



SEABIRDS AND MARINE MAMMALS IN THE WESTERN GREENLAND SEA, AUGUST-SEPTEMBER 2017

Results from an aerial survey

Scientific Report from DCE – Danish Centre for Environment and Energy

No. 335

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Data sheet

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Abstract:	In August and September an aerial survey for seabirds in the Greenland Sea was conducted as part of the Strategic Environmental Study Program for the Northeastern Greenland area. The aim was to search for concentrations of particularly migrating seabirds, which could be vulnerable to oil spills. The present report gives an overview of the observations – of both seabirds and marine mammals. The result of the survey was that northern fulmar and black-legged kittiwake occurred widespread (but in low numbers) in the surveyed area, little auks were found in a few concentrations areas on the shelf break and unexpectedly no thick-billed murres were recorded. Among the marine mammals a few bowhead whales were observed on the shelf and near the shelf break, and a few fin-, blue and humpback whales were observed off the shelf break. Of the 18 surveyed walrus haul-out sites only four were occupied.
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Preface

This report presents the activities and the results of an aerial seabird survey carried out as a part of the *Strategic Environmental Study Program for the North-eastern Greenland area*.

This background study program is a collaboration between DCE – Danish Centre for Environment and Energy at Aarhus University, the Greenland Institute of Natural Resources and the Environmental Agency for Mineral Resource Activities of the Government of Greenland.

Oil companies operating in Greenland are obliged to contribute to the knowledge base regarding environmental matters. The Strategic Environmental Impact Assessment and the background study program are funded under these commitments, administered by the Mineral License and Safety Authority and the Environmental Agency for Mineral Resource Activities.

Summary

In August and September an aerial survey primarily for seabirds in the Greenland Sea was conducted as part of the Strategic Environmental Study Program for the Northeastern Greenland area. The aim was to search for concentrations of particularly migrating seabirds, which could be vulnerable to oil spills. Marine mammals were also recorded. The survey was financed by the, at that time, active petroleum companies, through the Greenland authorities.

The survey platform was a DHC-6 Twin Otter, and the airstrips at Danmarkshavn and Daneborg was used as bases. The survey period was 24 August to 2 September 2017 and approx. 6000 km were flown along predefined transects spaced with 25 km (Figure 3).

In general few birds were observed, at least compared to the densities of seabirds in the West Greenland waters. Most numerous and widespread were northern fulmar and black-legged kittiwake. The only species to be found in distinct aggregations was the little auk, which were found in two concentration areas, where they apparently assemble to moult. Arctic terns were seen in several flocks on direct migration. Notably, there was a complete absence of thick-billed murres. These were expected to occur in the surveyed area, as they migrate in large numbers from their breeding sites in Svalbard to wintering sites off Newfoundland and Southwest Greenland. Apparently this migration takes place east of the surveyed area.

Among the marine mammals, some fin-, blue- and humpback whales were observed east of the shelf break, and in total four bowhead whales were seen on the shelf (one east of the shelf break).

Very few seals were observed, which may be a result of the scaring effect of the aircraft.

Eighteen walrus haul-outs known to be more or less regularly used was surveyed, and in only four of these walruses were found (Table 2).

Sammenfatning

Denne rapport beskriver resultaterne af fugleoptællinger foretaget fra fly over den grønlandske del af Grønlandshavet i august/september 2017. Optællingen var en del af baggrundsundersøgelserprogrammet *Strategic Environmental Study Program for the Northeastern Greenland area*, som udføres i forbindelse med opdateringen af den strategiske miljøvurdering af olieaktiviteter i området (Boertmann & Mosbech 2012). Formålet var at lokalisere eventuelle koncentrationer af trækkende havfugle, som kan være sårbare overfor oliespild. Arbejdet er finansieret af de i området aktive olieselskaber, gennem de grønlandske råstofmyndigheder.

Optællingen foregik efter metoden "distance sampling", hvor der flyves langs parallelle ruter (transekter), her med 25 km afstand (Figur 3). Observationsplatformen var en DHC 6 (Twin Otter) fra det islandske selskab Nordlandair (Figur 1), og tre observatører talte op.

Den overfløjne del af Grønlandshavet er præget af drivis hele året, selvom isen på denne tid har den mindste udbredelse. I undersøgelsesperioden var der relativt lidt is sammenlignet med tidligere år (Figur 4).

Både fugle og havpattedyr blev registreret.

Antallet af observerede fugle var forbløffende lavt, sammenlignet med tæthederne i de vestgrønlandske havområder. Kun to arter – malleuk og ride – var relativt talrige og vidt udbredte (Figur 5 og 7). Ismåger blev der kun set få af (Figur 8). Søkonger, som er vanskelige at opdage fra fly, blev fundet i højere koncentrationer i to områder (Figur 9) – formentlig ansamlinger af fældende fugle (jvf. Mosbech et al. 2012). Polarlomvier trækker i observationsperioden fra Svalbard mod overvintringsområder ud for Newfoundland og Sydvestgrønland og burde forekomme i det undersøgte område. Men ingen blev observeret, hvilket kunne tyde på, at deres trækruter ligger øst for undersøgelsesområdet. Denne antagelse støttes af sporinger af polarlomvier fra Svalbard (Steen et al 2013, SEATRACK).

Blandt havpattedyrene sås kun få sæler (Fig. 12), hvilket muligvis hang sammen med, at flyet havde en tydelig skræmmende effekt på disse. Mange hoppede i vandet fra isen eller dykkede foran flyet, så der kun sås ringe på vandoverfladen, hvor de havde været. Blandt de store bardehvaler (Figur 10) sås enkelte fin-, blå- og pukkelhvaler øst for kontinentalskrænten (i det relativt varme atlantiske vand) og fire grønlandshvaler (en øst for kontinentalskrænten og tre indenfor). Narhvaler sås i større antal i Dove Bugt (Figur 10). De 18 kendte landgangspladser for hvalros blev overfløjet, og der var dyr på kun fire af disse (Tabel 2).

Imaqarniliaq

Nalunaarusiami uani 2017-imi aggustimi / septemberimi Tunup Avannaata imartaani timmisartumiit timmissanik kisitsinermi paasisat oqaluttuarineqarput. Misissuineq taanna Tunup Imartaani Periusissiorfiusumik Avatangiisunik Misissuinerup pinngortitap uuliasiornikkut allanngortinneqannginnermini pissusianik misissuinermut ilaavoq (Boertmann & Mosbech 2012). Suliaq uuliasiortitseqatigiiffinit tamaani suliaqartunit Kalaallit Nunaanni oqartussat aqqutigalugit aningaasalersugaavoq.

Kisitsineq ungasissumiit kisitsinertut ingerlanneqarpoq, tassa timmisartoq titarnerit akuttoqatigiiaat, matumani 25 km-inik akuttussusillit atorlugit (titar-tagartaliussaq 3) ingerlaarluni misissuisarpoq. Timmisartoq misissuinermi atorneqartoq tassaavoq DHC 6 (Twin Otter) islandimiut ingerlatseqatigiiffiata Nordlandairip pigisaa (Assiliartaliussaq 1), kisitsisullu pingasuupput.

Tunup Avannaata imartaa misissuiffigineqartoq ukioq kaajallallugu sikorsu-aqartarpoq naak piffissap taamaalinerani siammarsimannnginnerpaasaraluartut. Piffissap misissuiffiusup nalaani ukiunut siuliinut sanilliullugu sikoqannginneruvoq (Assiliartaliussaq 4).

Timmissat miluumasullu imarmiut nalunaarsorneqarput.

Timmissat takusat ikissusiat uissuuminarpoq. Timmissat marluit kisimik – malamuit taatseraallu – kisimik amerlatsiarput siammarsimanagerullutillu (Assiliartaliussaq 5 aamma 7). Naajat avannarpasissormiut ikittuinnaat takuneqarput (Assiliartaliussaq 8). Appaliarsuit, timmisartumiit takuneq ajornakusoortartut, piffinni marlunni amerlasuusut takuneqarput (Assiliartaliussaq 9) – taakku tassaagunarput isasut (tak. Mosbech et al. 2012). Piffissap misissuiffiusup nalaani appat Svalbardimiit Newfoundlandimi Kujataani uki- isarfimminnut ingerlasarput piffimmilu misissuiffiusumi takuneqarnissaat ilimanaraluarpoq. Takusoqanngilaq, imaassinnaavorlu ingerlaartarfiat piffiup misissuiffiusup kujataatigoorsimassasoq. Taama ilisimasunneq Svalbardimi appat nassitsissuserneqartarnerisigut taparserneqarpoq (Steen et al 2013, SEATRACK).

Miluumasut imarmiut eqqarsaatigalugit puisit ikittuinnaat takuneqarput (Assiliartaliussaq 12), timmisartumut ersisarnerat pissutaasimassagunarpoq. Amerlaqisut timmisartoq qalligaangat napakkartarput aqqartarlutilluunniit, taamaallaallu aqqarfii takusarpavut. Arferit soqqallit angisuut eqqarsaatigalugit (Assiliartaliussaq 10) nunaviup avammut atanerata kanginnguani tikaagulliusaat, tunnullit qipoqqaallu ataasiakkaat takuneqarput (atlantikup imartaani kissakannersumi) arfiviillu sisamat takuneqarlutik (ataaseq nunaviup avammut atanerata kangiani pingasullu taassuma iluani). Qilalukkat qernertat attarmoortut Dove Bugtimi takuneqarput (Assiliartaliussaq 10). Aarrit qassimasarfii ilisimaneqartut qulaanneqarmata taamaallaat sisamat takuneqarput (Tabel 2).

1. Introduction

The birdlife on the offshore parts of the shelf off Northeast Greenland is generally poorly known. Most of time the area is covered with drift ice, and only in the months June, July, August and September open waters are present (Boertmann & Mosbech 2012). Along coasts and in the polynyas open waters can be found earlier and in case of the polynyas year round.

Very few reports on seabird observations in the area has been published and the knowledge of seabird occurrence and abundance is based on a few published papers (Meltofte 1972, Hjort 1976, Mehlum 1989, Bench & Hjort 1990, Joiris 2000, Byrkjedal & Madsen 2008, Kyhlin 2011, Joiris et al. 2014). Besides these reports, Marine Mammals and Seabird observers (MMSO) on seismic survey ships have contributed with seabird observations, so far only published in the first strategic environmental impact assessment of petroleum activities of the region (Boertmann & Mosbech 2012). However, in the Northeast Water Polynya more extensive studies have been carried out (Falk & Møller 1995, 1997, Falk et al. 1997a, Joiris et al. 1997). Most of all these studies focus on the summer situation and the autumn season is only described by a few (e.g. Hjort 1976, Bensch & Hjort 1990, Petersen 1995, Byrkjedal & Madsen 2008).

It is known, that especially ivory gulls pass through the shelf areas in high numbers (e.g. Hjort 1976, 1990, Bensch & Hjort 1990, Byrkjedal & Madsen 1998, Gilg et al. 2010), but other arctic seabirds may also pass through. For example the high numbers of little auks and thick-billed murrelets breeding in Svalbard and wintering off Southwest Greenland and Newfoundland.

Marine mammal surveys in the study area have only been conducted sporadically, and some species have been studied in more detail than other. Movements of harp seal, hooded seal walrus and bowhead whale in the Greenland Sea have been tracked by means of satellite transmitters (Folkow et al. 2004, Lydersen et al. 2012, Born 2012, Vacquie-Garcia et al. 2017). Harp seals and hooded seals whelp in spring inside the survey area, but disperse widely after the whelping season (Salberg et al. 2008, Kovacs 2016, Rosing-Asvid 2012). Ringed seals and bearded seals are on the other hand considered more or less stationary within the area (Rosing-Asvid 2012).

Narwhals occur in the area year round, performing migrations between summer habitats in the fjordlands and winter habitats on the shelfbreak (Ugarte & Rasmussen 2012a, Heide-Jørgensen et al. 2015, Ahonen et al. 2017). Bowhead whales are also present year round, but undertake migrations between summer and winter habitats (Lydersen et al 2012, Ahonen et al. 2017). White whale is an accidental visitor to the area, and one was actually observed in August 2017 in Dove Bugt (Boye & Hansen 2017).

Outside the shelfbreak, fin whales, blue whales and humpback whales are known to occur, but in less numbers than on the Svalbard side of the Fram Strait (Joiris et al. 2014, Ugarte & Rasmussen 2012b).

Finally, historical observations of marine mammals has been compiled by Dietz et al. (1985).

As a part of the background studies of the *Strategic Environmental Study Program for the Northeastern Greenland area*, this aerial survey of seabirds was conducted in August /September 2017, the period, when highest numbers of such migrating seabirds could be expected.

The results from that survey is reported here. Marine mammals were also detected. But as the survey design was aimed at seabirds, the observations are only briefly described.

2. Material and methods

The survey covered the waters off Northeast Greenland between 73° 30' N and 79° N. A set of parallel transect lines spaced with 25 km were distributed over the survey area. They were northeast-southwest oriented and reaching from the NE Greenland coastline or solid ice edge to the EEZ border between Greenland and Norway (Figure 3). It thus included the shelf, the shelf break and parts of the off-shelf waters. Data sampling was carried out applying the distance sampling method with single observer platform (cf. Webb & Durinck 1992, Buckland et al. 2001).

A Twin Otter (DeHavilland DHC-6) was the observation platform and four bubble windows allowed observation even below the plane (Figure 1, 2). It was chartered from Nordlandair in Iceland. Survey altitude was 250 feet (85 m) and survey speed approx. 100 knots (185 km/h). Three observers were observing, with two to the same side.

Densities is only actual to calculate for the widespread and numerous numerous species: Northern fulmar and black-legged kittiwake, as the other species were too few and their distribution too scattered. As two observers were active in same side, their observations were compared and all double registrations was removed from the calculations. However, these calculation will be made at a later stage, when the strategical environmental impact assessment is in preparation.

All observations were recorded on tape recorder, and each observation was dictated together with the observation time. A GPS (Nomad Rugged PDA IP67) recorded the flown track lines, and each observation was georeferenced by combining the observation time and GPS time. All clocks were synchronized with the GPS clock (UTC-time).

Figure 1. The Twin Otter TF POF used as observation platform during the survey.



Figure 2. The bubble windows in starboard side.



During ferry flights and flights between transects, observations were recorded on opportunistic basis – i.e. birds and mammals were recorded without being allocated to a transect.

Several known walrus haul-outs were specifically checked for presence of animals and the amounts of drift wood on coasts overflowed were recorded on opportunistic basis (Appendix 2). The latter because such gatherings may indicate where oil would concentrate on the coast following an oil spill offshore. These data will be used in the Oil Spill Sensitivity Atlas for Northeast Greenland.

In Appendix 1 observations of terrestrial birds and mammals are listed.

Two of the manned stations in Northeast Greenland were used as base: Danmarkshavn and Daneborg (Figure 3). The survey was launched from Akureyri in Iceland, where the company Nordlandair has its base.

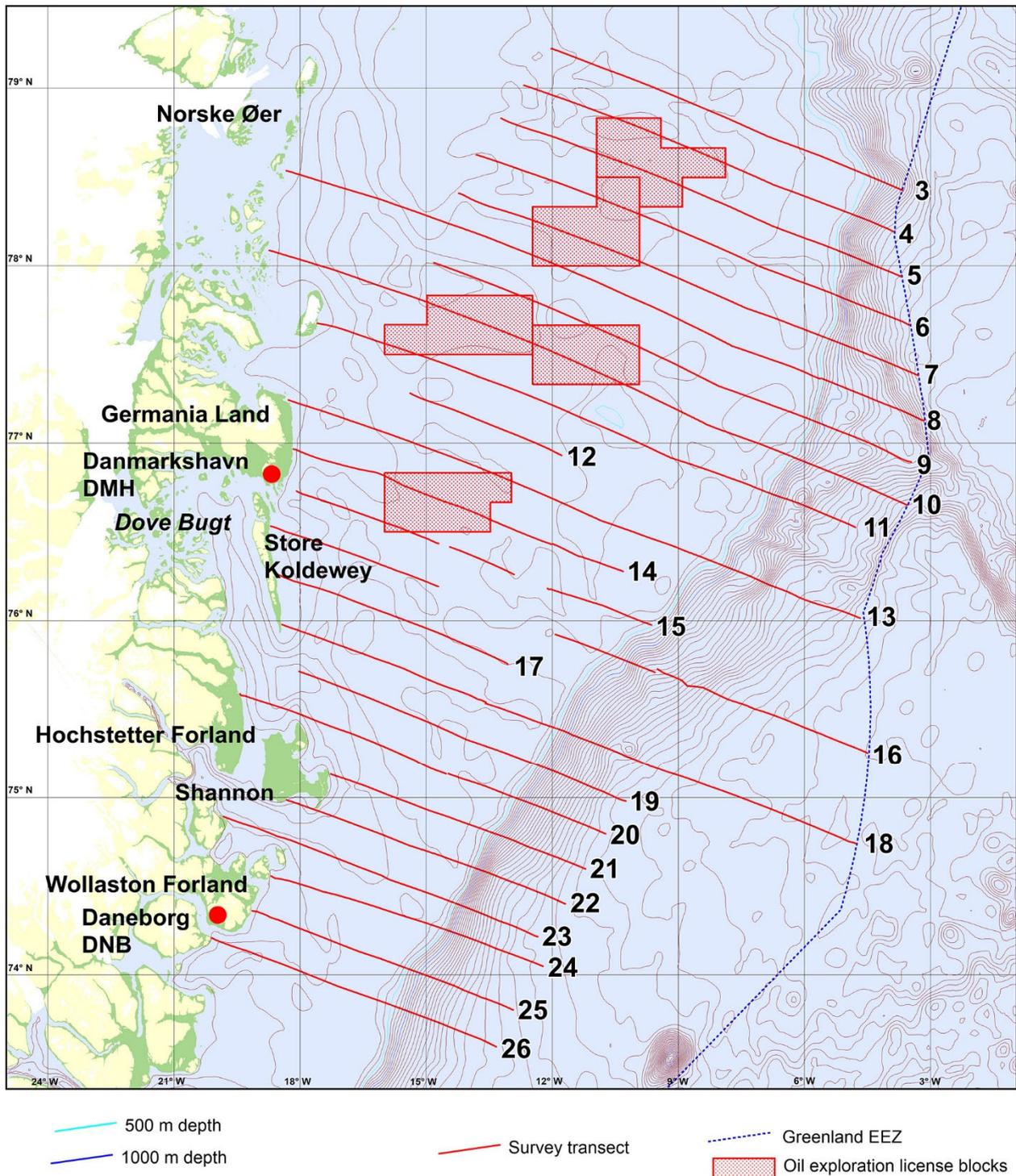


Figure 3. The surveyed area. With flown transects (their no. indicated), depth contours and other features.

2.1 Weather and ice

The weather was generally fine for surveying with calm conditions and high visibility. However, local fog and high seastate prevented surveying parts of some transects. The weather forecast for the period after 3 September indicated very rough weather unsuitable for surveying, why it was decided to terminate the survey and the crew went back to Iceland.

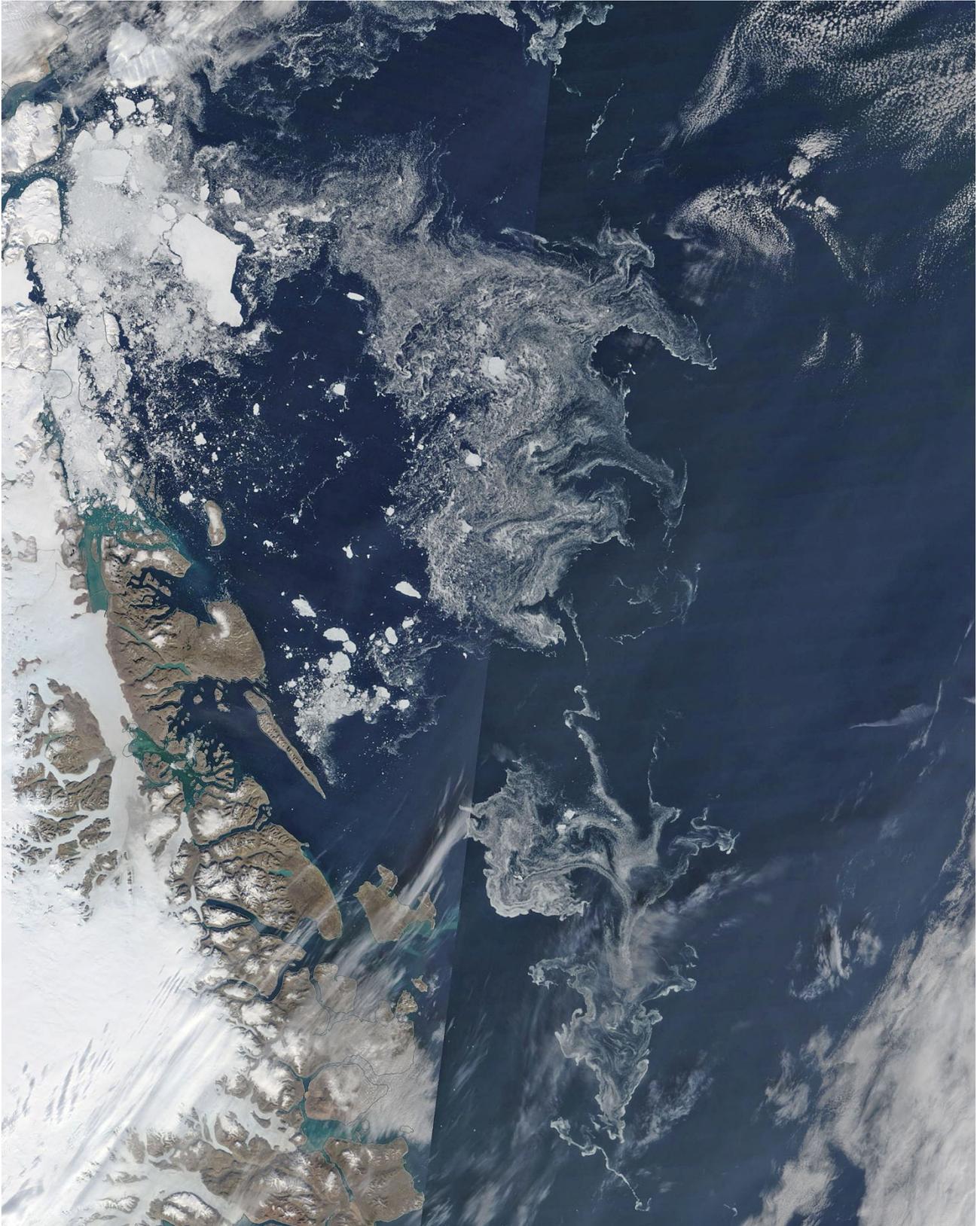


Figure 4. Distribution of sea ice on 26 August 2017. The large floes in the northern part and east of Store Koldewey are the remnants of long lasting and semi-permanent ice shelves (NASA world view).

The ice conditions are presented in Figure 4. The drift ice was located far off shore, only in the northernmost part of the surveyed area, drift ice was close to the coast, and this was mainly the semi-permanent Norske Øer ice shelf (see Schneider & Budeus 1997), which was under disintegration. East of Store

Koldewey there were also ice close to the coast, while entire Dove Bugt and the fjords between Danmarkshavn and Daneborg was completely free of ice (Figure 4).

2.2 Acknowledgements

Thanks to the personnel at Danmarkshavn weather station, to the Sirius sledge patrol at Daneborg for help during our stay at these two stations, and to the two teams of efficient and skilled pilots (Eggert Sæmundsson, Karen Morwood, Ragner Magnússon and Grétar Húnn Benediktsson) of Nordlandair.

3. Results

The daily surveys are summarized in Table 1 and the transects flown are shown in Figure 3. Total transect length was 6050 km.

Table 1. Summary of the daily flights. Airport codes: AEY = Akureyri, DNB = Daneborg, DMH = Danmarkshavn, CNP = Constable Pynt.

Date	Flying time	Base	Remark
23 Aug.	3 h 48 m	AEY-DNB	Incl. ferry flight from Iceland
24 Aug.	3 h 20 m	DNB-DMH	
25 Aug.	7 h 21 m	DMH	
26 Aug.	5 h 54 m	DMH	
27 Aug.	7 h 11 m	DMH	
28 Aug.	6 h 54 m	DMH	
29 Aug.	6 h 06 m	DMH	
30 Aug.	1 h 10 m	DMH-DNB	Transfer between bases
31 Aug.	3 h 26 m	DNB-CNP-DNB	Only flying for crew change and aircraft maintenance
1 Sep.	6 h 35 m	DNB	
2 Sep.	0 h 53 m	DNB	Survey given up due to fog and high seastate
3 Sep.	6 h 03 m	DNB	
4 Sep.	4 h 19 m	DNB-AEY	Only ferry flight
Total	63 h 02 m		

3.1 Observations

All observations of relevance to the preparation of the strategic environmental impact assessment of petroleum activities i.e. seabirds and marine mammals are reported here, while other observations are listed in Appendix 1. These can also be found in the field report (Boertmann et al. 2017).

The seabird observations are compared to previous reports from the autumn: Meltofte (1972) who in the period 19 July to 9 August 1972 sailed across the shelf to and from Daneborg. Bensch & Hjort (1990) reported observations of birds during a test cruise of an icebreaker in the drift ice between 76° 30' and 79° 30' N. on 3 – 10 October 1989. Byrkjedal & Madsen (2008) who in 2005 and 2007 participated in a Norwegian fish survey in the waters between 70 N and 78 N and in the period 30 September to 11 October primarily on the eastern side of the drift ice. There are moreover some reports of ivory gull observations in the autumn (Hjort 1976).

Mehlum (1989) surveyed the northern part of the Greenland Sea summer and autumn 1980-1984 and included parts of the present survey area. But his data are without indication of date, why it is impossible to filter out the autumn observations from the survey area of the present report. The SEATRACK-data from the Norwegian webpage <http://seatrack.seapop.no/map/> (kittiwake, glaucous gull, fulmar and thick-billed murre) are also referred to. These data show movements of tracked birds from mainland Norway, Svalbard, Jan Mayen, Bjørnøya, Russia, UK, Faroe Islands and Iceland.

3.1.1 Seabirds

Red-throated diver *Gavia stellata*

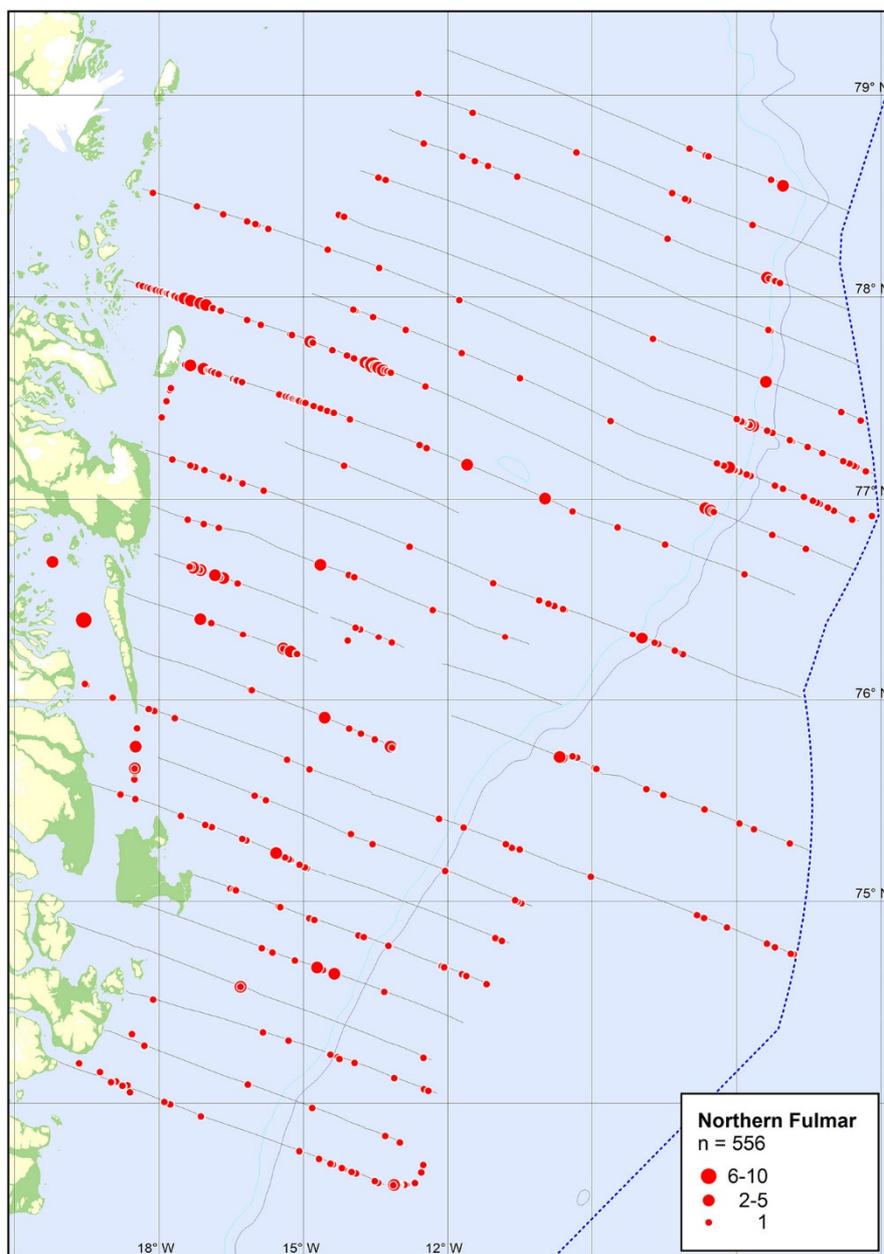
In total 10 birds (single and flocks up to 5 birds) were seen in coastal waters during ferry flights and on transects.

Northern Fulmar *Fulmarus glacialis*

Fulmars occurred almost all over the survey area, only avoiding areas with dense ice. In total 556 fulmars were recorded making it the second most numerous seabird observed. No concentrations were recorded (Figure 5). Byrkjedal & Madsen (2008) reported that it was common in open waters and more or less absent in dense drift ice, and the MMSO-data (Boertmann & Mosbech 2012) also show a similar picture.

None of the tracked individuals from the SEATRACK-data utilized the survey area.

Figure 5. Distribution of observed northern fulmars, both on transects and off transects.



Common eider *Somateria mollissima*

A flock of seven females was seen on transect on 26 August 154 km west of Île de France. Ten flocks ranging from 2 to 30 were observed along the Wollaston Foreland coast, at Sabine Island, near Kap Carl Ritter and at Kap Alf Trolle.

The breeding colony at Danmarkshavn counted at least 110 nests, and females with chicks as young as 10 days were observed near the weather station (27 August). The colony at Daneborg is considerably larger (estimated at 1300 nests by the Zackenberg personnel) and also here were females with relatively small chicks observed in nearby waters (2 September).

King Eider *Somateria spectabilis*

A flock of 350 birds was observed at the south coast of Shannon on 1 September.

Skuas

In total, 50 skuas of all four species were observed (Figure 6). Pomarine (*Stercorarius pomarinus*) was the most numerous with 22 birds and of long-tailed skuas (*Stercorarius longicaudus*) ten birds were seen. Only two great skuas (*Stercorarius skua*) and two arctic skuas (*Stercorarius parasiticus*) were recorded. Several of the skuas could not be identified to species.

Pomarine and long-tailed skuas are usually the most numerous species in the area (Meltote 1972, Byrkjedal & Madsen 2008).+

Glaucous gull *Larus hyperboreus*

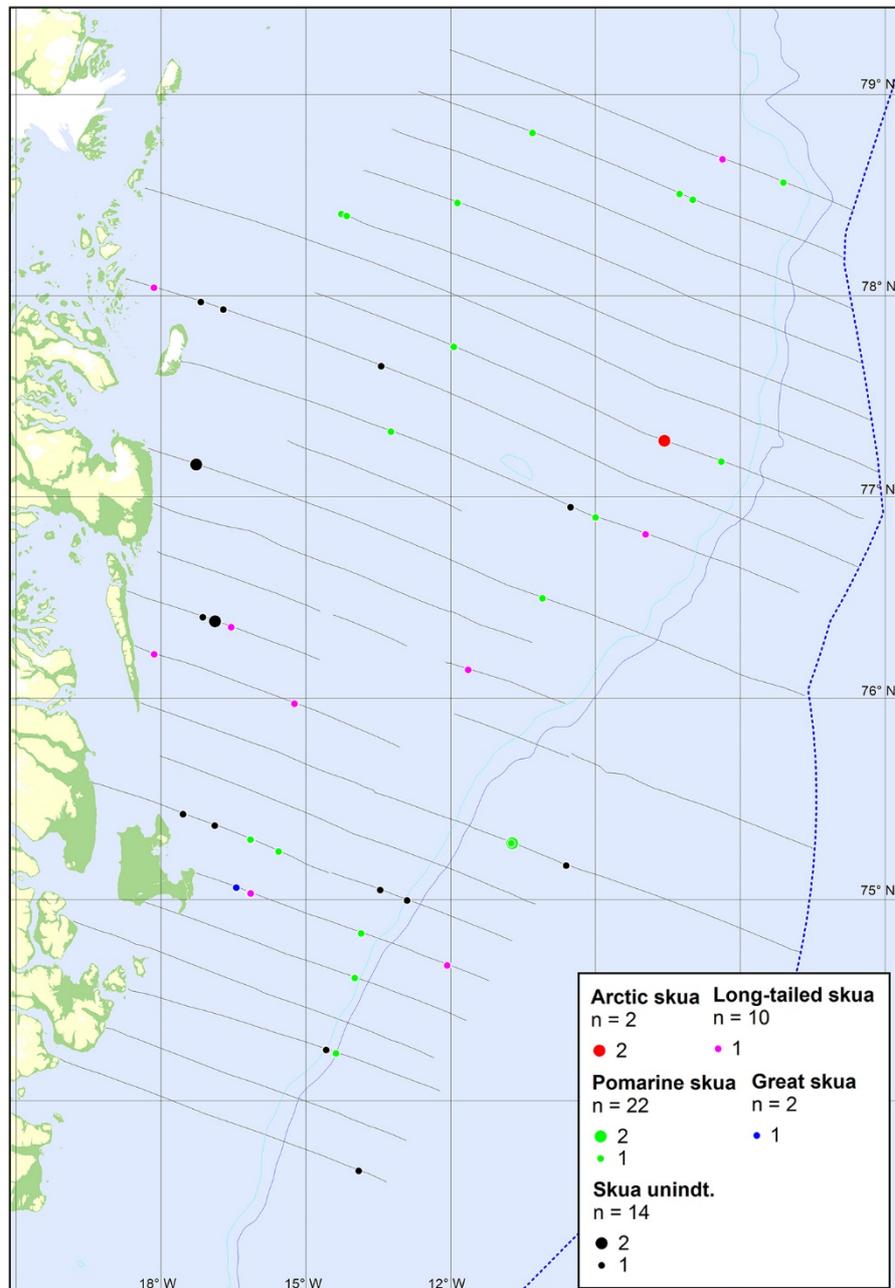
Single birds, pairs and small flocks seen here and there along the coast. Only few were seen in the offshore areas (Figure 8).

At the small colony on Kap Pansch (Shannon) two pairs (one with two juveniles) were present, and there were at least 10 birds at the colony on Hvalros Ø.

Meltote (1972) only saw glaucous gulls when sailing along the Greenland coast, while Byrkjedal & Madsen (2008) reported it as common in the drift ice and in the open waters east of the drift ice. Bensch & Hjort (1990) only reported a single observation of two birds.

The SEATRACK-data do not show any birds tracked to the survey area.

Figure 6. Distribution of observed skuas during the aerial survey.



Black-legged kittiwake *Rissa tridactyla*

This gull was the most numerous seabird observed with in total 3305 birds. They occurred widespread in the area and were seen mostly in small flocks up to 500 indivs. (Figure 7).

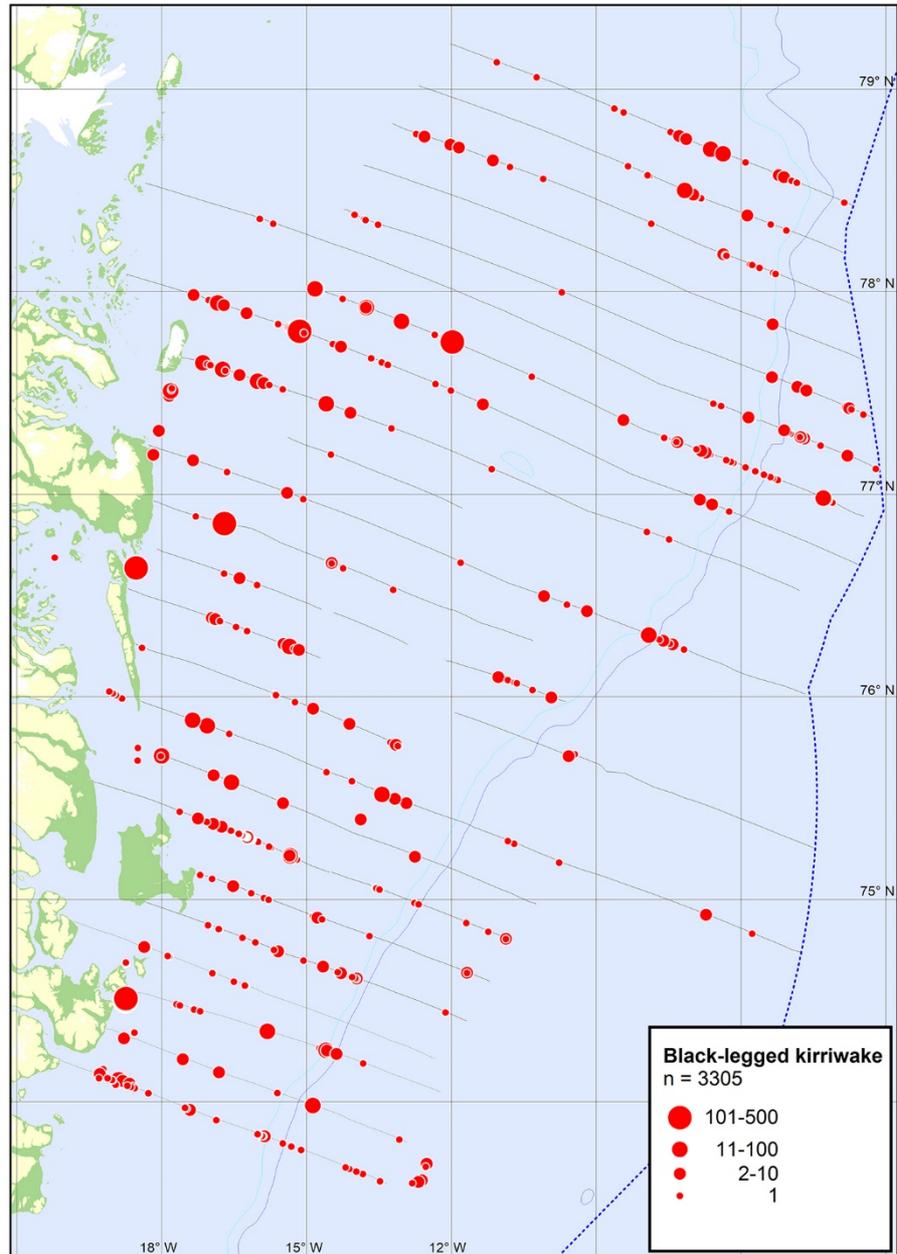
Birds were still present in the breeding colonies on Maroussia (southeast of Danmarkshavn) and on Hvalros Ø.

Meltofte (1972) reported the kittiwake as occurring everywhere, but less numerous than the fulmar and up to 10 km from the coast. Byrkjedal & Madsen (2008) wrote that it occurred regularly, but few in numbers in open drift ice. Bensch & Hjort (1990) only observed kittiwakes outside the drift ice, and the MMSO-data (Boertmann & Mosbech 2012) show generally very low densities inside the survey area. These observations are in contrast to ours, and may be interpreted as

our survey took place in the peak migration time for this species, or alternatively as the area since the historical surveys have become more suitable to kittiwakes, for example as a function of less ice and higher production?

The SEATRACK-data, show that kittiwakes from Svalbard, mainland Norway, Faeroe Islands and Iceland used the southern part of the surveyed area in autumn 2015. In autumn 2016 kittiwakes from Russia and UK also used the area, and especially mainland Norway birds was tracked to the entire survey area.

Figure 7. Distribution of observed black-legged kittiwakes, both on transect and off transect.



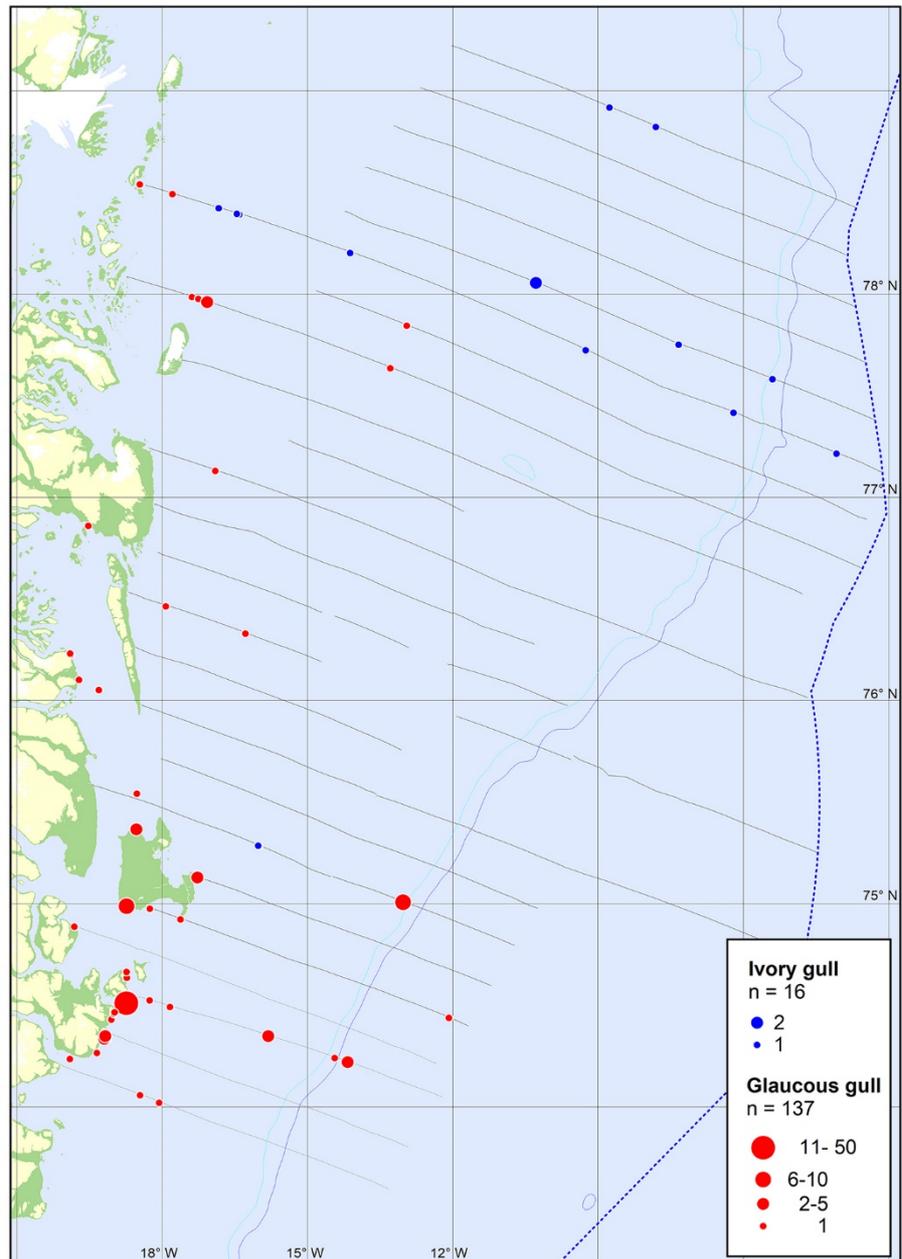
Ivory gull *Pagophila eburnea*

Only 16 ivory gulls were observed, all in areas where sea ice was present and all but one along the northernmost transects. (Figure 8).

Meltofte (1972) who observed much earlier in the season only saw one bird, while Byrkjedal & Madsen (2008) saw them regularly until 10 October, when

they encountered massive migration of ivory gulls. Hjort (1976) reported massive migration of ivory gulls as early as 1 and 2 September 1975 off Daneborg, and Bensch & Hjort (1990) observed numerous during October with the highest densities near the ice edge. These concentrations were interpreted as birds on dispersal by Gilg et al. (2010), because the birds they tracked migrated much later, in November. However, an observation of migrating adult ivory gulls in South Greenland late October (Boertmann 2014) indicate that ivory gulls also migrate earlier than November.

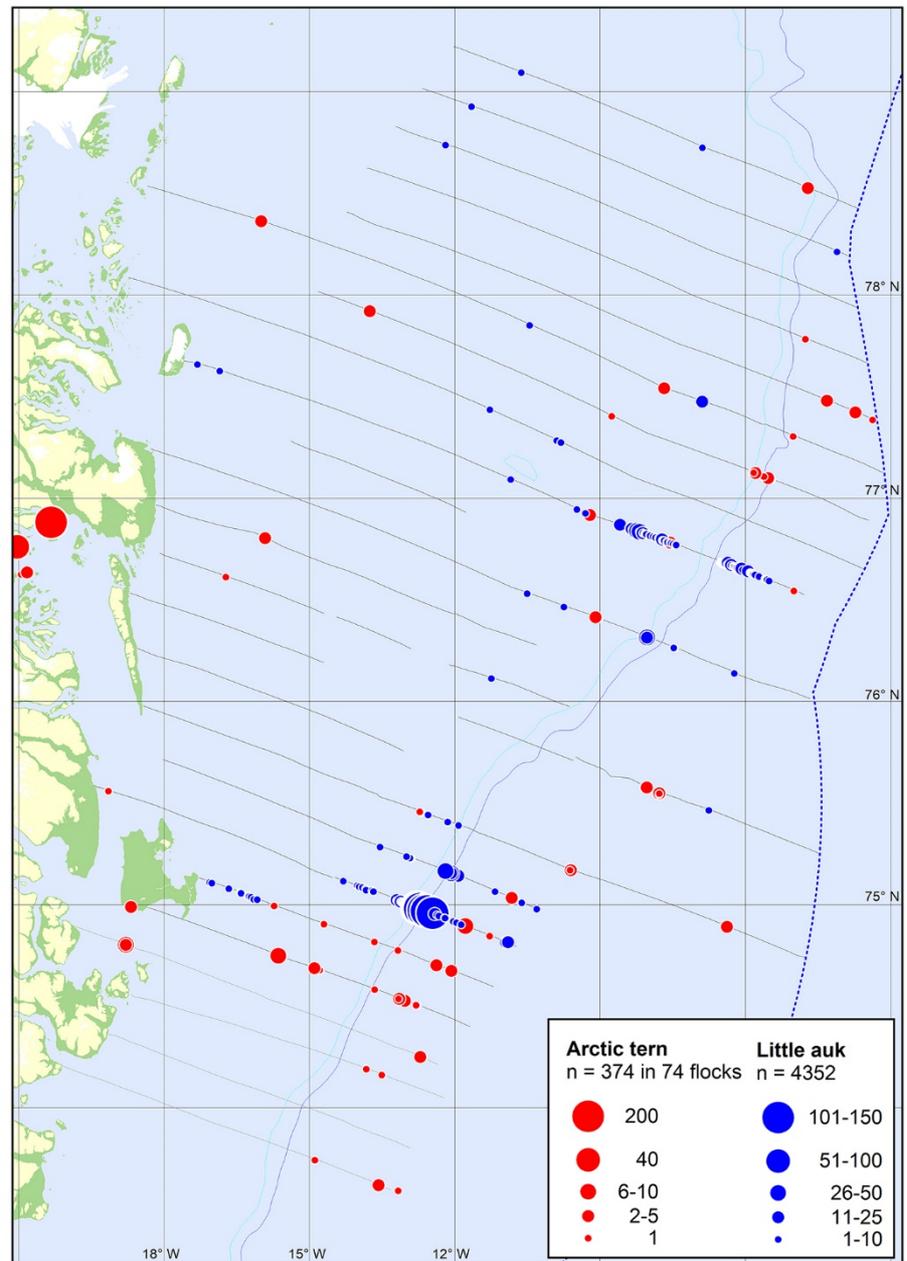
Figure 8. Distribution of observed glaucous gulls and ivory gulls, both on transect and off transect.



Arctic tern *Sterna paradisaea*

Single birds and small parties were regularly seen in the offshore areas, in total 374 birds. Especially in Dove Bugt, birds were still present in the breeding colonies. As almost all birds observed offshore were flying towards south, they probably were on active migration (Figure 9).

Figure 9. Distribution of observed Arctic terns and little auks during the survey. The high numbers of Arctic terns in Dove Bugt are birds still in the breeding colonies. The concentration of little auks on 75° N numbered 3300 birds.



This is in accordance with 10 Arctic terns tracked from their breeding colony near Daneborg as they left their breeding colony in mid to late August and from there moved directly to a stop-over site in the northern mid-Atlantic (Egevang et al. 2009).

Little auk *Alle alle*

Except for two areas with high concentrations (transect 11 and transects 19+20) where nearly 4000 little auks were recorded (n = 3980), very few (n = 370) were observed (Figure 9). The species is very hard to detect from an airplane, and moreover, it was obvious that little auks in the innermost transect band dived far in front of the aircraft and therefore went undetected by the observers, why many birds especially outside the concentrations areas were not recorded. Total numbers of birds in the survey area will be grossly underestimated based on these data alone.

Both concentrations areas at c. 75° N and 76° 30' N were situated above or near the shelf break.

Byrkjedal & Madsen (2008) reported many little auks along the eastern edge of the drift ice and Meltofte (1972) saw some both east of the ice and inside the drift ice. Bensch & Hjort (1990) found them quite common both inside and outside the drift ice. The MMSO-data (Boertmann & Mosbech 2012) show some high concentrations in the eastern part of the survey area.

Recently, it was discovered by tracking little auk post breeding movements, that birds both from Svalbard and East Greenland move to presumed moulting areas in the Greenland Sea, especially on the Greenland side (Mosbech et al. 2012, Fort et al. 2013), and it was probably such moulting concentration that we observed and which the MMSO-data show.

The SEATRACK-data of little auks from Svalbard and Bjørnøya, indicate that the birds utilize the offshore part of the surveyed area and that they primarily stay east of the drift ice.

Thick-billed murre *Uria lomvia*

No thick-billed murres were observed during the aerial survey. Byrkjedal & Madsen (2008) found them common along the eastern ice edge between 74° N and 76° N in 2007 and Bensch & Hjort (1990) reported them as numerous to the east of the drift ice. The MMSO-data (Boertmann & Mosbech 2012) show that thick-billed murres occur in the easternmost part of the survey area and none were recorded on the shelf. The SEATRACK-data and Steen et al. (2013) indicate that birds from Svalbard move across the eastern part of the shelf in the autumn and outside the drift ice. Active migration of thick-billed murres was observed off Southeast Greenland in late October 2011 (Boertmann 2014).

Many of the birds from Svalbard will migrate passively with the currents and Petersen (1995) calculated that the distance from Svalbard to Jan Mayen can be travelled on 19 days. With a mean initiation date for the migration on 12 Aug. the major part of the birds will be at Jan Mayen around 1. September. This means that the present survey was timed adequately to cover that migration, and either the murres was overlooked or they did not move through the surveyed region.

Black guillemot *Cepphus grylle*

This was another species not observed during the survey. Byrkjedal & Madsen (2008) observed high numbers along the eastern ice edge in early October while Bensch & Hjort (1990) saw them here and there inside the pack ice. These birds may have arrived from Svalbard, as the species is a rare breeder north of Scoresby Sound, or they were post breeding concentrations of birds from the numerous breeding population along the Southeast Greenland coast (Boertmann & Rosing-Asvid 2017) viz. the little auks. However, as we did not see a single black-guillemot, they most likely derive from Svalbard.

3.1.2 Marine mammals

Bowhead whale *Balaena mysticetus*

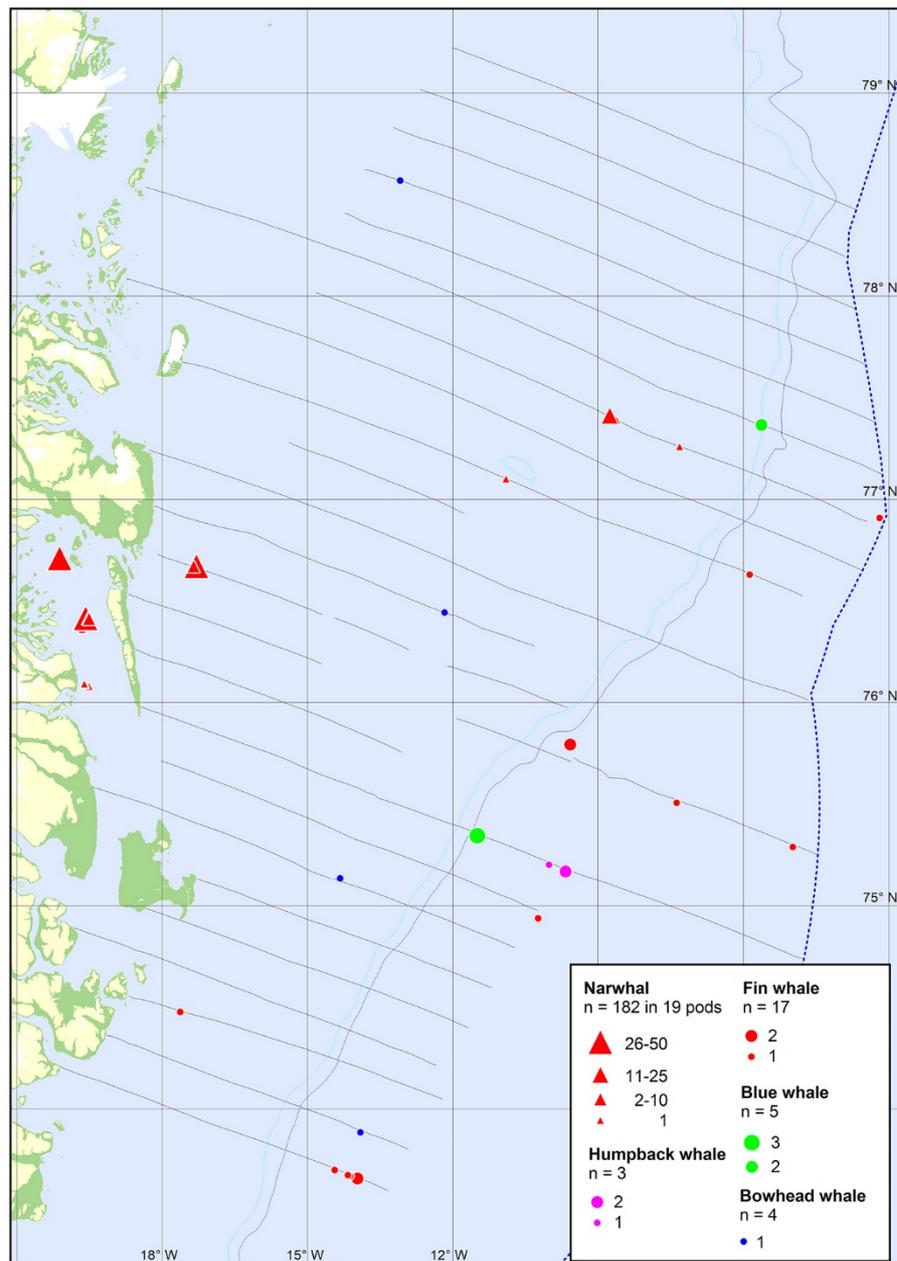
Only four bowheads were observed, see Figure 10. This is astonishing few compared to recent records of bowhead whales in both the shelf areas and along the shelf break (e.g. Boertmann et al. 2009, Boertmann & Nielsen 2010,

Lydersen et al. 2012). Observations of remarkable high numbers were reported by Boertmann et al. 2015 (nine were observed in August 2009 in the Northeast Water Polynya resulting in an abundance estimate of 102 individuals), by J. Durinck (pers comm.) (in late August/early September 2006 and 2013 when eight and three respectively were observed on the shelf between 77° 30' and 78° 00' N), by Nielsen & Hansen (2017) (56 individuals in late March/early April 2017 in the Northeast Water Polynya, most between 79° and 80° N) and by M. de Boer (pers comm.) (between 80 and 110 on the combined ice edge/shelf break between 76° and 78° N in 2016 and 2017).

Fin whale *Balaenoptera physalis*

In total 14 observations (17 individuals): seven on transect (nine individuals) and eight individuals off transect. All on or off the shelf break (Figure 10).

Figure 10. Distribution of observed whales during the survey. Most of the narwhals were observed off transect in Dove Bay.



Blue whale *Balaenoptera musculus*

On two occasions, large rorquals were observed (25 August 3 and 26 August 2) under conditions that were not optimal, but all features seen indicated blue whales. Figure 10.

Humpback whale *Megaptera novaeangliae*

Three were seen off the shelf break on 25 August (Figure 10).

Narwhal *Monodon monoceros*

A group of several narwhal pods (numbering 1-10-30) were observed on transect east of the entrance to Dove Bugt on 24 August and single whales were seen on transect far off shore on 28 August and 29 August. Off transect, numerous pods (at least eleven) with one to 50 individuals were observed in Dove Bugt on 24 August and crossing the bay again on 30 August two pods were seen (Figure 10).

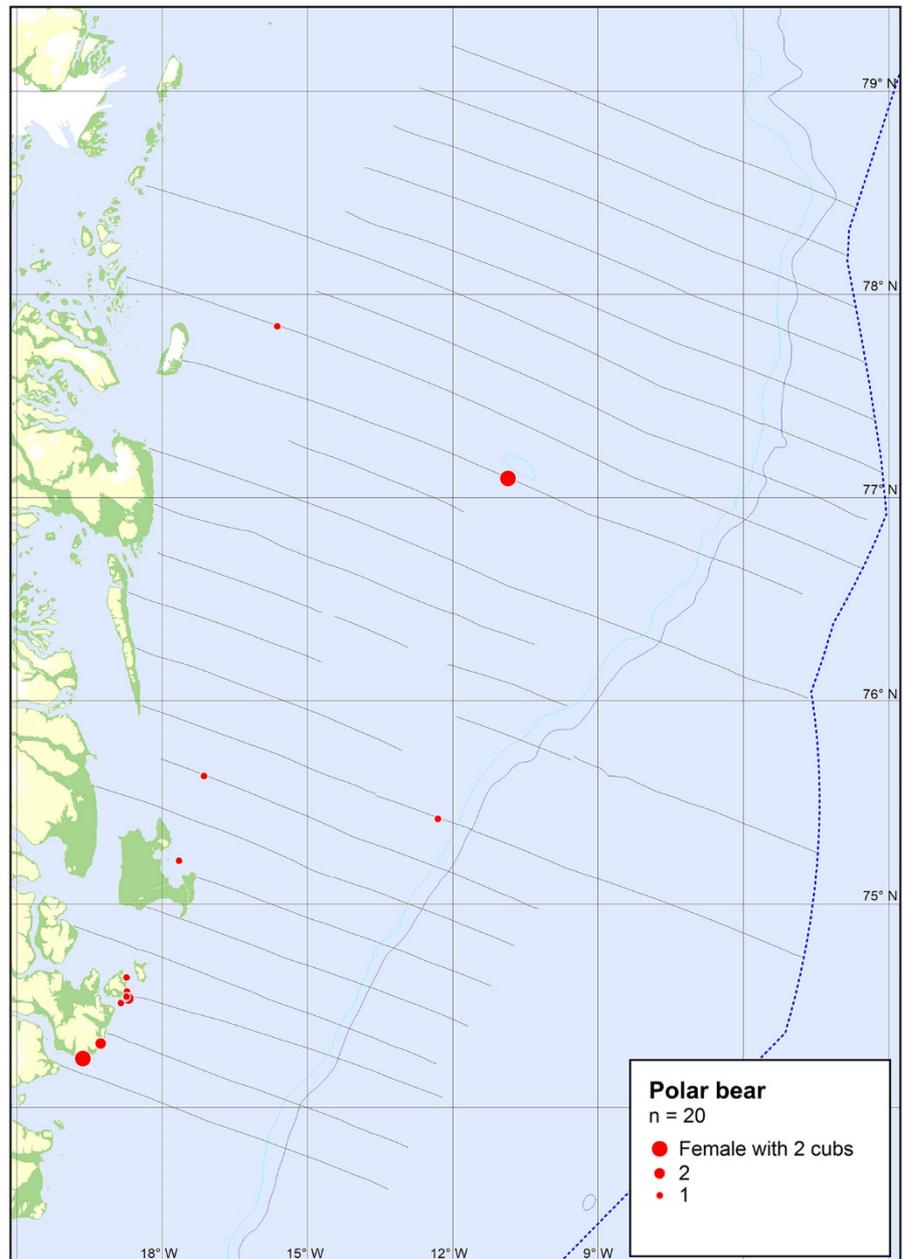
Dove Bugt and the waters between Shannon and Store Koldewey are well known summer habitats for narwhals (Dietz et al. 1985, Boertmann et al. 2009).

Polar bear *Ursus maritimus*

In total, 20 bears were observed during the survey and in addition, a young bear visited Danmarkshavn on 24-26 August. Among those seen during surveying were two females with two cubs (Figure 11). On 24 August five adult bears were observed on and near the east coast of Sabine Ø. On 3 September three bears were seen in the same area, and may very well be the same individuals.

Polar bears occur throughout the survey area – in offshore parts when drift ice is present. The population numbers are unknown, but this data gap is presently being addressed by Greenland Institute of Natural Resources.

Figure 11. Polar bears observed during the survey.



Walrus *Odobenus rosmarus*

Table 2 gives an overview of the haul outs identified in the literature and that were checked during the survey, see also Figure 13.

According to the staff at Danmarkshavn, Lille Snenæs has not be utilised by walruses for many years.

Ringed seal *Pusa hispida*

Very few recorded during the surveys: Only nine single individuals on transect and two off transect (Figure 12).

See below in the discussion section, on the disturbance effect of the Twin Otter. This effect reduced the number of observations, making any conclusions on abundance and numbers impossible.

Table 2. The walrus haul outs checked during the survey.

Date	Site	No.	Note
24-08-2017	Sandøen	9	
24-08-2017	Hvalros Ø	0	
24-08-2017	Shannon SW	9	including two juveniles
24-08-2017	Kap Alf Trolle	0	
24-08-2017	Kap Carl Ritter	28	including two juveniles
24-08-2017	Kap Peschel	0	
24-08-2017	Slædeøen	0	
24-08-2017	Store Snenæs	0	
24-08-2017	Lille Snenæs	0	
24-08-2017	Hvalrosodden	0	
24-08-2017	Port Arthur	0	
24-08-2017	Kap Bjarne Nielsen	1	
28-08-2017	Kap Alf Trolle	0	
30-08-2017	Kap Carl Ritter	16	all in water off haul out
01-09-2017	Shannon SW	0	
01-09-2017	Kap Phillip Broke	0	
02-09-2017	Sandøen	11	including one juvenile
02-09-2017	Kap Borlase Warren	0	
02-09-2017	Kap Herschel	0	
03-09-2017	Kap Borlase Warren	0	
03-09-2017	Kap Herschel	0	
03-09-2017	Kap Wynn	0	
04-09-2017	Sandøen	1	

Harp seal *Pagophila groenlandica*

In total, twelve observations on transect and four off transect – ranging from single individuals to flocks with approx. 100 individuals (Figure 12).

See below in the discussion section, on the disturbance effect of the Twin Otter. This effect reduced the number of observations, making any conclusions on abundance and numbers impossible.

Hooded seal *Cystophora cristata*

In total four observed, all on transect, of these two juveniles, ‘bluebacks’ (Figure 12).

See below in the section on ‘Twin Otter as observation platform’, on the disturbance effect of the Twin Otter. This effect reduced the number of observations, making any conclusions on abundance and numbers impossible.

Figure 12. Distribution of seal and walrus observations during the survey. Haul outs with walruses are shown with red circles, and numbers of walruses on these haul outs are listed above.

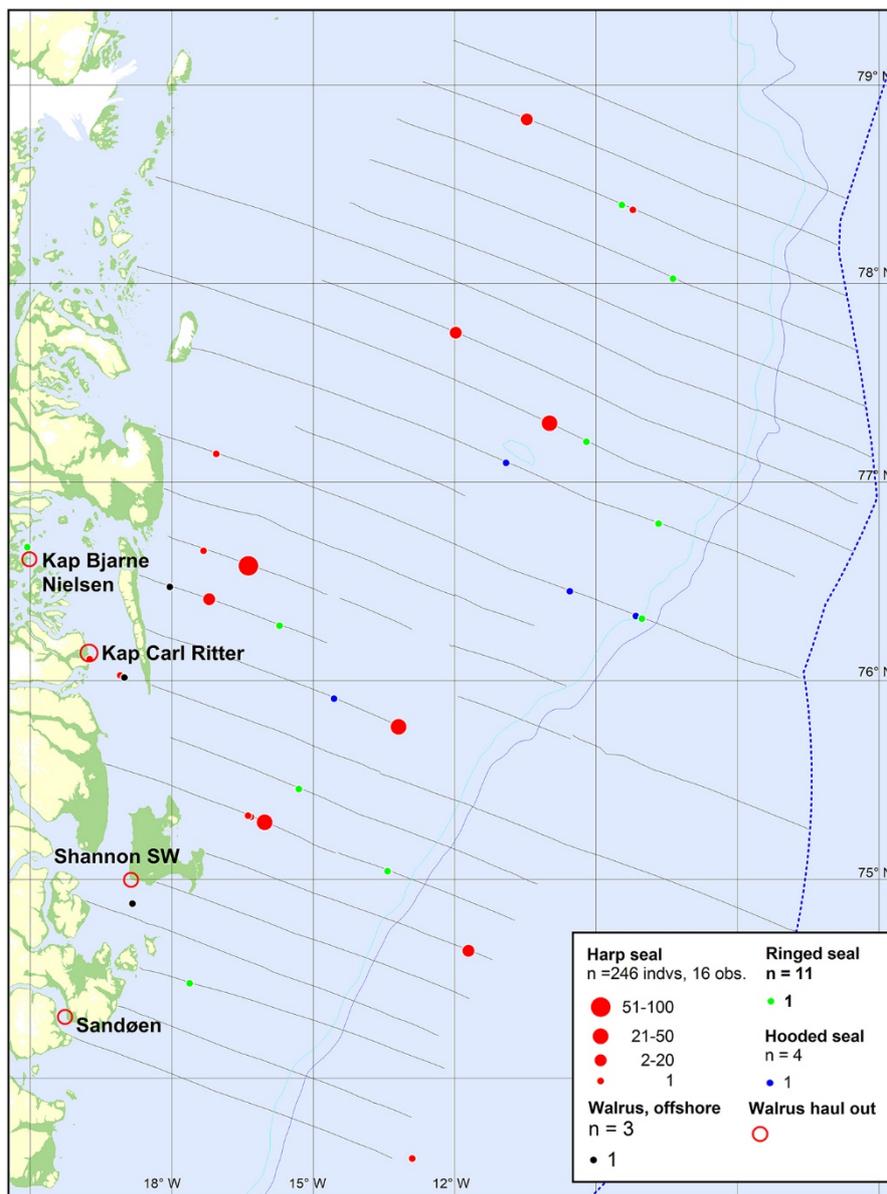




Figure 13. Walrus haul out sites. A: Sandøen 2 September, B: and C: Kap Carl Ritter 24 August, D: Kap Bjarne Nielsen 24 August 2017.

4. Discussion and conclusions

The numbers of seabirds observed during this survey were astonishingly low for example compared to the waters off West Greenland. Only fulmar and kittiwake were present in fair numbers and throughout the surveyed area.

Little auks were found in dense concentrations at two sites, and these coincide with the moulting areas revealed by tracking birds from breeding areas near Scoresby Sund in East Greenland and Svalbard (Fort et al. 2013).

Arctic terns were seen here and there, and most of these were apparently on migration, as almost all were flying towards south.

The survey and the previous data indicate that the thick-billed murre from Svalbard do not enter the shelf and stay and migrate outside the shelfbreak and the eastern border of the drift ice. This is in accordance with the tracking results of murre from Svalbard (Steen et al 2013, SEATRACK).

The numbers of observed marine mammals were also low, and at least in case of seals, we suspected that the approaching aircraft had scared some them to escape dive (see below).

All rorquals were observed in the icefree waters off the shelf break, while three of four bowheads were seen on the shelf among drift ice and one off the shelfbreak. Narwhals were mainly seen in and near Dove Bugt, a well-known summer concentrations area (Dietz et al. 1985, Boertmann et al. 2009).

Why so few of the well-known walrus haul outs were occupied is unknown, and this issue needs to be addressed.

Polar bears were seen on or near the coasts and in areas with heavy drift ice.

4.1 The Twin Otter as observation platform

It became clear that both marine mammals and little auks reacted to the approaching Twin Otter. Seal resting on ice floes jumped into the water and dived, seals swimming at the surface dived and two bowhead whales either dived or rolled to the side apparently to look at the aircraft. Also the large rorquals dived when we intentionally flew directly over them to check their identity. The avoidance behaviour of seals and little auks means that an unknown proportion of the animals on the track line remained undetected by the observers looking primarily down and a-beam. One of the assumptions of distance sampling is that all individuals/flocks on the zero line or within the innermost transect line are detected. The reactions observed here therefore means that this assumption is violated.

Another factor influencing little auk observations was that under some conditions, flocks could only be detected when they were in the sun glare on the sea surface, and only because they stirred a completely smooth sea surface. Outside the glare the flocks could remain undetected.

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Appendix 1

Observations of terrestrial birds and mammals.

Geese

Barnacle (*Branta leucopsis*) and pink-footed geese (*Anser brachyrhynchos*) were observed in large flocks when flying over land and at our bases. Many were on migration. A single snow goose (*Chen caerulescens*) was seen in a flock of barnacle geese on Shannon on 24 August.

Gyr falcon *Falco rusticolus*

An adult male staged at Danmarkshavn on 29 August.

Shorebirds

Flocks of great ringed plovers (*Charadrius hiaticulus*), turnstones (*Arenaria interpres*) and sandpipers (*Calidris* spp.) were observed when flying over land and in coastal areas. Ringed plovers and turnstones were staging at the two stations and dunlins (*Calidris alpina*) were recorded at Danmarkshavn.

Snowy owl *Bubo scandiaca*

Several seen during ferry flights across Germania Land north of Danmarkshavn: 25 August, 1, 26 August, 3, 28 August 3.

Passerines

Snow buntings (*Plectrophenax nivalis*) were seen here and there when flying over land. Arctic redpolls (*Carduelis hornemanni*) were common around Danmarkshavn in flocks up to 12 birds and a few wheatears (*Oenanthe oenanthe*) were observed at Daneborg.

Ravens (*Corvus corax*) were common at Daneborg, a single birds stayed at Danmarkshavn and three birds were seen off shore southeast of Daneborg on 2 September.

Muskox *Ovibos moschatus*

Observed only during ferry flights over land: 24 August. A single flock of four on Shannon, 28 August a flock of 4 on northeast Germania Land, 30 August and 3 September several flock in the area west of Daneborg.

Appendix 2

Drift wood was recorded opportunistically, to get an impression of where plastic and spilled oil may end up on Northeast Greenland coasts:

East coast of Germania Land: Nothing to very little

Kap Alf Trolle (Store Koldewey): Nothing.

West coast of Hochstetter Forland: Nothing.

Albrecht Bugt (north side of Wollaston Forland): Much, very high in the low tidal coast.

Shannon south coast: Nothing

Shannon, Frosne Bugt: Nothing

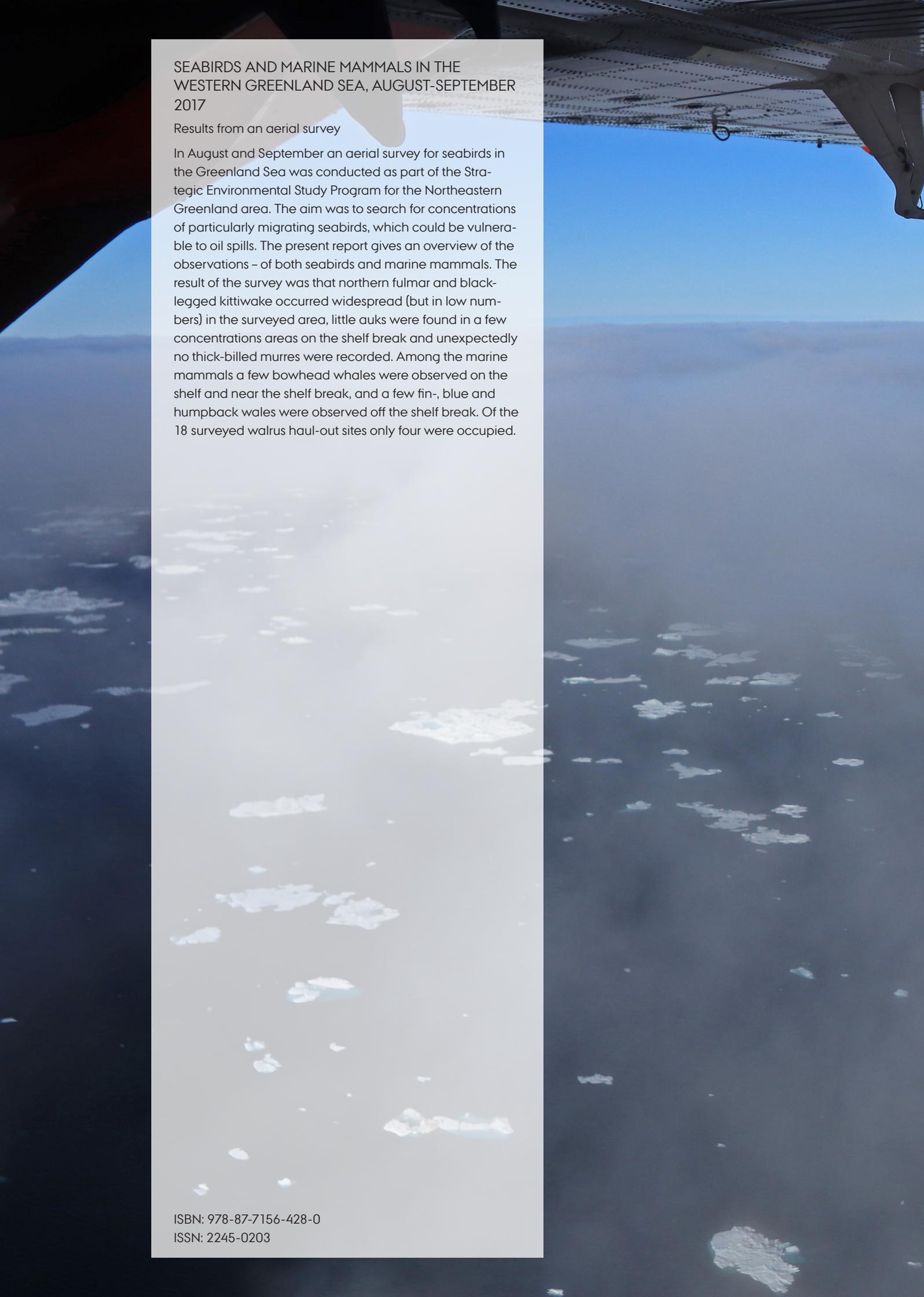
Shannon, Sengstacke Bugt: A few large trunks

Shannon, Kap Pansch: A few trunks, and on east coast some more

Shannon, Kap Phillip Broke: A few trunks on west side.

East coast of Wollaston Forland (south of Kap Borlase Warren): scattered trunks and other wood.

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SEABIRDS AND MARINE MAMMALS IN THE WESTERN GREENLAND SEA, AUGUST-SEPTEMBER 2017

Results from an aerial survey

In August and September an aerial survey for seabirds in the Greenland Sea was conducted as part of the Strategic Environmental Study Program for the Northeastern Greenland area. The aim was to search for concentrations of particularly migrating seabirds, which could be vulnerable to oil spills. The present report gives an overview of the observations – of both seabirds and marine mammals. The result of the survey was that northern fulmar and black-legged kittiwake occurred widespread (but in low numbers) in the surveyed area, little auks were found in a few concentrations areas on the shelf break and unexpectedly no thick-billed murres were recorded. Among the marine mammals a few bowhead whales were observed on the shelf and near the shelf break, and a few fin-, blue and humpback whales were observed off the shelf break. Of the 18 surveyed walrus haul-out sites only four were occupied.

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