*R. gracilis*	
R	*Rhoicosphenia curvata*	May 2, Oct 2
R	*Scenedesmus acutiformis*	Oct 7
A	*S. bicellularis*	
R	*S. dimorphus*	May 15, Aug 37, Sep 20, Oct 20
R	*S. falcatus*	May 7, Jun 7, Jul 15, Aug 40, Sep 7
A	*S. quadricauda*	
R	*S. quadricauda* v. *longispina*	May 4, Jul 38, Sep 7, Oct 18

TABLE 1 continued.

A	*S. tetradesmiformis*	
R	*S. wisconsinensis*	Jul 7
A	*Scenedesmus* spp.	
R	*Schroederia judayi*	Jul 1
A	*Sphaerocystis schroeteri*	
R	*Sphaerocystis* sp.	Jun 2
R	*Spirogyra* sp.	Sep 1
R	*Spongomonas uvella*	Jun 1937 (see text)
A	*Stephanodiscus alpinus*	
R	*S. astraea*	Apr 2
A	*S. binderanus*	
A	*S. hantzschii*	
A	*S. minutus*	
R	*S. niagarae*	Apr 4, May 43, Jun 2, Jul 4
A	*S. subtilis*	
A	*S. tenuis*	
A	*S. transilvanicus*	
R	*Stephanodiscus* sp. #5	Apr 2
R	*Stephanodiscus* sp. auxospores	Jul 2, Oct 4
A	*Stephanodiscus* spp.	
R	*Surirella angusta*	Apr 4, May 23, Jun 2, Jul 8, Oct 20
R	*S. angusta* v. *apiculata*	Apr 6
R	*S. ovata*	Apr 2, May 7, Oct 2
R	*Surirella* sp. #4	Oct 2
R	*Synedra acus*	Apr 2, May 9, Jun 28, Jul 11, Oct 4
R	*S. amphicephala*	May 4
R	*S. delicatissima*	Aug 6
A	*S. delicatissima* v. *angustissima*	
R	*S. demerarae*	Apr 4, May 15, Jun 34, Jul 2, Oct 13
A	*S. filiformis*	

TABLE 1 continued.

R	*S. minuscula*	Jul 2
R	*S. montana*	Jul 3
A	*S. ostenfeldii*	
R	*S. rumpens*	Aug 2
A	*S. tenera*	
R(r)	*S. ulna*	Apr 2, May 4, Jun 4, Jul 6, Oct 2
A(r)	*S. ulna* v. *chaseana*	
R	*S. vaucheriae*	Jun 2
R	*Synedra* sp. #8	Aug 2
R	*Synedra* sp. #17	Sep 4
A	*Synedra* spp.	
A	*Tabellaria fenestrata*	
A	*T. fenestrata* v. *intermedia*	
R	*T. flocculosa*	May 2, Jun 2, Jul 7, Sep 2
R	*Tetraedron caudatum* v. *longispinum*	Jul 13
R	*T. minimum*	Jul 1, Sep 12
R	*T. pentaedricum*	Jul 2
R	*T. trigonum* v. *setigerum*	Jul 15
A	*Thalassiosira pseudonana*	
A	*Ulothrix* spp.	
R	*Uroglenopsis americana*	Sep 67

TABLE 2. The 66 abundant phytoplankton forms in the 1974 Cook Plant collections, by stations and months. Dashes indicate that collections were not made. Number of cells/ml except where otherwise specified.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Anabaena flos-aquae (chains or masses/ml)									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	2	0	2	1	2	4	4
Aug	6	9	24	4	0	6	2	28	17
Sep	0	2	--	0	0	0	0	4	6
Oct	0	0	0	0	0	0	0	0	0
Anabaena flos-aquae (resting cells/ml)									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	22	134	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0
Anacystis incerta									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	2	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	26	109	0	213	0	0	0	122	50
Anacystis thermalis									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	4	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	96	124	82	143	187	109	100	50	67
Anacystis spp. (unidentified)									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	705	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	26	0	0	0	0	0	0	45	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Ankistrodesmus sp. #3									
Apr	0	0	--	0	4	4	0	0	0
May	0	7	0	0	0	0	0	2	2
Jun	0	0	0	0	2	0	0	0	0
Jul	0	0	0	0	0	0	2	0	0
Aug	9	22	0	4	6	2	4	4	7
Sep	4	0	--	0	0	2	0	0	0
Oct	0	2	0	6	7	0	4	0	2
Asterionella formosa									
Apr	69	126	--	160	109	260	122	70	32
May	26	4	59	13	0	26	19	15	19
Jun	19	32	100	67	32	13	37	20	39
Jul	352	180	91	74	32	30	50	56	52
Aug	74	13	13	15	4	9	7	7	0
Sep	17	6	--	7	41	19	9	7	0
Oct	19	126	41	50	70	6	48	7	50
Chroococcus prescottii									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	139	184	45	45	50	30	119	100	75
Sep	96	173	--	137	67	78	41	46	135
Oct	0	0	0	0	0	0	0	0	0
Coccoid green algae									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	15	37	0	0	0	11
Jun	9	43	41	24	2	0	0	6	2
Jul	0	0	7	0	9	11	59	0	0
Aug	19	41	20	37	41	33	26	27	29
Sep	45	46	--	30	48	57	45	66	37
Oct	7	0	20	76	26	0	0	22	0
Crucigenia quadrata									
Apr	0	0	--	0	0	0	30	0	0
May	0	0	0	0	0	0	0	0	7
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	59	19	0	0
Aug	7	22	2	148	52	15	37	7	0
Sep	7	30	--	37	15	0	4	0	0
Oct	0	0	0	63	0	7	15	0	19

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Crucigenia tetrapedia									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	30	30	7	0	22	15	7	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0
Cryptomonas spp. (unidentified)									
Apr	9	37	--	9	9	39	6	17	24
May	59	11	74	26	20	19	6	7	6
Jun	7	4	48	9	0	0	7	2	9
Jul	0	0	2	41	8	5	24	0	4
Aug	0	9	0	6	6	11	11	0	5
Sep	19	9	--	15	37	7	6	14	30
Oct	19	45	37	61	33	33	19	32	11
Cyclotella michiganiana									
Apr	0	6	--	0	2	4	0	2	4
May	0	0	0	2	2	0	2	0	0
Jun	0	4	0	2	0	0	4	4	0
Jul	7	22	0	2	0	0	0	6	15
Aug	15	6	15	7	6	7	2	5	5
Sep	9	4	--	7	11	12	6	6	7
Oct	6	24	20	32	20	28	13	26	13
Cyclotella ocellata									
Apr	2	6	--	4	4	13	6	7	4
May	11	2	4	2	2	6	0	7	2
Jun	4	15	26	9	4	17	37	9	50
Jul	45	26	17	20	8	8	13	54	41
Aug	2	0	4	2	0	6	2	0	0
Sep	4	0	--	0	0	4	8	4	1
Oct	11	43	11	7	15	7	7	19	17
Cyclotella stelligera									
Apr	4	32	--	0	4	6	22	32	11
May	7	0	11	6	0	6	7	28	7
Jun	32	30	22	41	95	83	156	76	82
Jul	50	19	28	48	10	6	19	19	82
Aug	15	0	13	26	4	7	4	18	2
Sep	32	9	--	28	78	37	23	30	6
Oct	0	7	0	2	13	0	0	9	6

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Cyclotella spp. (unidentified)									
Apr	9	20	--	0	9	19	11	17	2
May	33	2	22	13	7	2	7	7	4
Jun	0	0	7	26	6	2	0	0	0
Jul	33	43	6	0	1	1	2	24	19
Aug	0	0	0	0	0	2	0	0	0
Sep	2	4	--	6	4	0	0	0	0
Oct	4	0	4	2	6	2	4	7	2
Diatoma tenue v. *elongatum*									
Apr	32	32	--	4	56	61	35	15	2
May	15	7	26	9	4	13	4	6	0
Jun	43	43	100	56	41	15	22	6	4
Jul	15	17	13	13	5	1	9	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	2	0	0	0	0
Dinobryon divergens									
Apr	0	2	--	0	0	0	0	9	0
May	4	0	0	0	0	0	2	11	4
Jun	48	45	200	22	46	17	28	65	63
Jul	0	0	32	6	7	3	11	19	30
Aug	148	143	111	124	109	50	85	6	6
Sep	6	4	--	11	15	1	3	1	1
Oct	0	0	0	0	0	0	0	0	0
Dinobryon sociale									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	2
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	2	0	4	0	0	0	4	0	0
Sep	52	115	--	93	148	40	71	40	10
Oct	0	0	0	0	0	0	0	0	0
Flagellates (unidentified)									
Apr	352	629	--	310	245	631	306	176	41
May	319	96	393	217	115	171	26	89	80
Jun	59	26	160	59	74	20	72	43	117
Jul	63	26	130	371	207	125	210	0	349
Aug	169	113	35	119	102	158	83	81	107
Sep	83	80	--	85	297	60	90	90	157
Oct	247	276	195	223	228	256	230	382	315

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Fragilaria capucina									
Apr	0	0	--	0	0	20	0	0	0
May	0	30	275	0	2	0	0	0	0
Jun	0	26	89	72	0	0	0	0	0
Jul	0	0	46	69	1	0	0	0	0
Aug	4	0	6	4	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	111	163	4	0	2	2	4	0	0
Fragilaria crotonensis									
Apr	108	301	--	367	165	364	226	4	33
May	416	102	456	173	0	52	46	13	95
Jun	45	224	456	147	173	61	33	22	96
Jul	529	441	293	341	59	201	221	267	467
Aug	141	30	15	48	0	11	0	0	0
Sep	108	106	--	30	137	10	15	21	11
Oct	108	58	122	232	7	11	147	6	33
Fragilaria intermedia									
Apr	24	39	--	11	24	0	7	4	61
May	30	0	0	30	2	0	0	17	0
Jun	0	4	0	20	0	0	2	0	0
Jul	15	15	0	0	0	20	7	0	0
Aug	0	7	6	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0
Glenodinium spp. (unidentified)									
Apr	0	0	--	0	2	0	9	2	0
May	4	0	4	4	2	0	2	0	0
Jun	0	0	7	4	15	2	0	0	0
Jul	0	0	2	0	0	0	2	0	11
Aug	0	13	4	0	9	0	2	1	3
Sep	13	4	--	7	22	6	1	1	6
Oct	0	0	0	0	0	0	0	0	0
Gloeocystis planctonica									
Apr	15	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	167	24	0	0	0	0	0
Jul	0	0	0	0	0	0	80	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	83	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Gloeocystis spp. (unidentified)									
Apr	7	6	--	96	52	360	56	4	9
May	70	95	63	13	19	19	9	9	9
Jun	19	13	0	0	7	2	9	4	6
Jul	0	0	9	7	6	4	7	0	4
Aug	403	364	178	169	221	147	360	97	7
Sep	72	82	--	30	282	6	19	33	19
Oct	0	0	26	0	0	0	0	0	0
Gomphosphaeria lacustris									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	306	158	0	575	473	714	0	408	394
Sep	557	909	--	130	200	167	186	99	76
Oct	436	436	278	0	29	612	807	714	853
Melosira granulata									
Apr	0	0	--	0	0	9	0	0	0
May	82	37	297	43	15	0	0	0	0
Jun	13	13	15	7	6	0	6	4	0
Jul	48	15	15	7	11	6	6	74	48
Aug	6	6	9	13	26	7	20	0	2
Sep	0	0	--	0	0	0	0	0	0
Oct	43	22	100	52	13	24	33	35	0
Melosira granulata v. *angustissima*									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	85	0	0	0	0	0	0
Jun	4	0	15	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	4	0	2	0	0	0	13	0	0
Sep	0	2	--	0	0	0	0	0	0
Oct	9	20	91	72	20	7	13	0	0
Melosira islandica									
Apr	19	9	--	80	48	113	76	52	37
May	30	7	82	9	7	0	4	37	30
Jun	0	2	0	4	0	0	0	0	2
Jul	41	72	0	26	2	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	2	2	4	0	2	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Melosira italica									
Apr	19	45	--	26	0	87	22	109	100
May	37	7	89	33	4	24	33	58	28
Jun	7	15	7	7	9	7	6	2	17
Jul	41	91	26	19	3	0	0	0	0
Aug	0	0	0	0	0	0	0	0	2
Sep	0	0	--	0	0	0	0	0	0
Oct	4	15	7	33	11	13	17	4	0
Nitzschia acicularis									
Apr	7	15	--	2	2	6	4	2	4
May	4	4	26	4	2	9	2	11	2
Jun	7	19	30	13	4	6	2	0	0
Jul	22	6	17	19	1	1	0	0	4
Aug	0	0	2	0	2	0	2	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	4	7	4	17	17	11	7	6	0
Nitzschia bacata									
Apr	11	6	--	0	13	22	13	13	17
May	19	2	4	6	0	0	0	4	4
Jun	4	7	0	6	0	2	0	0	0
Jul	2	0	4	2	1	0	0	0	0
Aug	2	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	6	2	2	2	2	6	0	15	0
Nitzschia confinis									
Apr	0	4	--	0	0	7	0	9	0
May	26	2	37	22	4	4	11	4	4
Jun	2	9	15	4	2	0	2	0	0
Jul	6	4	4	2	1	0	0	2	0
Aug	0	0	0	0	0	0	2	0	0
Sep	0	0	--	0	4	0	0	1	0
Oct	19	6	17	9	2	6	13	6	0
Nitzschia dissipata									
Apr	2	7	--	0	0	2	2	9	15
May	11	0	7	0	0	0	0	0	4
Jun	0	2	7	6	0	0	0	0	2
Jul	4	4	0	4	0	0	0	4	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	2	0	0	0	0	0
Oct	0	6	2	0	2	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Nitzschia kuetzingiana									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	4	0	0	0	0	0	0
Jun	0	2	0	7	0	0	0	0	0
Jul	2	0	0	4	0	0	0	2	4
Aug	2	2	4	0	2	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	7	9	13	22	20	11	7	6	4
Nitzschia sp. #2									
Apr	11	15	--	19	15	19	20	20	6
May	19	2	26	17	0	0	2	2	0
Jun	0	2	0	2	0	0	0	2	0
Jul	7	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	2	6	0	2	0	0	2
Nitzschia spp. (unidentified)									
Apr	2	2	--	13	6	7	15	13	2
May	0	0	4	0	0	0	2	4	4
Jun	0	13	7	11	6	0	2	2	2
Jul	0	2	2	0	1	1	0	9	0
Aug	0	0	0	0	0	0	0	0	1
Sep	0	2	--	0	0	0	0	0	0
Oct	6	13	13	7	6	9	9	7	2
Oocystis spp. (unidentified)									
Apr	7	0	--	4	6	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	2	0
Jul	0	0	0	0	0	0	0	0	15
Aug	87	58	0	0	0	7	100	13	2
Sep	59	37	--	48	26	7	15	16	11
Oct	0	0	26	0	0	0	0	0	0
Oscillatoria spp. (unidentified)									
Apr	13	22	--	33	13	17	26	7	4
May	85	43	119	39	35	41	11	30	9
Jun	4	20	19	35	17	17	11	24	13
Jul	0	2	6	7	0	1	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	2	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Peridinium spp. (unidentified)									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	2	0	4	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	15
Aug	11	9	26	11	2	6	9	2	3
Sep	4	0	--	2	0	3	4	1	1
Oct	0	0	0	0	0	0	0	0	0
Rhizosolenia eriensis									
Apr	0	2	--	2	0	0	2	11	6
May	4	0	4	0	0	2	2	4	7
Jun	13	13	22	22	45	35	65	33	9
Jul	15	6	15	17	1	1	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	2	0	2	0	0	0	0	0	0
Rhizosolenia gracilis									
Apr	0	4	--	0	2	2	6	22	4
May	7	6	15	4	0	15	30	46	67
Jun	19	32	45	24	54	45	117	98	82
Jul	41	30	50	43	11	17	2	2	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	2	--	2	4	0	0	1	0
Oct	0	0	0	0	0	2	0	2	2
Scenedesmus bicellularis									
Apr	0	0	--	0	0	4	0	4	0
May	0	4	0	4	0	0	4	24	13
Jun	4	15	0	0	19	4	4	7	0
Jul	0	0	15	15	13	4	0	0	45
Aug	11	4	4	0	4	7	0	2	0
Sep	0	7	--	4	0	0	2	0	0
Oct	0	4	4	7	4	4	11	4	0
Scenedesmus quadricauda									
Apr	0	2	--	0	0	7	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	7	0	0	22	0	0	0	0	0
Jul	0	0	0	7	2	4	7	0	0
Aug	26	7	7	7	7	0	0	0	4
Sep	0	7	--	7	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Scenedesmus tetradesmiformis									
Apr	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0
Oct	0	35	19	22	0	0	7	28	15
Scenedesmus spp. (unidentified)									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	15	0	0	0	0	0	0
Jul	0	0	7	0	0	6	0	0	0
Aug	7	0	7	15	15	7	0	44	2
Sep	0	0	--	4	0	0	0	3	0
Oct	0	7	41	26	22	15	7	0	0
Sphaerocystis schroeteri									
Apr	0	0	--	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	82	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	148
Aug	0	0	0	0	15	0	0	0	0
Sep	19	0	--	15	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0
Stephanodiscus alpinus									
Apr	0	2	--	6	11	9	11	6	2
May	11	2	70	13	4	11	4	0	2
Jun	22	20	93	24	15	2	2	2	2
Jul	85	59	20	17	5	1	2	6	0
Aug	6	6	2	2	2	0	0	1	0
Sep	0	2	--	2	0	0	0	0	0
Oct	13	30	35	46	24	7	13	52	15
Stephanodiscus binderanus									
Apr	17	59	--	184	61	24	30	9	0
May	122	13	579	33	7	4	0	0	0
Jun	0	4	15	0	15	0	0	6	0
Jul	0	0	0	0	0	0	0	2	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Stephanodiscus hantzschii									
Apr	0	4	--	0	7	0	7	0	2
May	4	0	0	0	2	0	0	0	2
Jun	0	0	7	0	19	0	0	0	0
Jul	0	0	2	0	0	0	0	0	0
Aug	2	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	11	19	9	20	11	9	13	0	0
Stephanodiscus minutus									
Apr	9	82	--	30	32	141	87	115	22
May	122	35	200	69	26	32	28	63	32
Jun	67	61	111	52	87	28	19	0	17
Jul	191	7	13	95	21	2	11	147	96
Aug	4	9	2	0	4	0	2	0	0
Sep	6	2	--	7	15	1	1	1	0
Oct	50	109	54	80	58	26	20	61	43
Stephanodiscus subtilis									
Apr	0	2	--	2	0	0	0	4	0
May	0	0	41	9	4	0	0	0	0
Jun	2	6	0	9	2	0	0	0	0
Jul	58	7	2	2	1	0	7	72	22
Aug	0	0	2	0	0	0	0	0	0
Sep	4	4	--	4	7	1	1	2	0
Oct	24	56	48	54	39	26	30	52	17
Stephanodiscus tenuis									
Apr	50	132	--	11	33	191	52	30	11
May	134	43	486	72	9	17	7	6	7
Jun	28	22	33	20	9	9	2	0	2
Jul	72	33	26	20	9	19	67	304	282
Aug	11	7	0	2	6	0	2	3	1
Sep	0	0	--	0	0	0	0	0	0
Oct	15	46	70	32	26	7	17	17	9
Stephanodiscus transilvanicus									
Apr	6	20	--	0	2	22	19	13	6
May	4	4	56	0	0	2	2	6	0
Jun	0	0	0	0	0	0	0	0	2
Jul	2	2	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Stephanodiscus spp. (unidentified)									
Apr	13	65	--	15	37	32	30	17	9
May	52	19	67	41	15	13	11	11	28
Jun	17	9	30	11	17	2	4	2	4
Jul	9	22	28	9	1	0	2	0	22
Aug	2	0	0	0	0	0	0	0	0
Sep	0	0	--	6	7	0	0	1	0
Oct	2	2	13	15	17	19	11	6	0
Synedra delicatissima v. *angustissima*									
Apr	9	4	--	0	2	6	4	7	7
May	7	0	15	7	2	4	4	2	7
Jun	4	6	7	9	4	0	0	4	7
Jul	6	4	2	2	0	1	2	0	4
Aug	0	0	2	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	6	0	0	0	2	0	0	0
Synedra filiformis									
Apr	26	30	--	11	30	48	35	132	106
May	119	30	241	89	19	50	96	271	135
Jun	98	11	148	115	147	117	326	206	230
Jul	76	98	41	37	5	0	22	4	11
Aug	2	0	2	2	0	2	2	0	0
Sep	0	2	--	0	7	0	1	1	0
Oct	13	13	11	17	28	7	4	9	0
Synedra ostenfeldii									
Apr	6	11	--	9	7	11	19	13	9
May	7	2	0	2	0	2	2	6	0
Jun	2	2	4	2	0	4	0	4	22
Jul	7	2	0	6	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	6	0	0	0	0
Synedra tenera									
Apr	11	19	--	15	7	22	11	17	6
May	4	6	0	2	6	0	4	20	13
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	2	4	0	1	0	0
Oct	0	0	0	0	0	0	0	0	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Synedra ulna v. *chaseana*									
Apr	2	2	--	6	2	7	0	15	20
May	0	0	15	4	0	2	2	0	6
Jun	4	6	11	0	11	4	9	0	6
Jul	28	24	9	11	1	0	0	0	4
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	2	0	0	0	0
Synedra spp. (unidentified)									
Apr	2	13	--	17	11	6	2	0	6
May	30	2	15	9	4	9	9	11	4
Jun	6	7	0	7	6	2	0	4	6
Jul	0	0	0	4	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	2	0	0	0	4	0	0	0
Tabellaria fenestrata									
Apr	0	0	--	46	56	0	41	0	0
May	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	20	0	2	2	0	2	0	0
Tabellaria fenestrata v. *intermedia*									
Apr	32	43	--	0	0	76	0	22	52
May	22	0	26	7	4	11	4	30	11
Jun	9	11	41	15	26	4	0	6	19
Jul	208	256	126	167	19	32	33	4	11
Aug	0	0	4	0	0	0	0	0	0
Sep	7	4	--	0	4	0	1	1	0
Oct	24	11	45	13	9	13	13	37	9
Thalassiosira pseudonana									
Apr	0	0	--	0	0	0	0	6	2
May	89	0	33	4	19	19	0	0	0
Jun	9	69	37	33	58	19	7	7	2
Jul	43	0	6	43	26	4	20	130	378
Aug	6	0	2	2	0	0	2	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	4	4	0	4	13	6	6	9	0

TABLE 2 continued.

	NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Ulothrix spp. (unidentified)									
Apr	0	0	--	0	0	2	0	0	0
May	4	0	15	4	0	0	0	2	2
Jun	2	6	22	0	0	0	0	0	0
Jul	67	74	11	13	6	1	2	11	0
Aug	0	0	0	0	0	0	0	0	0
Sep	0	0	--	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0

Four species, *Coelastrum microporum, Desmidium schwartzii, Fragilaria intermedia* v. *fallax,* and *Spongomonas uvella,* were not included in the "abundant" tabulation because they exceeded 100 cells once in one collection and were not present in any other samples.

One species, *Rhizosolenia gracilis,* was abundant in 1974 and 1972 but not in 1973.

Twenty-three species or forms were abundant in the 1974 collections that had not been abundant in either 1973 or 1972. These were:

Anaebena flos-aquae
Anacystis incerta
Anacystis thermalis
Ankistrodesmus sp. #3
Chroococcus prescottii
Crucigenia quadrata
Crucigenia tetrapedia
Dinobryon sociale
Gomphosphaeria lacustris
Nitzschia acicularis
Nitzschia bacata
Nitzschia confinis
Nitzschia dissipata
Nitzschia kuetzingiana
Nitzschia sp. #2
Scenedesmus tetradesmiformis
Sphaerocystis schroeteri
Stephanodiscus transilvanicus
Synedra tenera
Synedra ulna v. *chaseana*
Tabellaria fenestrata v. *intermedia*
Thalassiosira pseudonana
Ulothrix spp.

The 66 abundant forms in 1974, compared to 50 so ranked in 1973 and 32 in 1972, might be evidence of a progressive increase of the phytoplankton population in the vicinity of the Cook Plant. This possibility is investigated in the following section.

PHYTOPLANKTON ABUNDANCES 1972 THROUGH 1974

The nine sampling stations of the monthly minimal surveys provide a means of assessing whether there has been increase of the phytoplankton population. The cells per ml data initially were condensed spatially by averaging the data from all nine stations for each month. Inspection of the results, however, suggested that in many of the surveys the counts were higher at stations near the shore, accordingly the nine short-survey stations have been separated into an inshore and an offshore group. The inshore group includes the stations situated at a half mile or less from the shore; these are stations DC-0, DC-1, NDC-.5-1, and SDC-.5-1. The offshore group (DC-2, DC-3, DC-4, DC-5, and DC-6) are all located at more than a half mile from shore. The choice of a half mile as the critical distance follows an inflection point in zooplankton numbers there and appears to give reasonably homogeneous groups.

Means and standard errors have been computed using the above groups. The results are given in Table 3 and are plotted in Figure 2. In most of the months studied the mean abundance was lower in the offshore stations; aside from this the abundance data seem to be essentially random. No repeating typical seasonal pattern is evident.

In July 1972 the Utermöhl method of phytoplankton analysis was replaced with the Settle-Freeze method of Sanford, Sands, and Goldman (1969) (see Ayers and Seibel 1973 for a discussion of the reasons). Because of the method change the abundance data of 1972 have not been subjected to statistical testing. The data for 1973 are counts by two different analysts of greatly different experience and have not been tested. The 1974 abundance data are all the work of one analyst and have been considered strong enough for testing. Application of the Student's-t test to the 1974 data shows the inshore-offshore abundance differences to be insignificant.

The grand mean of the abundance data from the inshore stations for all months for 1972 through 1974 is 1631 cells per ml. This can be a preoperational reference value to which postoperational data can be compared.

There is no clearly defined progressive increase in the abundance of phytoplankton in the Cook Plant region over the years 1972 through 1974. At present it is not possible to give a clear-cut reason for the increase in numbers of "abundant" forms, other than increased skill of the analysts. In

TABLE 3. Phytoplankton of the Cook Plant minimal survey stations 1972 through 1974. The inshore stations (I) are NDC-.5-1, SDC-.5-1, DC-0, and DC-1; offshore stations (0) are DC-2 through DC-6.

Month	Station group	Number of observations	Mean number of cells per ml	Standard error	Student's *t*
			1972		
Apr	I	3	1,041	61	
	0	5	720	156	
May	I	4	1,320	295	
	0	5	878	153	
Jun	I	4	2,037	909	
	0	5	643	51	
Jul	I	3	177	13	
	0	5	191	48	
Aug	I	3	447	64	
	0	5	691	258	
Sep	I	3	386	50	
	0	5	515	67	
Oct	I	2	1,560	373	
	0	5	1,137	274	
Nov	I	3	1,738	562	
	0	5	718	235	
			1973		
Apr	I	2	1,178	83	
	0	5	1,237	201	
May	I	3	1,394	304	
	0	5	978	220	
Jun	I	3	1,561	87	
	0	5	1,586	203	
Jul	I	2	3,785	288	
	0	5	1,309	836	
Aug	I	3	3,164	1,537	
	0	5	1,402	214	
Sep	I	3	2,666	1,368	
	0	5	1,170	106	
Oct	I	2	1,910	462	
	0	5	1,002	273	

TABLE 3 continued.

Month	Station group	Number of observations	Mean number of cells per ml	Standard error	Student's *t*
			1974		
Apr	I	3	1,440	279	
	0	5	1,399	349	0.08 n.s.[1]
May	I	4	2,069	823	
	0	5	608	86	2.00 n.s.
Jun	I	4	1,763	856	
	0	5	862	107	1.18 n.s.
Jul	I	4	1,664	212	
	0	5	1,192	373	1.02 n.s.
Aug	I	4	1,500	260	
	0	5	1,015	118	1.83 n.s.
Sep	I	3	1,292	249	
	0	5	786	188	1.63 n.s.
Oct	I	4	1,791	177	
	0	5	1,602	87	1.02 n.s.

[1]n.s.: not significant ($p > .05$). The null hypothesis was that the population means in the inshore and offshore regions were equal.

this connection it is noted that the numbers of unidentified "sp." and "spp." categories decreased from 48 in 1973 to 38 in 1974.

NUMBERS OF PHYTOPLANKTON FORMS, 1972 THROUGH 1974

Table 4 gives by station and month the total numbers of cells per ml, the total numbers of forms recognized, and the mean numbers of cells per form in the short survey collections at Cook Plant during 1974. Similar tables for the collections of 1972 and 1973 are given in Ayers and Seibel (1973, p. 42-43) and Seibel and Ayers (1974, p. 171).

Inspection of the table suggests that there may be a seasonal pattern in the numbers of forms: the numbers of forms at inshore and offshore stations being similar in April and October but with numbers of forms offshore being

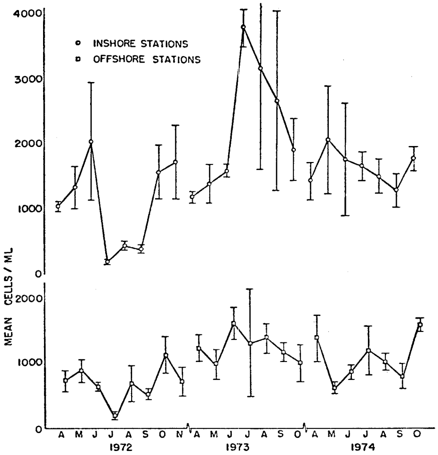

FIG. 2. Mean numbers of cells per ml and standard errors of phytoplankton collections at stations of the Cook Plant minimal survey grid, 1972 through 1974.

generally lower than inshore during the intervening months.

To ascertain whether the suggested seasonal (or bi-seasonal) differences between inshore and offshore numbers of forms were present in other years, Table 5 was constructed. It presents the monthly mean numbers of forms at inshore and offshore stations in 1972, 1973, and 1974; in addition it gives the 3-year grand mean of form numbers.

On the basis of the present three years of monthly data, the grand means indicate similar numbers of forms at inshore and offshore stations in April and May and again in the fall (though the latter is based on a single set of November data). Substantially fewer forms have been collected at offshore stations in the period June through October.

TABLE 4. Total numbers of cells/ml, total numbers of forms collected, and mean numbers of cells per form, 1974.

		Inshore stations				Offshore stations				
		NDC-.5-1	SDC-.5-1	DC-0	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Apr	Total cells/ml	924	1882	--	1514	1104	2723	1412	1056	700
	No. forms	37	47	--	37	43	49	42	45	42
	Cells/form	25	40	--	41	26	56	34	23	17
May	Total cells/ml	2123	655	4365	1135	450	611	412	893	675
	No. forms	46	40	70	57	46	39	36	41	37
	Cells/form	46	16	62	20	10	16	11	22	18
Jun	Total cells/ml	667	967	4314	1102	1110	543	1033	686	937
	No. forms	46	59	56	52	44	29	35	34	36
	Cells/form	15	16	77	21	25	19	30	20	26
Jul	Total cells/ml	2207	1646	1173	1629	528	592	975	1283	2582
	No. forms	39	40	49	51	47	38	41	31	44
	Cells/form	57	41	24	32	11	16	24	41	59
Aug	Total cells/ml	1742	2023	813	1420	1247	1325	937	869	696
	No. forms	51	37	54	33	32	33	36	24	32
	Cells/form	34	55	15	43	39	40	26	36	22
Sep	Total cells/ml	1261	1739	--	876	1524	547	583	535	739
	No. forms	34	48	--	42	31	30	34	34	25
	Cells/form	37	36	--	21	49	18	17	16	30
Oct	Total cells/ml	1488	2282	1582	1811	1451	1384	1747	1848	1580
	No. forms	56	62	61	63	59	50	51	46	31
	Cells/form	27	37	26	29	25	28	34	40	51

TABLE 5. Monthly mean numbers of forms taken at inshore and offshore stations in 1972 through 1974, also the monthly 3-year grand means of numbers of forms.

	Inshore stations	Offshore stations	Inshore stations	Offshore stations
	1972		1973	
Apr	28.7	34.4	47.5	46.8
May	26.0	27.8	45.3	47.8
Jun	27.0	26.6	35.7	33.4
Jul	20.7	24.4	52.5	31.2
Aug	30.0	29.2	44.0	40.8
Sep	33.0	23.0	54.3	44.6
Oct	44.5	37.8	57.0	49.2
Nov	40.3	38.4		
	1974		3-year grand means	
Apr	40.3	44.2	38.8	41.8
May	53.3	39.8	41.5	38.5
Jun	53.3	35.6	38.7	31.9
Jul	44.8	40.2	39.3	31.9
Aug	43.8	31.4	39.3	33.8
Sep	41.3	30.8	42.9	32.8
Oct	60.5	47.4	54.0	44.8
Nov			40.3	38.4

DOMINANT FORMS

From Table 2 the most numerous species or group each month was selected as being dominant. The summed monthly numbers of cells/ml of the dominant form were divided by the total monthly number of cells/ml from Table 4 to obtain the percentage of the total population which the monthly dominant form comprised. Table 6 gives the results. Dominance tables for 1972 and 1973 are given in Ayers and Seibel (1973, p. 41) and Seibel and Ayers (1974, p. 172).

The dominance of flagellates in April and May is in large part an artifact due to the category being a composite one containing several species which were counted together. If identification to species were possible, their apparent importance would be diminished.

TABLE 6. Monthly dominant forms and their abundance in the phytoplankton populations at the Cook Plant in 1974.

Month	Dominant forms	Percent of population
Apr	Flagellates	23.8
May	Flagellates	13.3
	Fragilaria crotonensis	11.9
Jun	*Fragilaria crotonensis*	11.0
	Synedra filiformis	12.3
Jul	*Fragilaria crotonensis*	22.3
Aug	*Gomphosphaeria lacustris*	27.3
Sep	*Gomphosphaeria lacustris*	29.8
Oct	*Gomphosphaeria lacustris*	27.5

Species of the genus *Stephanodiscus* did not dominate in any month of the 1974 surveys, although several attained the "abundant" rank.

The dominance of the blue-green *Gomphosphaeria lacustris* in August, September, and October is apparently due to onshore winds which preceded the survey dates. This blue-green is a widely distributed non-nuisance-forming alga common in offshore waters.

SEASONALITY OF ABUNDANCES

This section is prepared as an index of the preoperational variability of the phytoplankton community of the Cook Plant region as sampled in the monthly minimum surveys. It deals with the abundances of the "abundant" phytoplanktonic forms and the seasons or bi-seasons of their greatest numbers. Spring is defined as April and May; summer as June, July, and August; and fall as September and October. Abundance peaks that cross from one season to the next are defined as occurring in the spring-summer, summer-fall, or fall-spring bi-seasons.

There are four general patterns in the abundance numbers, the two major ones being 1) relatively uniform abundances through all three seasons, and

2) definite highs in one season or in a bi-season. The relatively uniform abundances may be of high, medium, or low numbers and are rather subjectively determined. Table 7 lists the species or groups rated as uniform in abundance during the surveys of 1972, 1973, and 1974.

TABLE 7. Phytoplanktonic forms subjectively rated as being of uniform abundance in the minimal surveys of 1972 through 1974. H denotes high numbers; M denotes medium numbers; L denotes low numbers.

	1972
Cryptomonas spp. (M)	*Nitzschia* spp. (L)
Fragilaria crotonensis (H)	*Tabellaria fenestrata* (H)
Gloeocystis spp. (M)	
	1973
Ankistrodesmus spp. (L)	*Nitzschia* spp. (M)
Cryptomonas spp. (L)	*Oocystis* spp. (L)
Cyclotella cryptica (L)	*Scenedesmus bicellularis* (L)
Cyclotella kuetzingiana (L)	*Stephanodiscus alpinus* (L)
Cyclotella michiganiana (L)	*Stephanodiscus binderanus* (L)
Cyclotella ocellata (L)	*Stephanodiscus hantzschii* (L)
Diatoma tenue v. *elongatum* (L)	*Synedra delicatissima* v. *angustissima* (L)
Dinoflagellates (L)	*Synedra filiformis* (L)
Gloeocystis planctonica (L)	*Synedra ostenfeldii* (L)
Gloeocystis spp. (M)	
Melosira italica (M)	
	1974
Ankistrodesmus sp. #3 (L)	*Nitzschia acicularis* (L)
Asterionella formosa (M)	*Nitzschia bacata* (L)
Coccoid green algae (M)	*Nitzschia confinis* (L)
Cryptomonas spp. (M)	*Nitzschia* spp. (L)
Cyclotella ocellata (L)	*Scenedesmus bicellularis* (L)
Flagellates (H)	*Scenedesmus quadricauda* (L)
Fragilaria capucina (L)	*Stephanodiscus alpinus* (M)
Fragilaria crotonensis (H)	*Stephanodiscus minutus* (M)
Glenodinium spp. (L)	*Synedra delicatissima* v. *angustissima* (L)
Melosira granulata (M)	

Table 8 presents for each "abundant" phytoplanktonic form, the season or bi-season in which it attained its maximum standing crop in the years 1972, 1973, and 1974.

In the three years of seasonality of abundance data available, a total of four patterns are evident. One is consistent relative uniformity of abundance over all three seasons; *Cryptomonas* spp. and *Nitzschia* spp. exhibited this in all three years.

A second pattern is that of a form which rises into and falls from the "abundant" category, e.g., *Rhizosolenia gracilis* was abundant and had its abundance peak in spring in 1972, did not attain abundant rank in 1973, and in 1974 was abundant and had its abundance peak in spring-summer.

Some forms have not yet exhibited relatively uniform abundance over the three seasons:

Forms	Abundance peaks in
Cyclotella spp.	Spring '72, Summer '73, Spring-summer '74
Cyclotella stelligera	Summer-fall '72, Summer '73, Summer-fall '74
Melosira granulata v. *angustissima*	Fall '72, Summer-fall '73, Fall '74
Melosira islandica	Spring '72, Summer '73, Spring-summer '74

Other forms have exhibited relative uniformity in some years and peaks of abundance in others:

Forms	Abundance peaks or uniformity
Diatoma tenue v. *elongatum*	Spring '72, Uniform '73, Spring-summer '74
Glenodinium spp.	Spring '72, Spring-summer '73, Uniform '74
Fragilaria crotonensis	Uniform '72, Summer-fall '73, Uniform '74
Tabellaria fenestrata	Uniform '72, Summer-fall '73, Fall-spring '74
Fragilaria capucina	Spring-summer '72, Spring '73, Uniform '74

The degree to which our phytoplankton data reveal all the possible natural variations is of course unknown, but at least they reveal some of the types and sizes of natural variations which, if occurring during plant operation, should not be attributed to plant operation.

TABLE 8. Phytoplanktonic forms which exhibited seasonal or bi-seasonal peaks of abundance during the Cook Plant minimal surveys of 1972, 1973, and 1974.

Spring	Spring-Summer	Summer
	1972	
Ankistrodesmus spp.	*Chlamydomonas* spp.	*Anabaena* spp.
Cyclotella spp.	*Dinobryon divergens*	
Diatoma tenue v. *elongatum*	*Fragilaria capucina*	
Glenodinium spp.	*Fragilaria intermedia*	
Melosira islandica	*Melosira* spp.	
Rhizosolenia gracilis	*Scenedesmus* spp.	
Rhizosolenia spp.	*Stephanodiscus* spp.	
	Synedra ulna	
	1973	
Fragilaria capucina	*Glenodinium* spp.	*Cyclotella atomus*
Fragilaria intermedia	*Synedra* spp.	*Melosira islandica*
Stephanodiscus minutus		*Cyclotella stelligera*
Stephanodiscus spp.		*Cyclotella* spp.
Oscillatoria spp.		*Dinobryon bavaricum*
		Dinobryon divergens
		Green cells
		Green colonies
		Melosira granulata
		Scenedesmus quadricauda
		Stephanodiscus tenuis
	1974	
Fragilaria intermedia	*Cyclotella* spp.	*Anabaena flos-aquae*
Nitzschia sp. #2	*Diatoma tenue* v. *elongatum*	*Crucigenia tetrapedia*
Stephanodiscus binderanus	*Melsoira islandica*	*Dinobryon divergens*
Stephanodiscus transilvanicus	*Melosira italica*	*Gloeocystis* spp.
Synedra ostenfeldii	*Oscillatoria* spp.	*Peridinium* spp.
Synedra tenera	*Rhizosolenia gracilis*	*Rhizosolenia eriensis*
Synedra spp.	*Stephanodiscus tenuis*	*Sphaerocystis schroeteri*
	Stephanodiscus spp.	*Tabellaria fenestrata* v. *intermedia*
	Synedra filiformis	*Ulothrix* spp.
	Synedra ulna v. *chaseana*	
	Thalassiosira pseudonana	

TABLE 8 continued.

Summer-Fall	Fall	Fall-Spring
	1972	
Cyclotella stelligera	*Chroococcus* spp. *Cyclotella kuetzingiana* Dinoflagellates *Melosira granulata* *Melosira granulata* v. *angustissima* *Oocystis* spp.	*Asterionella formosa* Flagellates
	1973	
Anabaena spp. *Anacystis* spp. *Chlamydomonas* spp. *Chroococcus* spp. *Fragilaria crotonensis* *Melosira granulata* v. *angustissima* *Scenedesmus* spp. *Stephanodiscus subtilis* *Tabellaria fenestrata*	*Navicula* spp. *Rhizosolenia eriensis*	*Asterionella formosa* Flagellates *Tabellaria flocculosa*
	1974	
Anacystis spp. *Chroococcus prescottii* *Crucigenia quadrata* *Cyclotella michiganiana* *Cyclotella stelligera* *Gloeocystis planctonica* *Gomphosphaeria lacustris* *Oocystis* spp. *Scenedesmus* spp.	*Anacystis incerta* *Anacystis thermalis* *Dinobryon sociale* *Melosira granulata* v. *angustissima* *Nitzschia kuetzingiana* *Scenedesmus tetradesmiformis* *Stephanodiscus hantzschii* *Stephanodiscus subtilis*	*Tabellaria fenestrata*

COOK INSHORE STATIONS VS. REFERENCE STATIONS, 1974

Beginning with April 1974, two reference (control) stations were added to the Cook Plant monthly minimal surveys. These stations, NDC-7-1 and SDC-7-1, are located seven miles north and south (respectively) of the plant. They are designed to provide pre- and postoperational data, from inshore stations which the plant's thermal plume is not expected to reach, for comparison with inshore stations in front of the plant which the plant's plume is expected to reach all or most of the time.

Table 9 compares the list of species and forms collected at the four inshore stations in front of the plant to similar lists from the two reference stations. Species or forms collected only at offshore stations have been omitted. In the four Cook Plant inshore stations forms that totalled 100 cells per ml or more collected during the seven months' surveys have been arbitrarily termed "abundant" and annotated by (A). Because the offshore collections are omitted from Table 9, the abundant forms of this table will not be the same as those rated abundant in Table 1.

Because the Cook Plant inshore collections were from four stations while the reference stations were single stations, the "abundant" rating was given to any reference station form that attained 25 or more cells during the seven surveys.

One form, *Pandorina* sp., from the north reference station was not annotated "abundant" because it occurred in large numbers in one sample only and was not present in any other.

A total of 249 forms is shown in Table 9; of these 124 were common to the Cook inshore stations and one or both the reference stations. In most cases these were the more abundant forms and the reference stations appear to be adequately representative of the Cook stations for these forms.

In the rare forms, chance catches play a large part in the collections. The Cook station collections showed 76 rare forms that were not taken at the reference stations, but the two reference stations provided 49 rare species that were not taken at the Cook stations. The four Cook stations were not twice as productive of rare forms as the two reference stations.

Table 10 compares the Cook Plant inshore stations and the reference stations by station and month. Both sets of stations exhibit wide variability,

TABLE 9. Comparisons of occurrences of phytoplanktonic forms at the inshore stations (NDC-.5-1, SDC-5-1, DC-0, and DC-1) near the Cook Plant with occurrences at the north reference station (NDC-7-1) and the south reference station (SDC-7-1) seven miles north and south of the plant. (A) denotes "abundant" and is explained in the text; ** means "did not occur"; all others are "rare." Data of the monthly minimal surveys of 1974.

Cook inshore stations	North reference station	South reference station
Achnanthes clevei	*Achnanthes clevei*	**
A. clevei v. *rostrata*	**	**
A. lanceolata v. *dubia*	*A. lanceolata* v. *dubia*	**
A. linearis	**	**
A. minutissima	**	**
Achnanthes spp.	**	*Achnanthes* spp.
**	*Actinastrum hantzschii* v. *fluviatile*	**
**	**	*Agmenellum quadruplicatum*
Amphipleura pellucida	*Amphipleura pellucida*	*Amphipleura pellucida*
Amphora neglecta	**	**
**	**	*Amphora ornata*
A. ovalis	*Amphora ovalis*	**
A. ovalis v. *constricta*	**	**
A. ovalis v. *gracilis*	**	*A. ovalis* v. *gracilis*
A. ovalis v. *libyca*	**	**
A. ovalis v. *pediculus*	*A. ovalis* v. *pediculus*	*A. ovalis* v. *pediculus*
A. rotunda	**	*A. rotunda*
A. sibirica	**	*A. sibirica*
Amphora spp.	*Amphora* spp.	*Amphora* spp.
Anabaena flos-aquae (chains/masses) (A)	*Anabaena flos-aquae* (chains/masses) (A)	*Anabaena flos-aquae* (chains/masses)

TABLE 9 continued.

Anabaena flos-aquae (resting cells) (A)	**	**
**	*Anabaena* spp. (A)	*Anabaena* spp.
Anacystis incerta (A)	*Anacystis incerta* (A)	*Anacystis incerta* (A)
A. thermalis (A)	*A. thermalis* (A)	*A. thermalis* (A)
Anacystis spp. (A)	**	**
Ankistrodesmus braunii	**	**
A. falcatus	*Ankistrodesmus falcatus*	*Ankistrodesmus falcatus*
A. gelifactum	*A. gelifactum*	*A. gelifactum*
Ankistrodesmus sp. #1	**	*Ankistrodesmus* sp. #1
Ankistrodesmus sp. #3 (A)	*Ankistrodesmus* sp. #3	*Ankistrodesmus* sp. #3
Ankistrodesmus spp.	*Ankistrodesmus* spp.	*Ankistrodesmus* spp.
Asterionella formosa (A)	*Asterionella formosa* (A)	*Asterionella formosa* (A)
**	**	Blue-green filaments (unknown)
Bottryococcus braunii	**	**
**	*Caloneis ventricosa* v. *minuta*	*Caloneis ventricosa* v. *minuta*
Ceratium hirundinella	**	*Ceratium hirundinella*
**	**	*Chodatella longiseta*
Chroococcus prescottii (A)	**	**
Chroococcus spp.	**	**
**	*Closteriopsis* sp.	**
Coccoid blue-greens	**	**
Coccoid greens (A)	**	Coccoid greens
Cocconeis diminuta	**	**
C. placentula	**	**
C. placentula v. *euglypta*	**	**
Coelastrum microporum	**	*Coelastrum microporum*
C. reticulatum	**	**
**	*Coelastrum* spp.	**
Coelosphaerium spp. (colonies)	**	*Coelosphaerium* spp. (colonies)
Cosmarium sp. #1	*Cosmarium* sp. #1	*Cosmarium* sp. #1

TABLE 9 continued.

Cosmarium spp.	**	**
**	*Crucigenia crucifera*	**
**	*C. fenestrata*	**
Crucigenia quadrata (A)	*C. quadrata* (A)	*Crucigenia quadrata*
C. tetrapedia	**	**
**	*Crucigenia* spp. (A)	**
Cryptomonas spp. (A)	*Cryptomonas* spp. (A)	*Cryptomonas* spp. (A)
Cyclotella atomus	**	**
C. comta	*Cyclotella comta*	*Cyclotella comta*
C. cryptica	*C. cryptica* (A)	**
C. kuetzingiana	**	**
C. kuetzingiana v. *planetophora*	**	**
C. kuetzingiana v. *radiosa*	**	**
C. meneghiniana	*C. meneghiniana* (A)	*C. meneghiniana*
**	*C. meneghiniana* v. *plana*	*C. meneghiniana* v. *plana*
C. mighiganiana (A)	*C. michiganiana* (A)	*C. michiganiana* (A)
C. ocellata (A)	*C. ocellata* (A)	*C. ocellata* (A)
C. operculata	**	**
C. pseudostelligera	**	**
**	**	*Cyclotella* sp. #6
C. stelligera (A)	*C. stelligera* (A)	*C. stelligera* (A)
Cyclotella spp. (A)	*Cyclotella* spp. (A)	*Cyclotella* spp. (A)
**	**	*Cymatopleura solea*
Cymatopleura solea v. *apiculata*	**	**
**	**	*Cymbella obtusiuscula*
Dactylococcopsis spp.	*Dactylococcopsis* spp.	*Dactylococcopsis* spp.
**	*Diatoma tenue*	*Diatoma tenue*
Diatoma tenue v. *breve*	**	**
D. tenue v. *elongatum* (A)	*D. tenue* v. *elongatum* (A)	*D. tenue* v. *elongatum* (A)
D. vulgare	**	**

TABLE 9 continued.

Dictoyosphaerium spp.	**	**
Dinobryon divergens (A)	*Dinobryon divergens* (A)	*Dinobryon divergens* (A)
D. sociale (A)	*D. sociale*	*D. sociale*
Dinoflagellates	**	Dinoflagellates
Diploneis oculata	**	**
**	*Diploneis* spp.	**
**	**	*Epithemia* sp.
**	*Eudorina* sp. (A)	**
Flagellates (A)	Flagellates (A)	Flagellates (A)
Fragilaria brevistriata	**	**
F. capucina (A)	*Fragilaria capucina*	*Fragilaria capucina*
F. construens	*F. construens*	*F. construens*
F. construens v. *minuta*	*F. construens* v. *minuta*	**
F. construens v. *pumila*	**	*F. construens* v. *pumila*
F. construens v, *venter*	*F. construens* v. *venter*	**
F. crotonensis (A)	*F. crotonensis* (A)	*F. crotonensis* (A)
F. intermedia (A)	*F. intermedia*	*F. intermedia* (A)
F. intermedia v. *fallax*	*F. intermedia* v. *fallax*	*F. intermedia* v. *fallax*
F. pinnata	*F. pinnata*	*F. pinnata*
F. pinnata v. *lancettula*	**	**
Fragilaria spp.	*Fragilaria* spp.	**
**	*F. vaucheriae*	**
Glenodinium spp.	**	**
Gloeocystis planctonica (A)	*Gloeocystis planctonica* (A)	*Gloeocystis planctonica* (A)
Gloeocystis spp. (A)	**	*Gloeocystis* spp. (A)
Gomphonema olivaceum	**	**
**	*Gomphonema*	*Gomphonema*
Gomphosphaeria lacustris (A)	*Gomphosphaeria lacustris* (A)	*Gomphosphaeria lacustris* (A)
G. wichure (colonies)	**	**
**	Green colonies	**

TABLE 9 continued.

Green filaments	Green filaments	Green filaments
Gymnodinium sp.	*Gymnodinium* sp.	**
Kirchneriella sp.	*Kirchneriella* sp.	**
Mallomonas pseudocoronata	*Mallomonas pseudocoronata*	*Mallomonas pseudocoronata*
**	*Melosira distans*	*Melosira distans*
Melosira distans v. *alpigena*	**	**
M. granulata (A)	*M. granulata* (A)	*M. granulata* (A)
M. granulata v. *angustissima* (A)	*M. granulata* v. *angustissima* (A)	**
M. islandica (A)	*M. islandica* (A)	*M. islandica* (A)
M. italica (A)	*M. italica* (A)	*M. italica* (A)
M. varians	**	**
Melosira sp.	**	*Melosira* sp.
Meridion circulare	**	**
Mougeotia spp.	*Mougeotia* spp.	*Mougeotia* spp.
Navicula bacillum	*Navicula bacillum*	**
N. capitata	*N. capitata*	*Navicula capitata*
N. capitata v. *luneburgensis*	*N. capitata* v. *luneburgensis*	**
N. costulata	**	**
N. cryptocephala	**	**
N. cryptocephala v. *veneta*	**	*N. cryptocephala* v. *veneta*
N. cuspidata	**	**
N. decussis	*N. decussis*	*N. decussis*
N. exigua v. *capitata*	**	**
N. gastrum	**	**
N. gregaria	**	*N. gregaria*
N. hambergii	**	**
N. lanceolata	**	**
N. latens	*N. latens*	*N. latens*
N. menisculus	**	**
N. menisculus v. *obtusa*	**	**

TABLE 9 continued.

N. Meniscculus v. *upsaliensis*	**	**
N. micropupula	*N. micropupula*	**
**	*N. placentula*	**
N. pupula	**	**
**	**	*N. radiosa* v. *tenella*
**	*N. reinhardtii*	**
N. rhynchocephala	**	**
N. tripunctata	*N. tripunctata*	**
N. viridula	**	**
**	*Navicula* sp. #23	**
Navicula sp. #78	**	*Navicula* sp. #78
Navicula spp.	*Navicula* spp.	*Navicula* spp.
**	*Nitzschia acicularioides*	*Nitzschia acicularioides*
Nitzschia acicularis (A)	*N. acicularis* (A)	*N. acicularis* (A)
N. acuta	*N. acuta*	*N. acuta*
N. bacata (A)	*N. bacata* (A)	*N. bacata* (A)
N. capitellata	**	**
N. confinis (A)	*N. confinis* (A)	*N. confinis* (A)
N. denticulata	**	**
N. dissipata	*N. dissipata*	*N. dissipata*
N. fonticola	*N. fonticola*	*N. fonticola*
N. fonticola v. *pelagica*	**	**
N. frustulum	**	**
N. Kuetzingiana	*N. kuetzingiana*	*N. kuetzingiana*
N. palea	*N. palea*	*N. palea*
N. paleacea	*N. paleacea*	*N. paleacea*
N. recta	**	*N. recta*
N. sigma	**	**
N. spiculoides	*N. spiculoides*	*N. spiculoides*
Nitzschia sp. #1	*Nitzschia* sp. #1	*Nitzschia* sp. #1

TABLE 9 continued.

Nitzschia sp. #2 (A)	*Nitzschia* sp. #2 (A)	*Nitzschia* sp. #2 (A)
Nitzschia sp. #7	**	**
Nitzschia sp. #8	**	**
Nitzschia sp. #9	**	**
Nitzschia sp. #10	*Nitzschia* sp. #10	*Nitzschia* sp. #10
Nitzschia sp. #18	**	**
Nitzschia spp. (A)	*Nitzschia* spp. (A)	*Nitzschia* spp. (A)
**	*Oedogonium* spp. (A)	**
Oestrupia zachariasi	**	**
Oocystis spp. (A)	**	*Oocystis* spp.
**	*Opephora martyi*	**
Oscillatoria limnetica	*Oscillatoria limnetica*	*Oscillatoria limnetica* (A)
**	**	*Oscillatoria retzii*
Oscillatoria spp. (A)	*Oscillatoria* spp. (A)	*Oscillatoria* spp.
**	*Pandorina* sp. (see text)	**
**	*Pediastrum boryanum*	**
Pediastrum sculptalum (colonies)	**	**
Peridinium spp.	*Peridinium* spp.	*Peridinium* spp.
Pinnularia sp.	**	**
**	**	*Quadrigula lacustris*
**	*Quadrigula* sp.	**
Rhizosolenia eriensis (A)	*Rhizosolenia eriensis* (A)	*Rhizosolenia eriensis*
R. gracilis (A)	*R. gracilis* (A)	*R. gracilis* (A)
Rhoicosphenia curvata	**	**
**	**	*Scenedesmus abundans* v. *brevicauda*
**	*Scenedesmus acuminatus* (A)	*Scenedesmus acuminatus* (A)
Scenedesmus acutiformis	**	**
S. bicellularis (A)	*S. bicellularis* (A)	*S. bicellularis*
**	**	*S. bijuga*
**	**	*S. bijuga* v. *alternans*

TABLE 9 continued.

**	**	*S. denticulatus*
S. dimorphus	**	**
S. falcatus	*S. falcatus*	**
S. quadricauda (A)	*S. quadricauda* (A)	*S. quadricauda*
S. quadricauda v. *longispina*	*S. quadricauda* v. *longispina* (A)	*S. quadricauda* v. *longispina*
**	*S. quadricauda* v. *parvus*	**
S. tetradesmiformis	**	*S. tetradesmiformis*
Scenedesmus spp. (A)	*Scenedesmus* spp. (A)	*Scenedesmus* spp.
Sphaerocystis schroeteri (A)	**	**
**	*Staurastrum paradoxicum*	**
**	**	*Staurastrum* sp.
Stephanodiscus alpinus (A)	*Stephanodiscus alpinus* (A)	*Stephanodiscus alpinus* (A)
S. binderanus (A)	*S. binderanus* (A)	*S. binderanus* (A)
S. hantzschii	*S. hantzschii* (A)	*S. hantzschii*
S. minutus (A)	*S. minutus* (A)	*S. minutus* (A)
S. niagarae	**	**
**	**	*S. subsalsus*
S. subtilis (A)	*S. subtilis* (A)	*S. subtilis* (A)
S. tenuis (A)	*S. tenuis* (A)	*S. tenuis* (A)
S. transilvanicus (A)	*S. transilvanicus*	*S. transilvanicus* (A)
Stephanodiscus sp. auxospores	**	**
Stephanodiscus spp. (A)	*Stephanodiscus* spp. (A)	*Stephanodiscus* spp. (A)
Surirella angusta	*Surirella angusta*	**
S. ovata	**	**
Surirella sp. #4	**	**
Synedra acus	*Synedra acus*	**
S. amphicephala	**	**
**	**	*Synedra cyclopum*
S. delicatissima v. *angustissima*	*S. delicatissima* v. *angustissima* (A)	*S. delicatissima* v. *angustissima*
S. demerarae	**	*S. demerarae*

TABLE 9 continued.

S. filiformis (A)	*S. filiformis* (A)	*S. filiformis* (A)
S. minuscula	**	**
S. montana	**	**
S. ostenfeldii	*S. ostenfeldii* (A)	*S. ostenfeldii* (A)
**	**	*S. parasitica* v. *subconstricta*
S. tenera	**	*S. tenera* (A)
S. ulna	*S. ulna*	**
S. ulna v. *chaseana* (A)	*S. ulna* v. *chaseana*	*S. ulna* v. *chaseana* (A)
S. vaucheriae	**	**
Synedra spp. (A)	**	*Synedra* spp.
Tabellaria fenestrata	*Tabellaria fenestrata* (A)	*Tabellaria fenestrata*
T. fenestrata v. *intermedia* (A)	*T. fenestrata* v. *intermedia* (A)	*T. fenestrata* v. *intermedia* (A)
T. flocculosa	*T. flocculosa*	**
Tetraedron minimum	**	**
**	*Tetraedron regulare* v. *incus*	**
**	*Tetraedron* sp.	**
Thalassiosira pseudonana (A)	*Thalassiosira pseudonana*	*Thalassiosira pseudonana* (A)
Ulothrix spp.	**	*Ulothrix* spp.

TABLE 10. Total numbers of cells/ml, total numbers of forms collected, and mean numbers of cells per form. Comparisons of Cook Plant inshore stations to the north and south reference stations, 1974.

		Inshore stations				Reference stations		Student's
		NDC-.5-1	SDC-.5-1	DC-0	DC-1	NDC-7-1	SDC-7-1	t
Apr	Total cells/ml	924	1882	--	1514	1098	4578	-1.03 n.s.[1]
	No. forms	37	47	--	37	31	47	
	Cells/form	25	40	--	41	35	97	
May	Total cells/ml	2123	655	4365	1135	4295	2000	0.76 n.s.
	No. forms	46	40	70	57	54	52	
	Cells/form	46	16	62	20	80	38	
Jun	Total cells/ml	667	967	4314	1102	1220	632	0.65 n.s.
	No. forms	46	59	56	52	48	58	
	Cells/form	15	16	77	21	25	11	
Jul	Total cells/ml	2207	1646	1173	1629	2703	1418	-0.78 n.s.
	No. forms	39	40	49	51	64	40	
	Cells/form	57	41	24	32	42	35	
Aug	Total cells/ml	1742	2023	813	1420	1345	977	0.83 n.s.
	No. forms	51	37	54	33	34	28	
	Cells/form	34	55	15	43	40	35	
Sep	Total cells/ml	1261	1739	--	876	452	447	2.61 n.s.
	No. forms	34	48	--	42	38	23	
	Cells/form	37	36	--	21	12	19	
Oct	Total cells/ml	1488	2282	1582	1811	1105	3781	-0.76 n.s.
	No. forms	56	62	61	63	46	52	
	Cells/form	27	37	26	29	24	73	

[1] n.s.: not significant ($p > .05$). The null hypothesis was that the population mean (cells/ml) sampled by the stations near the plant was equal to the population mean sampled by the reference stations.

both temporally and spatially, in total numbers of cells collected. For each month, the abundances measured at the inshore stations were compared to those at the reference stations using a two-sample *t*-test. The resulting *t*-statistics are given in Table 10. None of the differences were significant at the 5% level. Both reference stations showed in 1974 a tenfold variation in total cells while the greatest variation observed in the Cook inshore stations was fivefold at station DC-0.

The number of forms collected ranged from 23 to 70 but most were in the forties and fifties.

If the relation of number of forms to mean number of cells per form is considered a measure of diversity, the data of Table 10 indicate that fairly diverse populations were sampled (relatively large numbers of forms with relatively few individuals per form). Poorly diverse populations, indicated by few forms with many cells per form, were not observed.

CONCLUSIONS

During the field season of 1974, 256 phytoplanktonic forms were collected from the main group of monthly survey stations directly in front of the Cook Plant, and 49 additional forms were recorded from the two inshore reference stations added in 1974.

There were 66 forms from the main monthly survey stations that attained to the arbitrary "abundant" category in 1974, compared to 50 in 1973 and 32 in 1972. The increase in abundant forms was investigated to see if it represented a progressive increase in the size of phytoplankton populations in the Cook Plant region; no clearly defined increase in population sizes could be found. The increased numbers of abundant forms are attributed to increased skills of our phytoplankton analysts as evidenced by a decrease in numbers of unidentified "sp." and "spp." categories from 48 in 1973 to 38 in 1974.

Forms which were numerically dominant in at least one month of 1974 were: flagellates, *Fragilaria crotonensis, Synedra filiformis*, and the blue-green alga *Gomphosphaeria lacustris* which was dominant in August through October. The latter, a non-nuisance-forming species common in offshore waters, was apparently brought inshore by onshore winds that preceded the last three surveys.

The inshore stations in front of Cook Plant, stations where cooling water will be drawn and where the plant's thermal plume will be present all or most of the time, had a grand mean number of cells per ml of 1631 over the period 1972 through 1974 and a 1974 mean of 1667 cells per ml. These preoperational means can be compared to postoperational means as one analysis of possible effect of the plant on the population.

There is in general an annual trend in the numbers of phytoplanktonic forms--inshore and offshore stations have similar numbers of forms in April and May and again in late fall, with fewer forms in the intervening months. The summer and early fall reduction in form numbers is more pronounced in the offshore stations.

The "abundant" forms of the 1972, 1973, and 1974 monthly minimal surveys have been intercompared as one analysis of the preoperational phytoplankton conditions. There are two major general patterns in the numerical abundances of these forms: 1) relatively uniform numbers throughout the survey period, and 2) definite highs in one season or bi-season. The relatively uniform abundances may be of high, medium, or low numbers. There is no uniformity in the two groups from year to year or season to season. Forms having uniform abundances in one year may have peaked abundances in the next and vice versa. Peaks of abundance of a species may shift as much as a whole season from year to year. A species attaining "abundant" status in one year may fail to attain it in the next and vice versa.

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