BERING SEA PHYTOPLANKTON STUDIES

by

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I. SUMMARY OF OBJECTIVES, CONCLUSIONS, AND IMPLICATIONS WITH RESPECT TO OCS OIL AND GAS DEVELOPMENT

The specific objective of this project was to determine phytoplankton standing stock, plant pigments, primary productivity, and nutrient regimes in specific areas of the Bering Sea in spring.

Specific conclusions are difficult because, although samples were collected over a wide area of the Bering Sea, for the most part, we have one-time only samples. Primary productivity was variable and was usually, but not always, highest at stations and depths where diatoms were most abundant. Pennate diatoms were dominant in the Navarin Basin in early May; diatoms were dominant in Norton Basin in early spring and microflagellates became dominant later; microflagellates were dominant in late May in the St. Matthew-Hall area and in June in the St. George Basin. Cell numbers were variable. Most abundant species included pennate diatoms (*Navicula* spp. and *Nitzschia* spp. section *Fragilariopsis*); centric diatoms (*Chaetoceros* spp. and *Thalassiosira* spp.); dinoflagellates (*Peridinium* spp. and *Gymnodinium lohmanni*); and unidentif.ied microflagellates ranging in size from *ca.* 2-30 µm in diameter. Nitrate and phosphate concentrations were sometimes lower in the upper 20-30 m and may have been limiting at *times.*

The data presented here provide a small beginning toward understanding the phytoplankton community in the Bering Sea in spring. This is important because spring is the time when much biological activity occurs and carbon is being fixed by the phytoplankton which then become food for all higher trophic levels.

II. INTRODUCTION

A. General nature and scope of study

The 1979 and 1980 spring icebreaker cruises in the Bering Sea provided opportunities to study hydrography, microbiology, plankton, benthos, sea birds, and mammals at a time when conventional research vessels could not work in the area because of ice conditions. Special attention was given to the ice edge because it is an area of intense biological activity in spring.

Data reported here (Table 1) concern phytoplankton standing stock, plant pigments, primary productivity, and hydrographic conditions including temperature, salinity, and nutrient concentrations. Literature on the phytoplankton of the Bering Sea is briefly reviewed from 1883 through 1981.

B. Specific objectives

The specific objective of RU 359 was to determine the standing stock, plant pigments, primary productivity, and nutrient regimes in the Bering Sea in spring. In 1979, RU 359 also determined zooplankton standing stock and distribution (Homer and Wencker 1980).

Table 1. Number and kinds of samples collected and analyzed from the Bering Sea by RU 359, 1979, 1980.

Number	Data Type Collected/Analyzed	Date 1979	1980
	Number of Stations	24	60
	Phytoplankton		
	Standing Stock	189/189	467/331
	Plant Pigments	189/189	467/465
	Primary Productivity	189/189	467/467
	Zooplankton[1, 2]		
	Standing Stock	28/28	
	Temperature	189/179[3]	463/463
	Salinity	189/189	467/467
	Nutrients	189/189	465/465
	Secchi disk	24	58
	Ice conditions	24	60

[1] Previously reported (Homer and Wencker 1980)

[2] Not taken by RU 359 in 1980

[3] Thermometers malfunctioned

c. Relevance to problems of petroleum development

Basic background information on standing stock, species composition, distribution, and primary productivity of phytoplankton communities is poorly known for major parts of the Bering Sea, including Norton and Navarin basins currently under consideration for oil and gas development. Spring, just as the ice is breaking up, is an especially critical time because of the intense biological activity that occurs for all major groups of organisms. The primary producers, ice algae and phytoplankton, bloom providing food, directly or indirectly, for all higher trophic levels. Disruptions of these communities by industrial development during this critical season could cause major problems within the Bering Sea ecosystem. It is therefore important to know what conditions are before perturbation occurs.

D. Acknowledgements

It is a pleasure to thank the captains, officers, and crews of CGC *Polar Sea* and CGC *Polar Star* who provided excellent assistance to us during the cruises. LTJG J. F. Schmied, MSTC G. Lausch, and the Marine Science Technicians from both ships were especially helpful and were willing to work at all hours. Kendra Daly collected zooplankton and provided field assistance in 1979; Deborah Wencker provided field assistance in 1980, did much of the literature review, and, with Dave Murphy, analyzed chlorophyll samples from both cruises. Marc Weinstein and Jerry Hornof helped with data processing. Carl Schrader analyzed standing stock samples from 1980 and processed the standing stock data for both cruises.

III. CURRENT STATE OF KNOWLEDGE

Motoda and Minoda (1974) reviewed -early investigations concerning plankton in the Bering Sea, primarily based on summer surface community studies by Japanese scientists. They found that the surface currents circulating from the Pacific Ocean into, and the winter-cooled currents circulating within, the Bering Sea govern the distribution of plankton. This results in inshore assemblages of the *Chaetoceros-Hyalochaete* type, including *Chaetoceros debilis*, *G%. decipiens*, and *Ch. radicans*, along the coasts; offshore assemblages of *Thalassiothrix longissima* and the *Chaetoceros-Phaeoceros* group, including *Chaetoceros atlanticus*, *Ch. convolutes*, and C%. *concavicornis*, on the shelf, along with *Corethron hystrix*, *Denticula seminae*, and *Nitzschia seriata* in the surface waters of the deep basin area.

Soviet studies were reviewed by Gershanovich et *al.* (1974) and Zenkevitch (1963). The latter provided information on the northern Bering Sea community assemblages where the western half is dominated by arctic and arctic-boreal species, including *Thalassiosira nordenskioeldii*, *Th. gravida*, *Chaetoceros socialis*, *Ch. radicans*, *Porosira glacialis*, *Bacterosira fragilis*, and *Eucampia groenlandica*. The eastern part of the northern Bering Sea community is a mixture of boreal and brackish water neritic species, including *Actinoptychus undulatus*, *Rhizosolenia alata*, *Ditylum brightwellii*, *Actinocyclus ehrenbergii*, *Bellerochea malleus*, *Asterionella japonica*, and *Peridinium excentricum*.

Alexander and Cooney (1979) also reviewed previous phytoplankton studies in the Bering Sea with regard to species presence and distribution. Recent investigations not covered in their review include Ishimaru and Nemoto (1977) listing species and abundances from the western and eastern Bering Sea; Saito and Taniguchi (1978) discussing the species composition and abundance of the successional groups of ice, spring and summer diatoms in seasonally ice covered areas, and Furuya *et al.* (1979) including a species list and abundance of diatoms, dinoflagellates, and silicoflagellates from the eastern Bering Sea and north of St. Lawrence Island.

Most recent American investigations have been conducted in the southeastern Bering Sea. Alexander and Cooney (1979) applied numerical analysis techniques to their data from this area collected at discrete depths during all seasons except midwinter and they included an extensive species list. Iverson *et al.* (1978) determined that the area was highly productive, but primary production was not disproportionately higher than in other systems, suggesting that other factors were responsible for the high productivity. They theorized that a combination of frontal zones creating different food webs fractionalized the use of phytoplankton biomass and may be a factor responsible for the high productivity. OCSEAP reports provide data from southeastern (Alexander 1976) and northeastern Bering Sea (Alexander and Cooney 1979; Homer and Wencker 1980); and Cooney (1977) included phytoplankton references in his bibliography of the Bering Sea region fauna and flora.

McRoy and Goering (1974) discussed effects of the ice cover that most likely increased the total phytoplankton production of the Bering Sea with its highly productive population of ice algae and described the annual sequence of events in the spring beginning with the ice algae bloom. Primary production was greatest in the water column at the ice edge measuring as much as 89.28 mg C m^{-2} day^{-1} during investigations of production in ice covered and open water areas from February to April. Alexander and Cooney (1979) also discussed ice algae and its importance to the ecosystem.

Total annual production for the whole Bering "Sea has been calculated to be 274 x 10^6 metric tons with slightly greater than 50% from the shelf, including 20% from ice algae and some from rivers and lagoons (McRoy and Goering 1976). Motoda and Minoda (1974) reported summer surface primary productivity to be highest, 5 mg C m^{-3} hr^{-1}, east of Bower's Bank; less than 1 mg C m^{-3} hr^{-1} on the northern shelf and in the western gyre; and 1-3 mg C m^{-3} hr^{-1} in the central and western shelf areas. Additional contributions to chlorophylls and primary production values have been made for various regions by Taniguchi *et al.* (1976), Saino and Hattori (1977), Satake *et al.* (1977), Saito and Taniguchi (1978), Alexander and Cooney (1979), Saino *et al.* (1979); Stress *et* aZ. (1979), and Homer and Wencker (1980).

A summary of the literature on Bering Sea phytoplankton from 1883-1981 is given in Table 2. The references are arranged chronologically.

Table 2. Summary of phytoplankton literature from the Bering Sea, 1883-1981.

Author, Date	Region	Nature of Study, Methods	Results[1]
Cleve, 1883	Bering Sea	Surface samples, species list	Great abundance of *Thalassiothrix longissima;* also *Coscinodiscus borealis, Chaetoceros atlanticus, Rhizosolenia styliformis, R. hebetata*
Mann, 1925	65°15'N, 166°30'W	Net tow, species list	*Coscinodiscus concinnus, Melosira hyperborea, M. nummuloides*
Aikawa, 1933	western (Aleutians)	Samples collected in July, Aug.; quantitative distribution, species list, species percentages	*Chaetoceros* sp., *Nitzschia seriata, Thalassiothrix longissima, Coscinodiscus* sp., *Rhizosolenia* sp., *Denticula* sp.
Phifer, *1934*	eastern	Diatoms centrifuged and settled from water samples; seasonal occurrence and distribution	Found *Denticula seminae* and *Stephanopyxis nipponica* in July, Aug.
Cupp, 1937	Aleutians	Surface water filtered through no. 25 bolting silk; seasonal abundance, species list	Arctic and temperate oceanic species: *Chaetoceros debilis, Asterionella japonica, Rhizosolenia*; Arctic and temperate neritic species: *Thalassiosira nordenskioeldii, Chaetoceros socialis* in winter and spring
Kiseleff, 1937	northern, western	Samples collected with no. 12 & 25 bolting silk nets; species list, relative abundance, distribution, relation to hydrography	*Eucampia groenlandica, Achnanthes taeniata, Amphiprora hyperborea, Peridinium* spp., *Coscinodiscus stellaris, Actinocyclus ehrenbergii, Ceratium pentagonum, Ditylum brightwelli, Chaetoceros danicus*
Aikawa, 1940	southern (Aleutians)	In Japanese; figures of cell numbers	

[1] Species names are those used in the cited reference and may no longer be correct

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Cupp, 1943	southeast	Surface water filtered through no. 25 bolting silk, settled, cleaned; taxonomy, ecology; keys to pennate, centric diatoms,	Keys to diatoms collected from Scotch Cap, Alaska to southern California; classic taxonomic reference for diatoms
Lafond, *et al.* 1949	eastern	Collections in July, Aug. with no. 0 and 8 bolting silk Nansen nets; relative volumes, species list	Greatest volume just southeast of St. Lawrence Island; greatest bulk usually zooplankton
Motoda & Kawarada, 1955	southwest (Aleutians)	Samples collected with no. XX16 bolting silk vertically hauled from 50 m in May & June; area divided into regions by characteristic species	Maximum number of cells was $100/m^3$; dominant species: *Chaetoceros atlanticus, Ch. convolutus, Ch. debilis, Ch. decipiens, Ch. radicans, Corethron hystrix, Denticula* sp. *Nitzschia seriata, Rhizosolenia hebetata.* Six regions: two with neritic species, two with cold, oceanic species, one mixed, one purely oceanic
Marumo, 1956	southwest	Surface water collected June to Aug. centrifuged; important species identified, abundance, distribution related to temperature	Cell numbers generally 10^2-10^3 ℓ (10^2, 10^3-104); major species: *Chaetoceros debilis, Ch. convolutes, Corethron hystrix, Denticula* sp., *Nitzschia seriata*
Smetanin, 1956	western	Data from previous collections; phytoplankton standing crop determined by phosphate loss and related regions and hydrography	Northwest: 50-60 g C m^2 each season; northwest shelf break: 60-225 g C m^2 up to 15 June; deep inshore: 120-150 g C m^2 each season; deep open ocean: 35-55 g c m^2 each season
Fat. Fish. Hokkaido Univ., 1957	southern	Samples collected with 0.11 mm mesh net hauled vertically from 100 m	List major species collected

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Kawarada, 1957	Bering Sea	Samples collected by "dipping the water;" list of major species, abundance, distribution, vertical distribution in June, July	Usually 10^3-10^4 (40-10^6) cells ℓ present; *Chaetoceros* convolutes, *Ch. compresses, Ch. constrictus, Ch. debilis, Ch. radicans, Denticula* sp., *Nitzschia closterium, N. seriata, Rhizosolenia hebetata, Thalassiothrix longissima*
Kawarada & Owada, 1957	transect along 55°N to Attu Is.	Surface water samples collected with a bucket, centrifuged, settled April - July; species list, abundance	Monthly variations in community composition, abundance; highest concentration in April and composed of cold, subarctic species
Fat. Fish. Hokkaido Univ., 1958	southern (Aleutians)	Samples collected with 0.11 and 1.01 mm double net, hauled vertically from 100 m	List major phytoplankton species found at each location
Iizuka & Tamura, 1958	southwest	Samples collected with 0.33 and 0.86 mm mesh nets hauled vertically from 150 m, June to Aug.; list of dominant species; species characteristic of water masses	Dominant species were *Thalassiothrix longissima, Chaetoceros atlanticus*
Karohji, 1958	southern, central	Samples collected with 0.112 mm mesh net hauled vertically from 50 m. major species, standing crop, distribution by region	Cold oceanic populations of *Thalassiothrix longissima, Rhizosolenia hebetata, Fragilaria* spp., *Denticula* sp. widely distributed in west; *Nitzschia seriata, Chaetoceros* Hyalochaete dominant in southwest; *Ch.* Phaeoceros in eastern part of area
Fac. Fish. Hokkaido Univ., 1959	western	Samples collected with 0.11 mm mesh net hauled vertically from 100 m in May and July	List of dominant species and abundance

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Karohji, 1959	southern, central	Samples collected with Hardy Underway Plankton Catcher Model II, boltsilk no. XX13, in July, Aug.; major species, relative abundance	Western: *Thalassiothrix longissima, Nitzschia seriata;* Central: *T. longissima, N. seriata, Rhizosolenia hebatata;* North central, Bristol Bay, Cape Olyutorskii: *Chaetoceros* Hyalochaete group; Unimak Is: *Ch. didymus*; deep water: *Ch. furcellatus;* East: *Ch.* Phaeoceros
Takano, 1959	western (Aleutians)	Samples collected with 128 mesh/inch net vertically hauled from May-July; quantitative distribution from settled samples, species list, geographic distribution	Forty-eight species, 22 genera collected, including 39 centric and 9 pennate species
Fat. Fish. Hokkaido Univ., 1960	southern	Samples collected with a 0.11 mm mesh net hauled vertically from 100 m in June, July	Lists dominant species and abundance
Semina, 1960	western	Samples collected at various depths, May-June, Aug.-Ott. , analyzed using settling techniques; biomass related to stability of mixed layers	Olyutorskii, Anadyr regions neritic, rest of area oceanic; maximum biomass in neritic zone in spring; maximum in oceanic zone in autumn, but no intensive development
Fat. Fish. Hokkaido Univ., 1961	southern	Samples collected with 0.11 mm mesh net hauled vertically from 100 m and Van Dorn bottles, June-Aug.; surface standing crop, prim prod (^{14}C)	Surface standing crop, primary productivity, major phytoplankton species
Heinrich, 1962	Bering Sea	Biomass peaks determined from previous samples	Neritic zone peak in early spring to summer; oceanic zone peak small and in summer

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Tsuruta, 1962	northeast	Species composition, distribution, effects of temperature in early summer	Dense population drops off to south with copepod increase; dominant species: *Thalassiosira nordenskioeldii, Th. gravida, Th. condensate, Fragilaria oceanica*
Fat. Fish. Hokkaido Univ., 1963	southwest	Samples collected with 0.11 mm mesh net vertically hauled from 100 m in May-July	List dominant species in each sample
Kawamura, 1963	Bering Sea	Primary production, chlorophyll a, species composition, abundance from surface samples collected from June-August	Southeast: first record of arctic, neritic species *Fragilaria striatula, Gonyaulax tamarensis;* 1.14 mg C m^3 hr, 0.29 mg chl a m ; Northeast: 0.44 mg C m^3 hr, 0.29 mg chl a, *Fragilaria striatula, Chaetoceros concavicornis;* Western: 0.71 mg Cm^3 hr, 0.62 mg chl a m and 70% *Denticula marina*
Ohwada & Kan, 1963	eastern, southwest	Water collected from June-August; nutrients, temperature, salinity, dominant species, abundance, community characteristics	Divided into 7 regions; southward flow of water from central Bering Sea to the Aleutians suggested from distributions of *Chaetoceros* Phaeoceros, *Corethron hystrix, Denticula marina*
Tsuruta, 1963	southwest St. Lawrence Is.-s. St. Matthew Is.	Samples collected with Nakai vertical net, GG54 gauze, hauled from bottom; species, distributions in relation to water masses	Higher phytoplankton when large copepods not present; dominant species: *Thalassiosira nordenskioeldii, Th. gravida, Th. condensate, Fragilaria oceanica*
Zenkevitch, 1963	Bering Sea	Ecological summary from previous collections	Summary of Soviet studies to date

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Azova, 1964	Pribilofs to Bristol Bay	Primary production calculated from diurnal oxygen concentrations, April, July, Sept., Nov.	Average depth of euphotic zone was 26 m; mean primary production was 0.14 g C m^3 day, with total of 655 g C year
Meshcherya-kova, 1964	eastern	Samples collected with no. 38 silk Juday nets hauled from standard depths; chemical, physical oceano-graphy, major species distribution, biomass	Oceanic diatoms dominant from July-Sept., vigorous development of phytoplankton in Sept., but no large accumulations of peridinians
Fat. Fish. Hokkaido Univ., 1965	Bering Sea	Samples collected with 0.09 mm mesh nets hauled vertically from 100 m, June to Aug.	Lists dominant species from each sample
Koblents-Mishke, 1965	Bering Sea	History of studies prior to 1960, including volume of primary produc-tion, seasonal, geographic variations	Volume varied from 50-100 mg C m^2 day
Marumo, 1967	Bering Sea	Surface water collected, centrifuged for general distribution of species, abundance, communities in relation to water masses in summer	Generalized results for whole Bering Sea, cell counts of 10^2-10^6 ℓ, mainly cold water subarctic community: *Chaetoceros debilis*, *Ch. compresses*, *Ch. radicans*, *Leptocylindrus danicus* (coastal); *Fragilaria islandica*, *F. oceanica*, *Thalassiosira decipiens* in spring
Arsen'yev & Voytov, 1968	Bering Sea	Whole Bering Sea in summer, western region in winter, relative trans-parency, correlation of pattern of surface circulation to displacement of water masses	Plankton biomass inversely proportional to relative transparency

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Fat. Fish. Hokkaido Univ., 1968, 1969	eastern, central	Samples collected with Van Dorn bottles, primary productivity (^{14}C), phaeopigments, chemical oceanography	Plant pigments, primary productivity, standing crops, chemistry data
Taniguchi, 1969	eastern	Variation of primary production regionally, chl a for individual species, abundance in summer	High productivity where dinoflagellates dominant, low where *Chaetoceros* domianant, medium where *Nitzschia closterium* dominant
Fat. Fish. Hokkaido Univ., 1970, 1972	southeast	Samples collected with Van Dorn bottles, primary productivity (^{14}C), phaeopigments, chemistry	Plant pigments, primary productivity, standing crops, chemical data
McRoy, 1970	eastern	Surface water samples taken with a bucket, ice algae from melted ice; primary productivity, chl *a*, ratio of particulate N to chl *a*, *ice* algae composition	Chl *a* 0.10-1.40 mg m^3 in open water and leads; 5-70 times greater on underside of ice; Ice algae composed of *Navicula*, *Synedra*, *Fragilaria*, *Chaetoceros*, *Coscinodiscus*, *Rhizosolenia* spp., dinoflagellates
Meshcheryakova, 1970a, 1970b	southeast	Samples collected with no. 38 silk Juday net; quantitative distribution, biomass, seasonal species composition, Feb. to Dec.	Phytoplankton peaks in May, June, Sept., Oct. near Bristol Bay; highest concentrations near Pribilofs; deep sea peaks in June, July, Oct.
Starodubtsev, 1970	southeast	Samples collected with Nansen bottles; primary production (^{14}C), O_2 concentrations, species; review of Russian literature	Average production was 1.46 g C m^2 day; surface was 0.089 g C m^2; 54% in spring, 33% in summer, 13% in autumn; maxima in center and south of Bristol Bay, west of Pribilofs

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Karohji, 1972	Bering Sea	Samples collected in summer with 30 cm, XX13 mesh bolting cloth net hauled vertically from 100 m; standing crop, major species, characteristics for 7 regions; reviews literature	Standing crops large in western Aleutian, northern, eastern waters; small in central, western waters; neritic populations characterize northern, eastern shelf, western Aleutians; oceanic species found in rest of area
McRoy, *et al.*, 1972	eastern	Samples collected with large volume glass sampler in Feb., March, June, July ; ^{14}C uptake, chl a concentrations, ^{15}N uptake measured	Surface productivity in June, July in Aleutians 2.2-165 mg C m^3 day, chl a 0.2-9.9 mg m^3; in ice-covered surface water C uptake was 0.17-4,09 mg C m^3 day, chl a was 0.53 mg m^3; population on undersurface of ice averaged 44.4 mg C m^3 day and 6.83 mg chl *a* m^3
Taguchi, 1972	central	Collections made at six light depths in June; *in situ* ^{14}C uptake experiments; average total phytoplankton production calculated	Average total production was 80 g C m^2 yr; total Bering Sea production was 894 tons C day or 3.2 x 10^5 tons C year
Boisseau & Goering, 1974	Norton Basin	Nutrients, primary production, chl *a* measured from water samples	Primary productivity for the whole water column was 238.7-499 mg C m^2 day; chl a was 9.44-12.72 mg m^2
Fukuoka & Kido, 1974	Bering Sea	Compared areas of high productivity in Atlantic and Pacific oceans	Productivity may be related to thickness of mixed layer; mixed layers in Bering Sea have lower salinity than in Atlantic and higher productivity may be related to this

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Gershanovich, *et al.*, 1974	Bering Sea	Briefly summarizes Soviet information	Highest biomass in coastal waters of southeast Bering Sea; high abundance of nutrients and thawing of ice cover contribute to intense development of diatoms and dinoflagellates
Marumo & Minoda, 1974	Bering Sea	Review of previous work, includes species list from net collections	Species list includes 22 diatoms and 4 dinoflagellates
McRoy & Goering, 1974	Bering Sea	Primary production, chl *a*, ^{15}N uptake, hydrography, inorganic nutrients measured in ice and water column, Feb.-April	Surface water south of ice and under ice averaged 0.2-0.9 mg chl a m^3; at ice front, 4 mg m^3; total water column averaged 3-9 mg m^2; at ice edge, 168 mg m^2; primary productivity greatest at ice front at 89.3 mg C m^2 day, and 15-20 mg C m^2 day in the water
Minoda & Marumo, 1974	eastern	Collections made with Nansen bottles, vertical distribution of abundance and community components	Northeastern components in July were *Thalassiosira*, *Fragilaria*, *Nitzschia*, *Navicula*; *Chaetoceros diadema* and dinoflagellates indicate seasonal succession from spring to summer; *Thalassiosira* begins spring bloom
Motoda & Minoda, 1974	Bering Sea	Review of previous studies; surface samples collected with a bucket and ' 0.1 mm mesh net hauled vertically from 50 m; standing crop, chl a, primary productivity, species list	Standing crop is 10^5-10^7 cells m in early to midsummer; surface primary production east of Bowers Bank was 5 mg C m^3 hr, but < 1 mg C m^3 hr on northern shelf and western gyre, and 1-2 mg C m^3 hr in western and central areas
McRoy & Goering, 1974	Bering Sea	See McRoy and Goering, 1976	

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Alexander, 1976	southeast	Samples collected with CTD rosette; chl *a*, nutrients, standing stock, primary productivity, ^{15}N uptake; some ice cores collected	Surface chl *a* declined 50-100 miles from ice edge; species diversity in ice was low; *Fragilariopsis* sp., *Melosira moniliformis*, choanoflagellates in ice; *Fragilariopsis* sp., *Chaetoceros socialis*, *Thalassiosira nordenskioeldii*, choanoflagellates outside
Marumo & Minoda, 1976	eastern	See Minoda and Marumo, 1974	
McRoy & Goering, 1976	Bering Sea	Breakdowns for' regions and seasons; revised total annual production of organic matter from previous collections	Total production estimated to be 274 x 10^6 metric tons; slightly greater than 50% from shelf, including ice algae (20%), rivers and lagoons
Taniguchi, *et al.*, 1976	eastern	Water samples from several depths to 150 m; hydrography, species list, succession, nutrients, chl *a*, May-June	Dense concentrations of *Thalassiosira hyalina*, Th. *nordenskioeldii*, *Fragilaria*, *Navicula* on shelf in May; *Thalassiosira* spp. sink by June
Cooney, 1977	Bering Sea	Bibliography of arctic and subarctic marine flora and fauna with emphasis on pelagic community of the North Pacific and Bering Sea regions	List of references for Bering Sea
Ishimaru & Nemoto, 1977	57"N from 175-163°W, eastern	Norpac net vertical hauls from 150 m, water samples from 200 m; species list, distribution, June-Aug.	Diatoms especially abundant at western stations; *Chaetoceros convolutes*, *Denticula* sp., *Nitzschia seriata*, *Thalassiosira decipiens*, *Rhizosolenia alata*, *Rh. hebetata* widely distributed

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Otobe, *et al.*, 1977	57″N from 175–163°W, eastern	Secchi disk used to measure underwater irradiance; particulate matter counted with Coulter counter from June-Aug.	Irradiance coefficient significantly correlated with volumes of particulate matter, not chl a, in euphotic zone on the eastern shelf
Saino & Hattori, 1977	57°N from 175–163°W, eastern	Surface samples filtered through netting, incubated for ^{15}N, ^{14}C uptake; volume of particulate matter, estimates of growth constants for dominant species, maximum growth constants; June-Aug.	Volumes of particulate matter from 4-64 μm correlated with PON; PON volume ranged from 0.017-.42 g ml; growth constants for *Nitzschia seriata, Thalassiosira decipiens, Rhizosolenia hebetata, Chaetoceros convolutus* were: 1.05, 0.92, 0.91, 0.83
Satake, *et al.*, 1977	57″N from 175–163°W, eastern	Water samples collected from light depths, incubated for primary production	^{14}C uptake 0.04-0.17 mg C m^3 hr in western area; 0.22-0.58 mg C m^3 hr in eastern area
Semina *et al.*, 1977	Bering Sea	Distribution in relation to water masses	*Denticula seminae* endemic to boreal zone in western, central Bering Sea; *Thalassiosira nordenskioeldii*, neritic, arctic species, found to the north
Goering & Iverson, 1978	southeast	Identified ecologically important species, described processes regulating primary production, April-June (see Iverson *et al.*, 1978)	Chl a maximum found running parallel to shelf break representing two fronts; productivity greater in outer front and nutrient limited in interfrontal zone
Iverson, *et al.*, 1978	southeast	Water samples from standard depths, processed for chl *a*; Utermöhl technique for identification, cell numbers; Coulter counter for particulate matter; April-June, Sept.; species list	Three fronts divide shelf into two interfrontal zones: shelf break, middle, outer fronts; spring bloom in middle zone involves *Thalassiosira aestivalis, Th. nordenskioeldii, Chaetoceros debilis;* chlorophyll maxima near bottom; *Phaeocystis* in both zones through Sept., blooms in early May

Table 2. (cent.)

Author, Date	Region	Nature of Study, Methods	Results
Saito & Taniguchi, 1978	Bering Sea	Nutrient concentrations, pigments, species composition, succession, cell numbers in early July	*Chaetoceros convolutus*, *Ch. debilis* dominant on shelf in summer; mixture of spring, summer, ice species in northern area
Alexander & Cooney, 1979	eastern	Review of previous investigations; samples collected with Niskin bottles; cluster analysis used to identify species assemblages; species lists; primary productivity, chl a distribution; historical account of hydrography; ice edge ecosystem model	Four major groups delineated by cluster analysis: ice edge, deeper water, surface layer away from ice edge, shelf break; Ice survey in Norton Sound: chl a 0-213.7 mg m^3; most intense primary productivity at ice edge just prior to breakup with surface chl > 20 mg m^3, primary productivity 25 mg C m^3 hr
Dagg, 1979	southeast	Grazing impact of copepods on phytoplankton community	Copepod size affected what happened to the phytoplankton
Furuya, *et al.*, 1979	eastern	Samples collected with 0.1 mm mesh Norpac net hauled vertically from 150 m, water samples collected with Niskin bottles, filtered, settled, June-Aug. ; species list, abundance	Diatoms 70% of standing stock, but large populations of naked flagellates, coccoids; species of diatoms, dinoflagellates, silicoflagellates identified, listed
Goering & Iverson, 1979	southeast	See Goering and Iverson 1978	
Iverson & Goering, 1979	southeast	See Goering and Iverson 1978	Primary productivity during spring bloom: outer shelf: 200 g C m^2 yr; middle shelf: 400 g C m^2 yr; inner shelf: 120 g C m^2 yr
Iverson, *et al.*, 1979	southeast	See Iverson and Goering 1978	Local nitrate minima correlate with chl a maxima; calculated doubling time of four days for *Phaeocystis pouchetii*

Table 2. (cont.)

Author, Date	Region	Nature of Study, Methods	Results
Saino, *et al.*, 1979-	eastern	Water samples collected with Niskin bottles at light penetration depths; primary production; June-Aug.	Integrated production ranged from 11.6 mg C m^2 hr at Nunivak Is. to 80.2 mg C m^2 hr near the Pribilofs
Homer & Wencker, 1980	Norton Basin	Samples collected with Niskin bottles; temperature, salinity, plant pigments, primary productivity	Surface primary productivity 0.12-17.16 mg C m^3 hr; chl a 0.13-12 mg m^3
Niebauer, *et al.*, 1981	southeast	Cruises at ice edge in May-June 1975, March-April 1976; April-June 1977; hydrography; primary productivity; chl *a*	Nitrate depletion limits spring production at ice edge; increased light at ice edge as ice breaks up, but with some ice cover to reduce mixing, produces intense bloom; ice edge model
Alexander & Chapman, 1981	Norton Basin, southeast	Chl *a* in ice cores; productivity measured on brash ice collected at ice edge	Ice algae patchy on broad, narrow scales; some overlap in species composition between ice and seawater; ice algae < 1% of annual production in southeastern region, but important as concentrated food source early in season
Goering & Iverson, 1981	southeast	Water samples at discrete depths	Seasonal succession of shelf phytoplankton; factors affecting succession
Schandelmeier & Alexander (1981)	southeast	Water samples from discrete depths	Influence of ice on spring phytoplankton

IV. STUDY AREA

The study area and sampling locations for both cruises are given in Figure 1.

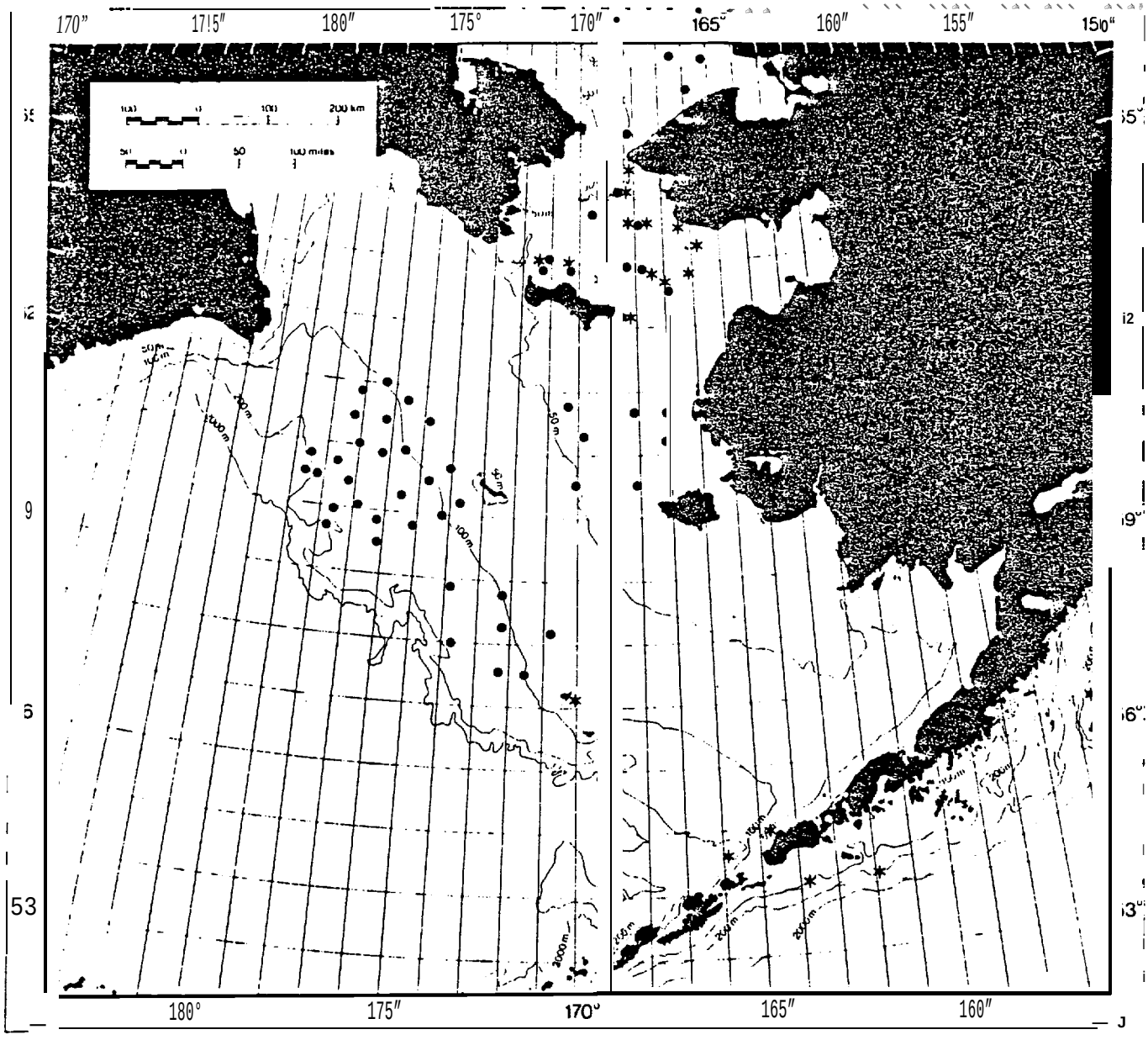


Fig. 1. Sampling locations for icebreaker cruises in the Bering Sea. * = CGC *Polar* Sea, 17 April-6 May 1979; .= CGC *Polar Star*, 4 May-24 June 1980.

V. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

A. Sample collection

Water samples were collected with 5 ℓ Niskin bottles equipped with reversing thermometers belonging to the U.S. Coast Guard. Samples were collected from 6 or 8 depths spaced throughout the water column with the bottom bottle placed as close as possible to the sea bed. Portions of each water sample were processed for phytoplankton standing stock, plant pigments, primary productivity, and nutrient and salinity determinations.

Phytoplankton standing stock samples contained in labeled 250 ml glass jars were preserved immediately with 4-5 ml 4% formaldehyde buffered with sodium acetate.

Plant pigment samples, usually 2 ℓ, were filtered through 47 mm, 0.45 µm Millipore filters with 2 drops of a saturated solution of $MgCO_3$ added near the end of the filtration. The filters and filter towers were rinsed with a few ml filtered seawater. The filters were removed, folded into quarters, placed in labeled glassine envelopes, placed in a dessicator, and frozen.

Primary productivity experiments were run in 60 ml. glass reagent bottles with 2 light and 1 dark bottle per depth. Each bottle was inoculated with 2 ml $NaH^{14}CO_3$, *ea. 5* µCi. *The* dark bottle was covered with black tape and wrapped in aluminum foil and all bottles were incubated for 3-4 hr under ambient light conditions in an incubator located on the fantail of the ship. Low temperature was maintained by constantly running seawater through the system. Light was measured at the beginning and end of the incubation period with a Gossen Super Pilot photographic light meter. Following incubation, the samples were filtered onto 25 mm, 0.45 µm Millipore filters, rinsed with a few ml 0.1 N HCl and a few ml filtered seawater, and placed in scintillation vials.

Nutrient samples were taken from the plant pigment filtrate. The first 500 ml of the pigment filtrate were discarded. The nutrient sample was taken from the next quantity of water filtered and before the $MgCO_3$ was added. The nutrient samples were poured into 125 ml polyethylene bottles and frozen.

Salinity samples were put in 250 ml polyethylene bottles and stored at room temperature for 4-5 days before analysis.

Temperatures were taken with reversing thermometers attached to the Niskin bottles. Thermometers were read within an hour of being brought to the surface.

Water transparency was determined to the nearest meter with a Secchi disc lowered on a calibrated handline. This determination was always done from a location next to the hydrographic platform and while the thermometers

were equilibrating. Two people determined when the Secchi disc was no longer visible.

B. Sample analysis

1. Standing stock

These samples were analyzed using Zeiss phase-contrast inverted microscopes and 5 and 50 ml Zeiss counting chambers. Large, rare organisms (> 100 µm) were counted at 125 X magnification in 50 ml chambers, while small, abundant organisms (< 100 µm) were counted at 312 X magnification in 5 ml chambers. Usually one-eighth of each chamber was counted. In some samples, the number of small flagellates (< 10 µm diameter) was excessive and were counted in one or two fields. The number of cells per liter was calculated by multiplying the number of cells counted in the 5 ml chamber by 1600 and the number counted in the 50 ml chamber by 160. References used to identify phytoplankton included Cupp (1943), Hendey (1964), Hustedt (1930, 1959-62), Schiller (1933-37), and Hasle (1965).

2* Plant pigments

Samples were analyzed by grinding the filters in *ca.* 10 ml *90%* acetone with a Teflon tissue grinder. The samples were centrifuged 3 times for a total of 30 rein, and the extract was analyzed with a Turner Model 111 fluorometer.

Chlorophyll a and pheopigments were calculated using the equations

$$\text{Chl a (mg m}^{-3}) = \frac{\dfrac{Fo/Fa_{max}}{(Fo/Fa_{max}) - 1}(K_x)(Fo-Fa)}{\text{Vol filtered}}$$

$$\text{Pheo (mg m}^{-3}) = \frac{\dfrac{Fo/Fa_{max}}{(Fo/Fa_{max}) - 1}(K_x)[Fo(Fo/Fa_{max})-Fa]}{\text{Vol filtered}}$$

where Fo = fluorometer reading before acidification; Fa = fluorometer reading after acidification; K = fluorometer door calibration factor; Fo/Fa_{max} = acid ratio; and vol filtered = volume of sample water filtered.

3. Primary productivity

Radioactive uptake was measured using liquid scintillation techniques in a Packard Tri-Carb Scintillation spectrometer. Aquasol (New England Nuclear, Boston, MA.) was the scintillation cocktail.

Carbon uptake was calculated using the equation

$$\text{Ps (mg Cm}^{-3}\text{ hr}^{-1}) = \frac{(L - D) \times W \times 1.05}{R \times T}$$

where L = light bottle disintegrations per minute; D = dark bottle disintegrations per minute; W = carbonate carbon present in the water; 1.05 = isotope factor for ^{14}C; R= activity of the ^{14}C added to each sample; T = incubation time (Strickland and Parsons 1968).

4. Nutrient concentrations

Nitrate, nitrite, ammonia, phosphate, and silicate concentrations were determined by the University of Washington, Department of Oceanography Chemistry Laboratory using autoanalyzer techniques (Pavlou 1972) .

5. Salinity

Samples were analyzed using a Bissett Berman Model 6220 induction salinometer using standard seawater to calibrate the instrument. The salinometer was standardized at the beginning and end of a run and after 30-40 samples if more than that were analyzed at-one time.

6. Temperature

In 1979, uncorrected thermometer readings were sent to the U.S. Coast Guard Oceanographic Unit, Washington, D.C., for correction. The 1980 thermometer readings were corrected using calibration factors provided by the Coast Guard and following procedures outlined in U.S. Naval Oceanographic Office Publ. 607 (1968).

VI. RESULTS

Temperature, salinity, plant pigment concentrations, primary productivity, nutrient concentrations, and ice cover for 1979 are given in Tables 3-4; vertical profiles of temperature-salinity and carbon-chlorophyll a are shown in Fig. 2. *Kite* diagrams of phytoplankton abundances are shown in Fig. 3. Integrated carbon uptake and chlorophyll *a* values are in Table 5. A list of phytoplankton species found in the Bering Sea in 1979 and 1980 is given in Table 6.

In 1979, at stations 1-18 in Norton Basin and Bering Strait, temperature was isothermal and < -1.0°C, while salinity *was* isohaline, ranging from 31.43-32.57°/00. Temperature and salinity at 8 stations south of the Pribilof Islands, south of Unimak Island, and in Shelikof Strait were also usually isothermal and isohaline, but temperatures were positive, ranging from 2.64-5.12°C and salinity ranging from 31.70-34.98"/...

Ice cover was variable with stations west of *ca.* 167°30′ and north of 64°N having relatively heavy ice cover, although a tongue of open water was present extending from ea. 167°30'-168°30'W and north to about 64°30'N. Some ice was also present at the station off Gambell on the northwest tip of *St.* Lawrence Island. No ice was present south of St. Lawrence Island.

Primary productivity was variable, with integrated production ranging from *ca.* 6 mg C m^{-2} hr^{-1} at station 17 north of St. Lawrence Island to 398

Table 3. Summary of station locations, hydrography, ice cover, chlorophyll a and phaeopigment concentrations, and primary productivity, CGC *Polar Sea* cruise, Bering Sea, 17 Apr - 6 May 1979.

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo (mg m^{-3})	Prim Prod (mg Cm^{-3} hr^{-1})
01	000	0644	19 Apr	64°15.5′	165°51.9′	8	2	*	31.842	1.68		8.23
	003							-1.67	31.845	1.92		7.29
	006							-1.69	31.887	2.32		9.82
	009							-1.68	31.886	1.28		7.00
	012							-1.68	31.877	1.36		7.25
	015							-1.69	31.800	1.36		8.26
	018							-1.71	31.820	2.72		10.31
	021							-1.72	31.929	2.64		11.82
02	000	1622	19 Apr	63°46.1′	166°03,2′	0	4,	-1.51	31.675	4.48		0.12
	003							-1.52	31.652	5.76		3.67
	006							-1.52		Bottle didn't trip		
	009							-1.53	31.653	5.04		2.84
	012							-1.53	31.654	5.76		3.35
	015							-1.54	31.665	7.56	0.36	3.44
	018							-1.56	31.684	10.44	0.36	2.12
	021							-1.54	31.693	11.16		2.79
03	000	0612	20 Apr	63°32.95′	166″52.78′	0	4	-1.62	31.559	4.66		9.19
	004							-1.63	31.554	3.36	0.42	10.51
	008							-1.64	31.550	1.34	1.83	7.88
	012							-1.63	31.555	3.90	0.26	7.63
	016							-1.64	31.557	3.22	0.40	6.41
	020							-1.64	31.559	2.94	0.28	8.09
	024							-1.65	31.553	3.80	0.44	5.32
	028							-1.64	31.556	2.10	0.28	4.58

* Where no temperature is present, both thermometers on the bottle malfunctioned.

Table 3. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Prim Prod (mg Cm^{-3} hr^{-1})
04	000	1237	20 Apr	63°56.7′	167°35.9′	5-6	4	-1.62	31.933	0.91		2.45
	004							-1.64	31.927	1.44		2.60
	008							-1.63	31.928	0.81	0.15	1.71
	012							-1.67	31.939	1.63	0.14	2.44
	016							-1.65	31.935	1.14	0.09	1.72
	020							-1.69	31.938	1.14	0.23	3.02
	024							-1.73	31.937	1.29	0.31	1.85
	028							-1.73	31.944	1.56	0.28	2.50
05	000	0537	21 Apr	64°30.3′	166°23.3′	6-7	4	-1.67	31.240	2.89		3.10
	003							-1.66	31.225	1.56		7.20
	006							-1 *68	31.457	3.20	0.19	3.88
	009							-1.66	31.438	1.28		4.13
	012							-1.68	31.490	1.93		3.61
	015							-1.72	31.456	1.68	0.06	6.16
	018							-1.71	31.456	0.83		5.51
06	000	0956	22 Apr	66°36.26′	168°25.40′	7-8	4	-1.29	31.587	0.25	0.94	0.97
	005								31.689	0.26	0.99	1.30
	010							-1.66	31.715	0.14	0.95	0.84
	015							-1.70	31.716	1.17		1.25
	020								31.740	0.35	0.59	0.81
	025							-1.69	31.760	1.07	0.22	1.19
	030							-1.71	31.763	0.12	1.42	0.77
	035							-1.72	31.760	1.00	0.40	1.26

Table 3. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°c)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg Cm^{-3} hr^{-1})
09	000	1222	24 Apr	65°36.6′	168°35.6′	7-8	2	-1.64	31.684	0.35	1.40	1.59
	005							-1.69	31.726	0.98	0.14	1060
	010							-1.70	31.723	0.94	0.08	1.33
	015							-1.72	31.714	0.82	0.18	1.27
	020							-1.70	31.723	0.91	0.27	1.56
	025							-1.71	31.723	0.93	0.21	1.21
	035							-1.73	31.722	1.16	0.27	1.01
	045							-1.72	31.719	1.16	0.38	1.07
10	000	1222	25 Apr	65°29.89′	168°06.11′	7-8	3	-1.30	31.437	0.62	0.08	8.66
	005							-1.39	31.432	0.52	0.07	11.24
	010							-1.63	31.442	0.53	0.09	5.93
	015							-1.37	31.444	0.41	0.03	10.42
	020							-1.39	31.443	0.48	0.09	6.84
	025								31.448	0.54	0.11	7.73
	030							-1.33	31.458	0.50	0.09	6.02
11	000	0625	26 Apr	65°01.8′	168°15.7′	7-8	3		32.312	0.49	0.42	0.53
	005							-1.38	32.308	0.39	0.27	0.52
	010							-1.49	32.308	0.26	0.33	0.33
	015							-1.44	32.311	0.26	0,23	0.42
	020								32.306	0.39	0.20	0.46
	025							-1.51	32.323	0.36	0.27	0.44
	030							-1.42	32.345	0.46	0.31	0.62
	040								32.359	0.40	0.40	0.60

Table 3. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg Cm^{-3} hr^{-1})
12	000	0634	27 Apr	64°29′64′	167°40.10′	0	2	-1.11	31.568	10.00	2.00	12.27
	004							-1.18	31.569	8.50	2.00	15.94
	008							-1.21	31.572	10.00	1.50	15.07
	012							-1.21	31.569	12.00	0.50	17.05
	016							-1.22	31.573	3.50		13.24
	020							-1.21	31.571	9,50	2.00	14.75
	024							-1.23	31.568	9.00	2.00	8.63
	028							-1.23	31.563	4.60	4.40	17.16
13	000	1337	27 Apr	64°37.82′	168°25.67′	< 1	2	-1.49	32.191	1.00	0.50	0.94
	004							-1.57	32.189	0.80	0.40	1.60
	008							-1.58	32.191	0.50	0.30	1.06
	012							-1.60	32.195	0.60	0.30	1.70
	016							-1.60	32.192	0.70	0.30	1.15
	020							-1.61	32.193	0.70	0.35	1.14
	024							-1.63	32.196	0.70	0.40	1.12
	030							-1.63	32.200	0.55	0.40	1.19
14	000	0602	28 Apr	64°12.66′	168°57.44′	4-5	4	-1.69	32.371	0.17	0.14	0.23
	004							-1.73	32.376	0.17	0.14	0.30
	008							-1.75	32.368	0.17	0.16	0.29
	012							-1.76	32.368	0.16	0.15	0.28
	016							-1.74	32.377	0.17	0.17	0.31
	020							-1.77	32.406	0.16	0,14	0.26
	026							-1.77	32.433	0.15	0.19	0.33
	032							-1.78	32.499	0.14	0.20	0.21

Table 3.. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo (mg m^{-3})	Prim Prod (mg C m^{-3} hr^{-1})
15	000	0611	29 Apr	63°50.91′	170°26.03′	0	3	-1.40	32.029	0.13	0.11	,0.38
	004							-1.53	32.032	0.17	0.12	0.44
	008							-1.54	32.028	0.18	0.10	0.36
	012							-1.54	32.031	0.16	0.10	0.33
	016							-1.53	32.025	0.15	0.10	0.32
	020							-1.54	32.035	0.18	0.10	0.39
	024							-1.54	32.037	0.14	0.12	0.33
	030							-1.56	32.034	0.17	0.12	0.32
16	000	1307	29 Apr	64°00.6′	171°25.5′	1-3	4	-1.52	31.978	0.38	0.11	0.71
	004							-1.64	31.980	0.30	0.06	0.54
	008							-1.66	31.979	0.39	0.09	O*90
	012							-1.69	31.980	0.40	0.06	0.77
	016							-1.68	31.979	0.27	0.24	0,83
	020							-1 .68	31.976	0.38	0.11	0.63
	024							-1.69	31.966	0.37	0.08	0,71
	028							-1.70	31.980	0.35	0.10	0.75
17	000	0600	30 Apr	63°44.83′	169°12.32′	0	5	-1.58	32.261	0.16	0.10	0.28
	002							-1.61	32.282	0.21		0.21
	006							-1.5?3	32.398	0.15	0.11	0.22
	010							-1.59	32.299	0.14	0.09	0.21
	014							-1.56	32.348	0.13	0.11	0.23
	018								32.316	0.12	0.10	0.18
	024							-1.63	32.346	0,11	0.11	0.22
	030							-1.68	32.434	0,12	0.13	0.16

Table 3. (continued)

Sta	Depth (m)	Time (Local	Date	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°c)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg C m^{-3} hr^{-1})
18	000	1343	30 Apr	63°17.83′	168°20.07′	0	4	-1.16	31.449	1.40	0.25	2.02
	004							-1.19	31.450	1.20	0.30	2.02
	008							-1.20	31.456	1.35	0.30	2.04
	012							-1.23	31.455	1.30	0.30	2.70
	018							-1.27	31.457	1.35	0.30	1.76
	024							-1.32	31.461	1.80	0.35	2.38
	030							-1.34	31.459	1.40	0.30	3.44
	036							-1.33	31.462	1.80	0.40	3.67
19	000	0552	2 May	57°06.89′	170°00.7′	0	3-4	2.68	32.583	1.05	0.35	2.13
	005							1.56	32.542	1.35	0.50	2.19
	010							2.67	32.540	1.05	0.35	2.47
	015							2.64	32.538	1.65	0.60	3.20
	020							2.67	32.664	1.05	0.45	1.69
	025							2.67	32.585	0.95	0.40	2.53
	030							2.66	32.583	1.05	0.25	2.35
	042							2.66	34.977	0.85	0.70	3.58
20	000	1255	2 May	56°27.50′	169°25.06′	0	12	3.91	32.546	0.28	0.15	0.54
	010								32.514	0.28	oil	0.81
	020							3.55	32.504	0.29	0.16	1.08
	030							3.49	32.485	0.24	0.11	1.07
	040							3.50	32.468	0.25	0.17	0.70
	050								32.444	0.25	0.17	0.85
	060							3.48	32.410	0.25	0.14	0.82
	080							3.48	32.379	0.28	0.14	0.93

Table 3. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg Cm^{-3} hr^{-1})
23	000	0657	3May	54°34.07′	165°58.64′	0	∿ 7	4.49	32.808	4.00	0.80	6.18
	010							4.57	32,788	3.30	0.70	10.42
	020							4.57	32.785	2.80	0.70	14.05
	030							4.40	32.785	1.90	0.30	7.99
	045							4.40	32.800	1.70	0.45	5.90
	060							4.35	32.808	1.55	0.40	5.55
	075							4.32	32.829	1.60	0.55	8.74
	100							4.09	32.977	0.65	0.40	2.15
24	000	1423	3 May	54°58.7′	164°36.2′	0	∿ 7	4.81	32.240	1.15	0.35	5.18
	005							4.76	32.235	0.95	0.25	5.19
	010							4.74	32.239	1.10	0.20	5.75
	015							4.70	32.252	1.10	0.30	5.60
	020							4.72	32.303	1.25	0.45	2.58
	025							4.52	32.318	0.70	0.35	4.45
	035							4.44	32.380	0.85	0.30	2.42
	045							4.41	32.424	0.55	0.40	0.98
25	000	0658	4 May	54°10.36′	163°47.78′	0	8	4.72	31.704	0.85	0.20	2.71
	010							4.69	31.709	0.80	0.30	2.45
	020							4.70	31.718	0.90	0.25	2.74
	030							4.54	31.812	1.60	0.45	3.23
	040							4.53	31.875	1.25	0.35	3.10
	050							4.47	31.923	0.90	0.60	1.91
	060							4.21	31.974	0.55	0.50	0.71
	075							4.04	32.170	0.09	0.32	0.20

Table 3. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Temp (°C)	S°/₀₀	Chl *a* (mg m^{-3})	Phaeo	Prim Prod (mg C m^{-3} hr^{-1})
26	000	1605	4 May	54″14.7′	161°52.5′	0	> 12	4.62	31.789	0.45	0.30	1.34
	005							4.60	31.798	0.50	0.20	1.25
	010							4.59	31.794	0.75	0.20	1.33
	020							4.47	31.805	0.55	0.20	1.43
	030								31.822	0.45		0.59
	040							4.15	31.953	0.13	0.27	0.15
	050							3.97	32.138	0.14	0.10	0.12
	060							4.03	32.250	0.07	0.22	0.08
27	000	1506	5 May	56°21.44′	155″30.78′	0	> 10	5.07	32.194	3.60	0.60	15.14
	005							5.00	32.192	3.40	0.60	16.23
	010							4.77	32.192	3.90	0.50	14.25
	015							4.55	32,205	3.10	0.40	7.91
	020							4.53	32.194	3.30		8.94
	030							4.47	32.199	2.25	0.40	5.47
	040							4.49	32.230	1.85	0.50	3.73
	050							4.64	32.323	1.25	0.65	3.49
28	000	0659	6 May	59°07.07′	152°54.38′	0	> 10	5.12	32.099	3.40	0.60	22.33
	010							4.98	32.044	3.70	0.60	19.80
	020							4.89	32.100	4.80	0.80	18.78
	030							4.71	32.144	3.10	0.70	13.47
	040							4.72		2.80	0.80	10.66
	050							4.70	32.142	3.10	1.00	9.27
	060							4.69	32.136	2.30	0.70	8.53
	070							4.68	32,138	2.60	0.90	8.88

Table 4. Hydrographic data, CGC *Polar Sea* cruise, Bering Sea, 17 Apr - 6 May 1979.

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Temp (°C)	S°/oo	PO_4	SiO_4	NO_3	NO_2	NH_3
										(µg at ℓ)				
01	000	0644	19 Apr	64°15.5′	165°51.9′	22	2	*	31.842	1.04	23.61	2.90	0.04	1.09
	003							-1.67	31.845	0.85	19.63	2.23	0.03	2.53
	006							-1.69	31.887	0.76	14.79	1.76	0.02	2.28
	009							-1.68	31.886	0.79	17.11	2.29	0,03	3.69
	012							-1.68	31.877	0.77	13.72	1.66	0.03	2.28
	015							-1.69	31.800	1.05	24.52	3.08	0.04	0.64
	018							-1.71	31.820	0.86	18.21	2.30	0.02	0.95
	021							-1.72	31.929	1.12	24.52	3.29	0.06	0.66
02	000	1622	19 Apr	63°46.1′	166°03.2′	26	4	-1.51	31.675	0.44	5.66	0.08	0.00	1.04
	003							-1.52	31.652	0,40	5.79	0.09	0,00	0.93
	006							-1.52		Bottle didn't trip				
	009							-1.53	31.653	0.51	6.94	0.12	0.00	0.65
	012							-1.53	31.654	0.44	7.18	0.21	0.00	1.60
	015							-1.54	31.665	0.35	4.97	0.09	0,00	1.07
	018							-1.56	31.684	0.52	7.93	0.09	0.00	0.50
	021							-1.54	31.693	0.43	6.64	0.09	0,00	0.79
03	000	0612	20 Apr	63°32.95′	166°52.78′	31	4	-1.62	31.559	1.15	16.69	5.06	0.22	1.24
	004							-1.63	31.554	1.12	16.70	5.17	0.23	1.23
	008							-1.64	31.550	1.13	16.32	5.17	0.19	1.08
	012							-1.63	31.555	1.13	16.32	5.11	0.19	1.12
	016							-1.64	31.557	1.15	16.71	5.08	0,21	1.07
	020							-1.64	31.559	1.11	16.33	5.11	0,24	1.19
	024							-1.65	31.553	1.11	16.41	5.17	0.20	1.11
	028							-1.64	31.556	1.12	16.41	5.08	0.19	0.99

* Where no temperature is present, both thermometers on the bottle malfunctioned.

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (“c)	S°/₀₀	PO_4	SiO_4 (µg at ℓ)	NO_3	NO_2	Ml_3
04	000	1237	20 Apr	63°56.7′	167″35.9′	32	4	-1.62	31.933	1.50	27.88	9.57	0.14	1.46
	004							-1.64	31.927	1.52	28.36	9.70	0.15	1.59
	008							-1.63	31.928	1.55	28.45	9.73	0.14	1.58
	012							-1.67	31.939	1.56	28.35	9.61	0.13	1.33
	016							-1.65	31.935	1.56	28.54	9.70	0.14	1.49
	020							-1.69	31.938	1.56	28.54	9.77	0.14	1.46
	024							-1.73	31.937	1.49	28.44	9.77	0.14	1.34
	028							-1.73	31.944	1.54	28.53	9.83	0.14	1.44
05	000	0537	21 Apr	64″30.3′	166°23.3′	22	4	-1.67	31.240	1.11	20.80	4.15	0.08	1.21
	003							-1.66	31.225	1.12	20.64	4.15	0.09	1.26
	006							-1.68	31.457	1.14	21.06	4.25	0.09	1.08
	009							-1.66	31.438	1.10	20.23	4.04	0.08	0.99
	012							-1.68	31.490	1.10	20.73	4.35	0.15	1.25
	015							-1.72	31.456	1.12	20.90	4.27	0.08	1.10
	018							-1.71	31.456	1.12	20.32	4.25	0.09	1.21
06	000	0956	22 Apr	66°36.26′	168°25.40′	40	4	-1.29	31.587	1.28	25.85	6.49	0.10	2.03
	005								31.689	1.29	26.22	6.54	0.11	2.32
	010							-1.66	31.715	1.26	26.12	6.57	0.11	2.41
	015							-1.70	31.716	1.07	20.75	5.23	0.07	2.29
	020								31.740	1.00	16.41	4.32	0.06	2.91
	025							-1.69	31.760	1.00	17.47	4.45	0.05	2.39
	030							-1.71	31.763	1.00	16.93	4.28	0.05	2.32
	035							-1.72	31.760	1.33	26.47	6.60	0.06	1.95

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (“C)	S°/₀₀	P04	SiO_4	NO_3	NO_2	NH3
										(µg at ℓ)				
09	000	1222	24 Apr	65°36.6′	168°35.6′	55	2	-1.64	31.684	1.49	26.09	8.71	0.’14	1.97
	005							-1.69	31.726	1.50	26.55	8.72	0.21	1.90
	010							-1.70	31.723	1.55	26.45	9.24	0.38	2.19
	015							-1.72	31.714	1.54	26.08	8.72	0.12	2.10
	020							-1.70	31.723	1.54	26.35	9.01	0.11	2.26
	025							-1.71	31.723	1.46	24.06	8.03	0.09	2.25
	035							-1.73	31.722	1.54	25.97	8.75	0.10	2.16
	045							-1.72	31.719	1.55	26.43	8.73	0.10	2.07
10	000	1222	25 Apr	65°29.89′	168°06.11′	40	3	-1.30	31.437	0.89	14.58	0.82	0.05	0.98
	005							-1.39	31.432	0.91	14.93	0.90	0.05	0.70
	010							-1.63	31.442	0.90	15.44	1.38	0.18	1.25
	015							-1.37	31.444	0.91	14.78	1.06	0.06	0.70
	020							-1.39	31.443	0.90	15.44	1.30	0.05	0.84
	025								31.448	0.63	9.43	0.69	0.11	1.16
	030							-1.33	31.458	0.93	15.95	1.06	0.02	0.70
11	000	0625	26 Apr	65°01.8′	168°15.7'	44	3		32.312	1.49	30.00	10.90	0.17	2*10
	005							-1.38	32.308	1.86	38.08	13.52	0.20	1.82
	010							-1.49	32.308	1.48	28.44	9.93	0.15	2.38
	015							-1.44	32.311	1.54	31.35	11.25	0.13	2.38
	020								32.306	1.57	31.32	11.07	0.12	2.16
	025							-1.51	32.323	1.32	26.41	9.46	0.10	2.11
	030							-1.42	32.345	1.38	24.80	8.99	0.12	2.49
	040								32.359	1.39	28.17	10.08	0.11	2.41

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (°C)	S°/₀₀	P04	SiO_4	N03	NO_2	NH3
											(µg at ℓ)			
12	000	0634	27 Apr	64°29.64′	167°40.10′	36	2	-1.11	31.568	1.02	12.68	2.37	0.17	0.47
	004							-1.18	31.569	1.05	13.15	2.21	0.18	0.40
	008							-1.21	31.572	1.01	12.95	2.25	0.14	0.51
	012							-1.21	31.569	1.04	13.22	2.25	0.19	0.31
	016							-1.22	31.573	1.03	13.22	2.18	0.13	0.33
	020							-1.21	31.571	1.05	12.95	2.35	0.11	0.33
	024							-1.23	31.568	1.02	13.50	1.99	0.12	0.20
	028							-1.23	31.563	1.02	12.34	1.91	0.10	0.34
13	000	1337	27 Apr	64°37.82′	168″25.67′	35	2	-1.49	32.191	1.90	37*39	14.09	0.23	1.04
	004							-1.57	32.189	1.94	38.45	14.09	0.17	1.08
	008							-1.58	32.191	1.92	38.81	14.31	0.16	0.94
	012							-1.60	32.195	1.92	38.93	14.22	0.20	0.98
	016							-1.60	32.192	1.60	37.04	13.50	0.19	1,66
	020							-1.61	32.193	1.60	38.81	14.53	0.18	1.40
	024							-1.63	32.196	1.90	38.69	14.00	0.20	0.94
	030							-1.63	32.200	1.83	37.98	13.79	0.23	0.94
14	000	0602	28 Apr	64°12.66′	168°57.44′	36	4	-1.69	32.371	2.05	43.88	17.25	0.20	0.80
	004							-1.73	32.376	2.06	43.83	17.25	0.16	0.71
	008							-1.75	32.368	2.09	44.97	17.25	0.11	1.08
	012							-1.76	32.368	2.06	45.24	17.25	0.12	1.03
	016							-1.74	32.377	2.05	45.38	17.36	0.12	0.88
	020							-1.77	32.406	2.00	45.94	17.30	0.12	1.01
	026							-1.77	32.433	2.10	46.22	17.36	0.12	1.15
	032							-1.78	32.499	2.10	47.36	17.70	0.14	1.07

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (°C)	S°/₀₀	PO_4	SiO_4	NO_3	NO_2	NH3
										(µg at ℓ)				
15	000	0611	29 Apr	63°50,91′	170°26.03′	34	3	-1.48	32.029	2.04	44001	16.76	0.17	0.87
	004							-1.53	32.032	2,05	45.24	16.98	0.14	0.78
	008							-1.54	32.028	2.04	45.24	16,92	0.13	0.80
	012							-1.54	32.031	2.05	44.97	17.03	0.20	0.82
	016							-1.53	32.025	2.05	44.69	16.71	0.12	0.72
	020							-1.54	32.035	2.04	45.24	17.03	0.11	0.86
	024							-1.54	32.037	2.04	45.24	17.08	0.12	0.82
	030							-1.56	32.034	2.05	44.56	16.92	0.13	1.26
16	000	1307	29 Apr	64°00.6′	171°25.5″	32	4	-1.52	31.978	1.95	42.63	16.28	0.11	0.43
	004							-1.64	31.980	1.99	43.43	16.48	0.12	0.45
	008							-1.66	31.979	2.03	44.10	16.74	0.13	0.63
	012							-1.69	31.980	2.00	43.31	16.43	0.10	0.40
	016							-1.68	31.979	2.00	43.32	16.42	0.10	0.34
	020							-1.68	31.976	1.99	43.46	16.47	0.09	0.40
	024							-1.69	31.966	1.99	44.01	16.57	0.10	0.34
	028							-1.70	31.980	2.00	44.15	16.68	0.10	0.53
17	000	0600	30 Apr	63°44.83′	169°12.32′	36	5	-1.58	32.261	2.08	44.71	17.26	0.20	0.74
	002							-1.61	32.282	2.09	46.24	17.26	0.15	0.75
	006							-1.58	32.298	2.09	46.82	17.42	0.14	0.79
	010							-1.59	32.299	2.10	46.68	17.59	0.18	0.73
	014							-1.56	32.348	2.09	46.84	17.31	0.14	0.71
	018								32.316	2.08	46.99	17.53	0.14	0.85
	024							-1.63	32.346	2.12	47.72	17.81	0.15	0.91
	030							-1.68	32.434	2.13	48.61	18.22	0.16	0.94

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (“c)	S°/₀₀	PO_4	SiO_4	NO_3	NO_2	NH_3
										(µg at ℓ)				
18	000	1343	30 Apr	63°17.83′	168°20.07′	42	4	-1.16	31.449	1.41	25.26	7.86	0.13	2.19
	004							-1.19	31.450	1.66	29.35	9.88	0.13	1.78
	008							-1.20	31.456	1.53	26.57	9.60	0.11	1.51
	012							-1.23	31.455	1.53	25.17	9.47	0.17	1.52
	018							-1.27	31.457	1.48	25.95	9.44	0,13	1.57
	024							-1.32	31.461	1.48	28.10	9.98	0.11	1.39
	030							-1.34	31.459	1.55	28.13	9.95	0.10	1.32
	036							-1.33	31.462	1.44	24.80	8.92	0.10	1.63
19	000	0552	2 May	57°06.89′	170′′00.7′	46	3-4	2.68	32.583	1.77	48.02	22.01	0.24	0.80
	005							1.56	32.542	1.77	48.91	22.00	0.21	0.78
	010							2.67	32.540	1.78	49.22	22.24	0.21	0.86
	015							2.64	32.538	1.77	48.94	22.08	0.21	0.89
	020							2.67	32.664	1.77	48.95	22.32	0.21	0.96
	025							2.67	32.585	1.80	49.71	22.32	0.21	0.97
	030							2.66	32.583	1.80	50.02	22.49	0.23	1.07
	042							2.66	34.977	1.79	49.88	22.40	0.21	1.03
20	000	1255	2 May	56°27.50	169°25.06′	93	12	3.91	32.546	1.7s	48.20	22.58	0.24	0.68
	010								32.514	1.79	50.00	22.74	0.24	0.73
	020							3.55	32.504	1.82	50.31	23.17	0.23	0.82
	030							3.49	32.485	1.80	50.94	23.16	0.24	0.69
	040							3.50	32.468	1.79	51.26	23.51	0.24	0.77
	050								32.444	1.79	51.27	23.60	0.25	0.83
	060							3.48	32.410	1.82	51.91	23.51	0.24	0.82
	080							3.48	32.379	1.78	49.92	22.74	0.24	0.88

Table 4, (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (°C)	S°/oo	P04	SiO4	NO3	NO2	NH3
										(µg at ℓ)				
23	000	0657	3 May	54°34.07′	165°58.64′	437	∿ 7	4.49	32.808	0.87	14.75	9.04	0.14	1.00
	010							4.57	32.788	1.29	28.22	16.54	0.29	0.47
	020							4.57	32.785	1.29	28.15	16.76	0.27	0.54
	030							4.40	32.785	1.49	32.50	18.41	0.24	1.06
	045							4.40	32.800	1.51	34.62	18.77	0.25	1.07
	060							4.35	32.808	1.54	35.09	19.35	0.25	1.13
	075							4.32	32.829	1.52	35.46	19.35	0.25	1.13
	100							4.09	32.977	1.78	43.94	23.68	0.29	1.03
24	000	1423	3May	54°58.7′	164°36.2′	55	∿ 7	4.81	32.240	1.27	32.54	14.32	0.23	0.79
	005							4.76	32.235	1.32	34.87	14.63	0.23	0.86
	010							4.74	32.239	1.30	35.12	14.73	0,21	0.87
	015							4.70	32.252	1.33	35.83	14.96	0,21	0.87
	020							4.72	32.303	1.38	36.90	16.49	0.22	1.11
	025							4.52	32.318	1.38	37.27	17.03	0.22	1.17
	035							4.44	32.380	1.47	37.89	17.87	0.23	1.55
	045							4.41	32.424	1.50	38.39	18.35	0.21	1.51
25	000	0658	4 May	54°10.36′	163°47.78′	86	8	4.72	31.704	0.78	26.29	5.32	0.21	1.37
	010							4.69	31.709	0.78	27.18	5.27	0.17	1.32
	020							4.70	31.718	0.80	27.20	5.29	0.15	1.66
	030							4.54	31.812	0.91	28.19	6.71	0.16	1.66
	040							4.53	31.875	1.06	28.81	10.47	0.16	2.11
	050							4.47	31.923	1.12	30.04	10.64	0.15	2.08
	060							4.21	31.974	1.29	32.35	13.25	0.19	2.13
	075							4.04	32.170	1.50	36.36	17.45	0.26	2.61

Table 4. (continued)

Sta	Depth (m)	Time (Local)	Date	Latitude (N)	Longitude (w)	Sonic Depth (m)	Secchi Depth (m)	Temp (°C)	S°/oo	PO_4	SiO_4	NO_3	NO_2	NH_3
										(µg at ℓ)				
26	000	1605	4 May	54°14.7′	161°52.5′	71	> 12	4.62	31.789	0.65	14.33	3.78	0.08	2.89
	005							4.60	31.798	1.04	25.85	6.61	0.12	2.21
	010							4.59	31.794	1.03	25.95	6.71	0.10	2.26
	020							4.47	31.805	1.03	25.97	6.59	0.10	2.22
	030								31.822	1.03	25.89	6.71	0.11	2.20
	040							4.15	31.953	1.20	29.75	10.99	0.14	2.16
	050							3.97	32.138	1.42	34.81	15.78	0.19	0.95
	060							4.03	32.250	1.45	36.17	16.65	0.20	0.84
27	000	1506	5 May	56°21.44′	155°30.78′	60	> 10	5.07	32.194	0.92	21.53	10.27	0.17	0.43
	005							5.00	32.192	0.93	22.39	10.44	0.23	0.50
	010							4.77	32.192	0.94	22.58	10.44	0.15	0.67
	015							4.55	32.205	0.98	22.76	11.33	0.15	1.03
	020							4.53	32.194	0.93	22.00	11.16	0.14	0.82
	030							4.47	32.199	1.05	23.68	12.01	0.14	1.63
	040							4.49	32.230	1.13	25.38	12.47	0.15	1.97
	050							4.64	32.323	1.21	27.33	13.28	0.15	2.39
28	000	0659	6 May	59°07.07′	152°54.38′	81	> 10	5.12	32.099	0.82	19.80	9.24	0.16	0.44
	010							4.98	32.044	0.89	20.62	9.90	0.19	0.66
	020							4.89	32.100	0.96	21.87	10.83	0.15	0.76
	030							4,71	32.144	1.07	23.95	12.32	0.16	1.16
	040							4.72		1.08	24.48	12.52	0.15	1.21
	050							4.70	32.142	1.12	24.93	12.72	0.15	1.30
	060							4.69	32.136	1.12	24.93	12.73	0.15	1.28
	070							4.68	32.138	1.13	24.38	12.90	0.15	1.29

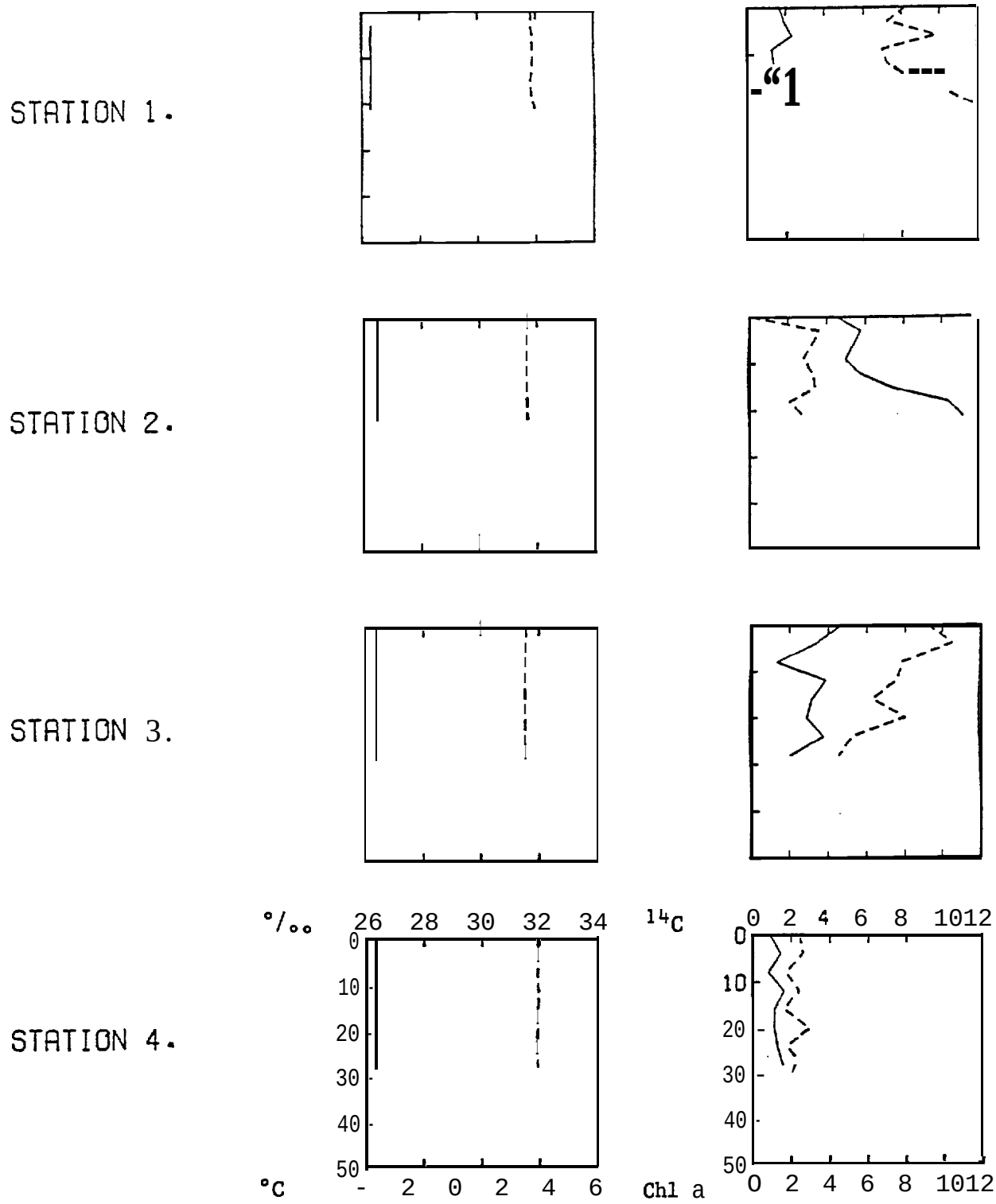
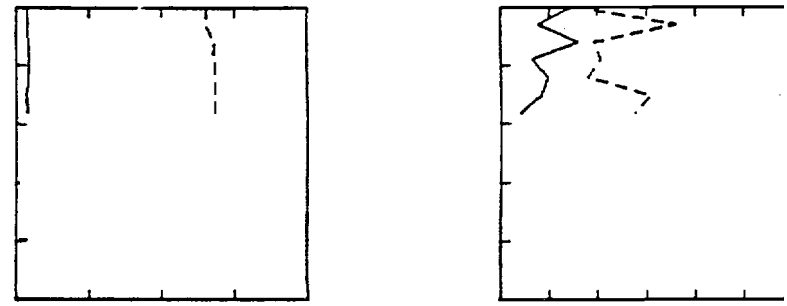


Fig. 2. Depth profiles of temperature-salinity and chlorophyll *a*-primary productivity in the Bering Sea and Shelikof Strait, 17 Apr-6 May 1979. Salinity (°/oo) ---; temperature (°C) —; primary productivity (mg Cm^{-3} hr^{-1}) ---; chlorophyll *a* (mg m^{-3}) _.

STATION 5.



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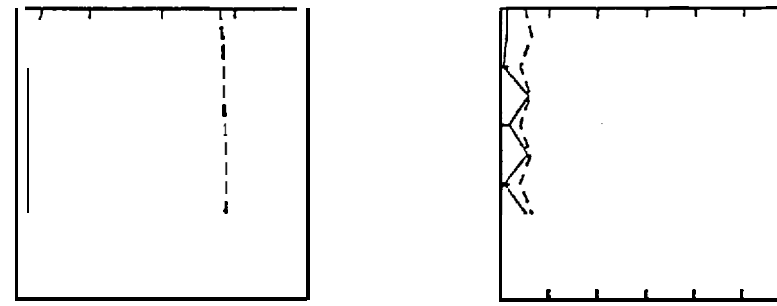
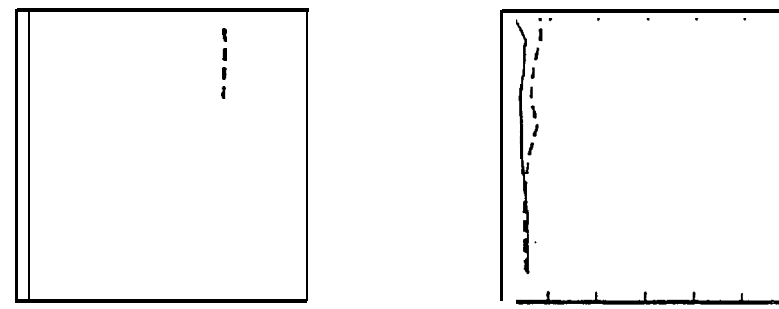


STATION 9.



STFITION1O.

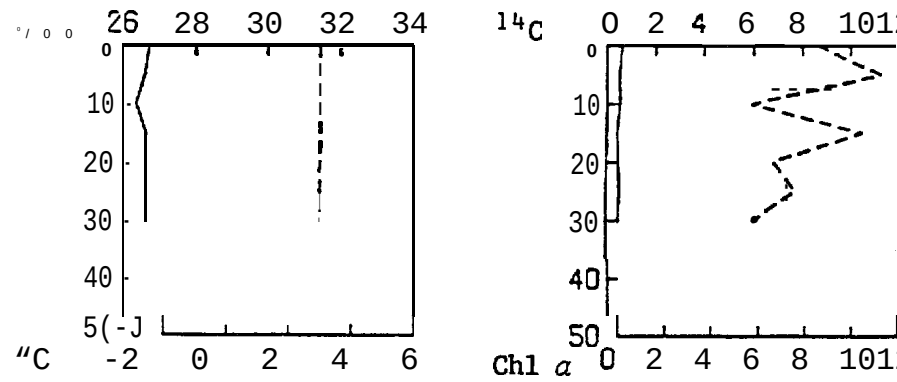


Fig. 2. (continued)

STATION11.

STATION12.

STATION13.

STATION14.

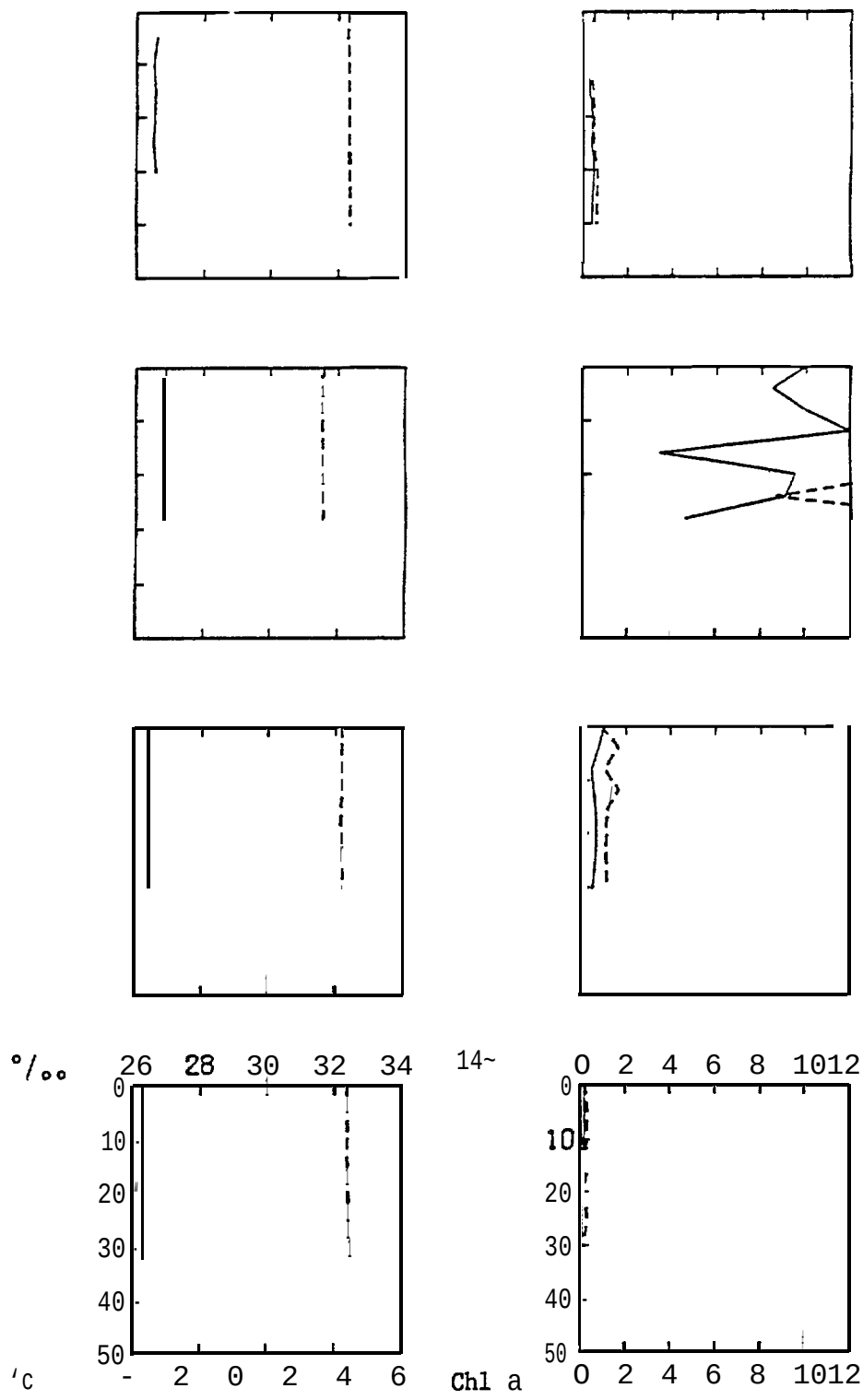


Fig. 2 (continued)

STATION15.

STATION16.

STATION17.

STATION18.

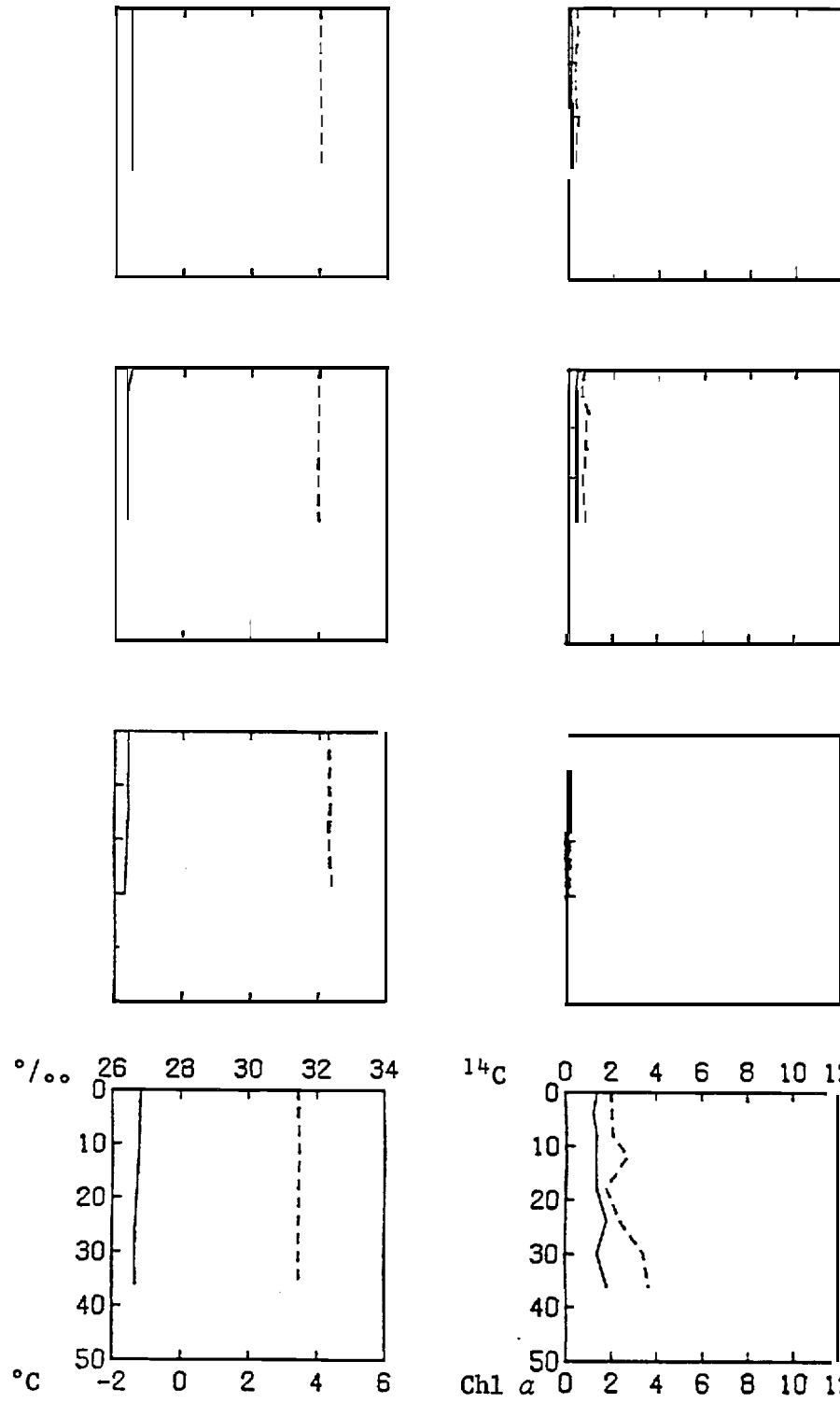


Fig. 2. (continued)

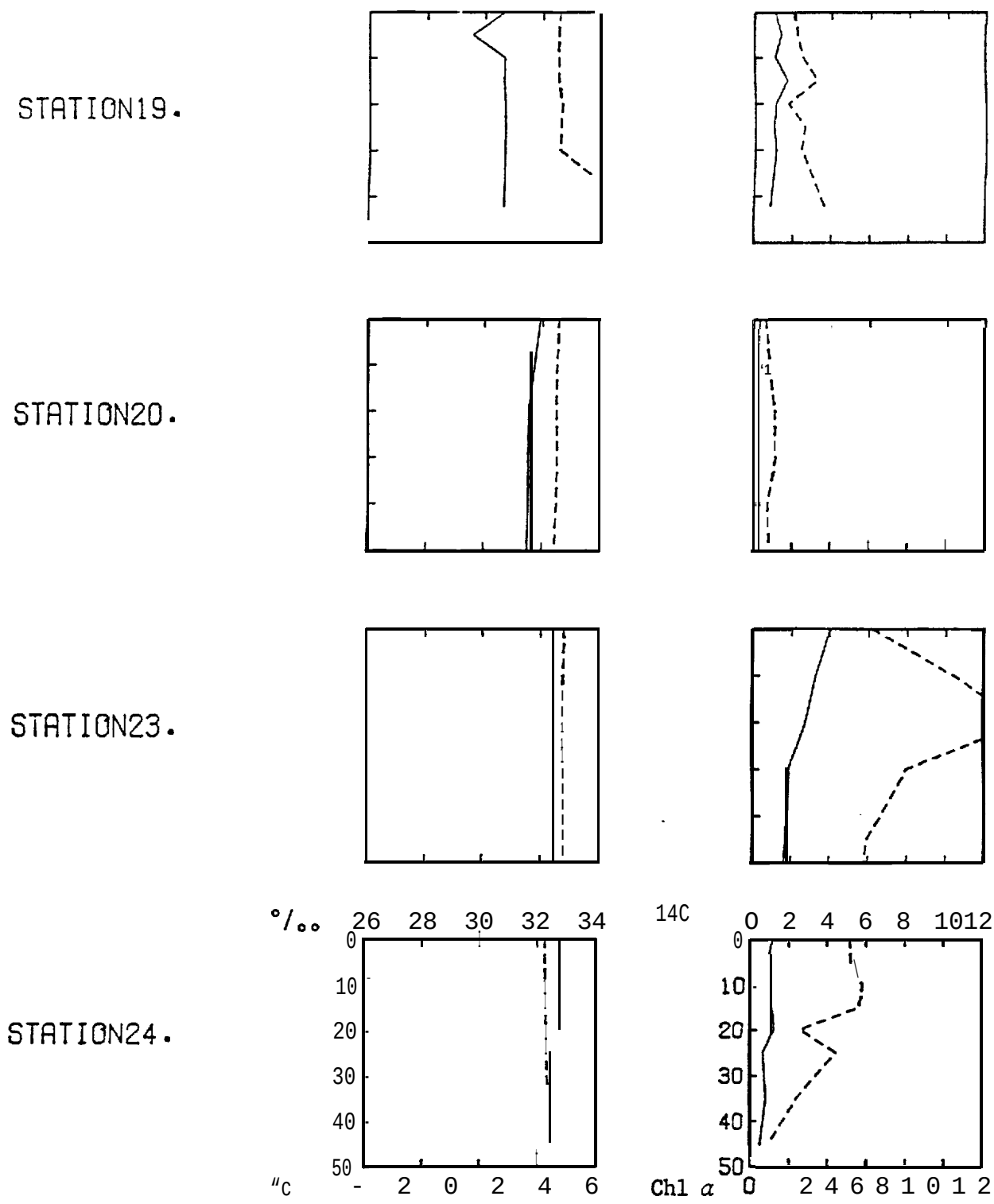


Fig. 2. (continued)

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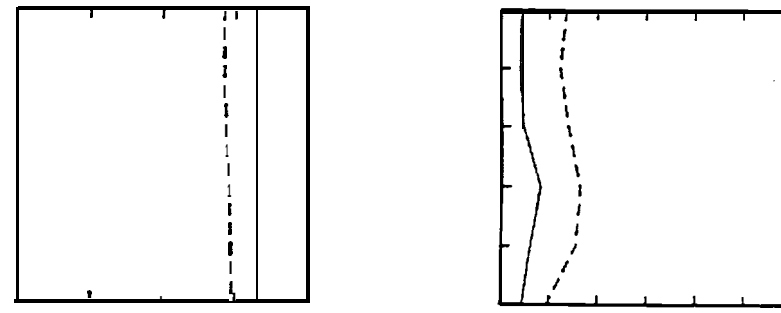

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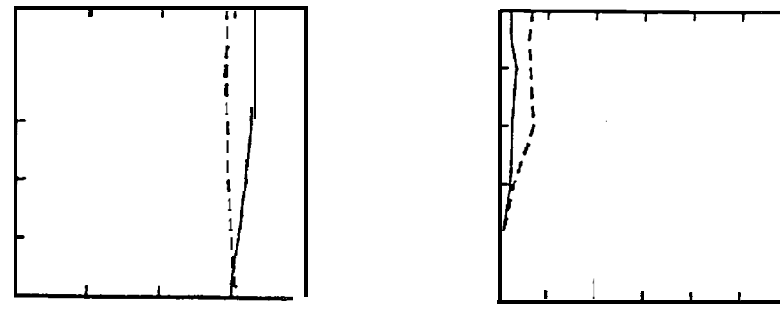

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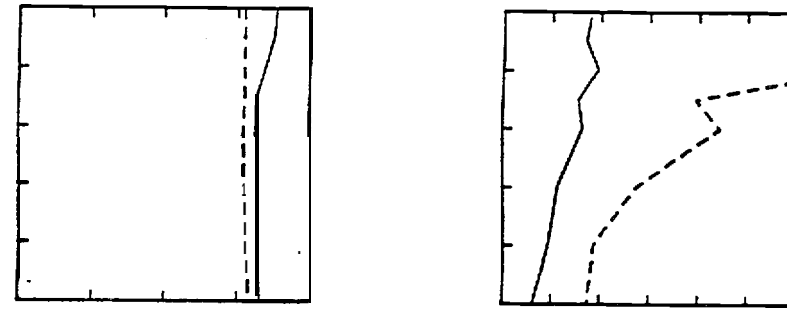

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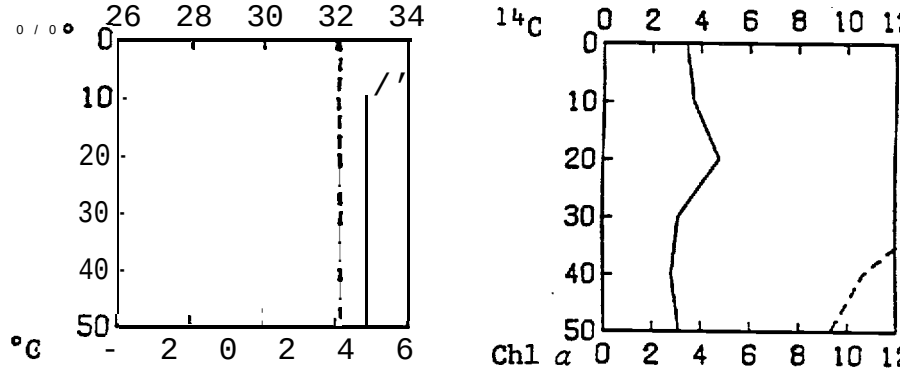


Fig. 2. (continued)

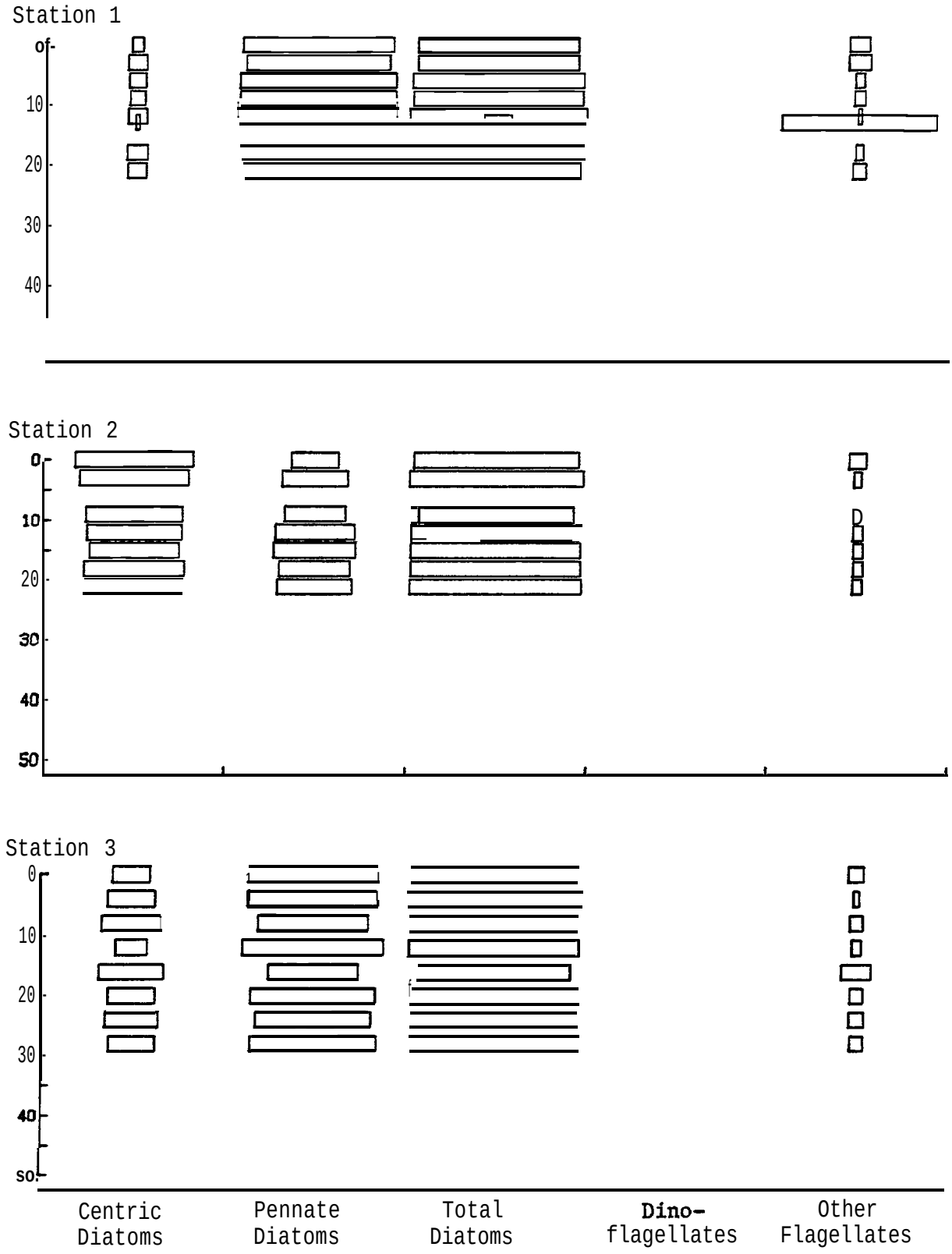


Fig. 3. Kite diagrams showing depth distribution of major categories of phytoplankton in the Bering Sea, 17 April-6 May 1979.

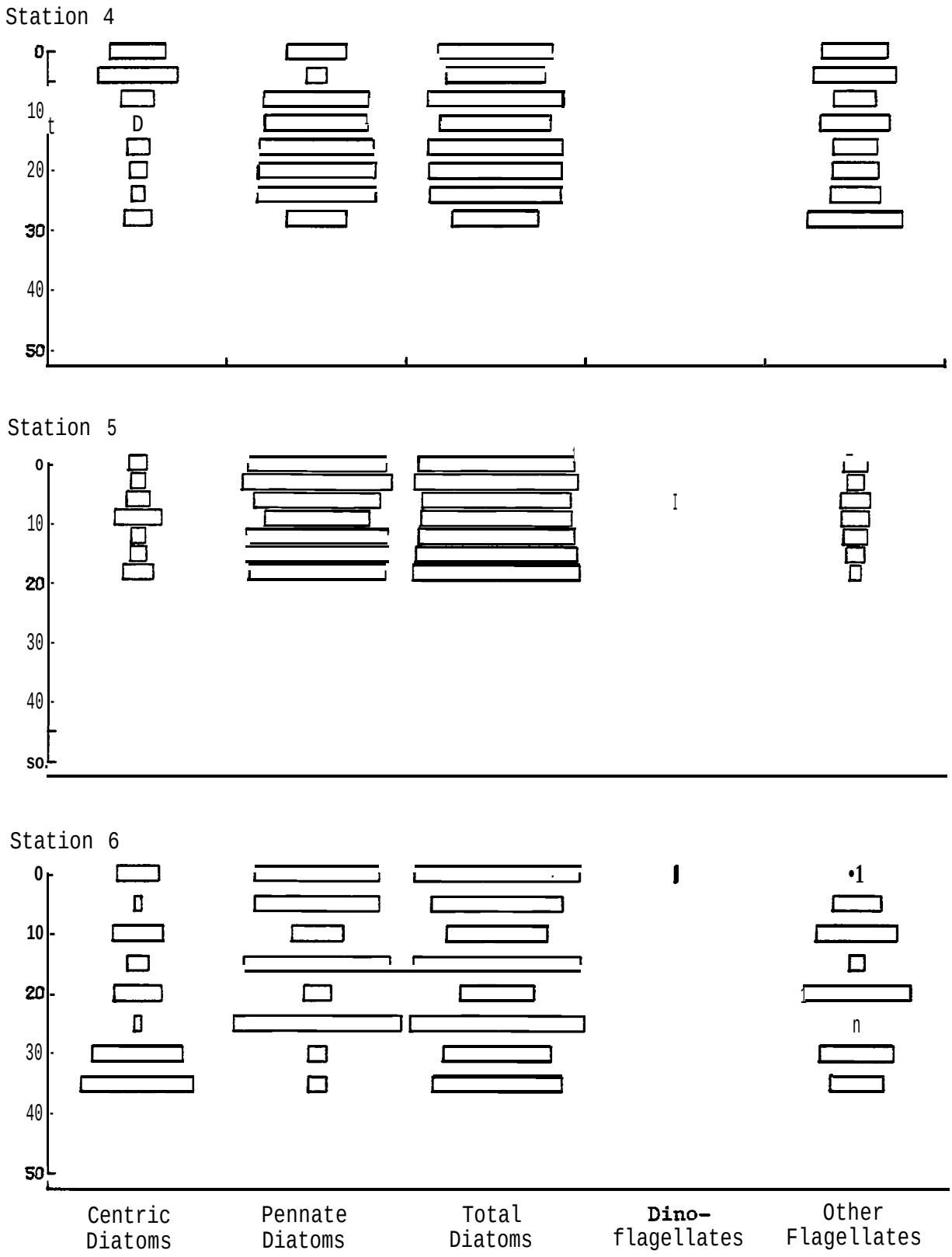

Station 4
0
10
20
30
40
50
Station 5
0
10
20
30
40
50
Station 6
0
10
20
30
40
50
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

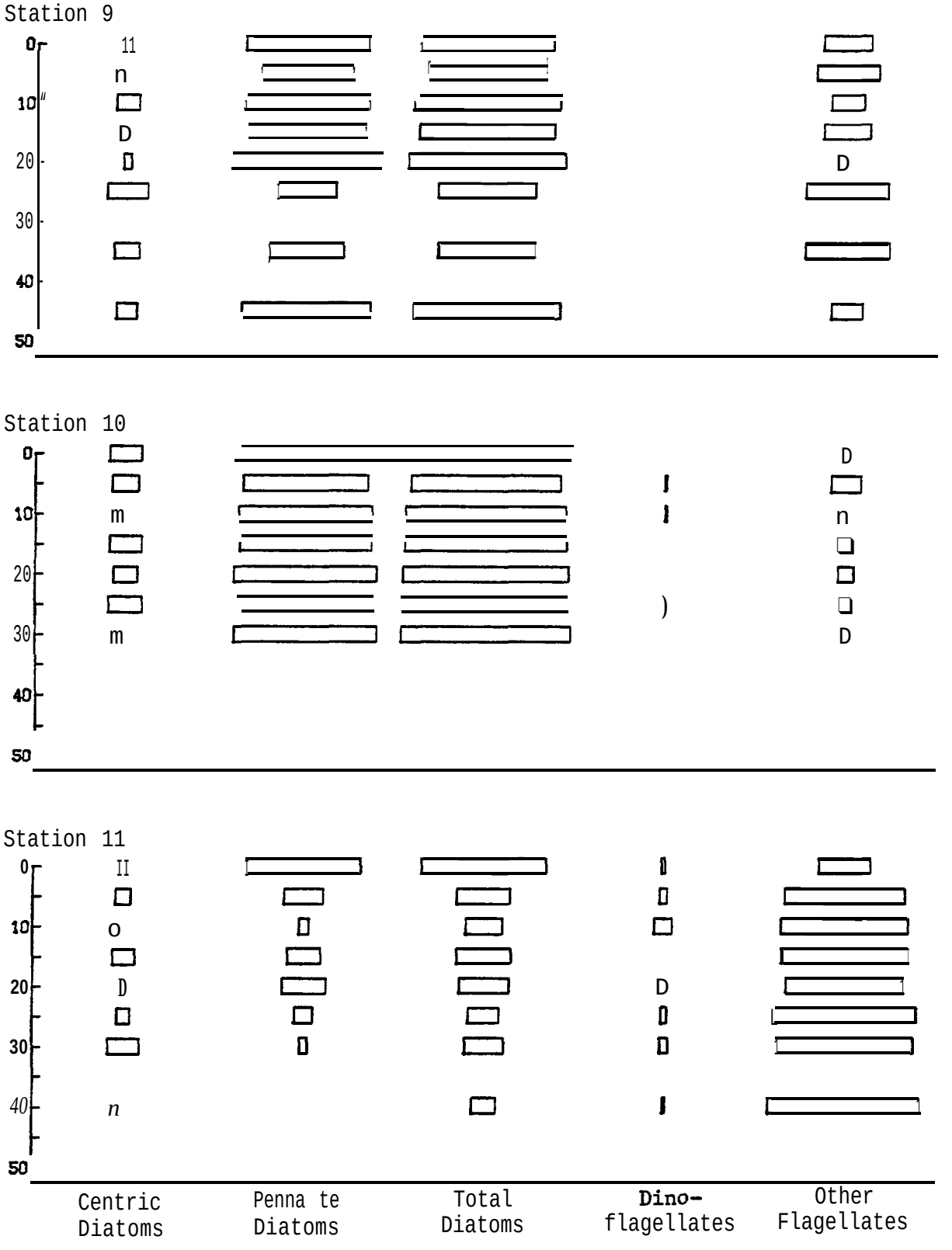

Station 9
0
10
20
30
40
50
Station 10
0
10
20
30
40
50
Station 11
0
10
20
30
40
50
Centric Diatoms
Penna te Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

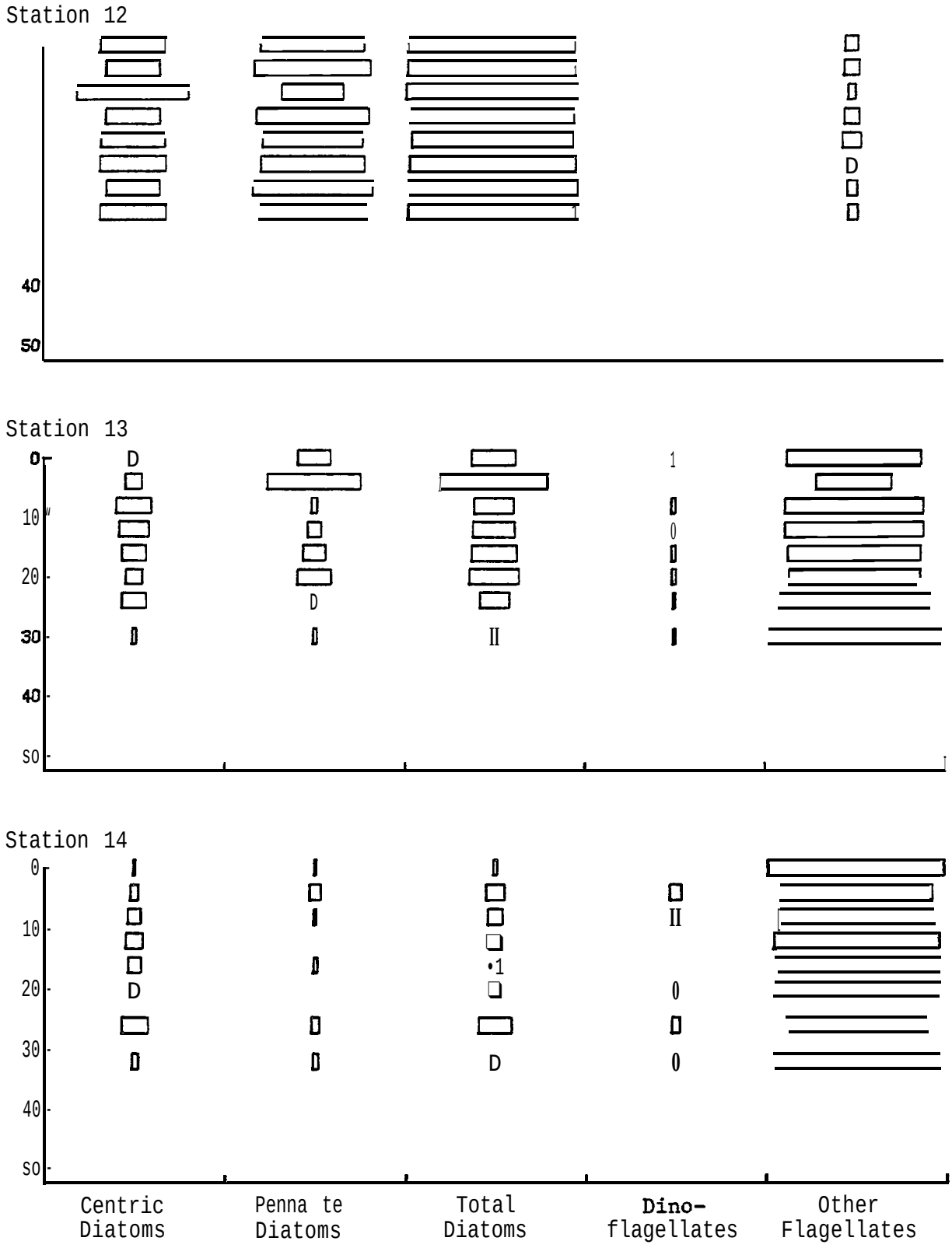

Station 12
40
50
Station 13
0
10
20
30
40
SO
Station 14
0
10
20
30
40
SO
Centric Diatoms
Penna te Diatoms
Total Diatoms
Dino- flagellates
Other Flagellates

Fig. 3. (cent.)

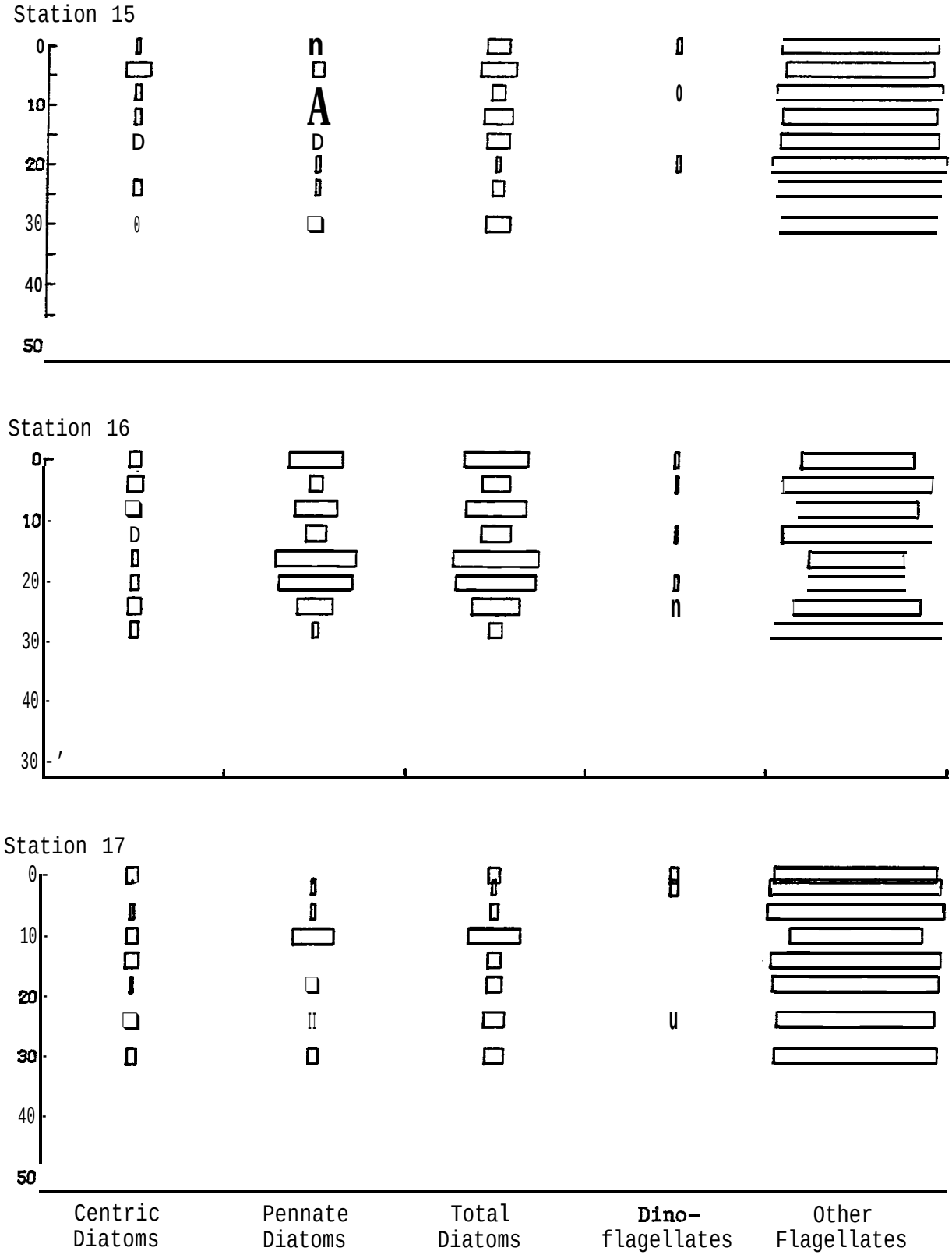

Station 15
0
10
20
30
40
50
Station 16
0
10
20
30
40
30
Station 17
0
10
20
30
40
50
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

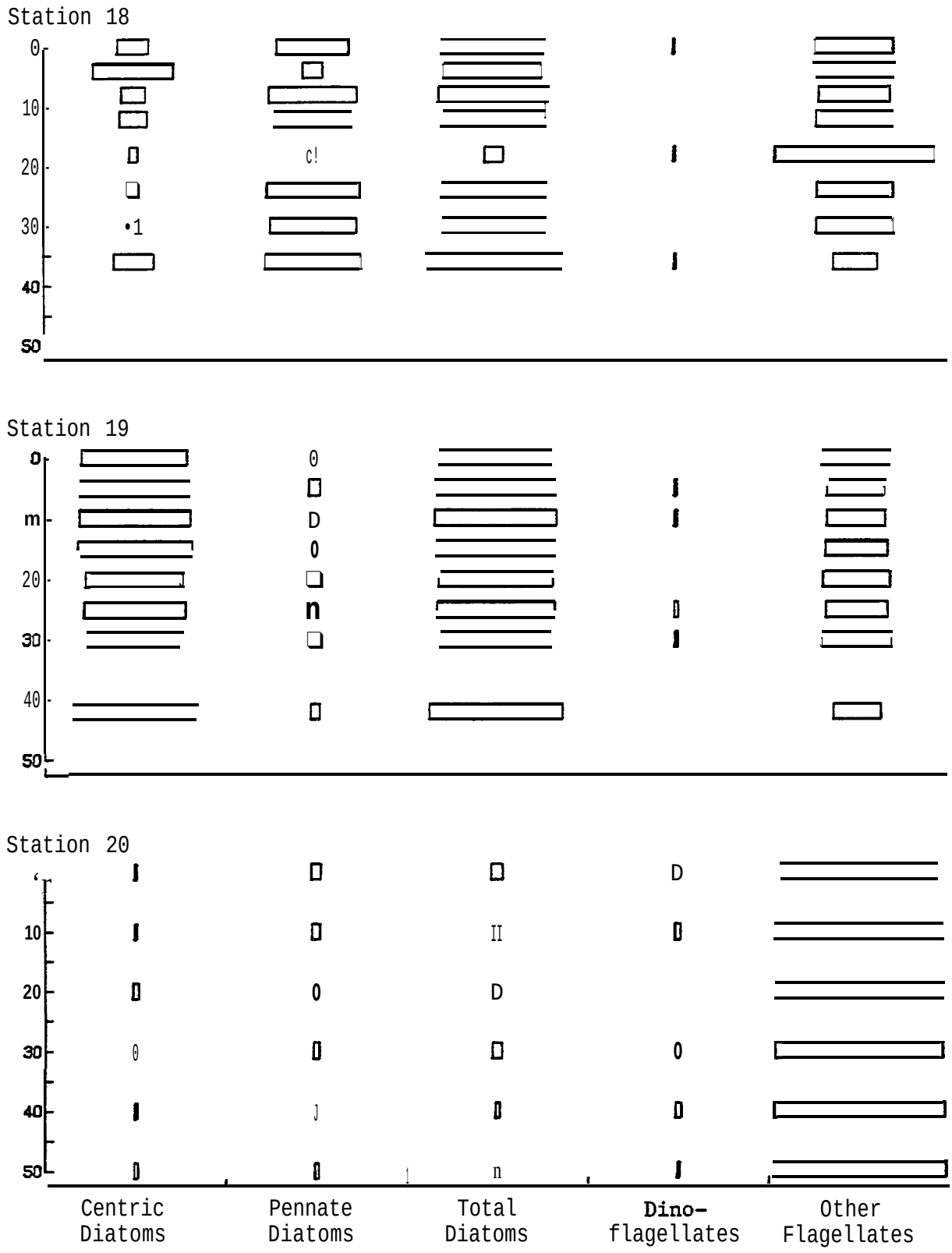

Station 18
0
10
20
30
40
50
Station 19
0
m
20
30
40
50
Station 20
10
20
30
40
50
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

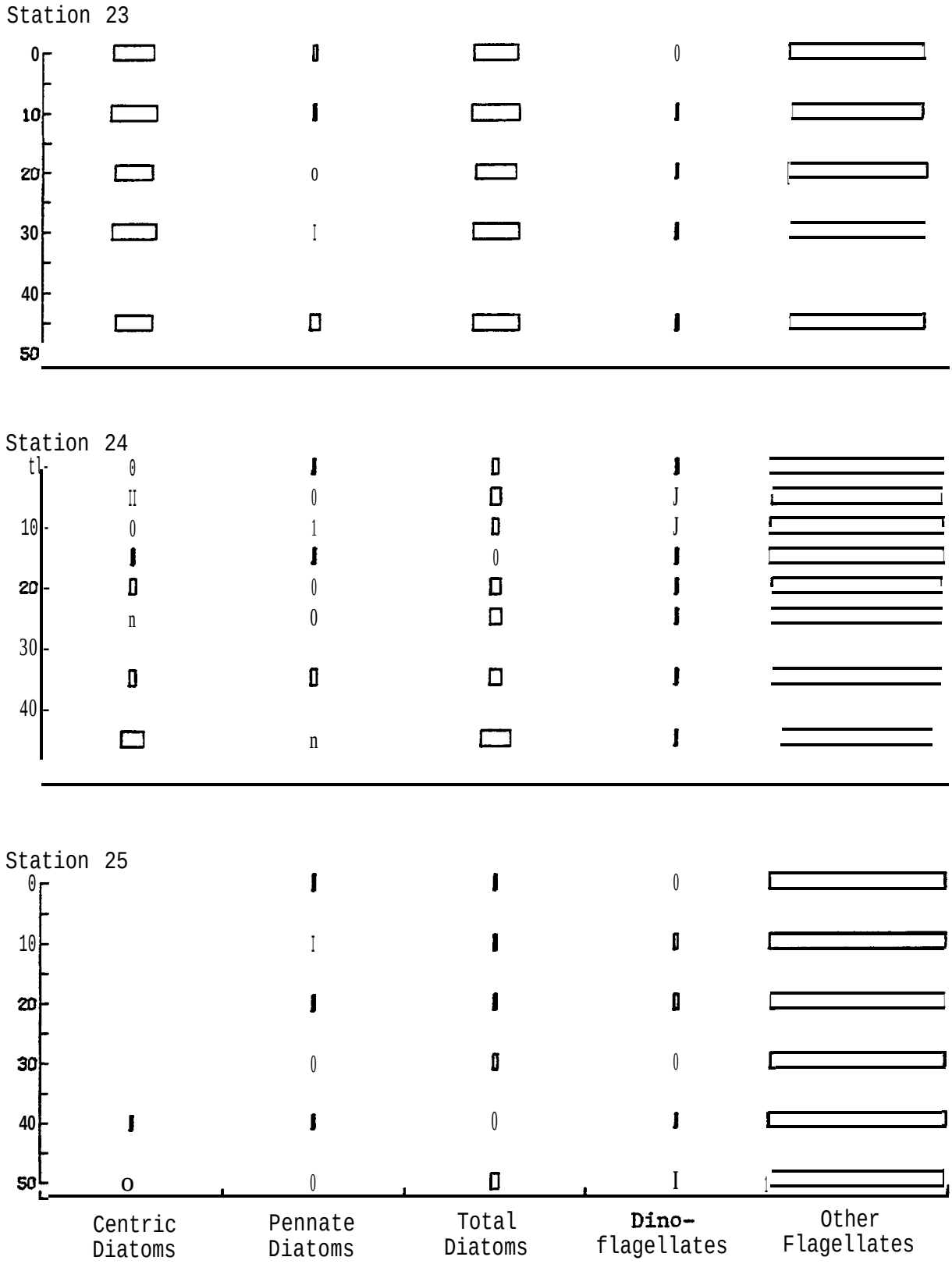

Station 23
0
10
20
30
40
50
Station 24
10
20
30
40
Station 25
0
10
20
30
40
50
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

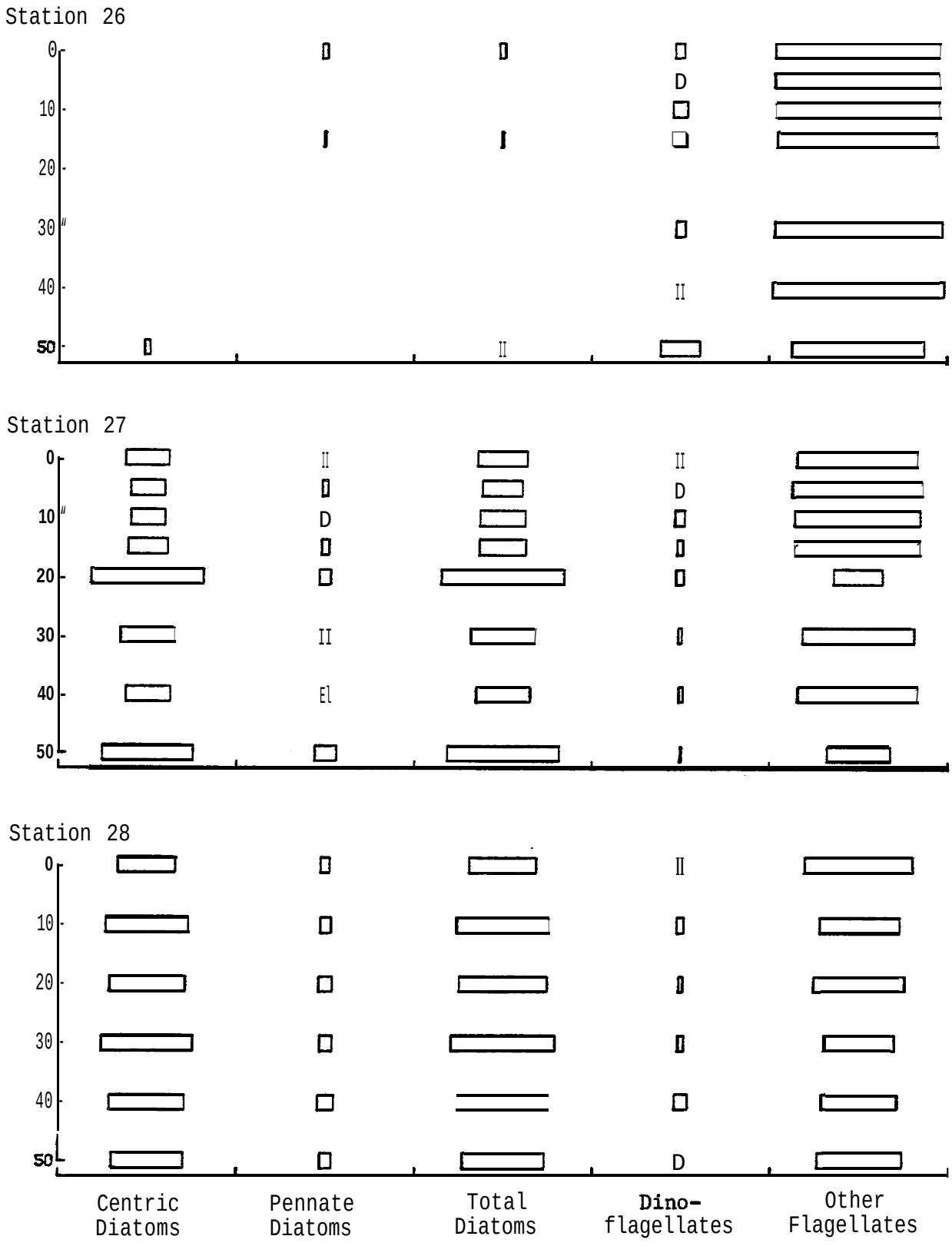

Station 26
0
10
20
30
40
50
D
Station 27
0
10
20
30
40
50
D
Station 28
0
10
20
30
40
50
D
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 3. (cent.)

Table 5. Integrated chlorophyll a and primary productivity in the Bering Sea, CGC *Polar Sea*, 17 Apr - 6 May 1979.

Sta	Chl a ($mg\ m^{-2}$)	Prim Prod ($mg\ Cm^{-2}\ hr^{-1}$)
1	39.36	179.86
2	143.34	60.39
3	85.65	211.91
4	34.74	63.26
5	34.53	87.86
6	18.68	36.38
9	43.50	57.30
10	15.20	247.50
11	14.98	19.83
12	239.20	397.58
13	20.35	37.65
14	5.14	9.09
15	4.83	10.73
16	9.90	20.44
17	4.09	6.25
18	52.20	90.27
19	46.90	107.18
20	21.05	69.40
23	193.63	748.90
24	41.38	171.02
25	66.30	158.23
26	22.30	42.87
27	133.00	406.30
28	228.00	961.15

Table 6. List of phytoplankton species found in the Bering Sea, spring 1979 and 1980. Not all species were found both years or in all areas.

Bacillariophyceae
  Centrales
    Actinoptychus sp.
    Bacterosira fragilis Gran
    Biddulphia aurita (Lyngb.) Bréb. & God.
    Chaetoceros atlanticus Cleve
    Chaetoceros cinctus Gran
    Chaetoceros compressus Laud.
    Chaetoceros concavicornis Mang.
    Chaetoceros convolutes Castr.
    Chaetoceros debilis Cleve
    Chaetoceros decipiens Cleve
    Chaetoceros furcellatus Bail.
    Chaetoceros gracilis Schütt
    Chaetoceros septentrionalis Østr.
    Chaetoceros similis Cleve
    Chaetoceros socialis Laud.
    Chaetoceros subsecundus (Grun.) Hust.
    Chaetoceros Spp .
    Corethron criophilum Castr.
    Coscinodiscus curvatulus Grun.
    Coscinodiscus oculus-iridis Ehrenb.
    Coscinodiscus radiatus Ehrenb.
    Coscinodiscus spp.
    Ditylum brightwelli (West) Grun.
    Eucampia zoodiacus Ehrenb.
    Lauderia borealis Gran
    Leptocylindrus danicus Cleve
    Melosira SOZ (Ehrenb.) Kütz.
    Melosira sulcata Rabh.
    Melosira spp.
    Porosira glacialis (Grun.) Jørg.
    Rhizosolenia hebetata (Bail.) Gran
    Rhizosolenia styliformis Brightw.
    Rhizosolenia spp.
    Skeletonema costatum (Grev.) Cleve
    Thalassiosira antarctica Comber
    Thalassiosira decipiens (Grun.) Jørg.
    Thalassiosira gravida Cleve
    Thalassiosira hyalina (Grun.) Gran
    Thalassiosira lacustris (Grun.) Hasle
    Thalassiosira nordenskioeldii Cleve
    Thalassiosira polychorda (Gran) Jørg.
    Thalassiosira Spp .

  Pennales
    Achnanthes taeniata Grun.
    Achnanthes spp.

Table 6. (cont.)

Amphiprora spp.
Asterionella kariana Grun.
Cylindrotheca closterium (Ehrenb.) Reimann & Lewin
Gomphonema spp.
Gyro-Pleurosigma spp.
Navicula directs (W. Sm.) Ralfs
Navicula distans (W. Sm.) Ralfs
Navicula pelagica Cleve
Navicula spicula (Hickie) Cleve
Navicula transitans Cleve
Navicula spp.
Nitzschia cylindrus (Grun.) Hasle
Nitzschia delicatissima Cleve
Nitzschia frigida Grun.
Nitzschia grunowii Hasle
Nitzschia seriata Cleve
Nitzschia spp., Section *Fragilariopsis*
Nitzschia spp.
Stauroneis quadripedis (Cleve-Euler) Hendey
Synedra spp.
Thalassionema nitzschioides Grun.

Pyrrophyta
Actiniscus pentasterias (Ehrenb.) Ehrenb.
Amphidinium spp.
Ceratium lineatum (Ehrenb.) Cleve
Ceratium spp.
Cladopyxis sp.
Dinophysis norvegica Clap. & Lachm.
Dinophysis spp.
Gymnodinium lohmanni Paulsen ,
Gymnodinium spp.
Protoperidinium belgicum (Wulff) Balech
Protoperidinium bipes (Pauls.) Balech
Protoperidinium brevipes (Pauls.) Balech
Protoperidinium conicum (Gran) Balech
Protoperidinium depressum (Bail.) Balech
Protoperidinium grenlandicum (Wolosz.) Balech
Protoperidinium pallidum (Ostenf.) Balech
Protoperidinium spp.
Prorocentrum baltica (Lohm.) Loeblich III
Scrippsiella trochoidea (Stein) Loeblich III

Chrysophyceae
Calycomonas gracilis Lohm.
Calycomonas ovalis Wulff
Dinobryon balticum (Schütt) Lemm.
Dinobryon petiolatum Willén
Pelagococcus subviridis Norris

Table 6. (cent,)

Euglenophyceae
Unidentified spp.

Cryptophyceae
Unidentified spp.

Craspedomonadales
Parvicorbicula socialis (Meun.) Defl.
Unidentified spp.

Dictyochales
Distephanus speculum (Ehrenb.) Haeckel

mg C m^{-2} hr^{-1} at station 12 just south of the ice edge. No ice was present at either station. Station 10, located off Cape Prince of Wales in 7-8 oktas of ice had integrated productivity of 248 mg C m^{-2} hr^{-1}. Nutrient concentrations at station 17 were high with phosphate *ca.* 2 µg-at ℓ^{-1} and nitrate slightly more than 17 µg-at ℓ^{-1} (Table 4). Chlorophyll a concentrations were low, only about 0.15 mg m^{-3} at all depths. Phytoplankton standing stock was low, generally being < 1 x 10^5 cells ℓ^{-1} and with small flagellates comprising > 80% of the population. At station 12, phosphate concentration was ea. 1 µg-at ℓ^{-1} and nitrate was *ca.* 2 µg-at ℓ^{-1}. Chlorophyll a concentrations were high, ranging from 3.5 mg m^{-3} at 16 m to 12.0 mg m^{-3} at 12 m. Phytoplankton standing stock was high with more than 1 x 10^6 cells ℓ^{-1} at all depths. Diatoms comprised ea. 90% of the population at all depths.

Nutrient concentrations at station 10 were relatively low with phosphate < 1.0 µg-at ℓ^{-1} and nitrate < 1.4 µg-at ℓ^{-1} suggesting nutrient utilization. Phytoplankton standing stock was also high at station 10 with more than 1 x 10^6 cells ℓ^{-1} at nearly all depths. Diatoms were the most abundant organisms being ea. 85% of the population at all depths.

Station 2 just south of the ice edge had only moderate integrated productivity, ea. 60 mg C m^{-2} hr^{-1}, but had high chlorophyll a concentration at 143 mg m^{-2}, and the highest cell counts of all the northern stations, up to 3.9 x 10^6 cells ℓ^{-1} at 3 m. Diatoms comprised more than 90% of the population at all depths.

At stations south of the Pribilof Islands and in Shelikof Strait, integrated productivity ranged from ea. 43 mg C m^{-2} hr^{-1} at station 26 south of Unimak Island to 961 mg C m^{-2} hr^{-1} at station 28 in the north end of Shelikof Strait. Chlorophyll a concentration was also low at station 26, 22 mg m^{-2}, and high at station 28, 228 mg m^{-2}.

For the two stations close to the Pribilofs, the number of cells per liter was somewhat higher at station 19 being near 4 x 10^5, with about 60% of the cells being diatoms, while at station 20, the number of cells per liter was generally between 2 x 10^5 and 3 x 10^5, with 85-95% of the cells small flagellates that may or may not have been photosynthetic. Primary productivity and chlorophyll a values reflect the cell composition with moderate productivity, 107 mg C m^{-2} hr^{-1}, at station 19, and low productivity, 69 mg C m^{-2} hr^{-1}, at station 20. Chlorophyll a was 47 mg m^{-2} at station 19 and 21 mg m^{-2} at station 20.

Of the four stations close to Unimak Island, stations 23, 24, and 25 had high phytoplankton standing stocks, from 1-3 x 10^6 cells ℓ^{-1}, but 70-95% of the cells were small flagellates. Station 23 had high integrated productivity at 749 mg C m^{-2} hr^{-1}, while stations 24 and 25 were considerably lower at 171 and 158 mg C m^{-2} hr^{-1}. Integrated chlorophyll *a* for these stations was 194 mg m^{-2} at station 23, 41 mg m^{-2} at station 24, and 66 mg m^{-2} at station 25. Station 26 had much lower standing stock with 0.1-0.8 x 10^6 cells ℓ^{-1} and 80-95% of the cells were small flagellates. Primary productivity at this station was 43 mg C m^{-2} hr^{-1} and chlorophyll a was 22 mg m^{-2}.

The two stations in Shelikof Strait had productivities of 406 and 961

mg C m^{-2} hr^{-1} and chlorophyll *a* concentrations of 133 and 228 mg m^{-2}. At station 27, cell numbers were near 1 x 10^6 cells ℓ^{-1} in the upper 15 m with about 70% small flagellates. Below 15 m, cell numbers dropped about 50% and the number of small flagellates was 30-70%. Cell numbers at station 28 ranged from about 0.5 x 10^6 to 1.4 x 10^6 with the highest numbers occurring in the upper 20 m; 40-60% of the cells were small flagellates.

Dominant species throughout the area were similar. Among the diatoms, species of *Chaetoceros*, *Nitzschia*, and *Thalassiosira* were common. In the Norton Basin, *Asterionella kariana*, *Porosira glacialis*, and *Melosira sulcata* were often present, but usually not in large numbers. Unidentified pennate diatoms were present, but also not in large numbers. Among the dinoflagellates, *Gymnodinium lohmanni* was probably the most abundant of the large identifiable species. Other species of *Gymnodinium* were present, along with species of *Peridinium* and *Amphidinium*. Athecate, small dinoflagellates were common, but could not be identified. Unidentifiable small flagellates, c 10 µm in diameter, were common at all stations and were often the dominant group of organisms. It is not known if these organisms were photosynthetic.

At stations north of St. Lawrence Island where diatoms were abundant, pennate diatoms were usually more numerous than centric diatoms, station 2 being the exception. At stations 12-17, small flagellates were the most abundant organisms, while at station 18 diatoms and flagellates were present in more or less equal numbers. Stations 19 and 20 near the Pribilof Islands had quite different species compositions with diatoms, primarily centric species, the most abundant organisms at station 19 and small flagellates dominating at station 20. Flagellates were most abundant at the four stations near Unimak Island. Dinoflagellates were more abundant at station 26 than at any other station during the cruise. Diatoms, primarily centric species, and small flagellates were about equally numerous at the two stations in Shelikof Strait.

Temperature, salinity, plant pigment concentrations, primary productivity, nutrient concentrations, and ice cover in 1980 are given in Tables 7-8; vertical profiles of temperature-salinity and carbon-chlorophyll *a* are shown in Fig. 4. Kite diagrams of phytoplankton abundance are shown in Fig. 5. Integrated carbon uptake and chlorophyll *a* concentrations are given in Table 9.

Four separate areas of the Bering Sea were sampled in 1980: Navarin Basin, St. Matthew-Hall, Norton Basin, and St. George Basin. These will be discussed separately. There will be some discrepancy with regard to station numbers in the Norton Basin because grab samples only were collected at some stations for the National Marine Fisheries Service Marine Mammal Division and all stations including the grabs only ones were numbered consecutively, so it might appear that we are reporting only selected stations.

Stations 1-25 were taken in the Navarin Basin from 59°31'N to 62°00'N and from 173°45'W to 178°39'W (Fig. 1). Ice cover was heavy in the southern and western parts of the area in early May when the cruise started necessitating an early change in our sampling program because of the difficulties in sampling in nearly solid ice and mechanical problems with the ship that occurred before we boarded.

Table 7. Summary of station locations, ice conditions, Secchi disc depths, temperature, salinity, plant pigment concentrations, and primary productivity in the Bering Sea, CGC *Polar Star*, 4 May - 24 June 1980.

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S‰	Chl a (mg m^{-3})	Pheo (mg m^{-3})	Prim Prod (mg m^{-3} hr^{-1})
1	4 May	0817	59°31.1′	176°06.2′	6-7			000	-1.71	31.72	2.20	0.31	35.27
								010	-1.65	31.70	1.44	0.24	19.22
								020	-1.63	31.67	5.66	1.30	16.71
								030	0.06	32.46	0.99	0.47	0.93
								045	-0.61	32.70	0.20	0.23	0.51
								060	*	32.78	0.29	0.20	0.19
								075			Bottle didn't trip		
								130			Bottle didn't trip		
2	5 May	1540	59°44.9′	177°44.7′	6-7	4	157	000	-1.76	31.89	2.47	0.54	15.88
								010	-1.71	31.89	2.78	0.59	14.02
								020	-1.45	31.90	2.53	0.60	18.42
								030	-1.69	32.65	4.93	0.84	26.92
								045	-0.64	31.91	0.87	0.37	0.66
								060			Bottle didn't trip		
								075			Bottle didn't trip		
								145			Bottle didn't trip		
3	6 May	0107	59°50.8′	177°29.2′	7	6	135	000	-1.74	31.87	1.80	0.32	26.39
								010	-1.56	31.87	4.95	0.56	16.36
								020	-1.66	31.88	3.32	0.62	14.78
								030	-1.54	31.89	2.09	1.02	21.96
								045	-1.45	32.58	1.82	0.32	2.11
								060		33.03	0.31	0.20	0.06
								075	-1.67	33,02	0.10	0.11	0.02
								125	-1.60	33.03	0.21	0.15	0.04

* Where there is no temperature, both thermometers on the bottle malfunctioned
† Indicates dark bottle value greater than light bottle uptake value

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S"/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
4	6 May	1557	60°27.0′	178°16.4′	7	16	165	000	-1.76	32.15	0.29	0.10	3.42
								010	-1.67	32.15	1.14	0.43	4.41
								020	-1.69	32.13	1.71	0.25	1.93
								030	-1.68	32.15	1.02	0.17	2.21
								045	-0.98	32.36	1.27	0.38	2.29
								060		33.01	0.17	0.12	0.14
								075	1.10	33.08	O*11	0.11	0.09
								145	1.72	33.13	0.06	0.11	0.05
5	7 May	0232	60°38.21′	178°38.67′	7	14	194	000	-1.71	32.24	2.75		3.77
								010	-1.62	32.24	1.65	0.36	5.23
								020	-1.65	32.26	1.50	0.68	2.69
								030	-1.66	32.25	2.20	0.31	1.96
								045	-1.56	32.30	2.07	0.19	2.55
								060		33.06	0.23	0.11	0.14
								075	2.14	33.12	0.08	0.10	0.05
								100	1.69	33.13	0.32	0.07	
6	7 May	1628	60"48.4′	178°24.63′	8	14	168	000	-1.69	32.20	1.64	0.48	3.84
								010	-1.69	32.24	1.64	0.13	3.75
								020	-1.68	32.24	2.18	0.15	3.60
								030	-1.68	32.17	2.10	0.22	3.78
								045	0.41	32.83	0.51	0.20	0.51
								060	0.65	33.10	0.13	0.12	0.23
								075	1.73	33.16	0.05	0.10	†
								145			Bottle didn't trip		
7	8 May	1643	60′′43.8′	177°37.6′	7	6	145	000	-1.33	31.98	7.64	1.13	14.91
								010	-1.66	31.93	9.56	1.26	19.12
								020	-1.70	31.96	8.52	0.99	18.15
								030	-1.68	31.96	8.74	0.52	12.93

Table 7. (cent, j

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (“c)	S°/₀₀	Chl *a* (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
								045	-1.70	32.07	3.74	0.89	9.16
								060	-2.06	32.92	0,85	0.24	2.10
								075	0.94	33.06	0.15	0.21	0.13
								125			Bottle didn’t trip		
8	9 May	0127	60°25.62′	177°15.72′	6-7	6	150	000	-1.63	31.85	8.33	1.48	29.75
								010	-1.90	31.84	14.26	3.34	31.13
								020	-2.22	31.85	12.11	2.47	23.32
								030	-1.68	31.87	16.91	2.13	18.94
								045	-1.53	31.99	1.79	0.67	14.49
								060	-0.18	32.88	0.34	0.26	0.33
								075	0.91	32.93	0.17	0.17	0.29
								125			Bottle didn’t trip		
9	9 May	1535	59°47.9′	176°12.3′	4	6	143	000	-1.63	31.66	20.66	2.58	9.83
								010	-2.53	31.62	9.36	1.11	12.05
								020	-1.62	31.69	6.93	1.55	16.84
								030	-1.68	31.78	8.48	1.19	7.57
								045	0.20	32.48	1.39	0.39	1.64
								060	-0.10	32.75	0.38	0.26	0.02
								115	0.96	32.96	0.13	0.18	0.02
								125	1.36	32.96	0.10	0.19	0.06
10	10 May	0128	60°04.40′	176°54.27′	0	6	137	000	-1.68	31.55	15.64	2.20	23.83
								010	-1.38	31.54	15.85	1.77	21.76
								020	-1.46	31.58	12.32	1.31	20.03
								030	-1.64	31.67	6.04	1.97	16.63
								045	0.40	32.61	0.95	0.58	17.62
								060	0.68	32.70	0.74	0.40	18.20
								075	1.02	32.82	0.34	0.34	23.39
								i25	1.36	32.94	0.21	0.25	7.38

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (“c)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
11	10 May	1541	59″44.7′	175°00.4′	1	5	119	000	-1.48	31.53	14.99	0.57	3.92
								010	-1.43	31.53	7.03	0.48	U.37
								020	-1.46	31.58	14.03	0.93	0.14
								C30	-1.55	31.68	7.98	0.66	29.15
								045	0.97	32.61	17.13	0.84	19.40
								060	1.40	32.76	0.50	0.12	19.48
								075	1.38	32.79	0.52	0.37	15.89
								100	1.34	32.77	0.44	0.29	11.80
12	10 May	2310	59°59.3′	174°12.42′	0	6	102	000	-1.51	31.66	5.28	1.12	1.28
								010	-1.50	31.69	6.43	0.25	0.17
								020	-1.56	31.72	8.68	0.99	t
								030	-1.66	31.90	2.46	0.16	11.20
								045	-1.67	31.91	1.94	0.16	12.77
								060	-1.66	31.94	2.61	0.18	23.61
								075	0.22	32.29	0.51	0.16	22.33
								095	0.24	32.31	0.47	0.15	6.57
13	11 May	1528	60°15.20′	173°45.24′	0	5	82	000	-1.52	31.63	4.75	0.65	0.48
								005	-1.47	31.63	9.15	1.10	0.42
								010	-1.47	,31.64	7.14	0.49	0.09
								020	-1.51	31.99	1.84	0.33	24.42
								030	-1.60	32.01	0.86	0.15	25.84
								045	-1.58	32.07	1.19	0.27	22.26
								060	-1.36	32.11	0.61	0.19	24.54
								075	-1.38	32.11	0.58	0.23	4.98
14	12 May	0013	60°42.67′	174°04.66′	7	5	88	000	-1.33	31.80	4.27	0.63	0.52
								005	-1.18	31.80	5.41	0.83	10.16
								010	-1.28	31.83	4.34	0.54	0.97
								020	-1.16	31.92	3.32	0.51	0.75

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
								030	-1.25	31.93	3.52	0.33	0.22
								045	-1.57	32.06	1.97	0.83	0.12
								060	-0.62	32.29	0.56	0.17	16.76
								075	-0.21	32.34	0.47	0.16	18.64
15	12 May	1530	60°31.11′	174°46.84′	0	5	101	000	-1.34	31.80″	4.66	0.83	9.27
								Clo	-1.30	31.91	2.75	0.62	10.77
								020	-1.30	31.91	4.71	0.74	15.57
								030	-1.43	31.92	6.27	0.68	0.89
								045	-1.68	31.97	4.35	0.60	0.74
								060	-0.56	32.25	1.77	0.35	0.42
								075	0.56	32.49	0.27	0.18	18.79
								095	0.73	32.54	0.21	0.17	10.81
16	12 May	2357	60°13.53′	175°29.56′	0	6	115	000	-1.29	31.64	3.18	0.41	13.98
								010	-1.25	31..63	3.47	1.05	3.84
								020	-1.24	31.64	15.67	1.61	7.07
								030	-1.38	31..73	10.67	0.67	3.70
								045	-0.29	32.29	7.45	0.68	0.38
								060	1.06	32.64	0.86	0.18	0.52
								075	1.15	32.74	0.17	0.18	33.58
								100	1.16	32.80	0.85	0.27	27.40
17	13 May	1555	60°55′	176°16′	0	7	117	000	-1.45	31.92	5.46	0.22	17.04
								010	-1.58	31.91	4.51	0.68	3.42
								020	-1.58	31.92	5.83	0.39	1.11
								030	-1..62	31.97	3.79	0.42	0.77
								045	-1.69	32.15	3.23	0.21	0.70
								060	-1.65	32.18	0.63	0.37	0.86
								075	0.93	32.68	0.40	0.21	14.83
								100	0.96	32.70	0.10	0.15	18.60

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
18	14 May	0001	60°59.95′	175°30.1′	0	6	104	000	-1.30	31.98	6.91	0.98	14.21
								010	-1.24	31.97	8.75	1.52	i4. 02
								020	-1.44	31.97	9.34	1.45	14.54
								030	-1.30	31.98	?.68	1.30	2.41
								045	-1.34	32.12	0.58	0.24	0.09
								060	-1.44	32.19	0.46	0.24	0.67
								075	0.26	32.57	0.96	0.25	0.23
								095	0.24	32.53	2.75	0.45	0.12
19	14 May	1556	61°29.6′	174°44.1′	0	5	82	000	-0.78	32.05	11.19	0.59	27.61
								005	-1.22	32.05	13.58	1.74	29.01
								010	-1.22	32.06	14.84	0.77	26.74
								020	-1.15	32.10	13.78	2.99	22.72
								030	-1.23	32.19	9.05	0.90	20.20
								045	-1.56	32.42	1.14	0.20	1.64
								060	-1.73	32.50	0.44	0.13	1.62
								075	-1.74	32.54	1.05	0.28	0.78
20	14 May	‘2330	61°43.42′	175°32.00′	0	10	93	000	-1.27	32.09	2.98	0.21	8.19
								005	-1 .21	32.09	3.63	0.13	10.45
								010	-1.26	32.09	3.60	0.05	8.22
								020	-1.36	32.11	4.31	0.47	12.64
								030	-1.30	32.25	4.44	0.08	13.24
								U45	-1.30	32.40	0.30	0.11	0.66
								060	-1.68	32.45	0.61	0.19	1.00
								075	-1.61	32.53	0.33	0.19	0.21
21	15 May	1525	61°31.12′	176°15′	0	8	106	000	-1.24	32.00	3.69	0.22	8.20
								010	-1.18	32.01	4.01	0.26	7.52
								020	-1.39	32.02	4.64	0.17	8.14
								030	-1.37	32.05	2.74	0.19	3.04

Table 7. (cent.)

Sta	Date Time (GMT)	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
							045	-1.66	32.12	0.76	0.15	0.93
							060	-1.09	32.22	0.73	0.16	0.37
							075	0.34	32.67	0.15	0.13	0.19
							095	0.38	32.68	0.05	0.16	0.10
22	16 May 0128	61°01.5′	177°01′	< 1	8	123	000	-0.95	31.97	4.96	0.23	12.02
							010	-1.25	32.04	5.44	0.22	17.53
							020	-1.38	32.05	4.38	1.14	18.90
							030	-1.34	32.06	5.00	0.53	12.56
							045	-1.31	32.08	4.50	1.01	9.02
							060	1.05	32.73	2.63	0.87	6.40
							075	0.96	32.87	0.21	0.26	0.36
							100	0.90	32.96	0.27	0.24	0.10
23	16 May 1530	61°29.9′	177°24.2′	3-4	9	123	000	-1.64	32.03	3.44	0.51	5.59
							010	-1.58	32.04	3.93		5.66
							020	-1.58	32.10	3.94	0.04	6.37
							030	-1.57	32.10	2.52	0.25	2.99
							045	-1.57	32.12	1.58	0.49	1.91
							060	-0.22	32.78	0.37	0.18	0.53
							075	0.98	32.84	0.15	0.15	0.23
							100	1.04	33.02	0.08	0.18	0.07
24	17 May 0239	61°54.4′	177°04.5′	2		114	000	-1.70	32.06	1.84	0.54	3.49
							010	-1.61	32.06	2.32	0.24	3.32
							020	-1.64	32.03	1.96	0.38	4,22
							030	-1.62	32.05	2.24	0.35	3.76
							045	-1.63	32.08	2.00	0.45	3.61
							060	-1.51	32.11	1.19	0.35	3.04
							075	-0.86	32.35	1.35	0.41	2.46
							100	-1.02	32.96	0.20	0.22	0.04

Table 7. (cont.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
25	17 May	1539	62°00.5′	176°17.8′	0	8	100	000	-1.57	32.19	5.99	0.73	13.74
								010	-1.44	32.19	3.05	0.14	12.47
								020	-1.44	32.19	4.73	0.17	15.57
								030	-1.42	32.19	2.95	0.25	13.30
								045	-1.69	32.36	1.15	0.12	1.42
								060	-1.52	32.41	1.21	0.19	1.67
								075	-0.52	32.41	0.08	0.23	0.17
								090	-0.32	32.66	0.15	0.21	0.17
26	22 May	2307	62°10.3′	168°59.1′	0	7	38	000	0.98	31.33	0.46	0.16	1.92
								003	0.51	31.33	0.34	0.64	2.20
								006	0.52	31.34	0.62	0.62	2.98
								009	0.58	31.33	0.81	0.21	2.65
								012	0.49	31.34	0.91	0.15	3.32
								018	0.56	31.35	0.86	0.22	3.98
								023	-1.26	32.14	3.91	0.81	19.94
								028	-1.29	32.14	4.37	0.64	16.04
27	23 May	1546	61°45.1′	170°22.6′	0	5	47	000	-0.16	31.31	4.60	0.61	21.03
								003	-0.06	31.31	3.56	1.04	20.06
								006	-0.06	31*31	4.13	1.33	15.65
								009	-0.11	31.31	5.61	1.19	15.03
								012	-0.26	31.31	4.98	1.13	12.69
								018	-0.11	31.32	6.20	2.10	19.79
								027	-1.59	31.81	2.69	1.21	6.02
								040	-1.57	31.82	2.28	0.62	4.37
28	23 May	2310	61°17.77′	169°50.59′	0	6	46	000	0.01	31.23	3.31	1.12	14.08
								003	0.07	31.22	3.53	1.39	10.25
								006	0.05	31.23	3.28	1.26	14.02
								009	0.08	31.23	3.58	1.16	15.20

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl *a* (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
								015	0.05	31.23	4.02	1.24	11.12
								024	-0.31	31.34	8.02	1.38	24.44
								030	-094	31.38	7.52	1.66	18.48
								040	-0.97	31.39	7.54	0.58	20.22
29	24 May	1520	61°47.5'	168°09.5′	0	6	31	000	-0.16	31.42	0.91	0.23	1.03
								003	-0.07	31.42	0.90	0.18	1.67
								006	-o .10	31.42	0.94	0.23	1.60
								009	-0.10	31.42	0.93	0.15	2.08
								012	0.15	31.44	0.95	0.14	2.02
								015	-0.12	31.42	0.97	0.26	2.71
								020	-0.40	31.45	1.12	0.26	2.32
								025	-0.14	31.55	1.07	0.37	2.64
30	24 May	2127	61°44.09′	167°07.5′	0	9	27	000	1.12	31.46	0.33	0.09	0.70
								003	1.27	31.46	0.37	0.08	0.64
								006	1.16	31.46	0.33	0.08	0.58
								009	1.34	31.46	0.30	0.08	0.59
								012	1.35	31.48	0.35	0.10	0.71
								015	1.06	31.50	0.21	0.08	0.69
								018	0.87	31.49	0.17	0.40	0.71
								021	0.85	31.49	0.38	0.08	0.80
31	25 May	1521	61°14.96'	167°08.32′	0	8	26	000	1.16	31.37	0.19	0.14	0.51
								003	1.60	31.37	0.23	0.17	0.50
								006	1.60	31.37	0.27	0.19	0.55
								009	1.68	31.33	0.27	0.14	0.58
								012	1.66	31.38	0.23	0.16	0.54
								015	1.74	31.38	0.22	0.17	0.61
								018	1.55	31.38	0.19	0.17	0.50
								021	1.53	31.39	0.19	0.15	0.47

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
32	25 May	2332	60°31.9′	168°13.1′	0	5	31	000	1.24	31.08	0.63	0.48	1.23
								003	1.25	31.08	0.58	0.49	1.17
								006	1.23	31.08	0.51	0.43	1.37
								009	1.20	31.08	0.62	0.61	1.27
								012	1.39	31.08	0.66	0.61	1.46
								015	1.53	31.08	0,65	0.56	1.23
								018	1.18	31.08	0.22	1.00	2.02
								025	1.18	31.07	0.92	0.75	2.96
33	26 May	1635	60°32.11′	170″01.8′	0	6	51	000	0.20	31.46	3,87	0.55	12.98
								005	0.24	31.46	4,13	0.75	15.16
								010	0.26	31.46	5.88	1.65	9.85
								015	0.28	31.47	2.54	0.30	13.10
								020	0.46	31.46	2.41	0.56	11.03
								030	0.29	31.47	3.56	0.88	14.88
								040	1.42	31.56	8.16	1.44	27.17
34	4 Jun	1540	63°11.8′	168°28.2′	0	4	46	000	0.14	31.53	3.56		18.79
								005	0.14	31.52	2.98	0.38	14.96
								010	-0.09	31.55	3.89	0.82	25.97
								015	-0.11	31.66	8.76	1.08	29.01
								020	-0.58	32.21	4.54	0.36	12.89
								025	-0.32	32.36	2.21	0.62	5.46
								030	-1.14	32.36	1.43	0.46	4.23
								040	-1.15	32.37	1.65	0.41	5.31
35	4 Jun	2310	63°33.5'	166°55.5′	0	10	29	000	3.50	30.93	0.19	0.05	0.39
								003	3.50	30.93	0.18	0.05	0.44
								006	3.56	30.93	0.16	0.05	0.38
								009	3.56	30.93	0,13	0.05	0.42
								012	3.52	30.93	0.14	0.04	0.34

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
								015	3.51	30.94	0.16	0.04	0.38
								018	0.22	31.53	0.16	0.11	0.51
								024	0.27	31.96	0.45	0.38	0.73
36	5 Jun	1525	63°52.21'	167°40.52′	0	3	37	000	0.24	31.27	3.89	0.55	14.20
								003	0.30	31.26	3.03	0.61	10.19
								006	0.14	31.36	3.80	0.64	15.41
								009	-0.33	32.16	6.77	1.21	21.21
								012	-0.30	32.22	4.72	0.87	8.07
								015	-0.24	32.27	2.70	0.83	8.56
								021	-1.13	32.28	3.23	0.92	5.68
								030	-1.12	32.29	3.57	1.23	6.88
37	6 Jun	0223	63°57.7′	168°22.92′	8	5	40	000	-0.33	30.86	4.93	1.00	28.31
								005	-1.30	31.56	7.77	1.63	23.36
								010	-1.16	31.83	6.97	1.07	23.48
								015	-0.98	32.07	6.57	0.63	21.34
								020	-0.61	32.34	7.82	1.22	21.23
								025	-0.96	32.99	4.99	1.06	14.08
								030	-1.71	33.10	1.63	0.71	7.44
								035	-2.27	33.22	1.12	0.64	2.39
41	6 Jun	2112	64°28.64'	167*51.92!	8	3	35	000	-0.55	30.47	2.47	0.40	11.27
								005	-1.10	31.42	8.39	1.12	29.74
								010	-1.23	31.57	7.70	0.92	23.70
								015	-1.34	31.96	6.04	1.18	16.10
								020	-1.06	31.15	6.37	1.23	18.27
								025	-1.18	32.29	3.91	1.28	10.52
								030	-1.16	32.31	3.85	1.23	8.42

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	so/o	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg m^{-3} hr^{-1})
47	8 Jun	0201	65°59.87′	168°17.92′	8	4	55	000	-0.39	30.56	1.32	0.41	3.48
								005	-1.09	31.24	2.40	0.34	5.15
								010	-1.32	31.53	3.16	0.38	9.20
								015	-1.40	32.15	5.03	0.39	10.28
								020	0.77	32.37	6.06	0.80	13.35
								030	-1.14	.32.39	4.88	0.73	11.57
								045	-1.02	32.40	6.02	1.21	19.54
48	9 Jun	0212	66°35.5′	165°58.6′	0	8	20	000	-0.06	31.02	0.72	0.10	2.91
								003	-0.33	31.14	1.21	0.26	5.95
								006	-0.65	31.21	1.64	0.26	9.55
								009	-0.33	31.42	2.42	0.32	7.54
								012	-0.27	31.64	3.52	0.81	12.05
								015	-0.90	31.67	4.86	0.46	11.29
								018	-0.86	31.75	4.75	0.76	12.49
49	9 Jun	1554	67″07.98′	165°12.45′	8	8	33	000	1.04	30.32	0.35	0.10	1.31
								003	0.16	30.91	0.49	0.09	2.41
								006	-1.02	31.32	1.62	0.25	5.80
								009	-0.21	31.88	4.17	0.13	26.00
								012	-1.26	31.91	3.96	0.92	17.63
								015	-1.07	31.98	7.67	1.24	30.27
								020	-1.30	32.18	8.46	0.16	23.04
								025	-1.64	32.59	0.85	0.14	8.08
50	12 Jun	0215	66°48.3′	165°01.5′	0	7	27	000	2.06	31.14			0.43
								003	1.02	31.51	0.28	0.08	2.25
								006	-1.52	31.84	1.37	0.30	4.66

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg m^{-3} hr^{-1})
								009	-0.22	31.93	1.76	0.33	10.24
								012	-0.27	32.05	2.27	0.32	10.97
								015	-0.82	32.06	2.73	0.40	31.81
								018	-0.92	32.08	4.28	0.80	17.73
								024	-0.94	32.13	2.84	0.41	25.88
51	12	Jun	1538	66°48.2′	164°00′	0	9	26	000	1.33	30.36	0.53	0.06	0.71
								003	0.19	31.39	0.47	0.20	1.24
								006	-0.28	31.44	0.93	0.27	2.31
								009	-0.45	31.48	0.76	0.19	1.41
								012	-0.99	31.54	0.48	0.23	0.90
								015	-0.72	31.77	1.24	0.28	2.79
								018	-0.83	31.88	2.18	0.57	4*37
								021	-0.98	32.29	4.70	0.42	8.36
52	13	Jun	1611	66°21.2′	166°36′	0	7	18	000	-0.36	29.56	0.46	0.12	0*59
								003	-0.18	29.74	0.44	0.12	0.76
								006	-0.41	30.20	0.79	0.24	2.34
								009	-0.66	30.33	1.39	0.24	2.20
								012	-0.45	30.57	1.41	0.27	2.76
								015	-1.38	31.64	3.16	0.53	12.04
54	15	Jun	1526	66°45.8′	168°33″	3	6	38	000	0.02	26.07	0.14	0.07	0.84
								005	-0.64	31.52	1.05	0.26	2.55
								010	-0.14	31.94	0.86	0.29	2.40
								015	-0.74	32.20	2.37	0.83	5.15
								020	-0.24	32.20	2.53	1.13	6.30
								025	-0.82	32.22	3.15	1.15	4.98
								030	-0.86	32.23	3.08	1.10	9.06
								035	-0.84	32.23	3*37	1.14	7.73

Table 7. (cont.)

Sta	Date Time (GMT)	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Phaeo	Prim Prod (mg m^{-3} hr^{-1})
55	15 Jun 2328	66°19′	168°36′	0	10	57	000	1.58	31.49	0.18	0.05	0.59
							005	1.69	31.83	0.15	0.06	0.66
							010	-0.26	32.16	1.42	0.49	4.26
							015	-0.86	32.21	3.44	0.85	7.79
							020	-0.88	32.21	3.38	1.09	7.84
							030	-0.81	32.33	3.73	0.29	9.00
							040	-0.89	32.22	3.60	1.20	13.83
							050	-0.88	32.22	4.33	1.42	11.05
56	16 Jun 1523	65°45.0′	168°35.3′	0	10	53	000	1.63	32.15	0.21	0.04	0.64
							005	2.85	32.26	0.45	0.08	1.38
							010	0.34	32.32	6.21	1.60	7.00
							015	-0.34	32.29	3.20	0.74	6.24
							020	-0,51	32.29	2.76	0.72	5.52
							030	-0.47	32.28	2.64	1.21	7.26
							040	-0.56	32.31	1.43	0.48	7.89
							050	-0.55	32.31	1.76	0.17	11.34
57	16 Jun 2314	65°06.2′	168°36.6′	0	10		000	2.92	32.44	0.23	0.07	0.90
							005	2.94	32.44	0.24	0.07	0.85
							010	2.14	32.44	0.38	0.08	1.65
							015	0.38	32.46	3.58	0.90	16.13
							020	0.25	32.46	3.02	1.28	9.42
							025	0.27	32.45	2.74	1.42	9.28
							035	0.10	32.48	1.79	0.77	11.85
							045	0.66	32.76	0.78	1.26	1.41
60	17 Jun 1533	64°40.0′	169°27.8′	0	5	50	000	2.83	31.89	0.97	0.25	
							005	-0.77	32.51	14.48	2.08	49.99

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg m^{-3})	Pheo (mg m^{-3})	Prim Prod (mg m^{-3} hr^{-1})
								010	-0.51	32.56	17.75	1.70	37.61
								015	-0.89	32.59	7.19	0.93	14.95
								020	-1.11	32.61	3.88	1.27	8.28
								025	-1.08	32.63	2.83	1.40	7.07
								030	-1.18	32.65	2.30	1.24	6.24
								040	-1.18	32.65	3.17	2.19	5.87
64	18 Jun	1530	64°01′	171°06′	0	9	32	000	*0.68*	32.42	1.61	0.52	2.77
								003	*0.75*	32.43	1.49	0.34	2.46
								006	*0.74*	32.45	1.82	0.49	3.08
								009	*0.76*	32.46	1.67	0.46	3.06
								012	*0.75*	32.47	2.30	0.53	3.41
								015	*0.82*	32.47	1.63	0.41	9.97
								020	*0.72*	32.48	2.79	0.48	3.15
								025	*0.74*	32.48	2.14	0.45	4.22
65	18 Jun	2225	63°51.6′	171°23′	0	10	26	000	1.51	32.36	0.84	*0.35*	2.19
								003	1.55	32.36	0.95	*0.35*	1.87
								006	1.52	32.37	1.03	*0.46*	2.15
								009	1.52	32.37	1.02	*0.34*	1.88
								012	1.51	32.38	0.96	*0.34*	2.15
								015	1.60	32.37	1.16	*0.34*	2.05
								018	1.48	32.37	0.94	*0.37*	2.93
								021	1.46	32.37	1.06	*0.40*	2.57
66	19 Jun	1544	63°52.0′	170°15.3′	0	10	42	000	1.02	31.28	0.25	0.07	0.62
								005	-0.93	31.67	0.60	0.10	1.48
								010	-0.02	32.26	3.14	0.70	5.31
								015	0.00	32.33	2.39	0.51	5.42
								020	0.03	32.34	4.70	0.99	6.66

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (“c)	S°/₀₀	Chl a (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
								025	0.11	32.34	2.93	0.58	6.15
								030	0.02	32.35	4.40	0.92	7.05
								035	0.02	32.34	4.56	0.69	6.73
68	20 Jun	0007	63°51.0'	169°08.3′	0	8	34	000	1.76	32.02	0.75	0.22	1.32
								003	1.82	32.03	0.60	0.17	1.32
								006	1.72	32.04	0.52	0.20	1.10
								009	1.89	32.05	0.57	0.18	1.44
								012	1.84	32.10	0.58	0.19	0.75
								017	1.86	32.15	0.61	0.19	1.37
								022	1.14	32.25	1.05	0.32	2.12
								027	1.60	32.28	1.52	0.45	2.79
69	21 Jun	1603	58°45′	172°20.2′	0	5	102	000	4.96	32.37	4.88	0.36	9.31
								010	4.91	32.37	4.48	0.31	10.46
								020	4.94	32.37	4.24	0.38	12.25
								030	3.17	32.39	0.65	0.29	1.36
								040	2.02	32.41	0.25	0.27	0.56
								050	1.47	32.47	0.18	0.64	0.22
								060	1.22	32.48	0.11	0.72	0.11
								075	1.22	32.47	0.17	0.97	0.13
70	22 Jun	0007	58°50′	173°58.5′	0	8	132	000	5.12	32.48	1.07	0.32	2.69
								010	5.05	32.48	0.97	0.61	3.00
								020	5.07	32.49	1.23	0.49	3.18
								030	4.08	32.53	0,87	0.14	1.48
								045	1.97	32.51	0.25	0.12	0.44
								060	1.40	32.62	0.12	0.13	0.17
								075	1.42	32.71	0.06	0.17	0.03
								100	1.80	32.82	0.07	0.22	0.03

Table 7. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl *a* (mg m^{-3})	Pheo	Prim Prod (mg m^{-3} hr^{-1})
71	22 Jun	1524	58°00′	173°45′	0	10	121	000	5.11	32.65	0.88	0.18	1.66
								010	5.22	32.64	0.76	0.23	1.61
								020	5.20	32.65	0.82	0.22	1.62
								030	5.20	32.66	0.73	0.22	1.53
								045	4.16	32.74	1.11	0.37	1.60
								060	3.08	32.80	0.13	0.21	0.15
								075	2.84	32.88	0.09	0.19	0.11
								100	2.92	33.04	0.04	0.16	0.05
72	23 Jun	0002	58°14.6′	172°22′	0	7	106	000	5.41	32.46	1.79	0.29	5.99
								010	5.41	32.47	1.87	0.60	6.32
								020	5.42	32.47	0.77	0.13	6.54
								030	5.41	32.47	2.03	0.06	6.18
								045	4.06	32.51	0.24	0.29	0.38
								060	2.41	32.63	0.10	0.32	0.04
								075	2.26	32.66	0.06	0.29	0.23
								100	2.26	32.67	0.06	0.30	0.09
73	23 Jun	1545	58°14.9′	170°43′	0	8	84	000	5.18	32.28	1.99	1.22	5.81
								005	5.04	32.27	2.07	1.07	6.32
								010	5.04	32.27	1.77	1.06	6.03
								020	4.97	32.27	1.99	0.95	5.77
								030	3.22	32.35	0.39	0.46	0.59
								045	1.46	32.36	0.27	0.28	0.28
								060	1.36	32.35	0.25	0.26	0.45
								075	1.36	32.36	0.24	0.31	0.36
74	23 Jun	2350	57′29.4′	171°30.2′	0	11	73	000	5.74	32.39	0.68	0.13	1.83
								005	5.80	32.38	0.70	0.11	2.09
								010	5.67	32.39	0.73	0.09	2.03

Table 7. (cont.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Ice Cover (oktas)	Secchi Depth (m)	Sonic Depth (m)	Sample Depth (m)	Temp (°C)	S°/₀₀	Chl a (mg Iq⁻³)	Pheo	Prim Prod (mg m⁻³ hr⁻¹)
								020	5.45	32.39	0.35	0.08	0.84
								030	4.12	32.33	0.22	0.22	0.50
								040	4.08	32.36	0.16	0.22	0.31
								050	4.00	32.36	0.17	0.18	0.34
								060	3.94	32.35	0.13	0.27	0.36
75	24 Jun	1526	57°30.3′	172°19.5′	0	8	110	000	5.65	32.55	1.76	0.53	4.03
								010	5.64	32.55	1.87	0.40	4.13
								020	5.56	32.58	1.24	0.34	3.30
								030	5.60	32.63	1.01	0.20	2.23
								045	4.56	32.65	0.34	0.34	0.46
								060	3.12	32.79	0.20	0.19	0.22
								075	3.06	32.93	0.10	0.12	0.05
								100	3.09	32.93	0.08	0.14	0.08

Table 8. Summary of station locations and nutrient concentrations in the Bering Sea, CGC *Polar Star*, 4May- 24 June 1980. * indicates samples thawed before analysis and values are questionable.

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	N03	NO_2	NH3
							(µg-at ℓ^{-1})				
1	4 May	0817	59°31.1′	176°06.2′		000	0.82	30.24	5.35	0.25	0.86
						010	0.82	30.90	5.52	0.25	1.06
						020	0.91	31.35	5.72	0.26	1.16
						030	2.05	50.77	24.46	0.30	1.61
						045	1.95	51.96	25.45	0.36	0.73
						060	1.74	36.03	17.22	0.36	0.97
						075		Bottle didn't trip			
						130		Bottle didn't trip			
2	5 May	1540	59°44.9′	177°44.7′	157	000	1.25	36.03	9.52	0.41	1*51
						010	1.16	36.16	9*99	0.42	1.64
						020	1.14	36.04	9.86	0.35	1.25
						030	1.16	35.43	9.70	0.29	1.38
						045	2.01	50.94	24.58	0.26	2.01
						060		Bottle didn't trip			
						075		Bottle didn't trip			
						145		Bottle didn't trip			
3	6 May	0107	59°59.8′	177°29.2′	135	000	1.22	37.92	11.97	0.30	0.89
						010	1.20	38.57	11.94	0.30	0.90
						020	1.21	38.05	11.94	0.28	0.81
						030	1.25	38.57	11.91	0.26	0.76
						045	2.03	52.49	25.19	0.27	0.88
						060	2.17	56.49	28.32	0.18	0.59
						075	2.25	58.42	28.33	0.22	0.45
						125	1.47	32.96	14.85	0.17	0.72
4	6 May	1557	60° 27.0′	178°16.4′	165	000	1.78	47.86	2i.46	0.24	0.67
						010	1.83	48.50	21.62	0.26	0.53
						020	1.98	48.66	21.70	0.25	0.54

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO_3 (µg-at ℓ^{-1})	NO_2	NH3
						030	1.76	48.66	21.62	0.21	0.48
						045	1.86	50.13	23.62	0.23	0.61
						060	2.28	56.50	28.36	0,16	0.41
						075	2.16	55.75	27.99	0.14	0.38
						145	2.25	60.45	29.68	0.17	0.24
5	7 May	0232	60°38.21'	178°38.67'	194	000	1.68	45.72	20.18	0.25	0.46
						010	1.53	45.57	19.84	0.27	0.34
						020	1.65	45.57	20.12	0.21	0.38
						030	1.68	47.88	21.58	0.21	0.27
						045	1.80	43.51	19.52	0.21	0.71
						060	2.08	56.51	27,89	0.17	0.16
						075	2.07	58.45	28.90	0.15	0.08
						100	2.08	57.28	28.39	0,13	0.14
6	7 May	1628	60°48.4′	178°24.63'	168	000	1.56	40.09	19.08	0.18	0.23
						010	1.62	41.44	19.67	0.18	0.22
						020	1.66	41.44	19.94	0.19	0.19
						030	1.49	41.17	20.14	0.17	0.21
						045	2.04	49.70	27.20	0.26	0.09
						060	2.09	52.25	28.65	0.13	0.02
						075	2.1.7	54 .05	28.40	0.16	0.02
						145		Bottle didn't trip			
7	8 May	1643	60″43.8′	177°37.6′	145	000	1.06	32.80	10.50	0.25	0.54
						010	1.07	33.36	10.75	0.27	0.51
						020	1.15	35.22	11.65	0.27	0.50
						030	1.10	34.63	11.32	0.22	0.47
						045	1.15	36.09	10.10	0.17	1*10
						060	1.15	36.90	19.47	0.21	0.79

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	P04	sio3	N03	NO_2	NH3
							(µg-at ℓ^{-1})				
						075	1.96	51.56	26.09	0.19	0.18
						125	Bottle didn't trip				
8	9 May	0127	60°25.62′	177°15.72′	150	000	1.13	33.93	10.43	0.23	0.47
						010	1.10	33.93	10.61	0.24	0.47
						020	1.11	34.40	10.96	0.24	0.61
						030	1.11	34.40	10.92	0.24	0.46
						045	1.54	39.05	17.51	0.18	0.79
						060	2.00	48.71	25.68	0.19	0.27
						075	2.10	52.25	27.20	0.14	0.14
						125	Bottle didn't trip				
9	9 May	1535	59°47.9′	176°12.3′	143	000	0.84	29.47	5.54	0.23	0.34
						010	0.89	29.57	5.56	0.23	0.43
						020	0.92	29.57	6.82	0.24	0.42
						030	1.18	35.10	12.22	0.21	0.87
						045	1.82	42.27	21.68	0,19	0.84
						060	1.86	45.00	23.49	0.15	0.26
						115	1.90	54.23	27.55	0.15	0.25
						125	2.03	54.79	27.67	0.16	0.34
10	10 May	0128	60°04.40′	176°54.27′	137	000	0.42	15.54	0.29	0.02	0.27
						010	0.47	15.54	0.32	0.03	0.23
						020	0.58	19.86	1.87	0.08	0.23
						030	1.08	30.41	8.94	0.24	0.83
						045	1.99	46.20	24.49	0.30	0.42
						060	2.04	48.88	26.42	0.29	0.26
						075	1.87	49.04	26.20	0.25	0.30
						125	2.02	57.88	28.91	0.18	0.13

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	N03 (µg-at ℓ^{-1})	NO_2	NH3
11	10 May	1541	59°44.7′	175°00.4′	119	000	0.44	12.23	0.26	0.05	0.11
						010	0.47	12.85	0.18	0.03	0.21
						020	0.39	13.35	0.18	0.02	0.17
						030	0.51	14 .14	0.56	0.02	0.58
						045	2.01	44.41	25.17	0.25	1.97
						060	1.87	47.28	25.07	0.26	0.19
						075	1.91	49.70	26.20	0.27	0.19
						100	2.03	50.53	26.97	0.26	0.41
12	10 May	2310	59°59.3′	174°12.42′	102	000	0.80	22.60	2.26	0.09	0.29
						010	0.69	19.13	1.58	0.09	0.43
						020	0.67	16.97	1.94	0.08	0.64
						030	1.60	43.24	14.44	0.14	0.43
						045	1.37	24.01	11.54	0.19	8.38
						060	1.07	21.86	7.45	0.04	0.52
						075	1.38	29.54	11.88	0.11	0.38
						095	1.58	37.76	15.34	0.14	0.28
13	11 May	1528	60°15.20′	173°45.24′	82	000	1.13	36.48	6.44	0.19	0.39
						005	1.20	37.11	6.44	0.19	0.23
						010	1.20	38.28	6.72	0.20	0.10
						020	1.25	31.10	10.47	0.18	0.45
						030	1.71	44.87	16.68	0.12	0.34
						045	1.79	45.47	17.17	0.18	0.98
						060	1.87	45.63	17.97	0.17	0.68
						075	1.85	48.61	18.58	0.17	0.65
14	12 May	0013	60°42.67′	174°04.66′	88	000	1.14	33.42	5.09	0.22	0.21
						005	1.09	30.88	4.62	0.23	0.30
						010	1.14	32.83	5.14	0.22	0.15

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO 3 (µg-at ℓ^{-1})	NO_2	NH3
						020	1.22	32.36	7.01	0.20	0.67
						030	1.27	34.74	8.90	0.20	0.29
						045	1.58	40.98	15.24	0.20	0.92
						060	1.97	37.24	21.31	0.24	0.27
						075	1.76	46.24	18.73	0.22	0.24
15	12 May	1530	60°31.11′	174°46.84′	101	000	0.93	28,35	3.06	0.17	0.13
						010	0.89	25.75	2.68	0.15	0.25
						020	0.94	28.89	3.35	0.18	0.14
						030	1.01	29.98	4.94	0.13	0.36
						045	1.27	34.74	12.33	0.17	O*51
						060	1.66	40.70	17.50	0.16	0.48
						075	1.97	54.65	23.97	0.16	0.17
						095	1.92	53.74	23.53	0.15	0.19
16	12 May	2357	60°13.53′	175°29.56′	115	000	0.43	14.90	0.26	0.03	0.20
						010	0.39	15.22	0.29	0.04	0.19
						020	0.44	15.47	0.38	0.04	0.29
						030	0.57	18.25	1.63	0.07	0.82
						045	1.66	43.83	18.83	0.19	1.16
						060	1.91	52.14	23.54	0.19	4.07
						075	2.00	54.83	24.27	0.13	0.29
						100	1.84	49.43	22.29	0.19	0.54
17	13 May	1555	60°55′	176°16′	117	000	0.99	33.61	8.11	0.17	0.16*
						010	1.18	30.96	10.57	0.19	0.44
						020	1.17	31.51	10.65	0.20	2.29
						030	1.26	33.19	12.47	0.15	0.30
						045	1.60	39.06	17.91	0.14	1.10
						060	1.70	40.65	19.65	0.64	1.70
						075	1.98	52.25	24.04	0.15	0.45
						100	1.94	51.20	24.42	0.14	0.42

Table 8. (Cent .)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO 3 (µg-at ℓ^{-1})	NO_2	NH3
18	14 May	0001	60°59.95′	175°30.1'	104	000	1.03	26.92	6.54	0.16	0.48
						010	1.09	28.95	7.11	0.18	0.58
						020	1.11	29.36	8.44	0.17	0.67
						030	1.12	28.84	8.59	0.16	1.44
						045	1.45	36.15	15.19	0.15	0.87
						060	1.58	37.64	17.85	0.17	0.73
						075	1.95	51.20	23.65	0.17	0.31
						095	1.92	50.34	22.80	0.19	1.51
19	14 May	1556	61°29.6′	174°44.1′	82	000	1.03	27.42	4.57	0.21	3.99
						005	1*14	28.84	4.75	0.22	1.19
						010	1.05	28.74	4.84	0.22	0.60
						020	1.14	29.78	5.74	0.17	0.65
						030	1.29	33.19	10.43	0.17	0.59
						045	1.84	42.03	19.43	0.18	0.76
						060	2.11	50.51	21.44	0.16	0.63
						075	1.98	44.93	19.63	0.16	0.88
20	14 May	2330	61°43.421	175°32.00'	93	000	1.38	37.26	14.72	0.22	0.47
						005	1.41	36.76	14.95	0.22	1.02
						010	1.36	35.66	13.93	0.19	0.33
						020	1.28	34.94	13.43	0.17	0.68
						030	1.43	37.51	14.97	0.17	0.55
						045	1.85	43.60	20.55	0.18	0.96
						060	1.90	46.92	21.27	0.18	0.69
						075	2,11	50.34	21.72	0.17	0.68
21	15 May	1525	61°31.12′	176°15′	106	000	1.25	32.74	11.23	0.19	0.27
						010	1.30	37.32	12.01	0.14	0.25
						020	1.37	37.33	13.45	0.15	2.14
						030	1.53	39.20	15 .93	0.10	0.25

Table 8. (cont.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO 3 (µg-at ℓ^{-1})	NO_2	NH3
						045	1.60	39.09	16.78	0.11	1.14
						060	1.68	42.08	18.80	0.09	0.49
						075	2.05	54.80	23.80	0.13	1.13
						095	2.08	56.34	24.40	0.14	0.38
22	16 May	0128	61″01.5′	177°01′	123	000	0.95	34.51	7.72	0.32	0.24*
						010	1.15	36.15	10.12	0.16	0.19*
						020	0.92	31.16	6.07	0.05	1.43*
						030	1.33	36.52	13 .91	0.12	10.42
						045	1.41	38.56	14.91	0.16	0.66*
						060	1.97	52.56	24.22	0.19	1.97*
						075	1.73	46.97	18.74	0.07	1.68*
						100	1.95	52.84	24.67	0.13	4.74
23	16 May	1530	61″29.9′	17?°24.2′	123	000	1.44	38.64	14.76	0.13	0.23
						010	1.53	41.33	15.40	0.14	0.71*
						020	1.49	39.53	15.07	0.16	0.47*
						030	1.52	41.33	16.50	0.11	0.39*
						045	1.34	43.75	14 .99	0.19	0.36*
						060	2.02	55 .35	18.16	0.07	2.02
						075	2.01	55.36	18.52	0.04	0,17
						100	2.11	60.71	26.64	0.10	0.62
24	17 May	0239	61″54.4′	177°04.5′	114	000	1.34	41.32	13.79	0.08	*
						010	1.58	44.45	17.21	0.16	3.19*
						020	1.60	43.92	18.40	0.15	0.47
						030	1.50	40.20	16.92	0.12	11.26
						045	1.52	39.70	16.28	0.08	0.35
						060	1.53	42.54	16.73	0.15	3. 25*
						075	1.83	53.71	20.88	0.11	3.29*
						100	1.52	43.93	17.55	0.13	3.25*

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO 3 (µg-at ℓ^{-1})	NO_2	NH3
25	17 May	1539	62°00.5′	176°17.8′	100	000	1.33	43.43	10.48	0.07	4.63*
						010	1.19	44.05	11.37	0.08	4.11*
						020	1.42	41.39	13.40	0.11	0.24
						030	1.39	42.99	13.04	0.18	3.62*
						045	1.68	47.25	17.02	0.21	3.22*
						060	1.64	31.65	13.36	0.11	2.22
						075	1.74	59.23	18.14	0.24	3.15*
						090	2.08	52.60	22.32	0.13	0.22
26	22 May	2307	62°10.3′	168°59.1′	38	000	0.74	2.15	0.51	0.04	3.72
						003	0.56	1.77	0.35	0.15	0.28
						006	0.50	4.71	0.15	0.09	3. 21*
						009	0.51	1.14	0.14	0.02	0.55
						012	0.55	3.12		0.00	3.12*
						018	0.55	2.63		0.00	3.18*
						023	0.90	12.56	0.82	0.14	3*05*
						028	0.94	12.85	0.79	0.15	3.04*
27	23 May	1546	61°45.1′	170°22.6'	47	000	0.52	4.26	0.03	0.03	3 .02*
						003	0.51	3.82	0.03	0.01	3.01*
						006	0.50	1.40	0.12	0.05	0.10
						009	0.49	3.82	0.04		3.04*
						012	0.44	1.34	0.14	0.01	0.16
						018	0.43	1.16	0.07	0.03	0.13
						027	1.36	21.20	4.00	0.22	3.00
						040	1.37	22.13	4.22	0.22	3.18
28	23 May	2310	61°17.77′	169°50.59′	46	000	0.52	2.54	0.10	0.02	0.13′
						003	0.51	1.97	0.20	0.03	0.22
						006	0.55-	1.52	0.08	0.02	0.14
						009	0.50	1.85	0,08	0.01	0.18

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (In)	Sample Depth (m)	PO_4	sio3	NO 3 (µg-at ℓ^{-1})	NO_2	NH_3
						015	0.52	1.67	0.11	0.02	0.73
						024	0.88	8.69	0.40	0.09	0.73
						030	0.93	10.54	0.62	0.11	0.70
						040	0.93	10.17	0.81	0.14	3.93
29	24 May	1520	61°47.5′	168°09.5′	31	000	0.54	0.91	0.07	0.01	0.15
						003	0.54	0.51	0.09	0.02	0.18
						006	0.54	0.77	0.11	0.04	5.38
						009	0.54	0.82	0.16	0.01	1.05
						012	0.54	0.62	0.08		0.32
						015	0.54	0.73	0.08		0.38
						020	0.58	0.93	0.06		0.41
						025	0.53	0.83	0.06	0.00	0.73
30	24 May	2127	61°44.09'	167°07.5'	27	000	0.34	3.51	0.04		2.98*
						003	0.26	0.64	0.09	0.03	4.65
						006	0.25	1.20	0.17	0.01	0.69
						009	0.23	0.70	0.26	0.01	0.93
						012	0.21	0.55	0.12	0.01	1.26
						015	0.25	1.11	0.16	0.00	
						018	0.31	0.76	0.67	0.08	10.22
						021	0.23	0.66	0.14	0.01	4.30
31	25 May	1521	61°14.96′	167°08.32′	26	000	0.40	4.07	0.04		3.04*
						003	0.40	3.76	0.05	0.02	3.01*
						006	0.39	4.64	0.05		2.95*
						009	0.38	4.07	0.06		3. 00*
						012	0.39	3.95		0.01	2. 99*
						015	0.35	4.32			2. 98*
						018	0.38	4.20			2.97*
						021	0.36	1.08			0.02*

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO_3 (µg-at ℓ^{-1})	NO_2	NH3
32	25 May	2332	60″31.9′	168°13.1′	31	000	0.39	1.29	0.06	0.01	0.02*
						003	0.37	0.48	0.05		0.13*
						006	0.40	1.08	0.07		*
						009	0.01	1.08	0.34	0.92	0.25
						012	0.44	0.48	0.07		0.01*
						015	0.43	0.53			*
						018	0.42	0.80	0.05		0.06*
						025	0.45	0.43	0.04	0.01	*
33	26 May	1635	60°32.11'	170°01.81?	51	000	0.58	4.47			*
						005	0.59	3.48			*
						010	0.56	4.18	0.03		*
						015	0.53	3.83			*
						020	0.55	3.66			*
						030	0.54	3.83			*
						040	0.75	9.79			*
34	4 Jun	1540	63°11.8'	168°28.2′	46	000	0.69	14.30	0.15	0.00	1.03
						005	0.62	14.16	0.44	0.01	1.09
						010	0.64	14.44	0.20	0.02	1.17
						015	0.79	14.72	0.34	0.01	1.23
						020	1.25	29.42	4.37	0.11	1.82
						025	1.66	41.66	9.09	0.20	2.84
						030	1.67	47.49	9.46	0.21	2.78
						040	1.71	43.48	9.53	0.21	2.86
35	4 Jun	2310	63°33.5′	166°55.5′	29	000	0.31	2.92	0.22	0.05	1.64
						003	0.34	3.03	0.07	0.02	
						006	0.33	3.57	0.12	0.02	
						009	0.33	3.30	0.08	0.01	
						012	0.32	3.31	0.18	0.02	

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO 3 (µg-at ℓ^{-1})	N02	NH3
						015	0.31	3.31	0.12	0.00	
						018	0.48	2.52	0.09	0.01	
						024	0.49	2.06	0.09	0.00	
36	5 Jun	1525	63°52.21'	167°40.52′	37	000	0.49	6.94	0.11	0.03	
						003	0.48	7.12	0.10	0.02	0.01
						006	0.59	9.32	0.18	0.04	0.11
						009	1.27	32.65	4.01	0.19	0.63
						012	1.41	39.36	5.34	0.18	1.38
						015	1.49	41.86	5.61	0.17	1.51
						021	1.54	41.87	5.75	0.18	1.71
						030	1.49	39.79	5.64	0.16	1.66
37	6 Jun	0223	63″57.7′	168″22.92′	40	000	0.57	13.17	0.13	0.03	0.39
						005	0.66	13.98	0.05	0.01	0.17
						010	0.94	19.84	1.16	0.07	0.35
						015	1.24	30.69	5.96	0.14	1.23
						020	1.57	41.05	8.87	0.20	2.00
						025	2.08	57.36	16.47	0.21	2.74
						030	2.20	61.06	18.06	0.24	3.04
						035	2.25	62.62	18.92	0.24	2.85
41	6 Jun	2112	64°28.64'	167°51.92′	35	000	0.56	12.39	0.06	0.03	0.37
						005	0.86	21.30	0.84	0.27	0.21
						010	0.96	38.09	0.94	0.17	0.34
						015	1.29	34.63	3.48	0.17	0.68
						020	1.37	35.94	4.38	0.18	0.86
						025	1.42	35.95	4.82	0.19	0.96
						030	1.43	36.56	4.82	0.16	1.34

Table 8. (cont.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO_3 (µg-at ℓ^{-1})	NO_2	NH3
47	8 Jun	0201	65°59.87′	168″17.92′	55	000	0.41	8.23	0.50	0.05	0.48
						005	0.69	11.16	0.81	0.09	0.09
						010	0.88	16.35	1.53	0.12	0.22
						015	1.26	31.92	4.89	0.13	0.39
						020	1.38	36.65	5.97	0.13	0.49
						030	1.39	36.79	5.89	0.14	0.57
						045	1.40	38.64	6.42	0.12	0.45
48	9 Jun	0212	66°35.5′	165°58.6′	20	000	0.59	11.19	0.13	0.09	0.23
						003	0.62	11.65	0.25	0.06	0.20
						006	0.61	11.97	0.31	0.14	0.29
						009	0.61	10.93	0.11	0.02	0.10
						012	0.56	7.22	0.14	0.06	0.27
						015	0.63	8.64	0.14	0.04	0.17
						018	0.63	8.37	0.12	0.02	0.15
49	9 Jun	1554	67°07.98′	165°12.45′	33	000	0.55	6.38	0.12	0.05	0.13
						003	0.63	6.99	0.09	0,04	0.05
						006	0.59	8.18	0.07	0.03	0.05
						009	0.67	11.56	0.11	0.01	0.06
						012	0.70	11.84	0.13	0.01	0.05
						015	0.70	12.19	0.17	0.02	0.06
						020	0.82	14.15	0.86	0.06	0.12
						025	1.50	35.15	9.36	0.17	0.97
50	12 Jun	0215	66°48.3′	165°01.5′	27	000	0.50	7.60	0.08	0.04	0.24
						003	0.57	6.81	0.18	0.05	0.07
						006	0.53	7.68	2.45	0.26	0.11

Table 8. (cont.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	N03 (µg-at ℓ^{-1})	NO_2	NH3
						009	0.47	4.40	0.07	0.05	0.13
						012	0.45	4.58	0.11	0.06	0.27
						015	0.65	7.70	0.17	0.08	0.24
						018	0.66	7.09	0.11	0.05	0.19
						024	0.70	9.16	0.15	0.02	0.04
51	12 Jun	1538	66°48.2′	164°00′	26	000	0.41	4.50	0.06	0.03	0.03
						003	0.40	3.59	0.16	0.07	0.05
						006	0.41	3.88	0.08	0.03	0.00
						009	0.41	3.32	0.16	0.02	0.06
						012	0.44	3.95	0.11	0.01	
						015	0.52	3.96	0.07	0.02	
						018	0.56	4.48	0.07	0.01	
						021	0.68	9.67	0.93	0.04	
52	13 Jun	1611	66°21.2′	166°36′	18	000	0.35	5.73	0.12	0.07	
						003	0.43	6.45	0.06	0.06	0.03
						006	0.40	7.13	0.06	0.05	
						009	0.44	7.20	0.08	0.02	
						012	0.47	7.51	O*10	0.03	
						015	0.79	17.05	1.47	0.08	0.07
54	15 Jun	1526	66°45.8′	168°33′	38	000	0.34	3.35	0,10	0.05	0.26
						005	0.61	10.97	0.24	0.06	0.11
						010	0.53	9.42	0.21	0.10	0.18
						015	0.99	21.65	2.16	0.07	0.61
						020	1.09	24.05	2.48	0.09	0.53
						025	1.11	24.59	2.61	0.08	0.70
						030	1.10	24.33	2.70	0.08	0.59
						035	1.10	24.07	2.61	0.08	0.66

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO 3 (µg-at ℓ^{-1})	NO_2	NH3
55	15 Jun	2328	66°19′	168°36′	57	000	0.42	4.46	0.12	0.04	0.00
						005	0.38	3.45	0.02	0.02	
						010	0.90	19.35	1.32	0.06	
						015	1.06	21.12	1.96	0.07	1.85
						020	1.10	22.54	2.37	0.07	0.67
						030	1.09	21.13	2.15	0.07	0.79
						040	1.10	22.46	2.31	0.09	0.52
						050	1.10	22.04	2.16	0.08	0.50
56	16 Jun	1523	65°45.0′	168°35.3′	53	000	0.53	8.52	0.08	0.03	0.18
						005	0.44	5.76	0.05	0.03	0.11
						010	0.87	16.14	2.34	0.09	0.77
						015	1.05	20.41	3.23	0.07	0.63
						020	1.10	22.06	3.61	0.08	0.75
						030	1.10	22.48	3.58	0.07	0.72
						040	1.10	21.24	3.48	0.07	0.73
						050	1.09	21.32	3.50	0.07	0.62
57	16 Jun	2314	65°06.2′	168°36.6′		000	0,30	3.62	0.14	0.05	0.34
						005	0.31	3.54	0.03		*
						010	0.25	3.89	0.03		*
						015	0.51	7.97	0.04	0.01	0.09*
						020	0.83	8.93	2.60	0.08	1.77
						025	0.83	8.55	2.55	0.07	4.92
						035	0.99	12.22	3.57	0.07	2.28
						045	1.47	32.67	10.24	0.13	3.06
60	17 Jun	1533	64°40.0′	169°27.8′	50	000	0.26	6.97	0.17	0.09	0.07
						005	0.56	22.09	0.07	0.03	0.12
						010	1.18	23.79	6.47	0.18	0.18

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (In)	Sample Depth (m)	PO_4	sio3	N03 (µg-at ℓ^{-1})	N02	NH3
						015	1.57	39.78	14.67	0.15	0.72
						020	1.74	40.96	16.27	0.16	1.70
						025	1.80	42.42	16.79	0.15	1.89
						030	1.74	42.30	17.00	0.16	1.90
						040	1.75	43.16	17.04	0.15	1.89
64	18 Jun	1530	64°01′	171°06′	32	000	0.65	10.15	2.05	0.13	0.16
						003	0.64	10.22	1.83	0.06	0.17
						006	0.68	11 .03	2.03	0.11	1.19
						009	0.67	10.23	1.99	0.04	0.26
						012	0.65	9.57	1.81	0.04	0.35
						015	0.64	10.57	2.01	0.03	0.22
						020	0.66	10.10	2.11	0.04	0.37
						025	0.66	10.24	2.00	0.04	0.31
65	18 Jun	2225	63°51.6′	171°23′	26	000	0.57	10.29	1.09	0.05	1.50
						003	0.61	10.36	1.12	0.05	0.39
						006	0.54	10.53	0.04		0.06*
						009	0.60	10.37	1.20	0.04	0.35
						012	0.51	9.66	0.04	0.02	0.06*
						015	0.60	10.71	1.17	0.04	0.26
						018	0.60	10.51	1.24	0.04	0.33
						021	0.60	10.38	1.21	0.04	0.46
66	19 Jun	1544	63°52.0′	170°15.3′	42	000	0.33	7.48	0.07	0.04	0.12
						005	0.42	8.37	0.81	0.07	0.32
						010	0.71	14.62	1.67	0.12	0.32
						015	0.74	14.20	1.83	0.06	0.29
						020	0.54	13.60	0.03	0.01	0.05*
						025	0.60	13.60	0.03	0.01	0.05*
						030	0.73	14.34	1.86	0.06	0.30

Table 8. (cont.)

Sta	Time (GMT)	Date	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO_3 (µg-at ℓ^{-1})	NO_2	NH_3
						035	0.71	13.99	1.90	0.06	0.31
68	20 Jun	0007	63°51.0'	169°08.3'	34	000	0.42	5.47		0.02	2.80
						003	0.40	5.72		0.02	0.24
						006	0.40	5.97		0.06	0.24
						009	0.41	5.97		0.01	0.10
						012	0.42	6.04		0.02	0.21
						017	0.39	5.49		0.02	2.05
						022	0.41	5.28		0.02	2.74
						027	0.44	5.99	0.09	0.03	2.24
69	21 Jun	1603	58°45'	172°20.2'	102	000	0.71	32.54	6.25	0.12	0.29
						010	0.19	31.86	0.03	0.01	0.07*
						020	0.74	33.67	6.54	0.10	0.74
						030	1.22	37.88	12.69	0.15	1.66
						040	1.47	39.73	18.52	0.23	1.00
						050	1.70	44.02	20.21	0.21	2.33
						060	1.77	45.12	20.59	0.20	2.68
						075	1.74	45.54	20.53	0.20	2.77
70	22 Jun	0007	58°50'	173°58.5'	132	000	1.02	40.40	10.70	0.13	0.25
						010	1.02	39.90	10.33	0.12.	0.39
						020	1.01	41.05	10.81	0.11	0.17
						030	1.24	41.31	14.05	0.12	0.83
						045	1.52	42.48	19.90	0.24	0.55
						060	1.68	48.27	23.14	0.15	0.33
						075	1.84	52.80	25.62	0.11	0.15
						100	1.75	46.44	22.11	0.06	2.91
71	22 Jun	1524	58°00'	173°45′	121	000	1.17	39.21	13.68	0.16	0.65
						010	1.22	41.49	14.40	0.15	0.95

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	PO_4	sio3	NO 3	NO_2	NH3
							(µg-at ℓ^{-1})				
						020	1.20	40.85	14.32	0.14	0.64
						030	1.20	41.12	14.49	0.15	0.93
						045	1.61	46.20	21.69	0.27	0.86
						060	1.74	49.80	24.10	0.31	0.48
						075	1.78	52.39	26.27	0.15	0.10
						100	2.03	61.63	29.59	0.07	0.18
72	23 Jun	0002	58°14.6′	172°22′	106	000	1.01	37.81	11.00	0.16	0.81
						010	1.07	41.30	11.69	0.12	0.61
						020	1.05	39.78	11.33	0.12	0.80
						030	1.04	38.68	11 .11	0.12	0.48
						045	1.70	51.52	23.63	0.12	0.16
						060	1.60	46.55	21.43	0.07	0.15
						075			sample missing		
						100	1.35	39.44	18.27	0.08	1.53
73	23 Jun	1545	58°14.9′	170°43′	84	000	0.60	29.13	4.25	0.21	0.61
						005	0.60	29.66	4.14	0.12	0.65
						010	0.60	29.78	4.14	0.12	0.87
						020	0.60	29.16	4.32	0.11	0.86
						030	1.54	40.61	18.28	0.23	2.25
						045	1.63	42.42	19.32	0.22	2.26
						060	1.63	42.55	19.45	0.22	2.17
						075	0.03	38.63	0.03	0.04	0.16*
74	23 Jun	2350	57°29.4′	171″30.2′	73	000	0.19	30.24	0.03	0.01	0.04*
						005	0.84	27.95	7.61	0.12	2.24
						010	0.15	30.46	0.03	0.01	0.06*
						020	0.16	30.67	0.18	0.01	0.04*
						030	1.26	35.90	14.22	0.20	1.65

Table 8. (cent.)

Sta	Date (GMT)	Time	Latitude (N)	Longitude (w)	Sonic Depth (m)	Sample Depth (m)	PO_4	SiO_3	NO 3 (µg-at ℓ^{-1})	N02	NH3
						040	0.08	33.89	0.12	0.02	0.06*
						050	0.10	30.78	0.16	0.02	0.17*
						060	0.13	31.21	0.10	0.02	0.17*
75	24 Jun	1526	57°30.3′	172°19.5′	110	000	0.06	28.58	0.09	0.01	0*05*
						010	0.01	28.58	0.09	0.02	0.12*
						020	0.01	28.07	0.09	0.02	0.11*
						030	0.08	24.31	0.12	0.02	0*14*
						045	0.01	42.79	0.12	0.04	0.16*
						060		49.16	1.70	1.65	0.03*
						075		56.22	0.02	0.03	0.08*
						100		56.80		0.03	0.15*

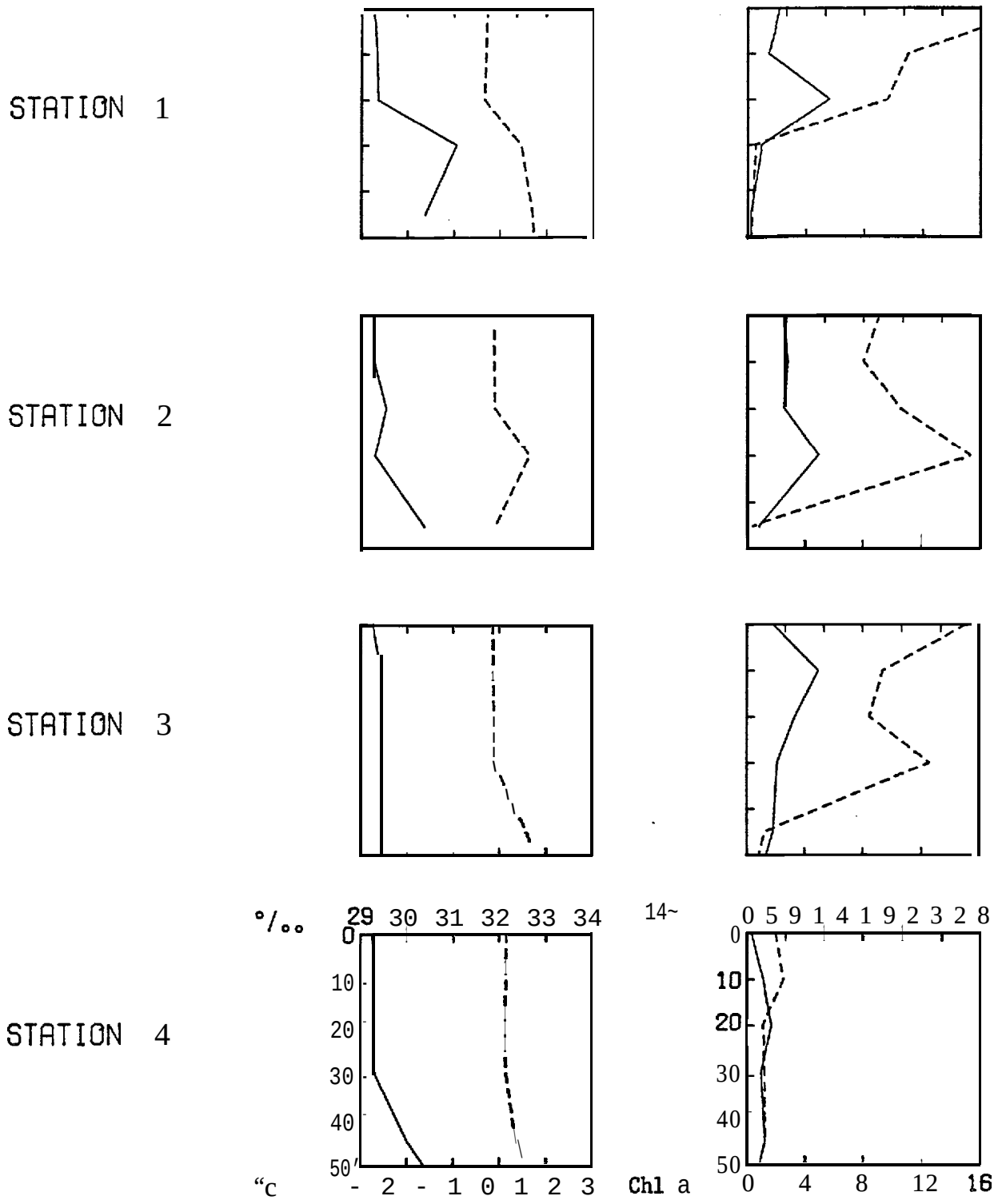
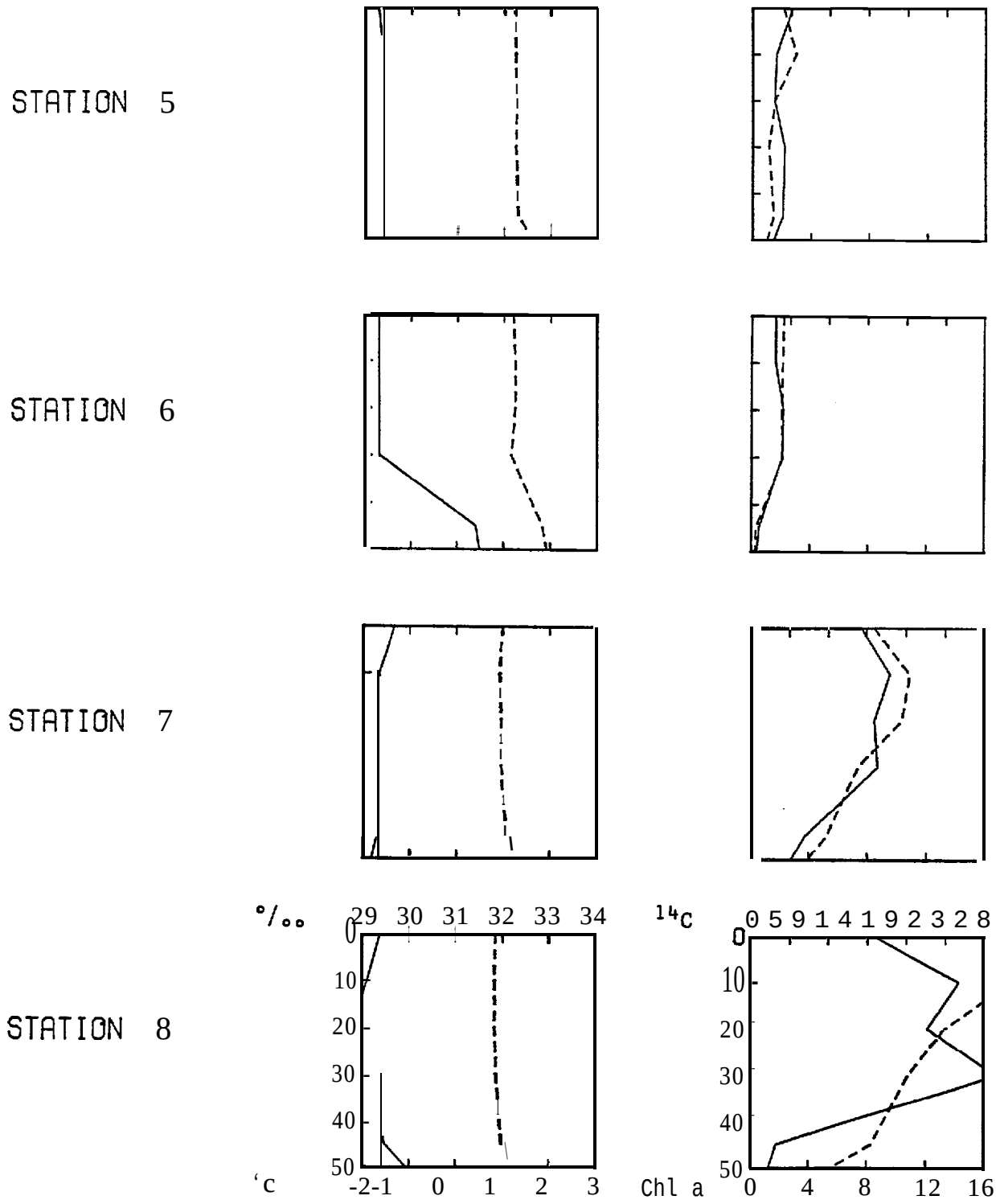


Fig. 4. Depth profiles of temperature-salinity and chlorophyll *a*-primary productivity in the Bering Sea, 4 May-24 June 1980. Salinity (°/oo) ---; temperature ("C) _; Primary productivity (mg C m^{-3} hr^{-1}) ---; chlorophyll a (mg m^{-3}) _.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STATION 6
STATION 7
STATION 8
°/oo
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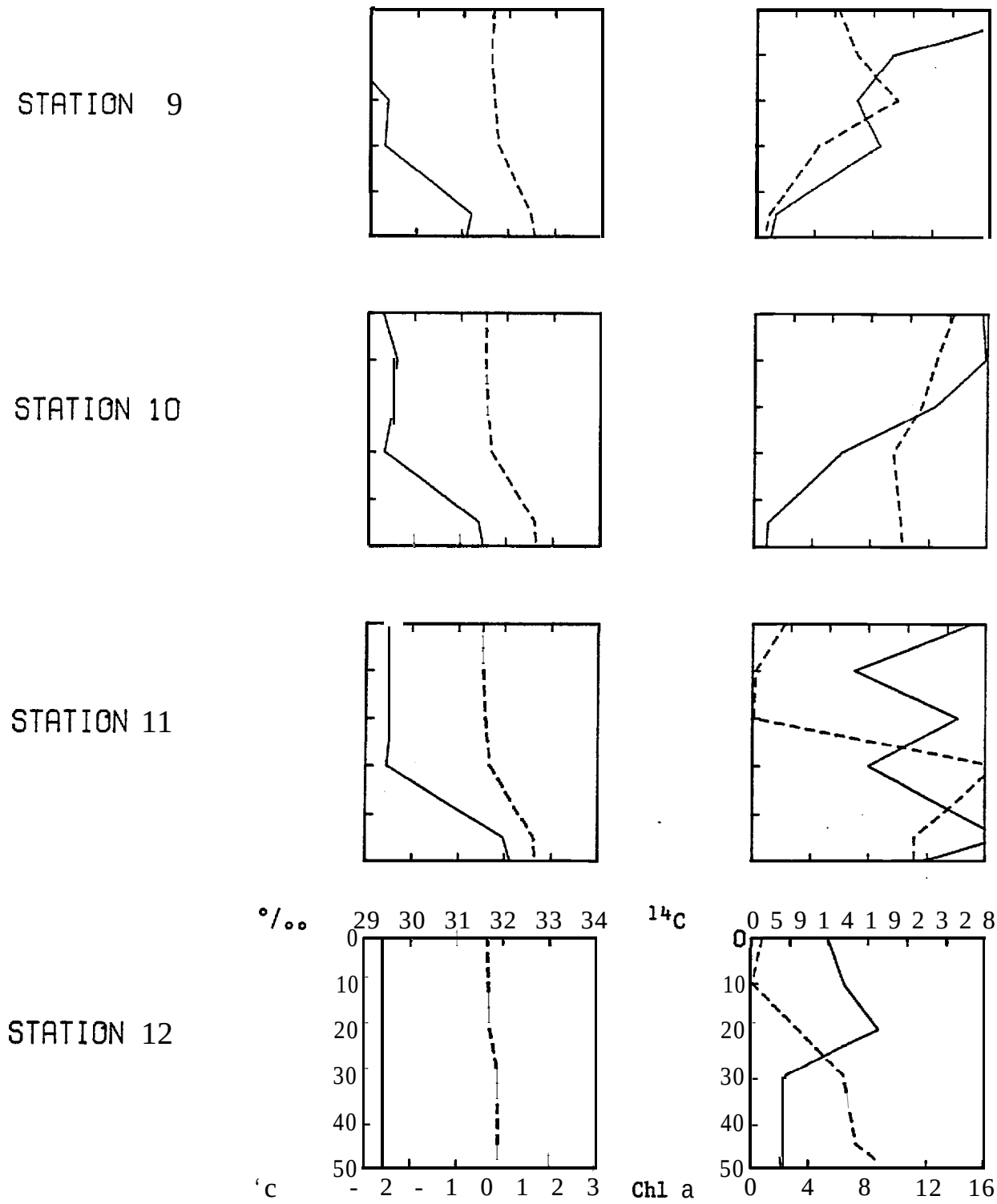
14C
0 5 9 1 4 1 9 2 3 2 8
0
10
20
30
40
50
'C
-2-1 0 1 2 3
Chl a
0 4 8 12 16

Fig. 4. (cent.)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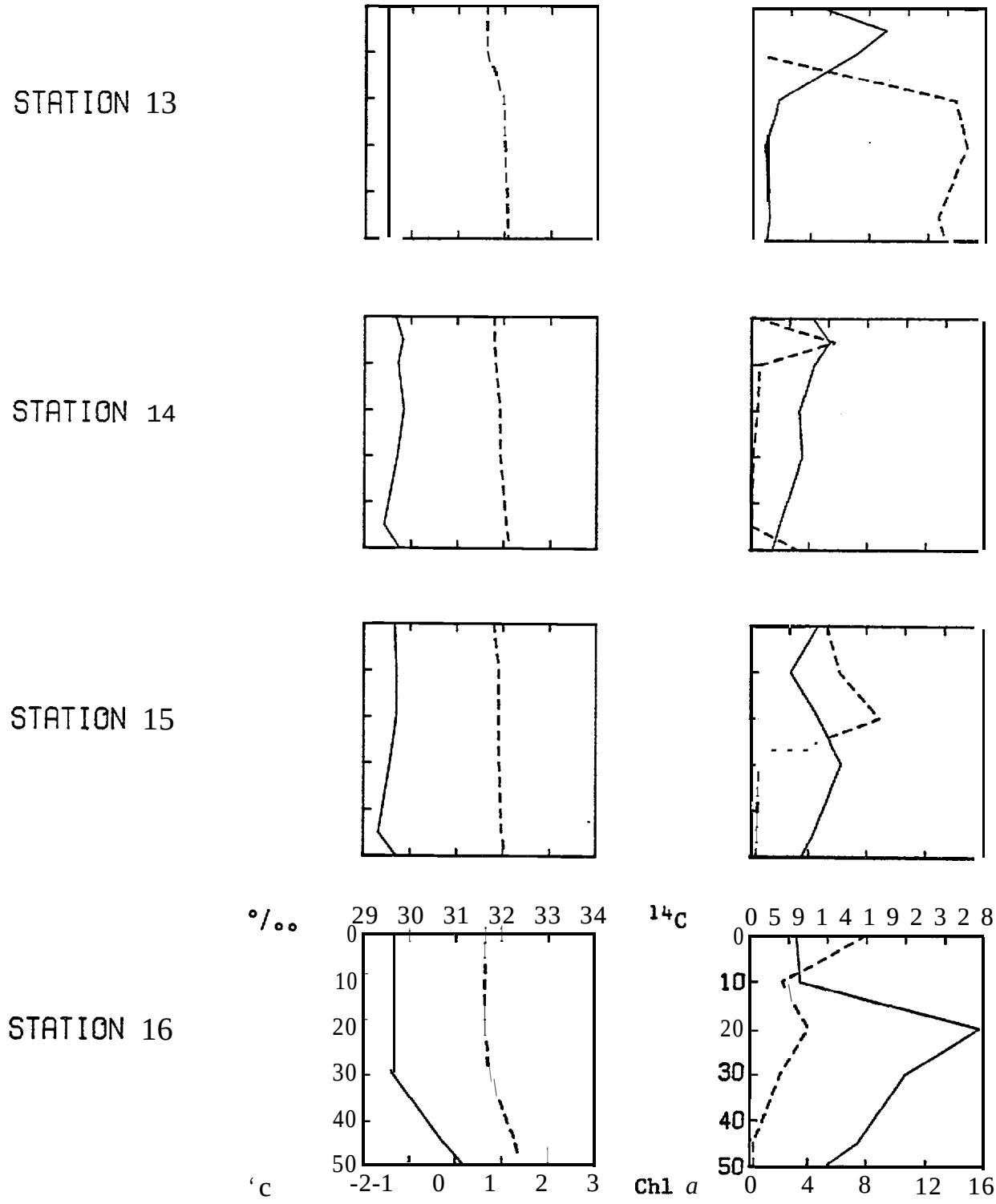
STATION 10
STATION 11
STATION 12
°/oo
29 30 31 32 33 34
14C
0 5 9 1 4 1 9 2 3 2 8
0
10
20
30
40
50
'c
- 2 - 1 0 1 2 3
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 14
STATION 15
STATION 16
°/oo
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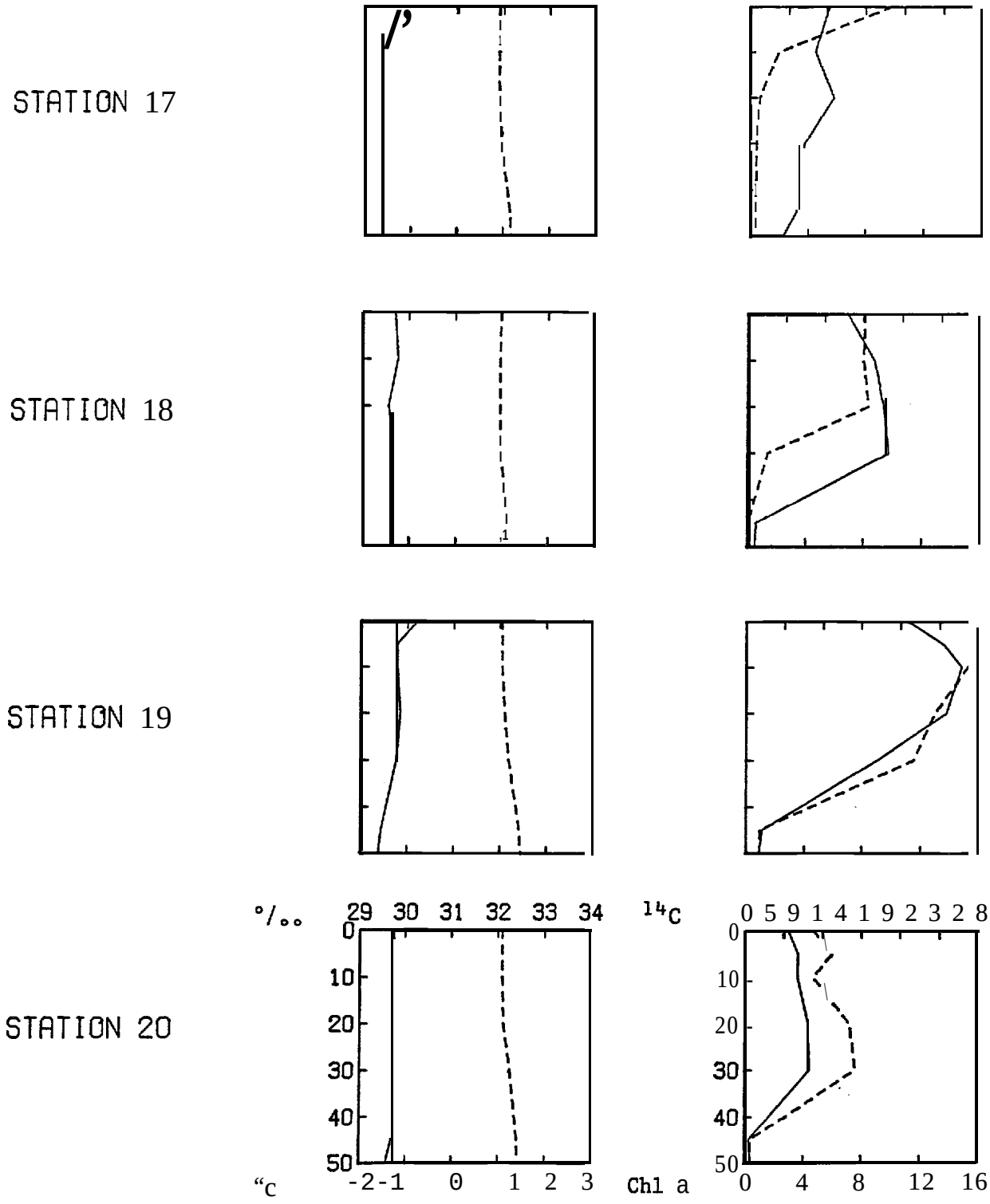
0
10
20
30
40
50
'C
-2-1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 18
STATION 19
STATION 20
°/oo
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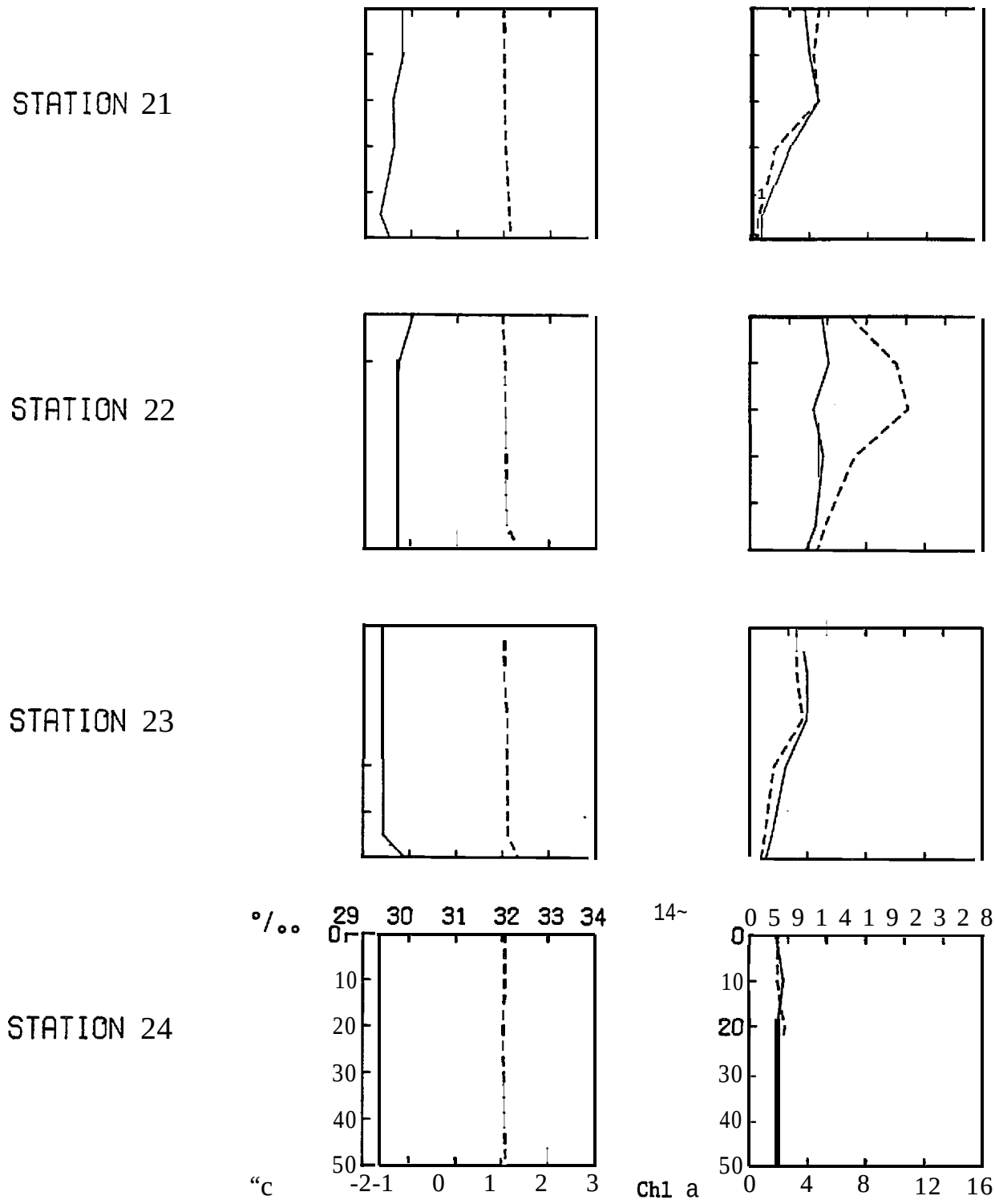
0
10
20
30
40
50
"C
-2 -1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 22
STATION 23
STATION 24
°/oo
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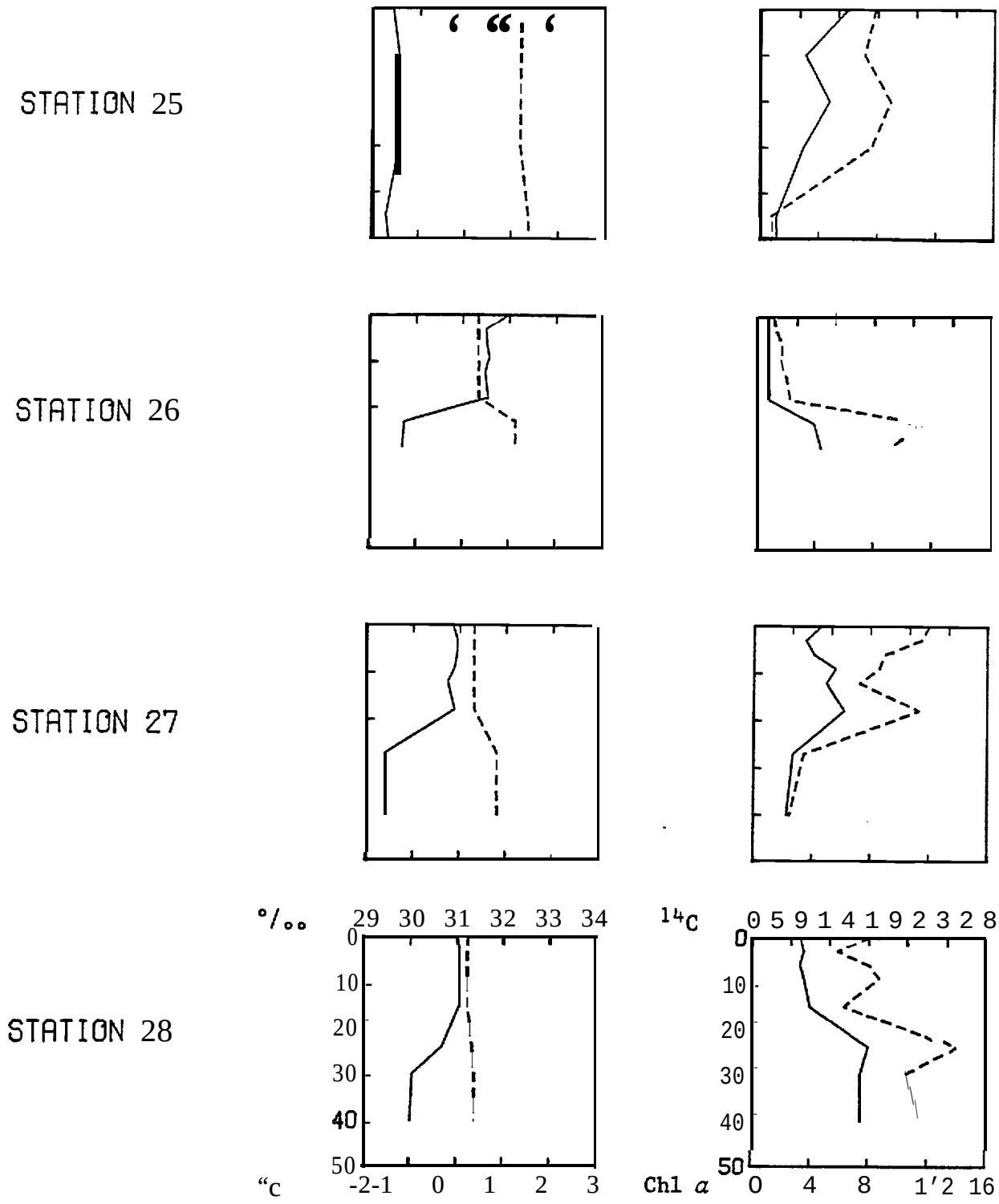
0
10
20
30
40
50
“c
-2 -1 0 1 2 3
14~
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 27
STATION 28
°/oo
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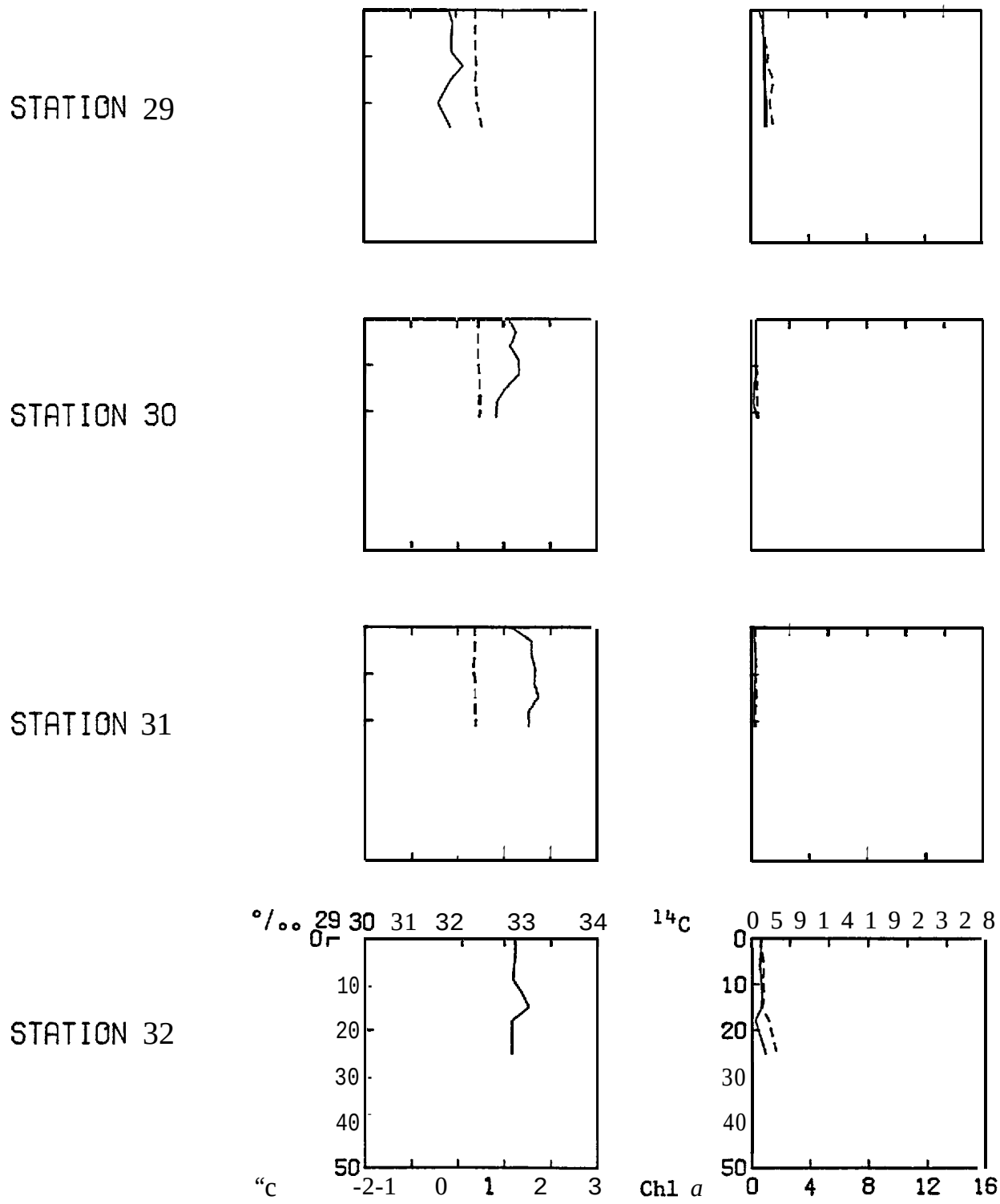
0
10
20
30
40
50
"C
-2-1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 1'2 16

Fig. 4. (cent.)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STATION 30
STATION 31
STATION 32
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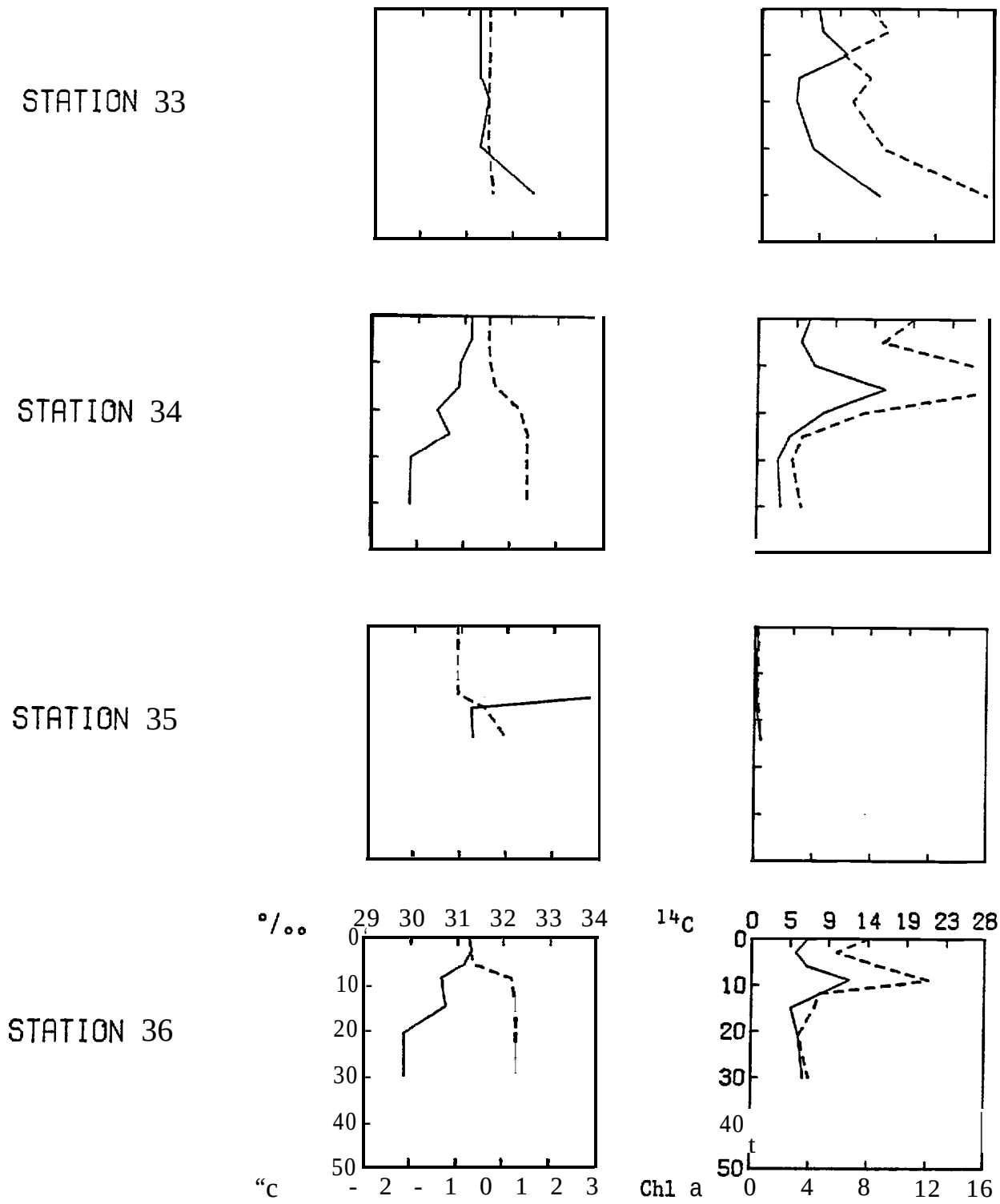
10
20
30
40
50
°C -2-1 0 1 2 3
14C 0 5 9 1 4 1 9 2 3 2 8
0
10
20
30
40
50
Chl a 0 4 8 12 16

Fig. 4. (cent.)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STATION 34
STATION 35
STATION 36
°/oo
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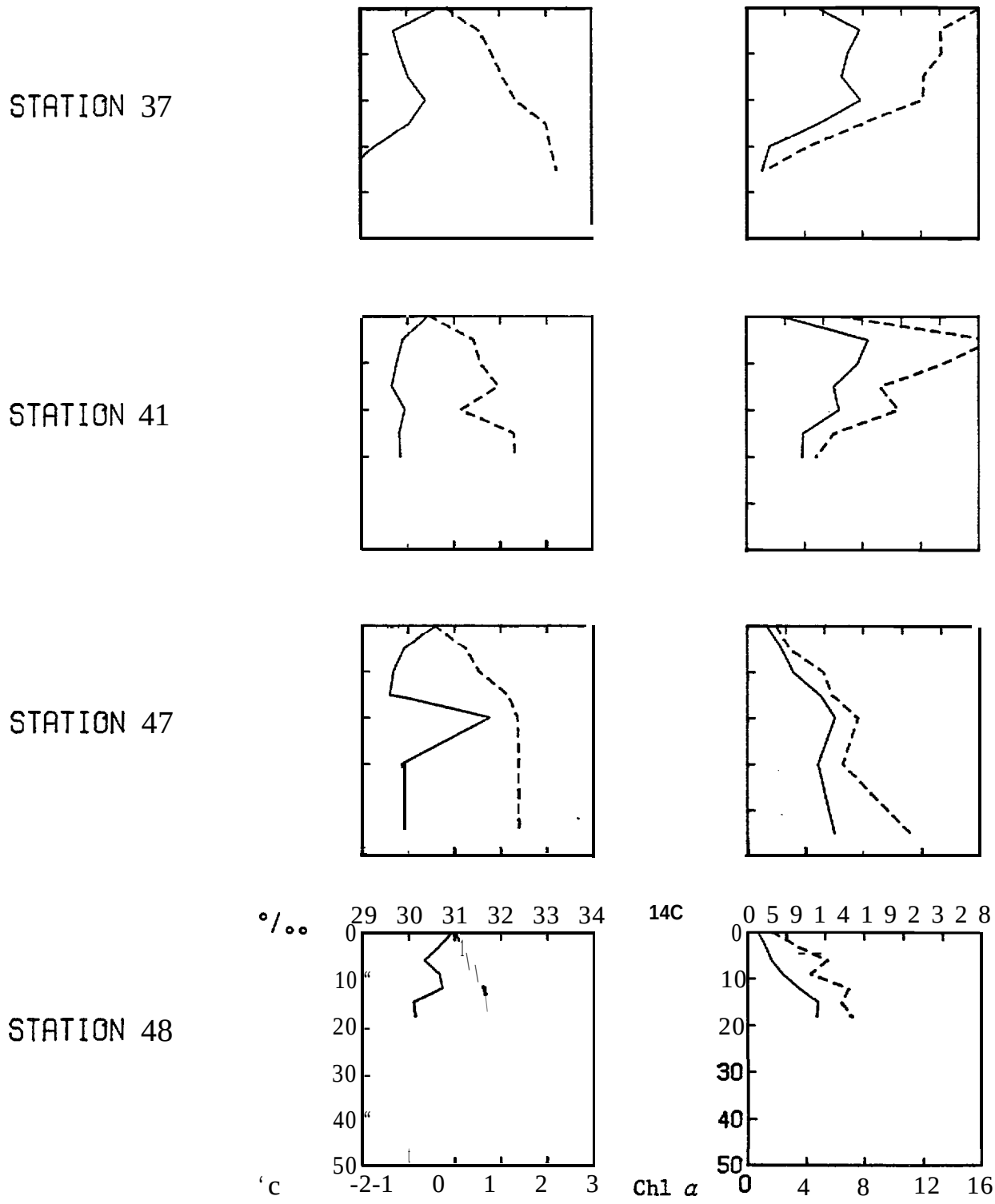
0
10
20
30
40
50
“c
- 2 - 1 0 1 2 3
14C
0 5 9 14 19 23 28
0
10
20
30
40
50
t
Chl a
0 4 8 12 16

Fig. 4. (cent.)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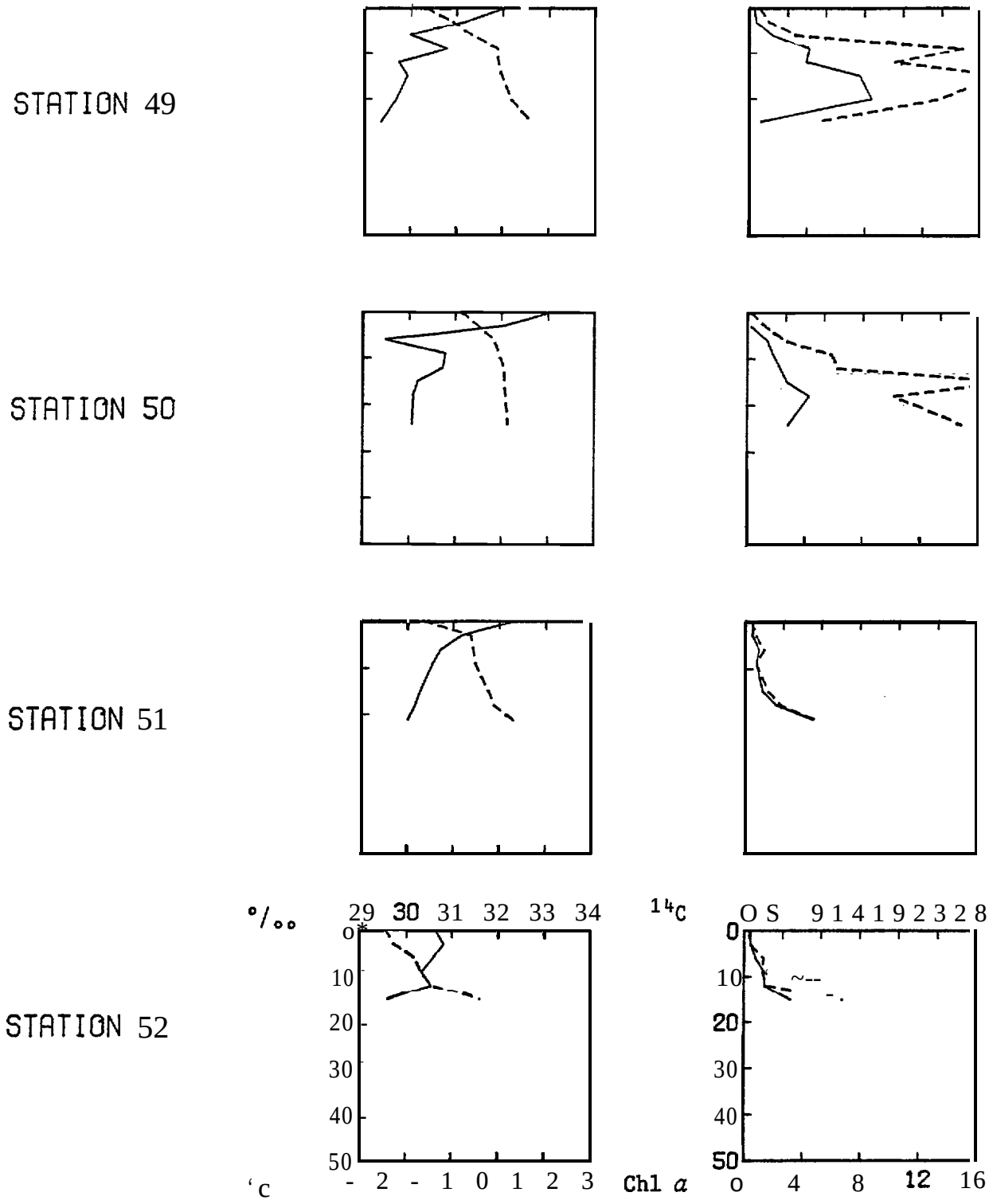
STATION 41
STATION 47
STATION 48
°/oo
29 30 31 32 33 34
14C
0 5 9 1 4 1 9 2 3 2 8
0
10
20
30
40
50
'C
-2-1 0 1 2 3
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 50
STATION 51
STATION 52
°/oo
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0
10
20
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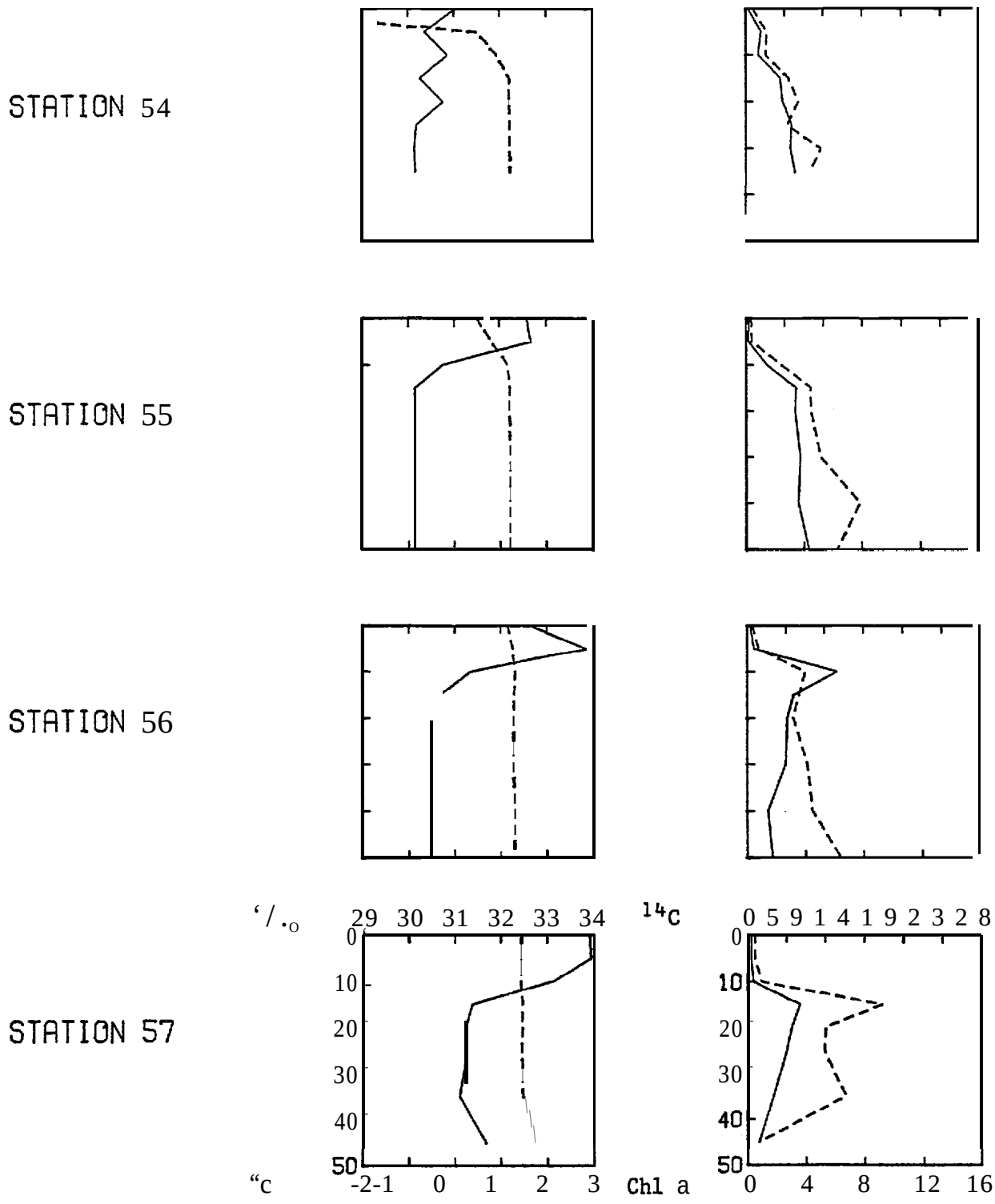
'C
- 2 - 1 0 1 2 3
14C
O S 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)


STATION 54
STATION 55
STATION 56
STATION 57
'/.o
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14C
0 5 9 1 4 1 9 2 3 2 8
0
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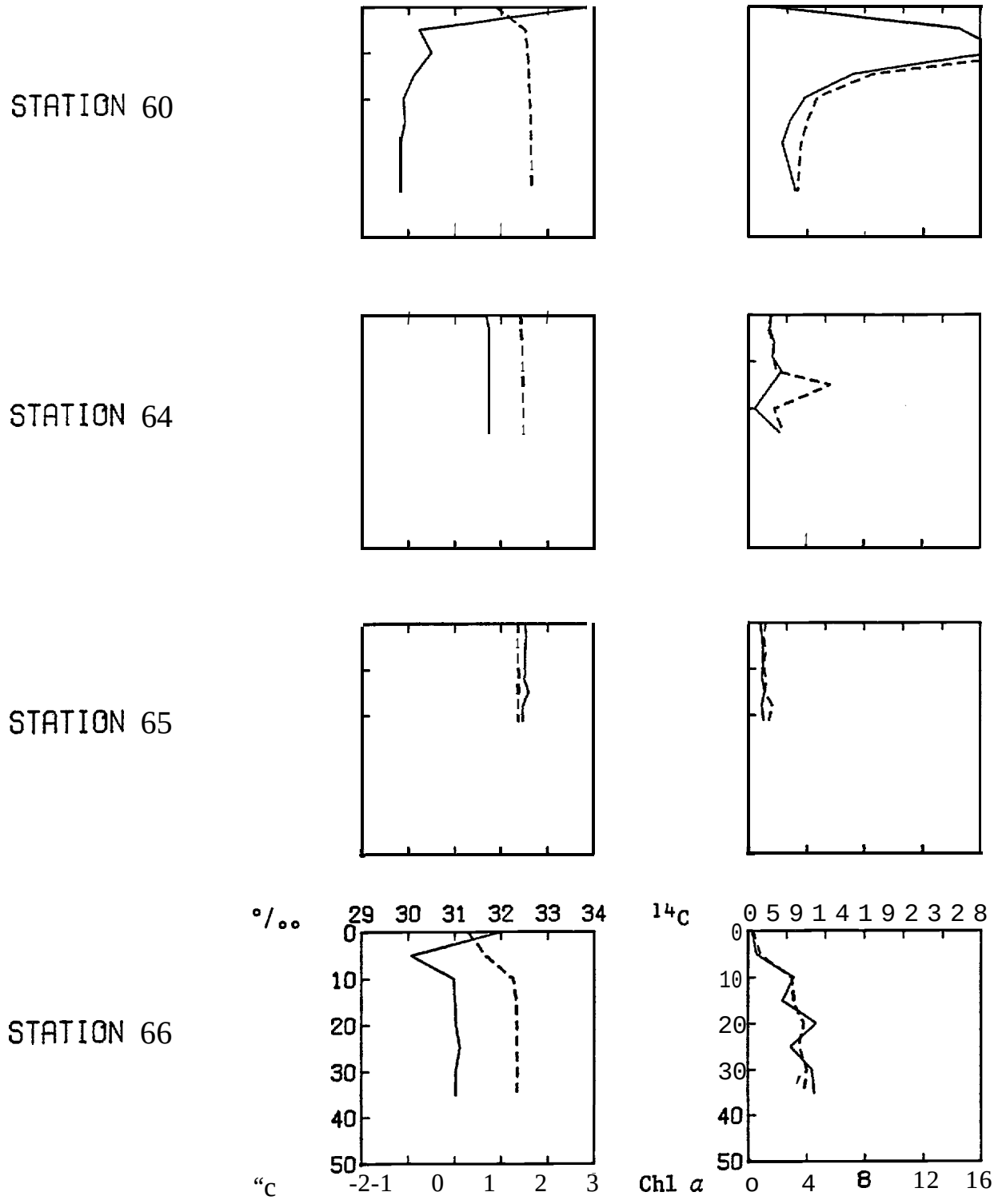
20
30
40
50
"c
-2-1 0 1 2 3
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 65
STATION 66
°/oo
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0
10
20
30
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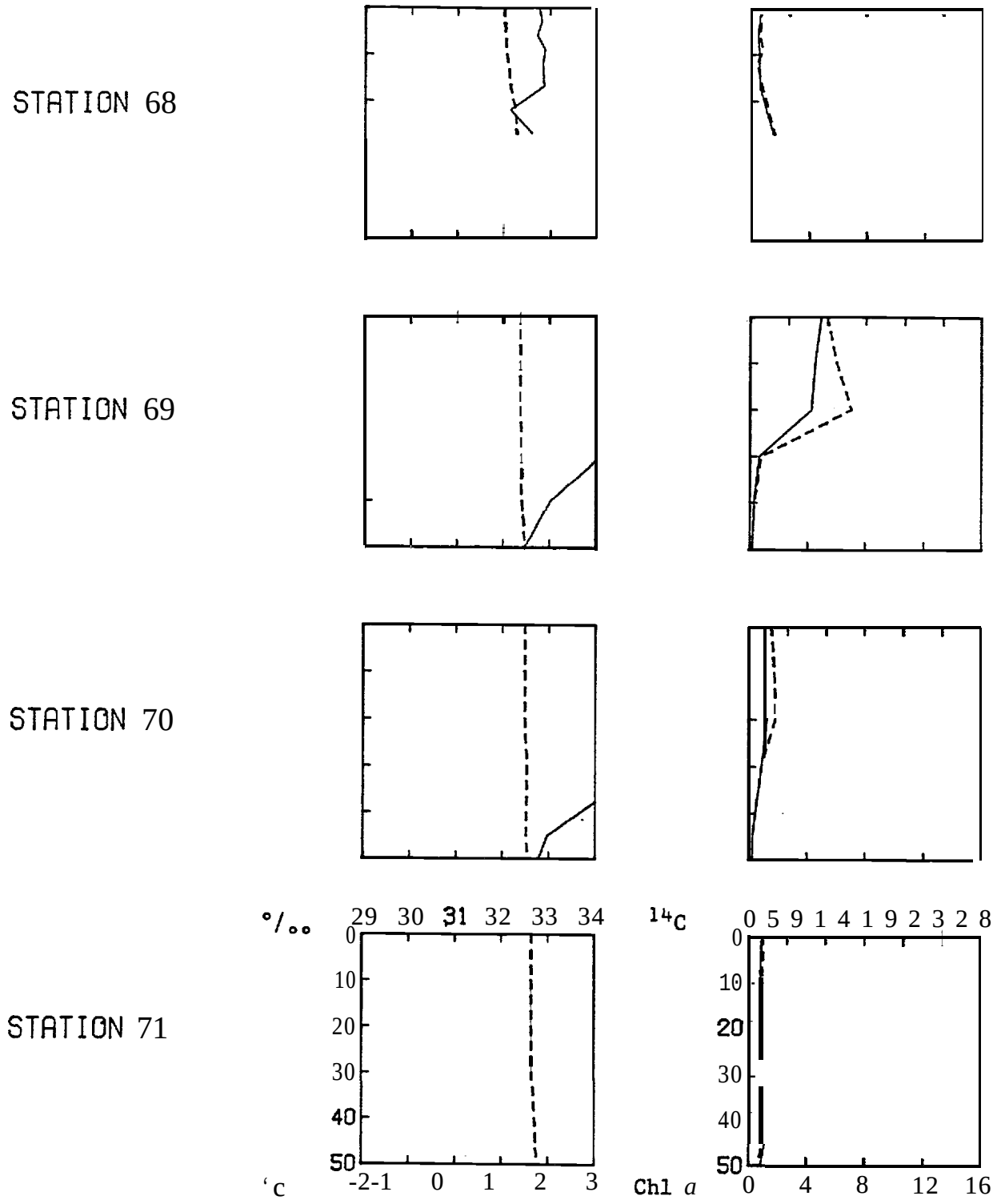
°C
-2-1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. *(cent.)*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STATION 69
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STATION 71
°/oo
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0
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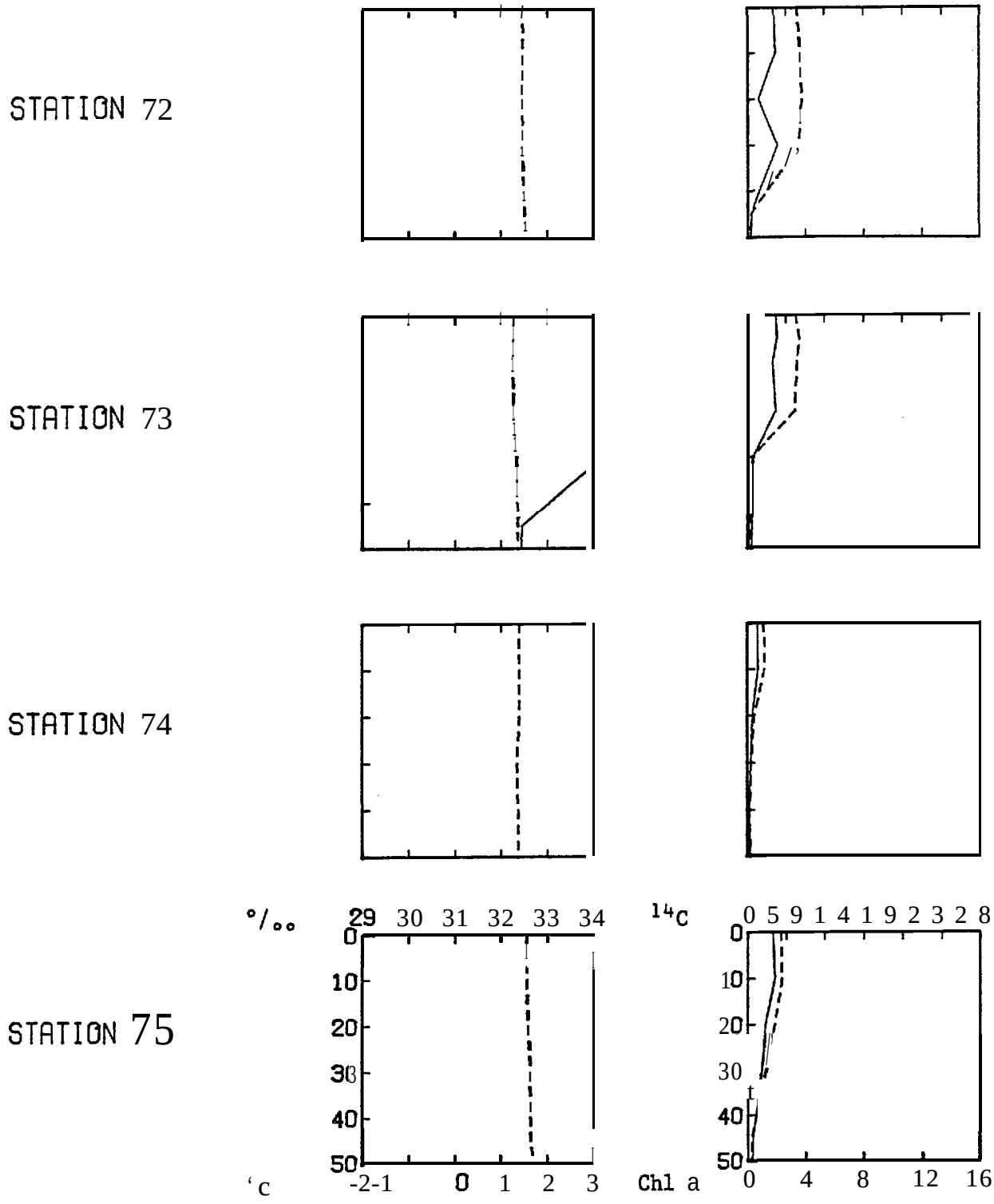
'C
-2-1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)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STATION 73
STATION 74
STATION 75
°/oo
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0
10
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'c
-2-1 0 1 2 3
14C
0 5 9 1 4 1 9 2 3 2 8
Chl a
0 4 8 12 16

Fig. 4. (cent.)

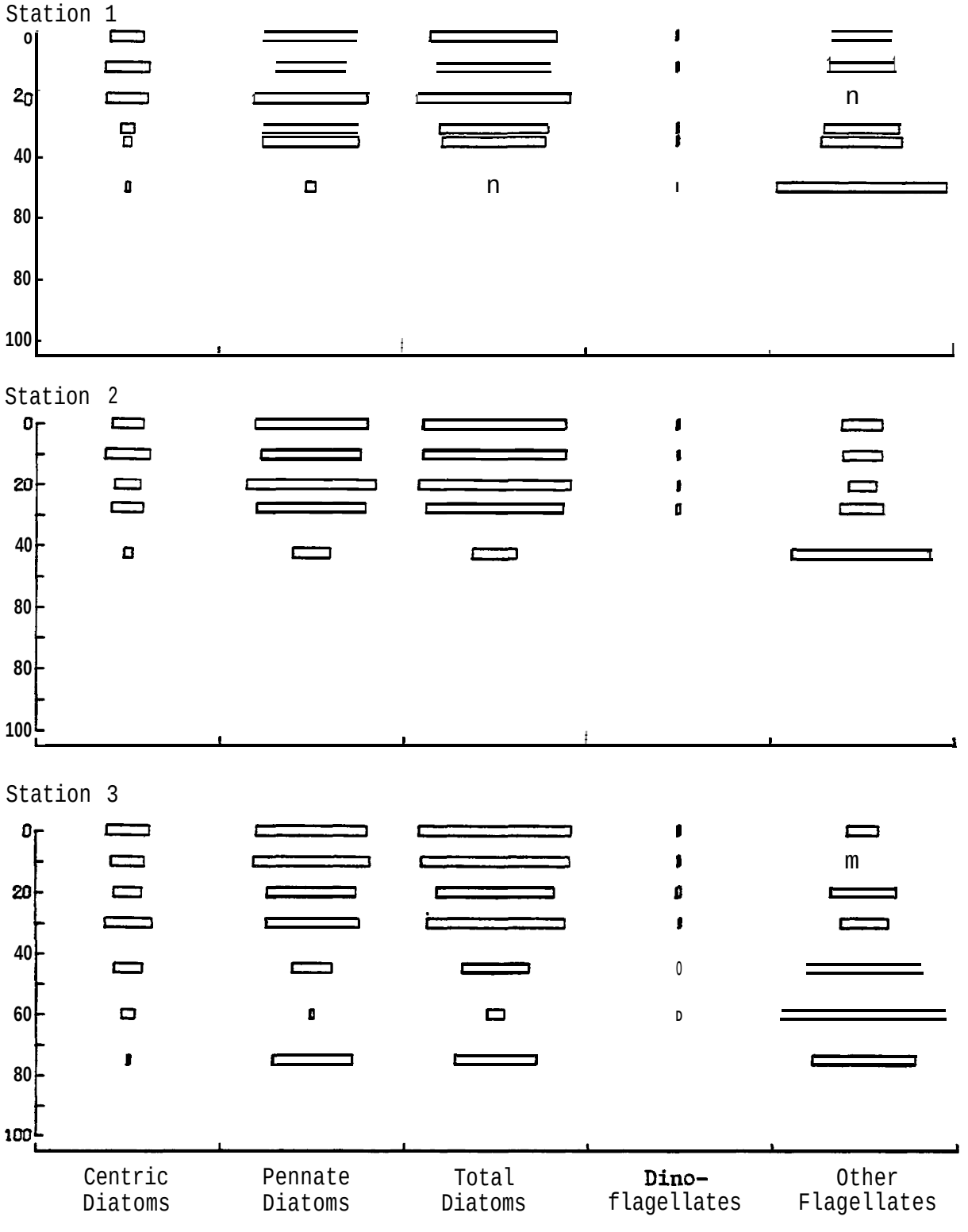
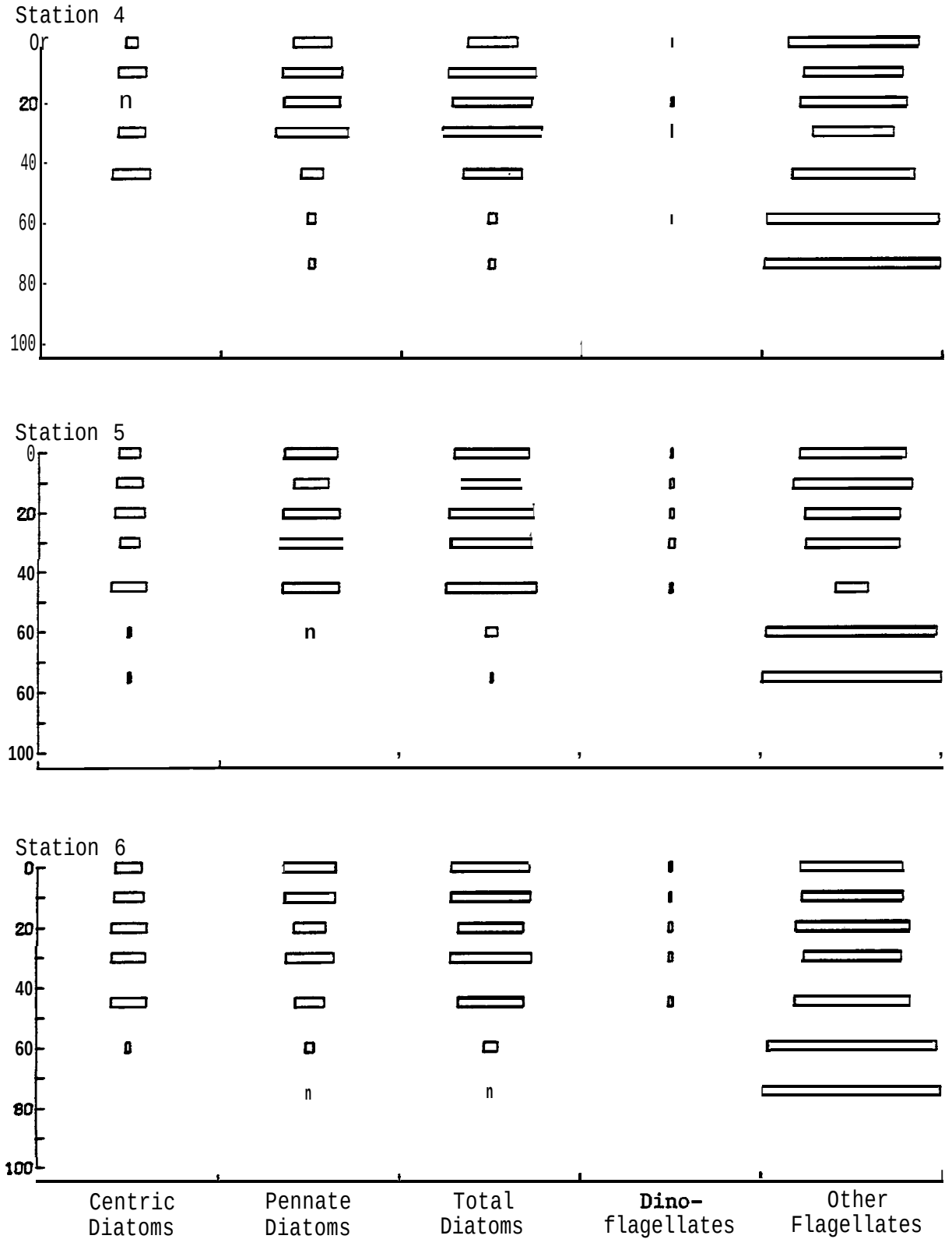


Fig. 5. Kite diagrams showing depth distribution of major categories of phytoplankton in the Bering Sea, 4 May-24 June 1980.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Station 6
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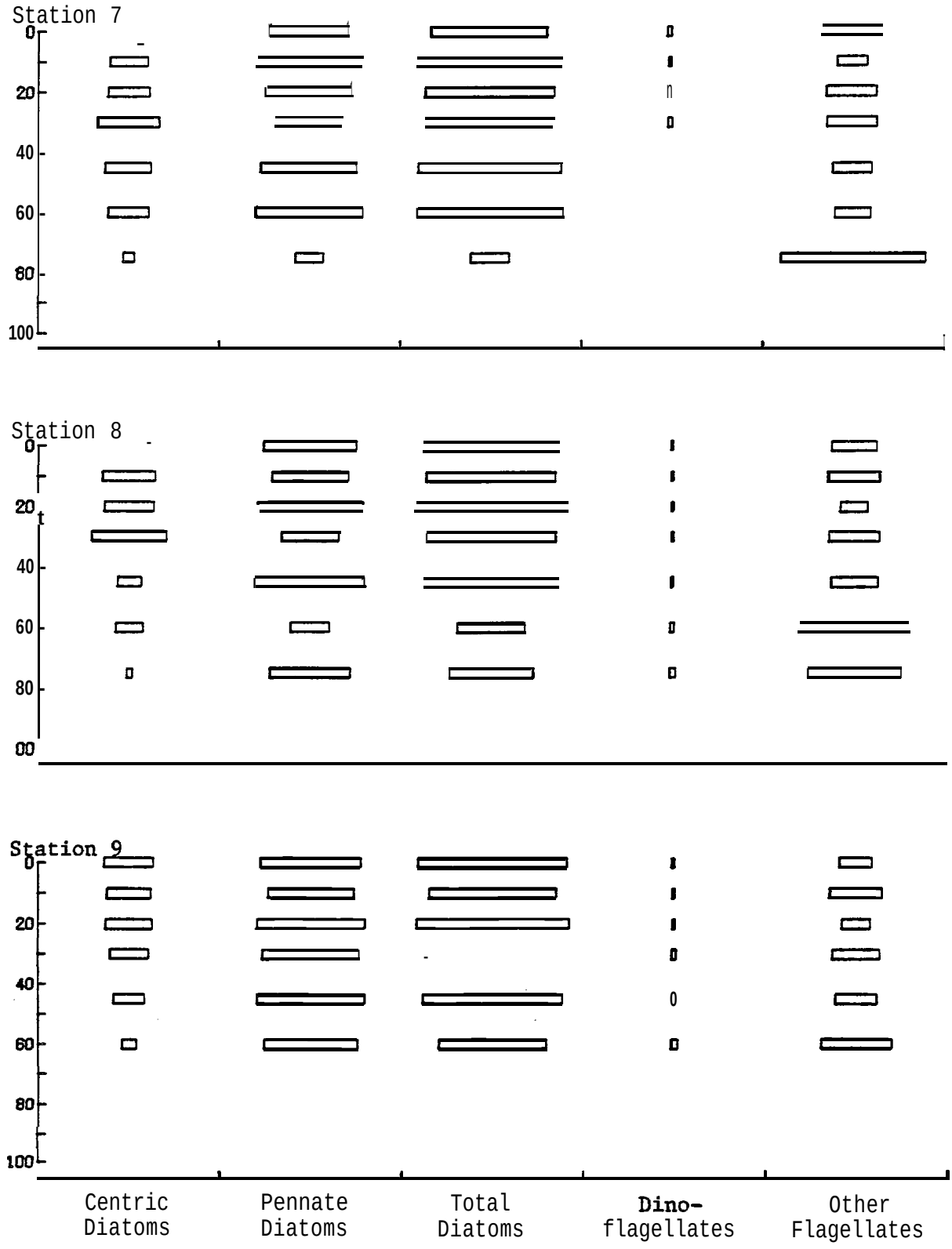
100
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 9
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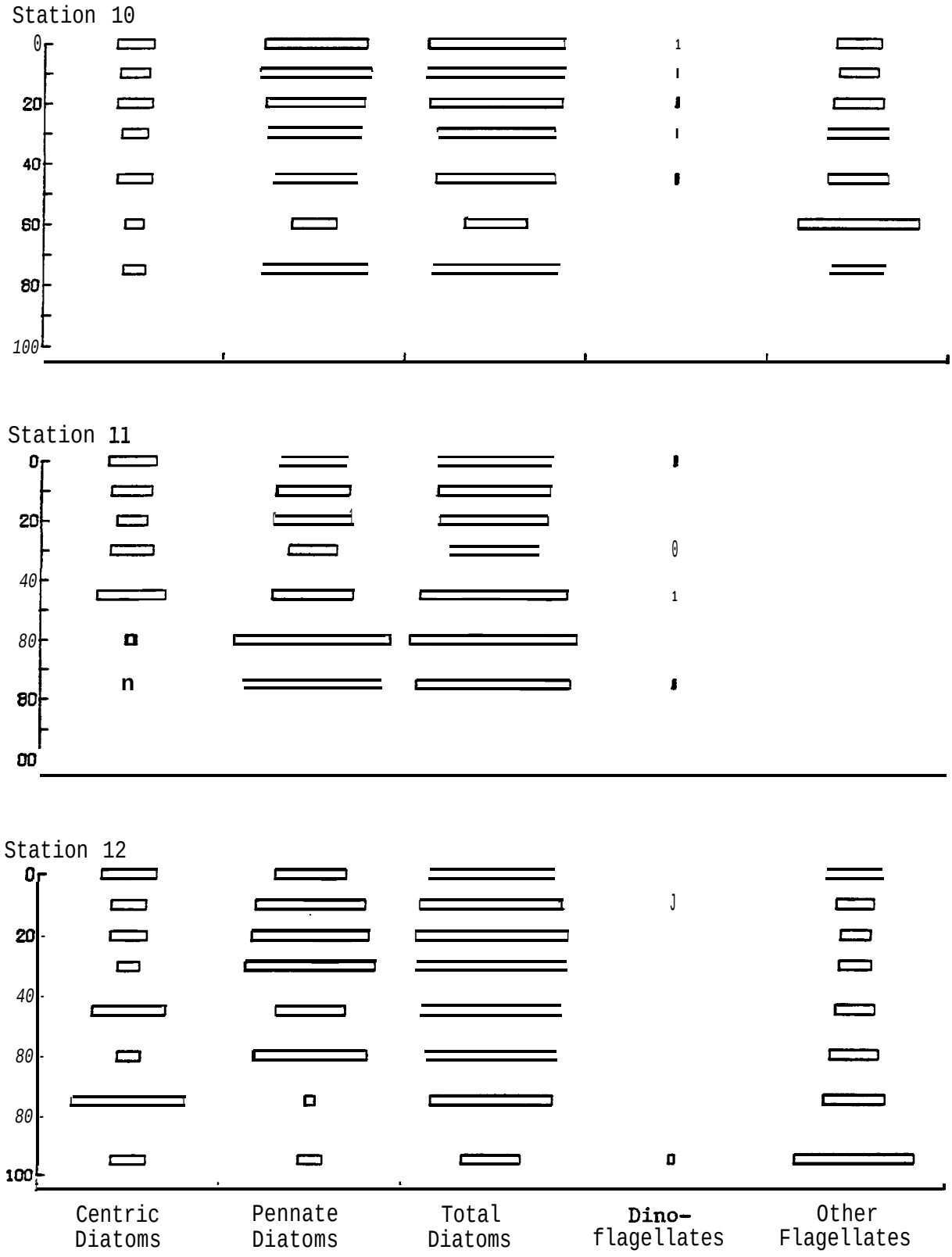
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 12
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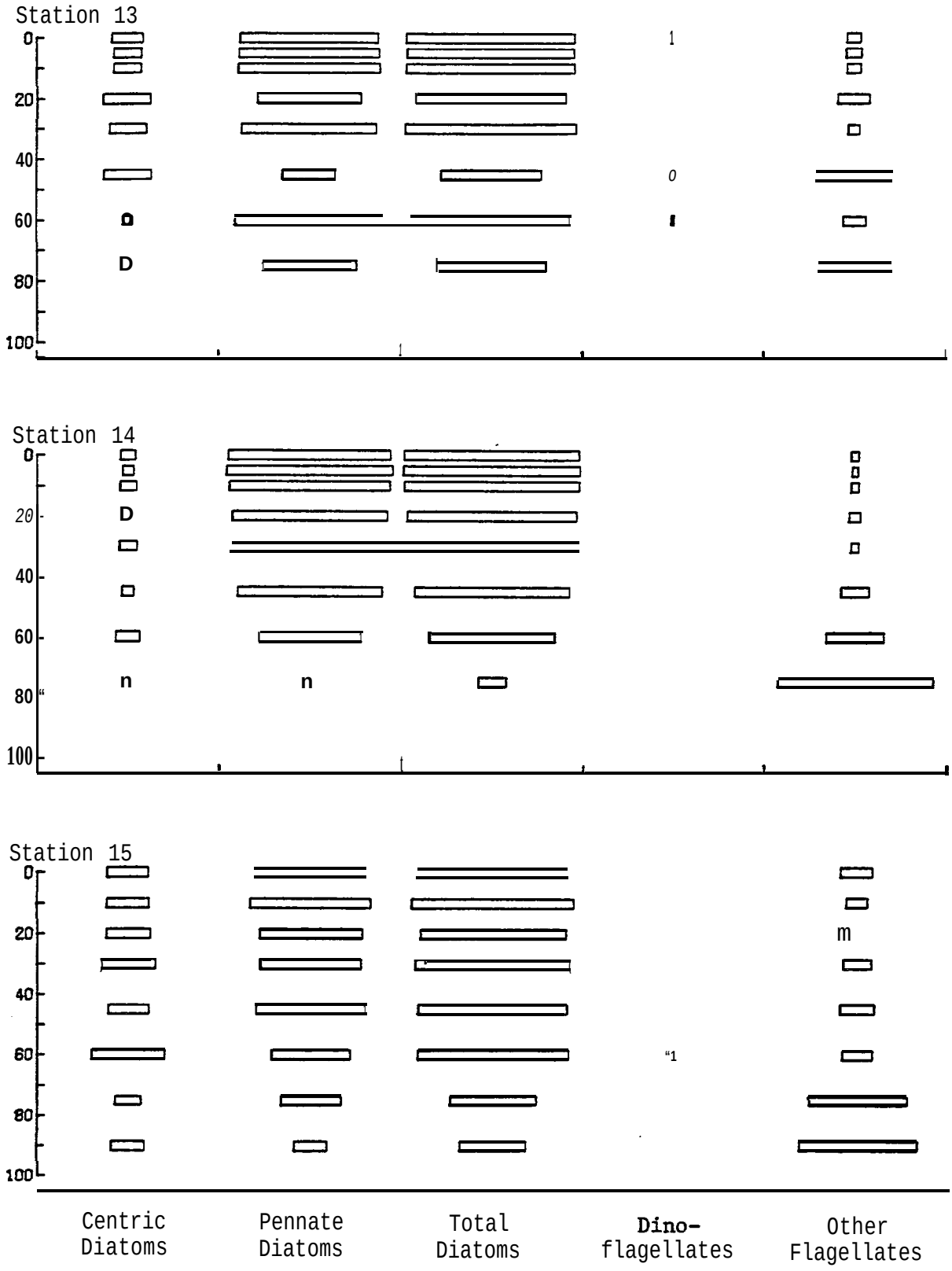
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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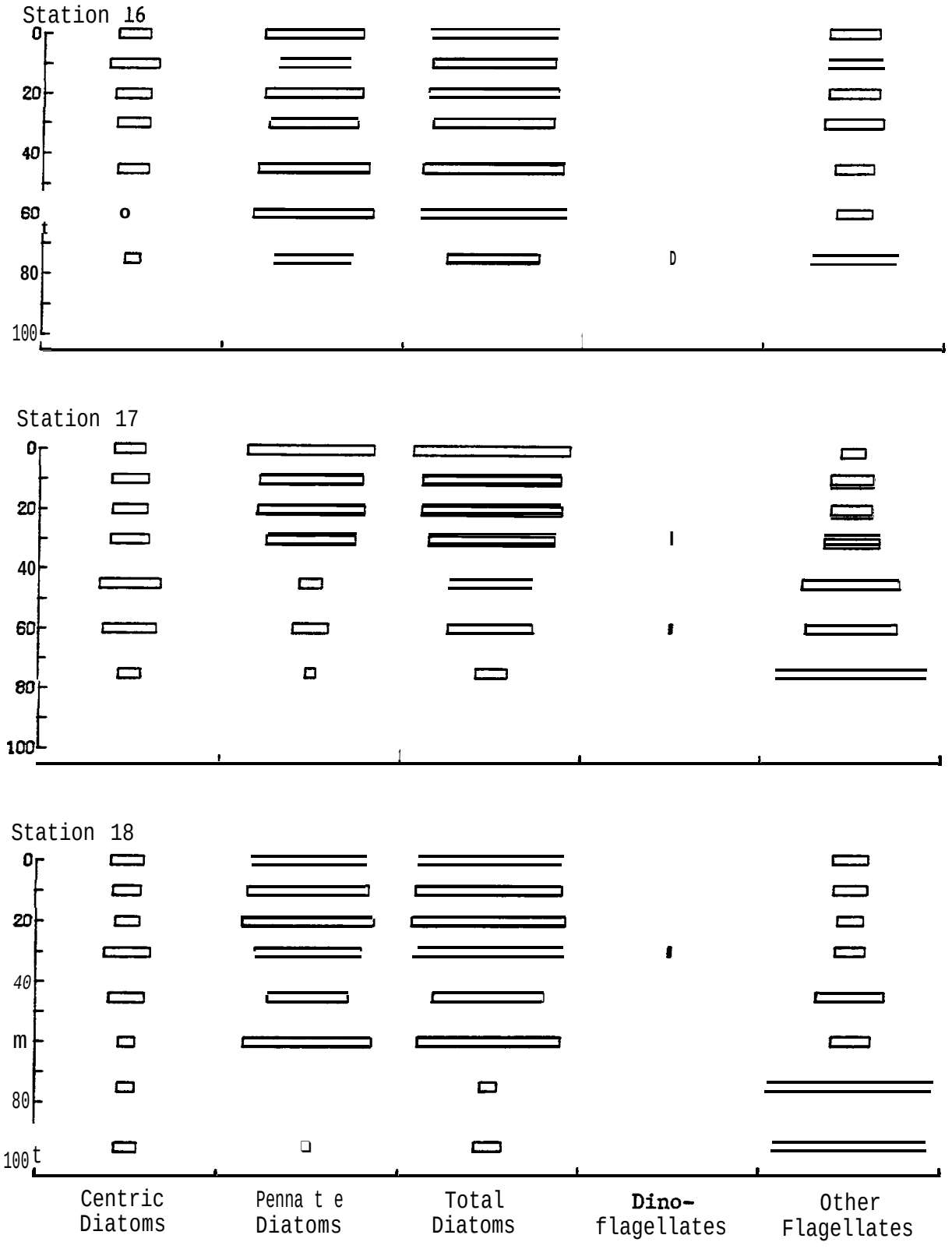
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 18
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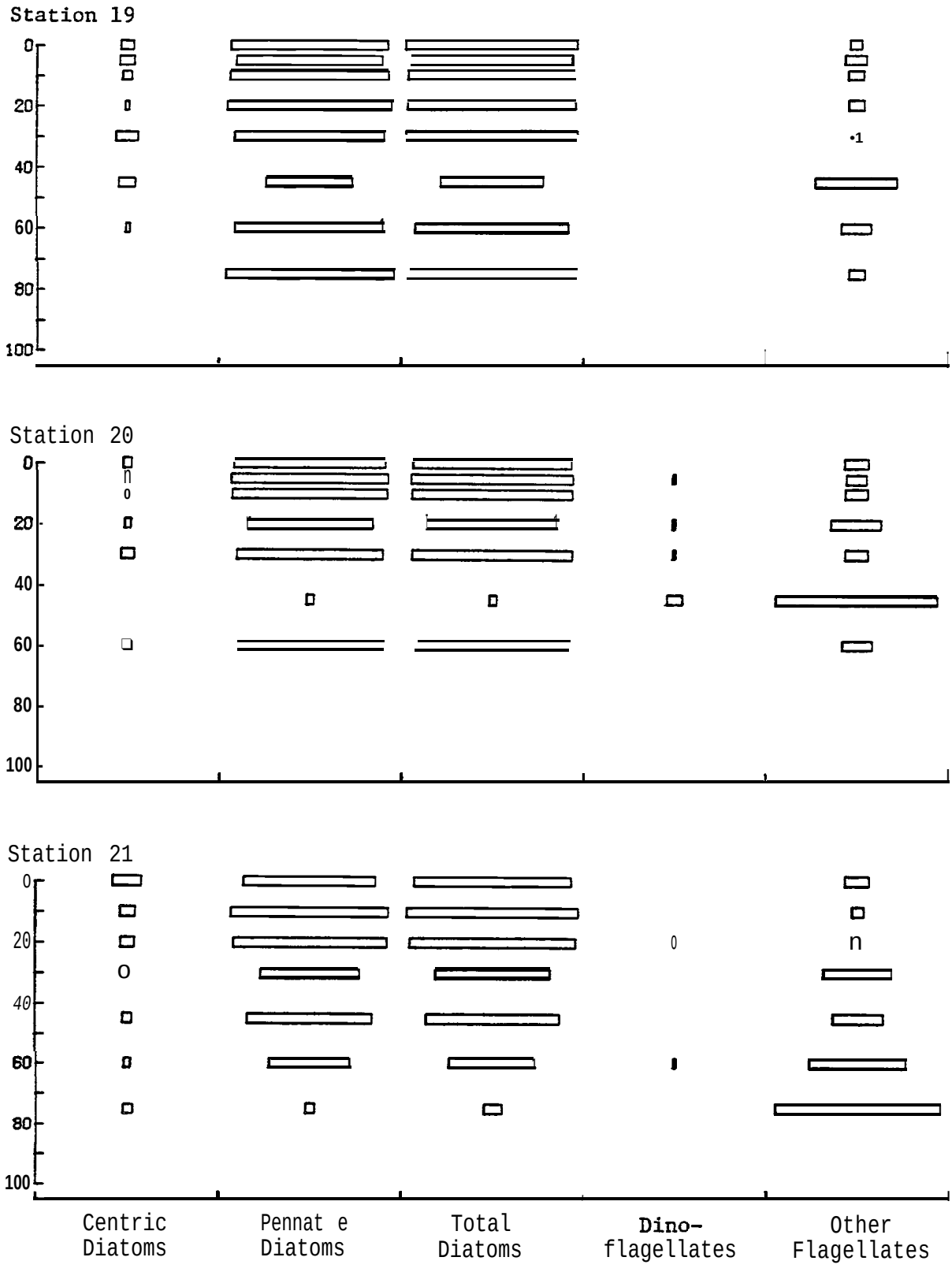
Centric Diatoms
Penna t e Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 21
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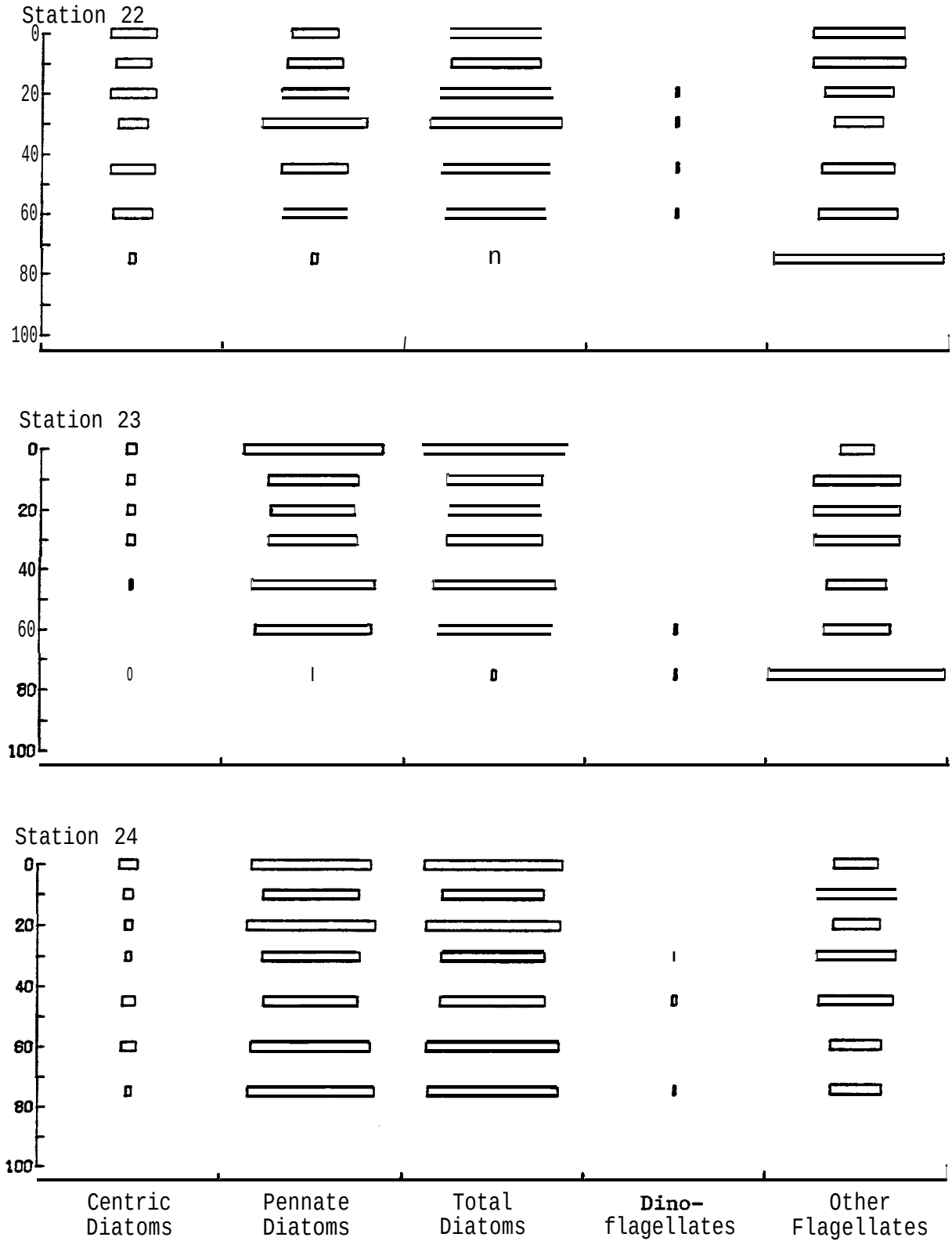
Centric Diatoms
Pennat e Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 24
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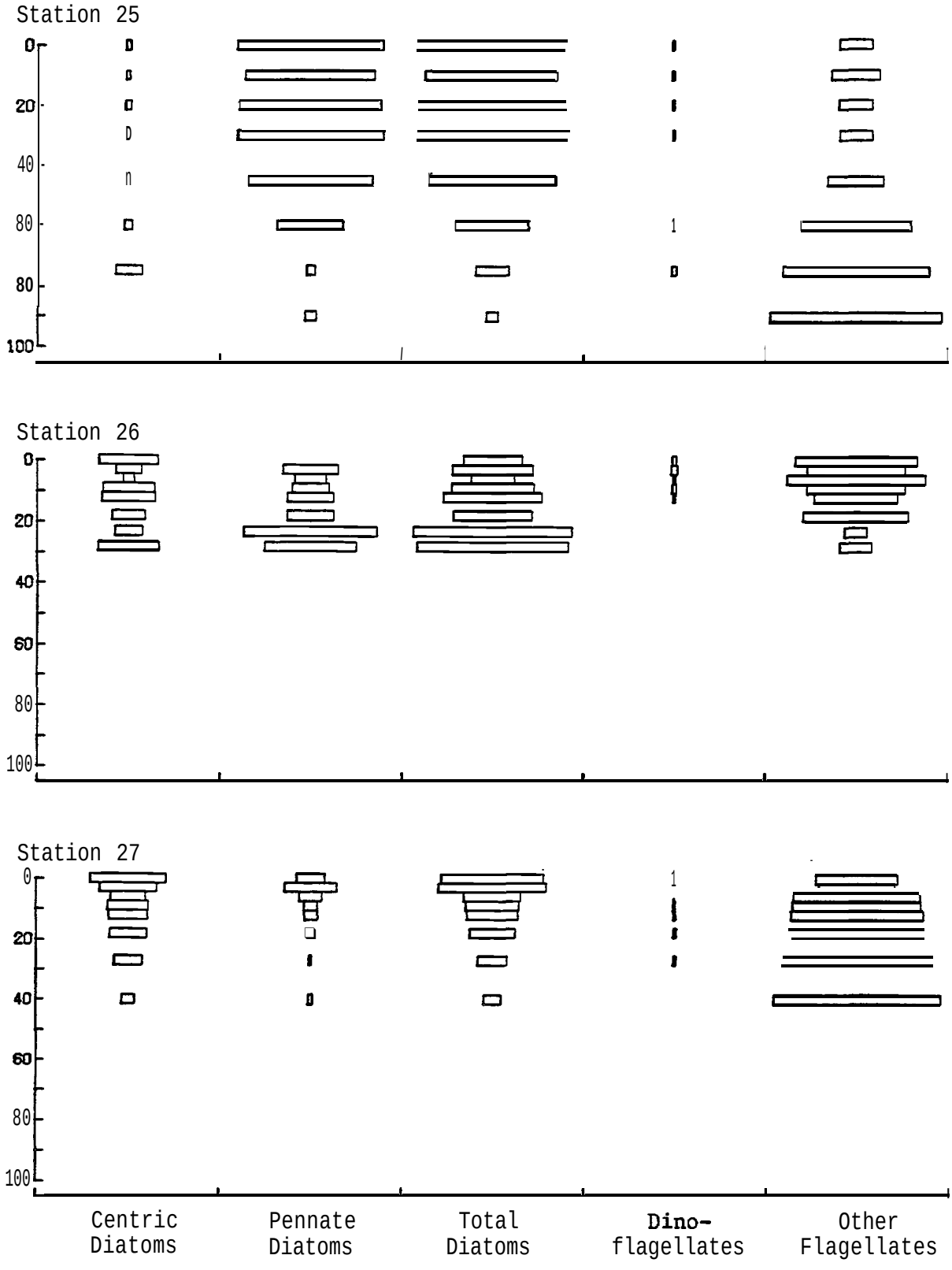
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 27
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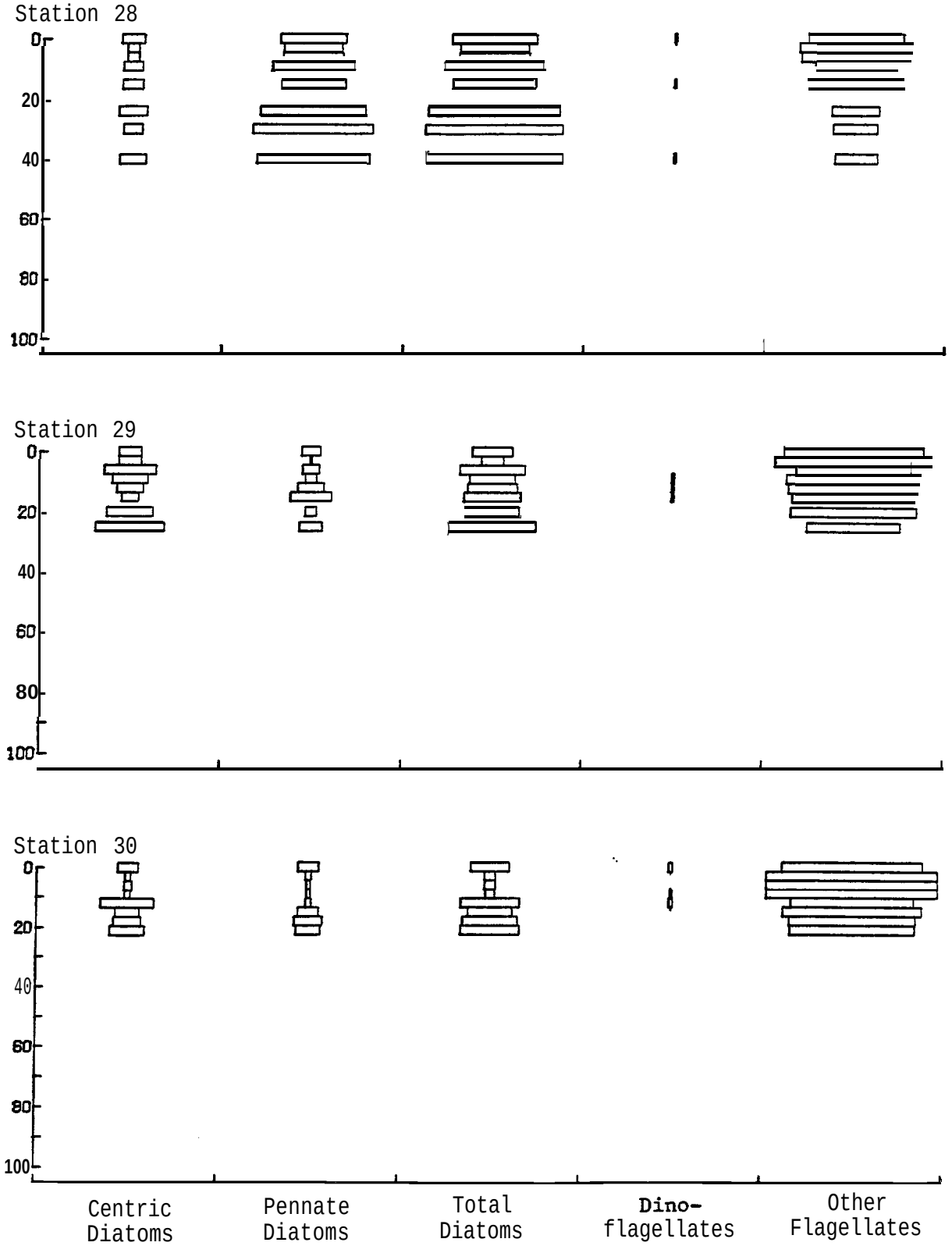
100
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 30
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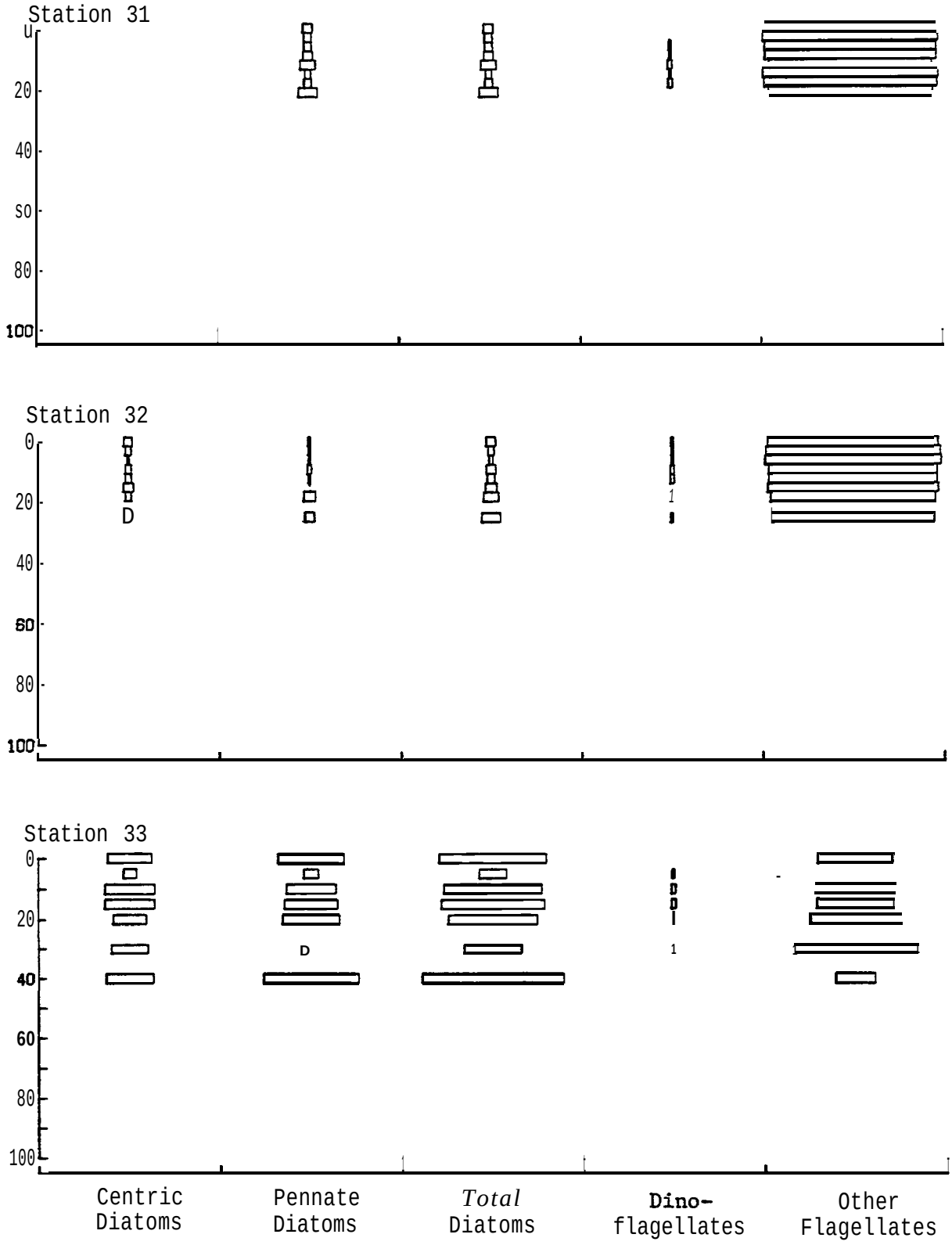
100
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 32
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Station 33
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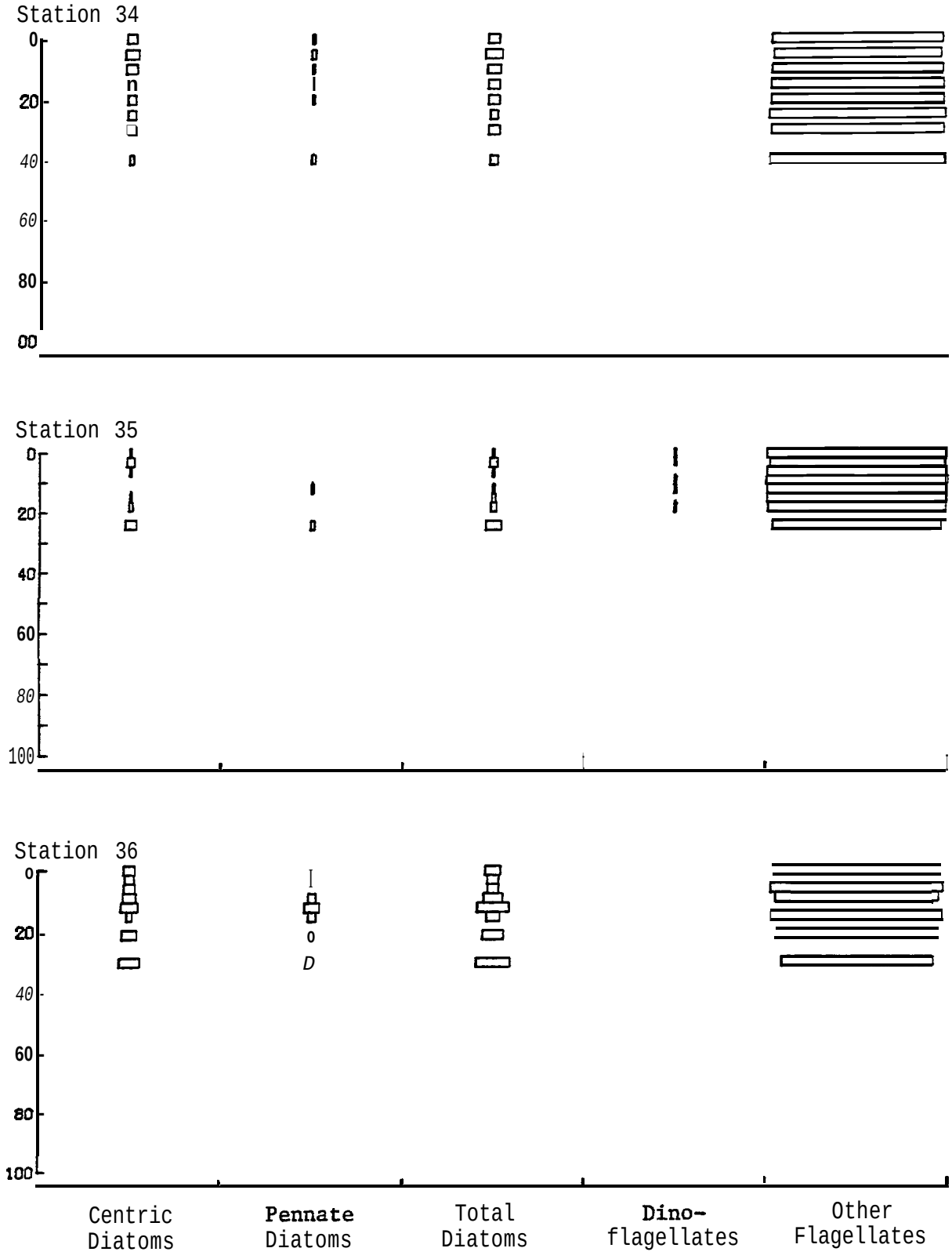
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 36
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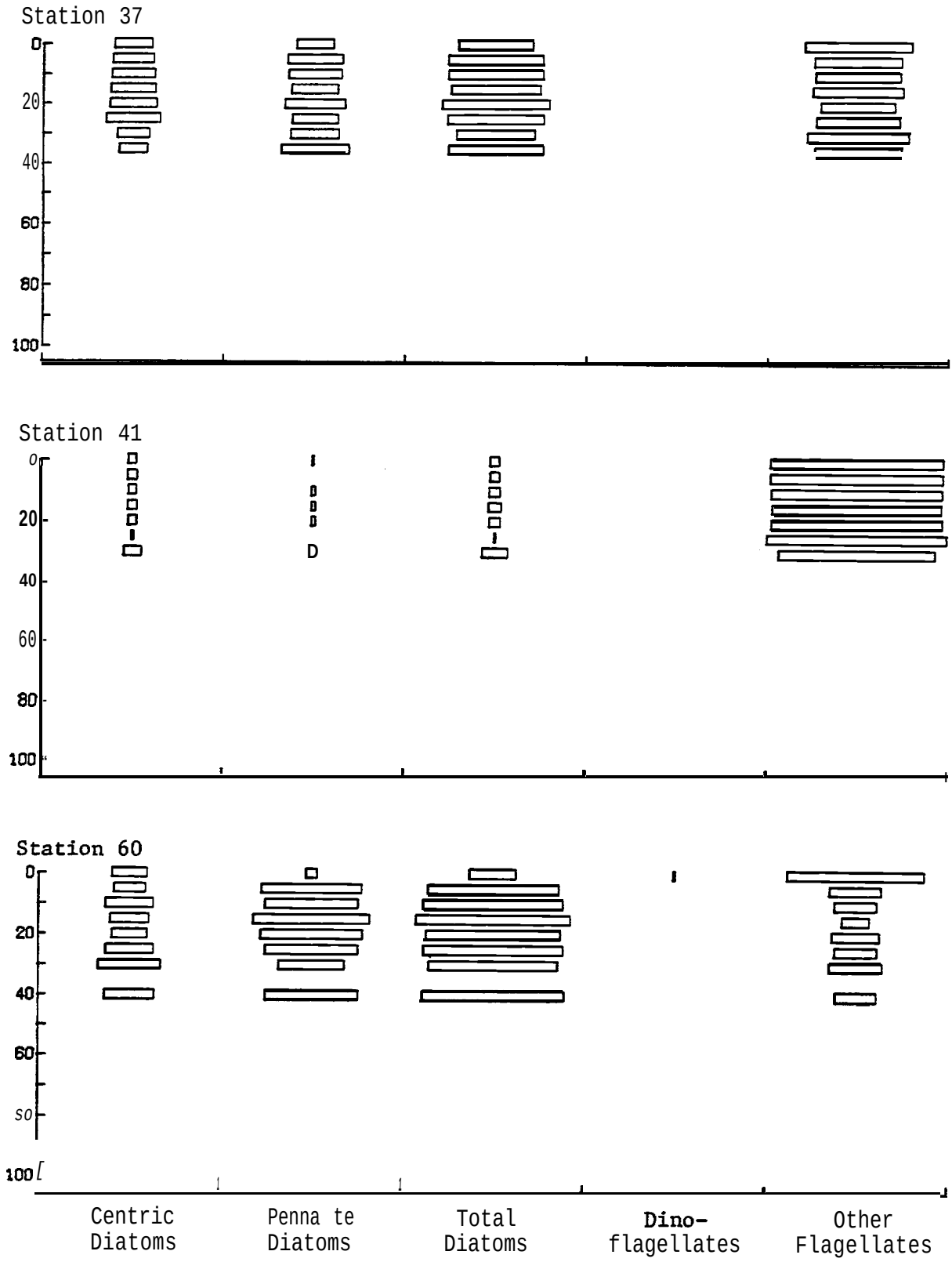
100
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 60
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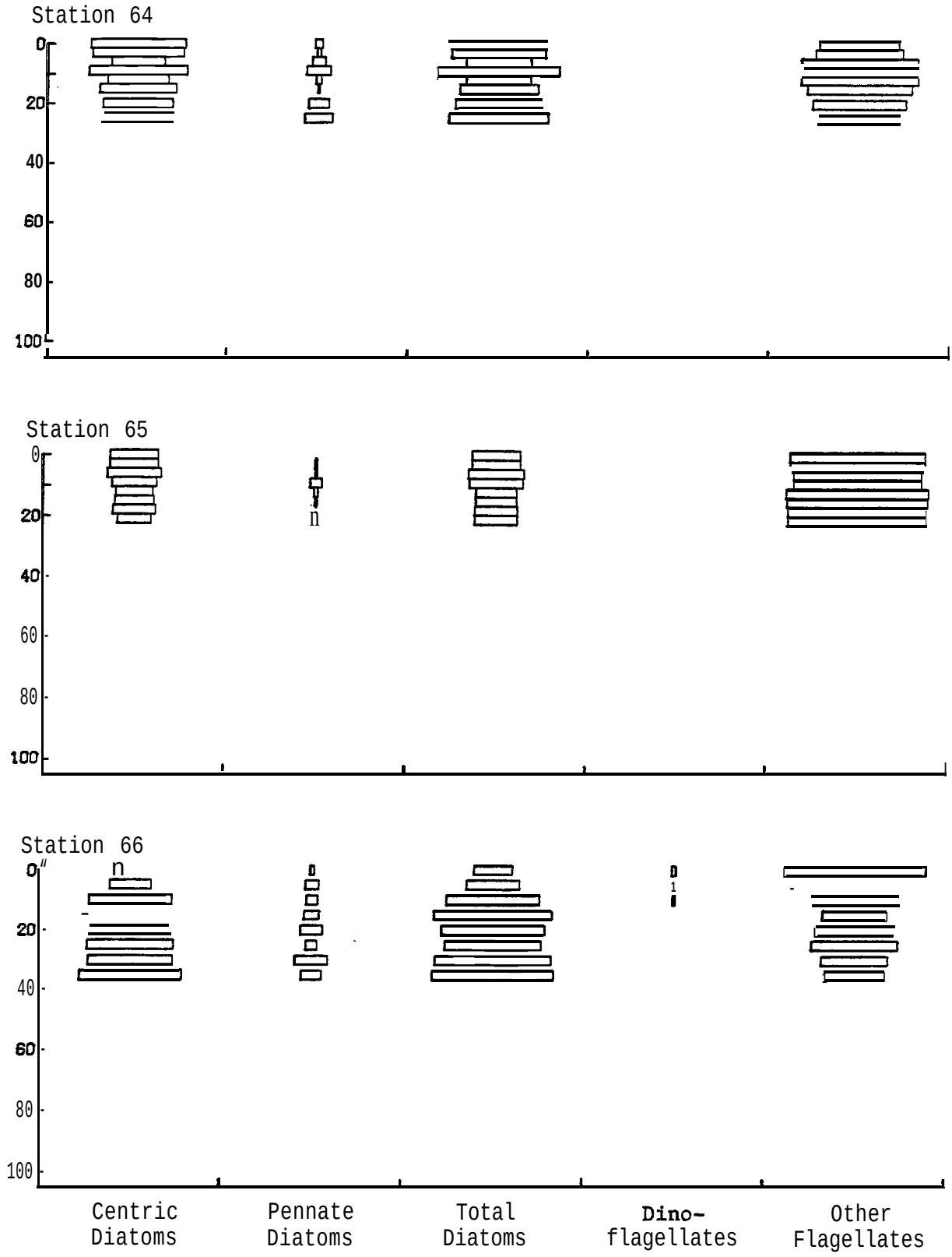
Centric Diatoms
Penna te Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)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Station 65
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Station 66
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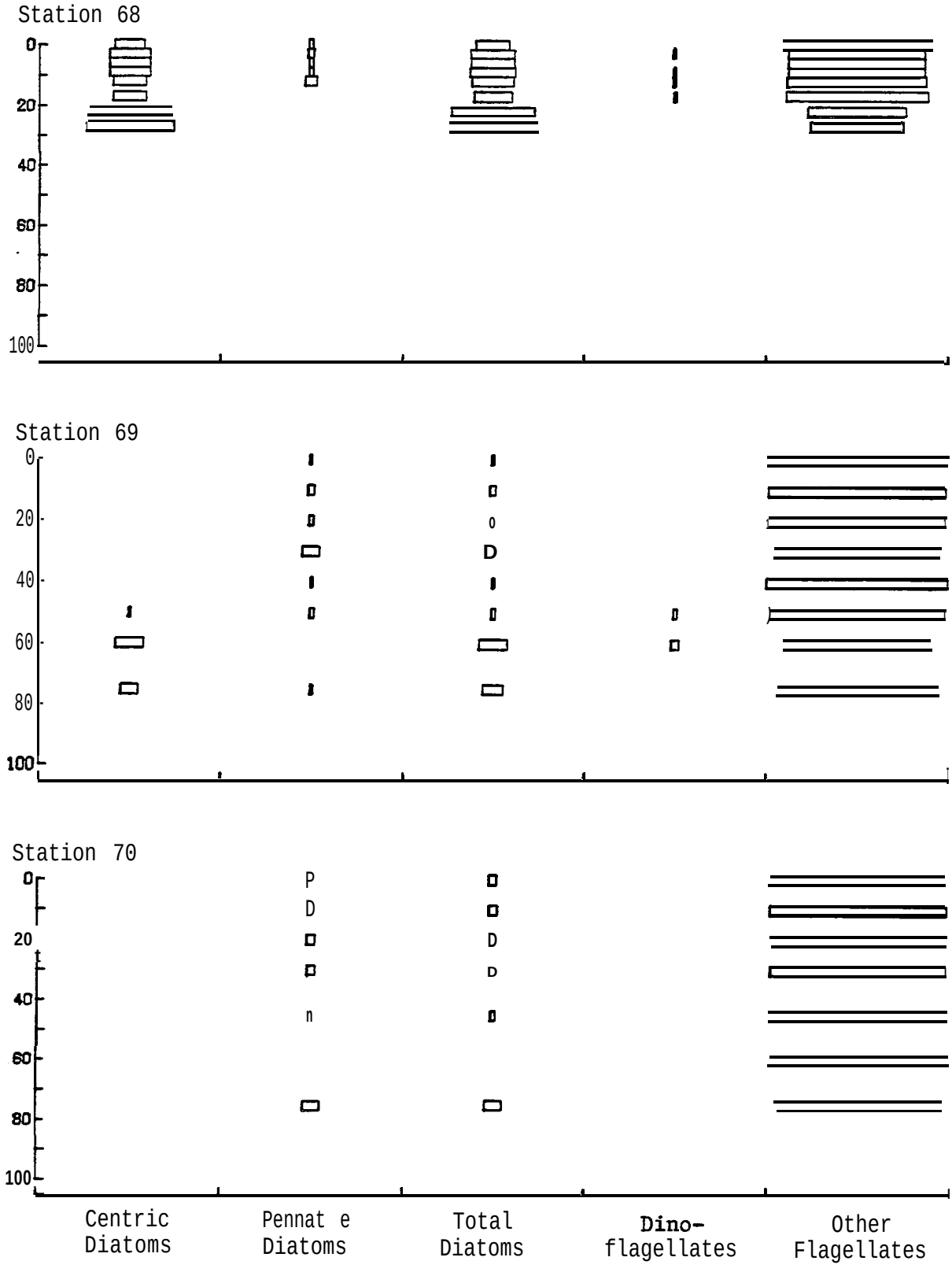
100
Centric Diatoms
Pennate Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cont.)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Station 69
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Station 70
0
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40
60
80
100
Centric Diatoms
Pennat e Diatoms
Total Diatoms
Dino-flagellates
Other Flagellates

Fig. 5. (cent.)

Table 9. Integrated chlorophyll a and primary productivity in the Bering *Sea, CGC Polar Star,* 4 May - 24 June 1980.

Sta	Chl a (mg m^{-2})	Prim Prod (mg Cm-z hr^{-1})
1	99.55	556.35
2	133.60	745.25
3	158.28	752.05
4	71.07	150.15
5	112.85	163.27
6	82.63	149.33
7	398.22	778.75
8	550.50	1154.48
9	411.07	458.93
10	477.05	2226.90
11	665.65	1437.58
12	290.12	1207.13
13	171.68	1310.53
14	188.95	462.63
15	274.90	775.20
16	479.35	1252.85
17	243.98	609.05
18	396.35	403.40
19	489.67	949.08
20	167.32	452.75
21	154.47	255.38
22	300.02	821.15
23	160.65	227.70
24	157.35	289.30
25	182.35	565.52
26	45.30	203.00
27	160.12	483.92
28	229.67	677.97
29	24.68	52.70
30	6.26	14.01
31	4.80	11.31
32	14.33	41.81
33	166.90	590.38
34	139.77	546.70
35	4.66	10.95
36	113.24	293.52
37	193.87	631.40
41	177.85	540.88
47	207.85	523.15
48	49.12	162.24
49	106.35	413.97
50	52.59	337.86
51	27.59	56.26
52	17.52	43.13
54	17.52	43.13

Table 9. (cont.)

Sta	Chl a (mg m^{-2})	Prim Prod (mg Cm-z hr^{-1})
55	145.80	407.38
56	120 .02	324.30
57	79.02	337.65
60	266.17	540.67
64	38.52	106.37
65	21.03	46.23
66	102.83	178.72
68	20.61	40.99
69	125.05	297.40
70	45.85	103.88
71	50.23	88.80
72	67.77	247.82
73	62.98	170.07
74	20.33	51.95
75	63.62	134.52

Temperatures in the upper 60-75 m were generally negative. Positive temperatures were sometimes found below 75 m. Thermoclines, when present, were usually about 30 m. Salinity in the upper 20-30 m ranged from 31.53-31.98°/.0 in the southeastern seacion (stations 1-3, 7-17), increasing to near 33°/$_{oo}$ at depth at some stations. Stations to the west (stations 4-6) and the north (stations 19-25) had salinities of 32.00-32.83°/$_{oo}$ in the upper 20-30 m, increasing to near 33°/00 at depth. Haloclines sometimes occurred about 30 m.

Ice cover was heavy with >50% cover at stations 1-9, 14, and 23. Little or no ice cover was present at stations 10-13, 15-22, and 24-25. The ice edge was generally near 175°30'W.

Primary productivity values were variable, but relatively high over the whole area regardless of ice cover. Highest values were in the upper 30 m except at the easternmost stations (stations 11-14) where highest values were below 20 m and extended to 75-100 m, which was near the bottom. Integrated productivity ranged from 150 mg C m^{-2} hr^{-1} at station 4 to 227 mg C m^{-2} hr^{-1} at station 10.

Chlorophyll a concentrations were also relatively high, ranging from ea. 1-20 mg m^{-3} in the upper 30 m over the whole area. Below 30 m, the chlorophyll a concentration was usually < 2 mg m^{-3}. Integrated chlorophyll a values over the whole area ranged from 71 mg m^{-2} at station 4 to 665 mg m^{-2} at station 11.

Nutrient concentrations over the whole area were variable, but relatively high and generally with higher values occurring below 30 m. Nitrate and phosphate may have been minimal at some stations and depths.

Diatoms were the most abundant organisms at all stations except stations 4-6, the three westernmost stations where ice cover was about 90%. Microflagellates were dominant at these stations and cell numbers were low. Pennate diatoms of the genus *Nitzschia* section *Fragilariopsis* were dominant elsewhere. Also abundant were *Porosira glacialis*, *Navicula pelagica*, species of *Thalassiosira* and *Chaetoceros*, and choanoflagellates. Microflagellates were often abundant and were sometimes most abundant at depth. Cell concentrations were near 2 x 10^6 cells ℓ^{-1} except at stations 14, 15, 19, and 25 where cell concentrations were >3 x 10^6 cells ℓ^{-1}. Dinoflagellates were present at most stations, but were never in large numbers.

Stations 26-33 were taken in the St. Matthew-Hall area between St. Lawrence and Nunivak islands (Fig. 1). No ice was present in the area.

Temperatures were generally positive except at stations 27 and 29 where slightly negative temperatures occurred throughout the water column and at stations 26-29 where negative temperatures were present at depth. Salinity ranged from 31.07-32.14°/00. The water column was relatively well-mixed in this shallow area.

Primary productivity was variable, being high at stations 27, 28, and 33 at the western edge of the area near 170°W. Stations 30 and 31, closest to shore near 167°W had lowest productivity with < 1.00 mg C m^{-3} hr^{-1} at all

depths. Stations 26, 29, and 32, located between 168 and 169°W, had productivity ranging from 1-3 mg C m^{-3} hr^{-1} except at 23 and 28 m at station 26, where productivity was 16-20 mg C m^{-3} hr^{-1}. Integrated productivity was > 480 mg C m^{-2} hr^{-1} at stations 27, 28, and 33; < 15 mg C m^{-2} hr^{-1} at stations 30 and 31; and ranged from 42-203 mg C m^{-2} hr^{-1} at stations 26, 29, and 32.

Chlorophyll a concentrations followed the same pattern with highest values, 2.5-7.5 mg m^{-3}, at stations 27, 28, and 33. Integrated values were > 160 mg m^{-2}. Stations 30 and 31 had low chlorophyll a concentrations, ranging from 0.17-0.38 mg m^{-3} with integrated values of 5-6 mg m^{-2}. Stations 26, 29, and 32 also had < 1.00 mg m^{-3}, but values ranged from 0.22-0.97 mg m^{-3}, except below 20 m at stations 26 and 29 where the chlorophyll concentration was 1-4.4 mg m^{-3}. Integrated chlorophyll values were > 14 mg m^{-2}.

Unfortunately, nutrient samples from stations 26, 27, 31-33 thawed before analysis could be done and the concentrations, though reported in Table 8, are questionable except for silicate. For samples not thawed, nutrient concentrations were low, even for silicate suggesting rapid utilization.

Microflagellates dominated at all stations in this area. Even at stations 27, 28, and 33 where productivity and chlorophyll were high, flagellates were dominant. At stations 30 and 31, closest to the coast, flagellates were 70-90% of the population. At station 31, *Cylindrotheca closterium* was the most abundant diatom, but was still less than 10% of the total population. Stations 26 and 29 had the lowest number of cells per liter, usually c 0.8 x 10^6. At station 32, cell numbers were relatively high, near 1 x 10^6 cells ℓ^{-1}, but flagellates comprised ea. 90% of the total population. Dinoflagellates were present at all stations, but in low numbers. The condition of the diatoms at-these stations suggested that the spring bloom had occurred earlier. Many cells appeared to be unhealthy and the pennate diatoms contained large oil droplets.

Stations 34-41 and 60-68 were taken in the Norton Basin; stations 47-57 were taken in the southern Hope Basin. Ice cover in Norton Basin varied with stations 37 and 41 in heavy ice, while all other stations were ice-free. Heavy ice was encountered north of Bering Strait along the southern edge and northward into Kotzebue Sound and this limited our sampling. Because of the ice and mechanical problems with the ship (one shaft not functional), the Captain decided not to go farther north as originally planned, but to limit sampling to areas that were ice-free. This meant staying generally west of 168°30'W north of Bering Strait. Stations 57-68 were taken in open water south of 65°N.

Temperatures ranged from -2.27-+2.94 over the whole area except for the shallow station 35 at 63°35'N, 166°55.5'W, where temperature was near 3.5°C in the upper 15 m, dropping to 0.2°C at 18 and 24 m. Salinity was also lower at this station, 30.93°/00, as were nutrient concentrations. Perhaps this station was located in the plume of the Yukon River.

Salinity was usually above 31°/00 except at some surface-3 m depths where ice was present, ranging from 31.02-33.22°/00. Nutrient concentrations

were variable with slightly higher values often occurring at depth.

Primary productivity was relatively high at stations 34, 36, 37, 41, and 60 located generally east of 168°36'W; and with both heavy ice cover at stations 37 and 41 and no ice cover at stations 34 and 36. Integrated productivity at these stations ranged from 294 mg C m^{-2} hr^{-1} at station 36 to 631 mg C m^{-2} hr^{-1} at station 37. Integrated productivity at station 35 was only 11 mg C m^{-2} hr^{-1} and, with stations 30 and 31, south of St. Lawrence Island, was the lowest of all stations. Productivity at stations 64-68 ranged from < 1 to ea. 10 mg C m^{-3} hr^{-1} with lower values, closer to 2 mg C m^{-3} hr^{-1}, being more common. North of Bering Strait, productivity varied greatly from < 1 to 30 mg C m^{-3} hr^{-1} with higher values usually at depth. This correlates to some extent with higher nutrient and chlorophyll concentrations also often occurring at depth.

Chlorophyll a concentrations at stations 34, 36, 37, and 60 corresponded with the high productivity at these stations. Integrated chlorophyll ranged from 113-266 mg m^{-2}. Slightly lower chlorophyll concentrations occurred at stations 64-68, also corresponding to lower productivity rates. North of Bering Strait, chlorophyll concentrations were variable, ranging from 18-207 mg m^{-2}.

Microflagellates were the dominant group of organisms at all stations in Norton Basin except the most northern one (station 60) where pennate diatoms, primarily *Nitzschia* section *Fragilariopsis*, comprised ea. 60% of the population. Centric diatoms were the most abundant diatom group at all stations except station 60, with species of *Chaetoceros* and *Thalassiosira* being the most common.

Stations 34, 36, and 31 had highest cell numbers, near 8 x 10^6 cells ℓ^{-1}, while stations 37 and 60 had moderately high cell numbers near 2 x 10^6 cells ℓ^{-1}. Stations 64-68 generally had slightly lower concentrations, between 1-2 x 10^6 cells ℓ^{-1}. Station 35 had the lowest number of cells, usually < 1 x 10^6 cells ℓ^{-1}. About 90% of the population was microflagellates. *Dinobryon balticum*, a photosynthetic chrysophyte flagellate, was more abundant at this station than elsewhere.

Standing stock samples from stations 47-57 in southern Hope Basin were not analyzed because of funding and time constraints.

The last group of samples is from the St. George Basin. These stations were taken in late June and no ice was present. Temperatures were all positive, generally being above 4°C, except below 45 m where the temperature was usually near 1°C. As a result, temperatures do not appear for most depths in Fig. 4. Salinity was always above 32°/₀₀.

Primary productivity was variable with higher productivity occurring in the upper 30-45 m. This was also true of chlorophyll. Integrated carbon and chlorophyll values are in Table 9. Nutrient concentrations were high with nitrate usually > 10 µg-at ℓ^{-1}, and phosphate near 1 µg-at ℓ^{-1}; silicate was always > 30 µg-at ℓ^{-1}.

Standing stock samples from stations 69 and 70 were the only ones analyzed for this area because of funding and time constraints. Micro-

flagellates were dominant, comprising more than 90% of the population. A small unidentified pennate diatom was usually the most abundant diatom, but still comprising only 2-3% of the population. Cell concentrations at these two stations were by far the highest at ea. 16 x 10^6 cells ℓ^{-1}.

VII. DISCUSSION

Other recent studies in the Bering Sea (Alexander and Cooney 1979, Goering and Iverson 1981) emphasized time series done over relatively small areas, *i.e.*, the ice edge zone and the so-called Golden Triangle in the southeastern Bering Sea. This study is considerably different because of the wide aerial coverage, *i.e.*, the Navarin Basin, St. Matthew-Hall area, Norton Sound, and the St. George Basin (Fig. 1). Only in Norton Basin were we able to repeat some stations the second year. One disadvantage of sampling a broad area as we did, is that it takes considerable time, in this case more than two months, which tends to obscure the synoptic picture.

The Navarin Basin samples (stations 1-25) were collected from 4-17 May 1981 at a time when ice cover was still heavy over much of the area. Even so, primary productivity was relatively high in the upper 30-40 m. Only at the most southwesterly stations (4-6) where ice cover was 90-100%, was productivity low, but still near 3-5 mg C m^{-3} hr^{-1}. These three stations also had the *lowest cell* concentrations and microflagellates were the most abundant organisms. A pycnocline, if present, was usually near 30-40 m and nutrient concentrations were generally higher below this depth. At stations 10, 11, and 16, nitrate levels in the upper 30 m were low, possibly indicating the end of the bloom in this area, although phosphate and silicate were still present in high concentrations. Pennate diatoms were the most abundant organisms.

Samples were collected in the St. Matthew-Hall area from 22-26 May 1980 when no ice was present. Microflagellates were the most abundant organisms in the area. Centric diatoms were usually more abundant than pennate diatoms. Stations closest to the coast (30 and 31) had the lowest productivity and chlorophyll in this area. Nutrient concentrations were low and cells appeared to be senescent indicating the end of the bloom.

Norton Basin samples were collected from 19-30 April 1979 and from 4-20 June 1980. Ice cover was variable, but heaviest ice was usually present west of 168°30'W and at more northerly stations. Stations located just north of St. Lawrence Island were generally ice-free both years. In 1979, productivity and chlorophyll were generally < 1 mg C m^{-3} hr^{-1} and < 1 mg chlorophyll m^{-3} at stations located west of 168°30'W where microflagellates were the dominant organisms. Much higher chlorophyll and productivity values were found at stations east of 168°30'W where diatoms were the dominant organisms. Pennate diatoms were the most abundant organisms at all the eastern stations except station 2 where centric diatoms were dominant. The pattern was not so clear for 1980 stations. Microflagellates were generally dominant at eastern stations and productivity and chlorophyll varied from very low at station 35 to relatively high at stations 34 and 41. Highest integrated productivity occurred at station 37 in the middle of the area where diatoms and microflagellates occurred in about equal numbers and

where ice cover was 100%.

Samples were collected in northwestern St. George Basin from 21-24 June 1980 and in southeastern St. George Basin from 2-3 May 1979. Productivity and chlorophyll a were moderately high in the northwestern area at this time. Cell concentrations were high, near 16 x 10^6 cells ℓ^{-1} with microflagellates the dominant organisms. A small, unidentified pennate diatom, *ca.* 6 µm in length, was also present and abundant. In the southeastern area, productivity and chlorophyll were high to moderate. Centric diatoms were dominant at the station between St. George and St. Paul islands, while microflagellates were dominant at the other two hydrographic stations.

These data point out a number of problems in trying to describe the seasonal phytoplankton cycle in the Bering Sea. The effect of ice cover on primary productivity was variable, but productivity was usually highest at stations where there was little or no ice and where pennate diatoms comprised the greatest percentage of cells, however there were exceptions.

In the Norton Basin in 1980, heavy ice was present only in the central area (stations 37 and 41), flagellates were most abundant and productivity was high. In 1979 when sampling was 5-6 weeks earlier, more ice was present, and productivity and cell numbers were relatively low. Diatoms, particularly pennate species, were more abundant at stations where ice was heaviest and productivity was highest. Also in 1979, flagellates were more abundant at stations closest to St. Lawrence Island where ice was light or absent. Productivity, chlorophyll a, and cell numbers were all low at these stations, too.

In the Navarin Basin, productivity was high at stations 1-3 where ice cover was near 90% and pennate diatoms were most common. But at stations 4-6 where ice cover was also about 90%, flagellates were more numerous at most depths and productivity was low, about one-fifth that at stations 1-3. All of these stations were taken within a three day period.

No ice was present in the *St.* Matthew-Hall area in 1980. Productivity and chlorophyll were variable from relatively high to very low; cell numbers were generally low and flagellates were most abundant at stations with lowest productivity, but also at some stations with relatively high productivity . The low productivity and high flagellate numbers probably indicate that *most* of the flagellates were not photosynthetic. Some microflagellates are photosynthetic, *i.* e., *Platymonas* and *Dinobryon*, but many are not, and unless positive identification can be made, it is impossible to determine from preserved material whether chloroplasts are present. In our samples where flagellates were generally identified by size class, we can only speculate as to their photosynthetic capabilities.

Levels of nutrient concentrations were also variable. In Norton Basin in 1979, nutrient concentrations were relatively stable throughout the water column with no distinctly lower concentrations in the upper layers which suggests relatively strong mixing. Low concentrations of nitrate and phosphate occurred at stations 2 and 10 where productivity was high; the silica concentration was also low at station 2 where centric diatoms were most abundant and pennate diatoms were also numerous. Pennate diatoms were

more abundant at station 10. Station 2 had no ice cover and station 10 had >90%. Station 14, with the lowest productivity in the area and dominated by flagellates, had high nutrient concentrations. " In 1980, nutrient levels in Norton Basin were low in the upper 20-30 m, and were usually higher below 30 m indicating stratification of the water column.

Lower nutrient levels were also present in the upper 20-30 m in the Navarin Basin, but only at a few stations were they low enough to be considered limiting. Nutrient levels in the St. Matthew-Hall area were very low which agrees with the observation that cells appeared to be senescent and the main spring phytoplankton bloom was past. Farther south in the St. George Basin, nutrient concentrations were lower in the upper 50 m, but were probably not low enough to be considered limiting. Flagellates were the dominant organisms.

Little can be said about the relationship between the ice algae bloom and the spring phytoplankton bloom in the water column. Saito and Taniguchi (1978) list a number of species as "ice plankton," but they apparently did not sample the ice itself (Taniguchi *et al.* 1976). This category is defined as "pennate diatoms which probably have grown in the sea ice and which are common in plankton collected after the ice has melted" (Saito and Taniguchi 1978). The species they list have been reported from both sea ice and the water column.

Alexander and Chapman (1981) list species found in slush-ice, ice cores, and the water column. They found considerable overlap in species present in the slush-ice and water column which would be expected because it would be difficult to collect slush-ice without also getting some seawater. Also, slush-ice is soft as the name implies, and cells normally found in the water column could easily become stuck either to the surface of the slush-ice or in channels and eroded areas of the ice. The comparison of ice algae and phytoplankton indicates fewer common species and most of the species from the ice have been frequently reported from ice. It is probably not surprising to find *Melosira sulcata* in the ice because it is usually considered to be a benthic species and another *Melosira* species, *M.arctica*, is commonly found associated with ice at higher latitudes (Gran 1904; Homer unpubl. ohs.). The *Thalassiosira* found in the ice was not identified to species, but could have been *Th. antarctica* Comber, a species often confused with *Th.gravida* and usually found associated with ice in both the northern and southern hemispheres. Because *Th. antarctica* forms resting spores, Hasle and Heimdal (1968) suggested that it might be dependent on ice or coasts for survival. Indeed, the spores are often found in ice.

Hameedi (1978) also suggested that ice algae contributed a significant amount of chlorophyll to the water column, but he did not sample the ice and did not report species composition for either the ice or the water column , therefore it would be difficult to tell if the chlorophyll came from the ice.

We collected only one ice sample during these cruises and that was between stations 5 and 6, the two westernmost 1980 stations in the Navarin Basin, and in an area where ice cover was nearly 100% and cell concentrations in the water column were low. The sample was analyzed for species present

and relative abundance. The most abundant species were *Achnanthes* spp.; *Cylindrotheca closterium; Navicula* spp.; *Nitzschia* spp., including *N. frigida* and species of the section *Fragilariopsis* that form ribbon-shaped colonies; and unidentified pennate diatoms ranging in size from < 10-100 µm in length. The only centric diatoms present were small *Chaetoceros* spp. and a few *Thalassiosira nordenskioeldii*. The list of species and taxonomic categories is longer for the ice sample than that for water samples collected at stations 5 and 6 by a factor of at least 3. There is some species overlap and most of the species found in the ice have been reported previously for ice (Homer and Schrader 1981).

We believe there is considerable overlap in the species present in the ice and in the water column in the Bering Sea, but the important factor is the relative percentage that each species contributes during the time it is present. Experience at Barrow and Prudhoe Bay has shown that there is contamination of the upper water layer under the ice when cores are cut using surface coring techniques, such as SIPRE corers. The bottom layer of ice containing the ice diatoms is soft and easily broken releasing ice algae cells into the water column. The reverse is probably also true. Cells normally found in the water could be caught on the ice surface, or perhaps be carried up into the ice in brine channels and would then be considered to be members of the ice community even though they normally do not live there. From the evidence reported in the literature and cited here, we still cannot say for sure what the contribution of the ice algae is to the spring bloom in the water column of the Bering Sea. Intensive sampling of both habitats at the same time during the spring is needed before this problem can be resolved.

VIII . CONCLUSIONS

It is difficult to come to wide-ranging conclusions concerning the phytoplankton of the Bering Sea because we covered such a large area over a relatively long time span. However, for these samples, we can say that:

1. Pennate diatoms were dominant in the Navarin Basin

2. Diatoms were dominant in the Norton Basin early in the season and microflagellates became dominant slightly later

3. Microflagellates were dominant in the St. Matthew-Hall area, the St. George Basin, and the Shumagin area

4. Microflagellates and centric diatoms were dominant at the two stations in Shelikof Strait (Cook Inlet area)

5. Primary productivity was variable, and was usually, but not always, highest at stations and depths where diatoms were abundant

6. Cell numbers were variable and the two areas, Norton and St. George basins, that were sampled both years were quite different in the upper 30-50 m (depth varied by area, but the depth interval was the same for any one area):

		1979	1980
a.	Navarin Basin		2×10^6
b.	Norton Basin	0.7×10^6	5×10^6
c.	St. Matthew-Hall	.	1×10^6
d.	St. George Basin	0.9×10^6	16×10^6
e.	Shumagin area	1.4×10^6	
f.	Cook Inlet	0.9×10^6	

All numbers are cells ℓ^{-1}

7. Dominant diatoms included *Navicula* spp.; *Nitzschia* spp., especially section *Fragilariopsis; Thalassiosira* spp.; and *Chaetoceros* spp. Most abundant dinoflagellates included *Peridinium* spp. and *Gymnodinium lohmanni*

8. Nutrient concentrations were varible, sometimes being lower in the upper 20-30 m. This was especially true of nitrate and phosphate, and these may have been limiting at times

9. We still cannot say with any certainty that ice algae initiate or contribute to the spring bloom in the water column

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