

**Oceanographic and Marine Biological Data from
Routine Observations near Syowa Station between
February 1983 and January 1984 (JARE-24)**

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Introduction

A three-year programme of marine biological investigations in the fast ice area near Syowa Station was planned by the Japanese Antarctic Research Expedition (JARE) as part of the international BIOMASS (Biological Investigations of Marine Antarctic Systems and Stocks) project. One of the main objectives of the programme was to acquire marine biological data and samples with environmental parameters throughout the year to draw out a scheme of Antarctic under-ice marine ecosystems near Syowa Station. This programme commenced in 1982 (JARE-23) and we took part in the second year survey in 1983. The second year survey was stressed on primary producers in the water column and in the sea ice. Series of routine oceanographic observations at selected stations were continued.

In this report, we present oceanographic and marine biological data (Tables 1-4). Some information on plankton samplings made at the routine observations from February 1983 to January 1984 is also given in Tables 5 and 6.

Study Area

From convenience of field work, observations were carried out at three stations out of five stations settled by JARE-23. For routine observations Nos. 1-3, Stn. 4 was substituted for Stn. 5, because open water was extending around Stn. 5. As fast ice around Syowa Station was flowed out between 2 and 3 May, the routine observation was interrupted till June when the sea ice grew sufficient to support a snow vehicle and a sledge. Observation stations (Stns. 1, 3 and 5) were settled again but the position of new stations slightly differed from those of JARE-23. Sampling locations, Stns. 1, 3, 4 and 5 are shown in Fig. 1. The depths at each station were 12, 38, 160 and >700 m, respectively. Seasonal variations of ice and snow thickness at Stns. 1, 3 and 5 are shown in Fig. 2. From late December, puddle formation took place in the Ongul Strait area.

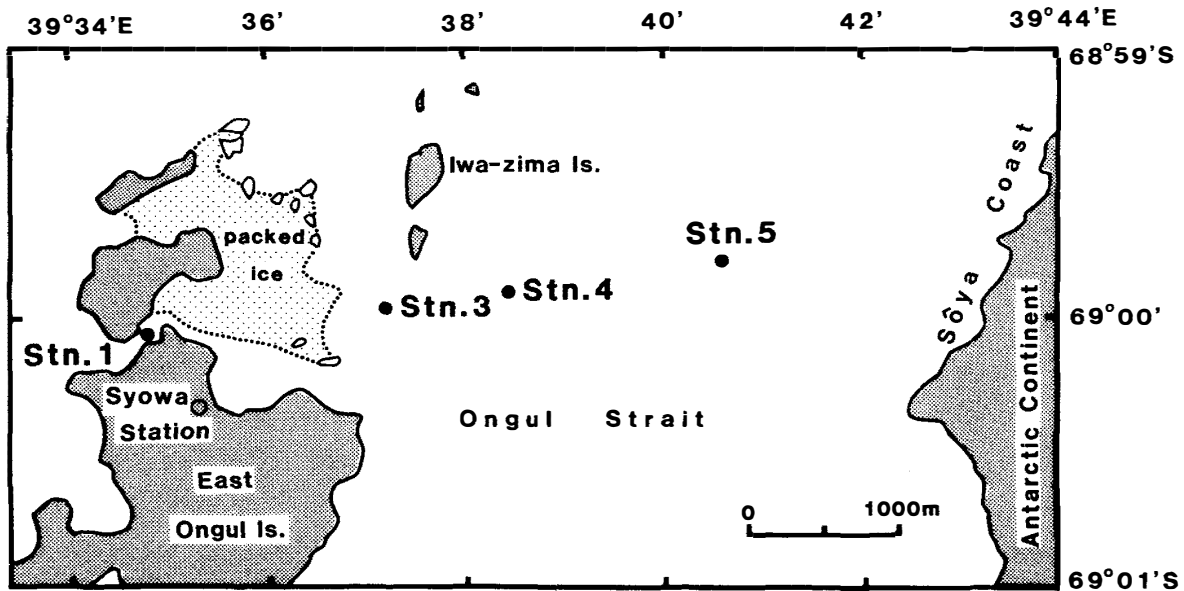


Fig. 1. Sampling locations for routine observations by JARE-24.

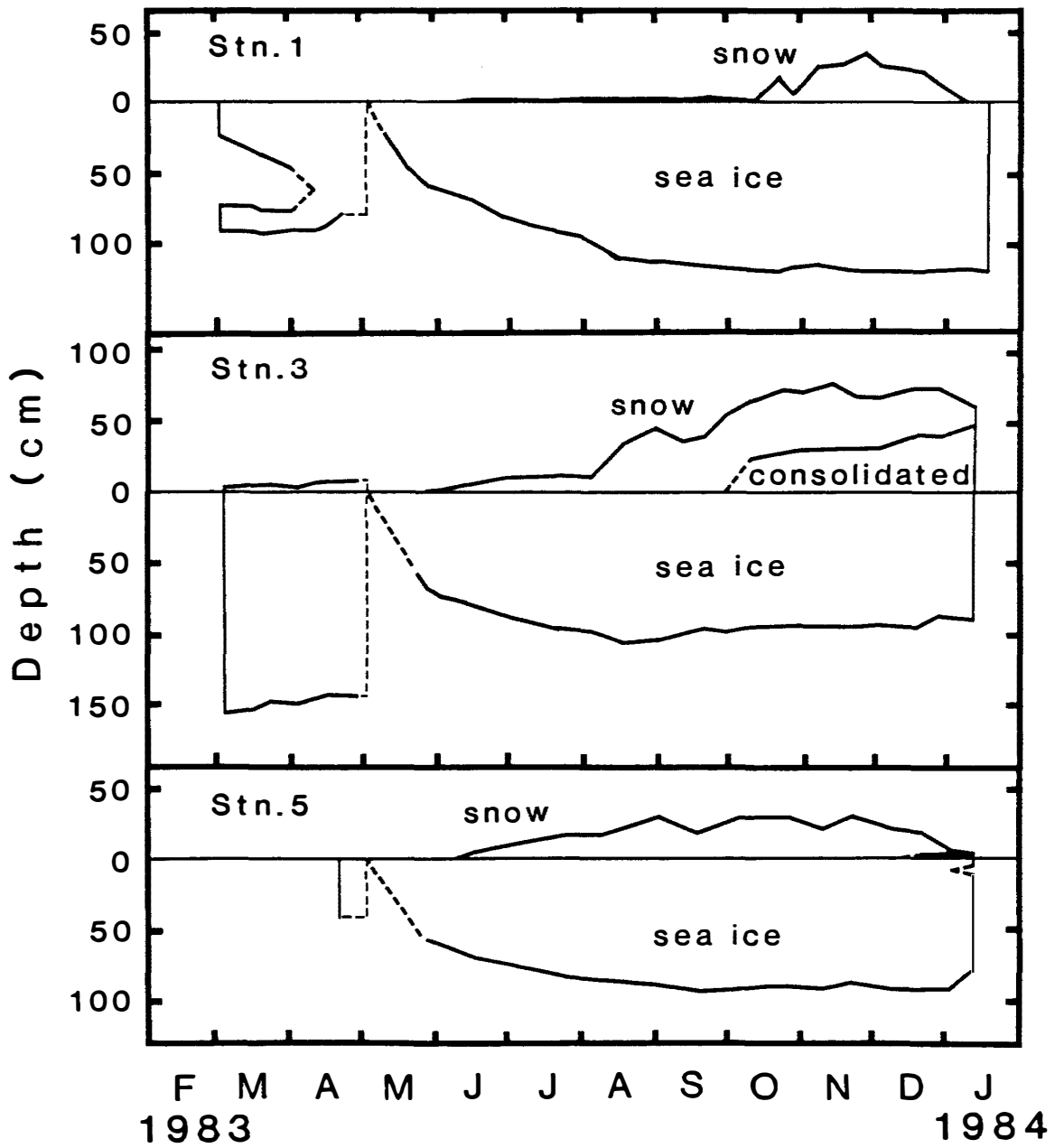


Fig. 2. Seasonal variations of ice and snow thickness at Stns. 1, 3 and 5.

Methods

Routine observations were carried out 11 times from 16 February 1983 to 13 January 1984 at three locations each time. The date of observations are listed below.

Routine No.	Stn. 1	Stn. 3	Stn. 4	Stn. 5
	1983			
1	18 Feb.	16 Feb.	17 Feb.	-
2	11 Mar.	11 Mar.	9 Mar.	-
3	1 Apr.	29 Mar.	28 Mar.	-
4	4 June	3 June	-	6 June
5	28 July	27 July	-	29 July
6	8 Sep.	10 Sep.	-	9 Sep.
7	5 Oct.	8 Oct.	-	7 Oct.
8	11 Nov.	9 Nov.	-	10 Nov.
9	29 Nov.	29 Nov.	-	30 Nov.
10	16 Dec.	15 Dec.	-	14 Dec.
	1984			
11	13 Jan.	12 Jan.	-	11 Jan.

Water samples for physical and chemical analyses were collected from depths listed below using Nansen 1.3-1 and Van Dorn 6-1 bottles.

Station No.	Depth (m)
1	2, 5(4), 8(6), 11(8),
3	2.5, 5, 10, 15, 25, 35,
4	2.5, 10, 25, 50, 75, 100, 150,
5	2.5, 10, 25, 75, 100, 150, 200, 400, 600

The depth was measured from sea level. Depths in parentheses at Stn. 1 indicate those for routine observation Nos. 1-3. Additional water samples for plant pigment analysis were collected from 5, 15 and 35 m depth at Stns. 4 and 5.

Methods for physical, chemical and plant pigment analyses were the same as those employed by JARE-23 (Fukuchi *et al.*, 1985). We employed a Hitachi model 320 spectrophotometer with a

sample sipper, a micro-flow cell and a data printer, and a Hitachi model 650-40 spectrofluorometer with a five-cell holder.

Plankton samples were collected by a twin-ring NORPAC net of 45 cm in diameter and 180 cm in side length. The mesh opening of the nets was 25 μm (P25 net) and 100 μm (NXX13 net). Samples of P25 and NXX13 net were fixed with 5-10 % formalin-acetic acid (1:1) and ca. 10 % neutralized formalin respectively. Settling volume of samples were read after two days of sedimentation time.

Acknowledgments

We wish to thank Prof. S. Mae, the leader of JARE-24 and his members for their encouragement and willing cooperation in field work. Thanks are also due to Prof. T. Hoshiai, Dr. M. Fukuchi, Mr. A. Tanimura and Mr. H. Ohtsuka of JARE-23 who paid much effort to start this programme and made field facilities ready to use for us from the beginning of our field observations.

Reference

Fukuchi, M., Tanimura, A., Ohtsuka, H. and Hoshiai, T. (1985): Marine biological data of BIOMASS programme at Syowa Station in the 1982 winter (JARE-23). JARE Data Rep., 98, (Mar. Biol., 6), 113p.

Table 1. Oceanographic data obtained at Station 1.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl.a Phaeo.		Pigment ratio (%)	Sample No.
					(µg-at./l)					(µg/l)			
No.1 (18 February 1983)													
2	-0.94	33.631	8.30	9.38	1.40	55.4	0.15	12.9	0.37	1.18	0.58	67.1	2401W001
4	-1.24	34.044	8.22	8.56	1.60	58.4	0.13	16.4	0.52	1.36	0.87	61.1	2401W002
6	-1.37	34.098	8.16	8.25	2.06	60.6	0.16	19.8	0.64	1.60	1.52	51.3	2401W003
8	-1.44	34.128	8.11	10.32	2.06	61.0	0.14	21.5	0.50	1.16	0.99	53.9	2401W004
No.2 (11 March 1983)													
2	-1.57	32.990	8.33	7.68	1.59	59.3	0.38	21.7	1.27	0.21	0.16	57.2	2401W005
4	-1.58	33.036	8.32	7.76	1.53	59.4	0.26	21.9	1.22	0.20	0.14	59.6	2401W006
6	-1.63	33.055	8.28	7.45	1.59	64.5	0.27	21.4	1.24	0.38	0.17	69.4	2401W007
8	-1.64	33.067	8.25	7.44	1.46	60.3	0.25	25.2	1.22	0.19	0.18	51.1	2401W008
No.3 (1 April 1983)													
2	-1.75	32.957	8.10	7.93	1.59	58.6	0.34	28.1	0.05	0.36	0.78	31.8	2401W009
4	-1.75	32.976	8.11	7.96	1.53	59.4	0.29	28.1	0.06	0.18	0.32	36.8	2401W010
6	-1.75	32.927	8.11	7.93	2.09	59.6	0.30	28.6	0.05	0.10	0.12	44.4	2401W011
8	-1.74	32.932	8.11	7.95	1.69	59.3	0.25	28.4	0.05	0.12	0.11	51.6	2401W012
No.4 (4 June 1983)													
2	-1.84	33.939	8.04	7.78	1.82	57.5	0.39	30.3	0.04	0.10	0.09	53.4	2401W013
5	-1.84	33.914	8.06	7.74	1.25	57.9	0.56	30.7	0.04	0.06	0.06	50.4	2401W014
8	-1.84	33.927	8.07	7.71	1.76	58.3	0.60	30.6	0.04	0.06	0.07	45.2	2401W015
11	-1.83	33.921	8.07	7.49	1.91	58.2	0.41	31.0	0.04	0.06	0.06	49.1	2401W016

Table 1. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P	SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N				Chl.a (µg/l)	Phaeo.	Pigment ratio (%)	Sample No.
						(µg-at./l)							
No.5 (28 July 1983)													
2	-1.85	34.702	7.95	8.03	1.87	77.1	0.90	25.1	1.25	0.02	0.03	39.3	2401W017
5	-1.82	34.033	7.92	7.87	1.76	71.7	0.68	32.5	1.00	0.02	0.04	34.2	2401W018
8	-1.81	34.036	7.98	7.87	1.81	72.3	0.57	33.8	1.09	0.02	0.04	31.6	2401W019
11	-1.81	34.114	7.94	7.88	1.71	65.2	0.62	34.3	1.05	0.01	0.03	30.0	2401W020
No.6 (8 September 1983)													
2	-1.78	34.072	7.91	7.65	1.73	70.7	1.59	34.5	0.79	0.05	0.05	50.2	2401W021
5	-1.77	34.068	7.92	7.72	2.52	69.3	0.94	35.0	0.66	0.03	0.04	47.2	2401W022
8	-1.75	34.055	7.93	7.65	1.95	69.8	0.44	33.5	0.72	0.03	0.03	48.4	2401W023
11	-1.76	34.048	7.94	7.66	1.89	71.5	0.43	33.7	0.80	0.04	0.03	53.3	2401W024
No.7 (5 October 1983)													
2	-1.76	34.058	7.95	7.79	1.86	71.4	0.70	32.8	1.18	0.11	0.05	68.1	2401W025
5	-1.75	34.030	7.98	7.79	1.76	66.5	1.98	30.8	0.47	0.08	0.05	60.5	2401W026
8	-1.75	34.035	7.98	7.75	2.26	52.4	0.33	31.8	0.15	0.07	0.04	61.3	2401W027
11	-1.75	34.033	7.99	7.73	2.02	66.5	0.29	31.6	0.91	0.07	0.04	61.3	2401W028
No.8 (11 November 1983)													
2	-1.79	34.062	7.97	7.69	1.74	61.2	0.25	32.0	0.02	0.17	0.14	55.5	2401W029
5	-1.77	34.066	8.01	7.69	1.85	62.2	0.48	32.4	0.02	0.16	0.15	50.8	2401W030
8	-1.77	34.051	8.00	7.58	1.79	87.7	0.19	32.3	0.02	0.13	0.16	44.2	2401W031
11	-1.76	34.046	8.00	7.57	1.97	66.7	0.34	29.3	0.02	0.35	0.22	62.1	2401W032

Table 1. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl.a (µg/l)	Phaeo. (µg/l)	Pigment ratio (%)	Sample No.
					(µg-at./l)								
No.9 (29 November 1983)													
2	-1.79	34.074	8.04	7.94	1.57	61.8	0.30	32.1	0.02	0.19	0.27	42.1	2401W033
5	-1.78	34.070	8.02	7.90	2.33	61.7	0.13	32.2	0.02	0.18	0.23	43.9	2401W034
8	-1.78	34.082	8.03	7.90	2.03	62.4	0.15	31.8	0.02	0.14	0.16	47.4	2401W035
11	-1.78	34.062	8.02	7.90	1.77	61.8	0.15	32.0	0.02	0.12	0.11	51.9	2401W036
No.10 (16 December 1983)													
2	-1.76	34.095	8.01	7.74	1.82	61.1	0.16	30.6	0.02	0.10	0.20	33.0	2401W037
5	-1.77	34.076	8.06	7.74	1.98	62.0	0.18	29.5	0.00	0.07	0.15	31.4	2401W038
8	-1.76	34.076	8.06	7.75	1.98	62.3	0.22	30.2	0.02	0.10	0.21	33.2	2401W039
11	-1.76	34.075	8.06	7.74	2.06	61.8	0.20	29.8	0.03	0.06	0.18	25.9	2401W040
No.11 (13 January 1984)													
2	-1.65	33.956	8.04	8.19	1.48	56.3	0.14	26.5	0.01	0.81	0.20	80.3	2401W041
5	-1.66	34.023	8.02	8.07	2.01	59.7	0.13	23.6	0.00	0.34	0.15	69.7	2401W042
8	-1.67	34.035	8.02	8.03	1.84	46.2	0.12	23.4	0.01	0.33	0.19	63.3	2401W043
11	-1.68	34.055	8.03	8.00	1.61	60.0	0.11	29.4	0.01	0.23	0.21	52.5	2401W044

Table 2. Oceanographic data obtained at Station 3.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl.a Phaeo.		Pigment ratio (%)	Sample No.
					(µg-at./l)					(µg/l)			
No.1 (16 February 1983)													
2.5	-1.19	33.484	8.30	10.18	1.65	52.6	0.33	14.6	0.45	4.30	2.63	62.1	2403W045
5	-1.27	34.064	8.27	9.97	1.53	50.0	0.28	16.1	0.33	4.67	2.80	62.5	2403W046
10	-1.44	34.105	8.22	8.85	1.75	58.4	0.26	19.9	0.47	3.70	3.07	54.7	2403W047
15	-1.54	34.107	8.12	8.49	1.51	53.9	0.27	21.3	0.32	4.99	2.61	65.6	2403W048
25	-1.56	34.165	8.05	7.69	1.97	63.7	0.29	24.5	0.35	3.62	2.18	62.3	2403W049
35	-1.59	34.169	7.79	7.49	2.74	65.1	0.30	25.0	0.27	1.22	0.87	58.3	2403W050
No.2 (11 March 1983)													
2.5	-1.68	32.780	8.24	7.51	1.70	62.2	0.39	25.1	1.30	0.39	0.35	52.8	2403W051
5	-1.69	32.947	8.28	7.41	1.56	59.1	0.32	25.0	1.14	0.18	0.18	50.0	2403W052
10	-1.67	32.981	8.28	7.35	1.33	59.9	0.29	25.4	1.25	0.12	0.13	48.4	2403W053
15	-1.65	32.957	8.27	7.28	1.54	58.7	0.35	25.5	1.20	0.14	0.14	51.3	2403W054
25	-1.69	33.050	8.27	7.21	1.36	61.1	0.28	24.5	1.13	0.14	0.18	43.0	2403W055
35	-1.68	33.074	8.26	7.24	1.59	60.2	0.22	26.0	1.14	0.10	0.17	36.6	2403W056
No.3 (29 March 1983)													
2.5	-1.76	32.777	8.04	8.05	1.64	57.8	0.29	27.5	0.04	0.59	0.87	40.5	2403W057
5	-1.76	32.424	8.04	8.12	1.89	54.7	0.66	25.8	0.06	0.18	0.14	56.0	2403W058
10	-1.76	32.529	8.05	-	1.59	58.0	0.29	27.7	0.05	0.16	0.15	51.1	2403W059
15	-1.77	32.668	8.04	7.90	1.55	57.9	0.32	27.7	0.05	0.12	0.11	53.3	2403W060
25	-1.75	32.787	8.08	7.95	2.06	58.5	0.31	28.3	0.05	0.15	0.16	48.2	2403W061
35	-1.72	32.832	8.05	7.96	1.64	58.8	0.30	27.9	0.05	0.12	0.14	47.2	2403W062

Table 2. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P	SiO ₃ -Si	NO ₂ -N	NO ₃ -N	NH ₄ -N	Chl.a	Phaeo.	Pigment ratio	Sample No.
					(µg-at./l)					(µg/l)		(%)	
No.4 (3 June 1983)													
2.5	-1.84	33.932	8.05	7.86	1.75	58.5	0.72	30.4	0.07	0.06	0.07	47.2	2403W063
5	-1.84	33.925	8.05	7.89	1.90	60.1	0.53	30.0	0.06	0.05	0.06	47.0	2403W064
10	-1.84	33.866	8.06	8.09	1.55	57.9	0.39	29.4	0.04	0.06	0.07	45.4	2403W065
15	-1.84	33.928	8.07	7.93	1.68	58.3	0.54	29.4	0.04	0.07	0.07	49.6	2403W066
25	-1.82	33.929	8.04	8.03	1.95	58.5	0.31	30.0	0.03	0.06	0.06	46.4	2403W067
35	-1.83	33.916	8.05	8.00	1.79	58.2	0.29	30.5	0.03	0.05	0.05	46.8	2403W068
No.5 (27 July 1983)													
2.5	-2.06	34.301	8.02	7.89	1.95	72.6	0.86	35.2	1.36	0.02	0.04	35.5	2403W069
5	-1.85	33.993	8.00	7.82	1.91	68.9	0.78	34.5	1.19	0.02	0.04	37.2	2403W070
10	-1.79	33.963	8.00	7.90	2.21	59.9	0.48	34.4	1.22	0.03	0.04	40.9	2403W071
15	-1.76	33.968	8.02	8.02	1.69	57.3	0.62	35.1	1.12	0.02	0.04	38.8	2403W072
25	-1.75	33.980	8.01	8.11	1.81	66.7	0.53	35.0	1.14	0.02	0.04	37.2	2403W073
35	-1.73	34.002	8.03	7.93	1.99	61.8	0.52	34.3	1.40	0.02	0.04	34.0	2403W074
No.6 (10 September 1983)													
2.5	-1.69	34.133	7.93	7.77	2.24	71.2	1.05	35.3	0.78	0.01	0.02	39.4	2403W075
5	-1.69	34.086	7.97	7.81	1.82	67.3	0.82	33.9	0.73	0.03	0.02	62.1	2403W076
10	-1.68	34.062	7.97	7.66	1.63	71.3	0.38	34.1	0.46	0.01	0.02	39.4	2403W077
15	-1.66	34.031	-	7.68	1.94	74.4	0.41	35.6	0.46	0.01	0.02	33.3	2403W078
25	-1.64	34.062	7.96	7.65	1.77	64.3	0.32	35.5	0.56	0.01	0.02	36.3	2403W079
35	-1.64	34.519	7.95	7.56	1.81	74.1	0.71	40.7	1.73	0.01	0.01	48.4	2403W080

Table 2. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl.a (µg/l)	Phaeo.	Pigment ratio (%)	Sample No.
					(µg-at./l)								
No.7 (8 October 1983)													
2.5	-1.70	34.095	7.93	7.90	1.99	74.0	0.93	32.1	0.45	0.06	0.07	44.2	2403W081
5	-1.68	34.076	7.93	7.87	1.95	61.3	0.81	31.8	0.37	0.07	0.04	63.6	2403W082
10	-1.67	34.056	7.96	7.90	1.85	75.4	0.50	31.4	0.24	0.05	0.04	56.5	2403W083
15	-1.65	34.072	7.94	7.79	1.94	73.7	0.66	27.2	0.27	0.04	0.03	58.1	2403W084
25	-1.57	34.076	7.94	7.71	1.84	73.0	0.16	31.8	0.08	0.02	0.02	51.9	2403W085
35	-1.56	34.099	7.95	7.72	1.85	74.2	0.63	31.9	0.00	0.03	0.03	49.8	2403W086
No.8 (9 November 1983)													
2.5	-1.76	34.074	8.00	7.49	1.61	62.3	0.75	33.0	0.03	0.06	0.10	39.4	2403W087
5	-1.76	34.038	8.03	7.48	1.39	62.8	0.80	32.7	0.03	0.05	0.08	40.6	2403W088
10	-1.75	34.046	8.02	7.44	1.57	62.1	0.92	33.3	0.02	0.07	0.10	41.7	2403W089
15	-1.75	34.054	8.02	7.40	1.26	62.9	0.78	33.2	0.02	0.06	0.08	39.8	2403W090
25	-1.74	34.055	8.01	7.44	1.92	63.1	0.19	32.9	0.02	0.06	0.10	36.3	2403W091
35	-1.71	34.049	8.01	7.41	2.24	62.1	0.38	32.8	0.02	0.04	0.08	34.2	2403W092
No.9 (29 November 1983)													
2.5	-1.80	34.066	8.03	8.00	1.73	61.5	0.14	32.3	0.02	0.06	0.10	38.8	2403W093
5	-1.79	34.065	8.06	7.97	1.67	61.8	0.13	32.8	0.01	0.08	0.11	41.8	2403W094
10	-1.80	34.045	8.06	8.01	1.71	62.0	0.14	32.0	0.01	0.07	0.11	41.1	2403W095
15	-1.79	34.052	8.05	7.97	1.69	50.1	0.12	25.9	0.01	0.05	0.07	41.2	2403W096
25	-1.76	34.036	8.04	7.92	2.03	61.8	0.13	31.2	0.02	0.06	0.13	32.3	2403W097
35	-1.75	34.067	8.05	7.94	1.88	62.5	0.09	32.1	0.03	0.05	0.13	29.5	2403W098

Table 2. Continued.

Depth	Temp.	Salinity	pH	DO	PO ₄ -P	SiO ₃ -Si	NO ₂ -N	NO ₃ -N	NH ₄ -N	Chl.a	Phaeo.	Pigment ratio	Sample No.
(m)	(°C)			(ml/l)	(µg-at./l)					(µg/l)		(%)	
No.10 (15 December 1983)													
2.5	-1.82	34.078	8.05	7.75	2.03	58.6	0.14	28.7	0.00	0.10	0.12	44.4	2403W099
5	-1.81	34.078	8.05	7.76	2.11	61.7	0.16	29.6	0.01	0.08	0.10	43.8	2403W100
10	-1.78	34.058	8.04	7.76	2.18	61.1	0.14	29.8	0.01	0.09	0.12	42.2	2403W101
15	-1.77	34.065	8.03	7.70	1.58	53.4	0.12	26.4	0.01	0.08	0.13	37.5	2403W102
25	-1.74	34.076	8.03	7.66	1.80	62.3	0.11	30.0	0.01	0.06	0.11	36.3	2403W103
35	-1.73	34.064	8.03	7.62	2.06	62.5	0.11	30.0	0.00	0.06	0.12	33.5	2403W104
No.11 (12 January 1984)													
2.5	-1.61	33.872	8.13	8.78	1.44	54.1	0.17	25.1	0.01	1.82	0.98	65.0	2403W105
5	-1.57	33.950	8.09	8.56	1.74	58.1	0.15	27.3	0.01	1.50	0.60	71.4	2403W106
10	-1.66	34.024	8.07	8.18	1.78	58.5	0.13	28.7	0.05	1.14	0.40	74.0	2403W107
15	-1.70	34.046	8.05	8.01	1.82	60.0	0.11	29.2	0.06	0.53	0.21	72.1	2403W108
25	-1.70	34.057	8.03	7.92	1.76	60.2	0.12	29.7	0.01	0.53	0.12	81.7	2403W109
35	-1.70	34.065	8.03	7.83	2.04	61.1	0.12	29.8	0.01	0.38	0.10	79.4	2403W110

Table 3. Oceanographic data obtained at Station 4.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N (µg-at./l)					Chl.a Phaeo. (µg/l)		Pigment ratio (%)	Sample No.
No.1 (17 February 1983)													
2.5	-1.03	33.690	8.31	10.79	1.59	53.1	0.15	9.8	0.43	3.75	2.05	64.7	2404W111
5	-	-	-	-	-	-	-	-	-	4.75	2.25	67.8	2404W112
10	-1.52	34.126	8.08	8.08	1.97	60.4	0.15	21.8	0.25	3.75	2.33	61.7	2404W113
15	-	-	-	-	-	-	-	-	-	2.48	1.64	60.2	2404W114
25	-1.64	34.188	7.99	7.38	2.26	65.0	0.15	25.6	0.17	1.75	1.15	60.4	2404W115
35	-	-	-	-	-	-	-	-	-	1.60	1.26	56.1	2404W116
50	-1.53	34.240	7.94	6.93	2.20	70.0	0.06	27.1	0.00	0.59	0.57	50.7	2404W117
75	-1.51	34.258	7.94	6.87	3.20	71.0	0.07	27.3	0.15	0.17	0.14	54.4	2404W118
100	-1.51	34.274	7.94	6.80	2.42	71.9	0.08	27.5	0.00	0.11	0.11	49.9	2404W119
150	-1.52	34.281	7.93	6.71	2.32	72.6	0.09	27.6	0.00	0.07	0.09	44.8	2404W120
No.2 (9 March 1983)													
2.5	-1.70	33.929	8.17	7.95	1.67	58.6	0.30	25.7	1.43	0.25	0.23	52.2	2404W121
5	-	-	-	-	-	-	-	-	-	0.15	0.19	44.2	2404W122
10	-1.71	33.012	8.16	7.88	1.66	59.6	0.32	25.6	1.40	0.14	0.20	41.8	2404W123
15	-	-	-	-	-	-	-	-	-	0.08	0.33	19.7	2404W124
25	-1.71	33.018	8.15	7.87	1.69	58.4	0.21	26.0	1.06	0.12	0.20	36.8	2404W125
35	-	-	-	-	-	-	-	-	-	0.11	0.20	35.3	2404W126
50	-1.69	33.119	8.15	7.83	1.52	59.9	0.27	25.4	1.33	0.09	0.15	37.0	2404W127
75	-1.55	33.676	8.17	8.06	1.72	65.8	0.15	30.4	0.48	0.18	0.22	44.7	2404W128
100	-1.64	33.735	8.17	7.94	1.50	60.0	0.26	26.1	1.14	1.16	1.07	52.1	2404W129
150	-1.63	34.241	8.07	7.09	1.25	59.7	0.17	25.9	1.10	0.54	0.62	46.6	2404W130

Table 3. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl.a (µg/l)	Phaeo. (µg/l)	Pigment ratio (%)	Sample No.
					(µg-at./l)								
No.3 (28 March 1983)													
2.5	-1.79	32.753	8.06	8.06	1.96	54.5	0.32	24.4	0.05	0.51	0.35	58.7	2404W131
5	-	-	-	-	-	-	-	-	-	0.09	0.10	48.8	2404W132
10	-1.77	32.909	8.06	8.12	1.70	58.5	0.37	28.0	0.04	0.12	0.15	44.8	2404W133
15	-	-	-	-	-	-	-	-	-	0.08	0.10	43.9	2404W134
25	-1.75	32.916	8.06	8.11	1.99	57.9	0.34	27.7	0.04	0.11	0.15	42.2	2404W135
35	-	-	-	-	-	-	-	-	-	0.13	0.13	50.3	2404W136
50	-1.70	32.920	8.05	8.04	1.88	59.0	0.29	27.9	0.04	0.11	0.17	39.6	2404W137
75	-1.63	33.122	8.03	7.90	1.89	58.8	0.33	28.1	0.04	0.11	0.15	42.8	2404W138
100	-1.48	33.506	8.04	7.84	1.93	60.9	0.26	29.3	0.03	0.07	0.15	32.4	2404W139
150	-0.79	34.071	8.02	7.50	1.64	63.4	0.26	30.1	0.03	0.03	0.09	24.9	2404W140

Table 4. Oceanographic data obtained at Station 5.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P	SiO ₃ -Si	NO ₂ -N	NO ₃ -N	NH ₄ -N	Chl.a	Phaeo.	Pigment ratio	Sample
										(µg/l)	(µg/l)	(%)	No.
No.4 (6 June 1983)													
2.5	-1.87	34.037	8.01	7.95	1.68	58.3	0.58	29.8	0.04	0.04	0.06	41.2	2405W141
5	-	-	-	-	-	-	-	-	-	0.04	0.06	40.1	2405W142
10	-1.85	33.974	8.04	7.94	1.85	57.8	0.38	30.3	0.03	0.04	0.06	42.0	2405W143
15	-	-	-	-	-	-	-	-	-	0.05	0.06	44.6	2405W144
25	-1.84	33.959	8.07	8.00	1.52	57.9	0.36	30.5	0.04	0.04	0.05	43.8	2405W145
35	-	-	-	-	-	-	-	-	-	0.03	0.03	45.7	2405W146
50	-1.85	33.966	8.06	8.04	1.85	58.0	0.67	30.0	0.05	0.03	0.04	40.0	2405W147
75	-1.81	33.974	8.04	8.02	1.68	58.0	0.32	30.4	0.03	0.05	0.06	43.9	2405W148
100	-1.84	33.970	8.05	8.00	1.57	57.6	0.84	29.7	0.03	0.03	0.05	38.2	2405W149
150	-1.83	33.973	8.03	8.03	1.88	57.9	0.49	30.5	0.03	0.03	0.05	39.1	2405W150
200	-1.73	33.973	8.00	7.74	1.80	58.2	0.33	29.9	0.02	0.03	0.06	32.6	2405W151
400	-1.58	34.255	8.01	7.31	1.91	66.0	0.17	29.9	0.01	-	-	-	-
600	-1.70	34.364	8.02	7.01	2.45	67.7	0.22	31.8	0.02	-	-	-	-
No.5 (29 July 1983)													
2.5	-2.11	34.282	8.04	7.71	1.54	62.3	0.67	31.0	1.42	0.02	0.03	36.7	2405W152
5	-	-	-	-	-	-	-	-	-	0.02	0.03	37.5	2405W153
10	-1.92	34.504	8.01	7.73	1.74	67.7	0.75	33.8	0.99	0.02	0.03	36.0	2405W154
15	-	-	-	-	-	-	-	-	-	0.02	0.03	41.1	2405W155
25	-1.87	34.281	8.01	7.60	2.04	65.8	0.59	32.5	1.28	0.02	0.03	39.6	2405W156
35	-	-	-	-	-	-	-	-	-	0.02	0.03	39.6	2405W157
50	-1.74	34.239	8.02	6.81	1.68	59.0	0.72	31.7	0.89	0.02	0.03	36.5	2405W158
75	-1.70	34.125	8.02	7.67	1.82	65.4	0.49	33.1	0.84	0.01	0.03	35.9	2405W159
100	-1.69	34.273	8.05	7.74	1.70	66.6	0.70	33.1	0.77	0.02	0.03	34.6	2405W160
150	-1.55	34.233	8.07	7.52	2.04	68.7	0.65	35.4	1.52	0.01	0.03	28.3	2405W161
200	-1.44	34.119	8.04	7.43	1.81	69.5	0.39	35.7	0.63	0.01	0.04	26.6	2405W162
400	-1.61	34.227	8.02	6.20	2.29	71.7	0.25	36.3	0.62	-	-	-	-
600	-1.48	34.058	8.02	7.37	1.99	70.9	0.42	35.0	0.76	-	-	-	-

Table 4. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P	SiO ₃ -Si	NO ₂ -N NO ₃ -N NH ₄ -N			Chl.a (µg/l)	Phaeo. (µg/l)	Pigment ratio (%)	Sample No.
							NO ₂ -N	NO ₃ -N	NH ₄ -N				
No.6 (9 September 1983)													
2.5	-1.82	34.066	7.91	7.74	2.01	53.2	0.31	36.4	0.90	0.02	0.02	52.5	2405W163
5	-	-	-	-	-	-	-	-	-	0.02	0.02	53.3	2405W164
10	-1.80	34.008	7.91	7.42	1.88	69.6	0.40	37.1	0.69	0.02	0.02	53.3	2405W165
15	-	-	-	-	-	-	-	-	-	0.02	0.02	50.4	2405W166
25	-1.80	33.976	7.93	7.64	2.02	69.8	0.40	36.8	0.56	0.02	0.02	43.6	2405W167
35	-	-	-	-	-	-	-	-	-	0.01	0.02	39.4	2405W168
50	-1.68	34.047	7.95	7.56	2.24	68.8	0.36	32.8	0.44	0.01	0.02	30.3	2405W169
75	-1.56	34.093	7.94	7.57	2.18	67.8	0.30	32.9	0.43	0.01	0.01	32.3	2405W170
100	-1.48	34.144	7.94	7.46	2.37	71.4	0.20	38.4	0.25	0.01	0.02	24.2	2405W171
150	-1.44	34.195	7.93	7.31	2.33	76.2	0.31	38.1	0.63	0.01	0.02	27.2	2405W172
200	-1.45	34.218	7.93	7.28	2.17	73.9	0.10	36.1	0.15	0.01	0.01	28.3	2405W173
400	-1.50	34.148	7.92	7.24	2.20	73.8	0.15	37.6	0.52	-	-	-	-
600	-1.67	34.352	7.90	6.89	2.27	77.7	0.13	38.0	0.23	-	-	-	-
No.7 (7 October 1983)													
2.5	-1.84	34.006	7.94	7.78	1.78	70.7	1.56	23.6	0.59	0.11	0.05	68.4	2405W174
5	-	-	-	-	-	-	-	-	-	0.12	0.07	64.9	2405W175
10	-1.80	34.010	7.98	7.76	2.11	72.1	1.18	29.7	0.32	0.11	0.06	65.4	2405W176
15	-	-	-	-	-	-	-	-	-	0.12	0.06	67.1	2405W177
25	-1.78	34.024	7.98	7.74	1.66	65.7	1.05	28.9	0.41	0.06	0.03	64.0	2405W178
35	-	-	-	-	-	-	-	-	-	0.04	0.04	55.5	2405W179
50	-1.63	34.066	7.99	7.65	2.24	76.4	0.74	18.5	0.00	0.04	0.03	59.4	2405W180
75	-1.49	34.104	7.98	7.52	1.78	75.8	0.45	31.2	0.03	0.01	0.02	35.0	2405W181
100	-1.45	34.158	7.98	7.43	1.38	75.7	0.77	17.2	0.09	0.00	0.00	31.0	2405W182
150	-1.48	34.222	7.96	7.29	2.19	75.5	0.49	22.0	0.04	0.01	0.01	33.8	2405W183
200	-1.52	34.246	7.96	7.34	1.99	71.8	0.23	19.6	0.50	0.01	0.02	27.4	2405W184
400	-1.51	34.297	7.96	7.31	2.29	75.8	0.09	30.6	0.03	-	-	-	-
600	-1.64	34.328	7.95	7.16	1.89	77.2	0.19	32.6	0.05	-	-	-	-

Table 4. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P	SiO ₃ -Si	NO ₂ -N	NO ₃ -N	NH ₄ -N	Chl.a	Phaeo.	Pigment ratio (%)	Sample No.
No.8 (10 November 1983)													
2.5	-1.82	34.068	8.03	7.62	2.52	62.9	0.30	33.3	0.03	0.08	0.10	44.1	2405W185
5	-	-	-	-	-	-	-	-	-	0.07	0.11	41.3	2405W186
10	-1.80	34.036	8.04	7.65	1.79	61.3	0.24	32.3	0.01	0.09	0.11	42.8	2405W187
15	-	-	-	-	-	-	-	-	-	0.10	0.13	44.2	2405W188
25	-1.79	34.043	8.03	7.61	2.04	62.6	0.18	31.7	0.02	0.09	0.13	42.9	2405W189
35	-	-	-	-	-	-	-	-	-	0.07	0.12	38.0	2405W190
50	-1.66	34.075	8.02	7.39	1.67	63.7	0.14	32.8	0.02	0.06	0.15	29.7	2405W191
75	-1.55	34.149	8.01	7.16	1.49	66.5	0.77	33.2	0.02	0.01	0.03	14.1	2405W192
100	-1.51	34.183	8.00	6.93	1.41	68.3	0.13	28.8	0.02	0.01	0.04	26.1	2405W193
150	-1.52	34.218	8.00	6.94	1.62	58.0	0.26	33.4	0.01	0.00	0.02	20.7	2405W194
200	-1.52	34.249	7.98	6.95	1.74	68.3	0.17	33.8	0.02	0.00	0.01	26.4	2405W195
400	-1.49	34.320	7.98	6.87	1.93	69.0	0.16	34.0	0.01	-	-	-	-
600	-1.58	34.320	7.99	6.90	1.94	69.2	0.31	33.8	0.02	-	-	-	-
No.9 (30 November 1983)													
2.5	-1.83	34.063	8.05	7.97	0.00	59.7	1.29	30.8	0.02	0.09	0.06	59.0	2405W196
5	-	-	-	-	-	-	-	-	-	0.09	0.06	58.3	2405W197
10	-1.81	34.050	8.04	7.92	1.55	59.6	0.37	31.8	0.01	0.06	0.06	48.0	2405W198
15	-	-	-	-	-	-	-	-	-	0.04	0.04	47.5	2405W199
25	-1.75	34.061	8.04	7.89	1.73	63.0	0.16	32.9	0.01	0.05	0.07	39.0	2405W200
35	-	-	-	-	-	-	-	-	0.01	0.03	0.08	30.8	2405W201
50	-1.66	34.112	8.03	7.71	1.67	64.1	0.53	33.1	0.02	0.02	0.07	24.2	2405W202
75	-1.57	34.154	8.02	7.49	1.63	68.9	0.41	33.3	0.01	0.02	0.06	26.9	2405W203
100	-1.56	34.199	8.02	7.28	1.85	66.9	0.18	34.1	0.02	0.01	0.03	25.8	2405W204
150	-1.51	34.242	8.01	7.26	1.53	69.8	0.22	34.6	0.01	0.01	0.03	18.5	2405W205
200	-1.50	34.242	8.00	7.19	1.74	70.8	0.09	33.8	0.01	0.01	0.03	22.7	2405W206
400	-1.46	34.304	7.99	7.19	1.84	71.9	0.06	33.4	0.01	-	-	-	-
600	-1.47	34.292	7.98	7.15	2.21	70.3	0.07	33.8	0.04	-	-	-	-

Table 4. Continued.

Depth (m)	Temp. (°C)	Salinity	pH	DO (ml/l)	PO ₄ -P SiO ₃ -Si NO ₂ -N NO ₃ -N NH ₄ -N					Chl. a Phaeo.		Pigment ratio (%)	Sample No.
					(µg-at./l)					(µg/l)			
No.10 (14 December 1983)													
2.5	-1.84	34.067	7.94	7.83	2.16	60.3	0.11	29.42	0.01	0.12	0.09	57.13	2405W207
5	-	-	-	-	-	-	-	-	-	0.15	0.09	61.21	2405W208
10	-1.83	34.063	7.93	7.84	2.18	60.7	0.13	29.78	0.01	0.10	0.07	58.11	2405W209
15	-	-	-	-	-	-	-	-	-	0.11	0.08	56.64	2405W210
25	-1.83	34.063	7.95	7.84	1.82	55.3	0.11	27.67	0.01	0.09	0.08	52.15	2405W211
35	-	-	-	-	-	-	-	-	-	0.06	0.07	47.15	2405W212
50	-1.70	34.094	7.93	7.58	2.07	62.3	0.06	29.74	0.01	0.04	0.06	40.86	2405W213
75	-1.57	34.155	7.92	7.22	2.11	67.6	0.05	30.86	0.00	0.04	0.05	44.10	2405W214
100	-1.58	34.198	7.93	7.18	1.87	67.9	0.06	30.00	0.00	0.02	0.05	30.82	2405W215
150	-1.60	34.221	7.93	7.18	2.18	67.1	0.04	30.77	0.00	0.01	0.02	20.18	2405W216
No.11 (11 January 1984)													
2.5	-1.38	33.886	8.04	8.82	1.91	56.2	0.16	24.6	0.01	1.57	0.47	76.91	2405W217
5	-	-	-	-	-	-	-	-	-	1.39	0.44	75.82	2405W218
10	-1.60	34.022	8.01	8.35	1.74	59.6	0.11	27.3	0.01	1.29	0.21	85.82	2405W219
15	-	-	-	-	-	-	-	-	-	0.91	0.19	83.12	2405W220
25	-1.68	34.059	7.99	8.06	2.07	59.8	0.17	29.2	0.00	0.56	0.17	76.49	2405W221
35	-	-	-	-	-	-	-	-	-	0.55	0.17	77.01	2405W222
50	-1.62	34.106	7.98	7.62	1.95	63.5	0.09	30.6	0.01	0.21	0.09	69.95	2405W223
75	-1.67	34.164	7.98	7.41	1.98	65.4	0.07	30.8	0.01	0.05	0.04	52.75	2405W224
100	-1.70	34.176	7.97	7.32	2.24	66.2	0.06	31.6	0.00	0.04	0.03	57.23	2405W225
150	-1.62	34.223	7.97	7.27	2.29	66.7	0.05	31.2	0.01	0.01	0.02	33.35	2405W226

Table 5. Data on plankton collected by vertical haul
with a NORPAC standard net(25 μ m mesh openings).

Stn.	Routine No.	Date	Length of Wire (m)	Settling Volume per a Haul (ml)	Sample No.
1983					
1	1	18 Feb.	8	0.8	2401NP01
	2	11 Mar.	8	2.4	2401NP02
	3	1 Apr.	8	0.8	2401NP03
	4	4 June	11	0.3	2401NP04
	5	28 July	11	0.2	2401NP05
	6	8 Sep.	11	0.1	2401NP06
	7	5 Oct.	11	0.1	2401NP07
	8	11 Nov.	11	0.4	2401NP08
	9	29 Nov.	11	0.2	2401NP09
	10	16 Dec.	11	0.2	2401NP10
1984					
	11	13 Jan.	11	0.5	2401NP11
1983					
3	1	16 Feb.	38	5.0	2403NP12
	2	11 Mar.	38	1.6	2403NP13
	3	29 Mar.	38	2.8	2403NP14
	4	3 June	38	1.0	2403NP15
	5	27 July	38	0.8	2403NP16
	6	10 Sep.	38	0.3	2403NP17
	7	8 Oct.	38	0.4	2403NP18
	8	9 Nov.	38	0.6	2403NP19
	9	29 Nov.	38	0.6	2403NP20
	10	15 Dec.	38	0.6	2403NP21
1984					
	11	12 Jan.	38	1.6	2403NP22

Table 5. Continued.

Stn.	Routine No.	Date	Length of Wire (m)	Settling Volume per a Haul (ml)	Sample No.
1983					
4	1	17 Feb.	150	3.2	2404NP23
	2	9 Mar.	150	8.2	2404NP24
	3	28 Mar.	150	10.0	2404NP25
5	4	6 June	150	5.8	2405NP26
	5	29 July	150	3.0	2405NP27
	6	9 Sep.	150	1.6	2405NP28
	7	7 Oct.	150	1.0	2405NP29
	8	10 Nov.	150	1.2	2405NP30
	9	30 Nov.	150	1.3	2405NP31
	10	14 Dec.	150	1.2	2405NP32
1984					
	11	11 Jan.	150	2.0	2405NP33

Table 6. Data on plankton collected by vertical haul
with a NORPAC standard net(100 μ m mesh openings).

Stn.	Routine No.	Date	Length of Wire (m)	Settling Volume per a Haul (ml)	Sample No.
1983					
1	1	18 Feb.	8	0.2	2401NX01
	2	11 Mar.	8	2.4	2401NX02
	3	1 Apr.	8	0.6	2401NX03
	4	4 June	11	0.6	2401NX04
	5	28 July	11	0.4	2401NX05
	6	8 Sep.	11	0.2	2401NX06
	7	5 Oct.	11	0.2	2401NX07
	8	11 Nov.	11	0.4	2401NX08
	9	29 Nov.	11	0.4	2401NX09
	10	16 Dec.	11	0.4	2401NX10
1984					
	11	13 Jan.	11	0.4	2401NX11
1983					
3	1	16 Feb.	38	2.0	2403NX12
	2	11 Mar.	38	6.0	2403NX13
	3	29 Mar.	38	3.0	2403NX14
	4	3 June	38	2.6	2403NX15
	5	27 July	38	1.0	2403NX16
	6	10 Sep.	38	1.0	2403NX17
	7	8 Oct.	38	0.8	2403NX18
	8	9 Nov.	38	1.0	2403NX19
	9	29 Nov.	38	0.6	2403NX20
	10	15 Dec.	38	0.8	2403NX21
1984					
	11	12 Jan.	38	0.7	2403NX22

Table 6. Continued.

Stn.	Routine No.	Date	Length of Wire (m)	Settling Volume per a Haul (ml)	Sample No.
1983					
4	1	17 Feb.	150	0.4	2404NX23
	2	9 Mar.	150	14.0	2404NX24
	3	28 Mar.	150	10.2	2404NX25
5	4	6 June	150	13.6	2405NX26
	5	29 July	150	4.2	2405NX27
	6	9 Sep.	150	2.5	2405NX28
	7	7 Oct.	150	1.0	2405NX29
	8	10 Nov.	150	1.4	2405NX30
	9	30 Nov.	150	1.8	2405NX31
	10	14 Dec.	150	2.2	2405NX32
1984					
	11	11 Jan.	150	2.0	2405NX33