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by

B. Bergstrøm & H. Vilhjalmarsson

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Eqqikaaneq

Angalanermit nalunaarusiaq manna Kalaallit Nunaata Kitaani 2005-imi ammassat, uukkat kiisalu illeqqat qaamasartut misissuiffigineqarnerannit inernerugallartunik kiisalu misissuinermi periusaasunik imaqarpoq. Misissuineq september/oktober 2005-imi ingerlanneqarpoq, Kalaallit Nunaatalu ikkannersuani allorniusaq 73° N-miit 60° N-p missaanut kiisalu Kitaani kangerluit ilaanni ingerlanneqarluni. Nipimik utersaartitsisarluni paasissutissanik katersineq ikerinnarmiillu misileragassanik katersineq immami miluumasut timmissallu imarmiut akulikissusaasa, qanoq siaruarsimatiginerisa assigiinngiiaassusaasalu nalilersorneqarnerannik akoqartinneqarpoq.

Nipimik (38kHz aamma 120kHz) utersaartitsisarluni paasissutissat misissuiffinni kangianiit kimmut sammisuni 22 sømilinik akuttussusilinni, sinerissamiillu 3 sømilinik avasitsigisumiit kimmut 400 miiterinik itissusilimmiittumut katersorneqarput. Uumassusillit nipimik uteriartitsisartut takuneqartut suussusersiniarnerat kingunissalimmik ikerinnakkut kilisannikkut kiisalu planktoninik kilisannikkut iluaquserneqarpoq, imaanillu paasissutissat CTD-mik uuttortaanerit iluaqutigalugit katersorneqarlutik. Kangianiit kimmut titarnerni misissuiffiusuni imaani miluumasut timmissallu imarmiut alaatsinaaqatigiittunit marluiusunit ataatsikkut suussusersineqartarput kisinneqarlutillu.

CTD-mik uuttortaanernit paasissutissat tunngavigalugit inerniugallartut ilimanarsitippaat imaq ″Tunumi sarfaminngaanneersoq″ misissuiffiusumi tamarmi 73° N tikillugu naammattuugassaasoq, ″Atlantikumiilli immamit″ kissartumit sunnerneqarneq 67-68° N-p missaannit annikilliartuaalerluni. Misissuiffigineqartup affaani avannarliusumi kissassuseq ataatsimoortoq annertoqisoq (3-4° C) septemberip naalernerani suli maluginiagassaavoq, misissuiffigineqartulli affaani kujalliusumi tamanna annikinnerujussuuvoq ilaatigullu allaat naammattuugassaasarani.

Misissuiffigineqartup avannarpasinnerpaartaani (73-70° N) nalinginnaasumik uukkat (*Boreogadus saida*) aammalu kinguit (*Themisto sp.)* nassaarineqarput.

Ikkannersuarni ammassaqanngilluinnangajappoq (*Mallotus villosus*), kangerlunnili tikinneqartuni kiisalu sinerissamut qanittuni (70-60° N-ip akornanni) peqarluni. Kangerlunni taakkunani sinerissamullu qanittumi ammassaqassuseq 170.000-200.000 tonsit missaanniissasoq nalilerneqarpoq.

Misileraatit katersorneqartut angissutsinut agguataarnerisa nalilersoqqissaarnerisa ilimanarsitippaat aappaagumut suffisinnaasussat aammalu ukioq mannameersut piffissami misissuiffiusumi piffimmi misissuiffigineqartumi nassaassaanngilluinnangajattut. Kangerlunni sinerissamullu qanittuni aalisakkat naammattoorneqartut 1-2-nik ukioqarput.

Piffiup annersaani illeqqat qaamasartut (*Meganyctiphanes norvegica*) akuttusuuni ataatsimoortorsuakkuutaat nassaarineqarput, 65° aamma 62° N-ip akornanni erseqqissumik amerlanersaallutik.

Saarulleeqqat (*Gadus morhua*) (ukioq manna tukertut), ilaanneeriarluni suluppaakkanik (*Sebastes sp.*) ukioq manna tukertunik ilaqartut Narsaliup Nanortallillu ikkannersuini (61°-60° N) akulikilluinnartumik naammattuugassaapput.

Nalunaaquttap akunnerini 222-ini pilersaarutigineqartutut 195-eriarluni alaatsinaannerup ingerlanerani immami miluumasut ataasiakkaat 577-it takuneqarput. Arferit assigiinngitsut katillugit 13-it takuneqarput. Kitaata avataani salliutillugu misissuiffigineqartumut ingerlaarnerup nalaani arferit assigiinngiiaarnerpaaffiat Davis Strædemi Tunullu avataani naammattoorneqarput (arfernit assigiinngitsunit 13-iusunit assigiinngitsut 11 takuneqarlutik). Tikaagulliusaanik (*Balaenoptera physalus*) takusaqartarneq nalinginnaasumik sinerissamut qanittumi pisarpoq, amerlanersaat Qeqertarsuup Tunuata Sisimiullu akornanni, Nunap Isuata kitaani kiisalu Kong Frederik VI-ta sineriaata avataani Ammassalik tikillugu naammattoorneqarlutik. Tikaagulliusaat takuneqarfigisaanni tikaagulliit (*Balaenoptera acutorostrata*) takuneqarput. Qeqertarsuup Tunuata avannaani arfernik takusoqanngilaq.

Qipoqqaat (*Megaptera novaeangliae*) sinerissamut ungasissumi sinerissamullu qanittumi takuneqarput. Arferit taakku taakkutuaapput kangerlunni takuneqartut, amerlanertigut kangerluit paaviniittarlutik.

Angalanerup nalaani nalunaaquttap akunnerini 67-ini alaatsinaaffiusuni 400-riarluni 10 minutsinik sivisussusilinnik imaani timmissat alaatsinaanneqarput. Peqqissaartumik kisitsinerit nalaanni timmissat assigiinngitsut 34-it takuneqartut nalunaarsorneqarput, taakkunannga 27-t titarnerni misissuiffiusuni 300 miiterit iluini. qaninnerusumiillutik. Takuneqakulanerpaaq timmissanillu amerlanerpaasut tassaapput qaqulluit (*Fulmarus glacialis*) (titarnermi misissuiffiusumi 300 miiterit iluini takusat 2578-init amerlanerullutik), tullerivaat taateraat (*Rissa tridactyla*) (takusat=2132), appaliarsuit (takusat=1675) kiisalu appat (*Uria lomvia*) (takusat=347). Angalanerup nalaani piffissaq tamarluinnangajaat qaqulluit umiarsuarmut qanilluinnartut takuneqartuarput. Ilaanneeriarluni qaqulluit ima amerlatigisarput timmissanik taakkuninnga tulleriinnilersorluakkamik kisitsineq ingerlanneqarsinnaasarani, marloriaammik kisitsisinngortitsisoorsinnaaneq pissutigalugu.

Sammenfatning

Denne tekniske rapport indeholder de foreløbige resultater af og beskriver undersøgelsesmetoderne for 2005-kortlægningen af lodde, polartorsk og krill/lyskrebs i Vestgrønland. Kortlægningen foregik i september/oktober 2005 og dækkede det vestgrønlandske plateau fra 73° N til omtrent 60° N samt nogle vestgrønlandske fjorde. Indsamling af akustiske data og pelagisk prøveudtagning blev kombineret med vurdering af havpattedyr og søfugles tæthed, udbredelse og diversitet.

Akustiske data (38 kHz og 120 kHz) blev indsamlet under E/W-transekter med cirka 22 sømils mellemrum i en afstand af cirka 3 sømil fra kysten og vest ud til 400 meterdybdekurven/isobathen. Bestemmelsen af de observerede lydafgivende organismer

blev faciliteret af målrettet pelagisk trawl og planktontrawltræk, og de hydrografiske data blev indsamlet ved hjælp af CTD-målinger. To separate observationshold identificerede og talte simultant havpattedyr og søfugle langs transekterne.
De foreløbige resultater baseret på CTD-data tyder på, at vand fra den ”østgrønlandske strøm” var til stede i det samlede undersøgelsesområde til 73° N, mens indflydelse fra det varme ”atlantiske vand” begyndte at aftage omkring 67-68° N. Et meget stærkt varmekontinuum (3-4° C) kunne stadig konstateres i den nordlige halvdel af undersøgelsesområdet i slutningen af september, mens dette var langt mindre udtalt og endog fraværende visse steder i den sydlige del af det udforskede område.
Generelt blev der fundet polartorsk (*Boreogadus saida*) og amfipoder (*Themisto sp.)* i den allernordligste del af undersøgelsesområdet (73-70° N).
Lodde (*Mallotus villosus*) var stort set fraværende på bankerne, men nærværende i de besøgte fjorde samt tæt på kystområderne (mellem 70-60° N). Loddebiomassen i disse fjorde og tæt på kystområderne blev anslået til at befinde sig i størrelsesordenen 170.000-200.000 tons.
En foreløbig analyse af størrelsesfordelingen i de indsamlede prøver tyder på, at både næste års gydningskomponent samt 0-gruppen praktisk talt udeblev i undersøgelsesområdet i det tidsrum, det blev udforsket. De fisk, der blev observeret i fjordene og tæt på kystområderne, var 1-2 år gamle.
Der blev fundet krill/lyskrebs (*Meganyctiphanes norvegica*) i spredte sammenhobninger i det meste af området med en udtalt øget forekomst mellem 65° og 62° N.
Ungtorsk (*Gadus morhua*) (0-gruppe), lejlighedsvis blandet med 0-gruppe-rødfisk (*Sebastes sp*.), optrådte med temmelig høj tæthed mellem Narsalik- og Nanortalik-bankerne (61°-60° N).
Der blev foretaget 195 observationer af 577 individuelle havpattedyr i løbet af de 222 timers tilrettelagte observationer. I alt blev der observeret tretten hvalarter. Den største hvaldiversitet blev observeret i Danmark Strædet og ud for Østgrønland (11 ud af de 13 hvalarter) under overfarten til det primære undersøgelsesområde ud for Vestgrønland. Generelt blev observationer af finhvaler (*Balaenoptera physalus*) indsamlet i kystområderne, hvoraf kerneområderne befandt sig mellem Diskobugten og Sisimiut, vest for Kap Farvel og ud for Kong Frederik VI's kyst op til Ammassalik. Vågehvaler (*Balaenoptera acutorostrata*) blev observeret i de samme områder som finhvalerne. Der blev ikke observeret nogen hvaler nord for Diskobugten.
Der blev observeret pukkelhvaler (*Megaptera novaeangliae*) både ud fra og ind mod kysterne. Denne art var den eneste, der blev observeret inde i fjordene, for det meste tæt på fjordens udmunding.
Der blev foretaget næsten 400 søfugleobservationer af ti minutters varighed i løbet af de 67 observationstimer, der samlet blev foretaget på togtet. Der blev registreret 34 fuglearter, hvoraf 27 blev observeret inden for 300 meter-transektbåndet under de systematiske optællinger. Den hyppigst forekommende og talrigeste art var

mallemuk (*Fulmarus glacialis*) (n>2578 i 300 meter-transektbåndet) efterfulgt af ride (*Rissa tridactyla*) (n=2132), søkonge (n=1675) og polarlomvie (*Uria lomvia*) (n=347). Der blev set mallemukker tæt på skibet næsten kontant på hele togtet. Af og til var der så mange mallemukker omkring skibet, at systematiske optællinger af denne fugleart ikke lod sig gøre på grund af risikoen for dobbelttælling.

Summary

This cruise report gives preliminary results and describes survey methods for the 2005 West Greenland survey for capelin, polar cod and krill. The survey was carried out in September/October 2005 and covered the West Greenland plateau from 73°N to about 60° N and some West Greenland fjords. Acoustic data collection and pelagic sampling was combined with assessment of density, distribution and diversity of marine mammals and seabirds.

Acoustic (38 Khz and 120 KHz) data were collected during E/W transects spaced at about 22 nautical miles between a distance of approximately 3 nautical miles from the coast and west out to the 400 m isobath. Identification of observed sound scattering organisms were aided by targeted pelagic trawl and plankton net hauls and hydrography data was collected by CTD casts. Two separate observer teams simultaneously identified and counted marine mammals and sea birds along the transects.

Preliminary results based on CTD data indicate that "East Greenland Current" water was present throughout the entire survey area to 73°N, while the influence of the warm "Atlantic water" began to decline around 67-68°N. A very strong thermo cline (3-4°C) still persisted in the northern half of the study area in late September, while it was much less pronounced and even absent in places in the southern part of the investigated area.

Generally polar cod (*Boreogadus saida*) and amphipods (*Themisto sp.)* where found in the northernmost part of the survey area (73-70° N).

Capelin (*Mallotus villosus*) was virtually absent on the banks but present in the visited fjords and near shore areas (between 70-60° N). The capelin biomass in these fjords and near shore areas was estimated to be between 170-200 thousand tonnes.

A preliminary analysis of size distributions in the obtained samples indicates that both next year's spawning component as well as the 0-group were virtually missing in the survey area during the investigated period. Fish observed in the fjords and near shore areas were 1 and 2 years old.

Krill (*Meganyctiphanes norvegica*) were found in scattered aggregations in most of the area with a pronounced increased prevalence between 65° and 62° N.

Juvenile cod (*Gadus morhua*) (0-group), occasionally mixed with 0-group redfish (*Sebastes sp*.), occurred in fairly high densities between the Narsalik and Nanortalik banks (61°-60°N).

One hundred and ninety-five sightings were made of 577 individual marine mammals during 222 hours on-effort observations. Thirteen whale species were sighted in all. The largest diversity of whales was observed in the Denmark Strait and off East Greenland (11 of the 13 cetacean species) during transit to the main survey area off West Greenland. Generally fin whale (*Balaenoptera physalus*) sightings were aggregated in the offshore areas, with the core areas being between Disko Bay and Sisimiut, west of Kap Farvel and off King Frederik VI's coast up to Ammassalik. Minke whales (*Balaenoptera acutorostrata*) were observed in the same areas as the fin whales. No cetaceans were observed north of Disko Bay.

Humpback whales (*Megaptera novaeangliae*) were observed both off and in-shore. This species was the only species observed inside the fjords, usually close to the mouth of the fjord

Almost four hundred ten-minute observation periods for seabirds were carried out during the cruise-totalling 67 observation hours. Thirtyfour bird species were recorded of which 27 were observed within the 300 m. transect band during the systematic counts. The most common and numerous species recorded was Fulmar (*Fulmarus glacialis*) (n>2578 in the 300 m. transect band) followed by Kittiwakes (*Rissa tridactyla*) (n=2132), Little Auks (n=1675) and Brünnich's Guillemots (*Uria lomvia*) (n=347). Fulmars were seen near the ship almost all the time during the cruise. Occasionally Fulmars occurred in such large numbers around the ship that systematic counts of this species was impossible, due to the risk of double counting.

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1. Introduction

In order to gain further knowledge on primarily the distribution, size and demographic composition of capelin in West Greenland waters the Home Rule Government allocated specific funds (from 50.01.03) in 2005 for an acoustic survey. Since the Greenland Institute of Natural Resources (GINR) does not have a suitably equipped vessel or the personnel to carry out an acoustic survey an Icelandic ship R/V Bjarni Sæmundsson owned by the Marine Research Institute (MRI) in Reykjavik was chartered for the venture. Included in the charter was experienced cruise leadership and technical expertise in analysing the acoustic and biological data. Participating in the survey were scientists and technicians from GINR who together with the Icelandic crew carried out the work. This combination facilitated transfer of knowledge and skills about acoustic survey work from the Icelandic experts to scientists and technicians from GINR. The R/V Bjarni Sæmundsson left Reykjavik September 2 and returned October 6 after having sailed some 7000 nautical miles. Figure 1 in Appendix I shows a map of the survey area and the survey track line.

Capelin, (*Mallotus villosus*), is a small, silvery, cold-water fish that often occurs in vast pelagic concentrations. Capelin occupies a central position in cold water ecosystems in the northern hemisphere and has attracted substantial scientific interest both due to its ecological importance but also owing to its substantial value for both large-scale commercial fisheries and for its small-scale traditional use in Inuit cultures.

The biology of capelin as well as stock assessment and management was recently and comprehensively reviewed during the ICES Symposium "Capelin-What Are They Good For? Biology, Management, and the Ecological Role of Capelin" held in Reykjavik, July 2001, (Hollingworth, 2002).

In West Greenland waters capelin are found from Upernavik (72° 30′ N) in the north down to Cape Farewell (60°N) in the south, and in East Greenland from Cape Farewell to the Tasiilaq area (66°N) (Friis-Rødel and Kanneworff, 2002). Although capelin undoubtedly has a pivotal role in both the West and East Greenland coastal systems only very few studies have been carried out to assess the distribution, size and demographic composition of capelin in Greenland waters. In 2002 Friis-Rødel and Kanneworff reviewed the few studies that have been carried out.

Although the general objective of the survey was to assess the capelin stock off West Greenland the used methods also allowed data gathering on several other ecologically and economically important pelagic species. In addition, since it was possible to combine the acoustic survey with quantitative estimation of abundance of marine mammals and sea birds, new information on the abundance and distribution of these predators was also obtained.

This report describes the activities and the data gathered during the survey and furthermore gives preliminary results that are briefly and tentatively discussed. The report is organised in three parts. One major part (A) describes the acoustic survey and the complementary biologic sampling (pelagic trawling and sampling with Bongo net) and also gives oceanographic information based on data gathered by CTD. A second part (B) deals with marine mammals and describes methods and gives preliminary results based on sightings. A third part (C) similarly gives an account of methods used and results obtained concerning sea birds.

Worth noting is that this is the first attempt to apply an "ecosystem approach" to survey work in Greenland waters. The ambition is that results obtained within these three different parts each containing information on the distribution of prey species and physical environment and predators respectively in due time will be analysed in combination. Such future analyses will hopefully give increased insights into the relative importance of factors governing the distribution of these components of the West Greenland pelagic marine ecosystem.

1.1. General scope and objectives of the survey

The principal objective of the cruise was to obtain acoustic biomass estimates of capelin by area (e.g. NAFO divisions 1A-1F offshore, Disko Bay/Vaigat and Godthåbsfjord separate).

In addition to that, biological samples were collected in order to describe:

- The geographical distribution as well the age, size and sex structure of the capelin stock
- The geographical distribution and size composition of polar cod
- The geographical distribution and size composition of other fish species occurring abundantly in the catches
- The distribution and demography of caught krill species and other larger plankton organisms in addition to acoustic data collected at the relevant frequency (120 KhZ)
- To make oceanographic observations by standard CTD casts, and continuous temperature recording in the near-surface layer, in conjunction with biological sampling to relate the distribution of the target species to water mass distribution

The onboard facilities further allowed observations on the species composition, abundance and distribution of marine mammals and sea birds during daylight hours. Such data were duly collected. A complete list of participants is given in Appendix II, Table 4.

1.2. Study area and progress

The ship left Reykjavik on 2 September. Initially, the cruise track followed the outer part of the East-Greenland shelf to the west from Dohrn Bank and then south to Cape Farewell. After rounding the Cape the ship headed directly for Nuuk to pick up participants from the Greenland Institute of Natural Resources (GINR).

After leaving Nuuk on September 9, the course was set directly north to 73°N where work was begun on the evening of September 10. From this location the survey continued southwards to Cape Farewell over the West-Greenland plateau, following E/W transect lines spaced at about 22 nautical miles from a distance of approximately 3 nautical miles off the coast and to the 400 m isobath. The original survey plan only included a few inshore and fjord systems, i.e. those of Vaigat, Disko Bay, Amerloq (south of Sisimut) and the Nuuk/Godthåbfjord. However due to adverse weather conditions off shore in the shelf area south from Fylla Bank the original plan had to be changed, hence several fjord systems, i.e. Kvane fjord, Arsuk fjord (outside Grønnedal) and Tasermiut fjord. Amerloq, Kvane and Arsuk fjord' were visited while seeking weather protection.

There was a change of GINR's scientific personnel in Nuuk on 26-27 September before the survey continued southwards. Two GINR scientists disembarked in Nanortalik on 3 October. From Nanortalik, the survey continued to south of Cape Farewell and the ship arrived in Reykjavik, according to schedule, on 6 October. Figure 1 in Appendix II illustrates the survey area and survey track line.

1.3. Acknowledgement

The Home Rule Government financed the acoustic survey by allocating specific funds (from 50.01.03) in 2005 in order to gain further knowledge on primarily the distribution, size and demographic composition of capelin in West Greenland waters.
However the general survey design and facilities onboard R/V Bjarni Sæmundsson also provided opportunities to gather a large amount of data on other pelagic fish and invertebrate species as well as on homoeothermic marine organisms (mammals and birds). This broader "eco-system approach", without loss of the main objective would have been difficult to carry out without the splendid support of the ships officers and crew to whom the scientific crew wishes to extend their gratitude. The sea-bird group also wants to acknowledge the support of KIIP for external funding of part of the seabird study.

2. Hydrography Plankton and Fish

(H. Vilhjalmarsson, K. Wieland, B. Bergström, S. Jonsson, B. Sigurdarson, H. Mathæussen and S. Jeremiassen)

2.1. Objectives

• To estimate the size of standing stock as well as the age, size and sex structure of the capelin stock in the survey area off West Greenland.

• Also if possible describe the geographical distribution and size composition of polar cod and other pelagic fish and invertebrate species observed by echo sounder and/or pelagic net sampling.

• To make oceanographic observations by standard CTD casts, and continuous temperature recording in the near-surface layer, in conjunction with biological sampling to relate the distribution of the target species to water mass distribution.

2.2. Data gathering, storage, analyses and biological sampling:

2.2.1. Hydrography:

Two different methods were used to gather temperature and salinity information. Measurements of sea temperatures and salinities were made with a CTD probe at a total of 58 locations as shown in Figure 2, Appendix I and in the station list (Appendix II, Table 1). Data from the CTD stations are stored at 1 m depth intervals. In addition to the CTD recordings, continuous recording of temperature and salinity was also made at a depth of about 6 m.

The CTD worked well apart from one major problem in the beginning. At the first station (# 664) there were a few spikes in the data that were subsequently edited out. At station #666 the CTD did not work properly and the cast was terminated at 40 meters. A faulty cable splice on the water unit of the CTD caused this problem. This was promptly repaired and no further problems with the CTD water unit were noted after that.

Although CTD casts were relatively few, distribution maps of temperature and salinity have been drawn for several depths in order to give a preliminary spatial overview of water mass distribution in the survey area.
The computer program Surfer 8 (Golden Software) was used to grid and draw contour lines. Initially all CTD profiles taken inside or in the entrances of fjords were excluded for the offshore overview of horizontal temperature and salinity variation in the survey area. A line was drawn close to the shore, marking the eastern most boundary of the area and a boundary line was drawn on the western side, close to the westernmost stations. Finally, connecting lines were drawn north and south in

order to close the polygon. The ″minimum Curvature″ method in "Surfer" was used for surface, 5m, 20, 50m, 100, and 200 m isobaths, but ″krieging″ was used at the 300 m level since the other method would not converge. Anisotropy was set at 2 for both and maximum iteration to 1000 for the Minimum Curvature procedure.

Temperature and salinity plots from the 300 m isobaths rest on only few data points and hence this plot should be interpreted with caution. No contour plots have been made for depths greater than 400 m since only few and scattered data points are available from this and deeper levels. Temperature and salinity plots for the surface as well as the 5, 20, 50, 100, 200 and 300 m isobaths are shown in Figures 6-12.

2.2.2. Acoustic data:
Continuous recording of acoustic data (measurements of volume backscattering strength of echo signals) were obtained through the use of an EK60 echo sounder with hull-mounted transducers (18, 38 and 120 kHz). Technical details and settings are given in Appendix III. Sample volumes are generally 1m deep and generally extending 5-10m horizontally, but depend on survey speed and depth. Recordings of capelin were interpreted and then integrated using the software "BI500" and "EchoView" following the same protocol as that used in assessment work for "the Iceland-East Greenland-Jan Mayen capelin stock" (Vilhjálmsson 1994, Vilhjálmsson & Carscadden 2002). Values of nautical area scattering coefficient (S_A/NASC) in units of m^2nmi^{-2} (McLennan *et al.* 2002) were stored with 1nmi spatial resolution. After cleaning of the echograms from noise and 'false echoes' (described in the section headed TOTAL EXPORT below), total along transect backscattering strength (as NASC) was processed with a resolution of 0.5nmi intervals of sailed distance by 5m depth layers in EchoView. Recordings, interpreted as capelin in BI500, were stored as capelin in EchoView for comparing the performance of the two types of interpretation software.

2.2.3. Biological sampling:
In order to identify ("groundtruth") organisms causing substantial mid water echoes (i.e. organisms producing "echoes" appearing on the echo sounder) targeted hauls with both pelagic trawl and plankton net were carried out during the survey. Some standard oblique hauls were also made with the plankton net.

A total of 54 pelagic trawl hauls (Figure 3) and 20 plankton (Bongo) hauls (Figure 4) were made (Appendix II, Table 1). Plankton samples were collected with a bongo net (0.335mm mesh) fitted with a Hydrobios flow meter and a SCANMAR MP 4 depth sensor. The net was fished at a speed of 2.5 knots over ground. In case where targeted hauls were made descent and ascent distances were kept short relative to distances at fishing depth. In the case of standard oblique warp was paid out at a rate of 0.5 m/sec and hauled back at a speed of 0.3 m/sec. According to the participating scientific personnel the Bongo worked properly in 14 out of 15 stations done during the first leg of the cruise.

However while launching the net at the first Bongo station during the second leg it was noticed that the Bongo frame was bent -a problem that caused the net to operate in an inadequate fashion. This problem was promptly rectified and no further problems were encountered.

Except for 3 stations in the beginning of the survey where a GLORIA trawl (GPT) was used, samples of pelagic fish and micro-nekton were collected by a 16x16 fm 'Harstad' type pelagic trawl (HPT) (cod end 10 mm mesh but with the distal 5-6 m lined with 5mm mesh). This trawl, which has a vertical opening of 10 m at normal towing speeds of 2.5-3 knots, was used from 15 m below the surface to a distance of 5-10 m from the seabed during the survey. Bridle length was 83 m. This type of trawl has been used as standard gear in Icelandic 0-group surveys for a number of years (Vilhjalmsson and Fridgeirsson, 1976; Sveinbjörnsson and Helgason, 1987; Sveinbjörnsson and Hjörleifsson, 2003) but in these the entire cod was fitted with a 5 mm mesh. Trawling (targeted hauls) was done at a speed of 2.5-3 knots over ground in locations where echograms indicated either dense or changing concentrations of organisms. When such signs were absent, at least one haul per east/west transect was carried out with the exception of in the northern area where next to no backscattering was observed.

The HPT is not a particularly good quantitative sampling tool, since catch rate may vary with e.g. currents and size range of the fish/micro nekton present in the water column. This holds especially true for krill and other micro-necton, that are normally sampled with relatively large mouthed nets, such as IKMT (Isaac Kidd Midwater Trawl) MIK net (Methot-Issac Kidd net) or RMT 8 (Rectangular Midwater Trawl) having a mesh size of 0,5-1,0 mm. Despite this lack of adequate sampling gear for micro nekton the weight proportion of different species in the catches are presumed to roughly reflect the relative abundance of species at each station. Comparisons can off course only be made between stations in this survey and it should be bourn in mind that especially for krill the smaller size groups are under represented in the catches due to the large mesh size.

The sizes of the total catches from the pelagic trawl were estimated by volume directly on deck. In cases when catches were large i.e. over about 70 litres they were split into equal portions. Subsequently one portion was picked at random and weighed in portions. This cumbersome *ad hoc* procedure was motivated by the lack of a suitable scale on board. The only scales available could handle a maximum load of 1.5 kg. When large organisms such as large scyphozooans (jellyfish) were present in the catch these were picked out from the total catch and treated separately. When necessary, species total weight was obtained through adequate sub-sampling.

We recorded individual lengths and weights from sub-samples of capelin selected at random and also collected otoliths from sub-samples of 25-50 individuals for subsequent analysis at the GINR and MRI laboratories. Also the length of polar cod was recorded, as were lengths of few other species of commercial interest (e.g. Greenland halibut, redfish, lumpsucker and cod). Samples of all these species were frozen to allow further processing ashore. Sub-samples of the most important species of micro-nekton were either deep frozen or preserved in formaldehyde for analyses at the GINR laboratory in Nuuk

2.2.4. Preliminary analysis of acoustic data:
Two types of analyses or preparations of the acoustic data have been performed so far. The objective of the first type is to estimate the biomass of capelin and polar cod and possibly other species in locations where acoustic backscatter emanating from these were recorded. The objective of the second type of analysis is to provide a basis for comparison of the spatial distribution of potential prey as recorded by acoustic backscatter and the observed distributions of seabirds and marine mammals.
The following account describes the procedures applied to preparing the acoustic raw data for these two purposes and also explains the content of data files stored on the GINR server. A detailed inventory of the data sets collected during and generated from the survey material is given in Appendix III. Data concerning krill will be subject to separate analysis in cooperation with the US Antarctic Marine Living Resources Program at the Southwest Fisheries Centre, La Jolla, USA that are leading experts on this type of analyses.

"TOTAL-EXPORT": BI500 data from EK60 were read into EchoView for more detailed analysis. For convenience, files consisting of approx. 5 days of registrations from the 38kHz and 120kHz transceivers were selected. A threshold of –70dB was used on both frequencies. Bad data regions were defined on the basis of the 38kHz echogram and those definitions were applied in the integration of the 120kHz echoes. In order to enable a more detailed analysis of near-surface registrations from specific areas (daytime, with birds utilizing organisms in the epipelagic layer, good/bad weather conditions, unknown registrations suspected to derive from biological organisms near the surface, where sets of bongo or trawl hauls failed to give indications of their origin, an additional export was made with a grid resolution of 0.5 nm x 1 m, excluding data above 3 m from the transducer and below 50 m and the portions of the echogram defined as bad above 3 m (propeller noise when stopping at and leaving stations, bottom artefacts and 'other noise created by station activities.

The remaining acoustic data were integrated over bins of 0.5 nm x 5 m. This procedure allows estimation of total backscattering strength along transect lines for comparison with counts of bird species with different diving range for feeding.

“RAW-EXPORT”: For comparison between the old BI500 and new “EchoView”-interpretetion softwarethe data below 5 meters and above BI500 bottom were integrated over the same grid resolution without excluding the registrations defined as 'bad' above.

“SURFACE-EXPORT”: For eventual comparison possibilities, the data below 5 meters and above BI500 bottom were integrated over the same bins without excluding the registrations defined as 'bad' above. Acoustic data registered during trawling or sampling with the bongo net, were excluded from the analysis of “total along transect backscatter strength”, except in case of capelin, shrimp, krill and 0-group fish. A time -varied threshold was applied on the 120kHz echogram to remove noise at long range.

2.3. Preliminary results and tentative conclusions

2.3.1. Hydrography

Two main North Atlantic water masses govern the oceanographic conditions off West Greenland- the cold and less saline waters of the East Greenland Current and the warmer more saline water in the Irminger Current (e.g. Buch et al 1994). The East Greenland Current passes Cape Farewell, then runs north along the west coast of Greenland and exerts a major influence in the topmost 100-150 meters of water along the entire coastline. The underlying warmer water of the Irminger Current may somewhat affect the cold east Greenland water above, by mixing and heat diffusion. The Irminger current is generally diverted westward across the Davis Strait at 66-68°N. The East Greenland current provides the main transport mechanism for fish fry and larvae irrespective of whether these derive from spawning off SE-, S-, SW- or W-Greenland – or even as far off as S- and W-Iceland waters. An exception is the fry of redfish that come from farther offshore areas in the warm Atlantic water of the Irminger Sea.

These main hydrographical features are clearly visible in the horizontal temperature and salinity patterns (Figures 6-12) from different depths observed during the present survey, albeit the data points are too few for any detailed analysis. Thus we can follow the East Greenland Current throughout the entire survey area to 73°N, while the influence of the warm Atlantic water begins to decline around 67-68°N. Apart from this expected pattern, a noteworthy feature of the hydrographical situation was the presence of a very strong thermocline (3-4°C), still persisting in mid-September in the northern half of the study area, while it was much less pronounced and even absent in places in the southern part.

2.3.2. Biology
Total weights of and the weight of dominating taxa in pelagic trawl catches obtained during the survey are given in Table 2, Appendix II.

Generally, based on the acoustic records and catches in the associated targeted hauls polar cod and amphipods (*Themisto sp.)* where found in the northernmost part of the survey area (73-70° N). Capelin was found chiefly in the 5 fjords and near shore areas (between 70-60° N) that were visited. Krill (mostly *Meganyctiphanes norvegica*) were found in most of the area but with a pronounced increased prevalence between 65° and 62° N as compared to the area north of 65° N were only scattered aggregations occurred. Juvenile cod (0-group), occasionally mixed with 0-group redfish (*Sebastes sp*.), occurred in fairly high densities between the Narsalik and Nanortalik banks (61°-60°N). More detailed information on the distribution of these and some other taxa will be given and tentatively discussed below.

2.3.3. Capelin:
Capelin biomass was estimated using the same protocol as in Icelandic capelin survey work (Vilhjalmsson, 1994; Vilhjálmsson and Carscadden, 2002). Following this procedure biomass estimates are based on the mean of 1 nmi averages of area backscatter density (NASC).

We did not find any indication of a substantial offshore population, in the surveyed area during the covered period despite that larger, (age 3+) capelin were caught earlier in the year (July/August 2005) with shrimp trawl during the GINR northern shrimp assessment survey. During the survey we only found adult capelin in three locations offshore. The northernmost area was just north of the Vaigat. In this location the pelagic trawl was operated very close to the bottom (station # 671). Secondly we caught capelin in two hauls prompted by weak indications on the echo sounder (not integrated) on the shelf area midway between the Godthaab fjord and Kvane fjord. Instead we found larger amounts of capelin in near shore areas (northern entrance to the Vaigat, south eastern part of Disko Bay and off Sisimiut) and in the visited fjords (the Godthaab, Kvane, Arsuk and Tasermiut fjords).

The results from NASC estimations in these 7 coastal/fjord areas are shown in Figures 13-18, Appendix I.

These estimates were made according to the following procedure. In echograms, sections assumed to contain capelin was delimited by a drawn border and <u>all</u> registrations inside these borders were assumed to emanate from capelin. Note that registrations during trawl station operations were included in this analysis in order not to waste data. This approach can be debated, however we believe that by excluding recordings made during trawling or in preparation for trawling would be wasteful since generally only a small amount of the survey effort could be spent in the fjords. Exclusion of registrations during these operations or otherwise not accounting for the difference in coverage would reduce the number of observations considerably and lower the estimates of area density in an unrealistic way. Subsequently the mean back-scattering cross-section and mean weight of capelin in catches from in each of the areas area were used to convert NASC to biomass density. Results from these calculations are summarized in Appendix II, Table 3.

The total biomass estimate in these near-shore and fjord areas adds up to some 170-200 thousand tonnes. Naturally this only represents the areas covered in this survey and thus must be only some fraction of the total capelin biomass in West Greenland waters. Also judging by the size distribution shown in Figure 20, Appendix I, the survey must have missed by far the largest part of next year's spawning component.

Since the present survey is the first attempt to give a biomass index estimate there are no earlier data to compare with. However in order to give some tentative indication of the order of magnitude of the amount of Capelin we found during the present survey it may be noted that Jákopsstovu and Røttingen (1975a and b) tentatively suggested that the stock size of Capelin in Greenlandic waters may be between 250 000 and 1 000 000 tonnes. Kanneworff 1988 estimated the size of the off shore portion in East Greenland waters to be 229 000 tonnes. This portion was assumed to be a part of the Icelandic stock at that time. The Icelandic stock was in 1988 estimated to exceed 2 million tonnes (Kanneworff 1988).

In West Greenland waters, capelin spawn and grow in the many and varied fjords or fjord complexes (e.g. Friis-Rødel and Kanneworff, 2002 and references therein). Since the planned objective of the survey was to investigate pelagic occurrence of capelin on the extensive shelf area from Cape Farewell to 73°N, there was little time for exploration and proper abundance assessments inside fjords. The only fjord that was planned to survey beforehand was in fact the Godthåbfjord while the other fjords were visited due to a need to seek shelter from adverse weather.

Nevertheless, brief investigations were made of in total 7 near shore and or fjords systems We found Capelin in all of these areas. The highest densities were registered in SE-Disko Bay, Amerloq and the outer reaches of the Nuuk fjord system (Table 3, Appendix II and Figures 13-19, Appendix I). Preliminary ageing of capelin based on the size distributions in the obtained samples indicates that most of the oldest and largest fish (next year's spawning component) were missing (see Fig. 20). Furthermore, average size in samples declines from north to south. This is a phenomenon that is well known locally as well as from the literature (Hansen, 1943; Kanneworff, 1967 and Sørensen, 1985). Surprisingly, we did not find any 0-group capelin anywhere in the surveyed area. Haul by haul length frequency distributions

(LFD) from the present survey have been produced and are kept in the GNRI database.

Although knowledge of the life history of capelin in West Greenland waters is fragmentary, feeding migrations into offshore areas are mentioned in most of the literature (e.g. Friis-Rødel and Kanneworff 2002 and references therein). Furthermore, these authors found the highest numbers of capelin, caught in northern shrimp surveys (aggregate map for 1988-2000 in Friis-Rødel and Kanneworff 2002), at the outer edge of the shelf, while the highest numbers in the 2005 survey were caught closer to the coast and in or near the gullies cutting transversely through the shelf (GINR, unpublished).

Although no capelin were found over the West Greenland shelf during the present survey, this fact does not disqualify the notion of offshore feeding migrations in summer. On the contrary, capelin catches in northern shrimp surveys corroborates the notion of such migrations. The obvious scope for further work is to describe these possible migratory pattern(s) both in time and space and to investigate to what extent –both in biomass terms and in demographic terms how different parts of -or the entire capelin stock migrates. These are all pertinent questions concerning the behaviour of the capelin stock during its life cycle that need answering.

Most researchers (e.g. Friis-Rødel and Kanneworff, 2002 and references therein) are of the opinion that the West Greenland capelin complex consists of many stocks or sub-populations, each occupying their own fjord or fjord system. In view of what is known of neighbouring beach spawning capelin populations of Labrador and Newfoundland, and indeed elsewhere, this is a reasonable proposition. In southern areas, these capelin spawn in May-June at the entrances of their respective fjords but also sometimes further out along the coasts as the surface temperature rises during summer. Farther to the north spawning takes place later, i.e. in June-July.

While juveniles seem to grow inside the fjords or fjord systems, adolescents (next year's spawning stock) as well as some spent females migrate out of the fjords for feeding in summer. This is well documented, while the offshore distance and timing of the return migrations remain unclear. Earlier research indicated that these feeding migrations were mainly limited to the eastern (shoreward) side of the shelf while later observations (mainly catches of large capelin in northern shrimp surveys) show that in summer capelin migrate at least as far out as to the shelf break. Furthermore, an acoustic abundance assessment survey varied out by the Institute of Marine Research, Bergen, Norway in June-July 1974 showed that the outward migration had begun already by mid-to late June south of about 65°N, but was delayed to the second week of July in most areas further north. The same survey showed that by the third week of July the outer limit of capelin distribution had reached the shelf break in most places south of 66°N (Jákupsstovu and Røttingen, 1975).

Capelin by-catches in northern shrimp trawl surveys off West Greenland, mainly in the month of August over the years 1988-2000, shows the highest incidence of capelin on the outer shelf or at the shelf break. While the 2005 shrimp survey also recorded large capelin, the catch distribution was more irregular and the largest catches were not taken in the westernmost stations.

The presence of capelin only in near shore areas or fjords shown by our results may not be uncharacteristic. A similar situation to the one we observed is often found during northern shrimp surveys in deeper waters north of Iceland. However, in this case it is known that most of the adult capelin stock is distributed farther north and only a minor proportion usually remain in the shrimp distribution area (Vilhjalmsson 1994, 2002). Since this survey covered none of the deep water areas west of the West Greenland shelf break, we can neither confirm nor reject the concept that the adult stock migrates right across the shelf to feed in summer/autumn in the deep waters of the eastern Davis Strait. Irrespective of this however, if a capelin fishery, even on a small scale for human consumption, is to be successfully established, an assessment of the biomass of next year's spawning stock has to be obtained well in advance. There are two main reasons for this:

a) the fishermen must know where and when it is the right time to catch capelin for the various products and

b) the exploitation effort must be directed so that it has a minimal effect on stock abundance in the various fjord systems.

An experiment of establishing a West Greenland capelin fishery for reduction to fishmeal and oil does not seem feasible. In the first place, the combined biomass is probably too small and divided into too many units that each would have to be managed separately. Second, a viable fishery for reduction depends on cheap raw material that must be supplied on a large and relatively steady basis throughout the year.

Based on the present survey results it is not unlikely that also other near shore or fjord systems on the West Greenland coast may contain an unknown quantity of capelin. Also the present survey did not cover the shelf-break area deeper than 400 meters and it is not possible to exclude the possibility based on the present study that the component of the capelin stock that will spawn the following year may be found in the deeper part of the shelf-break. Further directed surveys covering all of these three potential habitats for capelin i.e. the fjords, the banks and the shelf break area, may give more conclusive answers to these questions.

2.3.4. Polar cod:

Except for high numbers of 0-group (5 cm total length) fish in the surface layer north from about 68°N (offshore as well as in Disko Bay/Vaigat; Fig.20), no polar cod was found in the pelagic zone.

This suggests either that the main population of polar cod, i.e. age 1 and older, is much more demersal in West Greenland waters than in other areas, e.g. the Barents Sea. If this is the case, bottom trawl catches of polar cod from the GINR northern shrimp survey could be used for relative or even realistic estimates of biomass and geographical distribution. Alternatively, the adolescent and adult part of the population may occupy deeper waters outside of the West Greenland shelf, at least during the time of this survey. If this holds true the size of the stock will have to be assessed by acoustics there. Another, less likely explanation; may be that since this species is known to feed on amphipods, at the ice edge and under the ice, may be distributed in pack ice covered areas. In this case the stock is inaccessible to any established assessment protocol. However this scenario is less likely in the northern Davies Strait/southern Baffin Bay area than in e.g. the northern Barents Sea, since there is generally very little pack ice left in the former area during September.

2.3.5. Redfish:

Pelagic O-group redfish were mainly recorded and sampled, occasionally in large numbers (about 10 000/nautical mile) close to the shelf edge from about 61°N to the end of the survey area at Cape Farewell. North of Nuuk however only a few 0-group redfish were found in the near bottom layer at the offshore slope. This agrees with previous findings that settling of this species is not completed before later in the year. In addition a few older redfish were found here and there in the pelagic trawl catches during the survey, but mostly inside the fjords, in particular the Godthåbfjord.

2.3.6. Atlantic cod:

We generally found 0-group cod in increasing amounts southward from Nuuk (about 64° N) towards Cape Farewell in the pelagic trawl catches.

A few 0-group cod were also found in the surface layer of the Godthåb fjord, in particular near the mouth of the fjord. Further south, beginning just outside Kvane fjord (61°02N; 49°32W), we again recorded 0-group cod. From there, south to Cape Farewell, 0-group cod were recorded in mid water, sometimes in fairly high numbers (up to 7000 per 1 nm tow), and often mixed with 0-group redfish. The northern distribution limit of these cod is uncertain because bad weather prevented sampling for some 50 miles north of the first station with 0-group cod.

Assuming that the 0-group cod distribution reached some 20 nm farther north than actually recorded, the length of their distribution area was approximately 180 nautical miles. Due to the low number of trawl stations the width of this potential distribution area is difficult to judge and this is also true for the average density. These 0-group cod were in places mixed with a few 0-group haddock, which indicates -that most likely, they originated from spawning grounds off South and/or Southwest Iceland. The catches of 0-group cod in the HPT are shown in Figure 22.

If we assume the average width of the distribution area to be 10 nautical miles, the total distribution covers some 1800 square nautical miles. A non-stratified average catch per 1 nm tow is 659. Using the method for calculating Icelandic indices of 0-group cod, the distribution area along the West Greenland coast gives an index of about 120. While this is by no means a high abundance index, we should bear in mind that the standard Harstad trawl used was not equipped with the usual 5 mm mesh size cod-end, but only equipped with an inside lining of such net for some 3 fathoms up from the opening of the cod-end. This will have reduced the "catchability" of 0-group cod considerably, but there is no available information to quantify such a reduction.

The caught 0-group cod seemed to be in good physical condition with an average weight of just under 2.7 g in the northern part of the area and 2.2 g closer to Cape Farewell. Although the observed 0-group cod probably constitutes a good base for a 2005-year class of commercial importance off Southwest Greenland at present, it must be borne in mind that survival through the first winter is a critical determinant of the final size of a cod year class.

2.3.7. Notes on other fish, invertebrate nekton and zooplankton:
0-group and juvenile stages of several demersal fish species were frequently found in the surface layer, i.e. Greenland halibut (as far north as 73°N) and Sand eel, *Ammodytes* (relatively high numbers north from 67°N) especially close to the coast. This agrees with previous findings that settling of these species is not completed before fairly late in the year.

Northern shrimp of all sizes were occasionally found in the surface layer during night in areas where a pronounced thermocline was absent. In other areas, however, neither the echo signals nor the pelagic trawl catches indicated that northern shrimp left the bottom layer to a higher degree during nighttimes. Pelagic trawl catches from 10 to 20 m above the bottom however revealed a mixture of shrimp and krill.

The pelagic trawl catches indicated that small squid (juvenile *Gonatus fabricii*, appr. 2-4 cm mantel length) were widely distributed in the area (incl. Disko Bay and Amerloq fjord). These squid occurred at all depths, but most commonly in the surface layer. In addition to juveniles, a few larger specimens (14-17cm ML) were found in the Godthåbsfjord at intermediate depths (together with redfish, *Sebastes* *mentella*). Cursory gut analyses of both squid and redfish revealed that they had capelin in their stomachs.

Large patches of copepods (mixed with some amphipods and krill) were seen in particular in the northern part of the Sukkertoppen Deep while krill seemed to be more abundant on the southern part of the Store Hellefiske Bank and in the Holsteinsborg Deep. Krill was also found within the Godthåbsfjord and further south along the coast. Detailed analyses on krill distribution and abundance will be carried out based on the acoustic data set.

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Appendix I. Figures for section 2.

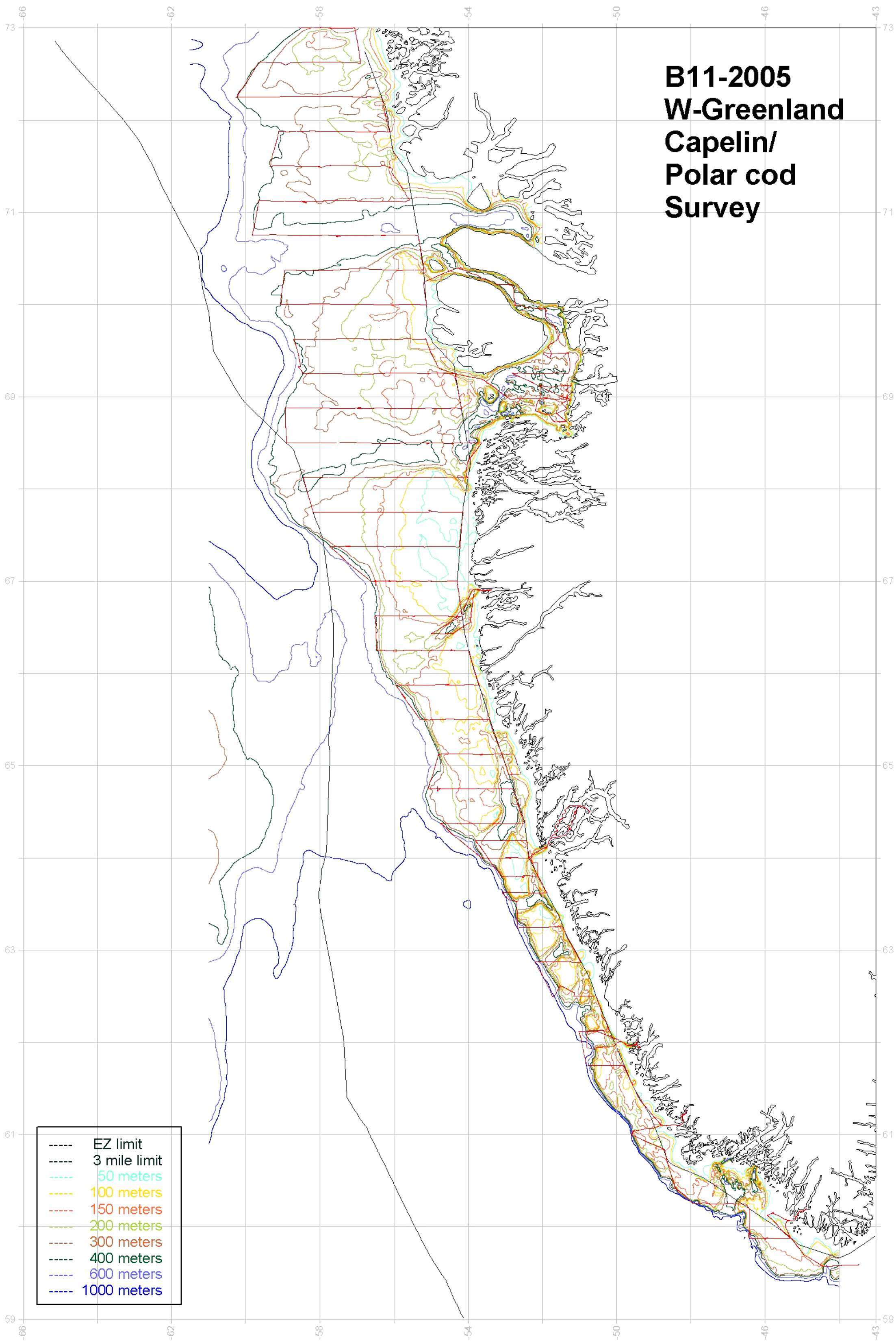


Figure 1. Map showing the survey cruise track during the 2005 Acoustic Capelin survey.

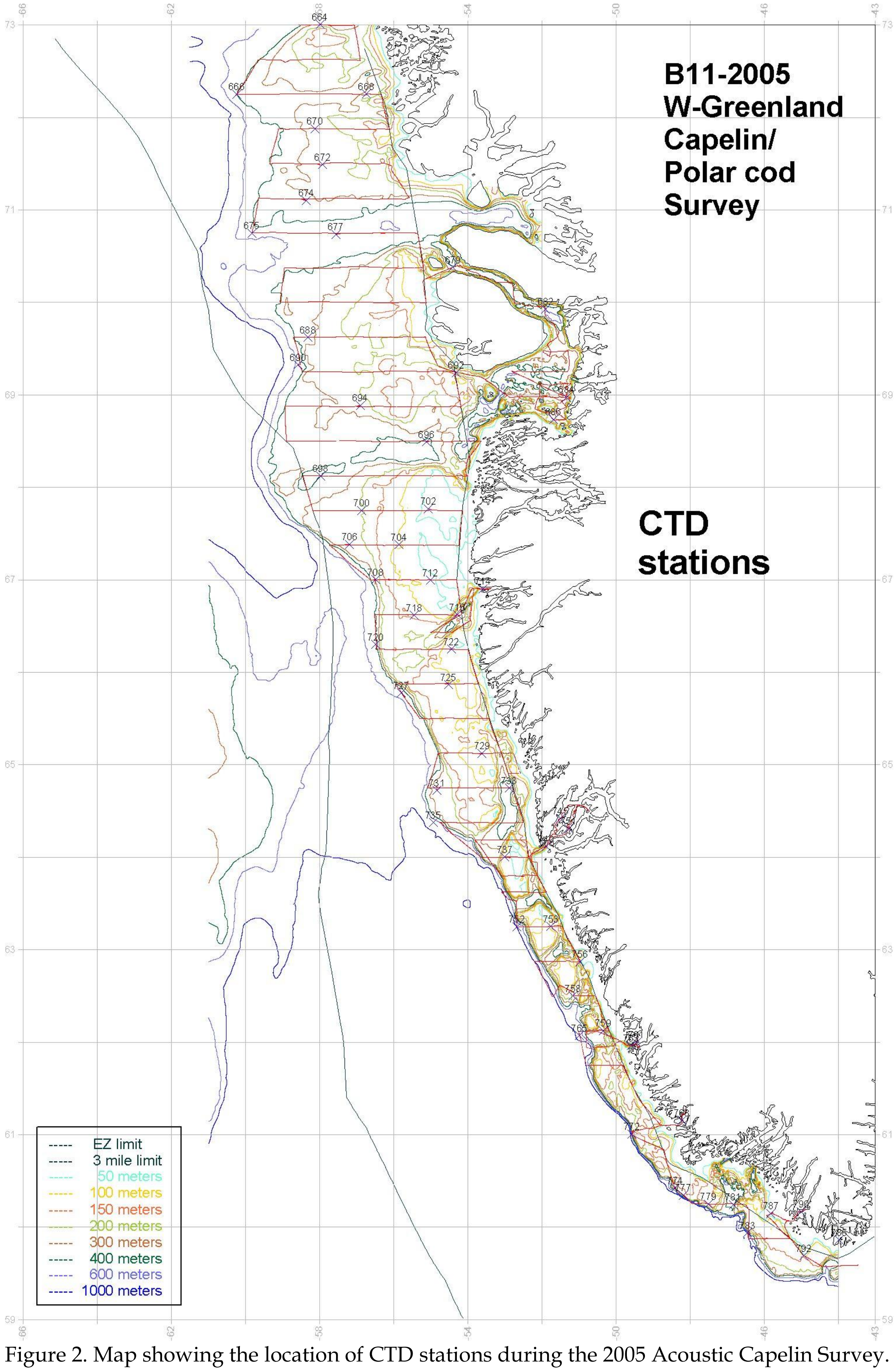


Figure 2. Map showing the location of CTD stations during the 2005 Acoustic Capelin Survey.

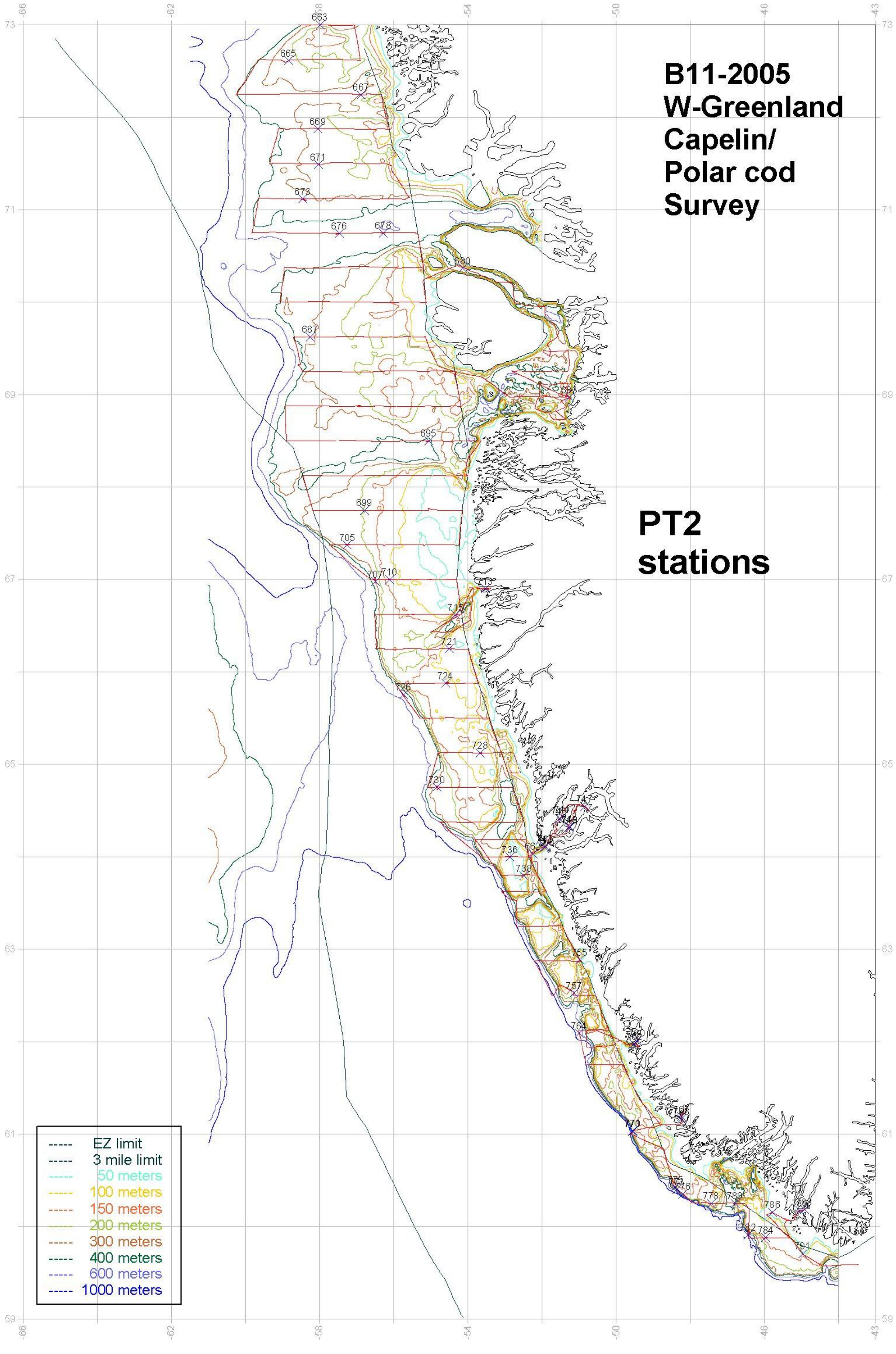


Figure 3. Map showing the location of pelagic trawl stations during the 2005 Acoustic Capelin Survey.

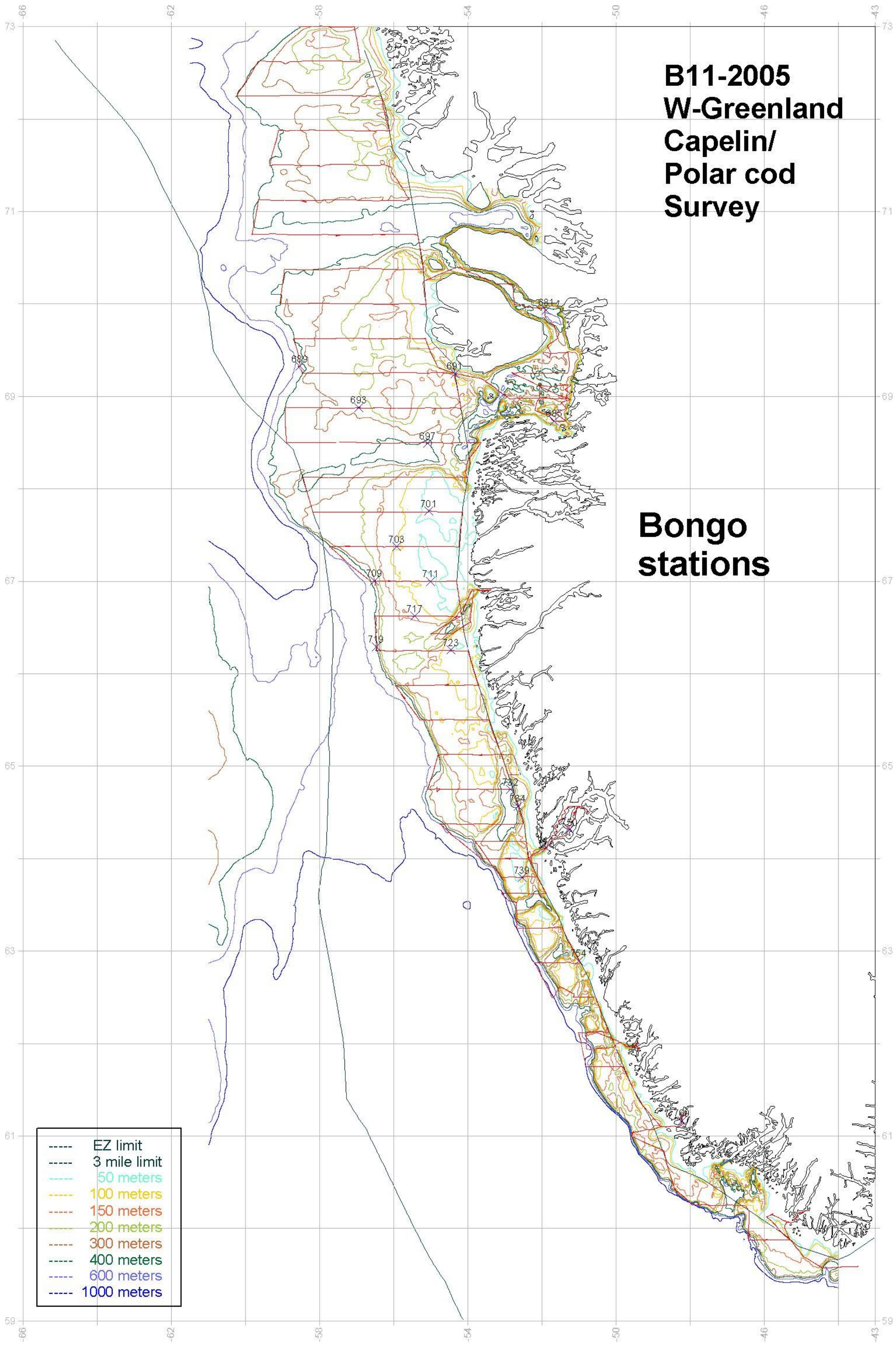
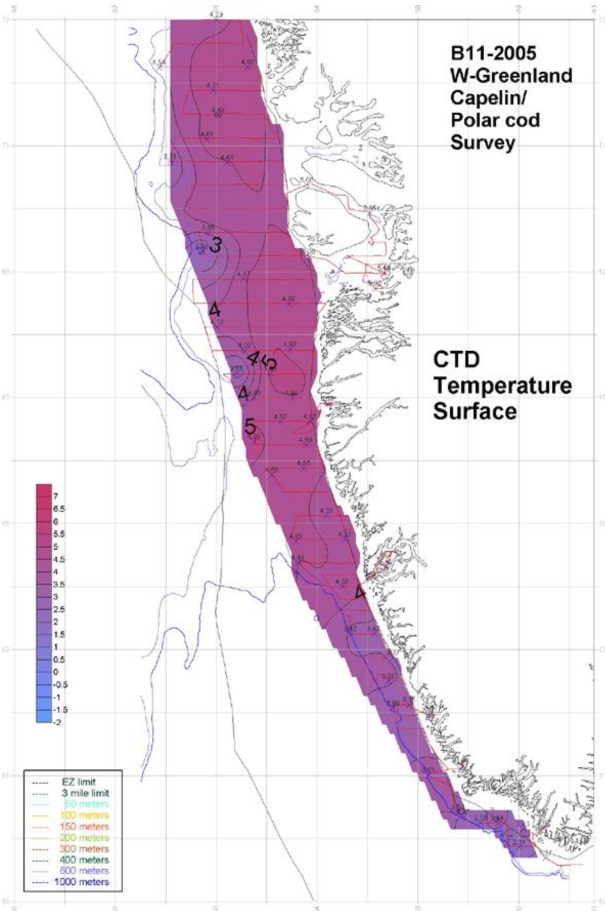


Figure 4. Map showing the location of Bongo net stations during the 2005 Acoustic Capelin Survey.



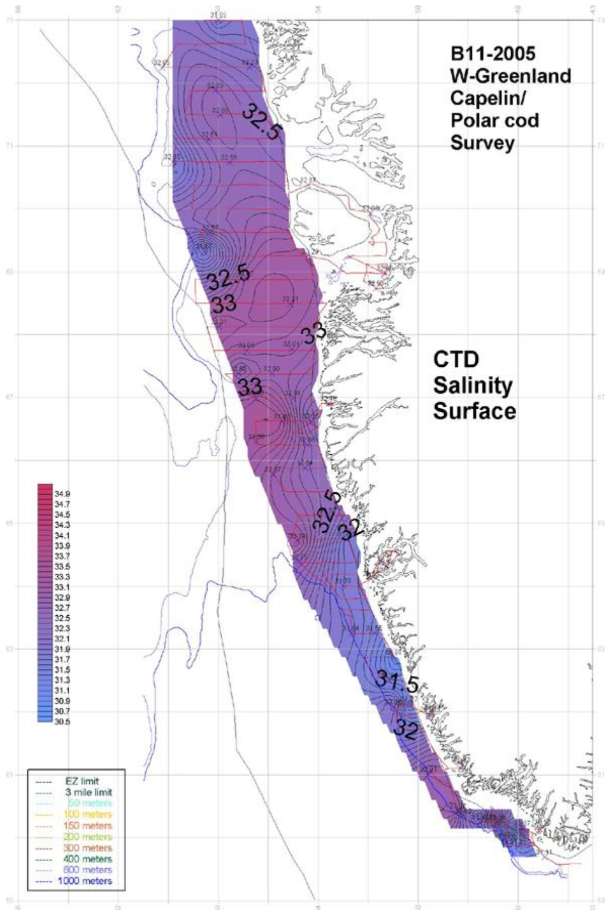


Figure 6: Surface salinity and temperature distribution off West Greenland during September-October 2006

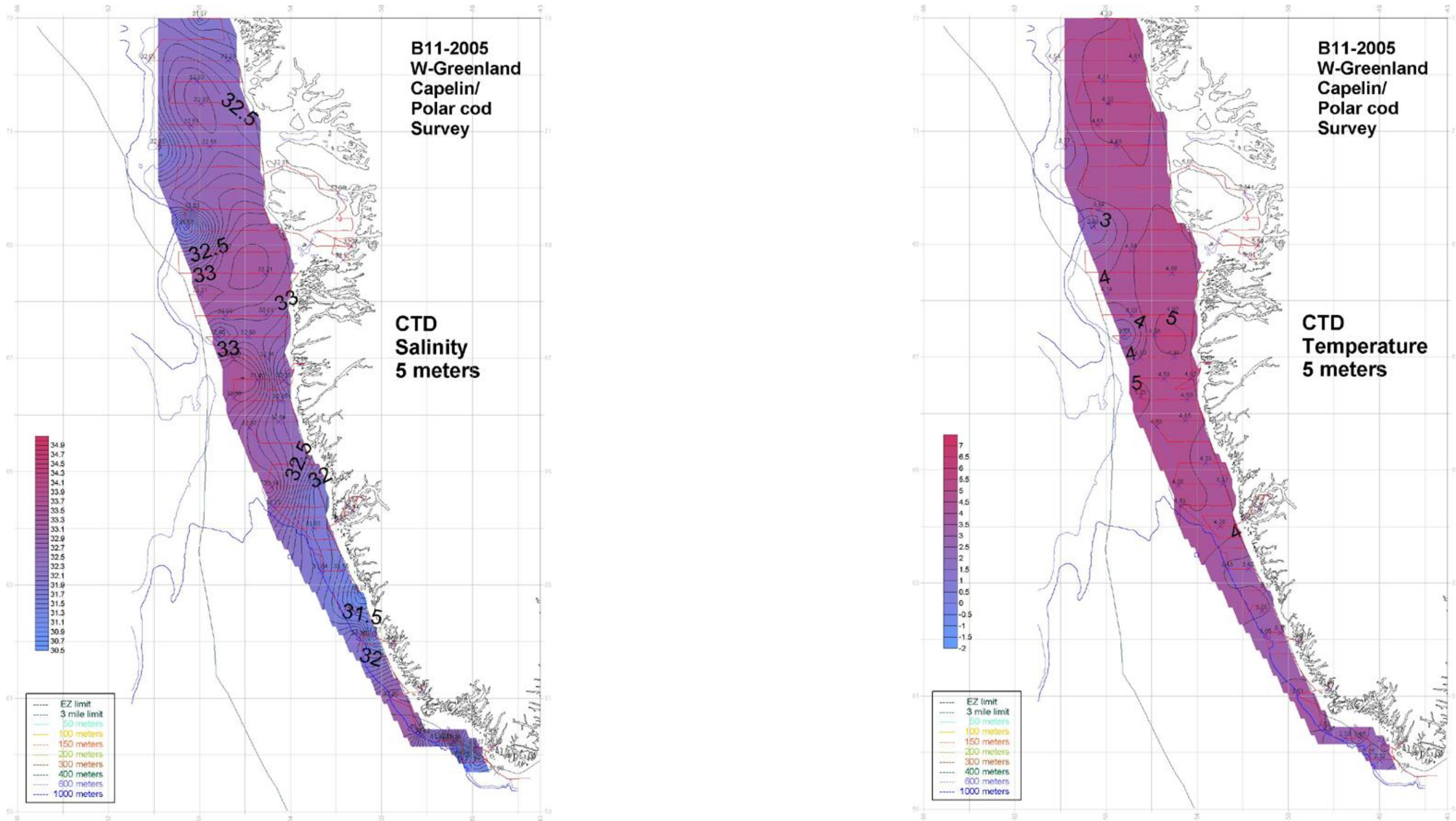
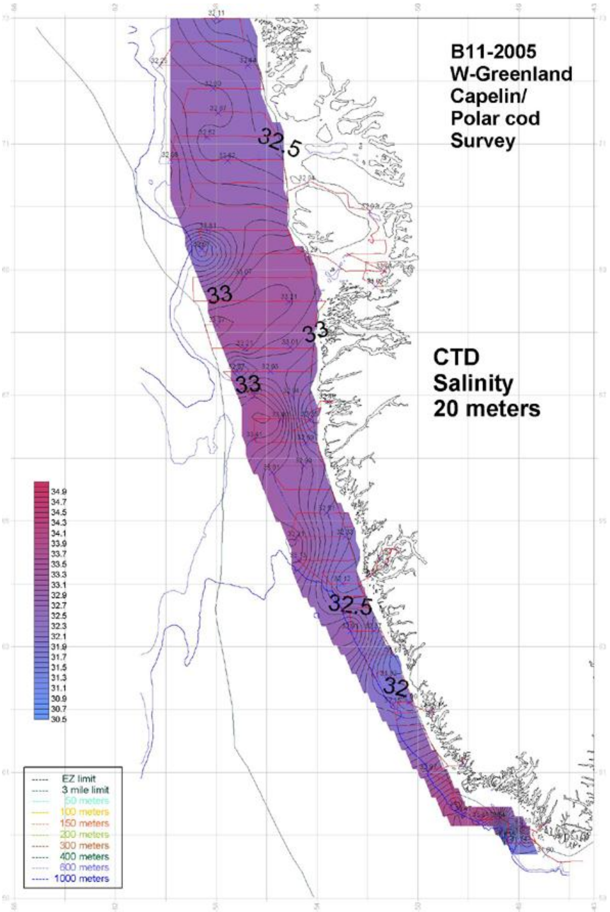


Figure 7: Salinity and temperature distribution at 5 m of depth off West Greenland during September-October 2006



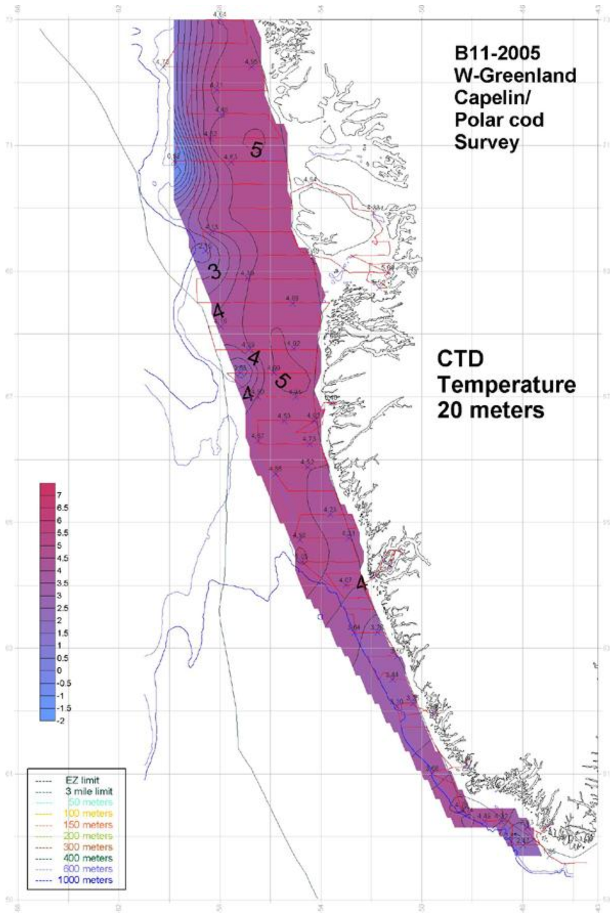
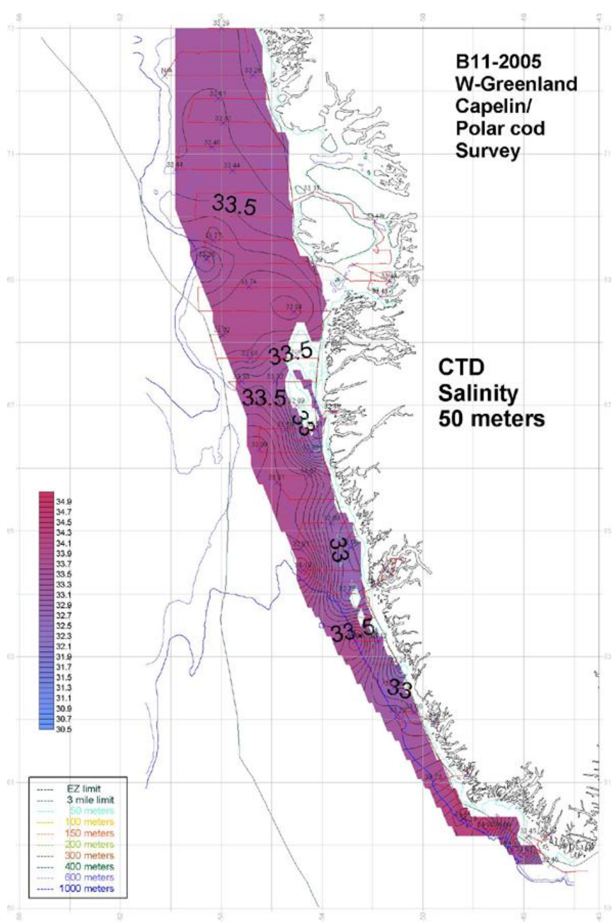


Figure 8: Salinity and temperature distribution at 20 m of depth off West Greenland during September-October 2006



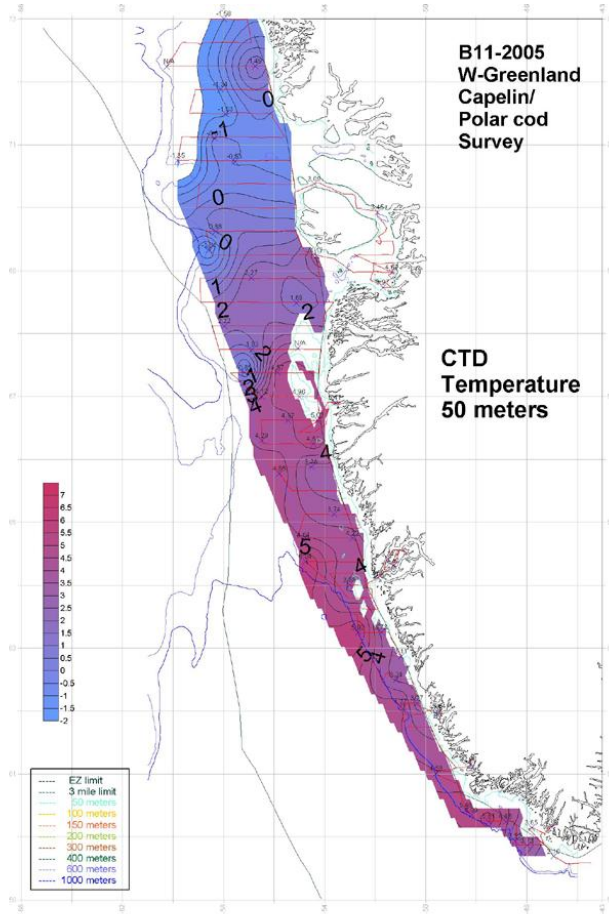
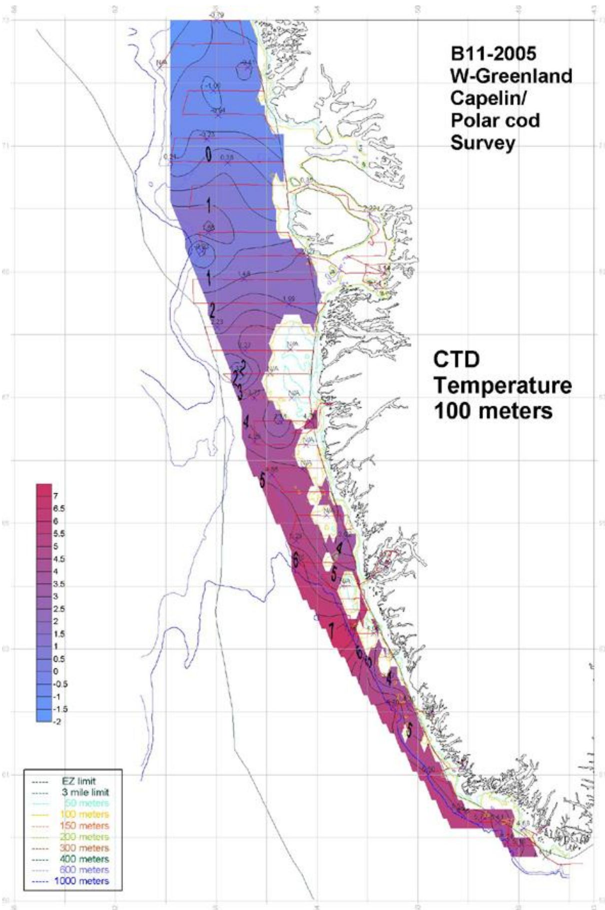


Figure 9: Salinity and temperature distribution at 50 m of depth off West Greenland during September-October 2006



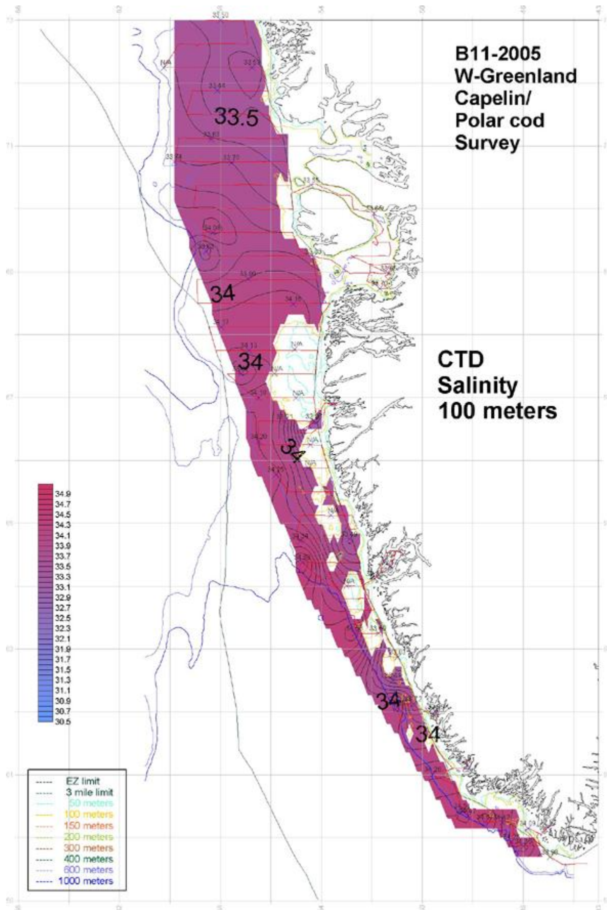


Figure 10: Salinity and temperature distribution at 100 m of depth off West Greenland during September-October 2006

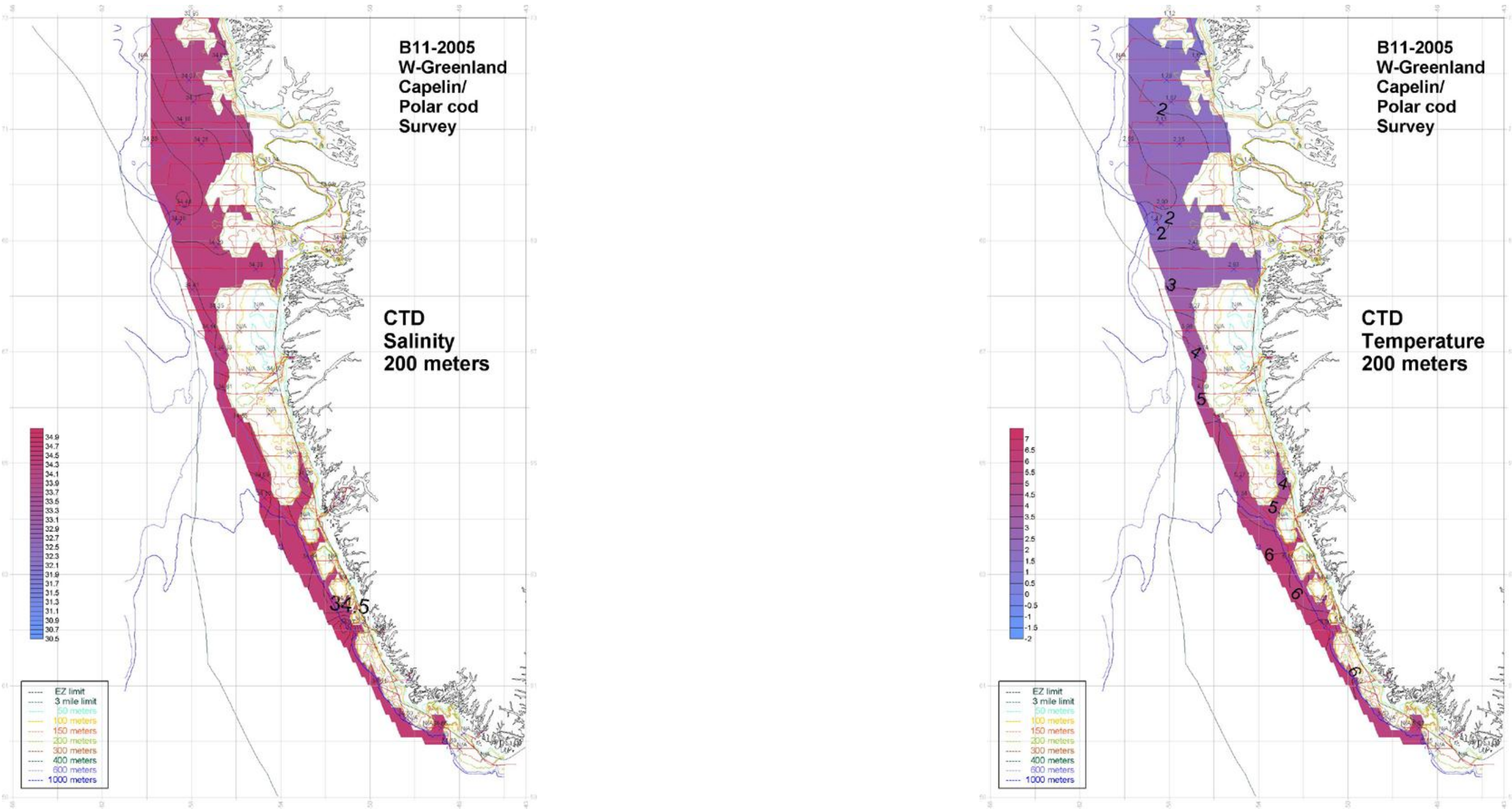
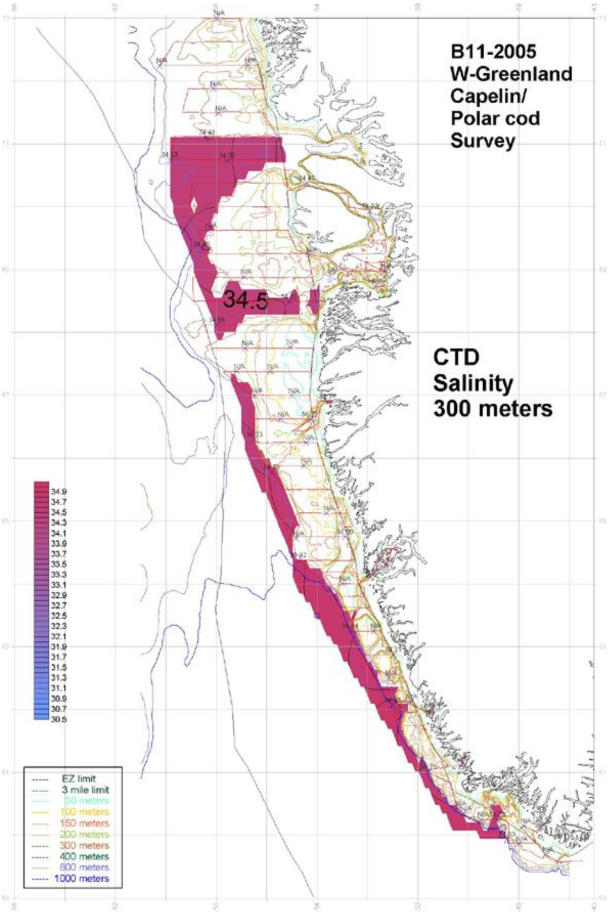


Figure 11: Salinity and temperature distribution at 200 m of depth off West Greenland during September-October 2006



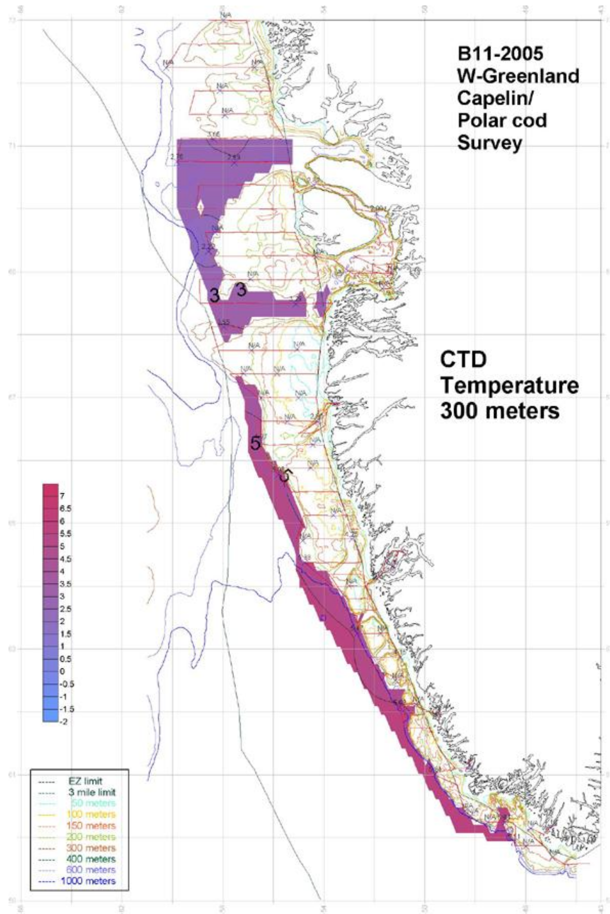


Figure 12: Salinity and temperature distribution at 300 m of depth off West Greenland during September-October 2006

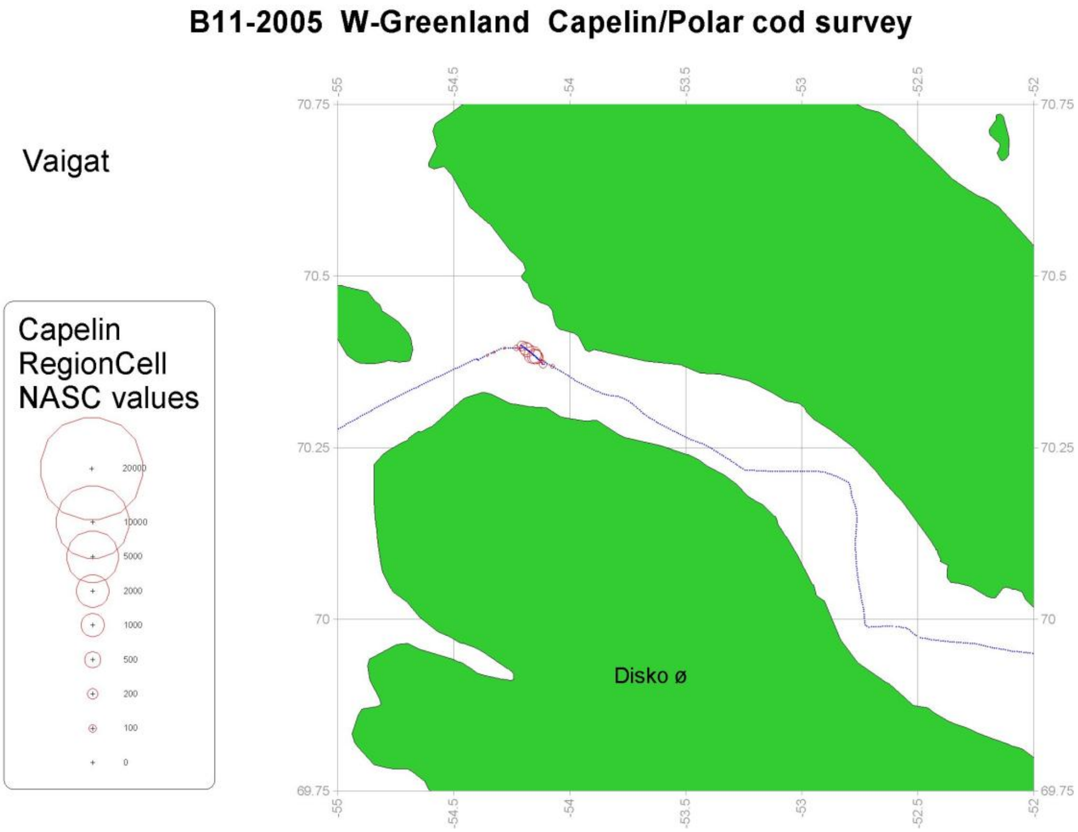


Figure 13. Back scatter density (NASC) of capelin (*Mallotus villosus*) at the north east entrance to the Vaigat sound September 2006.

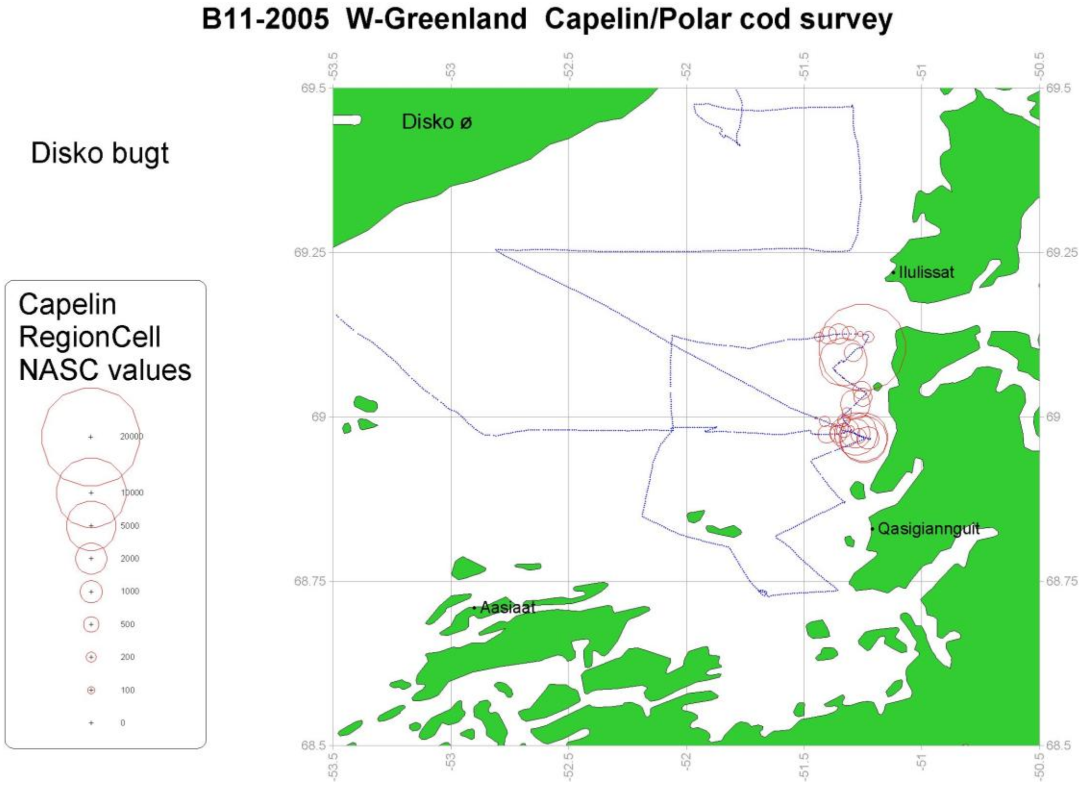


Figure 14. Back scatter density (NASC) of capelin (*Mallotus villosus*) in the eastern part of Disko Bay September 2006

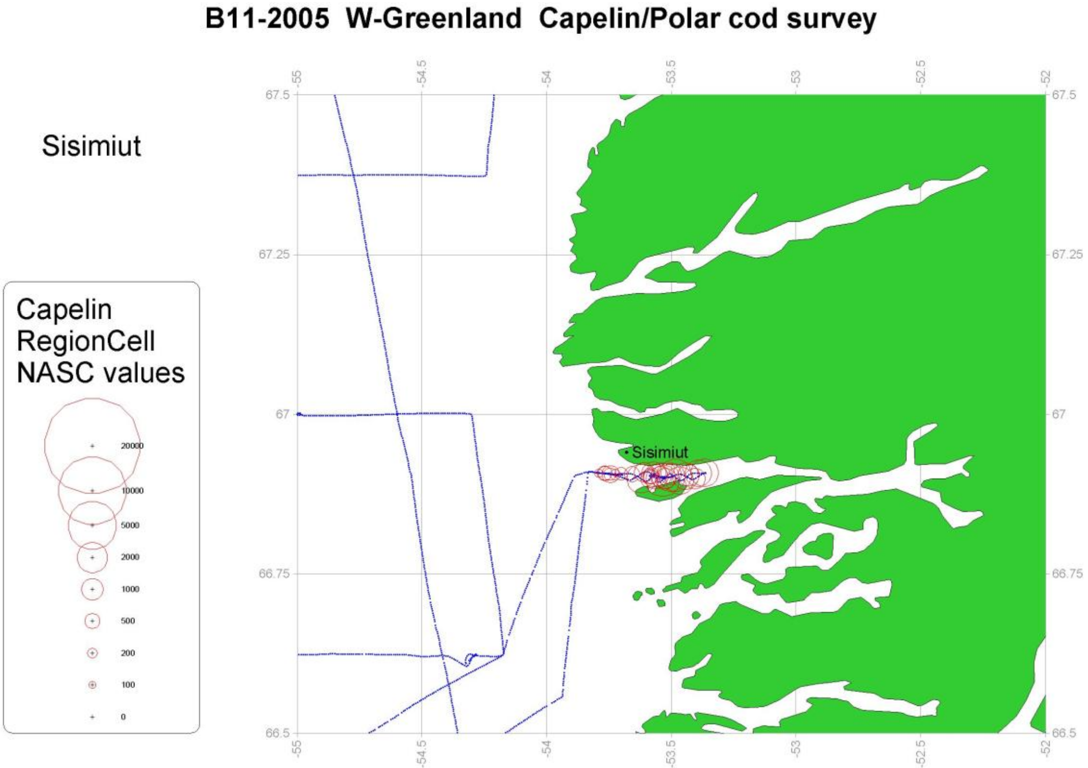


Figure 15. Back scatter density (NASC) of capelin (*Mallotus villosus*) in Amerdloq (south of Sisimiut) September 2006

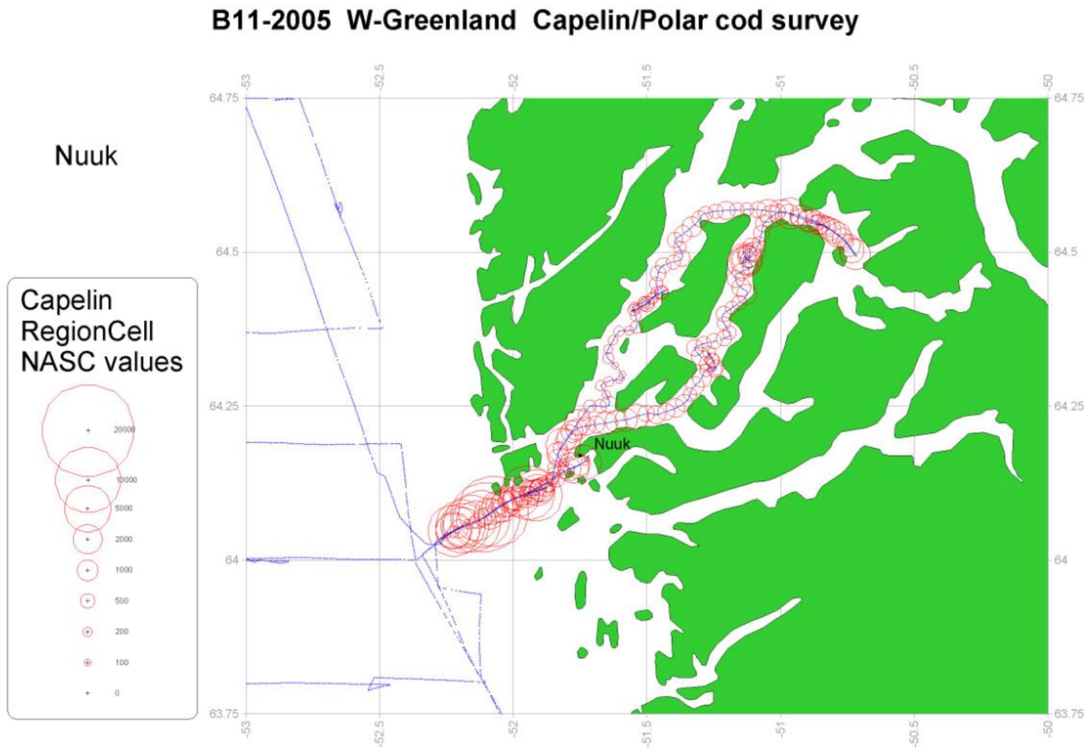


Figure 16. Back scatter density (NASC) of capelin (*Mallotus villosus*) in the Godthaab Fjord September 2006

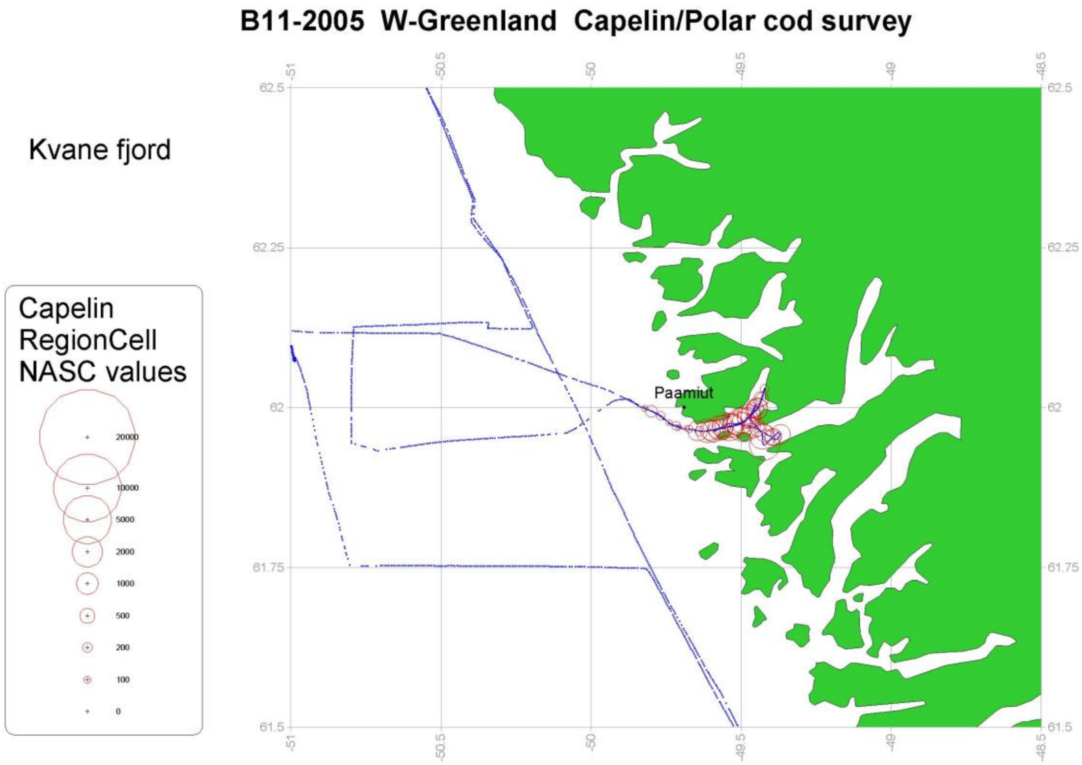


Figure 17. Back scatter density (NASC) of capelin (*Mallotus villosus*) in the Kvane Fjord September 2006

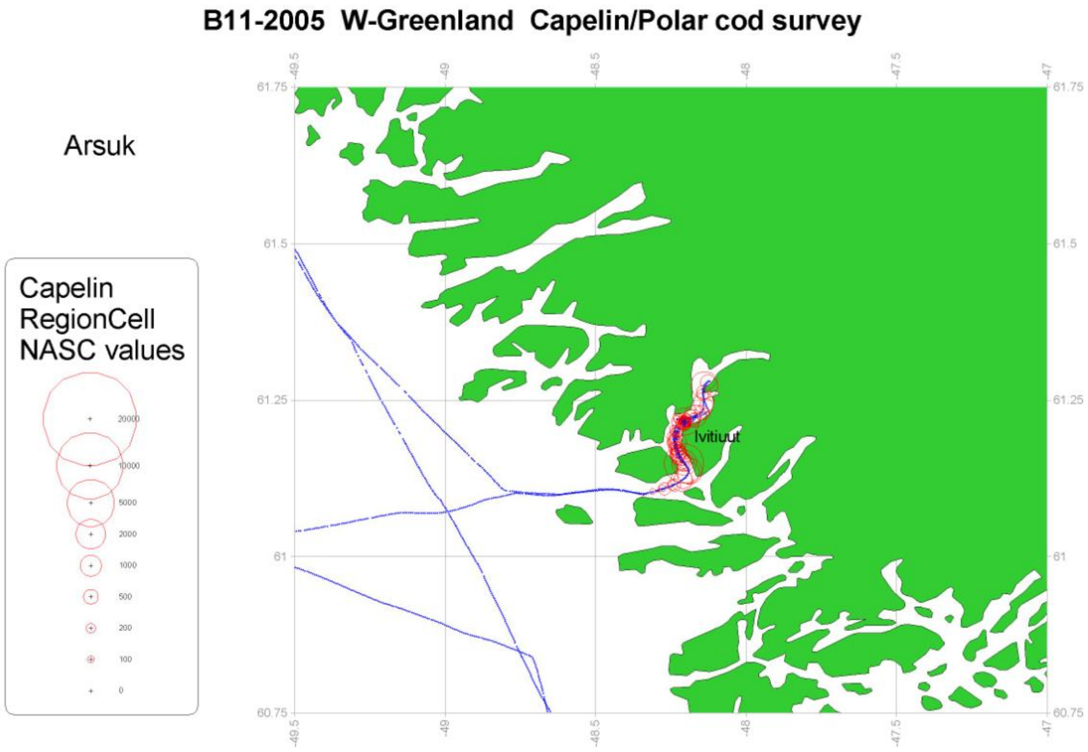


Figure 18. Back scatter density (NASC) of capelin (*Mallotus villosus*) in the Arsuk Fjord September 2006

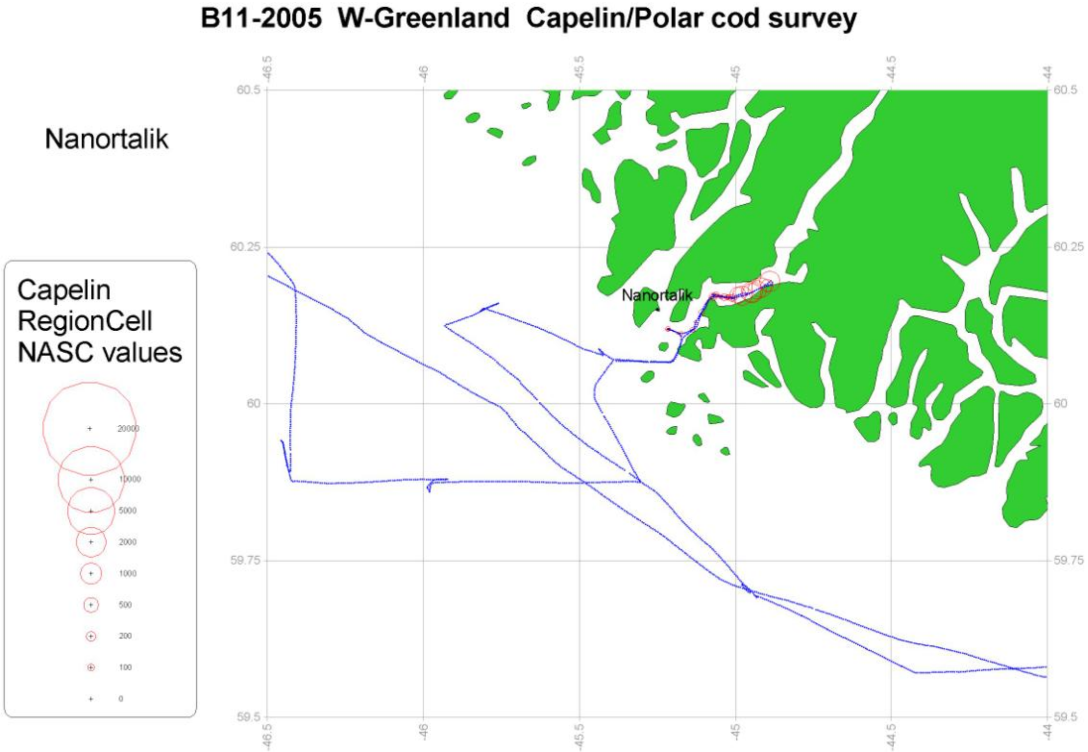


Figure 19. Back scatter density (NASC) of capelin (*Mallotus villosus*) in the Tasermiut Fjord (Nanortalik) September 2006

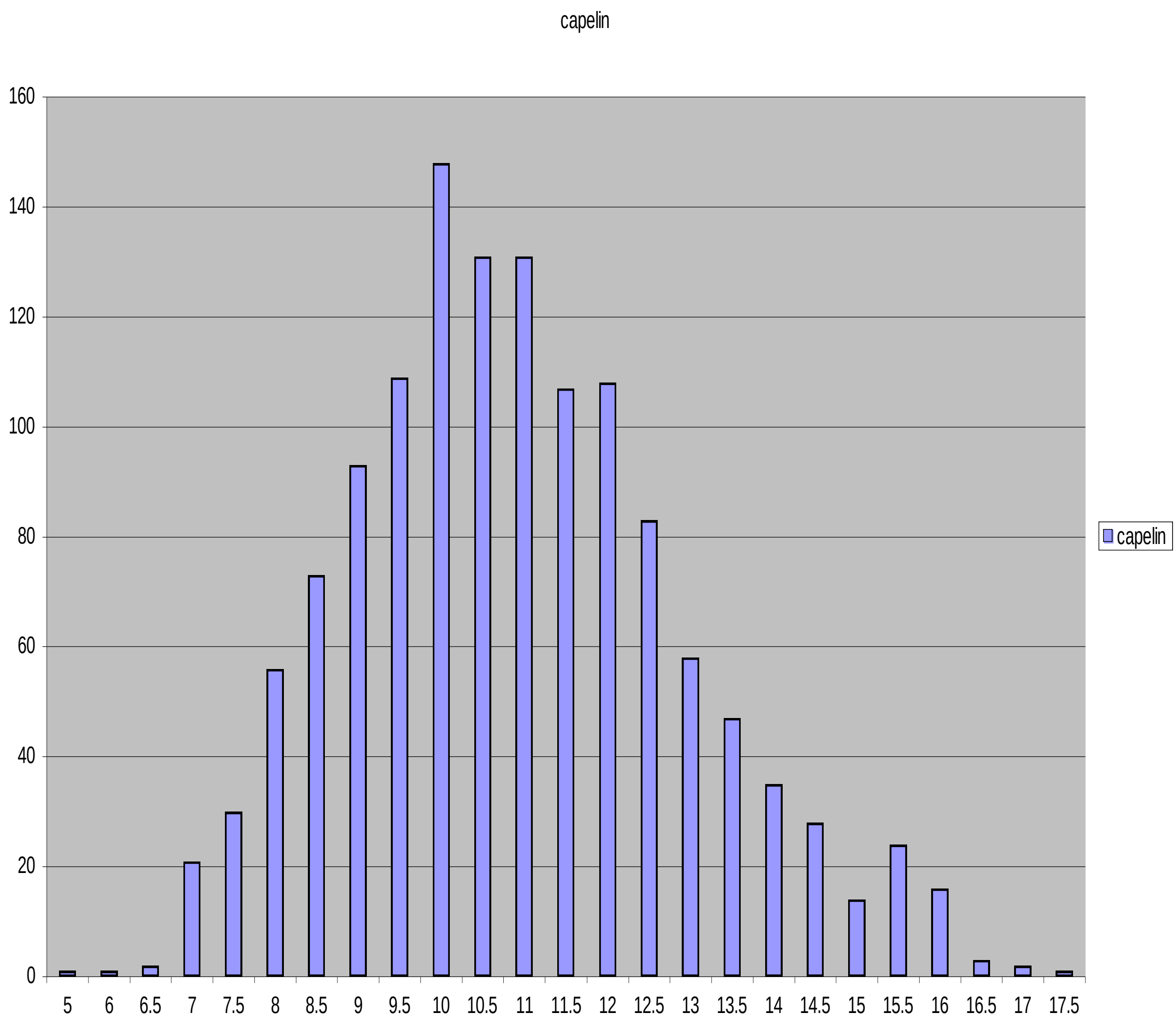


Figure 20. The pooled size distribution of capelin in samples collected during the B11-2005 survey

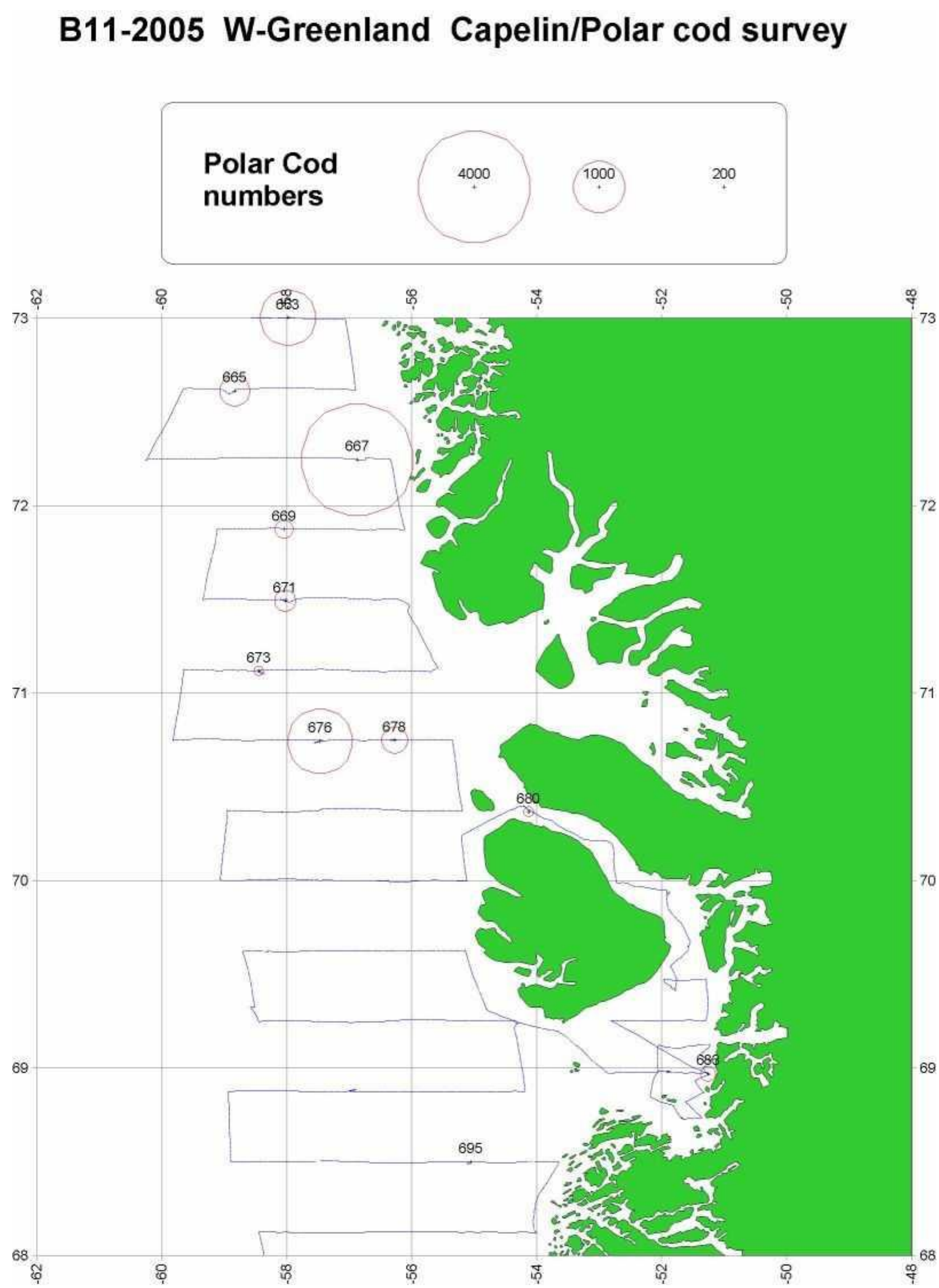


Figure 21: Catches of polar cod (*Boreogadus saida*) in targeted pelagic trawl hauls

B11-2005 W-Greenland Capelin/Polar cod survey

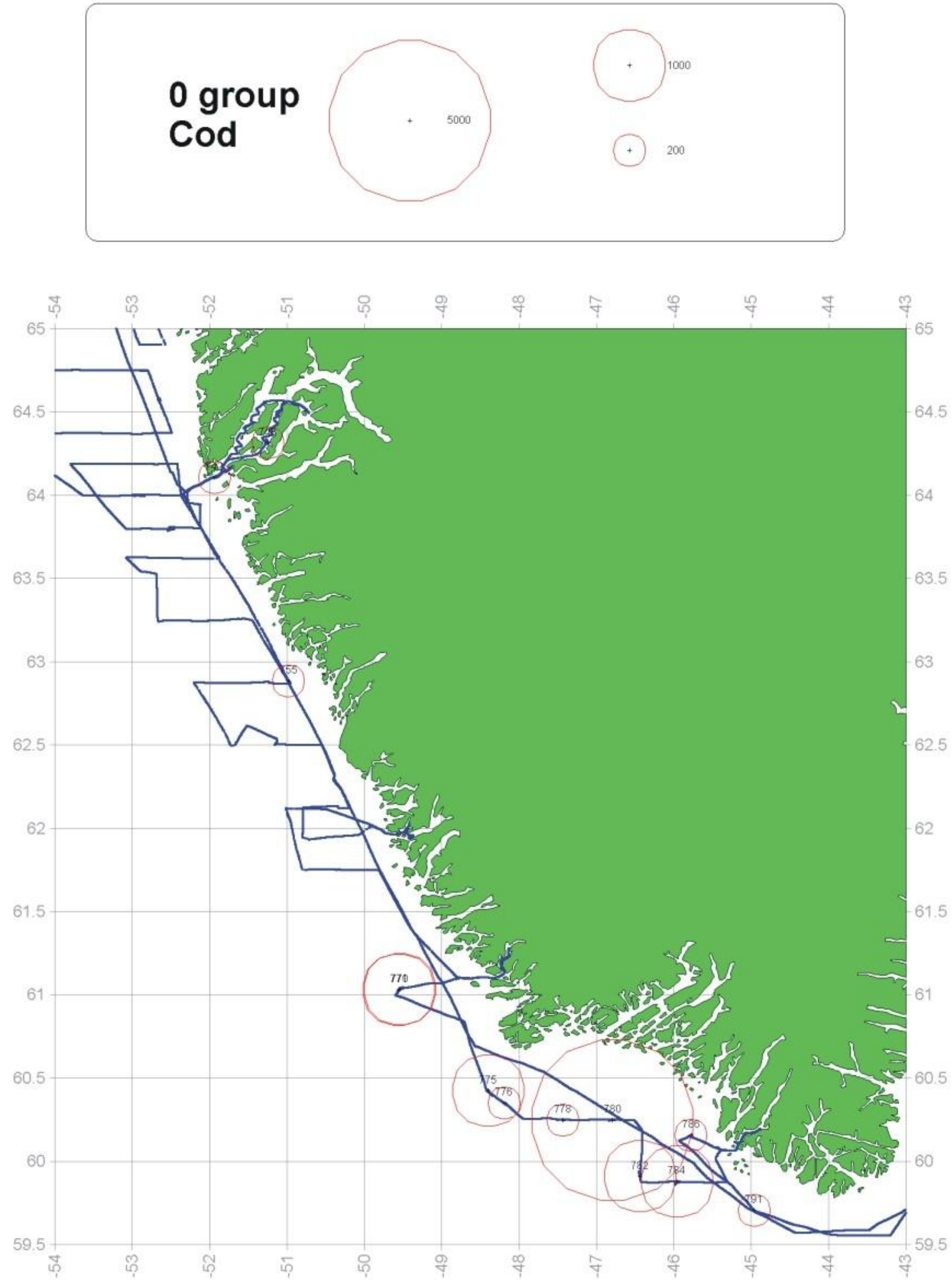


Figure 22. Catches of 0-group cod

in pelagic trawl hauls

Appendix II. Tables for section 2

Table 1. Station list. The total number of stations is 132 of these 54 are Pelagic trawl (GPT and HPT) stations, 20 are Bongo net Stations and 58 CTD stations.

Station #	Date	Gear	GMT start	GMT stop	Haul duration (min)	Lat. start	Long. Start	Lat. stop	Long. stop	Haul Length (N. miles)	Bottom depth start (m)	Bottom Depth Stop (m)	Operation Depth Start (m)	Operation depth Stop (m)
661	Sep 03	GPT	07:50	08:07	17	660490	292060	660460	291808	0.6			260	260
662	Sep 08	GPT	18:20	18:30	10	640200	521430	640160	521960	0.6			120	125
663	Sep 10	GPT	22:59	23:14	15	730020	575900	730030	575920	1.2	272	272	16	16
664	Sep 10	CTD	23:10			730027	575922				272			
665	Sep 11	GPT	06:04	06:19	15	723681	584999	723614	585298	1.2	206	216	15	20
666	Sep 11	CTD	08:50			721500	601400				403			
667	Sep 11	GPT	16:28	16:43	15	721480	565230	721460	564840	1.4	266	266	16	15
668	Sep 11	CTD	17:20			721520	564400				260			
669	Sep 12	HPT	00:00	00:15	15	715250	580260	715260	580613	0.7	276	276	8	12
670	Sep 12	CTD	00:30			715279	580717				276			
671	Sep 12	HPT	07:35	08:05	30	712952	580176	712909	575701	2	286	285	265	270
672	Sep 12	CTD	08:30			712948	575478				282			
673	Sep 12	HPT	19:38	20:08	30	710716	582688	710629	582233	1.6	369	369	10	15
674	Sep 12	CTD	20:27			710623	582103				369			
675	Sep 13	CTD	01:11			704495	594947				475			
676	Sep 13	HPT	05:58	06:28	30	704468	572784	704443	573225	1.7	506	503	180	200
677	Sep 13	CTD	06:45			704411	573354				503			
678	Sep 13	HPT	09:50	10:05	15	704497	561672	704487	561944	1	573	573	10	14
679	Sep 14	CTD	10:55			702272	542394				341			
680	Sep 14	HPT	12:14	12:30	16	702200	540800	702360	541120	0.9			220	235
681	Sep 14	Bongo	19:40	19:52	12	695607	515277	695570	515364	0.5	402	524	260	260
682	Sep 14	CTD	20:02			695561	515369				527			
683	Sep 15	HPT	18:02	18:25	23	685825	511538	685857	511743	0.8	265	265	110	200

684	Sep 15	CTD	18:49			685854	511979				247			
685	Sep 16	Bongo	00:33	00:43	10	684406	513981	684420	514109	0.5	282	278	25	30
686	Sep 16	CTD	00:51			684419	514129				277			
687	Sep 17	HPT	11:02	11:23	21	693742	581521	693750	581835	1.1	298	298	8	12
688	Sep 17	CTD	11:36			693734	581853				298			
689	Sep 17	Bongo	14:23	14:33	10	691951	583175	691964	583339	0.6	398	409	25	30
690	Sep 17	CTD	15:02			691946	583441				418			
691	Sep 17	Bongo	23:26	23:36	10	691469	542072	691441	541951	0.5	220	220	150	145
692	Sep 17	CTD	23:50		10	691443	541838				206			
693	Sep 18	Bongo	08:02	08:07	5	685276	565625	685280	565524	0.3	270	270		
694	Sep 18	CTD	06:22			685321	565403				263			
695	Sep 18	HPT	22:57	23:20	23	683004	550340	682969	550634	1.2	430	430	195	135
696	Sep 18	CTD	23:36			682944	550653				432			
697	Sep 19	Bongo	00:08	00:18	10	682950	550472	682970	550349	0.5	422	422	100	100
698	Sep 19	CTD	13:08			680746	575810				402			
699	Sep 19	HPT	19:40	20:10	30	674501	564720	674506	565094	1.3	209	209	40	42
700	Sep 19	CTD	20:22			674499	565152				212			
701	Sep 20	Bongo	00:16	00:21	5	674565	550317	674592	550348	0.3	36	37	28	10
702	Sep 20	CTD	00:30			674606	550358				36			
703	Sep 20	Bongo	07:55	08:15	20	672247	555468	672276	555179	1.1	100	98	15	20
704	Sep 20	CTD	08:25			672284	555105				100			
705	Sep 20	HPT	11:44	12:01	17	672240	571495	672262	571160	1.2	224	224	40	60
706	Sep 20	CTD	12:20			672296	571109				219			
707	Sep 20	HPT	17:42	17:57	15	665866	562946	665956	562917	1.2	287	287	240	260
708	Sep 20	CTD	18:15			670010	562915				279			
709	Sep 20	Bongo	18:53	18:58	5	670029	563139	670014	563205	0.3	296	319	270	270
710	Sep 20	HPT	20:24	20:34	10	665991	560676	665994	560797	0.6	139	129	5	8
711	Sep 20	Bongo	23:14	23:19	5	670003	545990	665986	550026	0.4	59	59	5	10
712	Sep 20	CTD	23:29			665982	550051				68			
713	Sep 21	HPT	12:53	13:18	25	665412	533175	665423	533430	1	370	370	104	120
714	Sep 21	CTD	13:35			665420	533514				320			
715	Sep 21	HPT	19:36	19:53	17	663706	541933	663734	541765	1	309	309	7	10
716	Sep 21	CTD	20:23			663737	541684				306			

717	Sep 22	Bongo	00:03	00:08	5	663748	552582	663730	552633	0.3	163	163	50	60
718	Sep 22	CTD	00:15			663701	552652				164			
719	Sep 22	Bongo	05:04	05:09	5	661745	562845	661773	562851	0.2	444	447	115	112
720	Sep 22	CTD	05:20			661812	562867				446			
721	Sep 22	HPT	10:23			661514	542981				65		18	
722	Sep 22	CTD	11:00			661497	542635				65			
723	Sep 22	Bongo	11:10	11:20	10	661551	542708	661570	542750	0.4	62	62	16	17
724	Sep 22	HPT	16:47	17:17	30	655278	543607	655289	543162	1.8	110	110	15	15
725	Sep 22	CTD	17:30			655200	543126				100			
726	Sep 22	HPT	22:12	22:42	30	654531	554403	654637	554633	1.4	519	519	512	510
727	Sep 22	CTD	23:23			654656	554760				523			
728	Sep 23	HPT	12:55	13:18	23	650738	534002	650756	533767	1	83	83	5	12
729	Sep 23	CTD	13:28			650753	533665				82			
730	Sep 23	HPT	20:27	20:51	24	644530	544980	644393	545006	1.4	280	280	265	265
731	Sep 23	CTD	21:10			644342	544978				280			
732	Sep 24	Bongo	02:35	02:40	5	644489	525086	644491	525162	0.3	319	367	100	100
733	Sep 24	CTD	02:55			644492	525303				416			
734	Sep 24	Bongo	04:47	04:52	5	643413	523843	643441	523848	0.3	480	574	90	90
735	Sep 24	CTD	11:37			642253	545585				540			
736	Sep 24	HPT	18:03	18:43	40	635976	525152	640003	525698	2.2	69	69	11	11
737	Sep 24	CTD	19:17			640014	525980				69			
738	Sep 25	HPT	06:07	06:27	20	634775	522887	634747	523165	1.3	31	38	12	12
739	Sep 25	Bongo	06:47	06:57	10	634771	523215	634821	523163	0.6	37	39	15	18
740	Sep 25	CTD	10:58			640699	515293				351			
741	Sep 25	Bongo	11:17	11:40	23	640695	515308	640631	515481	1	358	357	0	348
742	Sep 25	HPT	11:57	12:14	17	640650	515647	640683	515444	1	373	373	10	15
743	Sep 25	HPT	12:49	13:10	21	640686	515390	640720	515233	1	367	367	185	190
744	Sep 25	HPT	16:39	16:52	13	642599	512713	642555	512871	0.8	386	386	10	15
745	Sep 25	CTD	17:08			642518	512963				611			
746	Sep 25	HPT	18:09	18:24	15	642478	513190	642514	512962	0.6	616	616	310	390
747	Sep 25	HPT	21:36	21:49	13	643263	505088	643292	505263	0.8	584	584	30	25
748	Sep 26	HPT	11:26	11:41	15	641890	511500	641961	511536	0.8	423	423	6	14
749	Sep 26	HPT	12:07	12:22	15	641951	511540	641881	511468	0.8	426	426	110	120

750	Sep 26	Bongo	12:40	12:55	15	641870	511521	641849	511677	0.8	426	426	0	250
751	Sep 26	CTD	13:00			641848	511680				400			
752	Sep 28	CTD	02:20			631488	524035				1335			
753	Sep 28	CTD	05:35			631517	514517				122			
754	Sep 28	Bongo	10:28	10:50	22	625375	510018	625310	505697	1.6	245		215	
755	Sep 28	HPT	11:34	12:01	17	625317	505880	625230	505751	1	260	310	230	235
756	Sep 28	CTD	12:45			625229	505812				316			
757	Sep 28	HPT	22:22	22:45	23	623162	510769	623059	510883	1.3	231	231	80	92
758	Sep 28	CTD	23:08			623010	510950				218			
759	Sep 29	CTD	04:25			620753	502067				304			
760	Sep 29	HPT	13:12	13:24	12	620078	492589	620008	492659	0.7	170	170	155	160
761	Sep 29	CTD	13:45			615984	492698				235			
762	Sep 29	HPT	14:16	14:47	31	615844	493033	615798	493456	2	446	446	15	14
763	Sep 29	CTD	15:03			615784	493555				395			
764	Sep 29	HPT	22:42	23:05	23	620536	505959	620447	505932	1	977	977	40	50
765	Sep 29	CTD	23:20			620434	505915				860			
766	Oct 01	HPT	11:26	12:08	42	610971	481371	611189	481416	2	703		100	120
767	Oct 01	HPT	12:41	13:23	42	611130	481376	610920	481296	2	580	580	300	370
768	Oct 01	CTD	13:45			610945	481343				574			
769	Oct 01	Bongo	14:17	15:07	50	610984	481336	611209	481438	2.3	435	410	0	350
770	Oct 01	HPT	22:09	22:29	20	610202	493260	610125	493376	1.1	188	210	165	178
771	Oct 01	HPT	23:12	23:32	20	610192	493333	610111	493411	1	200	200	99	115
772	Oct 01	CTD	23:54			610056	493434				434			
773	Oct 02	HPT	06:12	06:30	18	602406	482170	602492	482325	1	244	237	80	110
774	Oct 02	CTD	07:00			602551	482411				212			
775	Oct 02	HPT	07:20	07:38	18	602549	482395	602493	482323	0.8	216	240	90	90
776	Oct 02	HPT	09:06	09:24	18	602117	481180	602161	481364	1	194	195	120	120
777	Oct 02	CTD	09:55			602078	481106				196			
778	Oct 02	HPT	12:53	13:15	22	601494	472609	601503	472896	1.4	138	141	90	120
779	Oct 02	CTD	13:47			601509	473024				140			
780	Oct 02	HPT	16:22	16:47	25	601492	464747	601495	465008	1.2	339	339	100	120
781	Oct 02	CTD	17:24			601471	465035				493			
782	Oct 02	HPT	20:27	20:47	20	595463	462636	595571	462684	1	868	868	60	65

783	Oct 02	CTD	21:00			595624	462705				692			
784	Oct 02	HPT	23:41	00:00	19	595277	455758	595207	455927	1	133	133	80	90
785	Oct 03	CTD	00:22			595173	435878				137			
786	Oct 03	HPT	07:31	07:52	21	600941	454667	600904	454855	1	151	145	60	60
787	Oct 03	CTD	08:02			600890	454900				133			
788	Oct 03	HPT	12:52	13:07	15	601112	445500	601073	445658	0.7	353	353	110	130
789	Oct 03	HPT	14:03	14:21	18	601022	450214	601006	450048	1	320	320	305	310
790	Oct 03	CTD	14:42			601009	450012				362			
791	Oct 03	HPT	21:29	21:57	28	594239	445770	594165	445628	1	131	131	70	80
792	Oct 03	CTD	22:15			594149	445591				126			

Table 2: "CPUE index" (kg/min) for dominating taxa in pelagic trawl catches obtained during the 2005 West Greenland acoustic Capelin survey.

Station #	Gear	Date (2005)	Start GMT	Haul duration (min)	Capelin (Kg/min)	Polarcod (Kg/min)	G. Halibut (Kg/min)	0-group Cod (Kg/min)	Haddock(Kg/min)	Sebastes. sp 0-group (Kg/min)	Sand eel (Kg/min)	Myctophids (Kg/min)	Pandalus CPUE ((Kg/min)	Krill & Mysids(Kg/min)	Amphipoda (Kg/min)	Cephalopoda (Kg/min)	Scyphozoa (Kg/min)	Total catch (Kg/min)
662	PT1	8-Sep	18:20:00	10.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
663	PT1	10-Sep	22:59:00	16.00	-	0.07	-	-	-	-	-	-	-	-	0.18	-	-	0.26
665	PT1	11-Sep	06:04:00	15.00	-	0.01	-	-	-	-	-	-	-	0.01	0.01	-	-	0.08
667	PT1	11-Sep	16:28:00	15.00	-	0.27	-	-	-	-	-	-	-	-	0.05	-	-	0.39
669	PT2	12-Sep	00:00:00	15.00	-	0.01	-	-	-	-	-	-	-	-	-	-	-	0.01
671	PT2	12-Sep	07:35:00	30.00-	-	-	-	-	-	-	-	-	0.23	-	-	-	-	0.29

673	PT2	12-Sep	19:38:00	3.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
676	PT2	13-Sep	05:58:00	30.00-	-	0.05	0.05	-	-	-	-	-	0.02	0.01	0.01	-	-	0.16
678	PT2	13-Sep	09:50:00	15.00	-	0.02	-	-	-	-	-	-	-	-	-	-	-	0.02
680	PT2	14-Sep	12:14:00	16.00	0.32	-	-	-	-	-	-	-	0.45	-	-	-	-	0.77
683	PT2	15-Sep	18:02:00	23.00	0.45	0.01	-	-	-	-	-	-	0.08	-	-	-	-	0.56
687	PT2	16-Sep	11:02:00	21.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0
695	PT2	18-Sep	22:57:00	23.00	0.01	-	-	-	-	-	-	-	0.06	0.02	0.02	-	-	0.11
699	PT2	18-Sep	19:40:00	30.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
705	PT2	20-Sep	12:14:00	30.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
707	PT2	20-Sep	17:42:00	15.00	-	-	0.01	-	-	-	-	-	0.36	0.27	-	0.01	-	0.66
710	PT2	20-Sep	20:24:00	10.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
713	PT2	21-Sep	12:53:00	25.00	3.00	-	-	-	-	-	-	-	-	-	-	-	-	3
715	PT2	21-Sep	19:36:00	17.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0
721	PT2	22-Sep	10:22:00	20.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
724	PT2	22-Sep	16:47:00	30.00-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	0.1
726	PT2	22-Sep	22:12:00	30.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
728	PT2	23-Sep	12:55:00	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0
730	PT2	23-Sep	20:27:00	24.00	-	-	-	-	-	-	-	-	0.10	1.54	-	0.02	0.21	1.87
736	PT2	24-Sep	18:02:00	41.00	-	-	-	-	-	-	-	-	-	-	-	-	0.01	0.01
738	PT2	25-Sep	06:07:00	20.00-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04
742	PT2	25-Sep	11:57:00	17.00	0.02	-	-	-	-	-	-	-	-	-	-	-	-	0.07
743	PT2	25-Sep	12:49:00	11.00	3.64	-	-	-	-	-	-	-	-	-	-	0.01	-	3.65
744	PT2	25-Sep	16:39:00	13.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0
746	PT2	25-Sep	18:09:00	15.00	-	-	-	-	-	-	-	-	-	0.05	-	-	-	2.19
747	PT2	25-Sep	21:36:00	13.00	4.51	-	-	-	-	-	-	-	-	-	-	0.01	-	4.51
748	PT2	26-Sep	11:26:00	15.00	0.01	-	-	-	-	-	-	-	-	-	-	-	0.27	0.27
749	PT2	26-Sep	12:07:00	15.00	0.33	-	-	-	-	-	-	-	-	-	-	-	-	0.49
755	PT2	28-Sep	11:34:00	27.00	0.13	-	0.05	-	-	-	-	0.01	0.65	1.81	0.13	0.01	-	2.79
757	PT2	28-Sep	22:22:00	23.00	-	-	-	-	-	-	-	-	-	1.87	-	-	-	1.88

760	PT2	29-Sep	13:12:00	12.00	0.13	-	-	-	-	-	-	-	-	0.60	-	-	-	0.73
762	PT2	29-Sep	14:16:00	31.00	0.56	-	-	-	-	-	-	-	-	-	-	-	-	0.57
764	PT2	29-Sep	22:42:00	23.00	-	-	-	-	-	-	-	0.73	-	0.73	-	-	0.72	2.17
766	PT2	1-Oct	11:26:00	42.00	0.47	-	-	-	-	-	-	-	-	-	-	-	-	0.49
767	PT2	1-Oct	12:41:00	42.00	-	-	0.03	-	-	0.12	-	-	-	0.02	-	0.01	0.13	0.31
770	PT2	1-Oct	22:09:00	20.00-	-	-	-	0.01	-	0.08	-	-	-	-	-	0.01	0.13	0.23
771	PT2	1-Oct	23:12:00	20.00-	-	-	-	0.09	-	0.14	-	-	-	0.01	-	-	0.04	0.28
775	PT2	2-Oct	07:20:00	18.00	-	-	-	0.09	-	0.06	-	-	-	-	-	-	0.01	0.17
776	PT2	2-Oct	09:06:00	18.00	-	-	-	0.01	-	0.77	-	-	-	0.01	-	0.03	-	0.83
778	PT2	2-Oct	12:53:00	22.00	-	-	-	-	-	0.02	-	-	-	0.04	-	-	-	0.06
780	PT2	2-Oct	16:22:00	25.00	-	-	-	0.36	-	0.01	-	-	-	-	-	0.01	0.15	0.53
782	PT2	2-Oct	20:27:00	20.00-	-	-	-	0.05	-	-	-	-	-	-	-	0.01	0.06	0.12
784	PT2	2-Oct	23:41:00	19.00	-	-	-	0.03	-	-	-	-	-	0.01	-	-	0.02	0.05
786	PT2	3-Oct	07:31:00	21.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
788	PT2	3-Oct	12:52:00	15.00	1.66	-	-	-	-	-	-	-	-	-	-	-	0.04	1.77
789	PT2	3-Oct	14:03:00	18.00	0.01	0.04	-	-	-	-	-	-	-	0.28	0.03	-	0.36	0.89
791	PT2	3-Oct	21:29:00	28.00	-	-	-	0.01	-	-	-	-	-	0.09	-	-	-	0.11

Table 3. Biomass estimates for capelin in near shore and fjord environments during the 2005 West Greenland Acoustic Capelin Survey

Area	Number of 1 nmi observations	Mean NASC (m^2/nmi^2)	Maximum NASC (m^2/nmi^2)	Mean capelin area density (t/nmi^2)	Maximum capelin area density (t/nmi^2)	Mean target strength (dB)	Mean weight (g)
Vaigat	14	170	531	28.3	88.2	-52.4	12.8
Disko	34	1379	15507	233.8	2575.5	-55.0	6.6
Amerloq (south of Sisimiut),	34	851	2509	98.4	290.0	-55.6	4.0
Godthåb fjord	196	1154	11720	170.2	1729.4	-54.9	6.0
Kvane fjord	45	776	2460	102.2	324.1	-55.2	5.0
Arsuk fjord	72	495	3493	52.2	368.1	-55.2	4.0
Tasermiut fjord	27	262	1002	42.0	160.6	-53.8	8.4

Table 4. Scientific cruise participants

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Appendix III. Section 2: Instrumentation and sampling gear

Pelagic trawl for sampling of echo recordings
Type: Harstad 16x16 fm with 83 m bridles.
Mesh size in codend 10 mm, with a covering of 5 mm mesh netting, reaching about 5-6 m up from the bottom.
Vertical opening: 10 m at a towing speed of 2.5-3 knts.
Range: From 15 m from surface to 5-10 m from bottom.

Acoustic instrumentation:
Echo sounder: Simrad ER60
Transducer: ES38B
Frequency: 38 kHz
Beamtype: Split
Gain: 24.50 dB
Sa correction: -0.56 dB
2-way beam angle: 20.70 dB
Angle sensitivity: Along: 21.90; Athwart: 21.90
Offset: Along: 0.10°; Athwart: 0.06°
Beamwidth: Along: 7.60°; Athwart: 7.02°
Pulse duration: 1024 µsec.
Sampling interval: Variable
Power: 2000 w
Receiver bandwidth: 2.43 kHz

Transducer: ES 120-7
Frequency: 120 kHz
Beamtype: Split
Gain: 26.86 dB
Sa correction: -0.73 dB
2-way beam length: 20.50 dB
Angle Sensitivity: Along: 21.00; Athwart: 21.00 dB
Angle Offset: Along: 0.43°; Athwart: 0.08°
3-dB Beam width: Along: 6.73°; Athwart: 7.02°
Pulse duration: 256 µsec.
Sampling interval: Variable
Power: 500 w
Receiver Bandwidth: 8.71 kHz

Transducer: ES18-11
Frequency: 18 kHz
Beamtype: Split
Gain: 22.99 dB
Sa correction: -0.65 dB

2-way beam angle: -17.30 dB
Angle Sensitivity: Along: 16.0; Athwart: 15.70
Angle Offset: Along: -0.11°; Athwart: -0.01°
3-dB Beam width: Along: 9.70°; Athwart: 9.52°
Pulse duration: 1024 μsec.
Sampling interval: Variable
Power: 2000 w
Receiver bandwidth: 1.57 kHz

Sonar: Simrad SP70 - Long Range Fisheries Sonar
Direction: Omni
Frequency: Variable between 18 and 30 kHz
TX-Power: 2000 w

Post-processing facilities
BI500 Echo Integrator (Foote et al., 1991)
EchoView Post-processing Software (SonarData 2002)
Main Postprocessor modules: Base Module, Analysis Export Module and Scripting Module.

Hydrography
CTD – SeaBird Electronics
Continuous T/S recorder – SBE21E (SeaBird Electronics)

Appendix IV. Section 2: Data inventory from Capelin survey (B11-2005)

Below is a list of the data sets in the root folder on the 'survey disk' sent to GINR in late November 2005. The directory structure on the disk is followed with a brief description of each folders content.

1) 18khz
   a) Folders containing one day of acoustic collections on 18kHz names as 'dMMDD'.
2) 38khz
   a) As above for 38kHz.
3) 120khz
   a) As above for 120kHz.

The first 3 folders contain files from the BI500 postprocessing system (.Vlog, .Ping, .Info, .Data with data, and .Snap, .Work with layers and interpretation). The data files were used as input for further processing in EchoView.

4) BI500files

Various files generated by BI500, datadumps and report tables containing initial interpretation, not used in further analysis except for comparison ('bakkekontakt').

5) EK60

Calibration (Foote et al. 1987; Reynisson 1985, 1990). Three files, one for each echo sounder frequency, giving details of the last calibration of the echo sounders, on 27 - 28 April 2005 for 120kHz and 38kHz, on 30 April 2004 for 18kHz.

6) Folders containing one day of acoustic collections names as 'dMMDD'.
   a) Raw data files in EK60.

7) dg_files
   a) Raw data files in EK500 format.

8) EVExports

As of now, one folder for each of 6 different types of data exports from EchoView generated with visual basic EchoView scripts (.vbs in folder EVScripts). The same naming conventions apply for all the cvs-files, i.e. filenames start with the name of the EchoView-file (.ev in folder EVFiles) which generated the output, followed by an acronym denoting the transducer/frequency used (SvQ2 for 38kHz, SvQ3 for 120kHz) followed by a four letter acronym for the type of export made. The acronyms are: ARIN for export:analysis by region: integration, by area enclosed on a polygon on the echogram and assigned to species; ACIN for export:analysis by cells: integration, gridded export of acoustic backscatter; and ABIN for export: analysis by regions and cells: integration, intersection of regions and grid cells, backscatter assigned to species. A thresold of -70dB was set for both

38kHz and 120kHz, a time varied threshold of -115dB was set for 120kHz as a remedy for reducing noise.

9) RawOutput
Raw or uncleaned total acoustic bacscatter over a 0.5nm by 5m grid, above BI500 bottom and below a line 5m from the face of the transducers, no other exclusions.

10) SpeciesByRegions
Average backscatter by regions assigned to species on the echogram not extending above the 3m line and below BI500 bottom. Contains mainly capelin, but two regions of shrimp are included as well. Note that registrations on stations are included in these data. The majority of registrations in many of the fjord areas (where capelin were mainly observed) were taken during operations, it was felt it would be wasteful to exclude them.

11) speciesByRegionsCells0.5nm5m
Backscatter assigned to species integrated by grid cells and regions, intersects of the standard grid and capelin (and the beginnings of shrimp) regions. Same grid and exclusions as in 'total' export.

12) SpeciesByRegionsCells1nm
Backscatter assigned to species integrated by grid cells and regions, intersections of a 1nm by 500m grid (essentially projecting the registrations on to a plane/the surface) and capelin (and the beginnings of shrimp) regions. Stations included as in speciesByRegions, used in further analysis of capelin densities based on 'one mile average NASC/sA values.

13) surfaceOutput
Backscatter in the surface layers, below 3m and above 50m, with a 0.5nm by 1m resolution after excluding 'bad data' and registrations on stations. This export was made to enable further study of near surface registrations.

14) totalOutput
Total along transect backscatter over a grid of 0.5nm by 5m after excluding 'bad data' and registrations on stations. The whales and birds data set.

15) EVFiles
EchoView files named 'dMMDD_MMDD.ev' for the range of collection dates indicated. Each file contains both 38 and 120kHz. September 11 is included in both d0908_0911.ev and d0911_015.ev since there was a gap in the BI500 fileset which has later been filled with files generated from raw data. The ev-files refer to BI500 files in folders 38khz and 120khz and can be opened for viewing in the EchoView program without a licence dongle.

16) EVScripts

Visual basic EchoView scripts used to export acoustic backscatter over a grid, by regions or by grid and regions.

17) HafVog_SeaScale
XML-files from the fish biology collection program used by MRI. The data itself is found as xl-files in folder Stations_and_samples.

18) Hydro
a) avg
Binned averages over 1m of the CTD data in cnv-files (next folder).
b) cnv
ASCII output of binary data from CTD.
c) cnv_filtered
Filtered CTD data from a few problem cast/stations.

19) Depth and position
Depth (corrected for transducer depth) along track based on 18kHz for the whole survey with date and time added.

20) Siriti
Registrations of temperature and salinity at ~4m depth at approximately 1min intervals as ASCII-files named by date. Note that there are gaps in this collection (GPS missing, pump malfunctioning).

21) Stations_and_samples
XL-files with station information and data from biological samples and their preliminary analysis.

22) Vinnumappa
a) DypisSkrar
Same as in ‘Kaj’ but only for the area west of Greenland. Used as basis for Bjössi’s maps.
b) Graenlandslinur
Data from Kaj with outline of Greenland, a selection of depth contours and the 3nm boundary as .mif.
c) output_maps
Various maps of the survey as pdf, possibly mif.
d) Mapfiles
Surfer and MapView files and the final map containing 'everything', xl-files with data sets used as basis for the maps

3. Marine mammals

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The part of the GINR 2005 Capelin survey concerning marine mammal had two main objectives.

1) To map the distribution of marine mammals along the survey track line in order to investigate possible correlations with distribution of fish, crustaceans and seabirds.
2) To provide a data set on which to base population estimates for fin whales, minke whales and humpback whales.

3.1. Material

Observation platform with windshield, 2 angle boards, 2 handheld GPS',4 distance sticks and tables, Binoculars (1 pair of Fujinon 16x70, several pairs of 8x42), Clipboards, pens, effort sheets and sightings sheets, 2 stopwatches, Digital SLR camera (Canon EOS 20) with a 70-300mm zoom lens for photo identification pictures

3.2. Methods

We used line transect distance sampling methods (Buckland et al. 2001) to collect data for population estimates. Observations were made from a large wooden "box" (H: 145 cm, D: 180 cm, L: 226 cm) fitted with an effective windshield. This observation "box" was placed on the roof of the bridge 10,3 m above sea level.

The team of four marine mammal observers were watching in pairs from the main platform during watches of 2-3 hours. Each observer covered a 90-degree sector in front of the vessel. The observers only used the binoculars for species identifications after recording a sighting. On-effort observations were carried out during all hours of daylight when weather conditions permitted (sea state less than 6 and visibility more than 500 m). However, on special occasions (e.g. when the weather was likely to improve in the near future and we were entering an especially interesting area) the observers would stay at the platform in sea states of up to 8.

During observations an effort log was updated every half hour or if observation conditions changed. The effort log contains information about GMT time, locations, heading of the ship, weather and visibility. Most of this information was obtained with a handheld GPS or ships navigational instruments. A sighting log was kept for each sighting and the angle and distance to the animals was measured using angle boards and distance sticks. Whenever possible, the breathing interval of the large whales was measured using a stopwatch.

3.3. Results

During the total of 222 hours on-effort observations, 195 sightings were made of 577 individuals. Thirteen species of cetaceans were sighted. Table 1 shows the number of individuals observed of each species and figure 1-4 shows where on the track line the species were observed.

Table 1. The numbers of observations of each of the different species of marine mammals observed during the survey.

Latin	**English**	**Greenlandic**	**Danish**	**Number of sightings**	**Number of individuals**
Balaenoptera musculus	Blue whale	Tunnulik	Blåhval	2	2
Balaenoptera physalus	Fin whale	Tikaagulliusaaq	Finhval	58	92
Balaenoptera borealis	Sei whale	Tikaagulliusaarnaq	Sejhval	18	27
Balaenoptera acutorostrata	Minke whale	Tikaagullik	Vågehval	14	14
Megaptera novaeangliae	Humpback whale	Qipoqqaq	Pukkelhval	30	46
Eubalaena glacialis	Northern right whale	Arfiviit arlaat	Nordkaper	1	1
Physeter macrocephalus	Sperm whale	Kigutilissuaq	Kaskelot	10	13
Ziphiidae sp.	Beaked whale	-	Næbhval	1	1
Orcinus orca	Killer whale	Aarluk	Spækhugger	2	8
Globicephala melas	Long-finned pilot whale	Niisarnaq	Langluffet grindehval	2	11
Lagenorhynchus albirostris	White-beaked dolphin	Aarluasuk	Hvidnæse	4	18
Lagenorhynchus acutus	Atlantic White-sided dolphin	Aarluasuk	Hvidskæving	4	140
	Unidentified dolphins			2	100
Phocoena phocoena	Harbour porpoise	Niisa	Almindeligt marsvin	1	2
	Unidentified cetacean			33	35
Pagophylus groenlandicus	Harp seal	Ataaq	Grønlands sæl	7	62
	Seal	-	Sæl	7	7

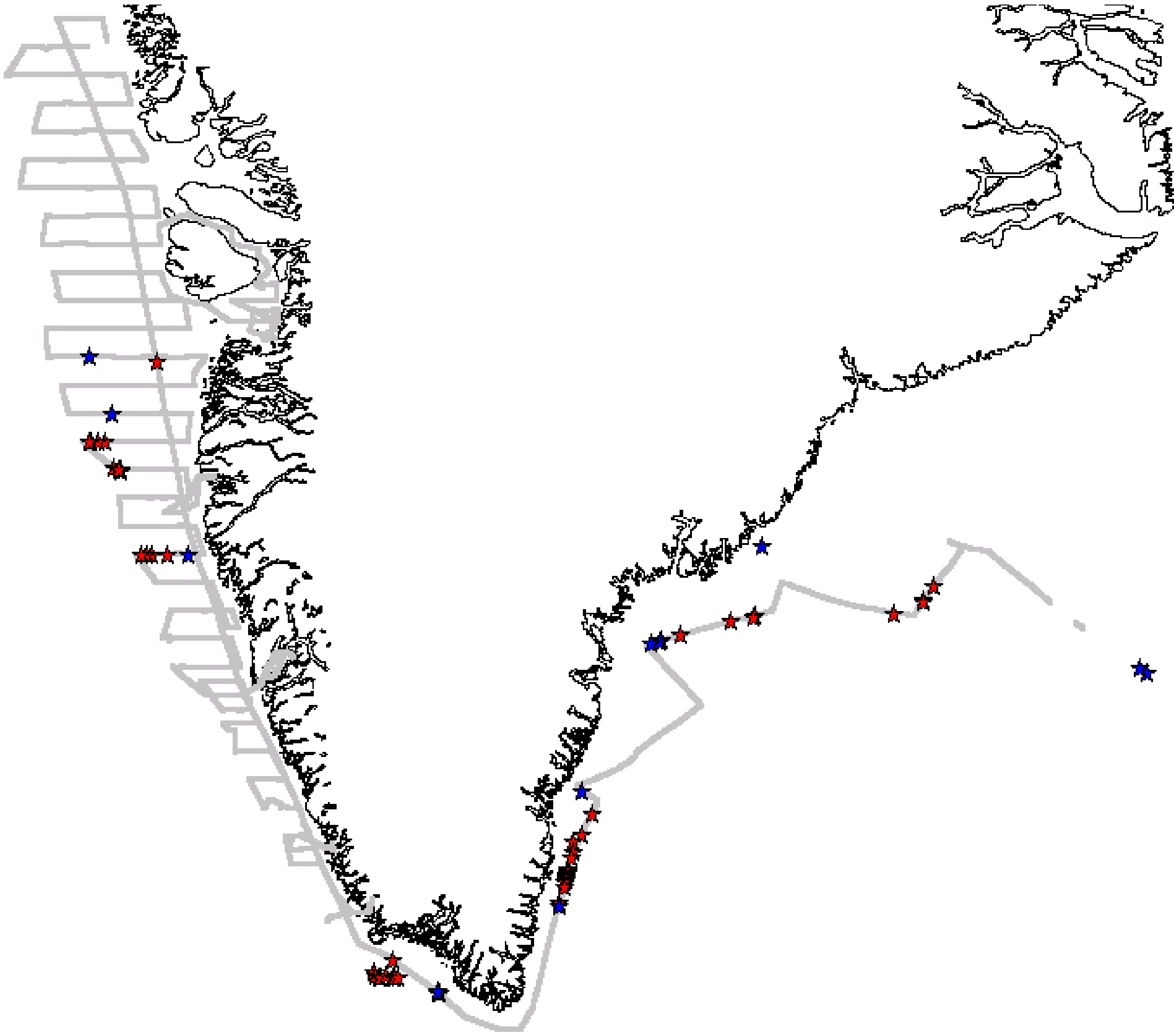

Figure 1. Sightings of fin whale (red) and minke whale (blue).

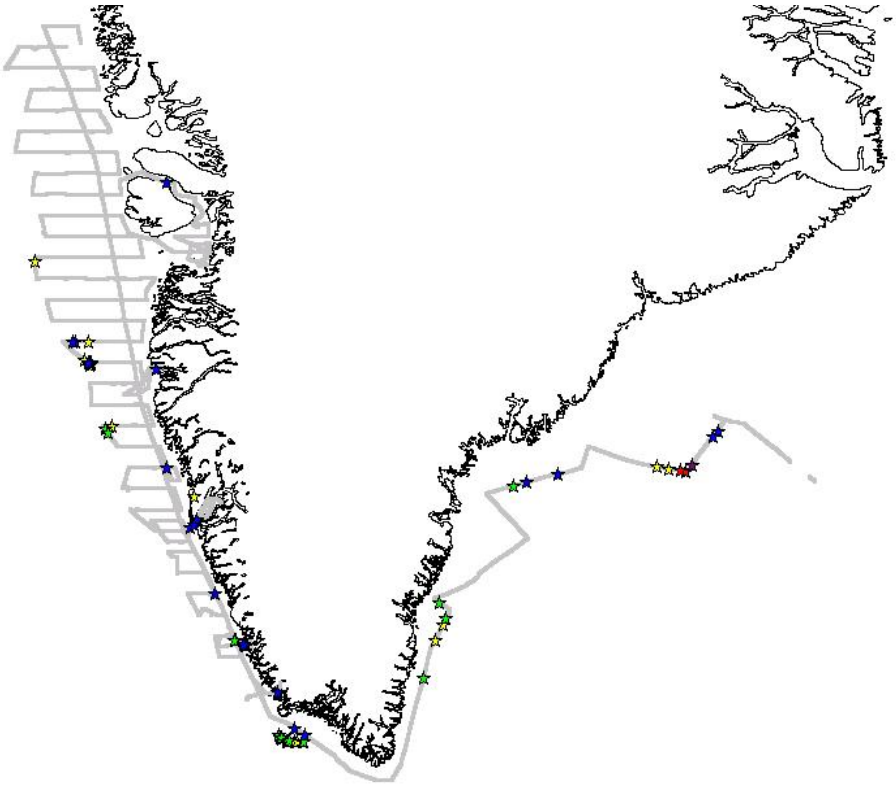

Figure 2. Sightings of humpback whales (blue), blue whales (red), sei whales (green), bowhead or northern right whale (purple) and unidentified large whales (yellow).

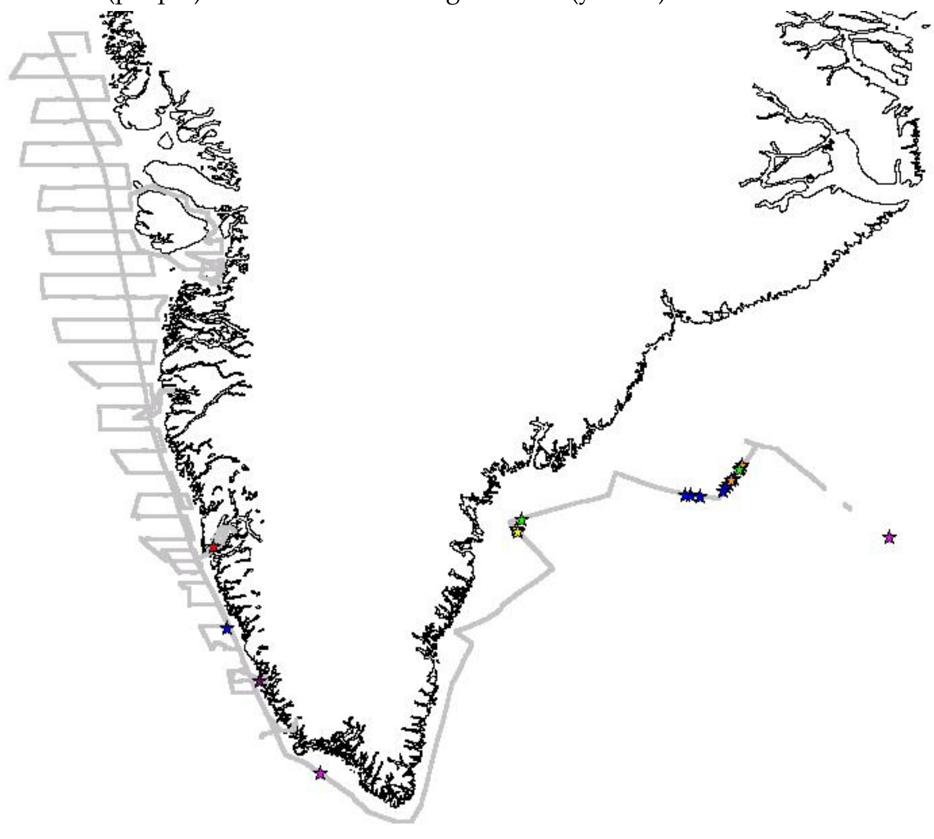

Figure 3. Sightings of sperm whales (blue), pilot whales (orange), white sided dolphins (green), white beaked dolphins (magenta), killer whales (yellow) and unidentified beaked whale (purple).

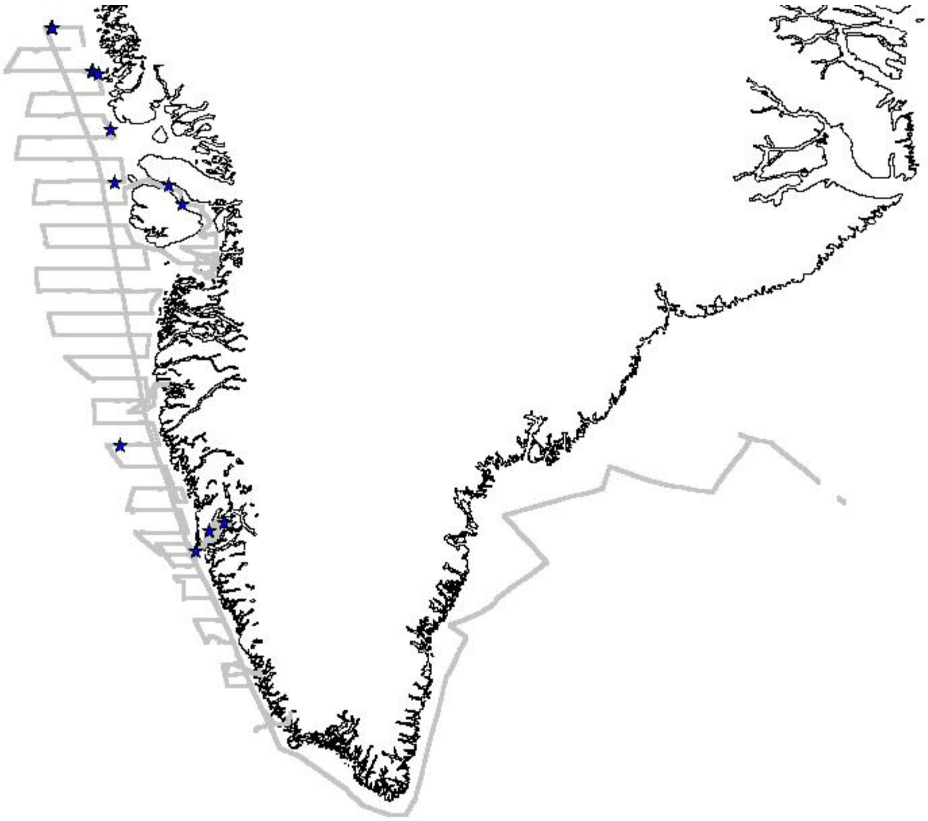

Figure 4. Sightings of seals.

3.4. Discussion

The largest diversity of cetaceans was observed in the Denmark Strait and off East Greenland's coast where 11 of the 13 cetacean species were seen.

Fin whale sightings were often aggregated in offshore areas, with the core areas being between Disko Bay and Sisimiut, west of Kap Farvel and off King Frederik VI's coast up to Ammassalik. Minke whales were observed in the same areas as the fin whales. No cetaceans were observed north of Disko Bay

Humpback whales were observed both off and in-shore. It was the only species of large baleen whales, observed inside the fjords, usually close to the mouth of the fjord (Figure 2).

We expect to be able to calculate a population estimate for fin whales and humpback whales. Unfortunately there were too few observations of minke whales to make an estimate for that species.

3.5. References

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. (2001). Introduction to Distance Sampling. Estimating abundance of biological populations. *Oxford University Press.*

4. Seabirds

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4.1. Objective

To study the spatial and temporal distribution of seabirds in relation to their potential prey species Capelin and Krill.

4.2. Methods

Observations were made from a large wooden "box" (H: 145 cm, D: 180 cm, L: 226 cm) fitted with a windshield. The observation "box" was placed on the roof of the ship's bridge 10.3 m above sea level. Counts of birds were conducted in 10-minute periods in a band 300 m wide on one side of the ship following Tasker et al. (1984) and Webb & Durinck (1992). Here all birds (species and numbers) were recorded. Observations were carried out during daylight hours whenever weather conditions allowed. For each 10-minute observation period we recorded start and stop time (local Greenland time) and start and stop GPS position (with hand held GPS´) of the observation, precipitation, sea ice, wind speed and direction and visibility. Further, non-systematic observations were carried out on a regular basis during the whole cruise.

4.3. Preliminary Results and Discussion

Almost four-hundred ten-minute observations were carried out during the cruise covering 67 observation hours. A total of 34 bird species were recorded of which 27 were observed within the 300 m. transect band during the systematic counts (Table 1.). The most common and numerous species recorded was Fulmar (*Fulmarus glacialis*) (n>2578 in the 300 m. transect band) followed by Kittiwakes (*Rissa tridactyla*) (n=2132), Little Auks (*Alle alle*) (n=1675) and Brünnich's Guillemots (*Uria lomvia*) (n=347). Fulmars were seen near the ship almost all the time during the cruise. Occasionally Fulmars occurred in such large numbers around the ship that made systematic counts of this species impossible, due to the risk of double counting.

<u>Fulmars</u> occur in various colour morphs from a white/light face to a dark brown face. Our results showed c. 1% dark birds (n=1144) north of 66°N which was significantly fewer compared to the 5% dark birds (n=309) that was found south of this latitude (Chi^2 = 1293.3, df=1, with Yate's correction). In the Disko Bay region 3% dark birds were seen (n=102).

<u>Kittiwakes</u> were also seen in large numbers and were most common south of 68°N. We divided Kittiwake recordings into age groups; i) adults and 2nd year birds and ii) 1st year birds. There was no clear latitudinal distribution in the proportion of i) and ii). The vast majority of Kittiwake recordings were adults and 2nd year birds. The overall proportion of 1st year birds was only c. 1.5%.

<u>Little Auks</u> were the most numerous alcid species. It was usually recorded near the edge of the shelf and on the Banks in accordance with Falk & Durinck (1996). They occurred most commonly between 67°N and 70°N.

Most Brünnichs Guillemots were observed south of 68°N with highest concentrations in the most southerly part of the cruise; i.e. 61°N-62°N. Often a large adult bird was associated with a smaller bird, most likely an adult male with it's offspring.

Two species of Skuas were recorded; Pomarine (n=6) and Arctic Skua (n=15) and eight unidentified Skuas (Pomarine or Arctic). Pomarine Skuas do not breed in Greenland and those seen are likely to be of Canadian origin. Contrary, the origin of the Artic Skuas is more unclear since they breed both in Canada and Greenland.

Apart from Kittiwakes the most numerous gull species seen was Iceland Gull (n=345), which was mostly seen in the fjords and close to land. Contrary, Glaucous Gull (n=309) was both seen near the coast but also furthest off shore.

No King Eiders were observed during the systematic counts and only 11 were seen during the un-systematic counts. Store Hellefiske and Fyllas Banks are known to be important wintering sites for this species (Boertmann et al. 2004) however, and the ships' transect route did cover parts of these areas. Therefore, significant numbers of King Eiders may not have arrived at to the banks at the time of the cruise.

Relatively few Common Eiders were seen (n=325). The highest number observed was a flock of c. 300 birds in Godthåbsfjorden. Godthåbsfjorden is an important wintering area for Common Eiders and the birds recorded may be over wintering birds arriving early.

Only six recordings of Sooty Shearwaters have been documented prior to the present cruise (Boertmann 1994). Sooty Shearwaters are seen around Iceland regularly and it is therefore likely that this species also occur in Greenland waters on a regular basis but is not recorded.

Six Common Scoters were seen; a species that has never been officially recorded in Greenland before.

The acoustic Capelin and Krill survey offered an outstanding opportunity to map the distribution of seabirds off west Greenland during autumn and to study the relationship between seabirds and their potential prey species. However, the latter part of the project has not yet been done.

During September the marine waters off west Greenland support a diverse group of seabirds (Durinck & Falk 1996, this study). Some Greenland breeders are leaving (i.e. Kittiwakes and Fulmars), some stay for the winter (e.g. some of the Brünnichs Guillemots and Eiders) and some foreign birds arrive to spend the winter in these waters (Brünnichs Guillemots, King and Common Eiders) (Salomonsen 1967, Lyngs 2003). Hence, the distribution pattern of the birds may have reflected this very dynamic time of the year.

The surface feeders Fulmars and Kittiwakes leave Greenland waters to spend the winter at more southerly latitudes (Lyngs 2003). This may reflect that their particular prey species are absent from the uppermost layers during the coldest months in winter. During our cruise both of these species were present in large numbers suggesting that large concentrations of their prey was still available. However, already in early November most Fulmars and Kittiwakes have left Greenland waters (Lyngs 2003).

4.4. References

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Table 1. Number of observations of each of the different bird species recorded within the 300 m transect and during non-systematic recordings. – Indicates no data.

Latin	English	Greenlandic	Danish	Total number of birds in 300 m transect band	Total number of birds (incl. non-systematic recordings)
Gavia immer	Great Northern Diver	Tuullik	Islom	2	3
Fulmarus glacialis	Northern Fulmar	Qaqulluk	Mallemuk	>2578	-
Puffinus gravis	Great Shearwater	Qaqullussuaq	Storskråpe	0	2
Puffinus griseus	Sooty Shearwater	-	Sodfarvet skråpe	7	11-13
Phalacrocorax carbo	Cormorant	Oqaatsoq	Skarv	0	20
Anser albifrons	Greenland	Nerleq	Grønlandsk	0	5

flavirostris	White-fronted Goose		blisgås		
Branta/Anser sp.	Goose sp.	-	Gås sp.	0	5
Anas Platyrhynchos	Mallard	Qeerlutooq	Gråand	0	5
Somateria mollissima	Common Eider	Miteq	Ederfugl	325	350
Somateria spectabilis	King Eider	Miteq siorakitsoq	Kongeederfugl	0	11
Melanitta nigra	Common Scoter	-	Sortand	6	8
Clangula hyemalis	Long-tailed duck	Alleq	Havlit	0	12
Haliaeetus albicilla	White-tailed Eagle	Nattoralik	Havørn	0	7 (ad.)
Falco peregrinus	Peregrine Falcon	Kiinaaleeraq	Vandrefalk	1	1 (2K)
Falco rusticolus	Gyr Falcon	Kissaviasuk	Jagtfalk	2	2 (1 lys, 1 grå)
Calidris maritima	Purple Sandpiper	Saarfaarsuk	Sortgrå Ryle	3	6
Phalaropus fulicarius	Grey Phalarope	Kajuaraq	Thorshane	0	2
Phalaropus lobatus	Red Phalarope	Naluumasortoq	Odinshane	5	12
P. fulicarius/lobatus	Phalarope sp.	Kajuaraq/ Naluumasortoq	Svømmesneppe sp.	8	12-13
Stercorarius pomarinus	Pomarine Skua	Isunngarsuaq	Mellemkjove	6	26
Stercorarius parasiticus	Arctic Skua	Isunngaq	Almindelig kjove	15	16
S. Pomarinus/parasiticus	Pomarine/Arctic Skua	Isunngarsuaq/ Isunngaq	Mellem/Alm. kjove	8	5
	Common Gull	-	Stormmåge	1	1
Larus argentatus	Herring Gull	-	Sølvmåge	0	5
Larus smithsonianus	American Herring Gull	-	Amerikansk sølvmåge	0	1 (1K)
Larus marinus	Great Black-backed Gull	Naajarluk	Svartbag	74	-
Rissa tridactyla	Black-legged Kittiwake	Taateraaq	Ride	2132	-
Larus hyperboreus	Glaucous Gull	Naajaurujussuaq	Gråmåge	309	-
Larus glaucuides	Iceland Gull	Naajaannaq	Hvidvinget måge	345	-
Sterna paradisaea	Arctic Tern	Imeqquaalaq	Havterne	4	15
Alle alle	Little Auk	Appaliarsuk	Søkonge	1675	4927
Fratercula arctica	Atlantic Puffin	Qilanngaq	Lunde	12	34
Cepphus grille	Black Guillemot	Serfaq	Tejst	22	72
Úria aalge	Guillemot	Appa sigguttooq	Atlantisk lomvie	2	2
Uria lomvia	Brünnich's Guillemot	Appa	Polarlomvie	347	1055
Alca torda	Razorbill	Apparluk	Alk	1	1
Alcid sp.	Unidentified alcid	-	Alkefugl sp.	42	70
Anthus rubescens	Buff-bellied Pipit	Kussattarnaq	Hedepiber	0	2

Corvus corax	Raven	Tulugaq	Ravn	4	1
Carduelis flammea	Redpoll	Orpimmiutaq	Gråsisken	2	2
Plectrophenax nivalis	Snow Bunting	Qupaloraasuk/Qupannaaq	Snespurv	2	3