NORSK POLARINSTITUTT

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FRIDTJOF MEHLUM (EDITOR):

CRUISE REPORT:

MARINE BIOLOGY CRUISE WITH *R/V LANCE* IN THE BJØRNØYA-SØRKAPP REGION, 30 JUNE - 9 JULY 1996

1. Scientific rationale and study area

The main scientific programme of the cruise focused on predator-prey relationships between foraging seabirds and their prey in the "Polar Front" zone around Bjørnøya. Large populations of seabirds, mainly Brünnich's and Common Guillemots, breed at the island and forage some 10s of kilometres from the island. Previous studies have indicated that the seabirds congregate near the Polar Front off Bjørnøya and avoid waters closer to the island as feeding area. It is also known that this frontal region is an important spawning area for krill (mainly Thysanoessa inermis) and an area of abundance of fish such as capelin, which are important components of the birds' diet.

The frontal zone is characterised by stratified water with a shallow pycnocline (20 m) on the Atlantic water side of the front, and mixed water throughout the water column on the Arctic water side. We hypothesise that krill and other zooplankton are concentrated near the pycnocline and thus are easily available as food for diving seabirds. The study focused on the spatial and temporal dynamics of the distribution of seabird predators and their zooplankton and fish prey. We also wanted to describe the zooplankton communities in the different water masses covered by the cruise.

We selected two different transects (ca 75 km in length) on the southern side of Bjørnøya crossing the front which were repeated several times. The sampling programme consisted of a) physical oceanography (CTD and XBT) for characterising the water masses, b) acoustic measurements of spatial and temporal patch dynamics of zooplankton (mainly krill), c) the use of ROV at the pycnocline for visual determination of zooplankton distribution, d) zooplankton net tows for supplementing the acoustic data, e) bird densities along transects, and sampling of birds for food analysis.

After the surveys at Bjørnøya a transect with CTD and XBT stations and marine bird observations was conducted between Bjørnøya and Sørkapp. This transect was a repeat of transects made by NP in 1992 and 1993, and focused on the effects of water masses and frontal regions on the distribution of foraging seabirds. The last part of the cruise was spent running transects from shallow water near Sørkapp, crossing the Sørkapp Current into Storfjordrenna and south to the frontal zone between Atlantic water and the colder Spitsbergenbank water. Sampling was similar to that made in the Bjørnøya region. This part of the cruise had to be shortened because of dense sea-ice coverage. Another transect from Sørkapp to the southwest crossing the continental slope was also made. The objectives were to document foraging regions for seabirds and their diet in different parts of the transects, and compare this to the physical oceanography and zooplankton availability.

2. Cruise narrative

The cruise started out from Tromsø on 30 June 02:45, and we arrived at the first station (73° 16' N, 19° 05' E) on 1 July 02:00 (Fig. 2.1). After conducting a transect towards Bjørnøya we arrived off Russebukta on the eastern side of the island at 09:30. The morning hours were used to deploy the terrestrial field parties at different locations on the island by the use of helicopter. In the afternoon supplies were delivered by helicopter to the station Bjørnøya Radio.

The field parties deployed at Bjørnøya comprised: Vidar Bakken, Norwegian Polar Institute; Guttorm Christensen, Akvaplan-NIVA; Steven Cooper and John B. Doherty, the Wildfowl and Wetlands Trust; Øyvind K. Hansen, Espen Henriksen, Magne Husøy and Kjell Sagerup, Norwegian Polar Institute; Karl-Birger Strann, NINA; and Elleke Wartena, Akvaplan-NIVA.

The marine sampling programme south of Bjørnøya continued from the afternoon 1 July to the evening of 6 July. The weather conditions were very favourable during the whole period with little wind. A total of 76 stations were sampled during this period (Fig. 2.1 and 2.2.).

After picking up the terrestrial field parties during the evening of 6 July, we started a seabird, CTD and XBT transect towards Sørkapp (Fig. 2.3). After arriving at Sørkapp in the afternoon of 7 July, we made a seabird transect towards SE. We encountered the ice-edge during this transect and had to limit the planned sampling program in this region. CTD and zooplankton stations were conducted during the return to Sørkapp. On 8 July we conducted a transect towards southwest from Sørkapp. This transect crossed the shelf slope, and the outermost station was taken in an area with 1300 m water depth. The sampling programme was concluded at station 120 after returning on this transect near Sørkapp at 22:00.

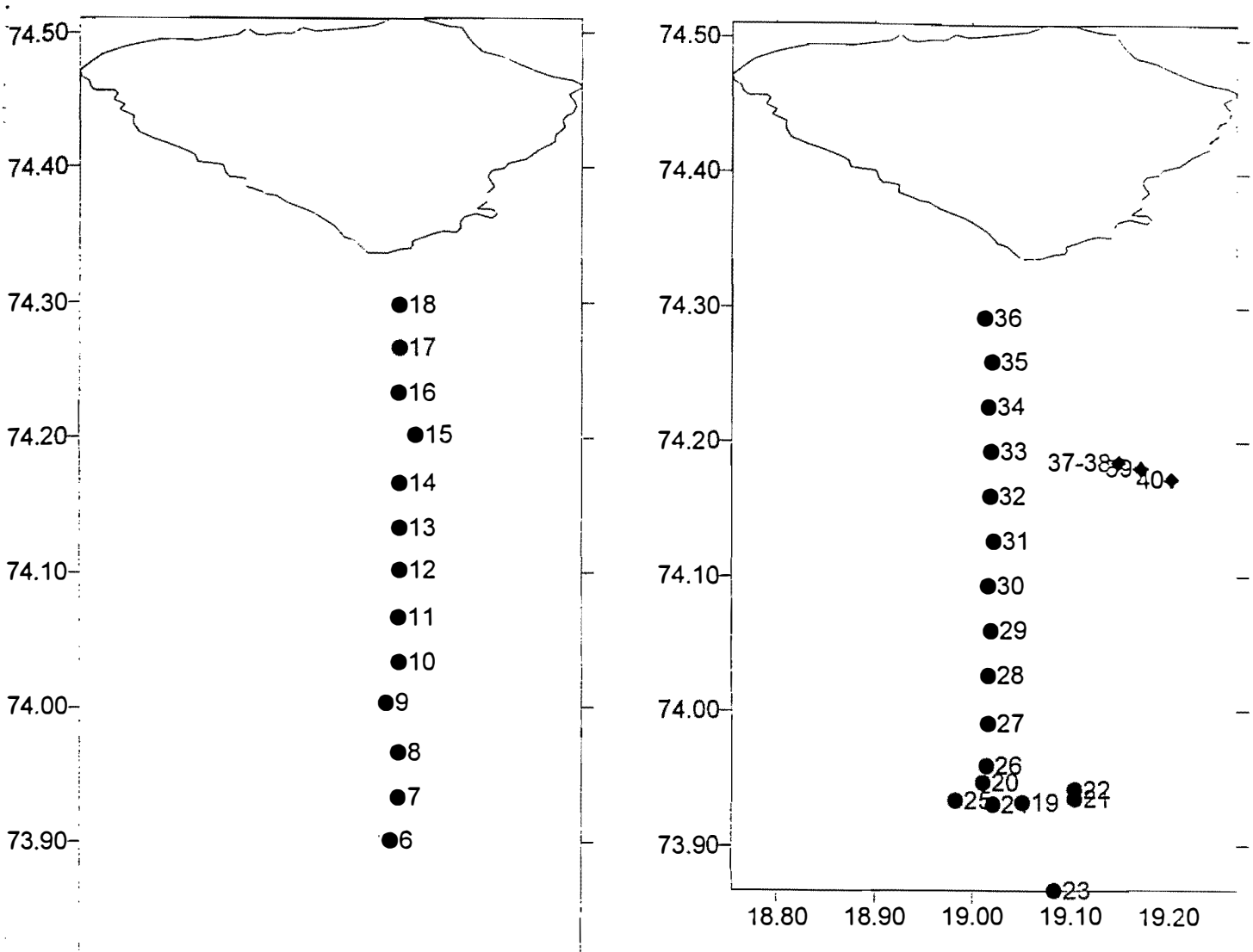
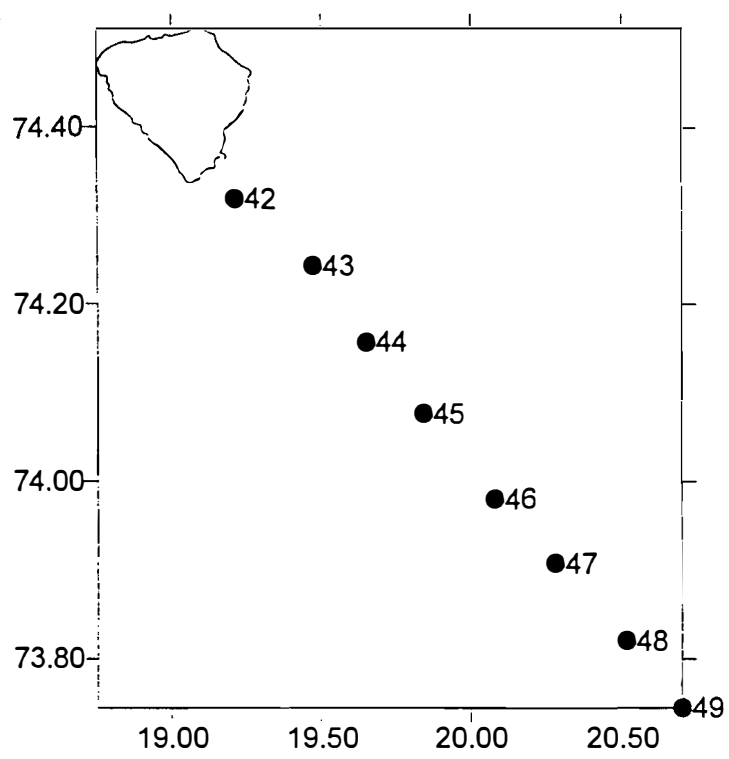
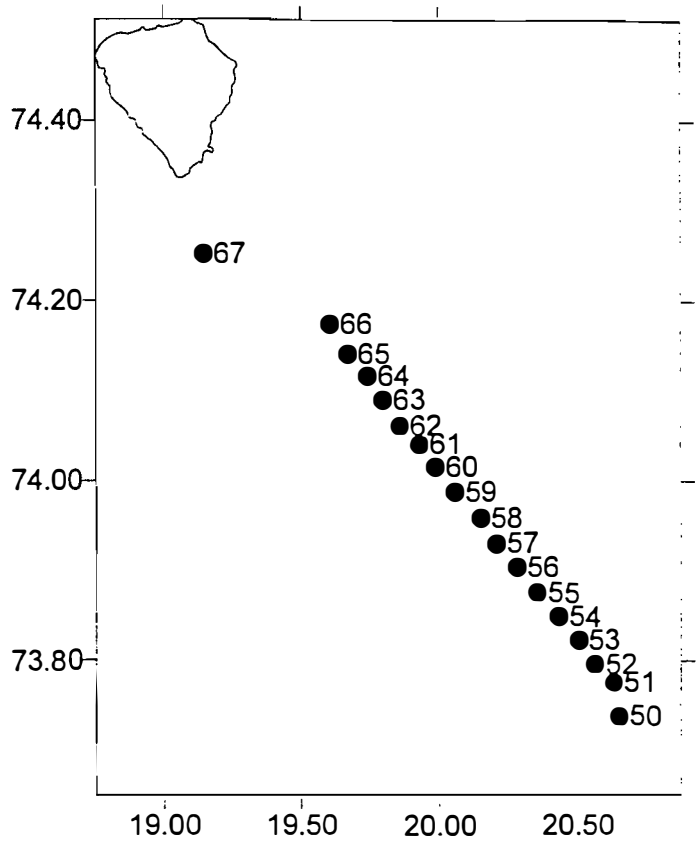


Fig. 2.1. Stations no. 1 - 40.





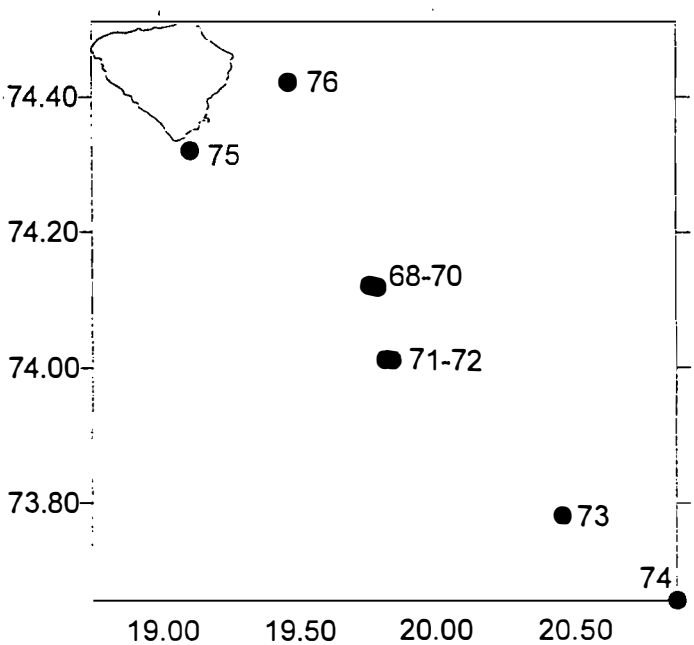


Fig. 2.2. Stations no. 42 - 76

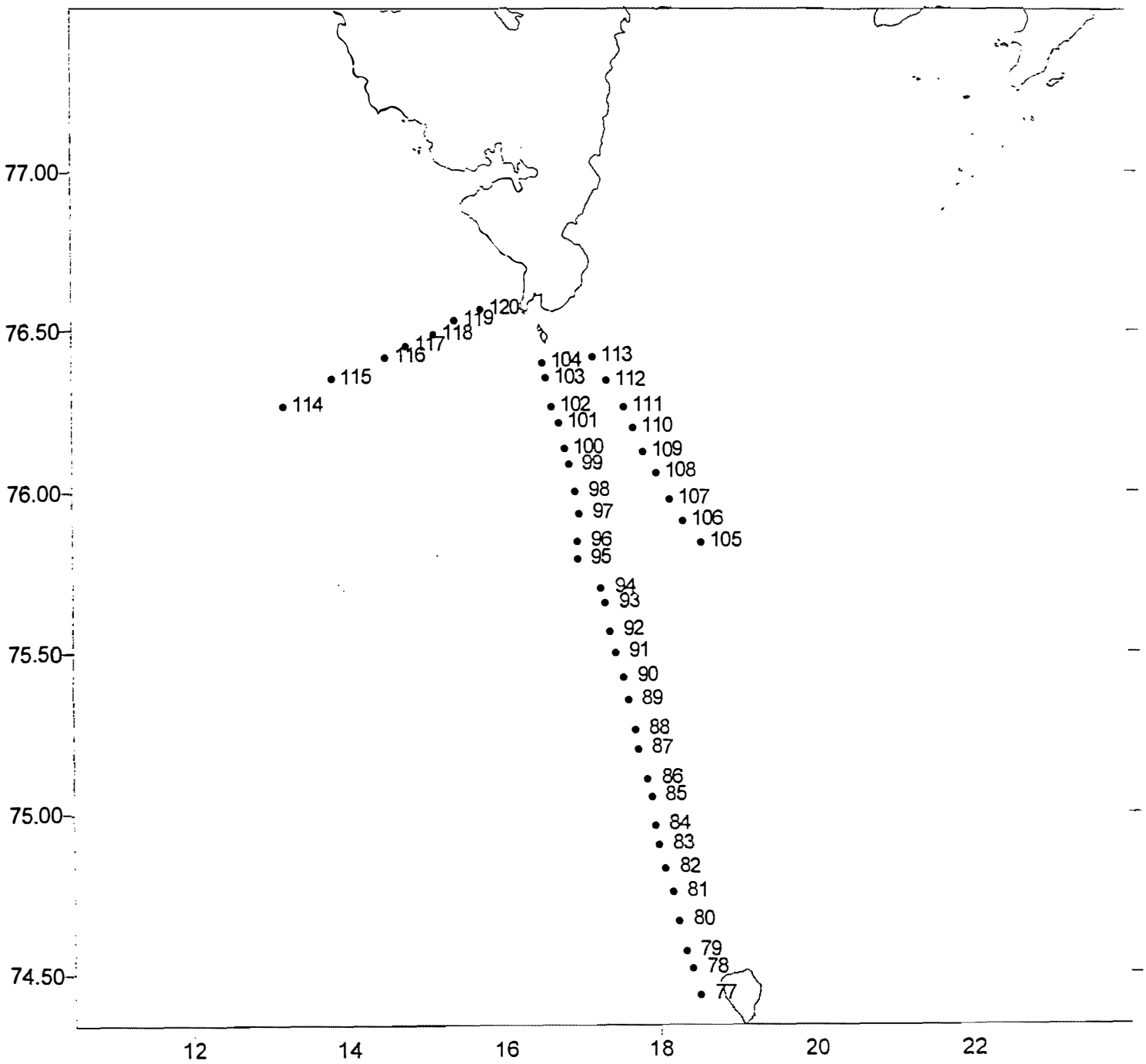


Fig. 2.3. Stations no. 77 - 120.

3. Individual project reports

3.1 Project title: Physical oceanographical studies in the Bjørnøya region

Participants: Nina Nordlund and Fridtjof Mehlum, Norwegian Polar Institute (Norway)

During the cruise, profiles of temperature and salinity were obtained using a conductivity-temperature-depth (CTD) probe (Neil Brown Mark III). Data acquisition and processing were carried out by use of EG&G software (EG&E Marine Instruments, CTD Acquisition Module Version 3.0 and Post-processing Module Version 3.0). The accuracy of measurements reported by the manufacturer is ± 0.002 °C for temperature. ± 0.004 PSU for salinity and ± =.1% of full scale (6500dbar) for pr4essure. For calibration of the conductivity cell, water samples were collected with a Niskin bottle attached to the wire above the CTD. The CTD was calibrated prior to the cruise. Samples were also taken for TOC (unfiltered) and DOC (filtered) measurements.

Table 3.1 Station list

station		DATE	TIME	LATITUDE		LONGITUDE		ECHO-
number	type of samples		(UTC/GMT)	deg	minutes	deg	minutes	DEPTH
1	CTD	30.07.96	11:35	73	16.319	19	5.210	446
2	CTD	01.07.96	01:06	73	25.960	19	5.270	465
3	CTD, NORPAC, WP-2	02.07.96	09:37	73	35.420	19	3.910	360
4	CTD	02.07.96	14:55	73	42.250	19	5.640	281
5	CTD, WP-2	02.07.96	16:00	73	47.980	19	5.100	250
6	CTD	02.07.96	17:22	73	54.070	19	4.520	175
7	XBT	02.07.96	19:19	73	56.000	19	5.000	150
8	XBT	02.07.96	19:52	73	58.000	19	5.000	126
9	CTD, NORPAC, WP-2	02.07.96	20:26	74	0.200	19	4.270	120
10	XBT	02.07.96	22:16	74	2.000	19	5.000	111
11	XBT	02.07.96	22:42	74	4.000	19	5.000	101
12	CTD, WP-2	02.07.96	23:14	74	6.120	19	5.050	80
13	XBT	03.07.96	00:09	74	8.000	19	5.000	71
14	XBT	03.07.96	00:39	74	10.000	19	5.000	70
15	CTD, NORPAC, WP-2	03.07.96	01:09	74	12.140	19	5.980	57
16	XBT	03.07.96	02:54	74	14.000	19	5.000	55
17	XBT	03.07.96	03:31	74	16.000	19	5.000	55
18	CTD, WP-2	03.07.96	04:30	74	17.920	19	5.030	35
19	MIK	03.07.96	08:43	73	55.910	19	3.090	

20	MIK	03.07.96	09:27	73	56.800	19	0.680	
21	MIK	03.07.96	10:00	73	56.100	19	6.260	75
22	MIK	03.07.96	11:22	73	56.490	19	6.260	102
23	Acoustics	03.07.96		73	52.000	19	5.000	
24	MIK	03.07.96	18:12	73	55.840	19	1.280	
25	Sjöuglan (ROV)	03.07.96	20:50	73	56.000	18	59.000	133
26	XBT	03.07.96	23:38	73	57.557	19	0.879	123
27	XBT	04.07.96	00:03	73	59.438	19	0.981	110
28	XBT	04.07.96	00:32	74	1.590	19	1.027	104
29	XBT	04.07.96	00:56	74	3.594	19	1.184	93
30	XBT	04.07.96	01:22	74	5.594	19	0.981	77
31	XBT	04.07.96	01:51	74	7.595	19	1.356	78
32	XBT	04.07.96	02:21	74	9.594	19	1.108	66
33	XBT	04.07.96	02:53	74	11.597	19	1.176	60
34	XBT	04.07.96	03:31	74	13.600	19	1.042	60
35	XBT	04.07.96	04:15	74	15.596	19	1.263	50
36	XBT	04.07.96	05:08	74	17.596	19	0.854	36
37	MIK	04.07.96	07:42	74	11.090	19	8.940	
38	MIK	04.07.96	09:07	74	11.090	19	8.940	
39	MIK	04.07.96	09:27	74	10.850	19	10.300	
40	MIK	04.07.96	09:45	74	10.360	19	12.220	
41	BIRDS	04.07.96	11:00					
42	CTD	04.07.96	13:05	74	19.093	19	12.597	43
43	CTD	04.07.96	13:50	74	14.519	19	28.180	71
44	CTD	04.07.96	14:35	74	9.420	19	38.970	87
45	CTD	04.07.96	15:30	74	4.560	19	50.564	89
46	CTD, NORPAC	04.07.96	16:25	73	56.957	20	4.796	179
47	CTD	04.07.96	17:25	73	54.415	20	16.843	270
48	CTD	04.07.96	18:32	73	49.210	20	30.780	395
49	CTD, WP-2	04.07.96	19:14	73	44.655	20	41.970	465
50	XBT	04.07.96	20:25	73	44.275	20	39.237	500
51	XBT	04.07.96	21:15	73	46.578	20	38.040	490
52	XBT	04.07.96	21:41	73	47.766	20	34.009	480
53	XBT	04.07.96	22:12	73	49.393	20	30.339	470
54	XBT	04.07.96	22:44	73	50.937	20	26.079	450
55	XBT	04.07.96	23:15	73	52.513	20	21.415	410
56	XBT	04.07.96	23:46	73	54.261	20	16.956	380
57	XBT	05.07.96	00:14	73	55.835	20	12.506	360
58	XBT	05.07.96	00:44	73	57.511	20	8.997	350

59	XBT	05.07.96	01:15	73	59.271	20	3.643	300
60	XBT	05.07.96	01:45	74	0.957	19	59.438	270
61	XBT	05.07.96	02:14	74	2.441	19	55.942	240
62	XBT	05.07.96	02:49	74	3.672	19	51.712	200
63	XBT	05.07.96	03:24	74	5.410	19	48.098	125
64	XBT	05.07.96	03:56	74	6.975	19	44.665	110
65	XBT	05.07.96	04:28	74	8.473	19	40.419	71
66	XBT	05.07.96	05:05	74	10.470	19	36.453	97
67	MIK, WP-2	05.07.96	09:15	74	15.080	19	8.780	45
68	BIRDS, CTD, WP-2	05.07.96	13:05	74	7.241	19	45.770	65
69	MIK	05.07.96	14:00	74	7.155	19	46.808	75
70	MIK	05.07.96	14:47	74	7.054	19	47.741	76
71	MIK	05.07.96	16:50	74	0.691	19	49.370	81
72	MIK,	05.07.96	17:47	74	0.677	19	51.058	84
73	CTD, WP-2, MIK, BIRDS	05.07.96	20:05	73	46.866	20	27.646	406
74	CTD	05.07.96	22:40	73	39.047	20	52.374	486
75	MIK (16)	06.07.96	13:40	74	19.284	19	6.637	38
76	Sjöuglan (ROV)	06.07.96	17:26	74	25.346	19	28.071	60
77	CTD	06.07.96	20:55	74	25.997	18	30.315	42
78	XBT	06.07.96	21:26	74	30.906	18	24.174	65
79	CTD	06.07.96	21:55	74	34.071	18	19.567	65
80	XBT	06.07.96	22:54	74	39.773	18	14.933	131
81	CTD, NORPAC	06.07.96	23:15	74	45.230	18	10.254	230
82	XBT	07.07.96	00:23	74	49.579	18	4.858	292
83	CTD	07.07.96	01:10	74	54.070	17	59.851	167
84	XBT	07.07.96	01:42	74	57.749	17	57.394	145
85	CTD	07.07.96	02:20	75	3.142	17	54.398	139
86	XBT	07.07.96	02:47	75	6.371	17	51.572	147
87	CTD	07.07.96	03:25	75	12.064	17	44.674	153
88	XBT	07.07.96	03:54	75	15.665	17	41.984	152
89	CTD, NORPAC	07.07.96	04:28	75	21.241	17	36.984	177
90	XBT	07.07.96	05:32	75	25.476	17	33.318	170
91	CTD	07.07.96	06:05	75	30.022	17	27.023	160
92	XBT	07.07.96	06:38	75	33.998	17	23.068	182
93	CTD	07.07.96	07:15	75	39.162	17	19.725	175
94	XBT	07.07.96	07:43	75	41.943	17	16.352	206
95	CTD	07.07.96	08:29	75	47.306	16	58.256	296
96	XBT	07.07.96	09:07	75	50.728	16	58.492	305
97	CTD	07.07.96	09:34	75	55.921	16	59.694	311

98	XBT	07.07.96	10:56	76	0.040	16	57.035	314
99	CTD	07.07.96	12:42	76	5.129	16	51.870	319
100	XBT	07.07.96	12:12	76	8.093	16	48.589	308
101	CTD	07.07.96	13:48	76	13.019	16	44.670	271
102	XBT	07.07.96	13:26	76	15.914	16	38.560	167
103	CTD	07.07.96	15:05	76	21.076	16	34.610	48
104	CTD	07.07.96	15:32	76	24.120	16	32.020	32
105	CTD, WP-2	07.07.96	20:30	75	50.499	18	33.432	109
106	CTD	07.07.96	21:48	75	54.520	18	19.670	142
107	CTD	07.07.96	22:23	75	58.493	18	9.791	180
108	CTD	07.07.96	23:11	76	3.587	17	59.702	230
109	CTD, WP-2	07.07.96	23:52	76	7.543	17	49.520	282
110	CTD	08.07.96	00:57	76	12.099	17	41.936	300
111	CTD	08.07.96	01:37	76	16.076	17	34.766	265
112	CTD	08.07.96	02:25	76	20.604	17	21.626	244
113	CTD, WP-2	08.07.96	03:09	76	25.116	17	11.091	128
114	CTD, NORPAC	08.07.96	10:14	76	15.887	13	12.498	1300
115	CTD, WP-2	08.07.96	13:07	76	21.020	13	50.043	1050
116	CTD	08.07.96	15:25	76	25.005	14	31.120	650
117	CTD, WP-2	08.07.96	17:10	76	27.048	14	46.469	222
118	CTD	08.07.96	18:31	76	29.191	15	7.533	136
119	CTD, WP-2	08.07.96	19:14	76	31.897	15	24.098	125
120	CTD	08.07.96	08:07	76	34.003	15	44.232	42

3.2 Project title: The role of plankton on the carbon cycles in the polar front zone

Participants: Sakae Kudoh & Atsushi Tanimura, National Institute of Polar Research (Japan)

3.2.1 Introduction

The Polar Front which is observed around Bjørnøya in the Barents Sea is thought to be one of the most productive area in the Arctic seas, because large numbers of higher trophic organisms such as sea birds and marine mammals are living and sustained around there. Preliminary data of our measurement of CO_2 concentration in the surface water of such polar fronts (Greenland and Barents Sea, Lance cruises of 1992 and 1995, respectively) suggested that active CO_2 absorption areas seemed to be well correlated with the fronts, in other words, possible phytoplankton blooming areas.

This information suggests that the CO_2 absorption was due to biological carbon uptake by phytoplankton production and biological (and partly chemical and physical) transportation through the arctic marine food web from surface water to the deep, or to the terrestrial ecosystems by birds. And then, these highly productive and highly CO_2 absorbed areas may play an important role of the sink of the CO_2 in the atmosphere.

3.2.2 Objectives

To obtain basic simultaneous information on the distribution and abundance of inorganic carbon (e.g. CO_2, Carbonate) and phyto- and zooplankton with relation to the several types of water mass structures which are observed around the Polar Front Zone in the Barents Sea, is our first intention.

3.2.3 Studies carried out

1. XBT measurements of temperature profiles in the polar frontal area around Bjørnøya.
2. Surface water monitoring (Salinity, temperature, chlorophyll-fluorescence, and nitrate plus nitrite concentration) along the cruise track.
3. Zooplankton sampling in different types of water masses which is observed near the polar front.

3.2.3.1 XBT

To find out the water mass structure, an XBT temperature profiler (Tsurumi Seiki Co. Ltd.) was used. Along the transect #1 (south of Bjørnøya), transect #2 (South-east of

Bjørnøya), and transect #3 (north of Bjørnøya), we have launched the probe at every 2 to 4 nm. Detailed information of location , date, time, etc. are listed in Tables 3.2, 3.3 and 3.4.

The data from the XBT, as well as the data from CTD observations carried out by NP will be used to draw the vertical profiles of the structure of the water masses along the transects.

Table 3.2. XBT observations along Transect #1 (South Transect)

Station	Date	Time (GMT)	Lat. degree	min.	Long. degree	min	Depth(m)
08	2.07	19:52	73	58.000	19	05.000	126
10	2.07	22:16	74	02.000	19	05.000	111
11	2.07	22:42	74	04.000	19	05.000	101
13	3.07	00:09	74	08.000	19	05.000	71
14	3.07	00:39	74	10.000	19	05.000	70
16	3.07	02:54	74	14.000	19	05.000	55
17	3.07	03:31	74	16.000	19	05.000	55
26	3.07	23:28	73	57.557	19	00.879	123
27	4.07	00:03	73	59.438	19	00.981	110
28	4.07	00:32	74	01.590	19	01.127	104
29	4.07	00:56	74	03.594	19	01.184	93
30	4.07	01:23	74	05.594	19	00.981	77
31	4.07	01:51	74	07.594	19	01.356	78
32	4.07	02:21	74	09.594	19	01.108	66
33	4.07	02:54	74	11.597	19	01.176	60
34	4.07	03:31	74	13.600	19	01.042	60
35	4.07	04:16	74	15.596	19	01.263	50
36	4.07	05.09	74	17.596	19	00.584	43

Table 3.3. XBT observations along Transect #2 (South-east Transect)

Station	Data	Time	Lat. degree	min.	Long. degree	min	Depth(m)
50	4.07	20:25	73	44.275	20	39.237	461
51	4.07	21:15	73	46.578	20	38.040	445
52	4.07	21:41	73	47.766	20	34.009	433
53	4.07	22:12	73	49.393	20	30.339	405
54	4.07	22:44	73	50.937	20	26.079	365
55	4.07	23:15	73	52.513	20	21.415	313
56	4.07	23:46	73	54.261	20	16.956	267
57	5.07	00:14	73	55.835	20	12.506	221
58	5.07	00:44	73	57.511	20	08.997	185
59	5.07	01:15	73	59.271	20	03.643	183
60	5.07	01:45	74	00.957	19	59.438	163
61	5.07	02:14	74	02.441	19	55.942	121
62	5.07	02:49	74	03.672	19	51.712	93
63	5.07	03:24	74	05.410	19	48.098	78
64	5.07	03:56	74	06.975	19	44.665	69
65	5.07	04:28	74	08.473	19	40.419	71
66	5.07	05:05	74	10.470	19	36.453	97

Table 3.4. XBT observation along Transect #3 (North Transect)

Station	Data	Time	Lat. degree	min.	Long. degree	min	Depth(m)
78	6.07	21:26	74	30.906	18	24.174	65
80	6.07	22:34	74	39.773	18	14.933	131
82	7.07	00:23	74	49.579	18	04.858	292
84	7.07	01:42	74	57.794	17	57.394	145
86	7.07	02:47	75	06.371	17	51.572	147
88	7.07	03:54	75	15.665	17	41.984	152
90	7.07	05:32	75	25.476	17	33.318	170
92	7.07	06:38	75	33.998	17	23.068	182
94	7.07	07:37	75	41.943	17	16.352	206
96	7.07	09:02	75	50.728	16	58.492	305
98	7.07	10:56	76	00.040	16	57.035	314
100	7.07	12:12	76	08:093	16	48.589	308
102	7.07	13:26	76	15.914	16	38.560	167

3.2.3.2 Surface water monitoring

Along the cruise track, salinity, temperature, chlorophyll fluorescence and nitrate plus nitrite concentration in the surface water were analysed continuously (transect #1,2,3, and 6 (stations 114-120) were completely monitored, 4 and 5 (sations 105-113) were observed partly). The surface water was collected and supplied continuously from the ship bottom (4-5 m depth) by a pump which was equipped R/V LANCE. The water was immediately flowed into tanks (ca. 20 l) which was installed AQUAPACK (Ci Co.), a CTD-Fluorescence analyser, and the CO2 sampler. At the same time a portion of the water was supplied to AutoAnalyzer II (Technicon), an automated nutrient analysing system. Data from AQUAPACK were stored in the hard disk of an PC-personal computer every 5 seconds, and the data from AutoAnalyzer II were recorded continuously on the charts of a pen recorder. CO_2 sampling was carried out at several locations where typical differences of the signals from the former two monitoring systems occurred.

By using the data of the position of the ship, horizontal patterns of the surface water and chlorophyll distribution will be analysed. For the instrument calibration purpose, several water samples were collected, and then they were filtered or fixed for further analysis.

3.2.3.3 Zooplankton

Zooplankton sampling was carried out at 8 stations, where different types of the water mass were observed, as indicated in Table 3.5. Samples were collected from several discrete depths using a closing NORPAC net (opening diam.: 45 cm, mesh size: 0.1 mm(XX13 type)).

Table 3. 5. Zooplankton samples.

Transect #	Stn. #	Position	Depth (m)	Time(GMT)	Sampling depth	Sample ID
1	3	73° 35.83 N 19° 04.12 E	360	2-Jul., '96 11:00 -11:50	0 - 50 m 50 - 100 m 100 - 200 m 200 - 350 m	01003D1 01003D2 01003D3 01003D4
1	9	74° 00.56 N 19° 02.41 E	120	2-Jul., '96 20:43 - 21:03	0 - 50 m 50 - 100m	01009D1 01009D2
1	15	74° 12.23 N 19° 09.32 E	59	3-Jul., '96 01:20 - 01:25	0 - 50 m	01015D1
2	46	73° 54.42 N 20° 16.84 E	152	4-Jul., '96 16:35 - 16:40	0 - 100 m	01046N1
3	81	74° 45.11 N 18° 10.31 E	222	6-Jul., '96 21:28 - 21:50	0 - 50 m 50 - 100 m 100 - 200 m	01081D1 01081D2 01081D3
3	89	75° 21.26 N 17° 37.12 E	160	7-Jul., '96 04:28 - 04:50	0 - 50 m 50 - 100 m 100 - 150 m	01089D1 01089D2 01089D3

3	97	75° 55.83 N 16° 59.95 E	311	7-Jul., '96 09:50 - 10:30	0 - 50 m 50 - 100 m 100 - 200 m 200 - 300 m	01097D1 01097D2 01097D3 01097D4
6	114	76° 15.21 N 13° 12.66 E	1300	8-Jul., '96 11:20 - 11:25	0 - 100 m	01114N2

All samples collected along transects 1 and 3 were divided into two subsamples; one was dried immediately after removing the water by several types of meshes (for size fractionation purpose), and another was preserved with 5% formaline seawater. Dry weight and carbon contents of each fractionated zooplankton will be analysed as well as the species composition.

3.3 Project title: Macro-zooplankton sampling and operations with a Remotely Operated Vehicle (ROV) in the Bjørnøya region.

Participants: Bo Bergström and Jan Otto Pettersson,

3.3.1 Introduction

The main objective of the expedition was to investigate the connections between variations in marine physical environment, zooplankton distribution and distribution of foraging sea birds in the waters around Bjørnøya. Large numbers of Brünnich's guillemot (*Uria lomvia*) and common guillemot (*Uria aalge*) nest on the steep cliffs of the island. Many of these birds have been found to forage in or in close vicinity the border zone between Atlantic-and Arctic water. This discontinuity in the water mass, commonly known as the "Polar front", is normally found about 20-30 km south of the island. The "Polar front" is often characterised by a pycnocline in the Atlantic water at about 20 m of depth, beneath which a well mixed Arctic water is found. Beside the zooplankton work, a secondary objective was to make video recordings from both the pelagic and the bottom with a ROV (Sea Owl MK II) in the area south of Bjørnøya.

3.3.2 Macro-zooplankton sampling

Against this brief background, sampling for macro-zooplankton was carried out with the aid of a Methot-Isaac-Kidd (MIK) net. The circular mouth of the net had a diameter of 2 m, the mesh size was 1.2 mm in the front 14 m, 500 μ in the 1.5 m long cod end and 500 μ in the bucket. The net was fitted with a flow meter and during some of the hauls a recording "Mini CTD". Fishing depth during operations were estimated by wire angle and amount of warp paid out according to the expression, Cos a*w=D, a= wire angle. w= length of the warp and D= depth. These estimates will be checked against "Mini CTD" recordings during sample post-processing. We did both oblique hauls from the surface and integrated hauls from 10 m above the bottom to the surface. The speed during the oblique hauls was kept between 3 and 3.5 knots. The procedure for the integrated hauls consisted of first lowering the net to 10 m above the bottom while the ship hove to and then while the ship started steaming, retrieving the net with 0.5 m/s.

By using data from CTD and XBT casts hauls were positioned both in Atlantic, Polar and front water. Oblique hauls were made to get integrated estimates of macro-zooplankton abundance over a larger area in each of the water masses (Atlantic, Polar and Front), while the integrated shorter hauls (three in approximately the same position) will be used for attempts to describe distribution patterns ("patchiness") in relationship to physical parameters. Both types of samples will off course be used for correlation

with distribution of foraging birds and for "ground truthing" hydroacoustic data.

In total 15 samples were obtained between July 3 and July 5, details of each haul is given in Table I.

Table 3.6. MIK net stations

STA-TION #	HAUL #	DATE	POS.START	POS.END	BOTTOM DEPTH	GMT TIME START	GMT TIME END	VOLUME (m^3)	MAX DEPTH	NOTES
19	1	03.07.96	73°55'91N;19°03'09E	73°56'73N;19°01'72E	173	08:43	09:04	1855.74	163	INTEGRATED HAUL
20	2	03.07.96	73°56'80N;19°00'68E	73°56'84N;19°00'03E	164	09:27	09:32	614.20	154	INTEGRATED HAUL
21	3	03.07.96	73°56'10´N;19°06'26E	73°56'10N;19°04'49E	175	10:00	10:06	802.58	165	INTEGRATED HAUL
22	4	03.07.96	73°56'49N;19°06'26E	73°5828N;19°06'26E	100	11:22	12:04	9969.19	40	OBLIQUE HAUL
24	5	03.07.96	73°5584;19°01'28	73°53'57N;18°59'22E	133-183	18:12	19:05	10703.95	18	OBLIQUE HAUL
37	6	04.07.96	74°09'35N;18°59'76E	74°09'68N;19°01'04E	63	07:42	8.16	8605.17	53	OBLIQUE HAUL
38	7	04.07.96	74°11'09N; 19°08'94E	74°11'15N;19°07'26E	59	09:07	09:11	618.89	49	INTEGRATED HAUL
39	8	04.07.96	74°10'85N;19°10'30E	74°10'75N;19°10'35E	59	09:27	11:32	590.63	49	INTEGRATED HAUL
40	9	04.07.96	74°10'36N;19°12'22E	74°10'29N;19°12'48E	61	09:45	11:48	618.89	51	INTEGRATED HAUL
67	10	05.07.96	74°15'08N;19°08'78E	74°16'11N;19°15'14E	51-49	09:15	09:54	11556.46	33	OBLIQUE HAUL
69	11	05.07.96	74°07'16N;19´°46'81E	740712N;19°46'93E	75	14:01	14:04	691.43	65	INTEGRATED HAUL
70	12	05.07.96	74°07'05N,19°47´74E	740705N;194783E	76	14:23	14:47	736.64	65	INTEGRATED HAUL
71	13	05.07.96	74°06'91N;19°49'37E	74°08'86N;19°49'52E	81	14:50	14:56	914.68	71	INTEGRATED HAUL
72	14	05.07.96	74°06'77N;19°51'06E	74°09'37N;19°56'80E	84	15:47	16.48	17180.20	74	OBLIQUE HAUL
73	15	05.07.96	73°46'47N:20°77'05E	73°46'51N;20°25'38E	117	20:57	21:13	3258.38	107	OBLIQUE HAUL

Generally the abundance of macro zooplankton was quite high in all samples. A preliminary impression from the samples was that chaetognaths, ctenophores, pteropods and large copepods dominated in the samples collected in the Polar water close to Bjørnøya, while the euphaiusiid *Thysanoessa inermis* was rare or absent in these samples. In the Atlantic water, however, krill were more common. Further analysis which will be carried out during the spring 1997 will produce species lists and abundance estimates of the species contained in the samples.

3.3.3 Operational considerations

The used MIK net worked very well for our macro-zooplankton sampling, but the lack of a net sonde made vertical positioning of the net very difficult in the strong and variable tidal currents occurring in the waters around Bjørnøya. A suggestion for the future is to either use a MIK net fitted with a net sonde and a mini CTD or even better a Rectangular Mid-water Trawl (RMT) with a opening/closing mechanism, net sonde and a Mini CTD. Launching and retrieving the net with the aid of "storbommen" and the deep sea winch worked very well.

3.3.4 ROV operations

Because we prioritised the macro-zooplankton net sampling only three dives with the ROV were performed. These dives were all done south of the island at about 40, 60 and 135 meters of depth. Operations were made difficult by strong currents, which however slacked towards evening. An added complication was that the fluxgate compass of the ROV did not function to satisfaction. According to information from the manufacturer of the Sea Owl system obtained after the expedition fluxgate compasses do not function well at high latitudes and in cold temperatures. The lesson for the future is off course that other types of compasses should be used in ROVs operated in these condition The impression from the video images from the pelagic confirmed the impressions from the net samples. Images from the bottom showed almost no epifauna at 60 and 135 meters, while some epifauna was observed closer to the island at 40 meters of depth. Conspicuous species in the shallow station were *Cucumaria frondosa* and *Hyas areneus*. At both 60 and 135 m fine grained sediment was virtually lacking, most certainly due to strong currents.

3.4 Project title: Zooplankton net sampling

Participants :Ludwik Balcer and Lukasz Glowinski, Institute of Oceanology Polish Academy of Sciences (report prepared by Lukasz Glowinski)

3.4.1 Introduction

The goal of the plankton work was to collect zooplankton samples that would allow to describe distribution of mesozooplankton organisms in the surveyed area.

3.4.2 Sampling

The sampling stations were located along transects in the south of Bjørnøya and between Bjørnøya and Sørkapp, crossing the Sørkapp Current into Storfjordrenna and south to the frontal zone between Atlantic water and the colder Spitsbergenbank water. Another transect from Sørkapp to the south-west crossed the continental slope. The stations were located along the birds watching transects and it was assumed, that the birds will not forage deeper then 50 m, so this was the max. sampling depth.

The sampling gear used was WP-2 net (57 cm diameters, mesh size 0.2 mm) towed vertically. At each station three replicates were taken every time. Table 3.7 shows the location of the sampling stations.

Table 3.7. WP-2 plankton sampling stations

Station no	Date	Latitude	Longitude
3	2.07.96	73°35'64	19°01'54E
5	2.07.96	73°47,84	19°04,84E
9	2.07.96	74°00,74	19°01,64E
12	3.07.96	74°08,44	19°04,64E
15	3.07.96	74°12,24	19°08,24E
18	3.07.96	74°17,64	19°04,34E
49	4.07.96	73°44,64	20°41,74E
66	5.07.96	74°16,34	19°16,84E
67	5.07.96	74°07,34	19°46,24E
73	5.07.96	73°46,84	20°27,64E
105	7.07.96	75°50,14	18°30,34E
109	8.07.96	76°07,54	17°49,84E

113		76°25,14	17°11,14E
115		76°2,14	13°50,24E
117		76°27,14	14°46,34E
119		76°31,94	15°23,94E

The results obtained after the analyses of the samples will be a contribution to the descriptions of the marine environment of the areas surveyed and will also be supplementing the acoustic data.

3.5 Project title: Acoustic mapping of fish and macrozooplankton

Participant: Tor Knutsen, Institute of Marine Research, Bergen (Norway)

The distribution of fish and macrozooplankton were repeatedly mapped on two transects (see Table 3.8), by a SIMRAD EK500 scientific echosounder equipped with a 120 kHz split-beam transducer. The transducer was mounted in a towed fish which was deployed from a boom at the stern side of the ship. It was observing vertically with a depth range of 0-100 m at a ping rate of approximately 1.3 pings per second. Towing speed was approximately 4.3 knots as measured by the ships GPS system and towing depth 4-6 m below the surface.

The towed fish was made at the Institute of Marine research, Bergen, from a divers air bottle with adjustable weight at the rear end. To stabilise the fish during towing two 5 l plastic containers with screw caps were mounted at the tail end by a nylon rope of 2 m length. The containers were partly filled with fresh water to adjust the drag and buoyancy.

The acoustic data were logged on a Sun SparcStation 10 using the Bergen Echo Integrator (BEI) system. All computers used in logging information along the cruise track, including the EK500 echosounder, were synchronised using their internal clocks. A portable GARMIN 45 GPS was used as the master clock. Data acquired on these computers could thus be exactly linked using time as the key parameter. Geographical position (latitude, longitude) and time in GMT were logged every 2 seconds in separate files on the Sun SparcStation using part of the BEI software. These data were used to link the continuous measurements of salinity, temperature and flourescence along the cruise track, as well as irregular measurements of carbon dioxide and nitrate, to en exact geographical location.

Table 3.8. Acoustic transects

Transect	Stations	Date	TimeStart (GMT)	TimeStop (GMT)	LogStart	LogStop	Geographical position Start Transect		Geographical position Start Transect	
1 (1)		01.07.96	23:27	?	4552	4592	74° 18.7' N	19° 5.67' E	73° 35.9' N	19° 05.07'E
1 (2)	St.6-9	02.07.96	18:45	23:20	4630	4649	73° 53.9' N	19° 1.87' E	74° 5.95' N	19° 05.03' E
1 (2)	St. 9-12	02.07.96	23:48	00:50	4651	4655	74° 06.5' N	19° 4.70' E	74° 10.4' N	19° 05.56' E
1 (2)	St. 12-15	03.07.96	00:50	01:11	4655	4657	74° 10.4' N	19° 5.56' E	74° 12.1' N	19° 05.59' E
1 (2)	St. 15-18	03.07.96	01:11	04:10	4660	4670	74° 12.4' N	19° 9.45' E	74° 16.5' N	19° 06.06' E
Front		03.07.96	14:09	19:15	4716	4739	73° 51.4' N	19° 9.13' E	73° 56.4' N	19° 01.8' E
MIK to ROV		03.07.96	19:25	20:48	4739	4744	73° 52.7' N	18° 57.6' E	73° 55.9' N	19° 00' E
1 (3)		03.07.96	23:22	05:45	4753	4781	73° 56.4' N	19° 0.9' E	74° 18.9' N	19° 00.7' E
2 (1)		04.07.96	20:35	07:45	4848	4895	73° 44.8' N	20° 39.5' E	74° 18.6' N	19° 10.2' E
2 (2)		05.07.96	20:15	12:27	4970	5027	73° 39.5' N	20° 50.5' E	74° 18.6' N	19° 09.8' E

3.5 Project title: Seabird foraging ecology around Bjørnøya, and between Bjørnøya and Sørkapp

Participant: Fridtjof Mehlum, Inger W. Anundsen, Endre Knutsen and Egil Soglo, Norwegian Polar Institute (Norway)

The rationale for the ornithological programme during the cruise is presented in Chapter 1. Transects were conducted crossing the frontal regions between warm and cold water south of Bjørnøya for locating areas of high densities of foraging seabirds, Brünnich's and common guillemots (*Uria lomvia* and *U. aalge*), in particular. This work was a follow up of a study conducted in the Bjørnøya region in 1993 (Mehlum et al. 1997). The distribution of foraging seabirds will be compared to the oceanographic features at different spatial scales, as well as to the results from zooplankton hauls and the acoustic sampling of zooplankton and fish biomass.

Seabird abundance was recorded from the research vessel by standardised strip transect methods (Tasker et al. 1984). A 300 m standard transect width was applied; however, during foggy conditions the transect width was reduced to 200 or 100 m. The observations were entered directly (in real time) into a pen computer (Grid Convertible), using a custom made data entry application to minimise the handling time of each observation. All birds observed within the transect were recorded by species, as was information on behaviour (birds flying and birds sitting on the sea surface), age, and environmental conditions. It was difficult to distinguish between Common and Brünnich's guillemots and in some cases the birds were recorded as *Uria* sp. The ship's geographical position (GPS-system) was entered into the field computer every 0.5 - 1 hour during periods with steady course and speed, and when the speed or direction of the ship changed. Two teams alternated on four-hour watches, each comprising two people: one observer; and the other as computer data-entry operator.

A sample of Brünnich's and common guillemots was collected from a zodiac using a shotgun south of Bjørnøya to identify the main prey of birds found in dense foraging aggregations. Stomach and esophagus contents of the birds were placed in a deep freezer within an hour after collection, for later identification of prey items to the lowest possible taxon.

A continuous seabird transect was conducted from Bjørnøya to Sørkapp accompanied by physical oceanographic stations. The seabird distribution data will be compared with data from the same transect made in the summers of 1992 and 1993 to study the variability in seabird distribution between years. In the Sørkapp region, the main emphasis were put on the foraging ecology of little auks (*Alle alle*). A sample of Little Auks was collected to document their diet in inshore and offshore habitats, using the same method as for the guillemots.

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