

JOINT



REPORT

**PRELIMINARY RESULTS OF THE JOINT  
RUSSIAN - NORWEGIAN AIRBORNE  
RESEARCH OF THE BARENTS SEA  
IN SEPTEMBER - OCTOBER 2002**



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**Joint IMR–PINRO report**

**PRELIMINARY RESULTS OF THE JOINT RUSSIAN-NORWEGIAN  
AIRBORNE RESEARCH OF THE BARENTS SEA  
IN SEPTEMBER-OCTOBER 2002**

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## **Introduction**

Data available to the present day on the abundance and distribution of marine mammals in the Barents Sea, primarily on the ichthyophagous species (harp seal and cetaceans) as well as on seabirds, mostly resulted from vessel-based observations. Unfortunately, these data are often separate and not systematised. However, these data could improve understanding of the interactions between marine predators and commercial fish species, including capelin.

A research programme has been underway since September 2002 jointly by PINRO (Russia) and Bergen Institute of Marine Research (Norway), with the participation of specialists from the Norwegian Institute of Fisheries and Aquaculture (Fiskeriforskning) and University of Tromsø (Anon., 2002). The design of the field work for 2002 took into account the experience of 2001. Moreover, specialists from Canada, Australia and Sweden were involved in the airborne surveys from the Norwegian side. Both Russian and Norwegian sides financed the research equally.

An important aspect of the airborne research described here was that it was conducted concurrently with the annual, vessel-based survey for capelin and other pelagic fishes of the Barents Sea. In 2002, research vessels participated in those works were “Johan Hjort” and “G.O. Sars” from Norway, and “AtlantNIRO” and “F. Nansen” from Russia. The aim of the project in 2002 was to assess the relationship between the distribution of marine mammals and capelin, data which could then be used as input into simulations of Barents Sea ecosystem.

## **Materials and methods**

Aerial surveys were carried out from AN-26 “Arktika”, a Russian specially equipped flying laboratory (Figure 1). While in flight, materials and data were obtained concurrently on a number of variables describing the marine environment, using almost continuous instrumental records in optical (LIDAR, photo- and video, including digital video), IR (radiometry and scanning) and VHF (radiometry and radar) electromagnetic wavebands, as well as during visual observations (Anon., 2002).

Aerial surveys in 2002 were scheduled for the period from 20 September to 11 October. This timing was determined from previous experience in the region, and oceanographic conditions, (including ice) and meteorological conditions. The aerial survey covered northern and central Barents Sea, from the Spitsbergen to the Franz Josef Land (FJL) (Figure 2), i.e. the same area that is annually surveyed by vessels carrying out researches into capelin and other pelagic fishes in the Barents Sea. The lines flown during the aerial survey are presented in Figure 2.

All information obtained during the aerial survey in real position and time was loaded into computer onboard, saved and printed at a given interval as a record of the flight. Preliminary processing and analysis were carried out onboard the flying laboratory during the journey back to Longyearbyen at the end of each flight. After the completion of each flight the results were presented in a form of GIS-maps, demonstrated in Figure 3 and tables.

While preparing the airborne survey, as well as when doing the survey, information was exchanged with RVs “F. Nansen”, “AtlantNIRO”, “Johan Hjort” and “G.O. Sars”.

During the aerial survey 9 flights were completed, preliminary results for these are given below. All the flights started from Longyearbyen airport, Spitsbergen. Information on each aerial survey including the required materials and data was expeditiously presented to both PINRO and Norwegian scientists including those onboard research vessels while they were making survey at sea.

The main results of each research flight is presented in Fig. 8-16 and Tables 1 and 2.

## **Discussion**

Meteorological conditions affected the quality of data obtained on the surveys, so quantitative analyses of the survey results are not possible. It is worth noting that the distinctive feature of this year compared to the last one was more southerly location of the ice edge, by 300 km on the average (Figure 2 and 4). With this, sea surface temperature (SST) in 2002 was 2.0° - 2.5°C below than that in 2001 over the same areas and for the same period of time, although the SST anomalies were positive and ranged from 0.8° to 1.5°C.

During the aerial surveys a number of local aggregations of marine mammals and seabirds as well as a few capelin schools were observed (See an example in Figure 3 and 4). Figure 5 to 7 show general spatial distribution of seabirds, chlorophyll and water transparency over the study area along with distribution of the capelin concentrations by density based on the vessel surveys.

During the flight on 20 September done over the area to the east of Spitsbergen and Hopen Island, the largest number of marine mammals and seabirds was observed between 75°00′/24°30′ and 79°00′/30°00′ (Figure 3). This aggregation consisted of a few local groups and in general as is seen from the figure was quite extensive from the north to the south. The depth of optical inhomogeneity from data of LIDAR sounding varied from 4 m to 20 m. With this, their maximal frequency of occurrence was noted between 77°30′/27°30′ and 78°50′/29°45′. Judging by the character of signals they were most likely subsurface sites of highly concentrated microorganisms.

Capelin schools were noted on the site, the centre of which was positioned at 76°18′/33°35′. Here, stable and extended LIDAR signals from optical inhomogeneity, where aggregations of whales and birds were recorded. A vessel-based acoustic survey indicated the presence of a large concentration of capelin (Figure 4-7).

The aerial survey of 21 September over the northern Barents Sea, from the northern coast of the Spitsbergen archipelago to the shores of the Franz Josef Land was done mostly in the near edge zone and on the sites of drift ice of different compaction, age and form. Maximum counts of marine mammals and birds were made at ice edge. Mostly they were harp seals (1333 individuals were counted) as well as walruses and white whales. In areas adjacent to the southwestern Franz Josef Land, over the area free of ice and directly at the ice edge several sightings of whales, dolphins and killer whales were recorded. Earlier (about 7 days) when

carrying out a survey by vessel in this area, concentrations of capelin and polar cod were observed (Figure 4).

Aerial surveys of 26 and 27 September were done to the south and east of Spitsbergen in the areas adjacent to the archipelago. There, groups of whales and dolphins were observed in the coastal zone. Their location coincided with capelin and polar cod concentrations found while doing trawl-acoustic surveys (TAS) by vessels (Figure 4). To the south of Spitsbergen several separate aggregations of cetaceans were observed.

The depth of optical inhomogeneity from data of LIDAR sounding ranged from 6 m to 35 m at the maximum frequency of occurrence at the sites between  $75^{\circ}30' / 19^{\circ}38' - 75^{\circ}30' / 18^{\circ}46'$  and  $75^{\circ}00' / 19^{\circ}15' - 75^{\circ}00' / 17^{\circ}08'$ . With the account for thermohydrodynamical features observed here, on those sites one should have expected high concentrations of prey microorganisms in the subsurface layer at these depths.

Flights done on 3 to 7 October surveyed the near edge zone of drift ice from the Spitsbergen archipelago to the FJL under conditions of fast ice formation and shift of the ice edge southwards. Analysis of the thermal process dynamics on the sea surface of the aerial survey area indicated that the pace of cooling here was high. Thus, compared to 20 September, SST in the northern surveyed area decreased by  $1.0^{\circ}$ - $1.2^{\circ}\text{C}$  on the average.

In the near edge zone, in the ice-free waters aggregations of seabirds and groups of whales were found. Directly in the ice zone and at the ice edge with compaction of 1-2, numerous groups of harp seals were observed, estimates of the abundance of which varied from a few individuals to hundreds.

Aerial surveys on 10 and 11 October in the areas of Persey and Central elevations as well as in the Hope Island area, the eastern slope of the Bear Island Bank and Western Deep recorded sightings of marine mammals and seabirds in some areas where RV "Johan Hjort" during the trawl acoustic survey found substantial concentrations of capelin (Figure 4-5).

Using LIDAR during aerial survey allowed us to record data on spatial distribution of chlorophyll and water transparency. This information along with data on capelin distribution is given in Figure 6 and 7. Preliminary analysis of these materials suggests that there is some relationship between distribution of these ecological measurements describing the sea surface and distribution of capelin. Taking into account that this paper has no purpose to study it thoroughly and comprehensively we will not consider that in detail. However, in future such investigation is planned.

During the aerial survey, sightings of Atlantic walrus, polar bear, ringed seal and bearded seal were recorded.

## Conclusions

The conclusions given below are preliminary and will be refined after detailed processing of materials and data gained.

1. Large aggregations of harp seals were observed mostly in the near ice-edge zone, which was north of the distribution of capelin.
2. Aggregations of other marine mammals were recorded in the areas to the south and southeast of the Spitsbergen archipelago, where data from vessel surveys showed a high biomass of capelin.
3. Data from this survey indicate that there is a relationship between distribution of capelin, and marine mammals and seabirds. Hence, materials and data on distribution of marine mammals and birds acquired during the aerial surveys are consistent with data from vessel-based surveys for capelin and other pelagic fish, and in some cases refine or supplement them.

Cooperation and expeditious exchange of data between airborne and vessel surveys are of particular importance when doing aerial research, as it is not always possible to identify a food item in the areas of aggregations of marine mammals and seabirds. Airborne survey allows detecting rather precisely and quickly the potential prey concentrations, primarily capelin that is close to the sea surface, as well as observing marine mammals.

## Acknowledgements

Participants of the expedition from both countries would like to take the opportunity to thank the crew and technical specialists of the flying laboratory AN-26 “Arktika”. Without the professional expertise of these people, this research would be impossible.

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**Table 1**

**Overall Amount of Biological Objects Observed and Their Recurrence During Carrying out of Air Research in the Barents Sea (September-October 2002)**

Flight Number	Distance and Time on Survey Altitude		Biological objects										
	hours	km	Fish schools (capelin)	Seabirds	Whales	Killer Whales	Dolphins	Beluga Whales	Harp Seals	Ringed Seals	Bearded Seals	Walrus	Polar Bears
9	42.83	12828	3	71537	160	65	423	41	2728	13	2	56	21
Recurrence:		1000 km		5577	12	5	33	3	213	1		4	2

**Table 2**

**Biological Objects Observation Results During Carrying out of Air Research in the Barents Sea (September-October 2002)**

Date	Biological objects														Total	
	Dolphins	Fish schools (capelin)	Harp Seals	Killer Whales	Minke Whales	Fin Whales	Sperm Whales	Humpback Whales	Unidentified Whales	Polar Bears	Beluga Whales	Walrus	Ringed Seals	Bearded Seals	Seabirds	
20.09.2002	89	2	1	25	4	0	0	3	11	0	0	0	0	0	11543	11678
21.09.2002	21	0	1333	13	2	0	0	1	1	9	12	50	12	1	2015	3470
26.09.2002	91	0	0	8	3	0	0	1	0	0	0	0	0	0	5307	5410
27.09.2002	12	0	1	2	6	0	0	4	1	0	1	0	1	0	13550	13578
03.10.2002	0	1	1057	0	8	1	0	15	6	8	2	3	0	1	18029	19131
04.10.2002	0	0	215	0	1	0	0	2	1	0	25	0	0	0	4422	4666
07.10.2002	0	0	21	17	0	0	0	0	0	4	0	3	0	0	1811	1856
10.10.2002	209	0	100	0	0	0	0	0	0	0	1	27	0	0	10168	10505
11.10.2002	1	0	0	0	0	2	1	1	4	0	0	0	0	0	4692	4701

## Destination and symbols




























	Flight course
	Dolphin
	Killer Whale
	Whale
	Ringed Seal
	Harp Seal
	Seal
	Beluga Whale
	Bearded Seal
	Walrus
	Polar Bear
	Fish School
	Jellyfish
	Seabirds
	Sea Surface Temperature
	Front
	Sliks
	Eddy
	Meander
	LIDAR signals from optical inhomogeneity
	Ice edge
	Ice edge
	Iceberg
	Buoy
	Oil derrick
	Vessels
	



Figure 1. Flying laboratory AN-26 "Arktika", Longyearbyen, Spitsbergen.

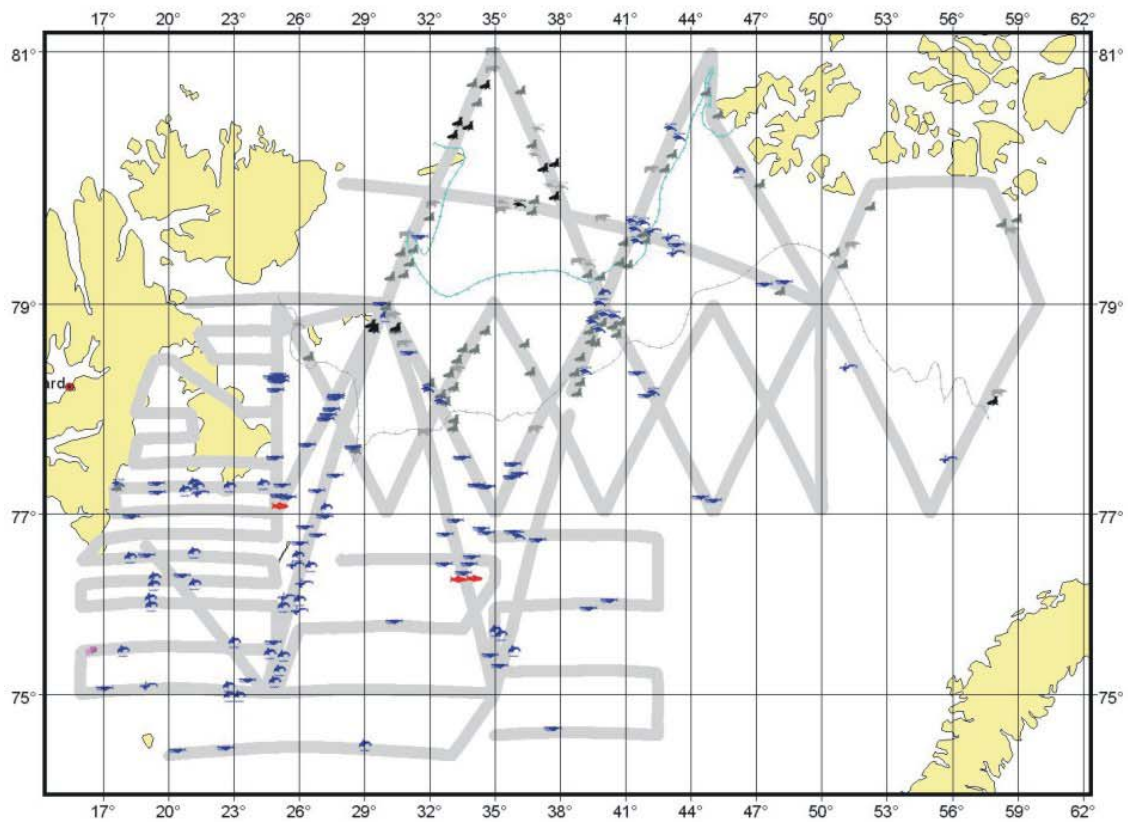


Figure 2. Air routes of the surveys done from 20 September to 11 October and distribution of marine mammals along the routes.

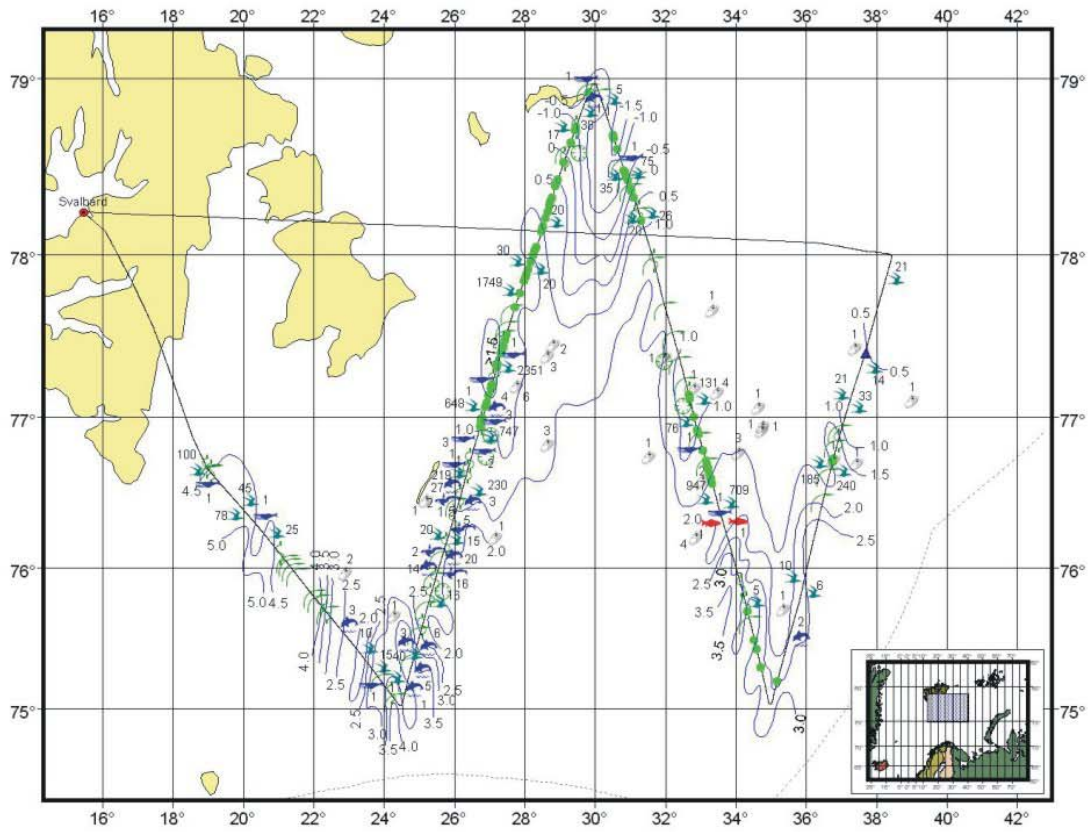


Figure 3. Resulting GIS-map of the flight on 20 September 2002.

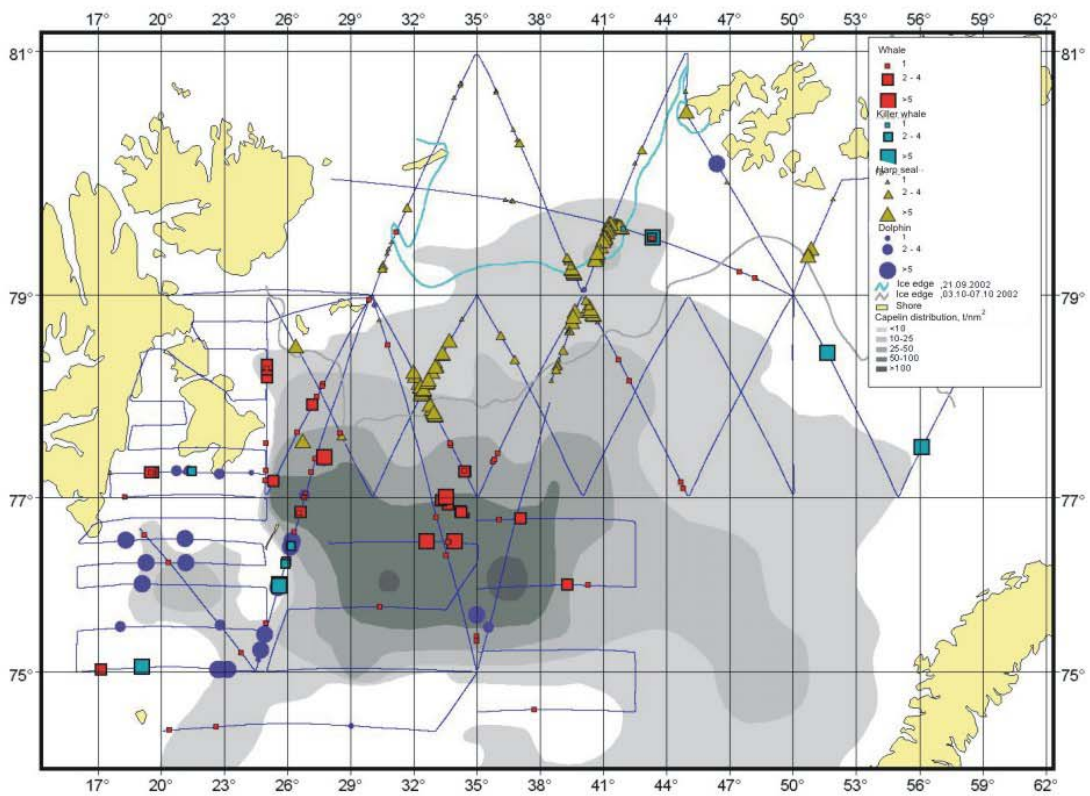


Figure 4. Distribution of marine mammals resulted from airborne surveys (September-October) and capelin distribution from vessel survey data (August-September) in 2002.



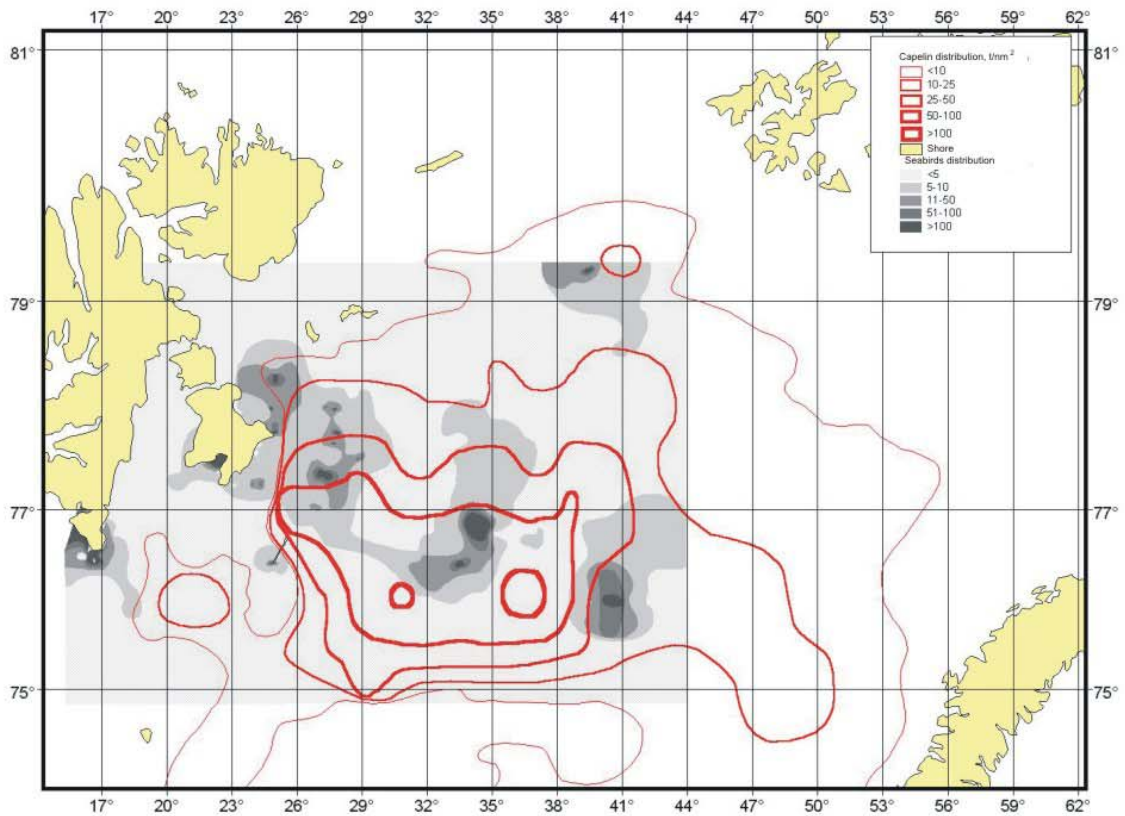


Figure 5. Distribution of seabirds as shown by aerial surveys (September-October) and capelin distribution from vessel survey data (August-September) in 2002.

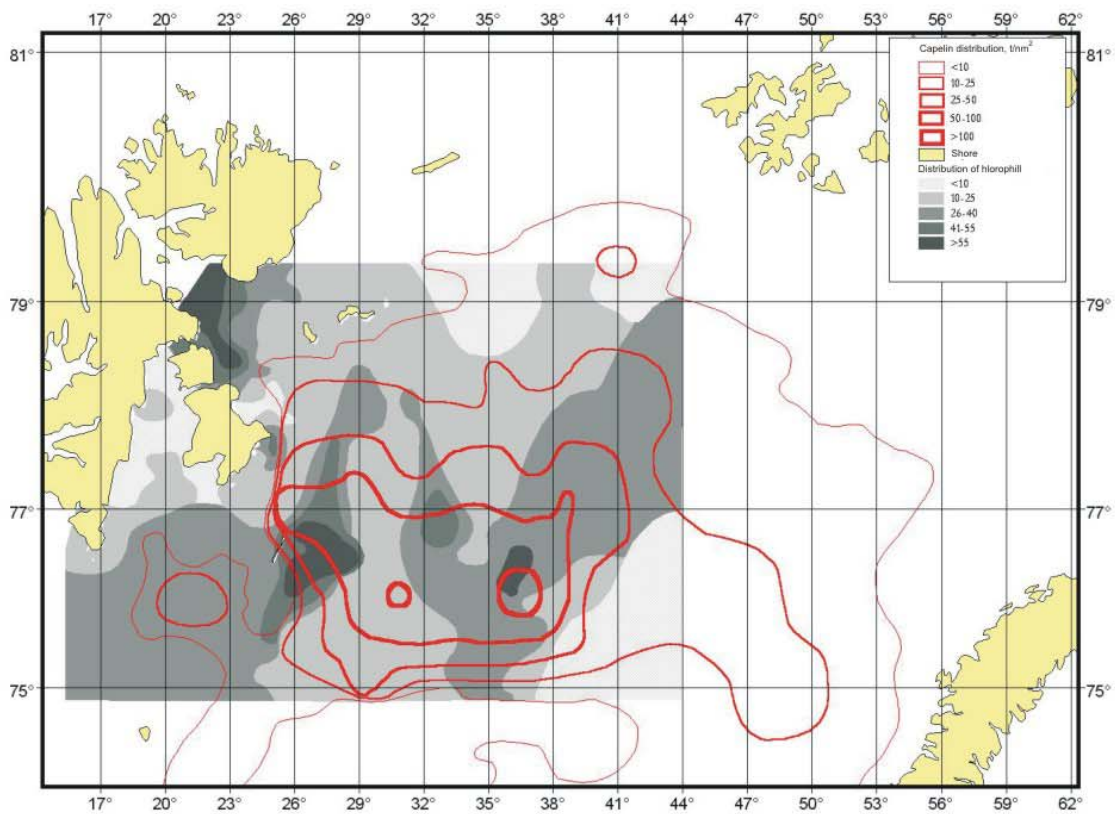


Figure 6. Distribution of chlorophyll from airborne survey data (September-October) and capelin distribution from vessel survey data (August-September) in 2002.

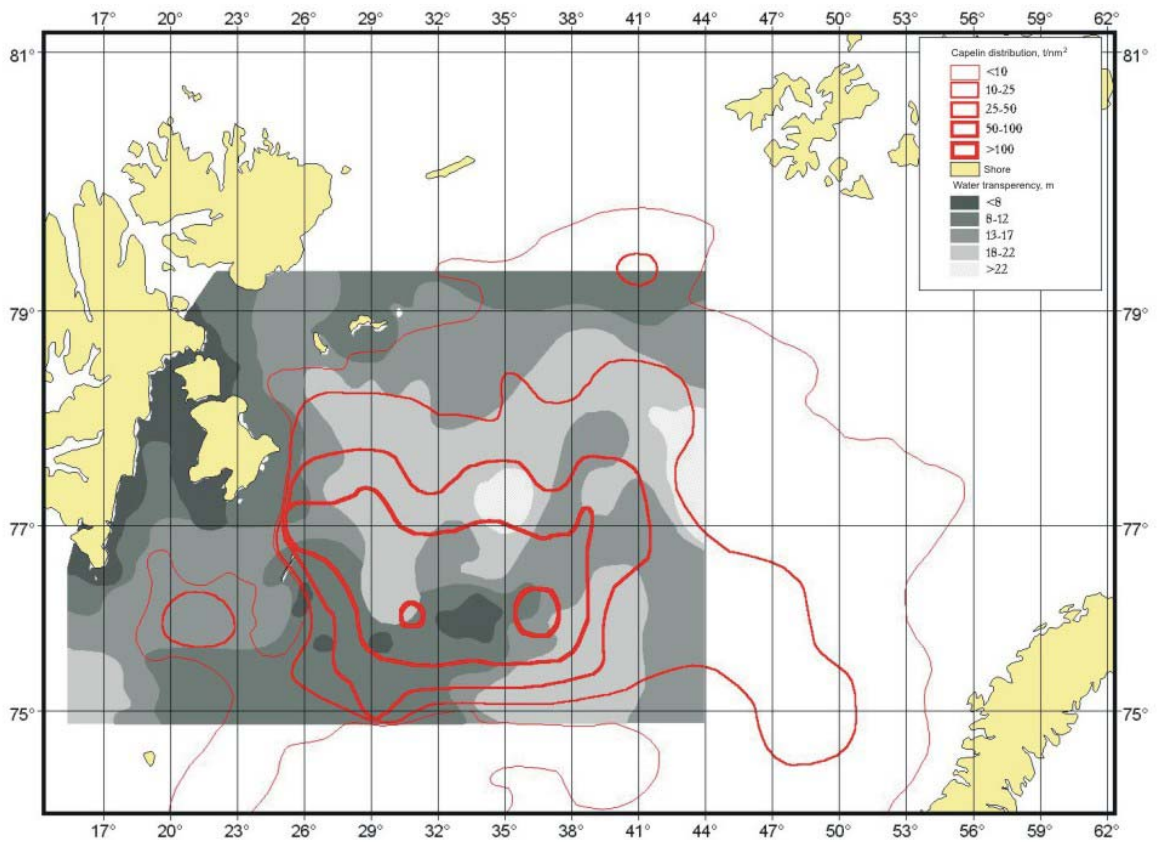


Figure 7. Distribution of water transparency based on the results of aerial surveys (September-October) and capelin distribution from vessel survey data (August-September) in 2002.

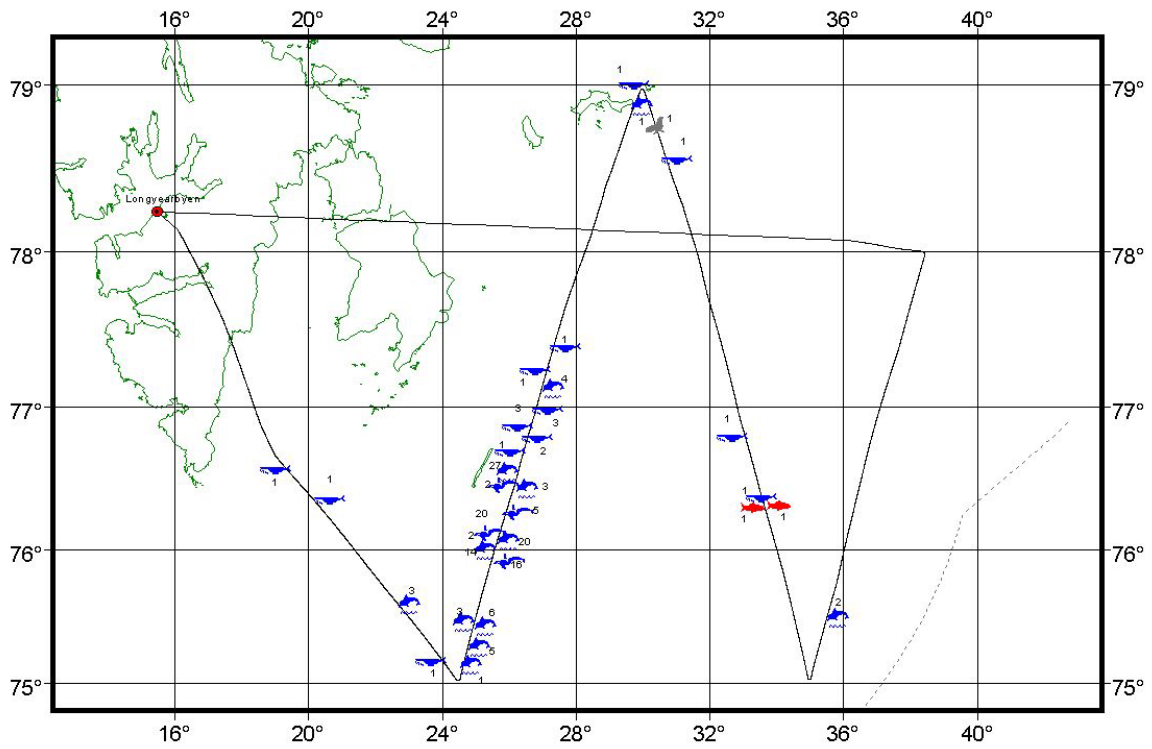


Fig.8. Air routes and marine mammals distribution in 20 September, 2002

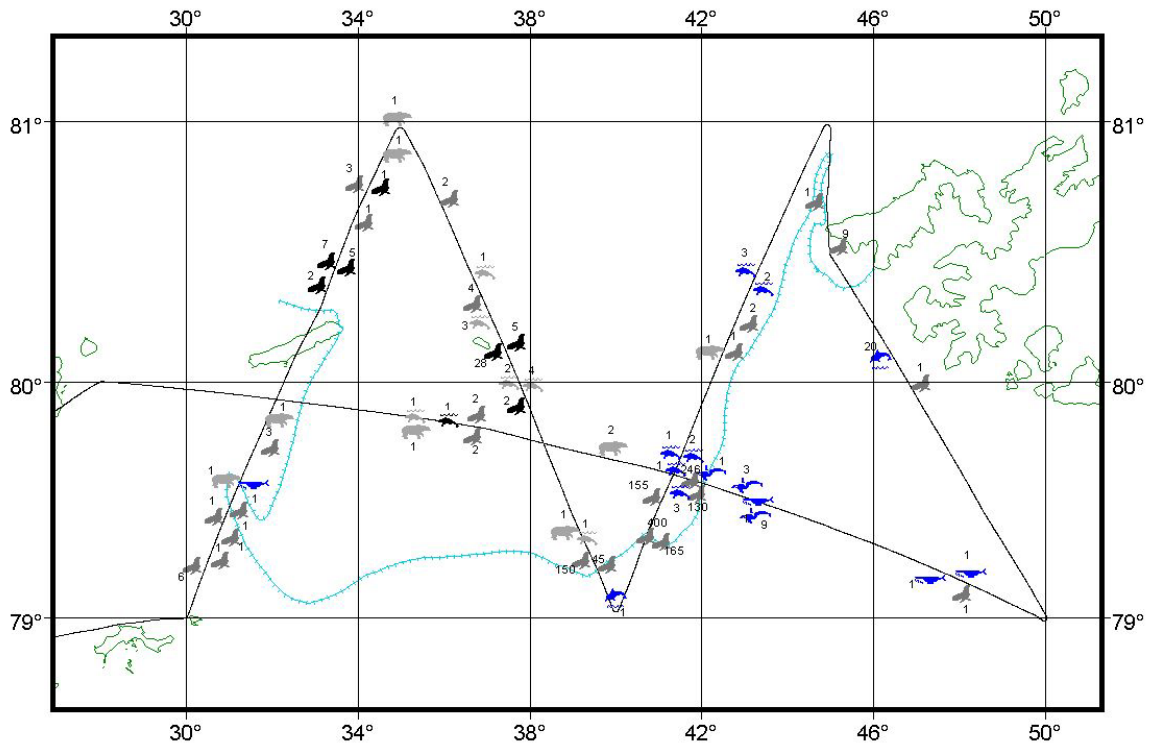


Fig.9. Air routes and marine mammals distribution in 21 September, 2002

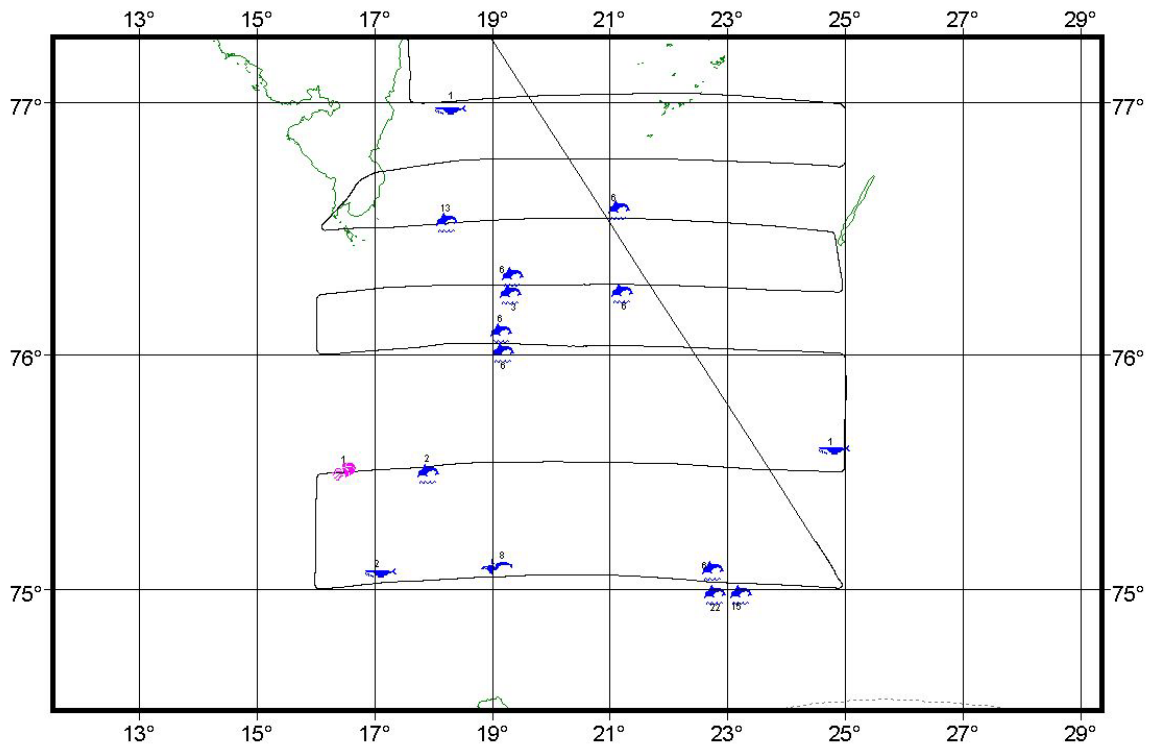


Fig.10. Air routes and marine mammals distribution in 26 September, 2002

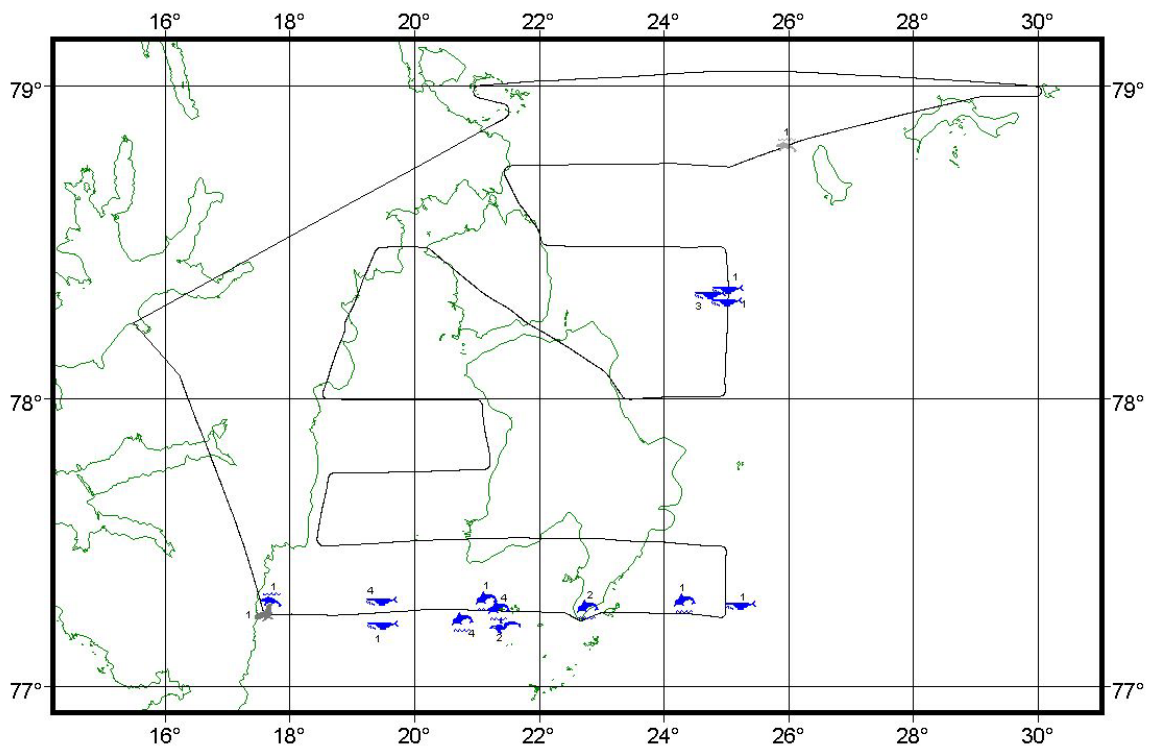


Fig.11. Air routes and marine mammals distribution in 27 September, 2002





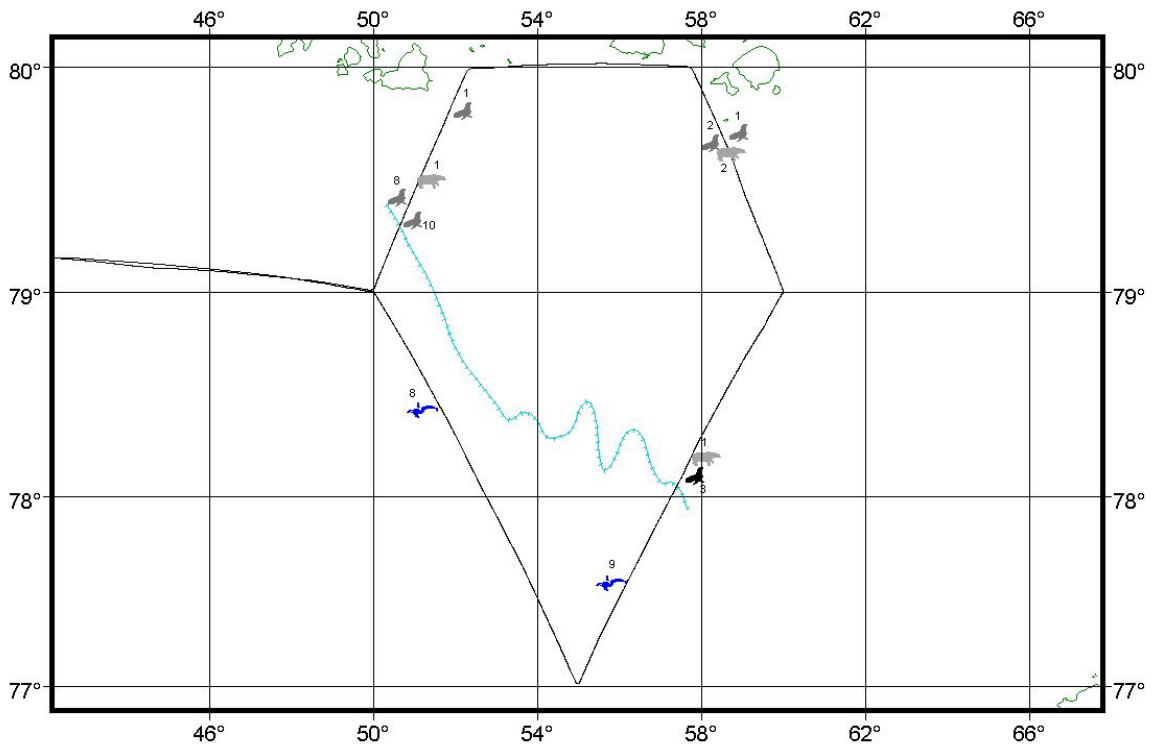


Fig. 14. Air routes and marine mammals distribution in 07 October, 2002

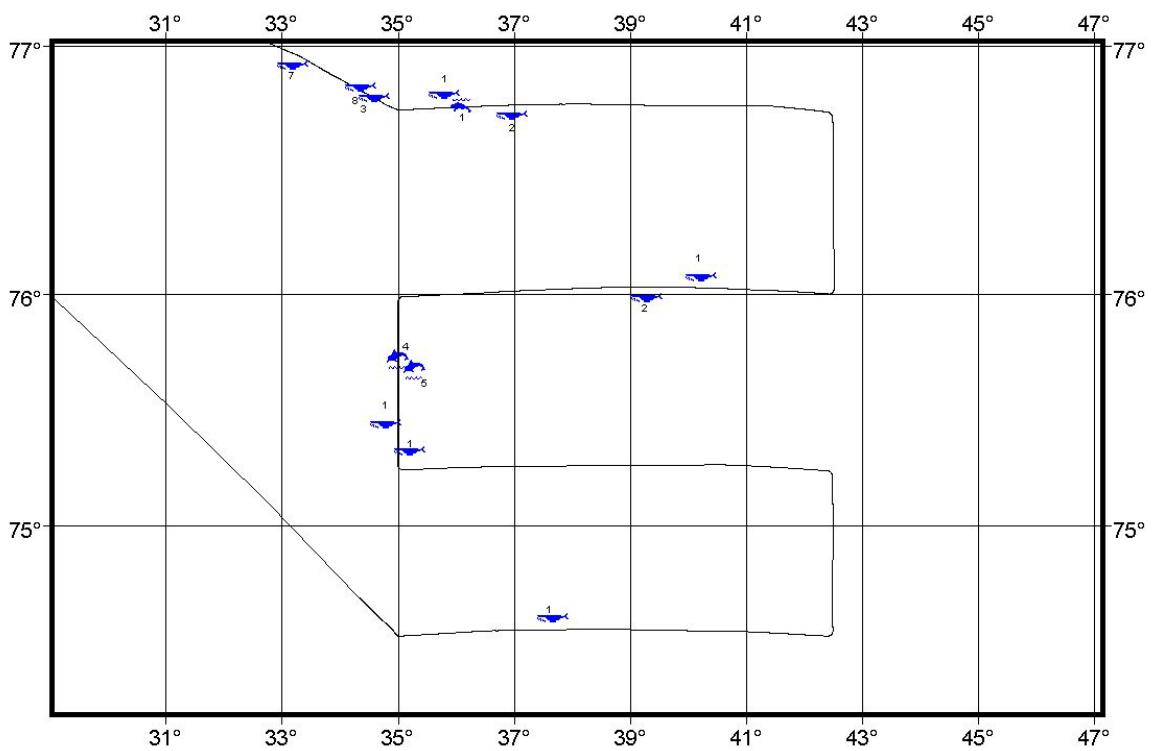


Fig. 15. Air routes and marine mammals distribution in 10 October, 2002

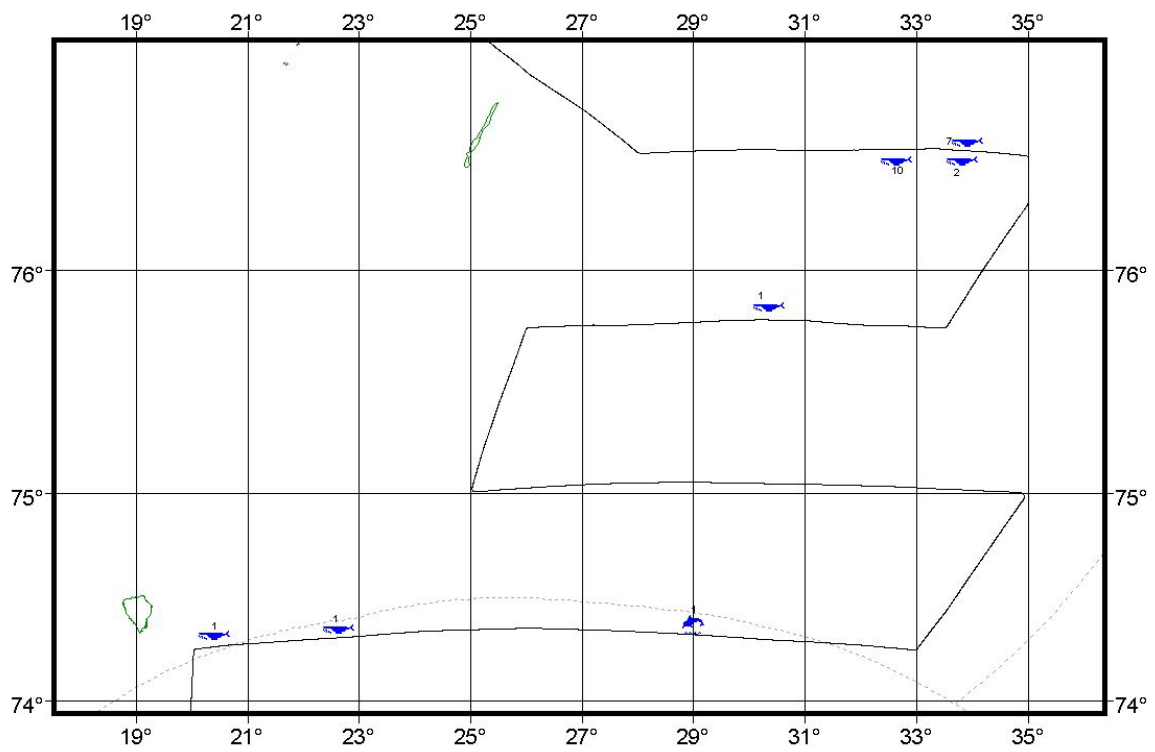


Fig. 16. Air routes and marine mammals distribution in 11 October, 2002

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#### No. 8

Anon. 2001. Report of the international 0-group fish survey in the Barents Sea and adjacent waters in August – September 2001. IMR/PINRO Joint Report Series, No. 8/2001. ISSN 1502-8828. 26 pp.

### **2002**

#### No.1

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