RAPPORTSERIE

Nr. 49 - Oslo 1989

BERT RUDELS & ØYVIND FINNEKÅSA:

Cruise with R/V LANCE to the Barents Sea and the Fram Strait, September 1988

NORSK POLARINSTITUTT

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CONTENTS

CRUISE WITH R/V LANCE SEPTEMBER 1988

BACKGROUND AND OBJECTIVES

The cruise with R/V LANCE arranged by Norsk Polarinstitutt between 2 September and 3 October 1988 concerned oceanography and sea ice work in the Barents Sea and in the Fram Strait. The programmes were part of the long term climatological research which NP is conducting in the area. The studies focus on the exchange of mass, heat and ice between the Polar Ocean and the North Atlantic, on mixing processes and on water mass formation.

The oceanographic work on the cruise was a cooperation between NP and LODYC, Université de Paris VI and IMF, Universität Hamburg. These two institutions also supplied instrumentation and personell to the expedition. A group from Universitetet i Tromsø working with ice fauna also participated in the cruise.

FIELD WORK

LANCE left Bodø on the 2 September and the oceanographic work began in the Barents Sea. Hydrographic sections were taken between the banks in the southern Barents Sea. The ship then continued into Storfjorden for further oceanographic work. After passing through Freeman-sundet a hydrographic section was taken from Edgeøya to Storbanken. Two moorings, equipped with upward looking sonars and Aanderaa current meters, were deployed, one on the slope east of Edgeøya, the other on the western slope of Storbanken.

Ice was encountered in the northern Barents Sea and it became possible for the other groups to commence their work. However, the ice conditions affected the progress of the cruise. Initially it was planned to go east of Kvitøya into the Polar Ocean. This could not be done. A section from Storbanken through Kong Karls Land to Bråsvellbreen was taken, after which the ship went north between Storøya and Kvitøya. However, it was not possible to reach further north than $80^0 28'$. The ice condition and bad visibility prevented LANCE from working westward north of Svalbard, and it was necessary to return south and reenter the Polar Ocean through Hinlopen. The ice was also here heavy and the ship could not penetrate further into the Polar basin than $81^0 05'$N at 16^0E. The work was finished on the 13 September and LANCE sailed to Longyearbyen for crew exchange.

LANCE left Longyearbyen on the 14 September for the Fram Strait. The work in the strait was divided between the French vessel R/V CRYOS, which earlier had occupied the stations in ice free water, and LANCE, which was expected to work in the ice covered waters.

This preliminary plan was based on the experiences in the Fram Strait in 1983 and 1984 and on climatological data, which indicated that September ought to be a "good" ice month. The preliminary goal was two zonal sections, along 80^0N and $78^0$30'N onto the Greenland Slope and two meridional sections, between $78^0$30'N and 80^0N along 1^0E and 3^0W.

Because one expedition member could not reach Longyearbyen on the 14th it was decided that the eastern meridional section should be occupied first. LANCE should then return to Bjørnhamna and pick up the remaining participant and one member of the crew. Their transportation to Bjørnhamna were to be done by the Sysselman helicopter, an arrangement which was made possible by the personal effort of Bjørn Gulliksen from Tromsø and the spontaneous help from the Syselmann office.

Ice was encountered already at $78^0$50'N on the meridional section. North of that position heavy ice condition, with floe sizes of several kilometers, forced the progress towards the east. Once out of the ice time only permitted work across the Nansen Ridge. However, the ice condition and the limited time prevented us from reaching the Sofia Deep.

After the remaining persons had been brought on board on the 20 September the work on the zonal sections could start. Thick ice and strong cooling (-15^0C) stopped the westward progress along 80^0N at 2^0E and LANCE had to return to open water. Not expecting to be able to reach further to the west on the northern section we sailed south to try the southern one.

The ice conditions there were as difficult as in the north and along $78^0$10'N the westward progress was stopped at $2^0$20'W and the ship moved further south to 77^0N. After an ice station at the westernmost point an oceanographic section was taken in open water along 77^0N. A section running obliquely across the Hovgaard Fracture zone brought LANCE back to the ice edge at 75^0N. Here the ice again prevented us from reaching the continental shelf. After the last ice station had been occupied a zonal section along 75^0N had to be abandoned because of an oncoming storm.

The ship sailed for Bergen and reached harbour on the 4 October. The equipment was unloaded and the participants left the ship on the following day.

The heavy ice conditions, the cold weather and the oncoming darkness, which prevented work during the night and forced the ship to lay still inside the ice field, all combined adversely against the work on the cruise. Many of the objectives of the expedition could therefore not be reached. It was clearly revealed that unless favourably conditions as those encountered on the previous years are present, a mere ice strengthened vessel has no possibility to work effectively in the heavy ice in the Fram Strait. Work in the strait should be conducted earlier in the year when the light conditions are good and the temperatures higher.

ACKNOWLEDGEMENT

As always we could enjoy the full support of the crew on LANCE. More than once they had to help repairing broken-down equipments, making it possible for us to complete our observation programme.

PARTICIPANTS

Bjørn Erlingsson	NP	Sea ice
Øyvind Finnekåsa	NP	Oceanography
Ånund Johnsen	NP	Sea ice
Bert Rudels *	NP	Oceanography
Torgny Vinje	NP	Sea ice
Bjørn Gulliksen	UiTø	Biology
Ole Jørgen Lønne	UiTø	Biology
Janja Corleis	IFM	Oceanography
Hans Friedrich	IFM	Oceanography
Jens Kleinfeldt	IFM	Oceanography
Marie-Noëlle Houssais	LODYC	Oceanography

* chief scientist

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NP - Norsk Polarinstitutt
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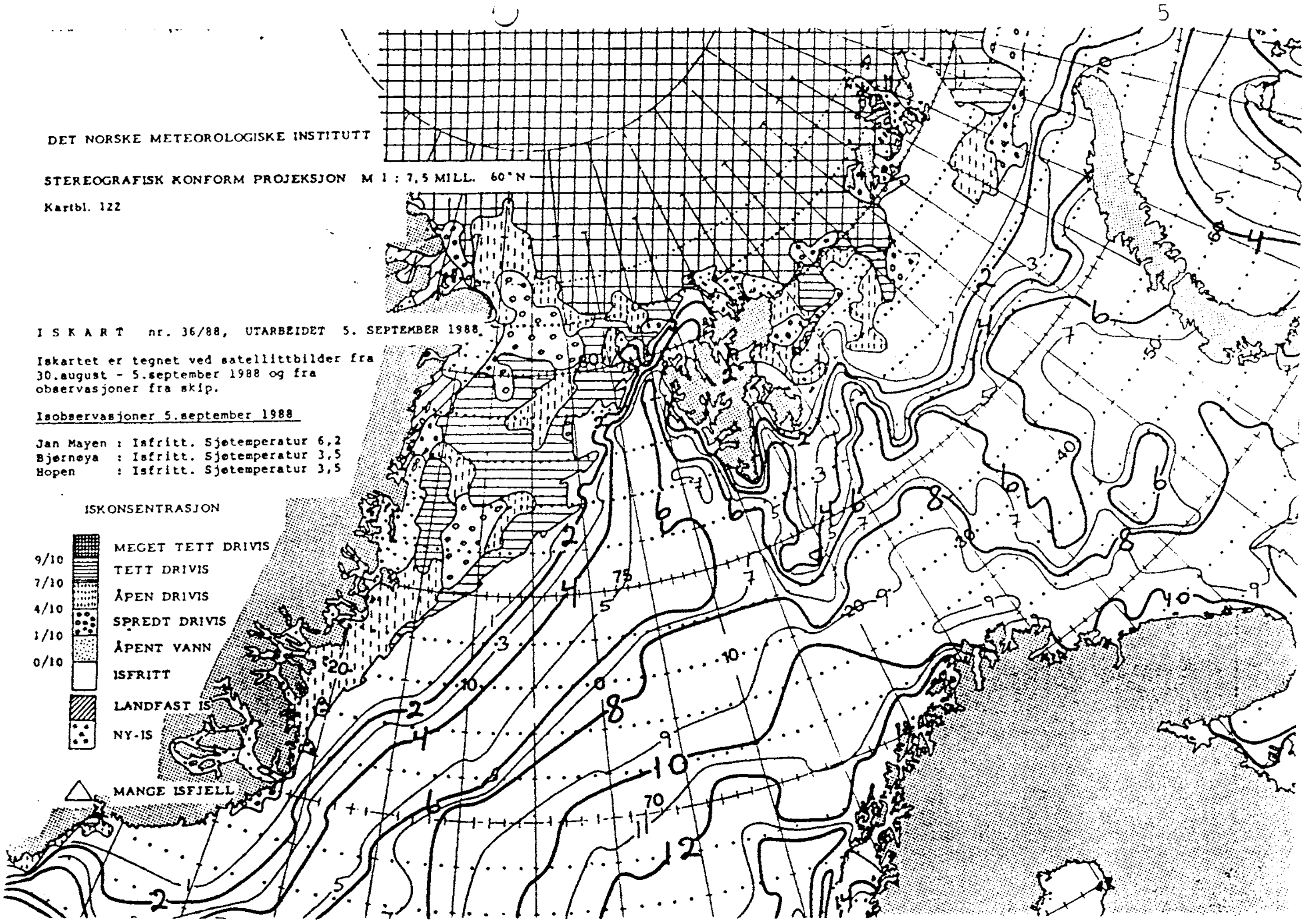
N-1330 Oslo lufthavn

NTNF - Norsk Teknisk Naturvitenskapelig Forskningsråd
Environmental Surveillance Technolgy Programme.

UiTø - Universitetet i Tromsø
N-9000 Tromsø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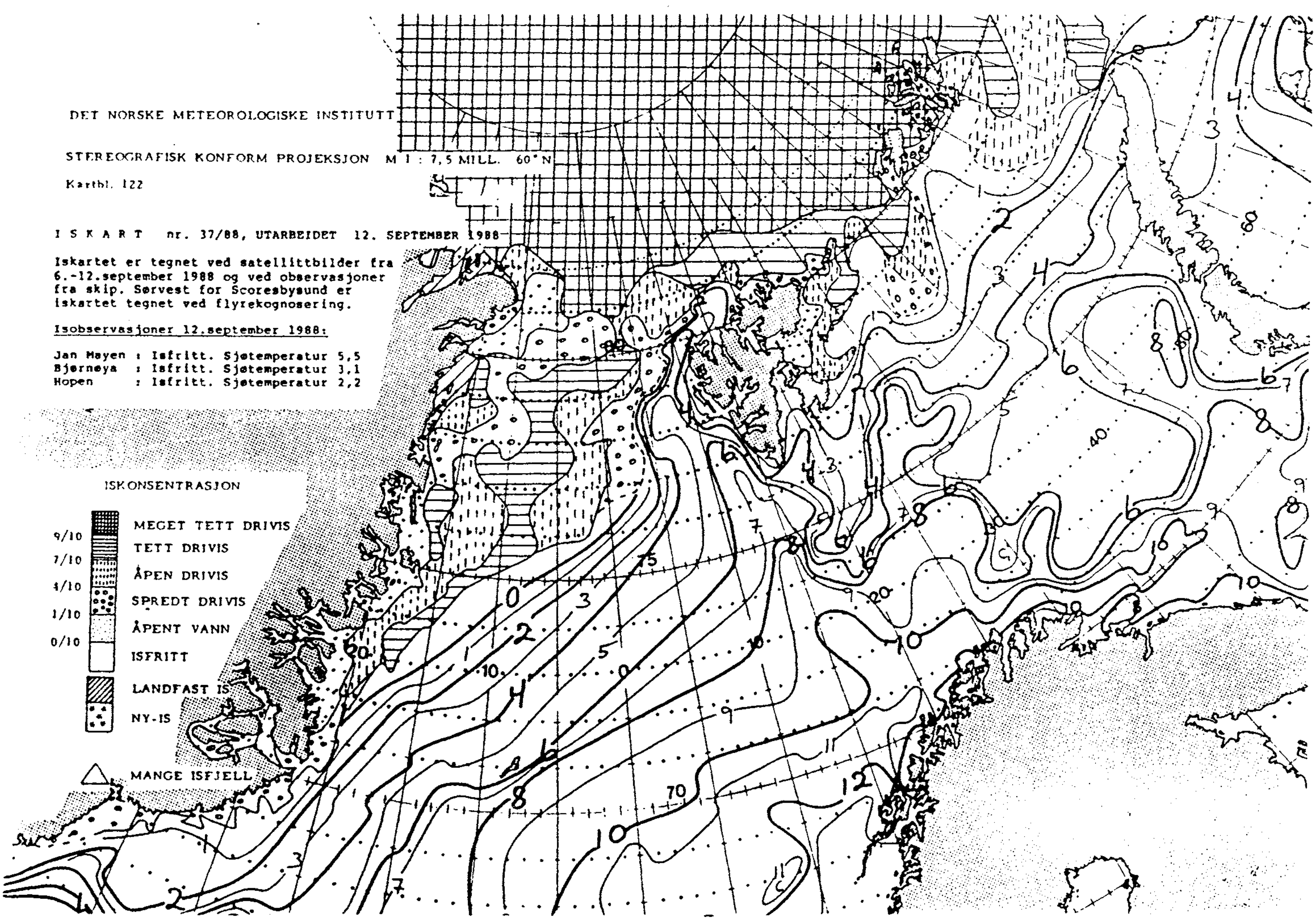
STEREOGRAFISK KONFORM PROJEKSJON M 1 : 7,5 MILL. 60°N
Kartbl. 122
I S K A R T nr. 36/88, UTARBEIDET 5. SEPTEMBER 1988
Iskartet er tegnet ved satellittbilder fra 30.august - 5.september 1988 og fra observasjoner fra skip.
Isobservasjoner 5.september 1988
Jan Mayen : Isfritt. Sjøtemperatur 6,2
Bjørnøya : Isfritt. Sjøtemperatur 3,5
Hopen : Isfritt. Sjøtemperatur 3,5
ISKONSENTRASJON
MEGET TETT DRIVIS
9/10
TETT DRIVIS
7/10
ÅPEN DRIVIS
4/10
SPREDT DRIVIS
1/10
ÅPENT VANN
0/10
ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL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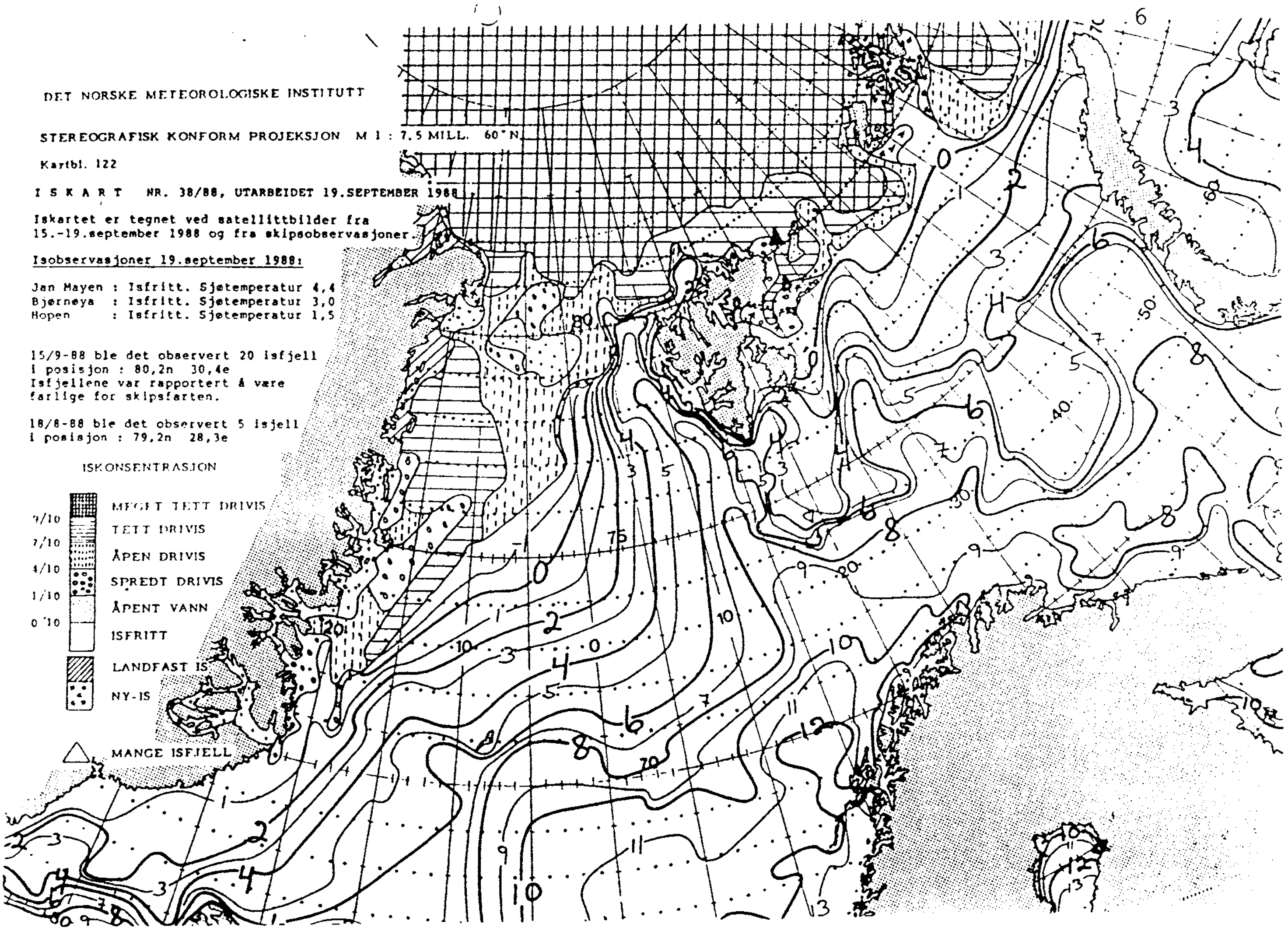
Kartbl. 122
I S K A R T nr. 37/88, UTARBEIDET 12. SEPTEMBER 1988
Iskartet er tegnet ved satellittbilder fra 6.-12.september 1988 og ved observasjoner fra skip. Sørvest for Scoresbysund er iskartet tegnet ved flyrekognosering.
Isobservasjoner 12.september 1988:
Jan Mayen : Isfritt. Sjøtemperatur 5,5
Bjørnøya : Isfritt. Sjøtemperatur 3,1
Hopen : Isfritt. Sjøtemperatur 2,2
ISKONSENTRASJON
MEGET TETT DRIVIS
9/10
TETT DRIVIS
7/10
ÅPEN DRIVIS
4/10
SPREDT DRIVIS
1/10
ÅPENT VANN
0/10
ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL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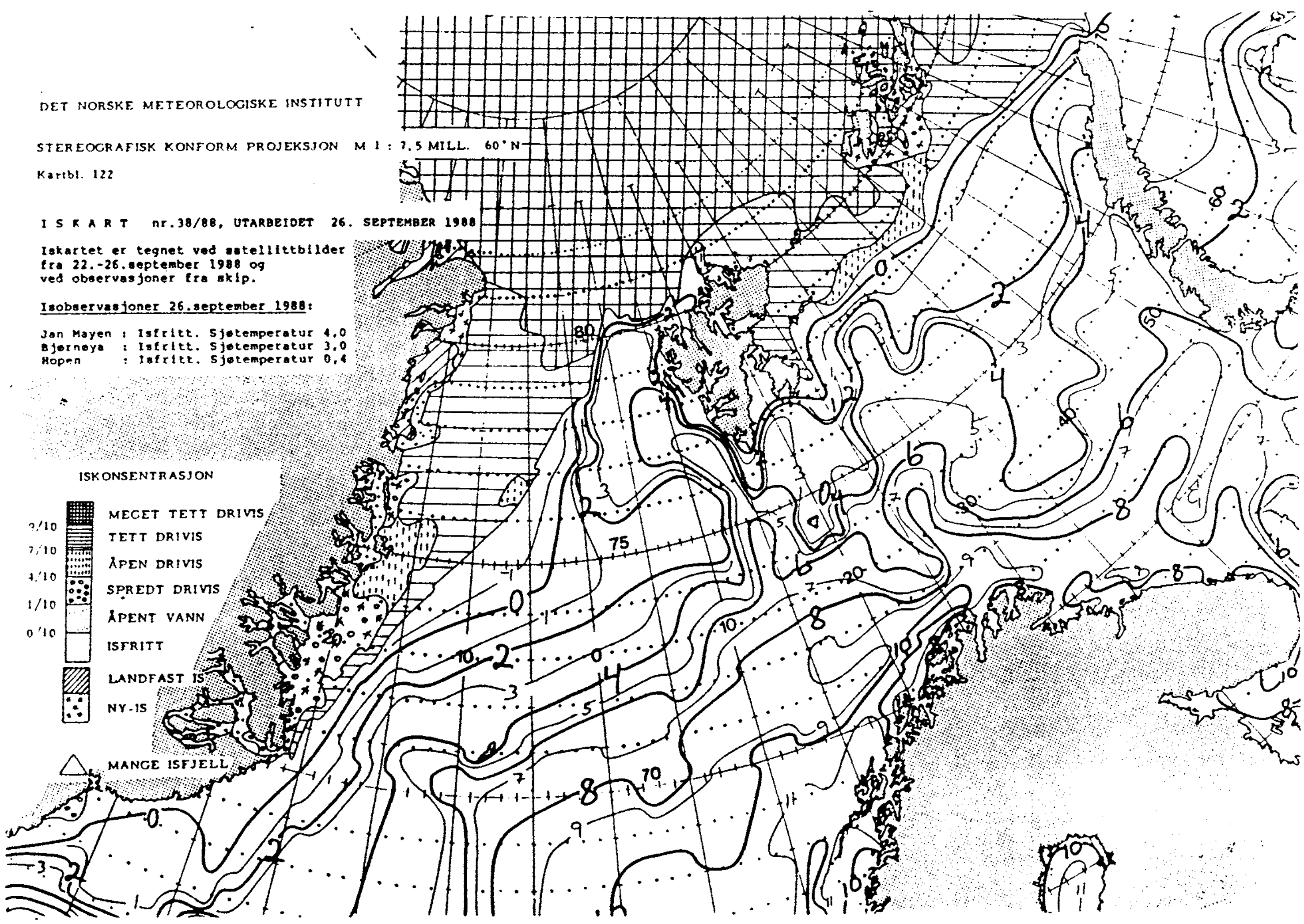
STEREOGRAFISK KONFORM PROJEKSJON M 1 : 7,5 MILL. 60°N
Kartbl. 122
I S K A R T NR. 38/88, UTARBEIDET 19.SEPTEMBER 1988
Iskartet er tegnet ved satellittbilder fra 15.-19.september 1988 og fra skipsobservasjoner.
Isobservasjoner 19.september 1988:
Jan Mayen : Isfritt. Sjøtemperatur 4,4
Bjørnøya : Isfritt. Sjøtemperatur 3,0
Hopen : Isfritt. Sjøtemperatur 1,5
15/9-88 ble det observert 20 isfjell i posisjon : 80,2n 30,4e
Isfjellene var rapportert å være farlige for skipsfarten.
18/8-88 ble det observert 5 isjell i posisjon : 79,2n 28,3e
ISKONSENTRASJON
MEGET TETT DRIVIS
9/10
TETT DRIVIS
7/10
ÅPEN DRIVIS
4/10
SPREDT DRIVIS
1/10
ÅPENT VANN
0/10
ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL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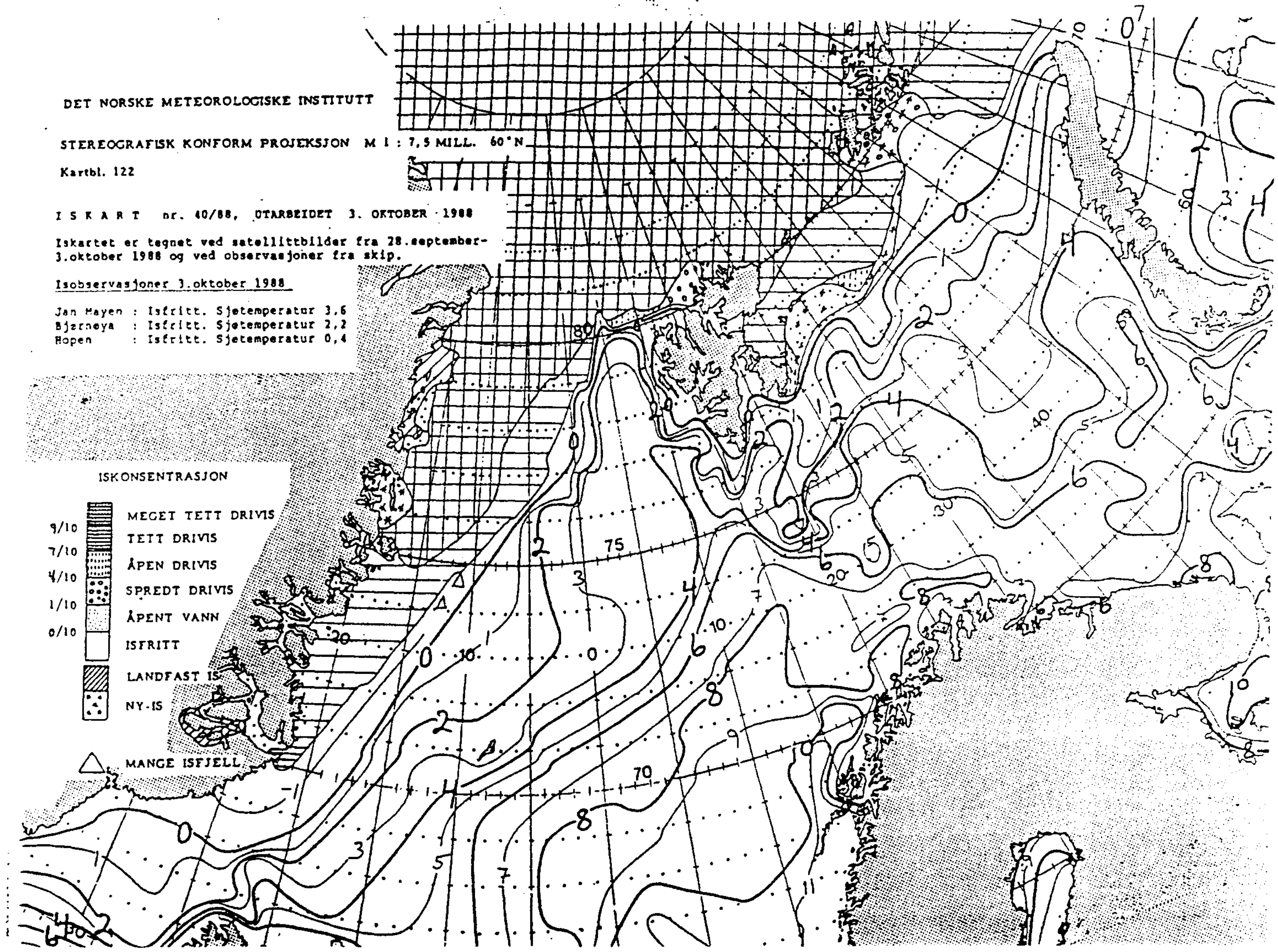
Kartbl. 122
I S K A R T nr.38/88, UTARBEIDET 26. SEPTEMBER 1988
Iskartet er tegnet ved satellittbilder fra 22.-26.september 1988 og ved observasjoner fra skip.
Isobservasjoner 26.september 1988:
Jan Mayen : Isfritt. Sjøtemperatur 4,0
Bjørnøya : Isfritt. Sjøtemperatur 3,0
Hopen : Isfritt. Sjøtemperatur 0,4
ISKONSENTRASJON
MEGET TETT DRIVIS
9/10
TETT DRIVIS
7/10
ÅPEN DRIVIS
4/10
SPREDT DRIVIS
1/10
ÅPENT VANN
0/10
ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL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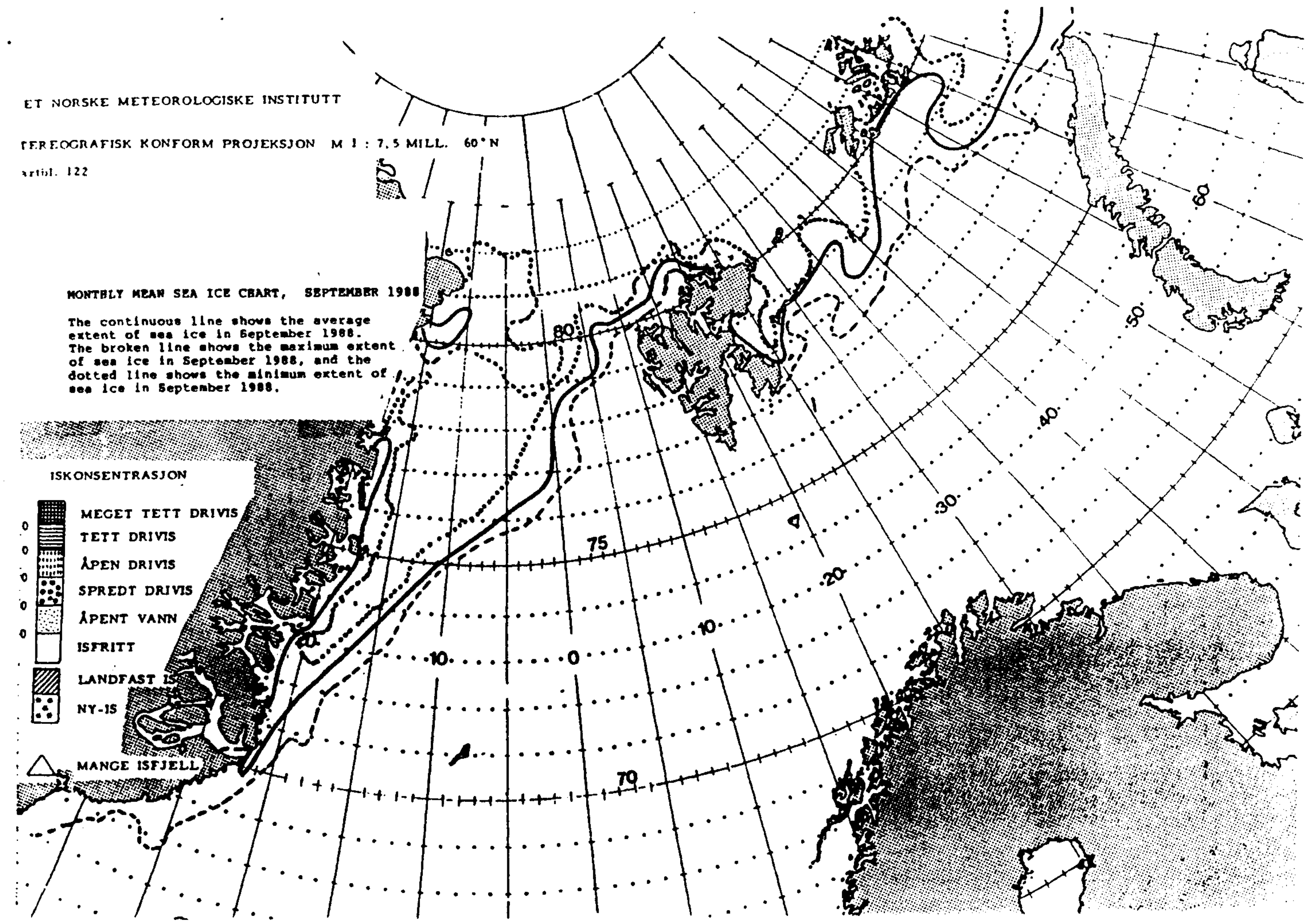
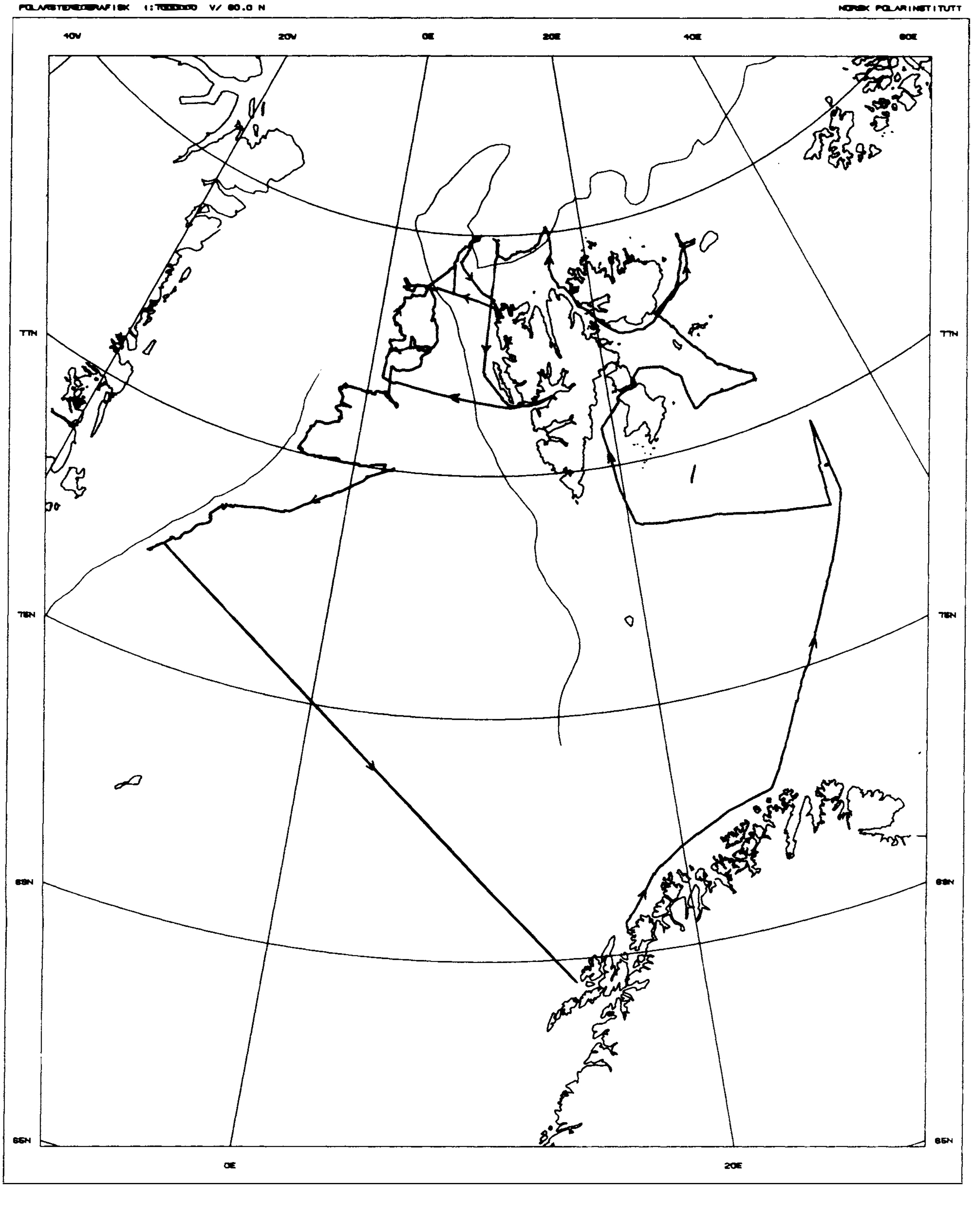
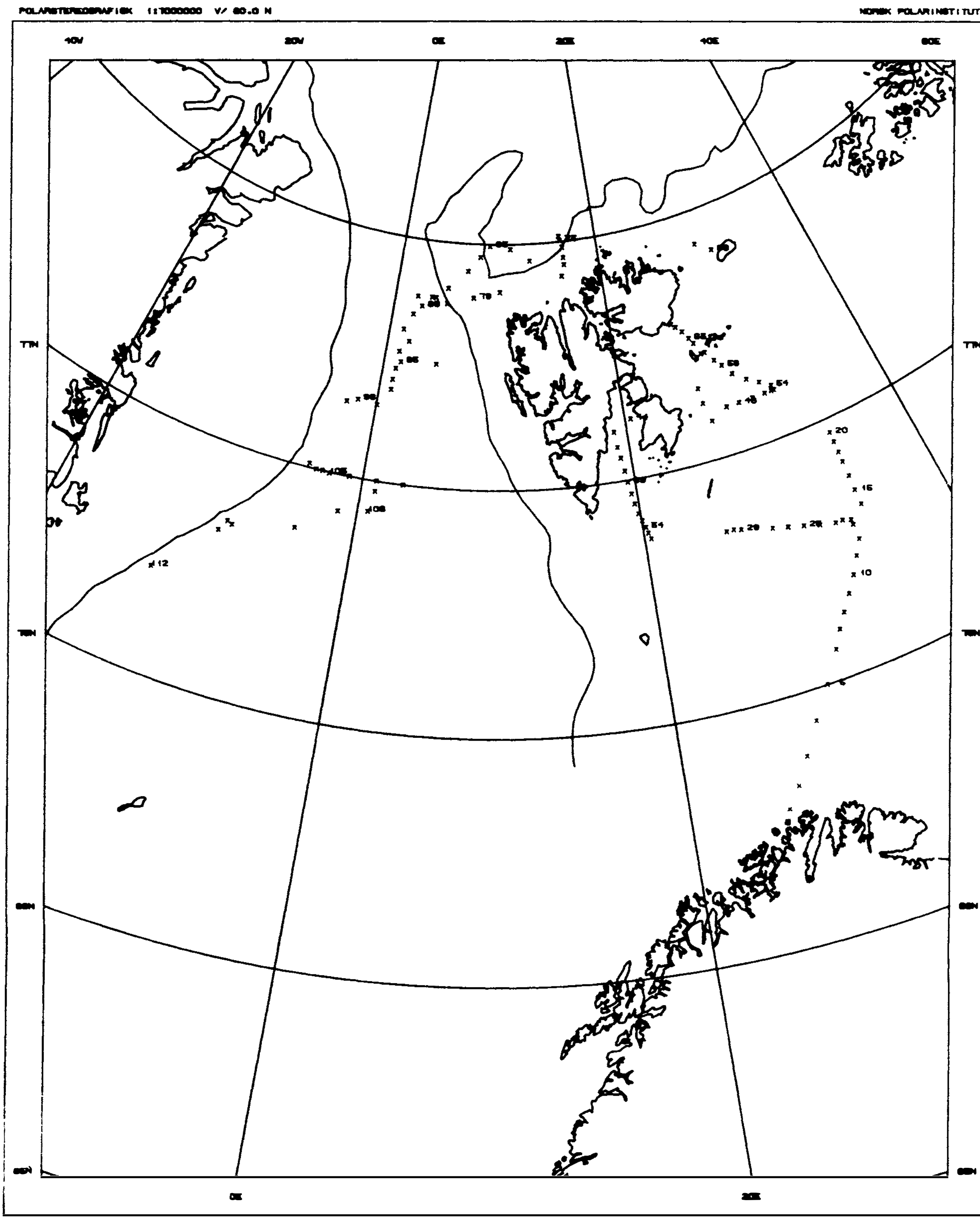
Kartbl. 122
ISKART nr. 40/88, UTARBEIDET 3. OKTOBER 1988
Iskartet er tegnet ved satellittbilder fra 28.september-3.oktober 1988 og ved observasjoner fra skip.
Isobservasjoner 3.oktober 1988
Jan Mayen : Isfritt. Sjetemperatur 3,6
Bjørnøya : Isfritt. Sjetemperatur 2,2
Hopen : Isfritt. Sjetemperatur 0,4
ISKONSENTRASJON
MEGET TETT DRIVIS
9/10 TETT DRIVIS
7/10 ÅPEN DRIVIS
4/10 SPREDT DRIVIS
1/10 ÅPENT VANN
0/10 ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL


ET NORSKE METEOROLOGISKE INSTITUTT
TEREOGRAFISK KONFORM PROJEKSJON M 1 : 7,5 MILL. 60°N
artbl. 122
MONTHLY MEAN SEA ICE CHART, SEPTEMBER 1988
The continuous line shows the average extent of sea ice in September 1988. The broken line shows the maximum extent of sea ice in September 1988, and the dotted line shows the minimum extent of sea ice in September 1988.
ISKONSENTRASJON
MEGET TETT DRIVIS
TETT DRIVIS
ÅPEN DRIVIS
SPREDT DRIVIS
ÅPENT VANN
ISFRITT
LANDFAST IS
NY-IS
MANGE ISFJELL



CRUISE TRACK



STATION POSITIONS

STATION LIST

O: Oxygen sampling; T: Tracer sampling

Stat. no.	Lat.	Long.	Date	GMT	Depth m.	Supplementary observations
0001	71^0 15'N	25^0 00'E	880904	0857	293	
0002	71^0 35'N	25^0 45'E	880904	1200	285	
0003	72^0 00'N	26^0 34'E	880904	1455	263	
0004	72^0 30'N	27^0 35'E	880904	1817	304	
0005	73^0 00'N	28^0 45'E	880904	2150	329	
0006	73^0 29'N	29^0 50'E	880905	0114	379	
0007	73^0 46'N	30^0 25'E	880905	0326	366	
0008	74^0 00'N	31^0 00'E	880905	0513	291	
0009	74^0 15'N	31^0 40'E	880905	0710	237	O
0010	74^0 30'N	32^0 20'E	880905	0919	193	
0011	74^0 46'N	32^0 56'E	880905	1041	120	
0012	75^0 00'N	33^0 30'E	880905	1325	142	
0013	75^0 15'N	33^0 30'E	880905	1511	163	
0014	75^0 30'N	34^0 30'E	880905	1650	175	
0015	75^0 45'N	34^0 30'E	880905	1831	198	
0016	76^0 00'N	34^0 30'E	880905	1956	263	
0017	76^0 15'N	34^0 30'E	880905	2134	283	
0018	76^0 25'N	34^0 29'E	880905	2240	259	
0019	76^0 36'N	34^0 30'E	880905	2350	196	
0020	76^0 46'N	34^0 30'E	880906	0104	143	
0021	75^0 20'N	33^0 30'E	880906	0854	200	O
0022	75^0 23'N	32^0 59'E	880906	1012	214	
0023	75^0 23'N	32^0 30'E	880906	1115	281	
0024	75^0 27'N	31^0 30'E	880906	1300	348	
0025	75^0 32'N	30^0 30'E	880906	1445	377	O
0026	75^0 36'N	29^0 30'E	880906	1640	335	
0027	75^0 40'N	28^0 30'E	880906	1814	272	
0028	75^0 46'N	27^0 30'E	880906	1948	253	
0029	75^0 48'N	26^0 30'E	880906	2134	150	
0030	75^0 50'N	26^0 00'E	880906	2223	117	
0031	75^0 50'N	25^0 30'E	880906	2309	108	
0032	76^0 00'N	20^0 28'E	880907	0554	95	

Stat. no.	Lat.	Long.	Date	GMT	Depth m.	Supplementary observations
0033	76^0 06'N	20^0 20'E	880907	0644	172	
0034	76^0 12'N	20^0 13'E	880907	0732	212	
0035	76^0 19'N	20^0 03'E	880907	0825	251	
0036	76^0 26'N	19^0 53'E	880907	0916	227	
0037	76^0 36'N	19^0 43'E	880907	1028	206	
0038	76^0 46'N	19^0 37'E	880907	1154	152	
0039	76^0 58'N	19^0 30'E	880907	1324	120	
0040	77^0 09'N	19^0 23'E	880907	1440	165	O
0041	77^0 22'N	19^0 15'E	880907	1608	152	
0042	77^0 33'N	19^0 06'E	880907	1737	180	O
0043	77^0 48'N	19^0 02'E	880907	1933	106	
0044	77^0 58'N	20^0 28'E	880907	2140	72	
0045	78^0 11'N	26^0 15'E	880908	1101	231	
0046	77^0 56'N	26^0 18'E	880908	1331	135	
0047	77^0 37'N	26^0 37'E	880908	1616	173	
0048	77^0 46'N	28^0 00'E	880908	1806	202	O
0049	77^0 46'N	29^0 00'E	880908	1929	252	
0050	77^0 46'N	30^0 06'E	880908	2119	260	O
0051	77^0 46'N	31^0 07'E	880908	2304	235	
0052	77^0 46'N	31^0 40'E	880909	0040	186	
0053	77^0 46'N	31^0 54'E	880909	0129	171	
0054	77^0 51'N	31^0 48'E	880909	0326	198	
0055	77^0 58'N	31^0 01'E	880909	0458	255	O
0056	78^0 05'N	30^0 10'E	880909	0651	289	
0057	78^0 15'N	29^0 12'E	880909	0857	343	O
0058	78^0 26'N	28^0 37'E	880909	0909	206	
0059	78^0 33'N	28^0 09'E	880909	1155	189	
0060	78^0 43'N	27^0 36'E	880909	1308	118	O
0061	78^0 43'N	27^0 16'E	880909	1407	75	
0062	78^0 55'N	26^0 54'E	880909	1446	79	
0063	79^0 01'N	26^0 37'E	880909	1651	199	
0064	79^0 09'N	26^0 13'E	880909	1835	258	O
0065	79^0 15'N	25^0 46'E	880909	1949	138	
0066	79^0 19'N	25^0 26'E	880909	2121	107	
0067	80^0 27'N	29^0 46'E	880910	0734	462	

Stat. no.	Lat.	Long.	Date	GMT	Depth m.	Supplementary observations
0068	80^0 16'N	31^0 07'E	880910	1356	146	
0069	80^0 26'N	16^0 10'E	880911	1453	451	
0070	80^0 37'N	16^0 30'E	880911	1628	163	
0071	80^0 44'N	16^0 30'E	880911	1712	524	
0072	80^0 54'N	16^0 28'E	880911	1918	1200	O
0073	81^0 01'N	16^0 16'E	880911	2138	1800	
0074	81^0 05'N	16^0 13'E	880912	0118	2040	O
0075	80^0 43'N	13^0 02'E	880912	1014	1040	O
0076	80^0 55'N	11^0 04'E	880912	1640	1560	O
0077	80^0 13'N	9^0 60'E	880912	2201	586	
0078	80^0 07'N	7^0 28'E	880912	0054	536	
0079	80^0 00'N	4^0 59'E	880912	0356	1124	
0080	78^0 30'N	1^0 00'E	880915	1113	1700	
0081	78^0 40'N	1^0 00'E	880915	1330	2550	O
0082	78^0 51'N	1^0 06'E	880915	1626	2400	
0083	78^0 58'N	1^0 28'E	880916	0803	2490	
0084	79^0 08'N	1^0 12'E	880916	1238	2750	O
0085	79^0 19'N	1^0 55'E	880917	0614	3500	
0086	79^0 30'N	1^0 17'E	880917	1346	3160	
0087	79^0 46'N	1^0 57'E	880917	1753	2890	O
0088	79^0 55'N	2^0 39'E	880918	0503	2760	
0089	80^0 05'N	3^0 53'E	880918	1140	1670	
0090	80^0 15'N	4^0 59'E	880918	1510	823	
0091	80^0 33'N	6^0 48'E	880918	1934	700	O T
0092	80^0 47'N	8^0 00'E	880919	0448	840	
0093	80^0 58'N	8^0 57'E	880919	0824	800	
0094	80^0 05'N	3^0 30'E	880920	1957	2100	O T
0095	80^0 04'N	2^0 08'E	880921	0516	2700	
0096	79^0 00'N	4^0 31'E	880922	1354	2550	O T
0097	78^0 13'N	0^0 06'E	880923	1401	3975	O T
0098	78^0 15'N	1^0 32'E	880923	1847	3000	O T
0099	78^0 11'N	2^0 22'W	880924	1137	2950	T
0100	77^0 04'N	4^0 04'W	880925	1125	1680	O T
0101	77^0 00'N	3^0 30'W	880925	1347	1760	O T
0102	77^0 00'N	3^0 00'E	880925	1636	2750	O T
0103	76^0 59'N	2^0 30'W	880925	2006	3045	T

Stat. no.	Lat.	Long.	Date	GMT	Depth m.	Supplementary observations
0104	77^0 00'N	1^0 00'E	880926	0128	3270	
0105	77^0 00'N	1^0 02'W	880926	0710	3270	
0106	77^0 00'N	3^0 00'E	880926	1249	3050	O T
0107	76^0 50'N	1^0 02'E	880926	1816	3300	
0108	76^0 30'N	0^0 45'E	880926	2256	3150	
0109	76^0 25'N	1^0 20'W	880927	0159	2800	
0110	76^0 00'N	4^0 00'W	880927	0840	3540	O T
0111	75^0 37'N	8^0 51'W	880928	0935	2400	O T
0112	74^0 41'N	12^0 07'W	880929	0828	2400	O T
0113	75^0 46'N	8^0 07'W	880929	2321	2190	O T

OCEANOGRAPHY

The oceanography programme for the 1988 cruise in the Barents Sea and in the Fram Strait had three main objectives:

1. Study the inflow of Atlantic Water to the Barents Sea, its interaction with low salinity Arctic Waters and its transformations due to local atmospheric forcing.

2. Study the water mass characteristics on the northern Barents Sea shelf, in the Polar basin and in the Fram Strait.

3. Estimating the transports through and the recirculation and mixing in the Fram Strait.

The programme was a cooperation between NP and IFM, Hamburg and LODYC, Paris VI. The work with Hamburg is a continuation of previous joint studies of the climatological aspects of the circulation in the northern seas. The rosett sampler used on the expedition was provided by IFM, and personell from Hamburg conducted the oxygen analysis.

The programme together with LODYC is an initial effort of a Norwegian-French cooperation in studying the circulation and mixing in the Fram Strait. The programme consisted of CTD observation, sampling of ^{18}O,^{3}H and ^{3}He and the deployment of SOFAR floats. The floats should follow the circulation of Atlantic Water and were launched from R/V CRYOS in August, when that vessel operated in the ice free waters of Fram Strait. The plan was that LANCE should continue the CTD and tracer survey in the ice covered part.

In addition to the French tracer programme which was designed to study the interaction between the Atlantic and the Polar Surface Water in the upper 500 m, ^{3}H and ^{18}O samples were to be collected in the deep and bottom waters of the Barents Sea and the Polar Ocean for the University of Miami.

PERFORMANCE

The first part in the Barents Sea went smoothly and several sections were obtained between the main banks, the mainland and Svalbard and in Storfjorden (fig. 2). It was originally planned to enter the Polar Ocean east of Kvitøya and work west towards the Fram Strait. This was not possible because of the ice conditions. Only two stations were taken between

Storøya and Kvitøya after which LANCE had to return and go north through Hinlopen. Again the ice conditions were such that the ship could not penetrate so far north that the deep basin could be reached.

The ice situation was even worse in the Fram Strait. A closely spaced meridional section was occupied. Because of the ice the section which initially started at $78^0 30'$N and 1^0E was deflected towards the east and reached the Nansen Ridge.

It was not possible to complete the zonal sections started by CRYOS at $80^0 05'$N and $78^0 30'$N. Several efforts were made further to the south to reach the Greenland shelf but none were successful and the sections taken along $80^0 05'$N, $78^0 15'$N and 77^0N as well as an oblique section across the Hovgaard Fracture zone all ended east of or at the deeper parts of the Greenland slope.

The equipment worked well throughout the cruise except for the CTD winch. On the first part in the Barents Sea the connection at the slip-rings was defective and at the end of the cruise the brake jammed. At both instances the winch could be repaired with the assistance of the crew and only small interruptions in the observation programme were necessary.

113 hydrographic stations were occupied. 65 in the Barents Sea and the rest north of Svalbard and in the Fram Strait. Oxygen sampling was done on 31 stations and 15 tracer stations with in all 123 samples were taken in the Fram Strait. The original tracer program, focussing on the processes in the upper 500 m had to be changed to also accomodate sampling in the deeper layers, especially of water masses with the T-S characteristics of the Polar Ocean.

PRELIMINARY RESULTS

In the Barents Sea warm Atlantic Water was found not only in the Hopen Deep and in the passage between Sentralbanken and Storbanken but was also in the deeper parts of the northern sections. This indicates a flow of Atlantic Water from the south into the northern Barents Sea across the sill between Edgeøya and Storbanken.

The bottom water on the slope of Sentralbanken was cold and dense. The low temperature and the position high on the bank suggest that it is locally formed by freezing during winter.

It then slides down the slope and penetrates into and under the warmer Atlantic Water. This water was, apart from the extremely saline water found in Storfjorden, the densest water observed in the Barents Sea.

The high salinity (35.46) in Storfjorden is the result of freezing and the accumulation of brine enriched water over shallow, weakly ventilated areas.

A temperature minimum, found in the northern Barents Sea between 100 and 140 m, indicates that the winter convection generally does not reach the bottom but stops above a warmer but much diluted Atlantic layer.

The stations north of Svalbard showed a bifurcation of the Atlantic inflow to the Polar Ocean. One branch follows the Svalbard coast towards the east, while another branch continues northward along the western slope of the Nansen Ridge.

In the Fram Strait two high salinity waters were found close to the Greenland Slope - one at about 1200-1500 m, the other at 2000-2300 m. These waters most likely derive from the Polar Ocean, the warmer from the Canadian, the colder from the Eurasian basin. This is supported by the low oxygen content of these water masses.

Especially the Canadian basin Deep Water, was confined to the Greenland Slope. However, intrusions of colder, fresher waters were observed on most of the stations and cold, fresh waters dominated on the deep stations in the Boreas and Greenland Sea basins.

On the meridional section, which passed through the Molloy topographic area latitudinal variations of the water mass distribution were clearly seen. Eurasian Basin Deep Water was found to the north and on the eastern/northern slopes of the sea mountains while the Greenland Sea Deep Water was present to the south and on the south and west slopes. Surprisingly, deep waters with Polar characteristics were also found close to the Nansen Ridge, far to the east in the Fram Strait, an area where a northward flow of Norwegian Sea Deep Water was expected.

SEA ICE INVESTIGATIONS

PROGRAMMES

1) Deployment of moorings in the Northern Barents Sea for long term registrations of ice thickness and currents.

2) Ice floe topography investigations for estimation of the interrelations hips between top and bottom features for frictional studies and for estimation of the pooling capacity of oil under ice.

3) Systematic spesification of the ice conditions along the track as part of a long term observation programme.

4) Test of a continous ware radar for ice thickness measurements.

PARTICIPANTS

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FIELD WORK

Moorings.

Two moorings were deployed at the following satellite-fixed position:

$77^0 37'N - 26^0 44'E$ and $77^0 44'N - 31^0 50'E$.

The first mooring was deployed 8 September at 1550z at a depth of 172 m. A Chr. Michelsen Institute upward looking sonar (ULS) was mounted on the top of the mooring at a depth of about 50 m below the surface. An Aanderaa RCM current meter was inserted 20 m above the bottom.

The second mooring was deployed 9 September at 0215z at a depth of 161 m. A Mesotech ULS and an Aanderaa current meter were mounted at the depths given above.

The two ULS's record the ice draft every four minutes while the RCM's record the current speed and direction every 30 and 60 min. respectively. The moorings will be retrieved after one year.

ICE FLOE TOPOGRAPHY

The surface topography of altogether 14 multi-year ice floes were measured with the aid of a theodolite at about 100 points for each floe. The bottom topography was measured with a Mesotech 971 scanning sonar device for 10 of the 14 ice floes. The sonar head was lowered to a depth of 14 m below the ice surface through a hole drilled near the center of each floe, and scannings were made for each 5^0. A 300 m long cable connected the sonar head with the registering and commanding units onboard the ship. The sonar profiles indicated occasionally that ice floes 3-5 m thick had been forced underneath the multi-year floes we surveyed. This in agreement with reports from the divers and has also been observed on several occasions previous years. As the thickness of the ice blocks in the ridges generally is below half a metre, this suggests that pressure in a multi-year ice field may be released by rafting instead of ridging. This could explain the special sub-surface pattern observed under multi-year ice from a submarine using a side scan sonar (Wadhams 1988).

TEST OF RADAR

Altogether five ice floes were surveyed by the NTNF. PFM continous wave radar along transects profiled by the scanning sonar and the theodolite. The radar was also tested outboard from a winch along the trach of the ship. Fifteen radar runs were made altogether.

A later soft-ware filtering of the structure of the return signals will be compared with the measured ice thickness profiles for intercomparison of the two methods.

ICE CONDITIONS

Ice observations were taken according to the WMO ICEOB code. No winter ice was encountered in the areas of investigation. Second-year ice was predominant along the route in the Northern Barents Sea, while 3-5 m thick multi-year ice was observed along the ice edge in the Greenland Sea. Large (500 - 2000 m) and medium (100 - 500 m) ice floes of multi-year ice was encountered in the Fram Strait and north of

Svalbard. Otherwise the ice fields consisted of small (20 - 100 m) floes.

The formation of new ice started the 16 September while we operated west of Svalbard. Extensive areas were after a couple of days covered with grey and grey-white ice (10 - 30 cm) and hampered a further west-ward navigation between the 3-5 m thick multy-year ice floes. The air temperature was then between 10 and 20 deg. below zero. Compared with the previous years since 1980, the general impression is that the 1988/89 freezing season started with a relatively large amount of thick multi-year ice both in the Barents and the Greenland Seas.

As much as 89 icebergs were observed grounded along the eastern coast of Edgeøya, 9 in the western part of Kong Karls Land, 8 north of the western part of Kvitøya and 10 in the southern entrance to Hinlopenstretet. Free floating icebergs (3) were observed in the southern part of Olga-stretet only. About 50% of the altogether 119 spotted icebergs were characterized as small, i.e. < 50 across. The largest one observed was tabular in form and free floating. It measured 120 m across and had a height of 15 m. Totally, only a few percent of the 119 icebergs had a tabular form.

Salinity and density profiles were determined for 5 and 14 ice floes, respectively.

CRUISE-REPORT FROM PROJECT:

ICEFAUNA (SYMPAGIC FAUNA) IN THE ARCTIC

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INTRODUCTION

Sympagic organisms are organisms living in the sea ice environment. They may be divided in two main groups: an autochtonous group (living constantly near or in the undersurface of the ice) and an allochtonous group (living there temporarily). The most conspicuous sympagic organisms are amphipods, but other groups (among them copepods, polychaetes and fish) have also been recorded. The sympagic fauna functions as an important trophic link between primary production (ice-algae, phytoplankton) to marine mammals and seabirds.

The main object on the cruise with Lance in September 1988 was to study the distribution and abundance of sympagic fauna in the Barents Sea and the Fram Strait, its dependency upon ice for survival (autochtonous/allochtonous), and the relationship between the sympagic fauna and the age and history of its ice substrate.

SAMPLING

The collection of sympagic organisms was performed using SCUBA-equipment from the edge of ice-floes or through holes in the ice. Quantitative samples were collected using either a suction-sampler for predetermined time-intervalls or by scraping a plankton net with a quadrate frame a known distance (20m) along the undersurface of the ice. The technique used were dependent upon the morphology of the subsurface of the ice.

A total of 20 sampling stations were visited (Table 1). Collected invertebrates were either fixed in 80 % alcohol or frozen. The samples will be treated in a land-based laboratory. (Weight determinations cannot be done on LANCE due to vibrations in the ship.) The lab-treatment will among others include identification of the different species, determination of sex and developmental stage, weight-determinations and biochemical analyses (lipid-content, calorific values).

DISCUSSION

This cruise with Lance was the eleventh (and probably the last) for collection of field data for the project. Earlier cruises has mainly taken place in spring and summer. This autumn cruise supports the hypothesis that there is an autochtonous sympagic fauna with the highest diversity and density in multiyear ice. The occurrence of the sympagic fauna decreases rapidly with melting of the ice. The most conspicuous species in the sympagic fauna is the amphipod Gammarus wilkitzkii which undoubtedly is autochtonous. The amphipods Apherusa glacialis and Onisimus spp. were also quite common in the samples. These three species have also in general been the dominant species on earlier cruises. The ecologically very important amphipod Parathemistho libellula were quite common between the ice-floes. P. libellula is allochtonous species eating smaller sympagic fauna in ice-covered waters.

A new experience on this cruise was the frequent occurrence of a polynoid polychaete and the amphipod Gammarocanthus sp. A harpactoid copepod was also more common than on earlier cruises. There were no mats of ice-algae below the ice in September, and the ice-algae recorded were only scattered clumps frozen into the ice.

An important goal for the project on this expedition was to collect samples from multiyear ice before melting of the subsurface had taken place. Sampling in such ice would give maximum values for density of sympagic fauna in the polar pack-ice. A cruise-plan was prepared before the cruise started. Unfortunately, the cruise-plan for ice-covered waters could not be followed, and most sampling had to take place below melting ice along the ice-edge. This was a great disappointment for the project.

Table 1. LIST OF STATIONS AND COLLECTED MATERIAL.

SS= quantitative samples with suction-sampler
S = quantitative samples using scraping technique
N = vertical net hauls using a 500 micron WP-2 type net.
(n) = no of samples

STATION No.	CTD STATION No.	DATE	POSITION	TASK (n)
01	063	09.09	N79°01' E26°37'	SS(3)
02	064	09.09	N79°10' E26°13'	N
03	065	09.09	N79°15' E25°40'	N
04	066	09.09	N79°19' E25°25'	N
05	067	10.09	N80°28' E29°46'	SS(8)
06		10.09	N80°13' E31°05'	SS(5),S(5)
07		12.09	N81°04' E16°12'	SS(3),S(2)
08		12.09	N80°43' E13°02'	SS(5)
09		12.09	N79°53' E10°50'	SS(4)
10	083	16.09	N78°57' E01°27'	SS(9),S(3)
11	084	16.09	N79°09' E01°11'	SS(10)
12	085	17.09	N79°21' E01°55'	SS(7)
13	086	17.09	N79°30' E01°16'	SS(6)
14	088	18.09	N79°55' E02°39'	SS(5)
15	089	18.09	N80°05' E03°52'	SS(4)
16	093	19.09	N80°57' E08°56'	SS(6)
17	-	21.09	N80°02' E01°46'	SS(3)
18	096	22.09	N79°03' E03°00'	SS(5)
19	097	23.09	N78°12' E00°02'	SS(2)
20	-	23.09	N78°12' W02°21'	SS(2)