GEESE, SEABIRDS AND MAMMALS IN NORTH AND NORTHEAST GREENLAND

Aerial surveys in summer 2009

NERI Technical Report no. 773 2010

NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE
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Data sheet

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Abstract: This report presents the results of aerial surveys for birds and mammals in North and Northeast Greenland in summer 2009. The surveys included:

- moulting geese in Jameson Land and the Ramsar site Heden,
- moulting geese in potential new Ramsar sites in Hold-with-Hope or Wollaston Forland,
- a follow-up to the surveys in 2008, mainly ivory gull breeding colonies, light-bellied brent geese and moulting pink-footed geese in North Greenland,
- general biological data from the National Park in North and East Greenland and
- a photo survey of the little auk breeding colonies at the mouth of Scoresby Sund.

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Summary

This report describes the results of an aerial survey carried out in North and Northeast Greenland in July and August 2009 (Figure 2), comprising the following elements.

1. In connection with a potential reduction in the extent of the internationally important wetland, Heden (Ramsar site no. 389), the moulting geese in Jameson Land were surveyed (duplicating the 2008 survey).

2. A survey of moulting geese in two potential Ramsar replacement areas in Hold-with-Hope and Wollaston Forland – both previously designated as Important Bird Areas (IBAs, BirdLife International 2000).

3. A follow-up to the KANUMAS survey in 2008 (cf. Boertmann et al. 2009c).

4. Collection of general biological data (occurrence and distribution) from the National Park in North and East Greenland.

5. A photo survey of the breeding colonies of little auk in Liverpool Land and along the shore of Volquart Boon Kyst in the Scoresby Sund area.

The Bureau of Minerals and Petroleum (Greenland Government) financed the surveys.

The surveys were carried out as "total counts" (cf. Laursen et al. 2008) along shores, rivers, ice edges, lush valleys and wetlands. A single set of transect flights was performed in the Hold-with-Hope lowlands. The results are presented on the maps shown in Figures 6-44.

The most significant results include:

Much fewer geese (pink-footed as well as barnacle) in Jameson Land compared to in the 2008 survey (Table 3)

Identification of the most important goose moulting areas in Hold-with-Hope and Wollaston Forland (Figure 30-33)

Identification of important moulting areas for at least 30,000 pink-footed geese in North Greenland (Figure 25)

Much fewer light-bellied brent geese along the coasts of Kronprins Christian Land, Peary Land and Johs. V. Jensen Land compared to 2008.

The survey for breeding colonies of ivory gull initiated in 2008 was continued in 2009. Five new colonies were located, and in 2009 the most important colony on Henrik Krøyer Holme was not occupied. Furthermore

some colonies without birds in 2008 were occupied in 2009. A total of 31 breeding sites have now been identified in Greenland north of 79°.

One of the new colonies was situated on low gravel banks off the coast, 50 km east of Kap Morris Jesup at 83° 38′ N. Besides the ivory gulls, Sabine's gulls and Arctic terns were present as well as common eider. Furthermore, the presence of two female and one male common eider also indicate breeding of this species. This colony must be the northernmost seabird breeding colony in the world.

The only known moulting area for male king eiders in East Greenland (located in Knighton Bugt in 2008) was surveyed again in 2009 and some hundred birds were observed.

The walrus haul-out on Sandøen held 34 males on 20 July 2009. The same date, 15 walruses were observed on ice floes in Clavering Stræde and, among these, at least one female with a calf. Very few were seen in the Northeast Water polynya.

Narwhals were observed along Blosseville Kyst, particularly in Barclay Bugt and de Reste Bugt. Many were also seen along the ice edge between Île de France and the Northeast Water.

The most important observation was a female bowhead whale in company with an approx. 3–month-old calf. This is the first observation of calves in the Spitsbergen stock of bowhead whales for many decades.

The little auk colonies in Liverpool Land and at Volquart Boon Kyst were surveyed on 21 and 22 July. It is the plan to estimate the extent of the colonies based on the photos from these areas and use this information to estimate the breeding population of little auks, just as has been carried out in the Thule area of northwest Greenland (Egevang et al. 2003).

The results indicate that the fauna and flora protection areas designated in 2009 (Aastrup & Boertmann 2009) should be supplemented with the ice edge between Île de France and the Northeast Water (bowhead whale) and with the long valley of Vitskøl Elv in Peary Land (pink-footed goose).

Sammenfatning

Denne rapport beskriver resultaterne af en optælling af fugle og pattedyr foretaget fra fly i Nord- og Nordøstgrønland i området mellem Kap Coster på Blosseville Kyst og I.P. Koch Fjord (lidt vest for Grønlands nordspids). Flyvningerne blev gennemført i perioden 16. juli til 2. august 2009.

Optællingerne tjente flere formål:

1. Optælling af fældende gæs i det internationalt vigtige vådområde (Ramsar-område) Heden i Jameson Land. Ramsar-området skal formentlig reduceres i størrelse og som erstatning skal der udpeges nye Ramsar-områder. Ørsted Dal i det nordlige Jameson Land er en kandidat, men Grønlands Selvstyre har ønsket at der er flere mulige kandidater. Derfor omfattede gåseoptællingerne også de vigtige vådområder på Hold-with-Hope og på Wollaston Forland (begge "Important Bird Areas" – IBAs, BirdLife International 2000).

2. Indsamling af biologisk viden i og op til de såkaldte KANUMAS-områder (områder, hvor en række olieselskaber i 1990erne foretog seismiske undersøgelser og som omfatter store dele af havet ud for Nordøstgrønland (Figur 1). Denne viden skal primært bruges i forbindelse med miljøvurdering af fremtidig olieefterforskning. En foreløbig strategisk miljøvurdering for det nordøstgrønlandske område blev udgivet i 2009 (Boertmann et al. 2009a).

   I 2008 gennemførtes to optællinger fra fly i maj-juni og i juli-august (Boertmann et al. 2009a) og 2009-flyvningerne er en fortsættelse af disse flyvninger.

3. Indsamling af biologisk viden i Nationalparken i Nord- og Østgrønland til brug for forvaltning af området.

4. Gennemfotografering af søkongernes ynglekolonier på kysten af Liverpool Land og langs Volquart Boon Kyst, ligesom tidligere gjort i Thule-området (Egevang et al. 2003).

Flyvningerne blev finansieret af Råstofdirektoratet, Grønlands Selvstyre dels i forbindelse med en evt. reduktion af Ramsarområdet Heden, dels som en del af de baggrundsundersøgelser der udføres i forbindelse med en kommende åbning af KANUMAS-området for olieefterforskning.

Optællinger blev primært gennemført som "total-tællinger", dvs. der blev fløjet langs kystlinier, iskanter og elve, ligesom områder med søer og damme og frodige områder opsøgtes. Her optaltes så vidt som muligt alle fugle og pattedyr. Dog gennemførtes et sæt transekt-flyvninger over lavlandet på Hold-with-Hope.

Resultaterne fra flyvningerne præsenteres på kortene Figur 6 til 44.

De vigtigste resultater:

I Jameson Land taltes der betydeligt færre gæs end under de tilsvarende tællinger i 2008 (Table 3). Det vigtigste gåseområde på Hold-with-Hope var Østersletten og tilsvarende på Wollaston Forland var det den nordvestlige del af Albrechtsletten.

I Nordgrønland (Johs. V. Jensen Land, Peary Land, Mylius Erichsen Land og Kronprins Christian Land) fandtes betydelige antal af fældende kortnæbbede gæs. I alt mere end 20.000. Hvis de områder der optaltes i 2008 inddrages, fås en total på ca. 30.000 fældegæs i de overfløjne områder. Store velegnede områder blev ikke optalt, og det samlede antal af fældende kortnæbbede gæs i Nordgrønland kan være betydeligt højere. Fældende kortnæbbede gæs blev først registreret i Nordgrønland i begyndelsen af 1990erne, og denne markante udvidelse af området de fælder i vidner om den islandsk/grønlandske bestands meget store fremgang i de seneste årtier.

Der taltes meget færre knortegæs i 2009 end i 2008. De samme områder blev overfløjet og kun 403 gæs sås. Heraf kun to familier med gæslinger mod ca. 30 familier i 2008.

Eftersøgningen af ynglekolonier af ismåge, der påbegyndtes i 2008, fortsatte. Der fandtes fem nye ynglekolonier, bl.a. på Tobias Ø og 50 km øst for Kap Morris Jesup. Flere af de kolonier der var besat i 2008 var ikke besat i 2009, bl.a. den største koloni på Henrik Krøyer Holme. Det omvendte kunne også konstateres; kolonier der var tomme i 2008 var besat i 2009 (Table 8). De to vestligste kolonier der kendes i området, på Kap Kane og Kap Washington var ikke besat, ligesom kolonien på "Hauge's Nunatak" syd for Gåsefjord i Scoresby Sund heller ikke var det.

Kolonien øst for Kap Morris Jesup på 83° 38′ N må være verdens nordligste ynglekoloni for havfugle. Her var også sabinemåger og havterner, ligesom tre ederfugle (en og to hunner) stærkt indikerer ynglen.

I alt kendes nu 31 steder, hvor ismågen har ynglet i området nord for 79° N.

En flyvning langs Blosseville Kyst mod syd til de Reste Bugt bekræftede at Knighton Bugt er en fældelokalitet for kongederfuglehanner. Der sås som i 2008 både isbjørn, storkjove, ismåge og islom på denne strækning.

På Sandøen i Young Sund sås den 20. juli 34 hvalrosser liggende på stranden. Samme dag sås yderligere 15 dyr liggende på isflager i den sydlige del af Clavering Stræde, heraf mindst én hun med en unge. I Nordøstvandet sås kun 3 dyr.

Narhvaler sås særligt langs Blosseville Kyst i Barclay Bugt og de Reste Bugt (i alt 21 flokke med mindst 39 dyr) og et sted langs iskanten mellem Île de France og Nordøstvandet sås 18 flokke med mindst 43 dyr. Derimod sås ingen i selve Nordøstvandet.

Grønlandshval sås kun en gang. Men det var en meget bemærkelsesværdig observation, idet det var en hun sammen med en kalv født samme forår (Figur 22). Bestanden ("Spitsbergen stock") anses for meget lille og der er ikke observeret kalve i mange år. Sidste års observation af et ungt dyr ved Blosseville Kyst (Boertmann et al. 2009d) må sammen med

denne tolkes som de første tegn på en bestandsfremgang. Disse observationer viser, at reproduktion blandt lokale dyr er medvirkende, men det udelukker ikke at også indvandring fra andre bestande (Gilg & Born 2005) kan spille ind.

Der sås i alt 1400 moskusokser, hvoraf størstedelen optaltes i Jameson Land og på Hold-with-Hope. I Siriuspasset, den vigtige nordgrønlandske lokalitet, sås 60.

Den 21. og 22. juli gennemførtes flyvninger i 7000 fods højde for at fotografere kyststrækningerne med ynglekolonier af søkonge på Liverpool Land og Volquart Boon Kyst (Figure 38 og 39). Det er planen på disse fotos at foretage en opmåling af koloniernes udstrækning, og ud fra disse mål at estimere bestandens størrelse, ligesom det er gjort i Thuleområdet (Egevang et al. 2003).

I foråret 2009 udpegedes en række biologiske interesseområder i Nordøstgrønland (Aastrup & Boertmann 2009). Disse områder bør nu suppleres med iskanten mellem Île de France og Nordøstvandet og hele dalen med Vitskøl Elv og dens delta, på baggrund af forekomsten af henholdsvis grønlandshval og kortnæbbet gås.

Eqikkaaneq

Nalunaarusiami matumani Kalaallit Nunaata avannaarsuani Tunullu Avannaarsuani Blossevelle Kystimi kiisalu I.P Koch Fjordip (Kalaallit Nunaata avannamut isuata kitinnguani) akornanni timmisartumiit timmissanik miluumasunillu kisitsinermi paasisat oqaluttuarineqarput. 16. julimiit 2009-imi 2. august timmisartumik misissuinerit ingerlanneqarput.

Kisitsinermi siunertat qassiijupput:

1. Sumiiffimmi pingaarutilimmi Jameson landimi Hedenimi (Ramsarikkut illersukkat) nerlernik isasunik kisitsineq. Sumiiffiit Ramsarikkut illersukkat millineqassagunarput allanillu toqqaasoqartariaqassagunarluni. Jameson Landip avannarpasissuani Ørsted Dal toqqagassanut ilaavoq, kisiannili Namminersorlutik Oqartussat arlaqarnerusunik toqqagassaqarnissaanik kissaateqarput. Taamaammat Hold-with-Hopemi aammalu Wollaston Forlandimi (Timmiaqarfittut pingaarutilittut tamarmik nalunaarneqarsimasut"Important Bird Areas" – IBAs, BirdLife International 2000) masarsuit pingaarutillit ilanngullugit nerlernik kisitsivigineqarput.

2. Sumiiffinni KANUMAS-inik taaneqartartuni (1990-ikkunni uuliasiortitseqatigiiffiit sajuppillatsitsisarlutik misissuiffigisaat aammalu Tunup avannaata imartaata ilarujussuanut atasut) iluini taakkununngalu atasuni uumasunik misissuinerit (Titartagaq 1). Ilisimalikkat tamakku siunissami uuliaqarneranik misissueqqissaartarnerrni avatangiisinik naliliinermi atorneqartassapput. 2009-imi Tunup avannaani avatangiisit periusissiorfiusumik naliliiffigineqarallarput (Boertmann et al. 2009a).

   2008-imi maj-junimi aammalu juli-augustimi timmisartumiit marloriartarluni kisitsisoqartarpoq (Boertmann et al. 2009a) 2009-imilu timmisartumiit kisitsinerit timmisartukkut misissuisarnernut taakkununnga nangissutaapput.

3. Kalaallit Nunaata avannaarsuani Tunullu avannaani Nunami Eqqissisitami uumasunik misissuinerit tamatuma aqunneqarnerani atugassanik.

4. Qaanaap eqqaani siusinnerusukkut misissuisimanerup assinganik Liverpool Landip sineriaani aammalu Volquart Boon Kystimi appaliarsuit erniorfiinik assiliisaqattaarnerit ingerlanneqarput(Egevang et al. 2003).

Timmisartumiit misissuinerit Namminersorlutik Oqartussat Aatsitassanut Ikummatissanullu Pisortaqarfiannit aningaasalersugaapput, tassa ilaatigut Hedenip Ramsarikkut illersugaasup millisinneqarneranut atatillugu ilaatigullu sumiiffiit KANUMAS-imik taaneqartartut misissueqqissaarnermut ammaqqinneqarnissaannut atatillugu pissutsit allanngortinneqanngikkallarnerini misissuinernut atatillugit.

Kisitsinerit annermik attarmut kisitsinertut ingerlanneqartarput, tassa sineriak, sikup sinaavi, kuuit, aammalu tatsit, taseqqat suullu naggorissut tamakkerlugit orninneqartarlutik. Taama qulaassuinermi timmissat miluumasullu sapinngisamik tamakkerlugit kisinniarneqartarput. Taamaattorli Hold-with-Hopemi nuna pukkitsuajaaq sanileriiaanik titarnikkuutaartumik qulaassorneqarpoq.

Timmisartumit misissuinermit paasisat Titartagaq 6-imiiit 37 xx-mut nunap assingini takutinneqarput.

Paasisat pingaarutillit:

2008-imi kisitsinermut taama ittumut sanilliullugu Jameson Landimi nerlerit ikinneroqisut kisinneqarput (Table 3). Nerleqarfiit pingaarnerit Hold-with-Hopemiittut tassaapput Østersletten taamatullu Wollaston Forland Albrechtslettenip avannaata kitaaniittoq.

Kalaallit Nunaata avannaani (Johs. V. Jensen Land, Peary Land Mylius Erichsen Land aammalu Kronpris Christian Land) nerlerit siggukitsut isasut amerlaaloqisut naammattoorneqarput. Katillutik 20.000-init amerlanerusut. Sumiiffiit 2008-imi kisitsivigineqartut ilanngukkaanni timmisartumiit misissuiffigineqartunit nerlerit isasut 30.000 sinneqarput. Kisitsiffissaqqissut kisitsivigineqanngillat, aammalu nerlerit siggukitsut Kalaallit Nunaata avannaaniittut amerlanerujussuusinnaapput. Nerlerit siggukitsut isasut Kalaallit Nunaata avannaani siullermeersumik 1990-ikkunni nalunaarsugaapput, isaaffiusartullu annertuseriarujussuarsimaneratigut takuneqarsinnaavoq islandip/Kalaallit Nunaata nerleri ukiuni qulikkaani kingullerni qanoq amerleriarsimatigisut.

2009-imi nerlerit siggukitsut kisinneqartut 2008-imi kisinneqartuniit ikinneroqaat. Sumiiffiit taakkorpiaat timmisartumik qulaassorneqarput nerlerillu taamaallaat 403-it takuneqarlutik. Taakkunannga aappariit nerleqqanik piarallit marluinnaat naammattoorneqarput 2008-imi 30-it missaanniissimagaluarlutik.

Naajavaarsuit piaqqiorfiinik ujaasineq 2008-imi aallarnerneqartoq nanginneqarpoq. Piaqqiorfiit nutaat tallimat nassaarineqarput, ilaatigut Tobiap Qeqertaani Kap Morris Jesupip kanginnguaniittumi. Ineqarfiit 2008-imi inoqarsimasut massakkut 2009-imi inuerussimapput, ilaatigut ineqarfiit annersarisaat Henrik Krøyer Holme. Aammattaaq illuatungaa paasineqarpoq; ineqarfiit 2008-imi inoqarsimanngikkaluartut 2009-imi inoqalersimapput (Tabel 8). Ineqarfiit killersaat tamaaniittut ilisimaneqartut, tassa Kap Kane aammalu Kap Washington inoqanngillat, taamattaaq "Haugep Nunataani" ineqarfik Scoresby Sundip kujataani Nerlerit Kangerluanniittoq inoqanngilaq.

Piffiit katillugit 31-it avannarpasissutsip 79° avannaaniittut naajavaarsunnit erniorfiusarsimanerat paasineqarpoq.

Blosseville Kyst atuarlugu kujammut Reste Bugtip tungaanut timmisartukkut ingerlaarnermi uppernarsarneqarpoq Knighton Bugt mitit siorakitsut isaffigisaraat. 2008-imisut nannut, isunngarsuit, naajavaarsuit aammalu qarsaat takuneqartarput.

Sandøenimi Young Sundimiittumi 20. juli aarrit 34-it sissamiittut naammattoorneqarput. Ulloq taanna suli allat 15-it Clavering Strædep kujasinnerusortaani puttaamiittut naammattoorneqarput, taakkunanngalu minnerpaamik ataaseq arnaviaavoq piaqqisartoq. Nordøsvandimi uumasut pingasuinnaat takuneqarput.

Pingaartumik Blosseville Kystimi Barclay Bugtimiittumi aammalu de Reste Bugtimimi qilalukkat qernertat naammattoorneqartarput (katillugit ingerlaaqatigiit 21-it ikinnerpaamik 39-inik qilalugartallit) aammalu Île de Nordøstvandellu akornanni sikup sinaavani attarmoortut 18-it ikinnerpaamik 43-inik qilalugartallit takuneqarput. Nordøstvandimi namminermi takusaqartoqanngilaq.

Arfivimmik ataasiaanarluni takusoqarpoq. Takusarli uissuuminaqaaq tassami arnaviaavoq ukioq taanna inunngortumik piaralik (Titartagaq 18x). Attarmoortut (”Spitsbergen stock”) ikittuarannguusutut isigineqarput ukiorpassuarnilu piaqqisartumik takusoqarsimanani. Blosseville Kystimi siorna piaqqamik takusoqarnera (Boertmann et al. 2009d) aammalu massakkut takusaq eqqarsaatigigaanni amerliartulersimanerannut takussutissatut siullertut paasisariaqarput. Takusat aallaavigalugit malunnarpoq arfiviit tamaaniittut piaqqiulersimasut, tassalu allanit tikittuunngillat (Gilg & Born 2005).

Katillugit umimmaat 1400 takuneqarput, taakkulu amerlanersaat Jameson Landimi aammalu Hold-with-Hopemi kisitaapput. Kalaallit Nunaata avannaani sumiiffimmi pingaarutilimmi -Siriuspasset- 60-it takuneqarput.

Ulluni 21. aamma 22. juli isikkanik 7000-inik portussuseqarluni timmisartortoqarpoq Liverpool Land aamma Volquart Boon Kystimi (titartakkat 35 aamma 36) appaliarsuit ineqarfii assilisaqattaarniarlugit. Pilersaarutigineqarpoq assilisat taakku piaqqiorfiit siammasissusiannik naatsorsuinermut atorneqassaut taakkulu aallaavigalugit amerlassusii missingerniarneqassasut, soorlu Avanersuarmi taamaaliortoqarsimasoq (Egevang et al. 2003).

2009-imi upernaakkut Tunup avannaani (Aastrup & Boertmann 2009) sumiiffiit uumasoqarnikkut soqutiginaateqartut toqqarneqarput. Sumiiffiit taakku maanna ilaneqarput, tassa Île de Francep aammalu Nordøstvandep akornanni sikup sinaava kiisalu Vitskøl Elvip qoorua taassumalu akua tamarmi ilanngunneqarmata arfiveqarnera aammalu siggukitsunik nerleqarnerat pissutigalugu.

1 Introduction

In 2006, the Bureau of Minerals and Petroleum decided to initiate the opening of the KANUMAS areas for licensing rounds.

KANUMAS is an acronym for an oil exploration initiative, Kalaallit Nunaat Marine Seismic Project, and the KANUMAS areas are the waters off Northeast and Northwest Greenland (Figure 1). The KANUMAS group was in 1989 granted a prospecting licence to the KANUMAS areas and carried out a regional seismic exploration programme.

Figure 1. Overview of the surveyed region with the most important site names and the KANUMAS East area shown in yellow.

Strategic environmental impact assessments (SEIA) of hydrocarbon activities in the two KANUMAS regions are under preparation, and preliminary versions were published in 2008 (Boertmann et al. 2009a, b). The database for these SEIAs, however, is not adequate and a number of projects aiming to provide supplementary data for the SEIA have been initiated in cooperation between the National Environmental Research Institute (NERI), Aarhus University, Greenland Institute of Natural Resources (GINR) and the Greenland Bureau of Minerals and Petroleum (BMP).

One of the projects is a survey of important marine and coastal habitats, potentially sensitive to oil spills. Two aerial surveys of seabirds and mammals were carried out in Northeast Greenland in 2008, in May-June and in July-August (Boertmann et al. 2009c). These surveys were followed up by a survey in July-August 2009.

The mining company Minelco inc. was planning to establish harbour and airstrip facilities in the Gurreholm area in northwest Jameson Land. These facilities will overlap and impact the internationally important wetland, Heden (designated under the Ramsar Convention). The plans involve a reduction in the extent of this Ramsar site and establishment of replacement areas at another location in Northeast Greenland (Glahder et al. 2010).

To evaluate the impacts on the Ramsar site, NERI collected baseline data on the most important species in the area in 2008, i.e. the moulting geese (Glahder et al. 2010). Aerial surveys were conducted on 17 and 18 July 2008, duplicating surveys carried out in the late 1980s (Mortensen et al. 1988, Mosbech et al. 1989, Mosbech & Glahder 1990). In 2009, similar surveys were conducted on 16 and 17 July.

Ørsted Dal has been designated as a potential replacement area for the impacted part of the Ramsar site Heden. However, the Greenland Government would like to evaluate additional areas as potential replacement sites. The aerial surveys in 2009 therefore included the two important goose wetland areas of Hold-with-Hope and Wollaston Forland, previously designated as Important Bird Area (IBAs) by BirdLife International (2000).

The Greenland Government is also preparing new practices concerning management of the National Park of North and Northeast Greenland (Aastrup et al. 2005). These may involve designation of biologically important areas, but available data for this task is inadequate for large areas of the national park (Aastrup & Boertmann 2009). The survey in July 2009 therefore also included collection of information from potentially important biological areas.

This report presents the results of the surveys.

The first author participated in an aerial survey for walrus (*Odobenus rosmarus*) in August 2009 carried out by Greenland Institute of Natural Resources (Born et al. 2009). This survey took place along the coasts between Clavering Ø (74° N) and the Northeast Water (81° 30′ N). A few bird observations from this survey – mainly of breeding colonies – are included in this report.

1.1 Acknowledgements

We extend our thanks to the Bureau of Minerals and Petroleum for the grants which made the surveys possible; to the staff of Constable Pynt especially Henrik "Thy" Jensen; to the staff at Station Nord; to Grønlands Kommando (GLK) for permission to use Station Nord as base for the surveys in the northern part of the survey area, and particularly to John Lau Hansen who arranged the transport of aviation fuel to Station Nord; to Olivier Gilg for information on ivory gulls; to Kasper L. Johansen who calculated the results from the distance sampling surveys; and finally to flight captain Leif Petersen with his aircraft OY-CAG who has flown seabird and marine mammals surveys in Greenland since 1982.

2 Methods

The aircraft used was a Partenavia P-68 Observer equipped with bubble windows by the seats behind the pilot seats. Most surveys were carried out as "total counts" (cf. Laursen et al. 2008), flying at an altitude of 250 feet (85 m) and with a speed of 90 knots (160 km/hr). Occasionally lower or higher altitudes were flown if conditions allowed. The observation routes are shown in Figure 2.

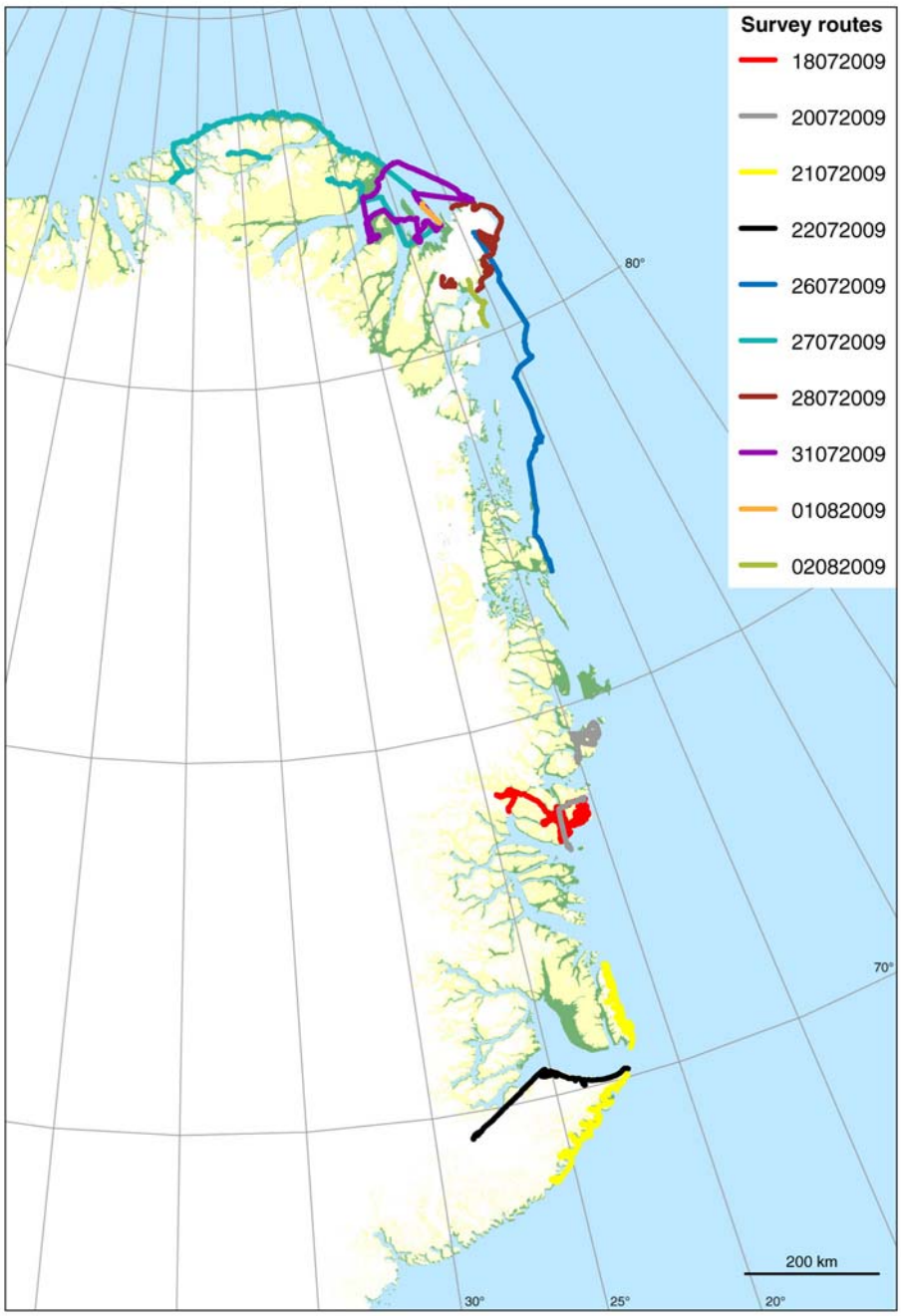


Figure 2. Survey routes July and August 2009.

A set of transect flights applying distance sampling (Webb & Durinck 1992, Buckland et al. 1993) were performed over the lowlands of Hold-with-Hope (Figure 30). Observations were applied to transect bands (Table 1), which were determined by the use of a clinometer (Silva Clino Master CM PA). The distance between the east-west transects was 5 km.

Observations of seabirds and mammals were recorded on a tape recorder and each observation was dictated together with the observation time. A GPS (Trimple GeoXT) recorded the track lines flown, and by combining observation time and GPS time each observation could be geo-referenced. All clocks were synchronised with the GPS clock (UTC time).

Table 1. Transect bands.

Transect band	Angle compared to horizon, °	Distance from trackline, m
1/A	60-25	44-164
2/B	25-15	164-285
3/C	15-10	285-433
4/D	10-4	433-1091
5/E	4-3	1091-1456

Seabird breeding colonies were recorded during the surveys. Previously known colonies were controlled and new colonies were sought out. However, the large colonies at Kap Brewster and Mallemukfjeldet were avoided in order not to scare or disturb breeding birds, and the coasts with little auk colonies were also avoided due to the potential risk of bird strikes.

Potentially biologically important areas were identified on satellite images of lush areas (NDVI images), and some particularly lush areas in North Greenland, such as Siriuspasset, Valdemar Glückstadt Land and Herluf Trolle Land were overflown and surveyed (Figure 3).

The little auk photo survey was flown at an altitude of 7,000 feet. The entire coasts of Liverpool Land between Murray Ø and Kap Swainson, and the Volquart Boon Kyst between Kap Brewster and Kap Stevenson were photographed as vertically as practically possible, with large overlap between the single frames (Figure 38 and 39). The camera clock was synchronised with the GPS clock.

Two airports were used: Constable Pynt (CNP, BGCO) close to Ittoqqortormiit/Scoresbysund and Station Nord (NOR, BGNO) (Figure 1).

The aircraft was navigated by pilot Leif Petersen (LP) and observers were David Boertmann (DMB) and Rasmus Due Nielsen (RDN).

Table 2 gives an overview of the activities and Figure 2 the routes flown.

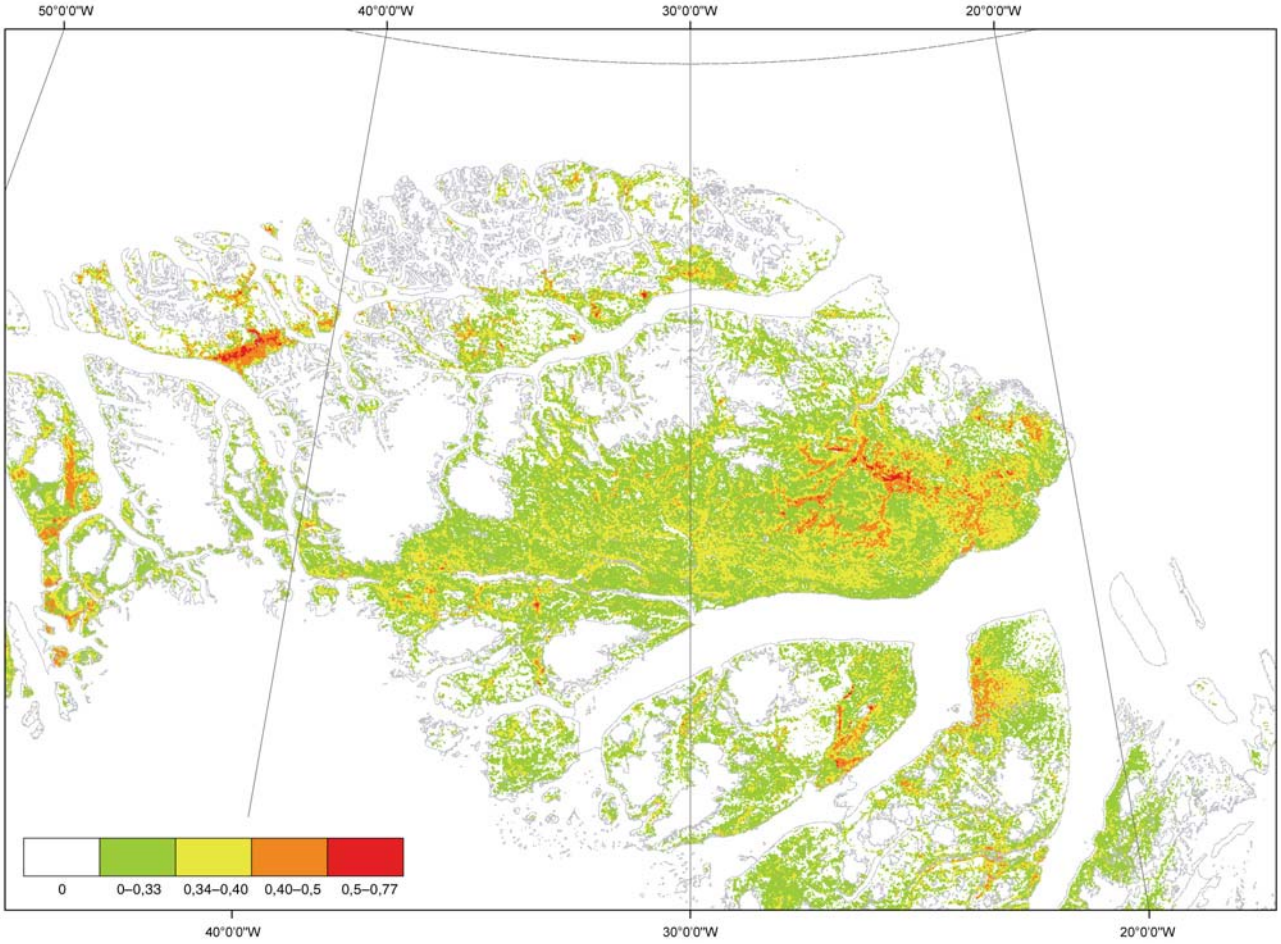


Figure 3. A map showing NDVI-values (Normalised Difference Vegetation Index) from Northeast Greenland in August 2004. The NDVI is a measure of "greenness" ("lushness").

Table 2. Observation activities during the two survey periods. NEW = Northeast Water, CNP = Constable Pynt, NOR = Station Nord.

Date	Airborne	Landed	Survey and airport of departure	Co-pilot seat	Rear seat
16 July	10.36	14.58	Northern part of Jameson Land, CNP	DMB	RDN
17 July	08.53	14.12	Southern part of Jameson Land, CNP	DMB	RDN
18 July	10.31	15.21	Hold-with-Hope, Stordal, Krumme Langsø, CNP	DMB	RDN
20 July	09.04	14.28	Wollaston Forland, Sabine Ø, Hvalros Ø, Tobias Dal, CNP	DMB	RDN
21 July	08.37	14.56	Little auk photo survey (Liverpool Land), Blosseville Kyst, CNP	RDN	DMB
22 July	13.27	16.38	Little auk photo survey (Volquart Boon Kyst), CNP	RDN	DMB
26 July	10.26	16.28	Ice edge from Ile de France to Tobias Ø, Northeast Water, Kilen, CNP-NOR	DMB	RDN
27 July	10.03	15.52	Coast of Peary Land, Johs. V. Jensen Land, Siriuspasset, Frigg Fjord, Herluf Trolle Land, NOR	DMB	RDN
28 July	09.21	12.45	Coasts of the Northeast Water, Kilen, NOR	DMB	RDN
31 July	09.32	13.02	Fjord and ice edge N and W of St. Nord, NOR	DMB	RDN
1 Aug	10.11	10.41	Pr. Magrethe Ø, NOR	DMB	RDN
2 Aug	09.44	14.58	Coast of Holm Land, NOR-CNP	DMB	RDN

2.1 Weather and observation conditions

The weather was perfect for observation during all the surveys out of Constable Pynt; calm and sunny with unlimited visibility. When flying

to Station Nord on 26 July, fog unfortunately prevented observation along the ice edge north of Shannon. On 28 July fog prevented observations along the Holm Land coast, and when flying southwards again on 2 August the entire ice edge from Holm Land to Germania Land was swept in fog. But besides these fogs, observation conditions were excellent during the surveys from Station Nord.

2.2 The ice situation

The large and semi-permanent fast ice barriers off Store Koldewey and between Germania Land and Holm Land were in place when flying between Constable Pynt and Station Nord. The Northeast Water, in contrast to the situation in 2008, was filled with drift ice 5-9/10. The ice in the mouth of Independence Fjord inside the permanent barrier between Nakkehoved and Kap Eiler Rasmussen was much more solid than in 2008. Along the coast of Peary Land and Johs. V. Jensen Land there was a narrow strip of fast ice and large open water areas off this strip even beyond Luigi Amadeo Ø. The Blosseville Kyst coastline was completely free of winter ice. (Figure 4 and 5).

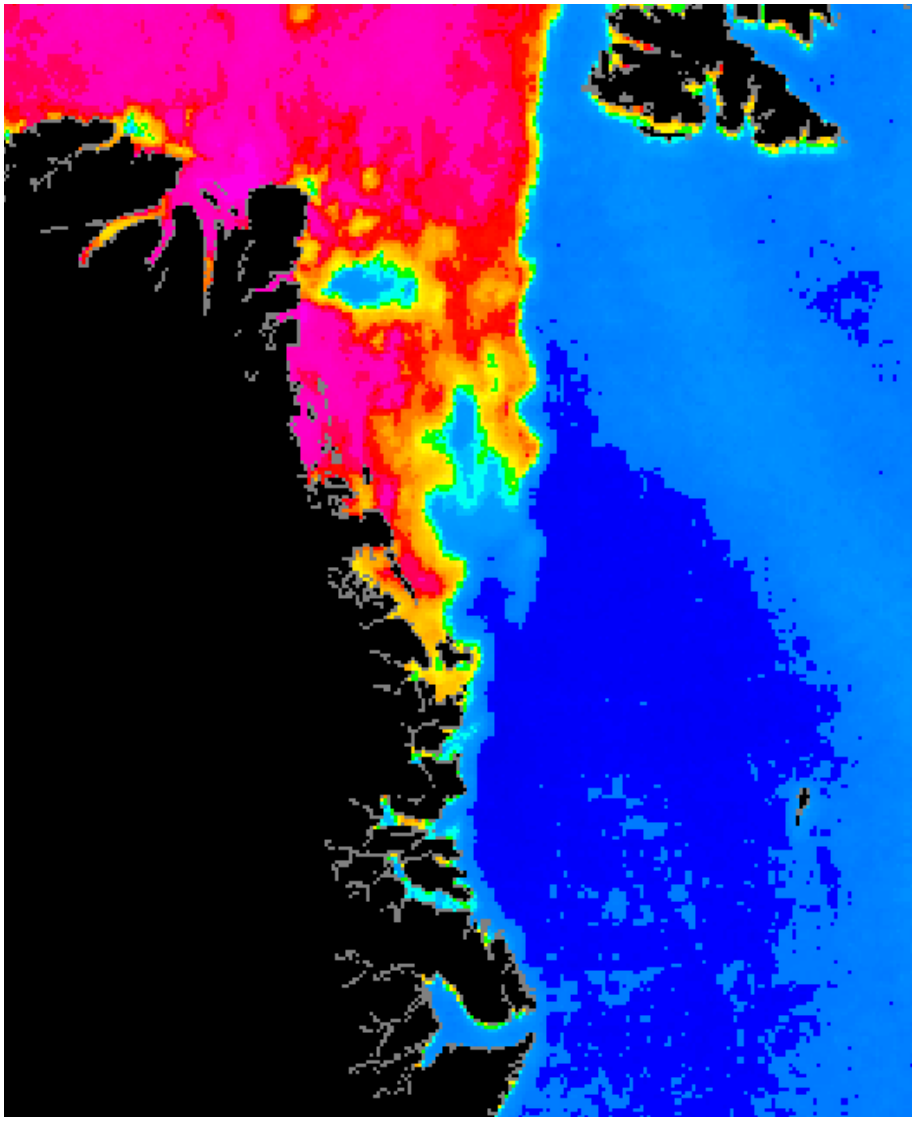
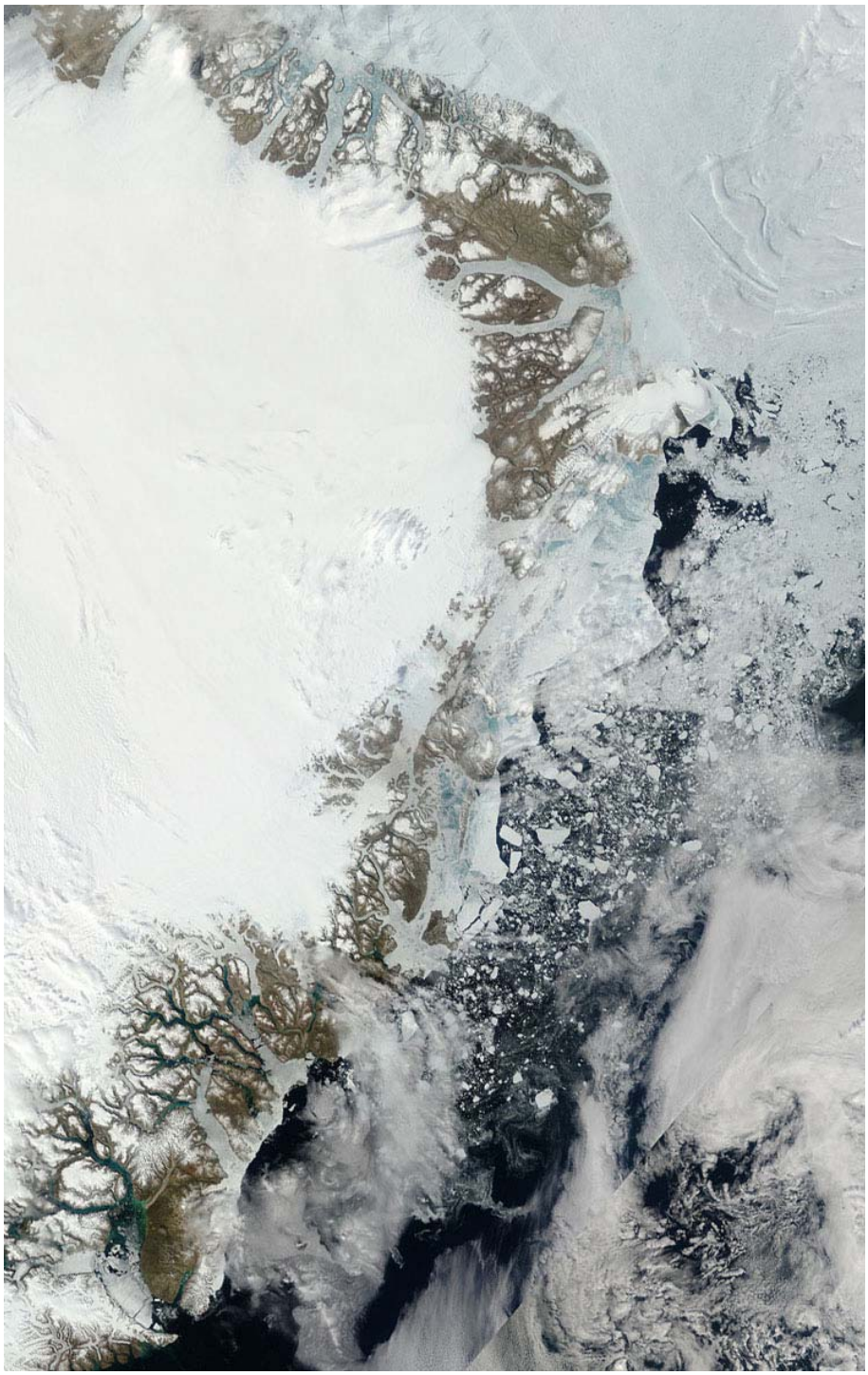


Figure 4. The ice situation in July 2009. An AMSR-E passive microwave image from the NASA Aqua satellite at 27 July. Purple and red indicate high ice concentrations, yellow and green low concentrations and blue no ice. Downloaded from www.seaice.dk.

Figure 5. A MODIS Rapid response true colour image from 11 July (("NASA/GSFC, MODIS Rapid Response"). Downloaded from www.seaice.dk.



3 Results

3.1 Species recorded during the surveys

3.1.1 Birds

Only relevant coastal birds will be enumerated here.

Great northern diver, *Gavia immer*

Very few observed and only on Blosseville Kyst (Figure 6). One was observed in the same lake where a pair was present in 2008.

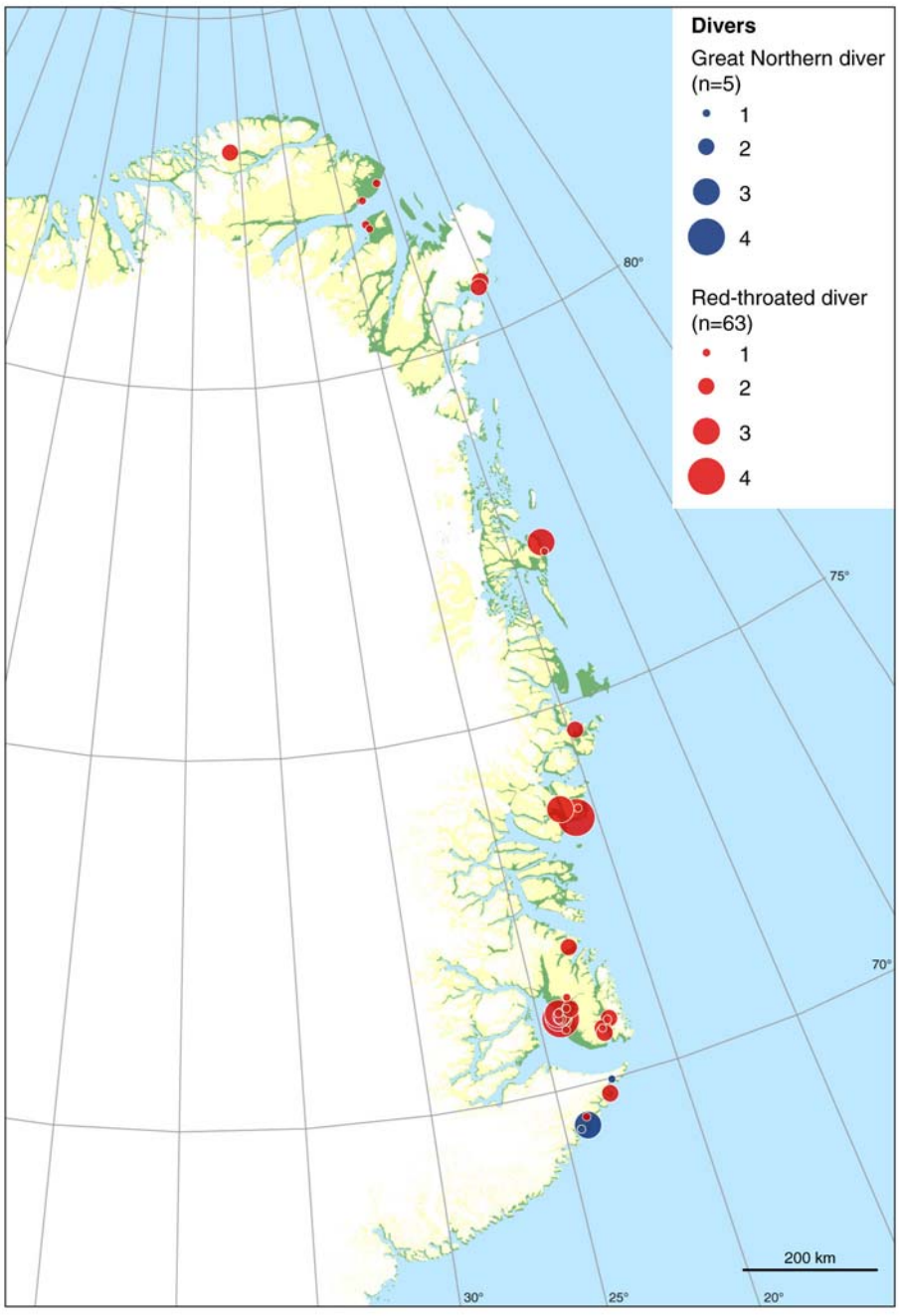


Figure 6. Distribution of observations of red-throated diver and great northern diver during the surveys in July and August 2009.

Red-throated diver, *Gavia stellata*

In total 63 birds were observed (Figure 6) scattered throughout the survey area. They were seen on lakes, ponds and in shallow coastal waters.

Northern fulmar, *Fulmarus glacialis*

Only few were seen; along Blosseville Kyst, along the ice edge between Germania land and Holm Land and in the Northeast Water (Figure 7).

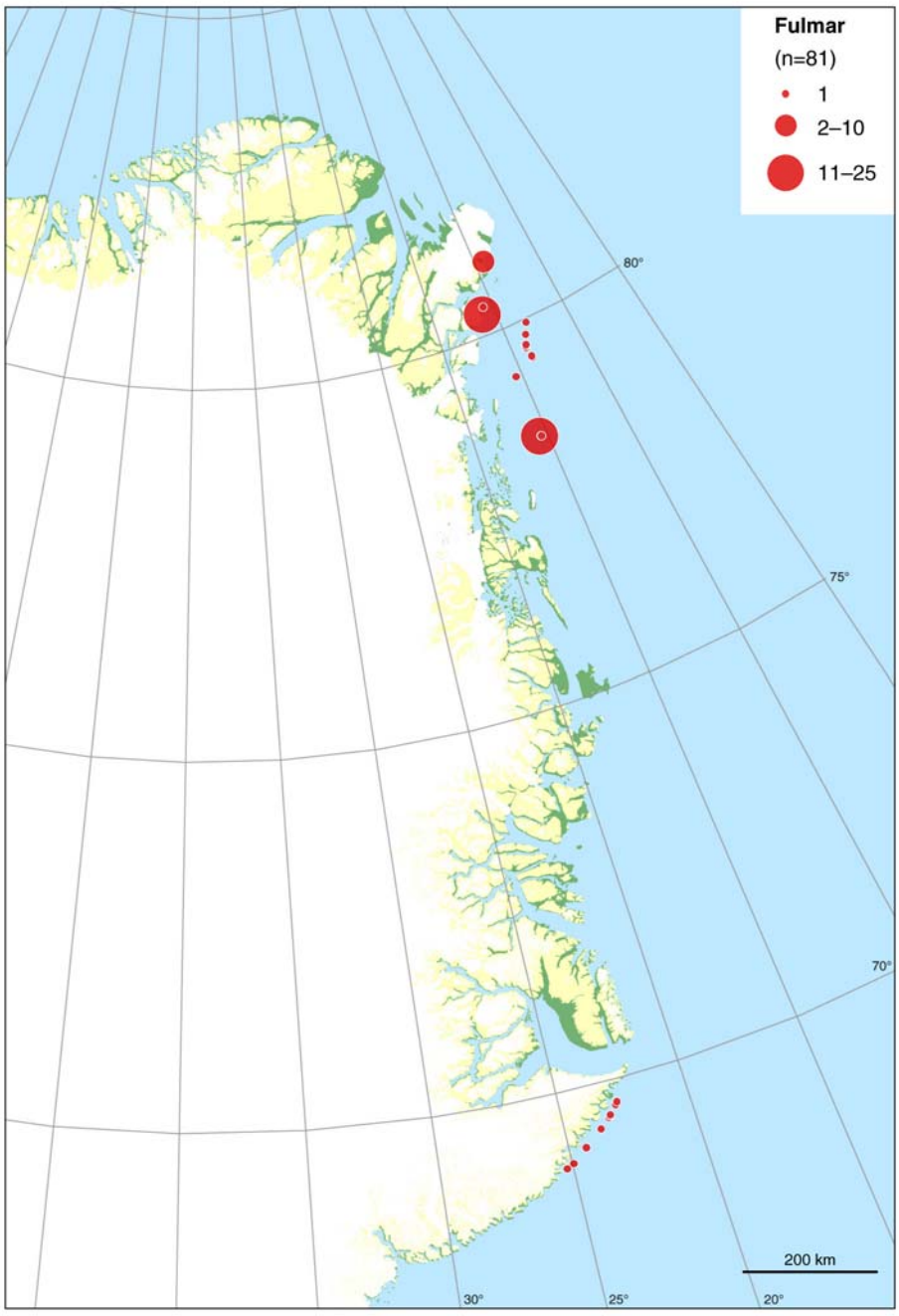


Figure 7. Distribution of observations of northern fulmar during the surveys in July and August 2009.

Whooper swan, *Cygnus cygnus*

A single adult bird was seen in Ørsted Dal on 16 July and a flock of five adult birds were seen in Badlanddal on Hold-with-Hope on 20 July (Figure 8).

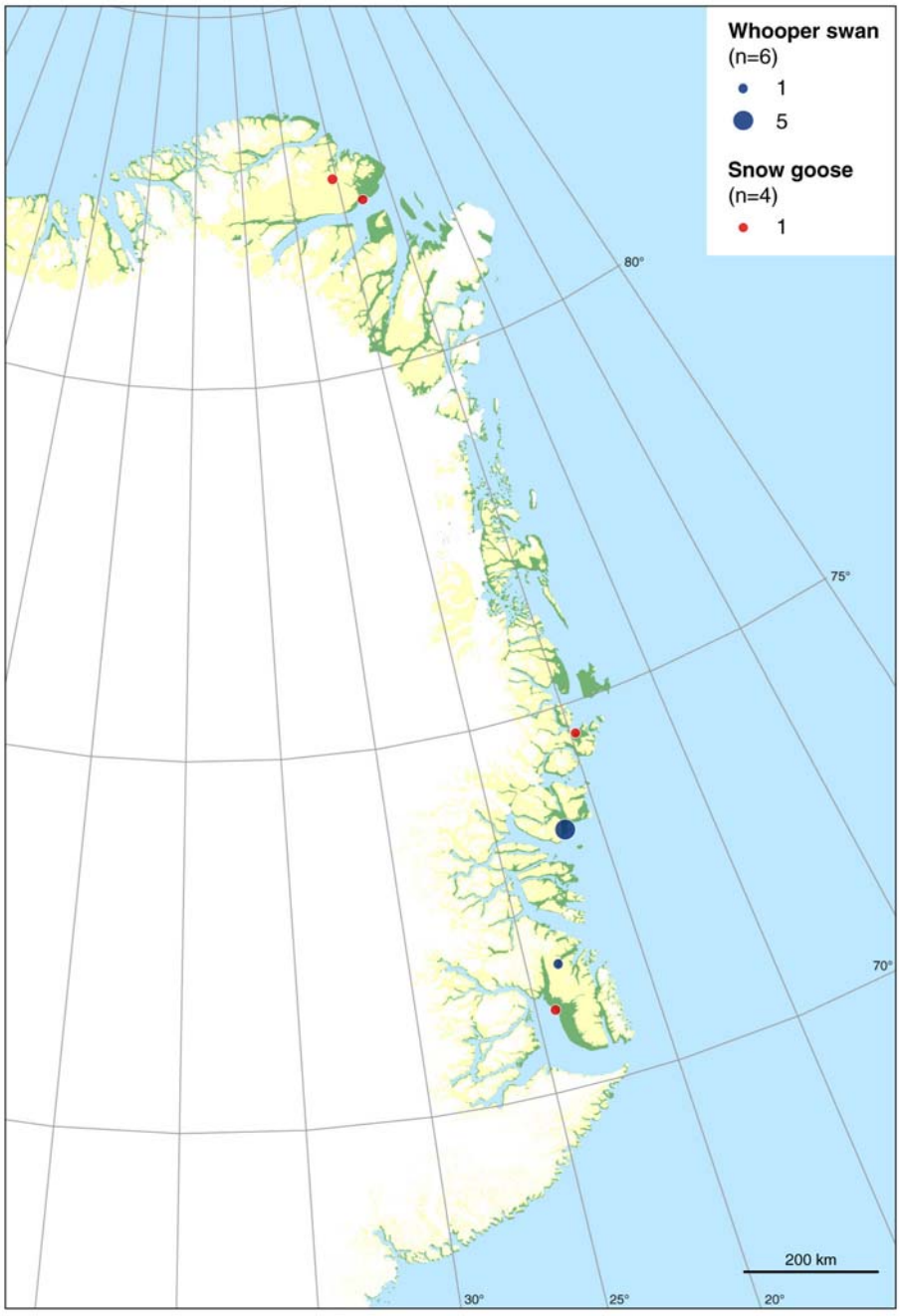


Figure 8. Distribution of observations of whooper swan and snow goose during the surveys in July and August 2009.

Pink-footed goose, *Anser brachyrhynchos*

See separate section on goose surveys, section 3.2 page 39.

Barnacle goose, *Branta leucopsis*

See separate section on goose surveys, section 3.2 page 39.

Light-bellied brent goose, *Branta bernicla hrota*

See separate section on goose surveys, section 3.2 page 39.

Snow goose, *Anser caerulescens*

Four snow geese, all white-phase birds, were seen among moulting pink-footed geese: one on the west coast of Jameson Land on 17 July, one in Wollaston Forland on 20 July, and two in Peary Land on 27 July (Figure 8).

Common scoter, *Melanitta nigra*

A pair was recorded on Kilen on 28 July. This is only the third record of this species from Northeast Greenland.

Common eider, *Somateria mollissima*

Common eiders were observed along most of the coasts surveyed (Figure 9). The majority were seen along Blosseville Kyst on 21 July, where 64% of the sexed individuals (n = 1,114) were males.

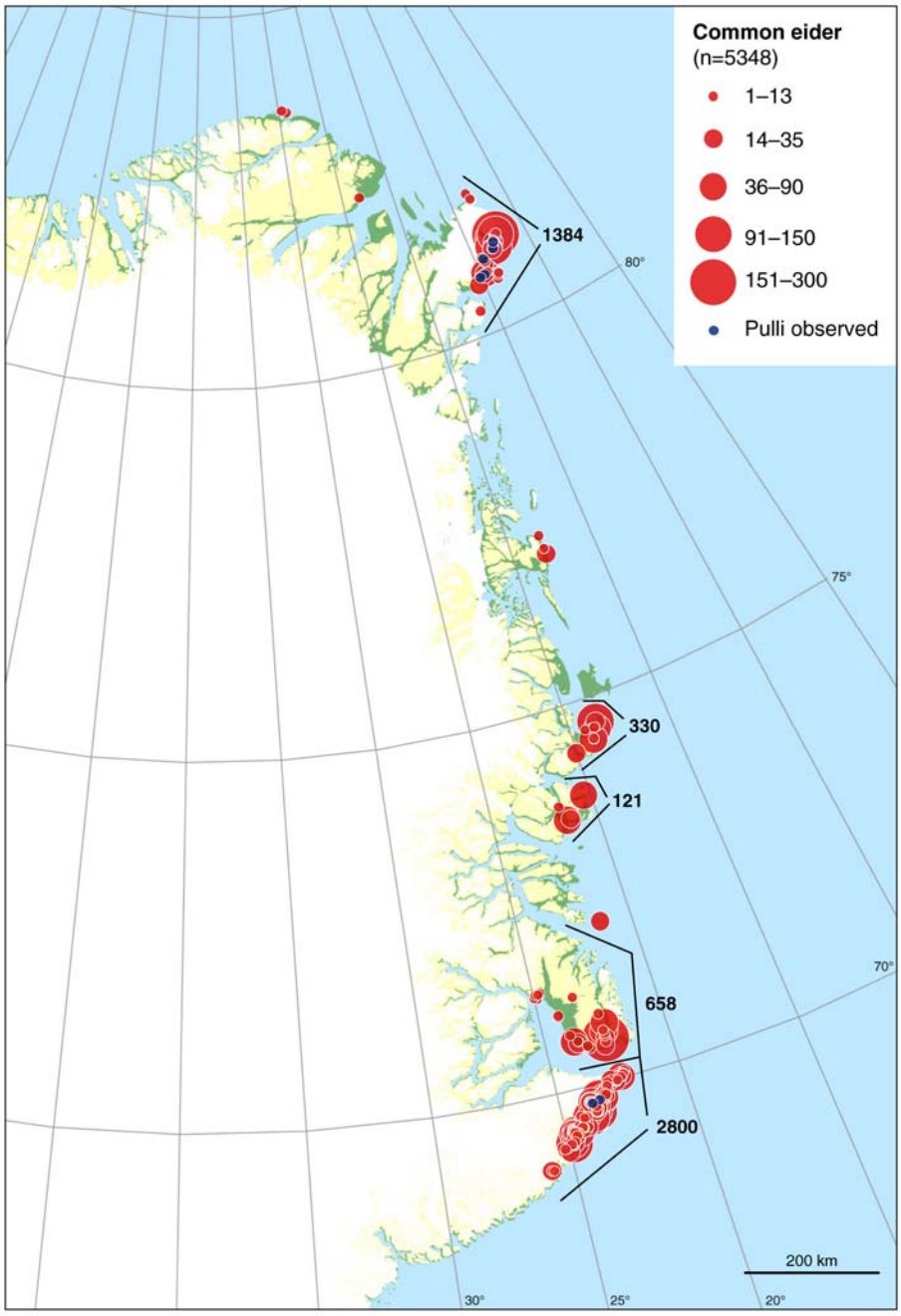


Figure 9. Distribution of observations of common eider during the surveys in July and August 2009.

Females with pulli were seen on the Northeast Water coasts (n = 7 broods on 26 and 28 July), and along Blosseville Kyst (n = 2). However the birds (2 females, 1 male) seen just east off Kap Morris Jesup on 27 July were probably also breeding birds.

Besides the aerial observations a female on a nest was found at Station Nord. It was brooding until 19 August, when the nest was found predated.

King eider, *Somateria spectabilis*

The concentration found in 2008 in Knighton Fjord was re-sighted in 2009. On 21 July 244 birds were observed (Figure 10), of which 75% were males and 4% were in flight.

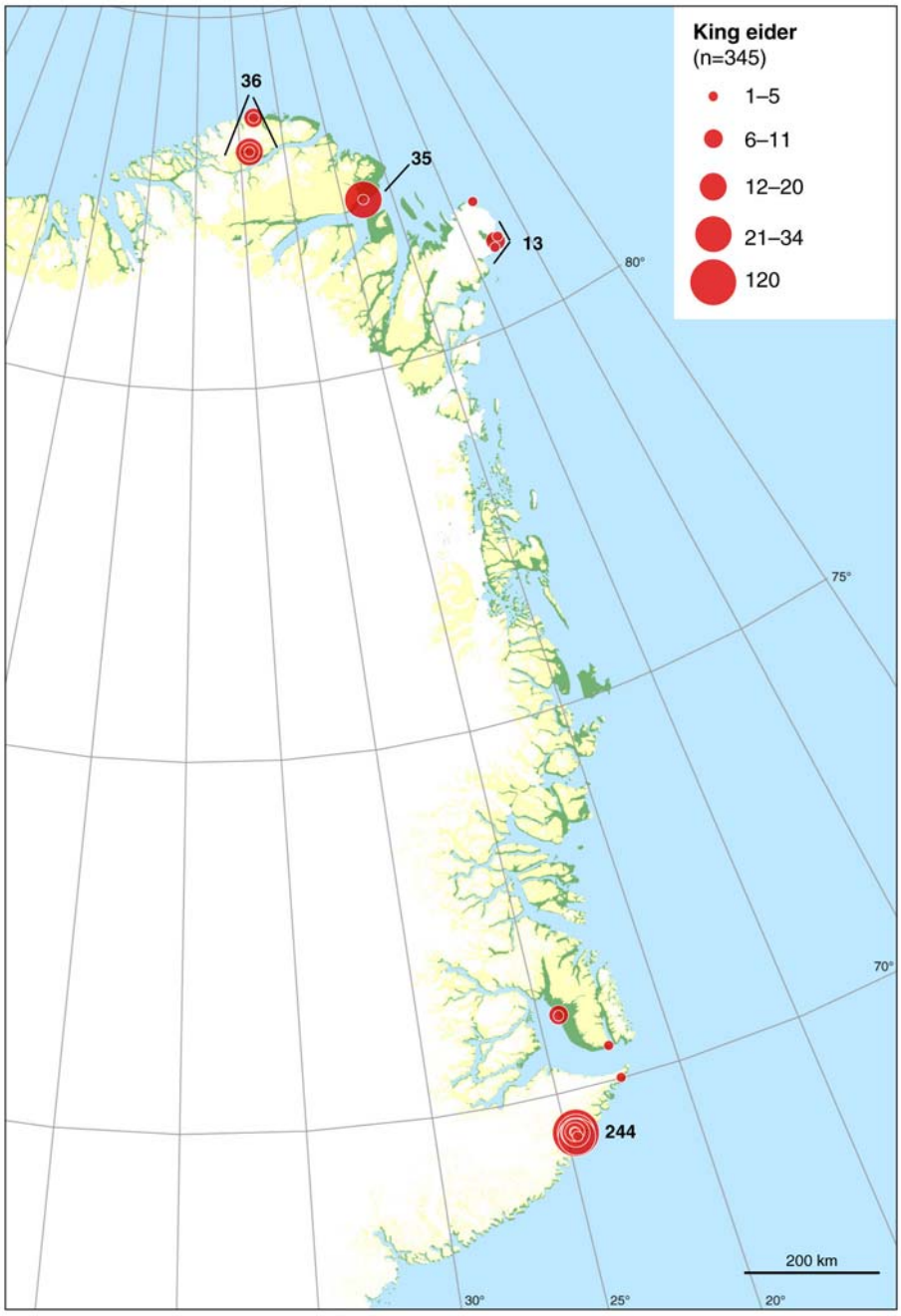


Figure 10. Distribution of observations of king eider during the surveys in July and August 2009.

In North Greenland smaller concentrations were located at the head of Frigg Fjord (n = 27, 26 females and 1 male) and in the delta of Vitskøl Elv (n = 35, 34 females, 1 male). All these were in flight.

Long-tailed duck, *Clangula hyemalis*

The majority were seen in shallow bays and fjords, which is the preferred habitat for moulting birds. The largest moulting concentration was observed (n = 460) in the delta off Dr. Augusta Dal in Wollaston Forland, a site which also held a large concentration in July 2008 (Figure 11). Relatively large numbers were recorded along the west coast of Jameson Land and along Blosseville Kyst with 250 in Knighton Fjord, where also the king eiders assemble.

A few birds were seen inland and these were probably breeders.

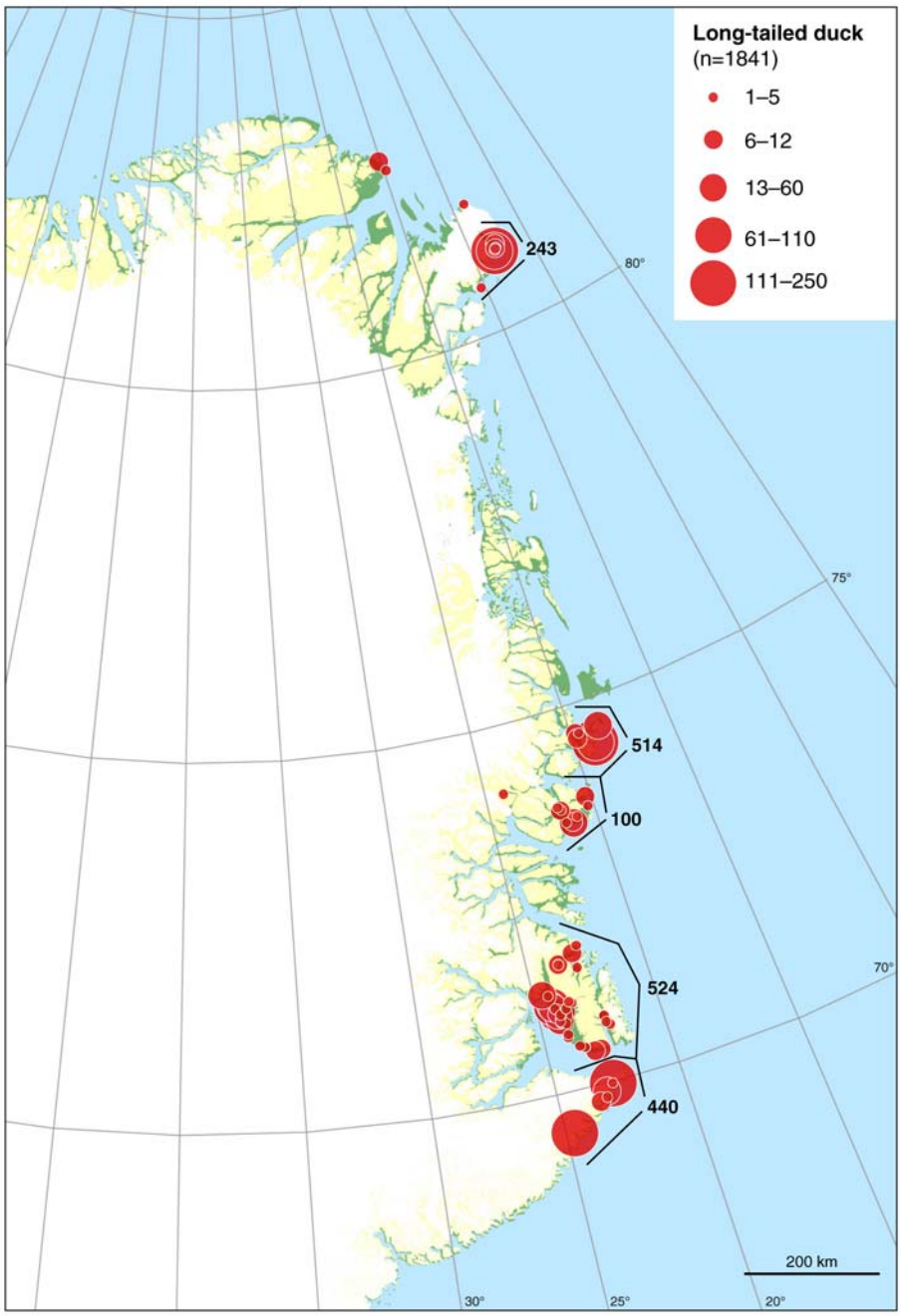


Figure 11. Distribution of observations of long-tailed duck during the surveys in July and August 2009.

Red-breasted merganser, *Mergus serrator*

Only three birds were seen at Blosseville Kyst on 21 July.

Great skua, *Stercorarius skua*

One seen at Turner Fjord on Blosseville Kyst on 21 July, close to where it was seen in July 2008.

Four observations in the Northeast Water area: one at Henrik Krøyer Holme on 26 July, two on the narrow strip of land at Nordostrundingen and two single birds inland Kilen on 28 July.

Both at Nordostrundingen and at Kilen one of the birds behaved aggressively towards the aircraft – attempting attack from above. These observations indicate that the species may breed in the area. The repeated occurrence at Turner Fjord and Blosseville Kyst also indicates breeding.

Arctic skua, *Stercorarius parasiticus*

Only five observations of eight birds recorded; the northernmost at Vestersletten on Gauss Halvø.

Long-tailed skua, *Stercorarius longicaudus*

A total of 268 birds were seen (Figure 12), the majority during the goose counts inland in Jameson Land. The birds had begun to assemble in flocks (max. number = 35) indicating that many birds had given up breeding.

Sabine's gull, *Larus sabini*

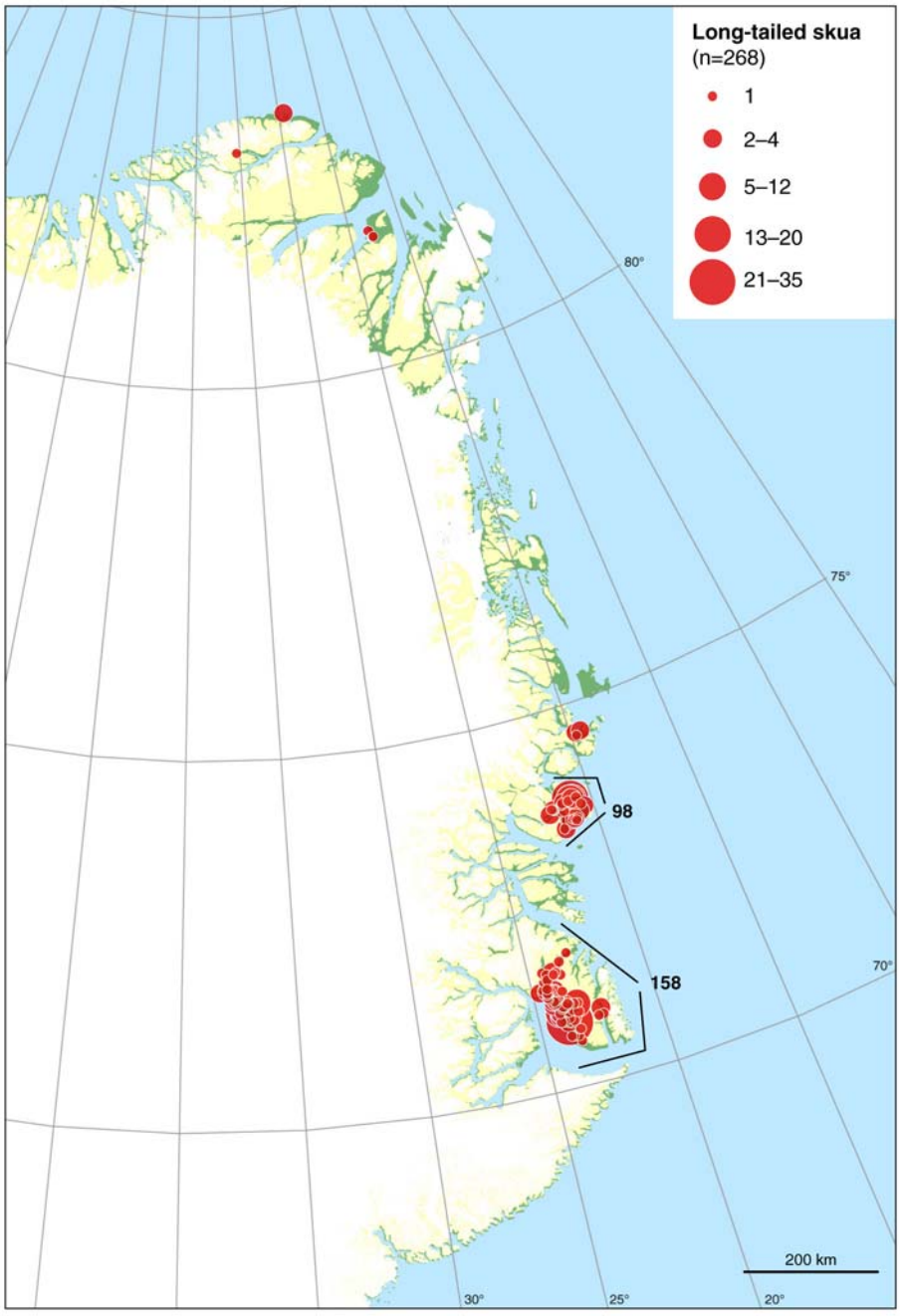
Besides the traditional sites in Jameson Land and in the Northeast Water, Sabine's gulls were found in a new breeding colony just east of Kap Morris Jesup, where they (n = 8 individuals) were nesting on low gravel islets (probably pushed up by ice floes), together with ivory gulls and Arctic terns. The largest assemblage of breeding birds was seen on the southeastern corner of Kilen, where 286 adult gulls were counted on a relatively large area (Figure 13).

A large meltwater river runs into the sea at the head of Antarctic Bugt where the glacier meets the land, and both in 2008 and in 2009 large numbers of gulls and fulmars assembled here to feed. On 28 July more than 360 Sabine's gulls were seen here. The site was overflown again on 15 August, when at least 300 Sabine's gulls were present.

Lesser black-backed gull, *Larus fuscus*

Adult birds (n = 4), probably breeding birds, were present on Dunholme on 21 July. Additional birds (n = 24) were observed along the Blosseville Kyst mainly in flocks of other large gull species.

Figure 12. Distribution of observations of long-tailed skua during the surveys in July and August 2009.



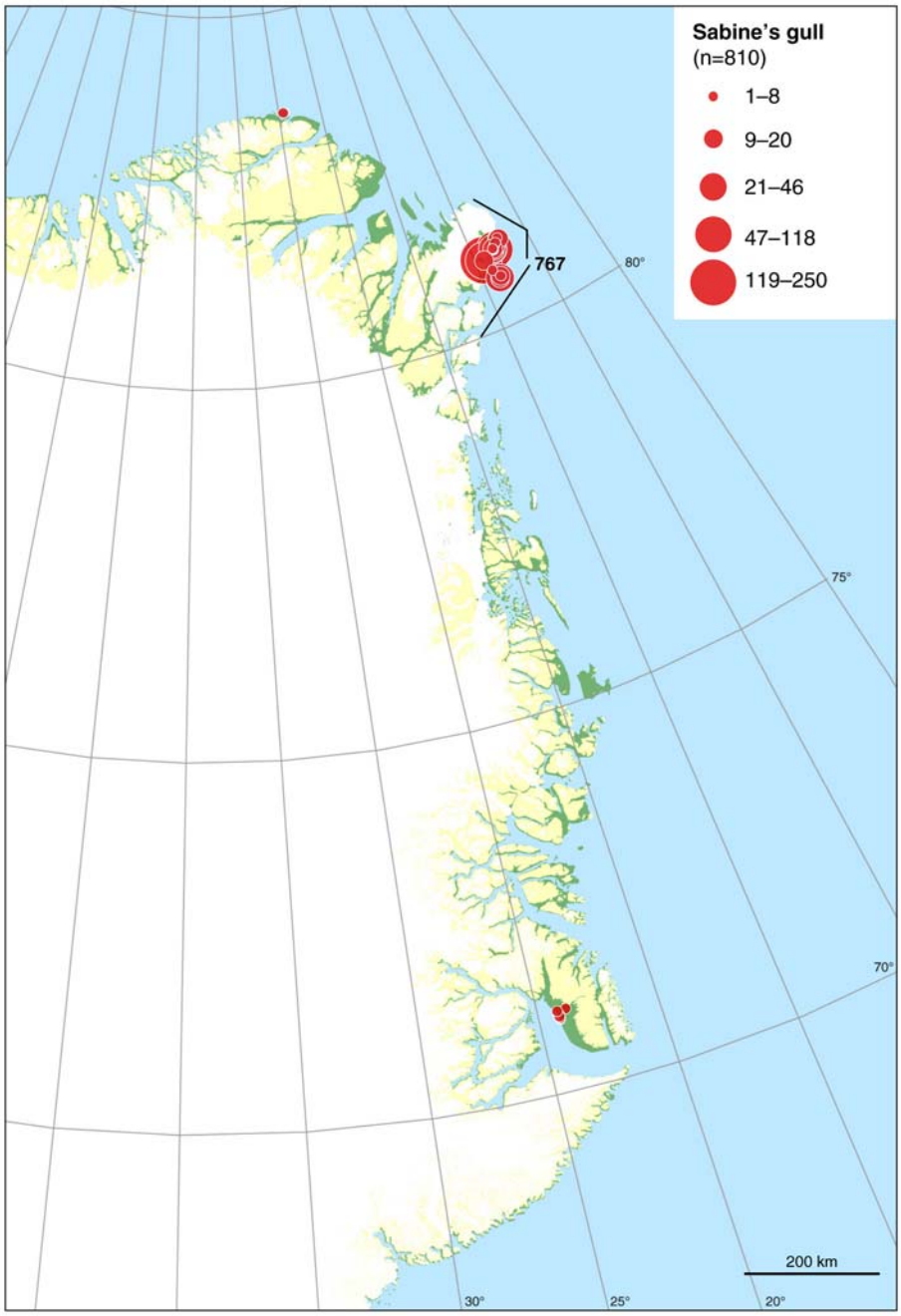


Figure 13. Distribution of observations of Sabines gull during the surveys in July and August 2009.

Glaucous gull, *Larus hyperboreus*

Glaucous gull represented the most widespread of the seabirds observed during the surveys both in 2008 and 2009. The gulls were observed at coasts, ice edges, on the drift ice and even at inland sites, and were most numerous along Blosseville Kyst (Figure 14). A number of the gull (n = 13) were seen inland when flying in the valleys of Hudson Land and Ole Rømer Land, probably birds on the move from one fjord to another.

Great black-backed gull, *Larus marinus*

Only three birds were sighted, all on 21 July in Barclay Bugt on Blosseville Kyst.

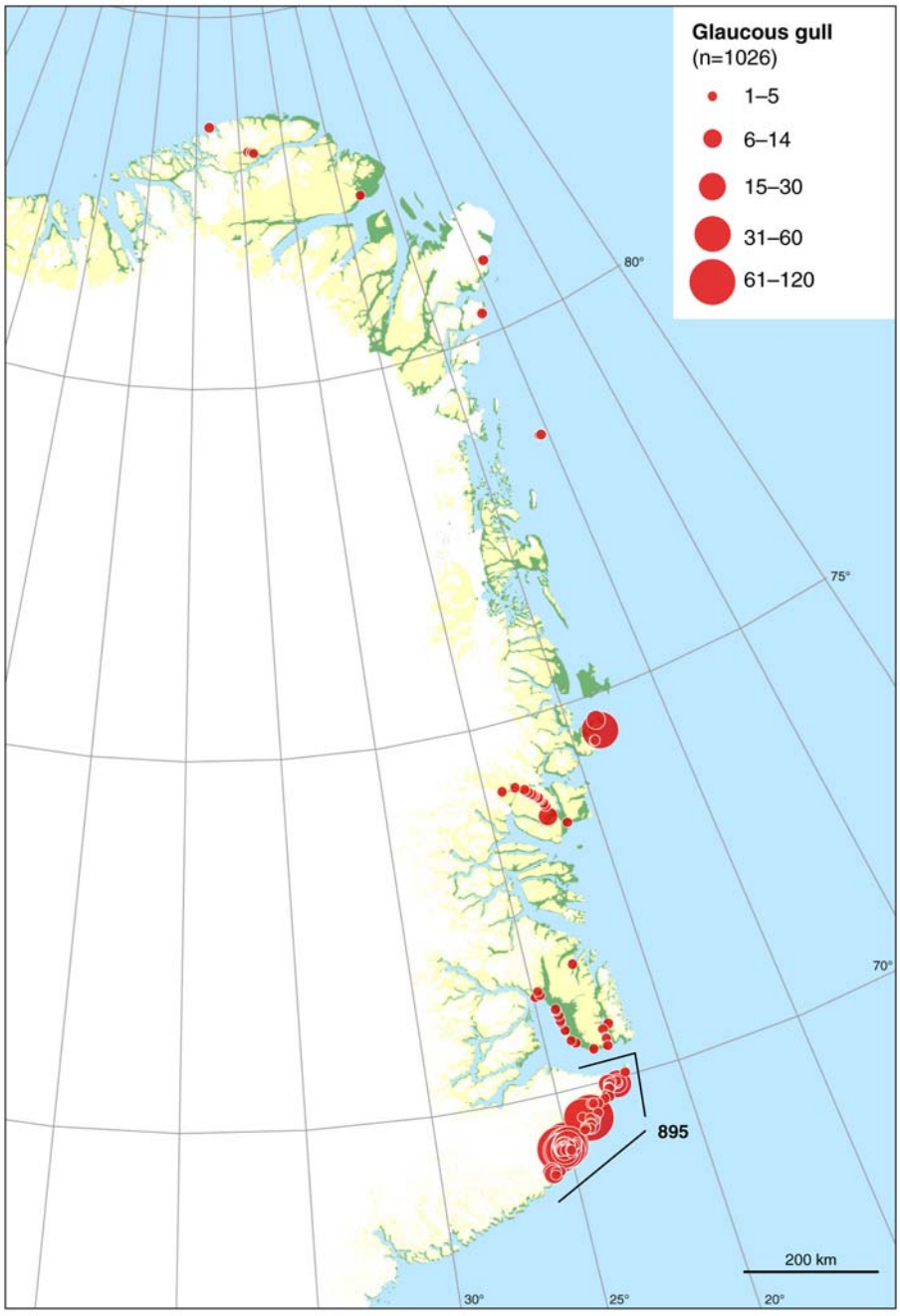


Figure 14. Distribution of observations of glaucous gull during the surveys in July and August 2009.

Black-legged kittiwake, *Rissa tridactyla*

Very few observations were made outside the breeding colonies on Dunholme and Hvalros Ø (Figure 15). In mid-August, a new colony (approx. 200 birds) was discovered very high on the north coast of Hovgaard Ø, just west of Kap Poul.

Ivory gull, *Pagophila eburnea*

See separate section on ivory gulls, section 3.3, page 49.

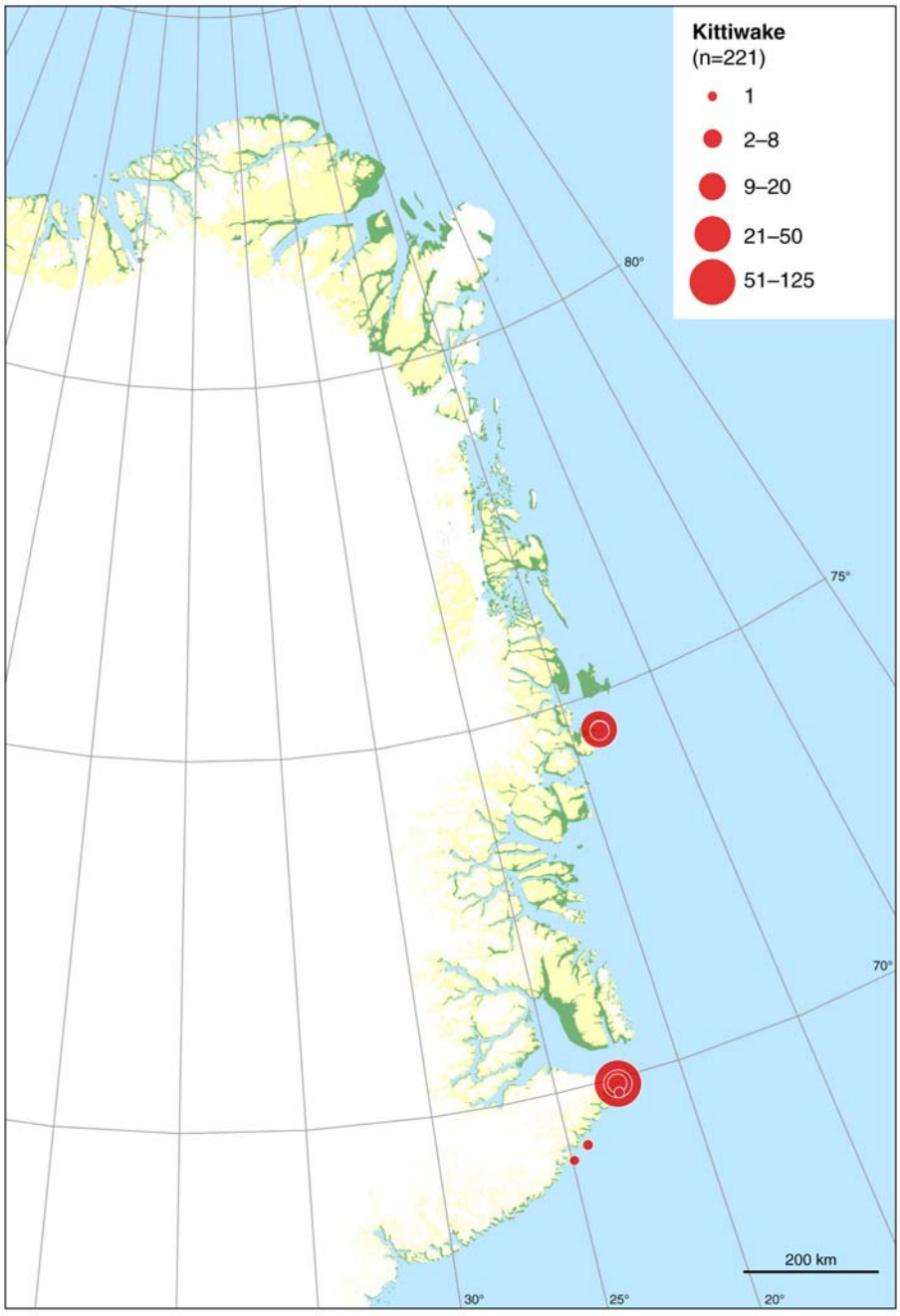
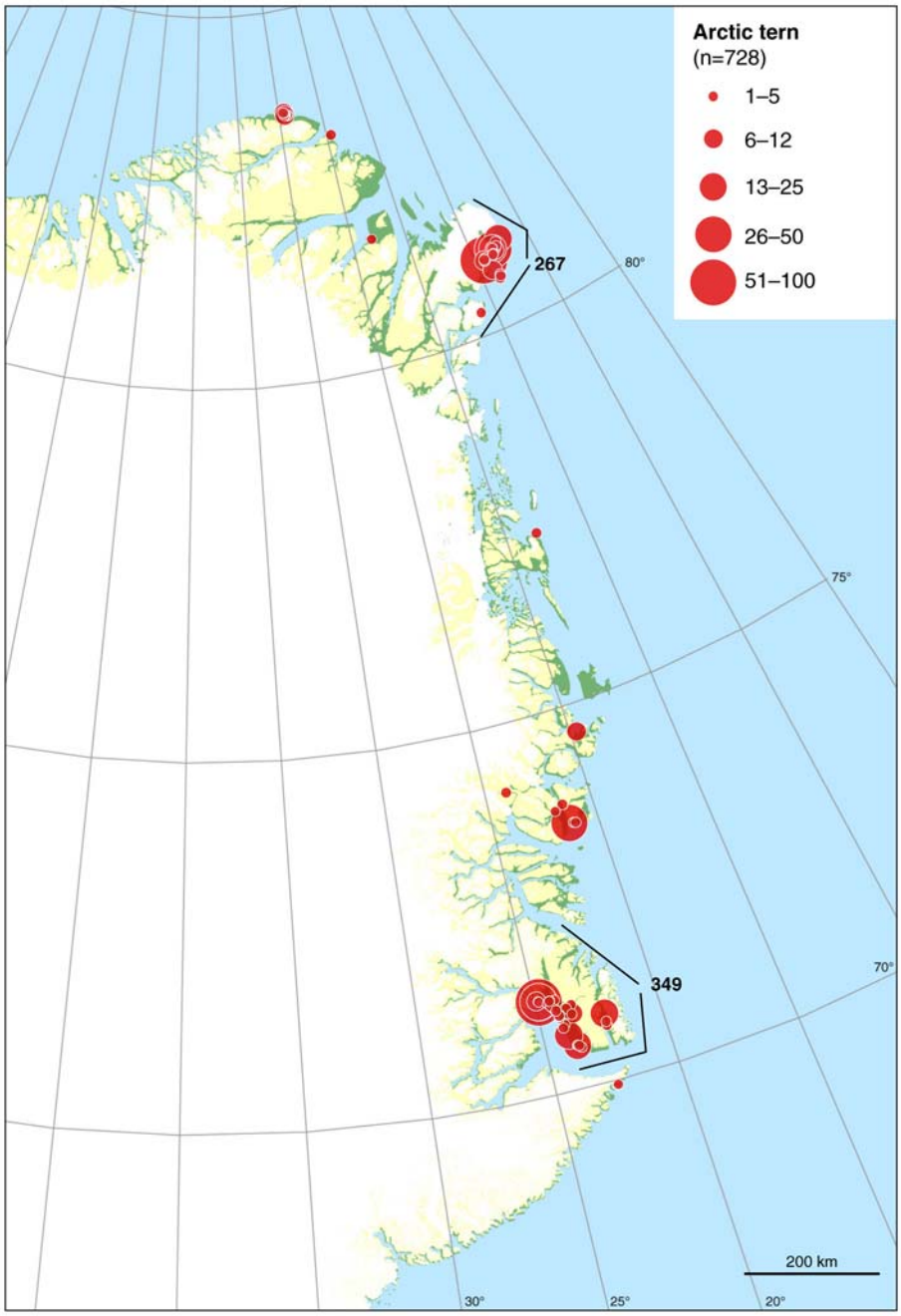


Figure 15. Distribution of observations of black-legged kittiwake during the surveys in July and August 2009.

Arctic tern, *Sterna paradisaea*

The majority were seen in areas with breeding colonies – particularly in Hall Bredning west of Jameson Land and at the coasts of the Northeast Water (Figure 16).

Figure 16. Distribution of observations of Arctic tern during the surveys in July and August 2009.



Black guillemot, *Cepphus grylle*

In 2009, only seen at regular breeding sites or areas (Figure 17): Hvalros Ø (n = 16) and Blosseville Kyst (n = 94).

Little auk, *Alle alle*

Only seen off Blosseville Kyst on 21 July (n = 247 in 7 flocks). However, the survey stopped before areas with high concentrations were reached.

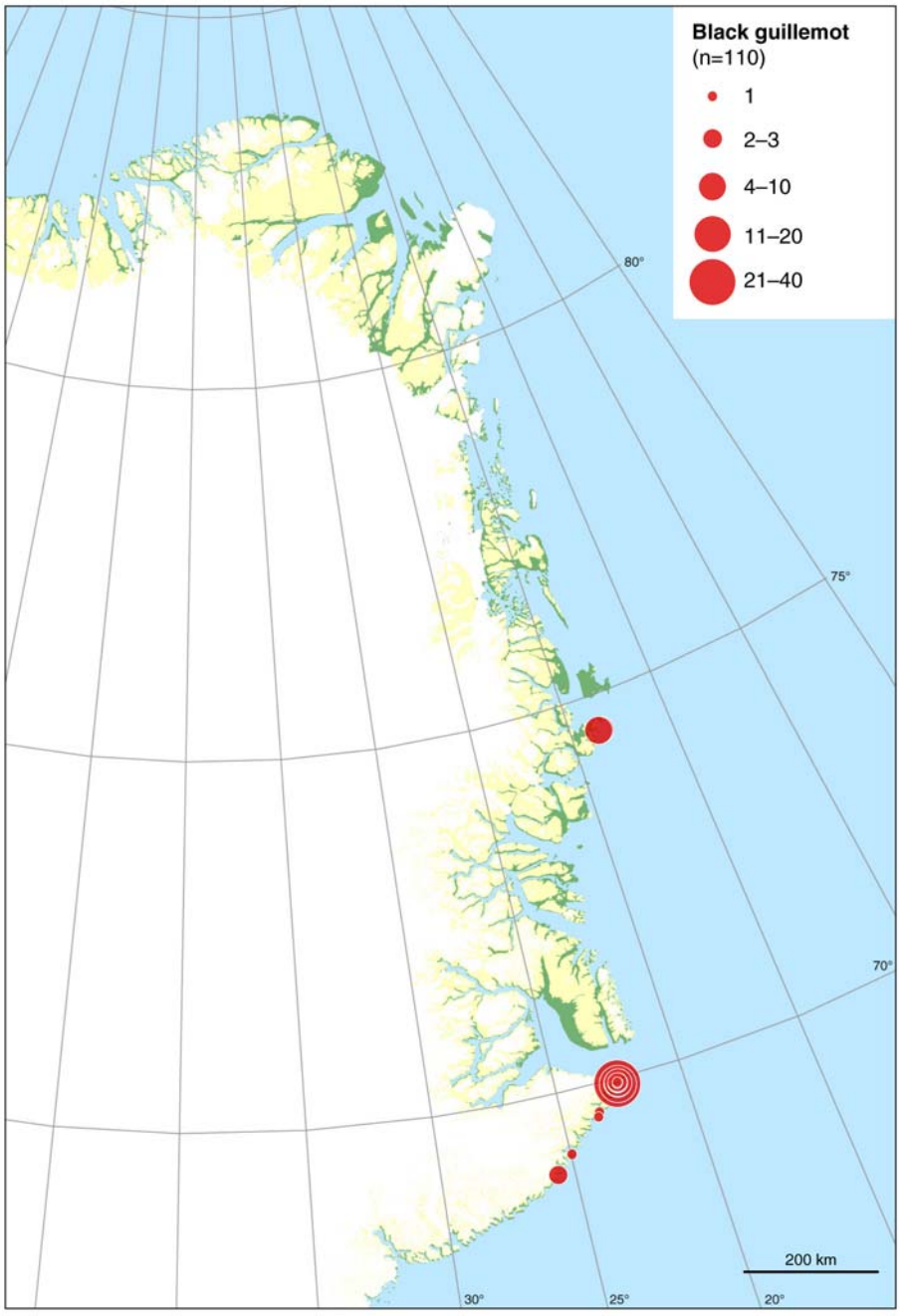


Figure 17. Distribution of observations of black guillemot during the surveys in July and August 2009.

3.1.2 Marine mammals

Polar bear, *Ursus maritimus*

Only one observation was made in 2009 – a large male seen on land in de Reste Bugt on 21 July (Figure 18).

Figure 18. Distribution of observations of polar bear and bowhead whale during the surveys in July and August 2009.

Walrus, *Odobenus rosmarus*

Walrus were observed at the traditional haul-out on Sandøen on 20 July, when 34 males were present. The same day a total of 15 animals were seen resting on ice floes in Clavering Stræde and at least one female with a calf was among these (Figure 19).

Only three were observed in the Northeast Water, two on 26 July and one on 28 July.

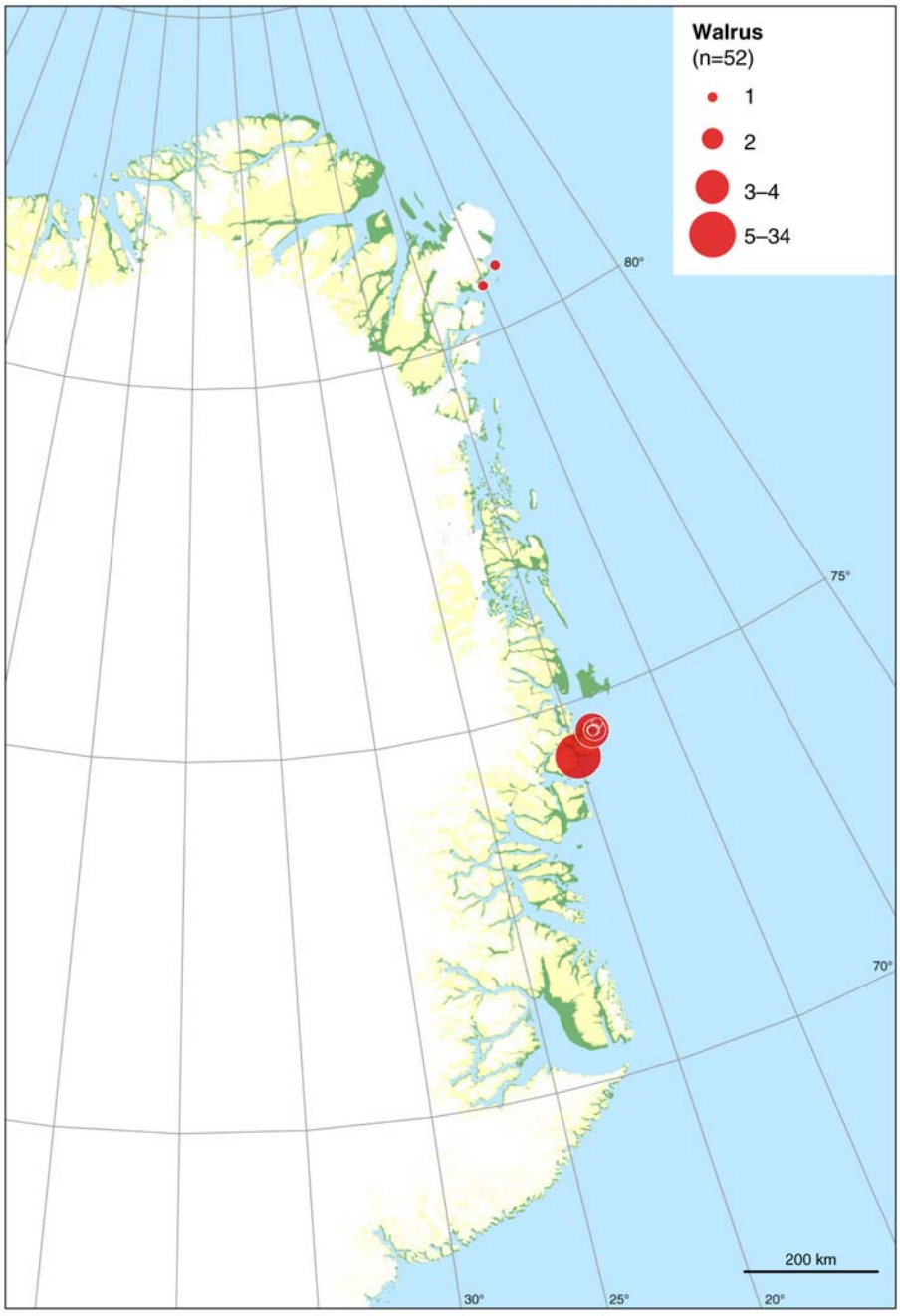


Figure 19. Distribution of observations of walrus during the surveys in July and August 2009.

Bearded seal, *Erignathus barbatus*

Only eight bearded seals were observed, dispersed throughout the survey area (Figure 20).

Harp seal, *Phoca groenlandica*

Only three animals observed, all off Blosseville Kyst on 21 July.

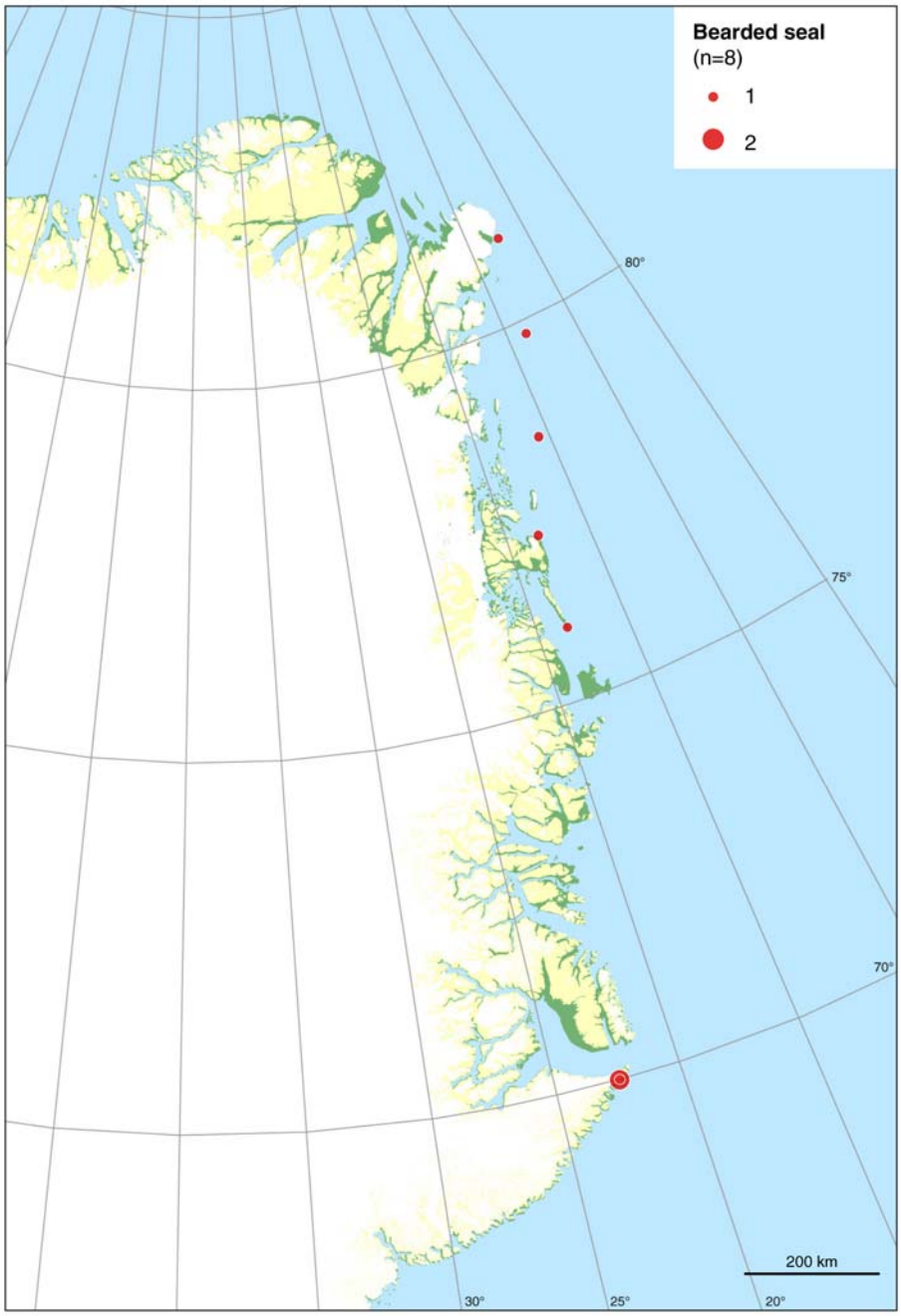


Figure 20. Distribution of observations of bearded seal during the surveys in July and August 2009.

Ringed seal, *Phoca hispida*

Only few seen, and almost all in areas with more or less permanent fjord ice, e.g. Carlsberg Fjord north of Jameson Land and on the drift ice adjacent to the ice barrier in the mouth of Independence Fjord (Figure 21).

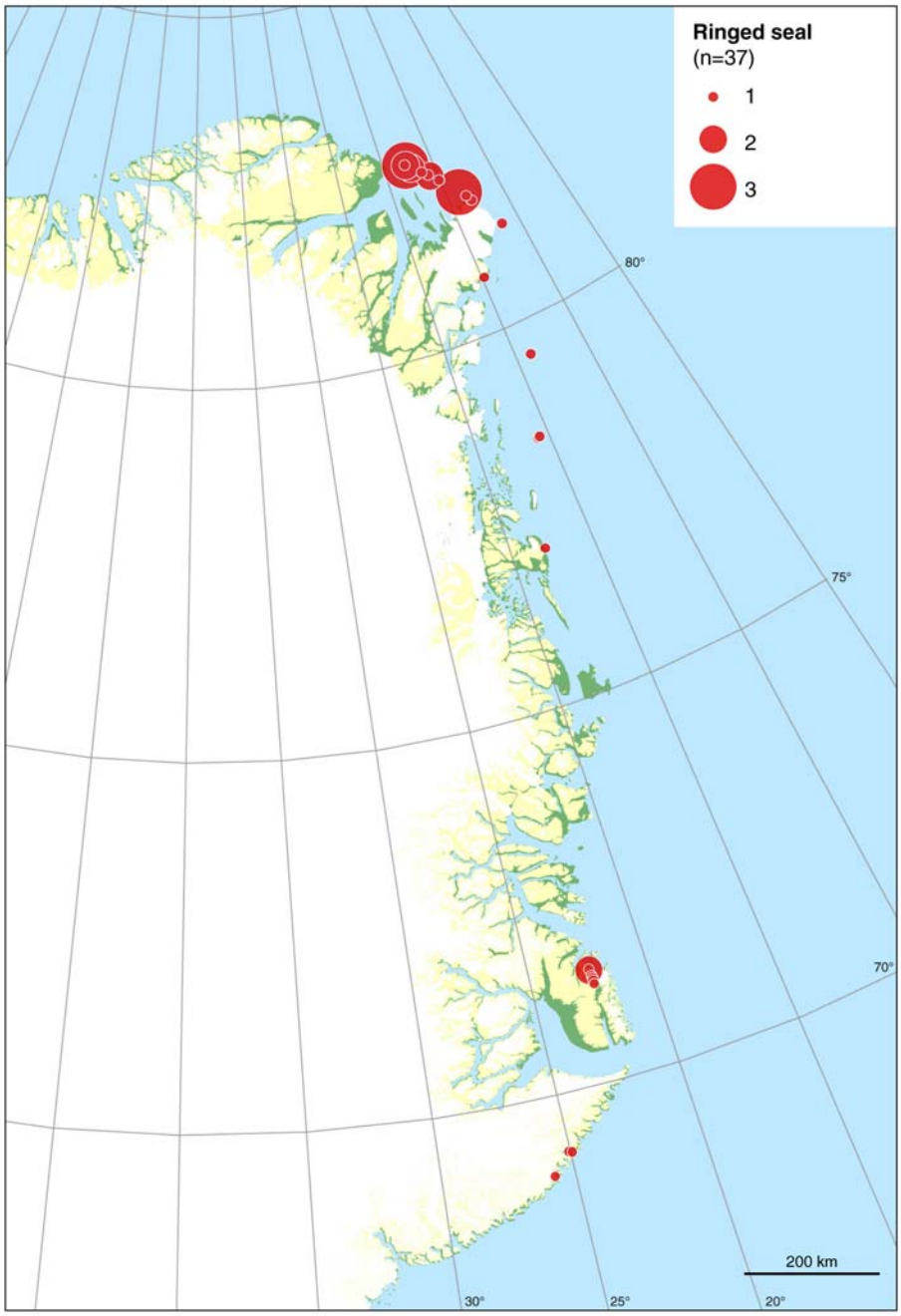


Figure 21. Distribution of observations of ringed seals during the surveys in July and August 2009.

Bowhead whale, *Balaena mysticetus*

One observation: a female with a calf at the ice edge off Danske Øer (Figure 18 and 22).

Figure 22. A female bowhead whale with a calf at the ice edge at 78° 41' N, 16° 26' W on 26 July 2009.

Narwhal, *Monodon monoceros*

Fifty pods with at least 139 individuals were seen (Figure 23). The absence in the Northeast Water was remarkable, while many pods were observed along the ice edge between Germania Land and Hovgaard Ø, the majority in the same areas as the Bowhead Whale. At Blosseville Kyst, 21 pods (at least 39 individuals) were recorded southeast of Kap Ryder and in the fjords Barclay Bugt and de Reste Bugt on 21 July.

In mid-August 2009 many narwhals (198 in 64 pods) were observed in the Northeast Water, during a walrus survey.

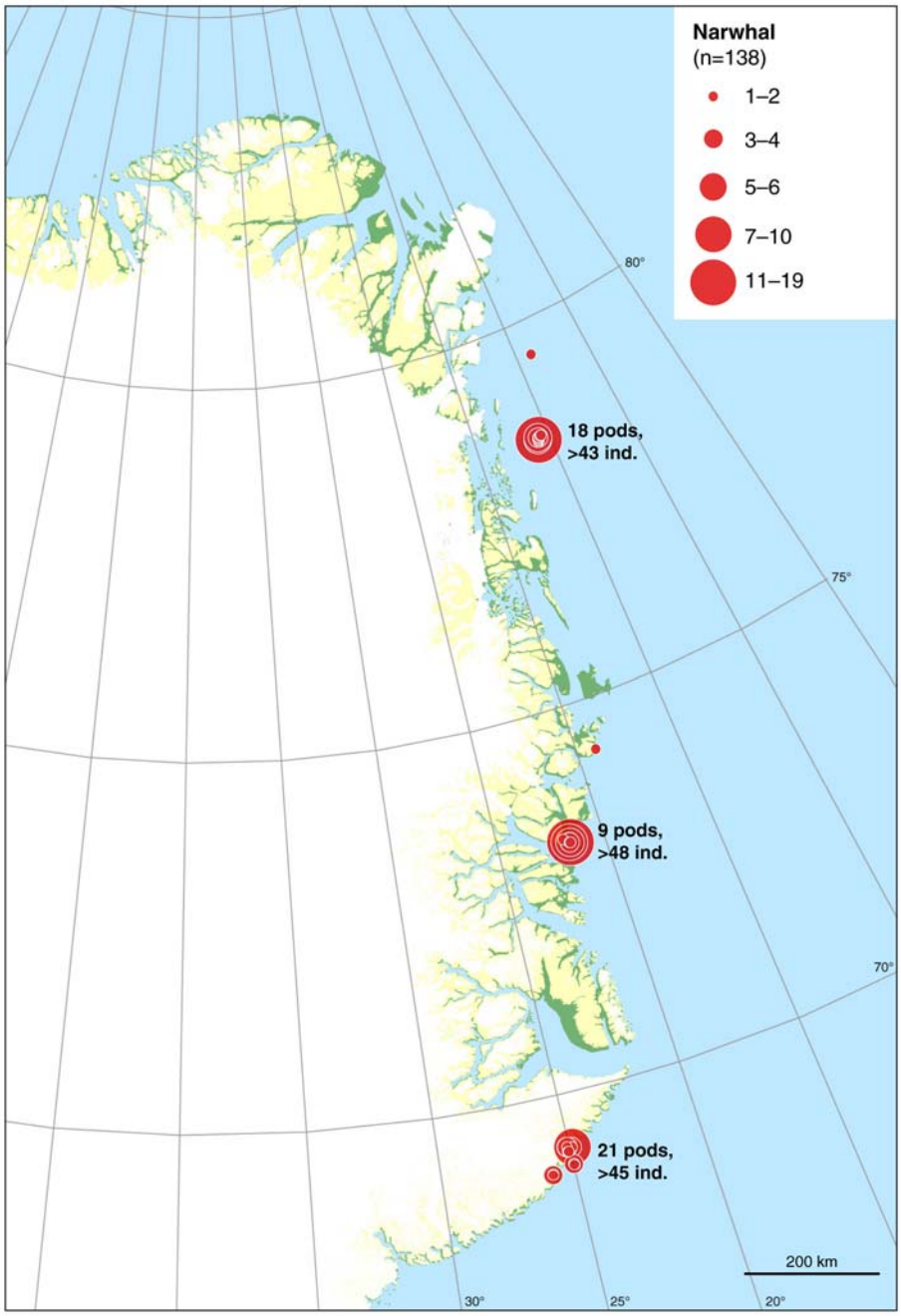
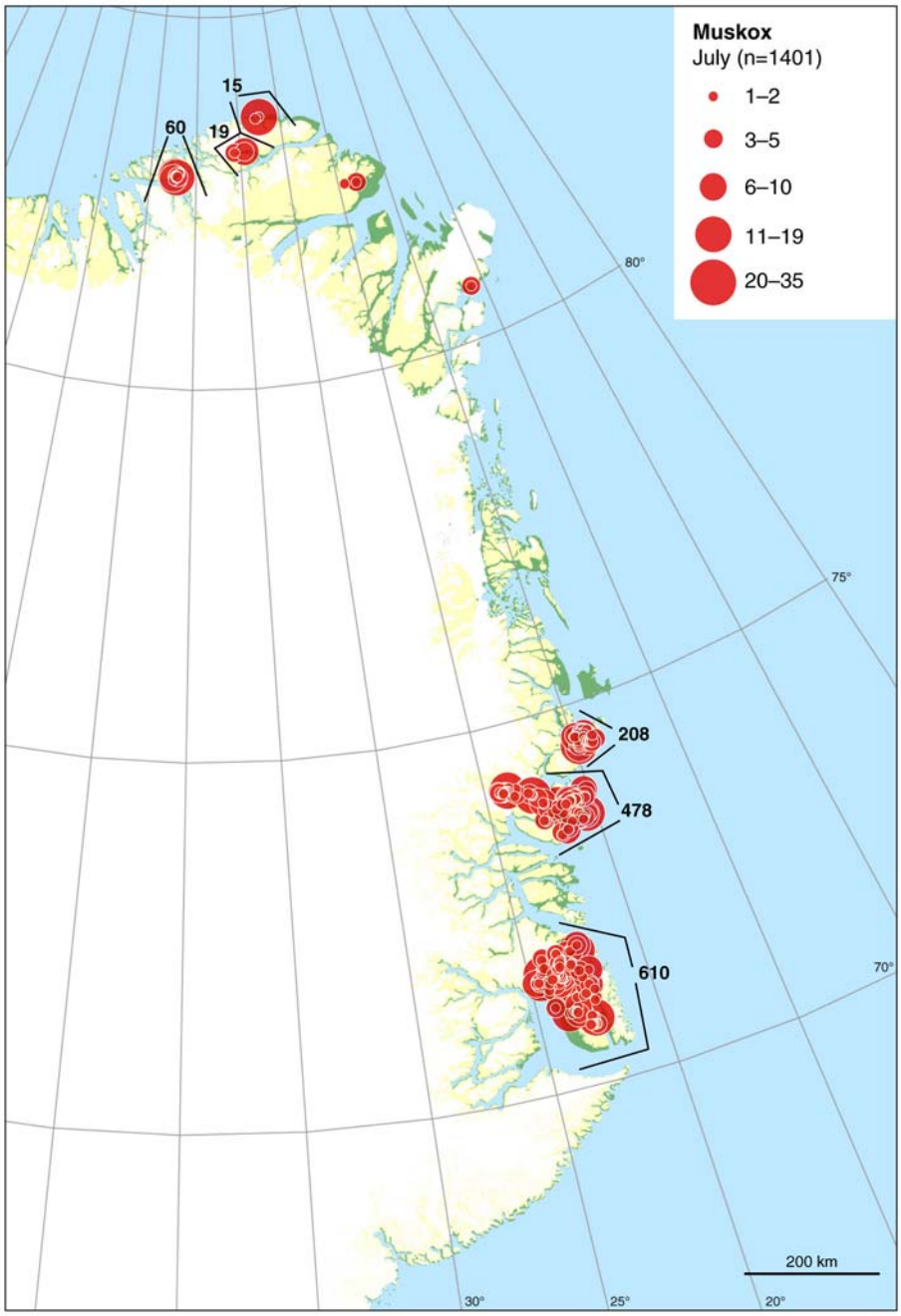


Figure 23. Distribution of observations of narwhals during the surveys in July and August 2009.

Muskox, *Ovibos moschatus*

High numbers were recorded in Jameson Land, Hold-with-Hope and adjacent areas as well as Wollaston Forland (Figure 24). Much fewer were seen in North Greenland: 60 individuals in 20 flocks in Siriuspasset, 19 individuals in four flocks in Frigg Fjord, six individuals in three flocks in Vitskøl Elv, 15 individuals in three flocks in Constable Bugt (east of Kap Morris Jesup) and five in two flocks in southern Amdrup Land.

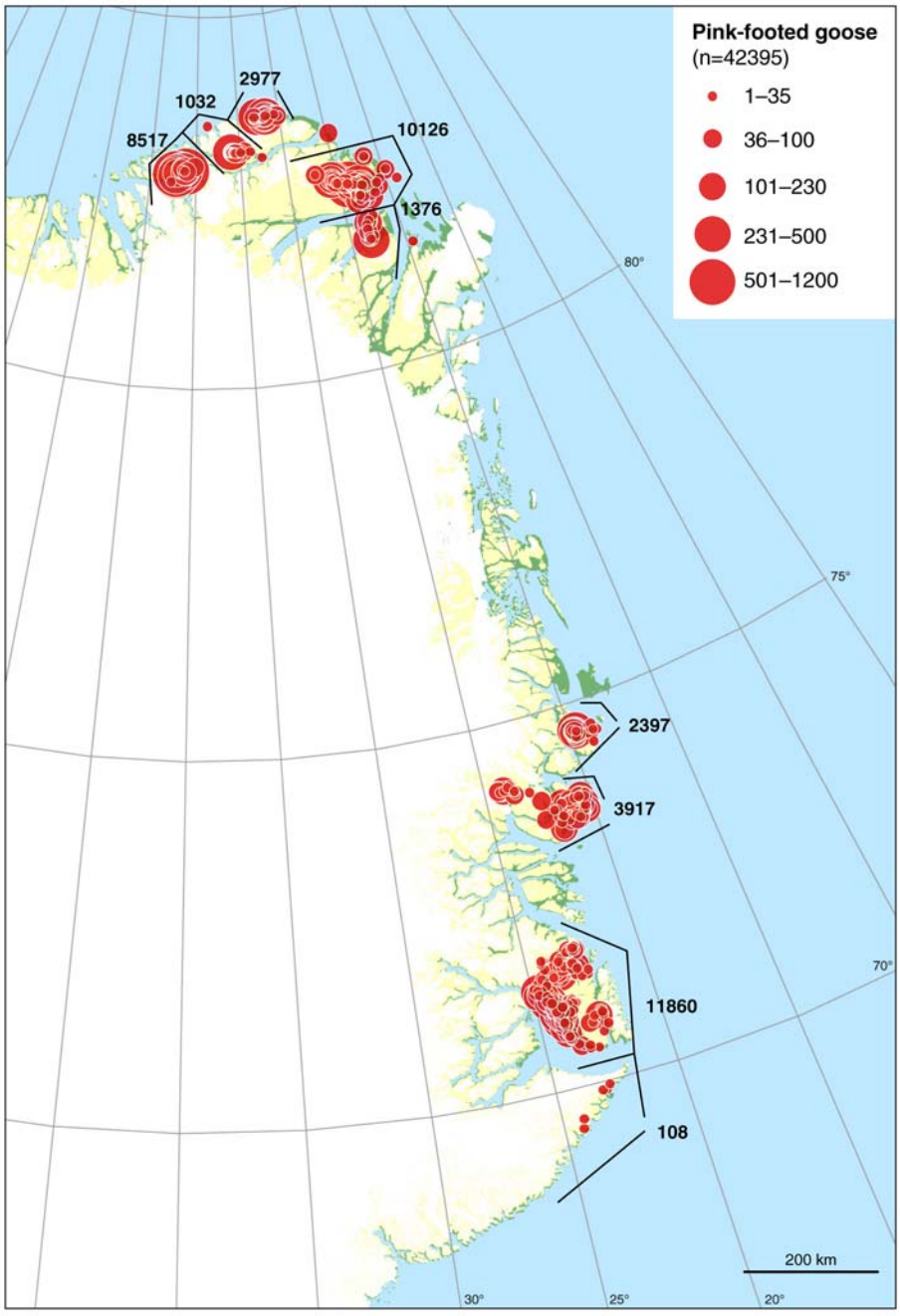
Figure 24. Distribution of observations of muskoxen during the surveys in July and August 2009.



3.2 Goose surveys

In total, approx. 42,000 pink-footed geese and approx. 17,500 barnacle geese were recorded during the surveys (Figure 25 and 26).

Figure 25. Distribution of pink-footed geese observed during all surveys in July and August 2009.



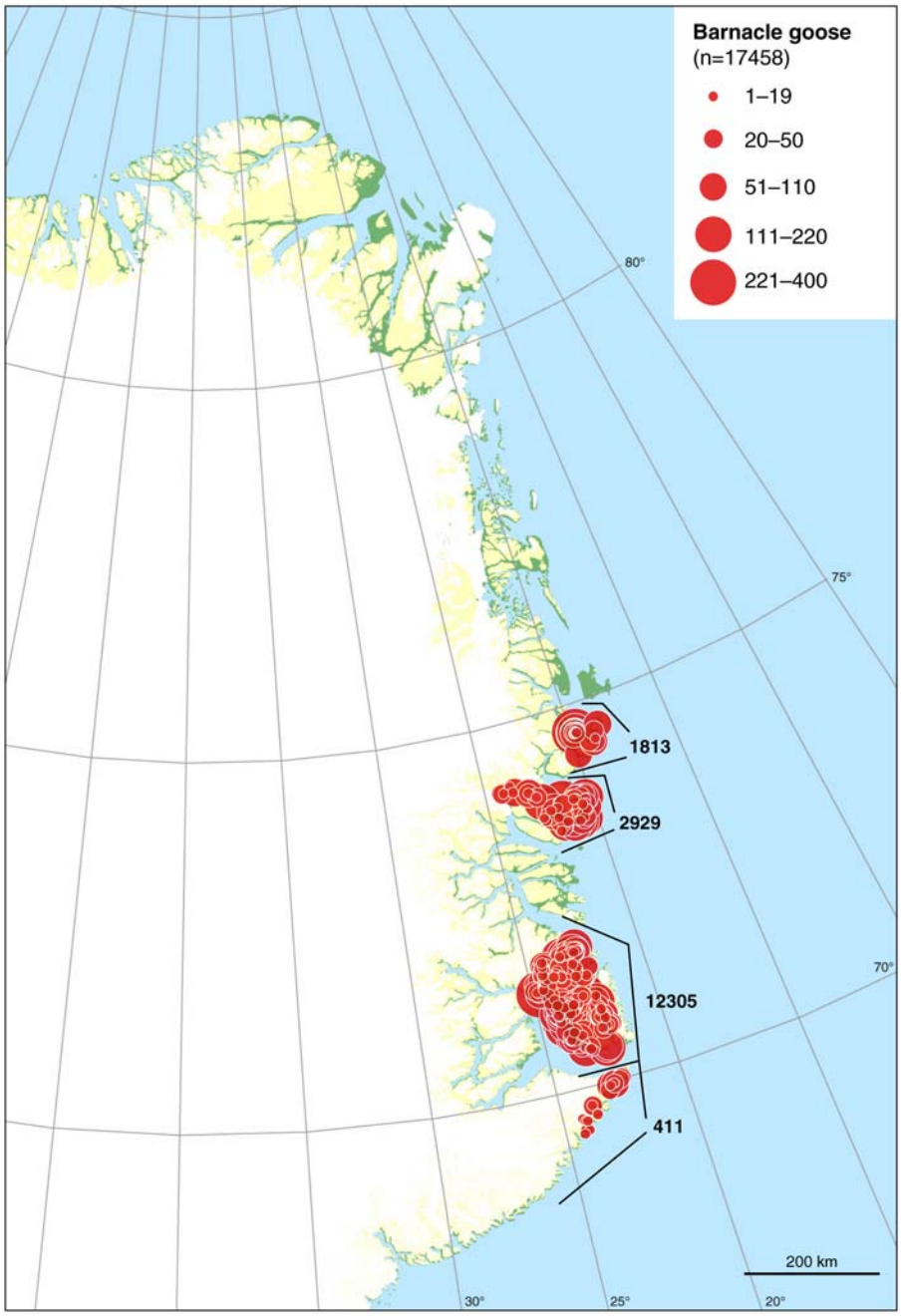


Figure 26. Distribution of barnacle geese observed during all surveys in July and August 2009.

3.2.1 Jameson Land

The survey in Jameson Land was carried out on 16 and 17 July. The survey was as similar as possible to that in 2008 (Boertmann et al. 2009c). Survey routes are shown in Figure 27.

On 16 July the survey took place in the northern part of the survey area, including the valleys of Ørsted and Schuchert, with a total of 701 km being surveyed. The following day the large lowland, Heden, and the southern part of the area were surveyed, in total 1,055 km.

Total numbers of geese recorded during the survey appear in Table 3, and their distributions are shown in Figures 28 and 29.

Figure 27. Survey routes in Jameson Land on 16 and 17 July.

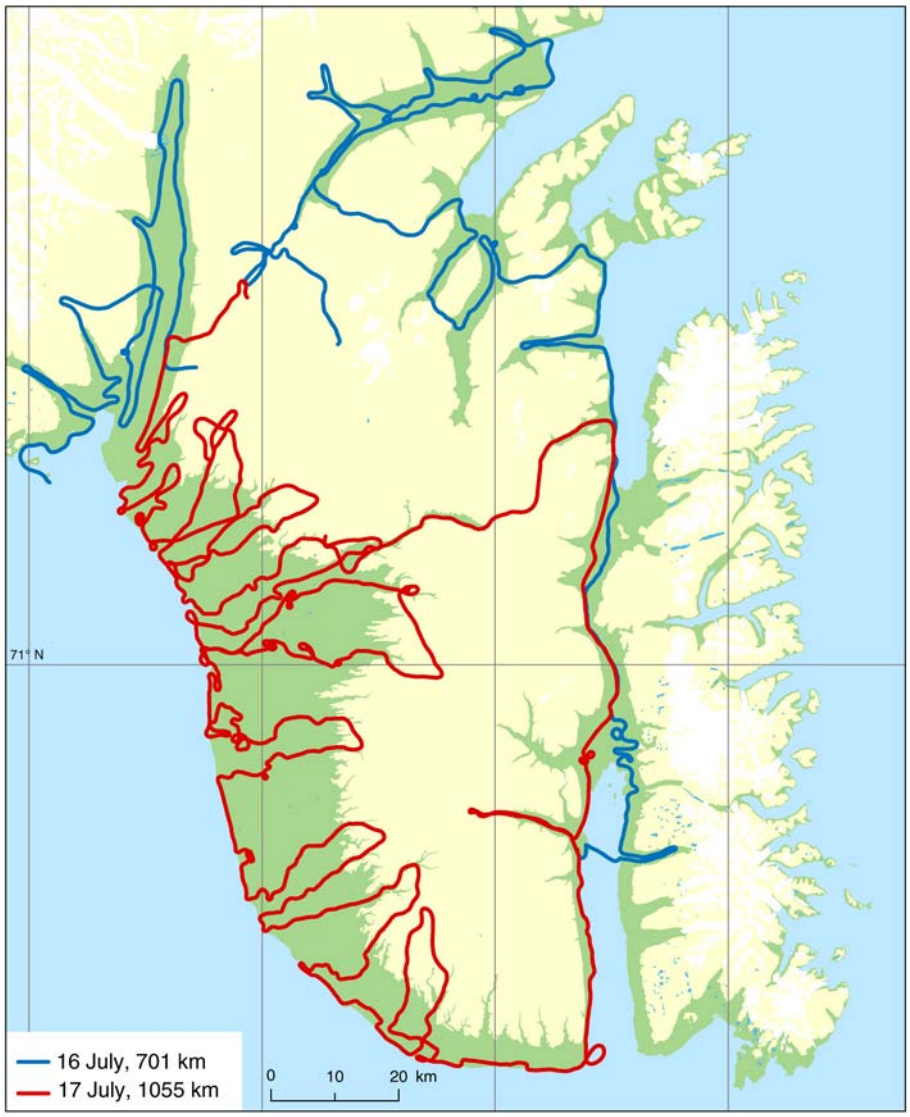
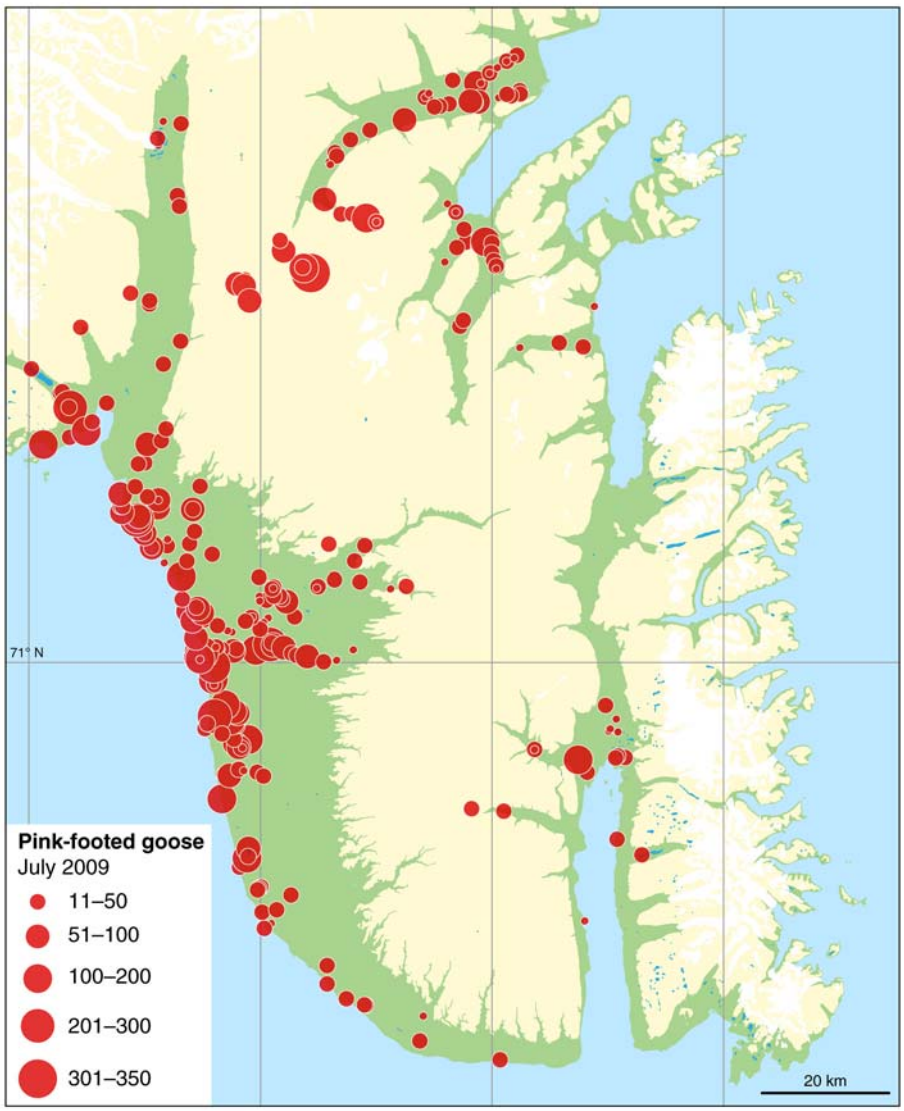


Table 3. Total number of geese recorded during the aerial survey in Jameson Land, 16 and 17 July 2009. Compared to the result from 2008.

	2008		2009	
Species	**Indiv.s**	**Flocks**	**Indiv.s**	**Flocks**
Pink-footed	19,068	384	11,860	304
Barnacle	16,603	431	12,349	349
Canada	2	1		
Snow			2	2

Almost all geese were moulting non-breeding birds. However, here and there downy young were seen in the flocks, and small flocks or single pairs with chicks were also recorded. In total, 171 pink-footed and 192 barnacle chicks were recorded.

Figure 28. Distribution of pink-footed geese in Jameson Land on 16 and 17 July 2009.



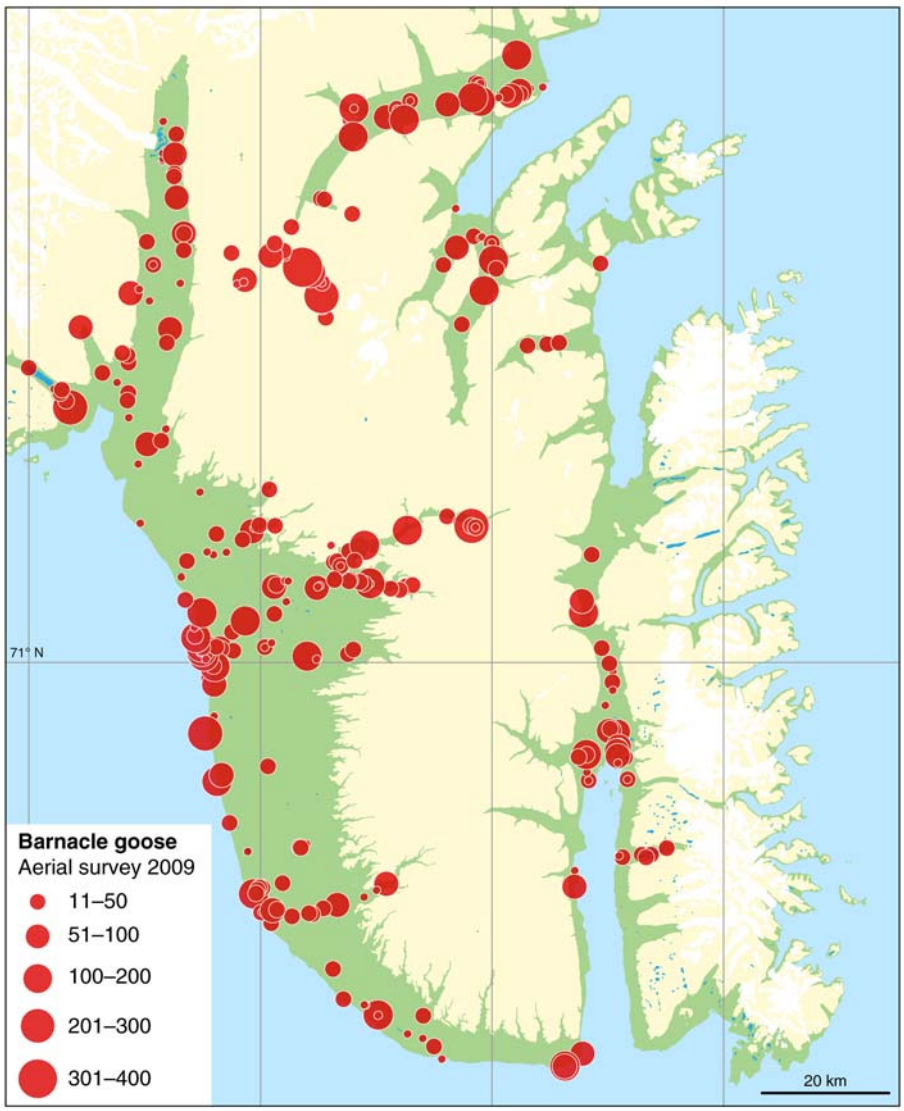


Figure 29. Distribution of barnacle geese in Jameson Land on 16 and 17 July 2009.

Only two barnacle geese and a single pink-footed goose were observed in flight; almost all of the remaining birds were flightless and were recorded on water – rivers, lakes, ponds and the sea (Table 4).

Table 4. Number of goose flocks in the different habitats of Jameson Land.

Species	Lakes and ponds	Rivers	Sea	Land	Total
Pink-footed	153	95	45	11	304
Barnacle	167	140	22	20	349

3.2.2 Hold-with-Hope and Wollaston Forland

The lowlands of Hold-with-Hope and Wollaston Forland were discovered as important moulting grounds for geese during an aerial survey in 1988 (Bay & Boertmann 1989, Boertmann 1991). These areas were partially surveyed in 2008 (Boertmann et al. 2009), and in 2009 the lowlands were surveyed more thoroughly (Table 5).

Table 5. Results of aerial surveys in Jameson Land, Hold-with-Hope and Wollaston Forland. Survey routes between years are only similar for Jameson Land. Hold-with-Hope was surveyed along fixed transects in 2009. The 2009 results in Hold-with-Hope are recorded numbers and not abundance estimates.

Area	1998/89*	2008	2009
Barnacle goose			
Jameson Land	5,733	16,637	12,305
Hold-with-Hope			
Østersletten + Sydkyst	370	504	828
Vestersletten + Badlanddal	222	-	560
Wollaston Forland	0	1,738	1,229
Pink-footed goose			
Jameson Land	6,484	19,068	11,860
Hold-with-Hope			
Østersletten + Sydkyst	580	957	1,630
Vestersletten + Badlanddal	245	-	395
Wollaston Forland	1,670	1,980	2,266

* Figures from Hold-with-Hope are from 1988 and figures from Jameson Land are from 1989.

Distance sampling (Buckland et al. 2001, Webb & Durinck 1992) was applied to the survey of the lowlands of Hold-with-Hope. The 18 transects and the distribution of the geese is shown in Figures 30 and 31. The stratum area was 1,166 km^2 and the total length of the transects (sea excluded) was 252.5 km.

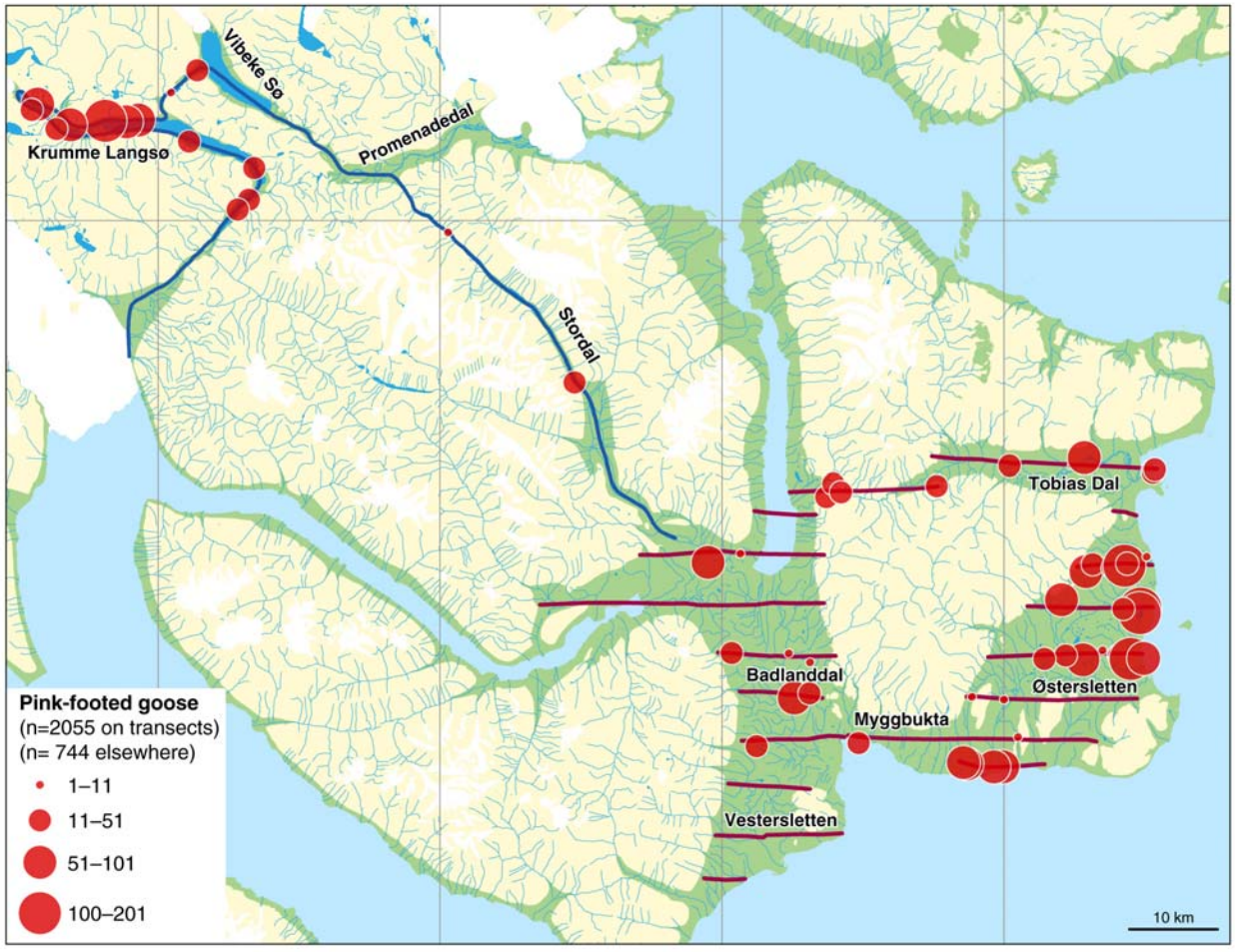


Figure 30. Distribution of pink-footed geese in the Hold-with-Hope area on 18 July 2009. Red lines are the Distance Sampling transects and the blue line is the "total count" route.

The result of the distance analysis was:

- Pink-footed goose: 12,751, 95% CI 6799-23912
- Barnacle goose: 5,184, 95% CI 2703-9942

In one of the areas, the Tobias Dal, a total count was carried out two days later (Table 6).

Table 6. Comparison between no. of geese observed during the transect flight and a total count in the Tobias Dal in Hold-with-Hope.

Species	Transect, 18 July	Total, 20 July
Pink-footed goose	305	803
Barnacle goose	318	866

After the survey in Hold-with-Hope, the major valleys of the adjacent areas Hudson Land and Ole Rømer Land (Stordal, Promenade Dal, Krumme Langsø and Vibeke Sø) were surveyed (total count), and here a total of 744 pink-footed geese and 542 barnacle geese were located (Figures 30 and 31).

In Wollaston Forland and adjacent areas, total count was applied and, in total, 2,392 pink-footed geese and 1,813 barnacle geese were recorded (Figures 32 and 33). The majority of the geese were found on the north-western part of the extensive lowland, Albrechtslette: 2,266 pink-footed geese and 1,229 barnacle geese.

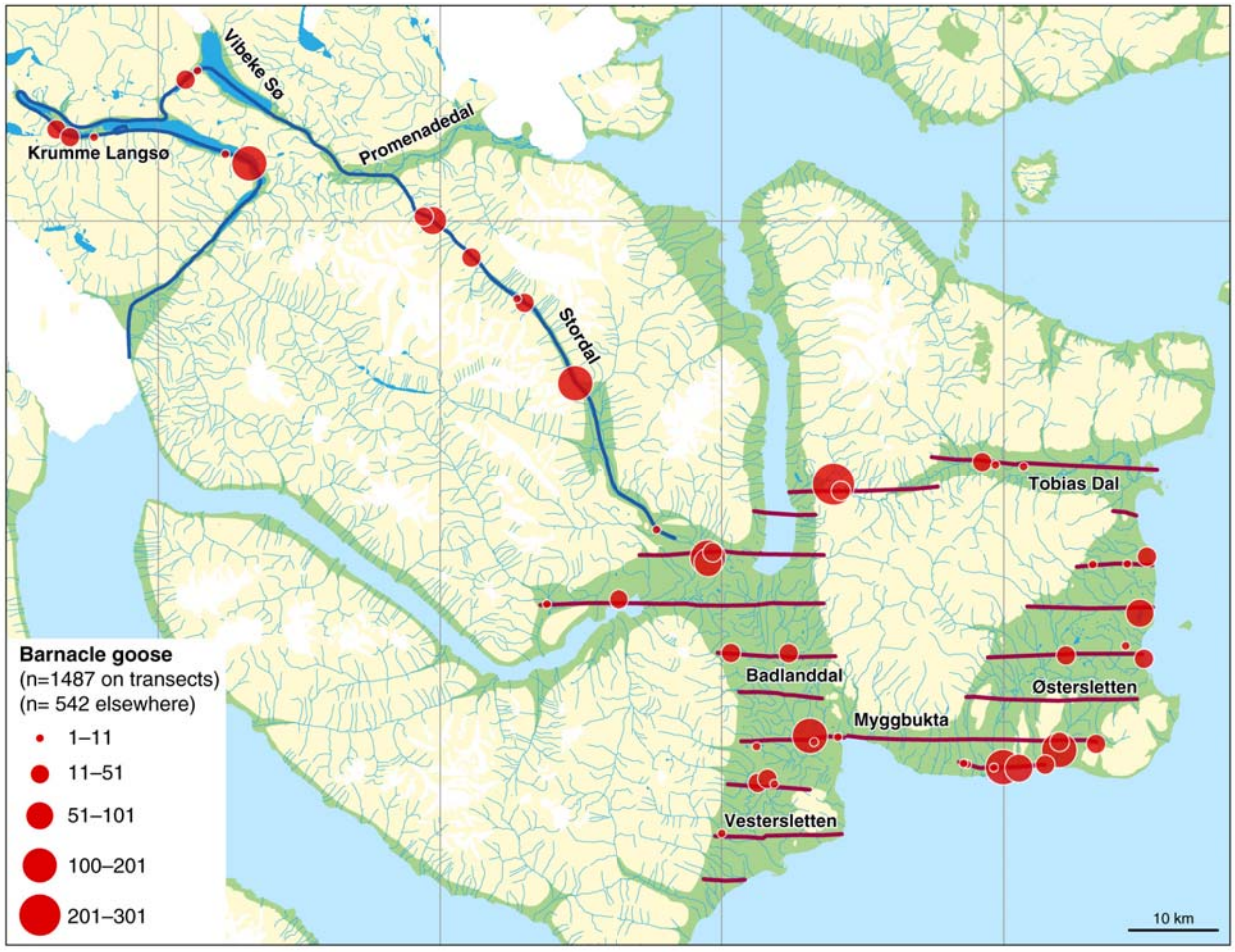


Figure 31. Distribution of barnacle geese in the Hold-with-Hope area on 18 July 2009. Red lines are the Distance Sampling transects and the blue line is the "total count" route.

Figure 32. Survey routes and distribution of pink-footed geese in Wollaston Forland on 20 July 2009.

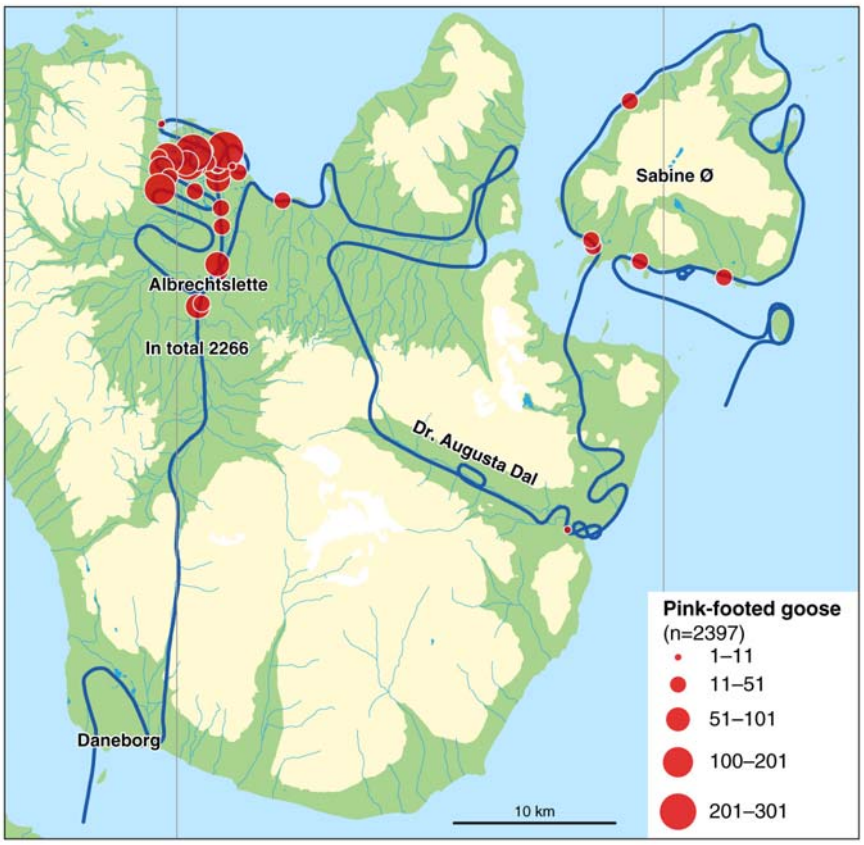
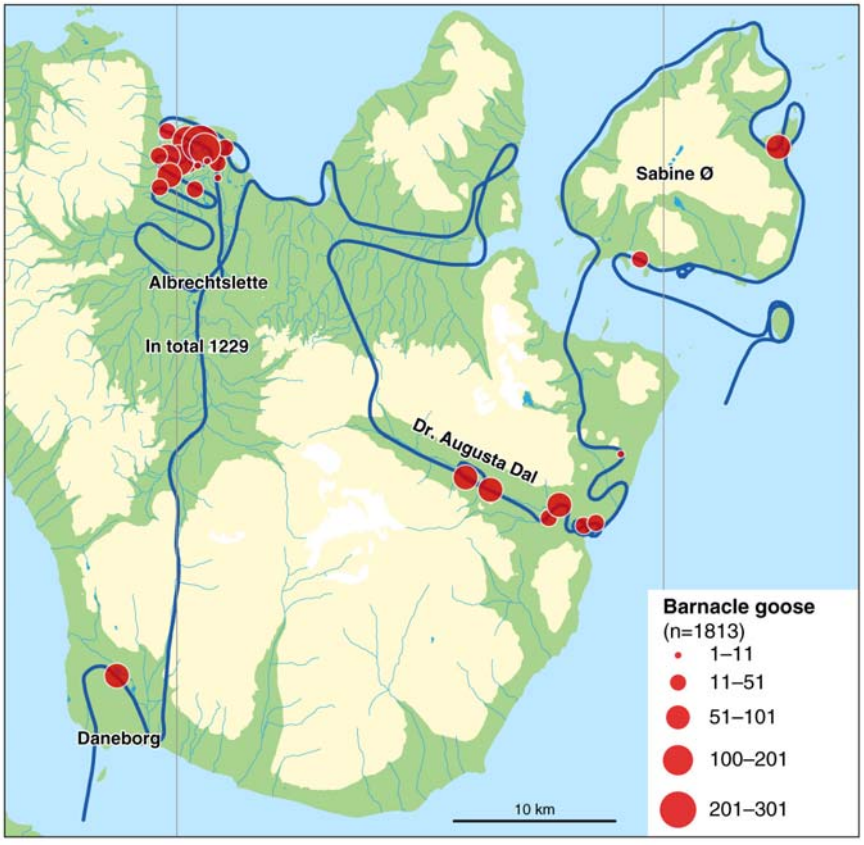


Figure 33. Survey routes and distribution of barnacle geese in Wollaston Forland on 20 July 2009.



3.2.3 North Greenland

Considerable numbers of pink-footed geese were found in Peary Land and in Johs. V. Jensen Land (Figure 25); more than 20,000 in total. They were mainly found in river valleys with lush vegetation, but large flocks were also located along the north coast of Greenland.

If the surveys in 2008 and 2009 in North Greenland are combined, adding the geese seen in areas only surveyed once and compensating for double observations in areas surveyed both years, a total of 30,000 geese is arrived at.

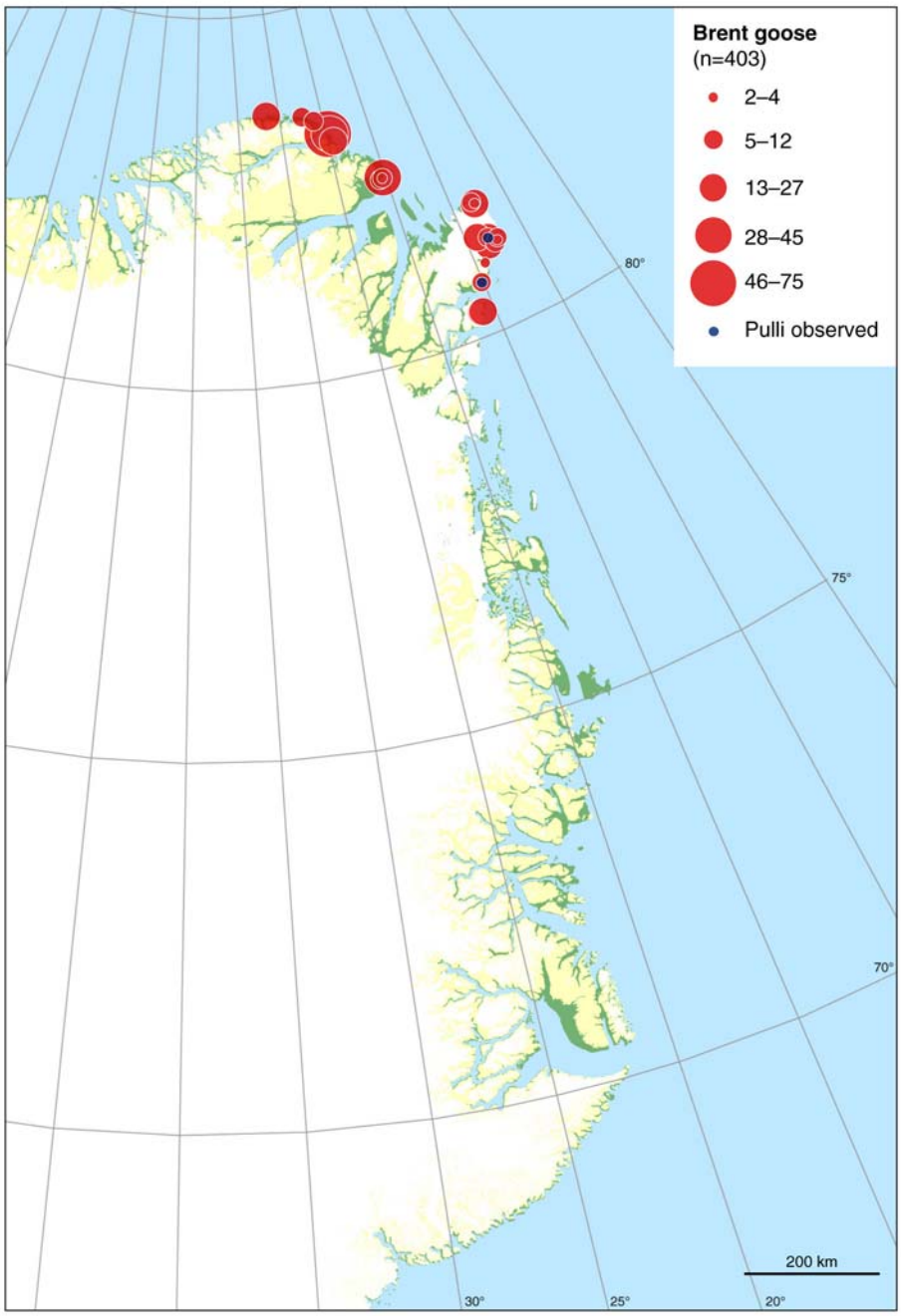


Figure 34. Distribution of light-bellied brent goose observations in July and August 2009.

3.2.4 Light-bellied brent geese

In total, only 403 geese in 25 flocks were encountered. This is less than half of the 2008 result (1,075 in total), despite the areas surveyed being almost identical in both years. Only two broods were seen (in Kilen and Amdrup Land), compared to approx. 30 broods in 2008 (Figure 34).

3.3 Ivory gull

The search for breeding colonies initiated in 2008 proceeded in 2009. In total 21 previously known sites were controlled, including the two colonies in western Johs. V. Jensen Land (Kap Kane and Kap Washington) and the remote nunatak south of Scoresby Sund ("Hauge's Nunatak"). Five new colonies were located; on Tobias Ø (a newly discovered island (Bennike et al. 2006)) and in the area between Northeast Water and Kap Morris Jesup (Figure 35). One of these was placed on a nunatak, one on a debris covered ice floe (similar to the floe in 2008, but another one) and three on small gravel islands (Figure 36).

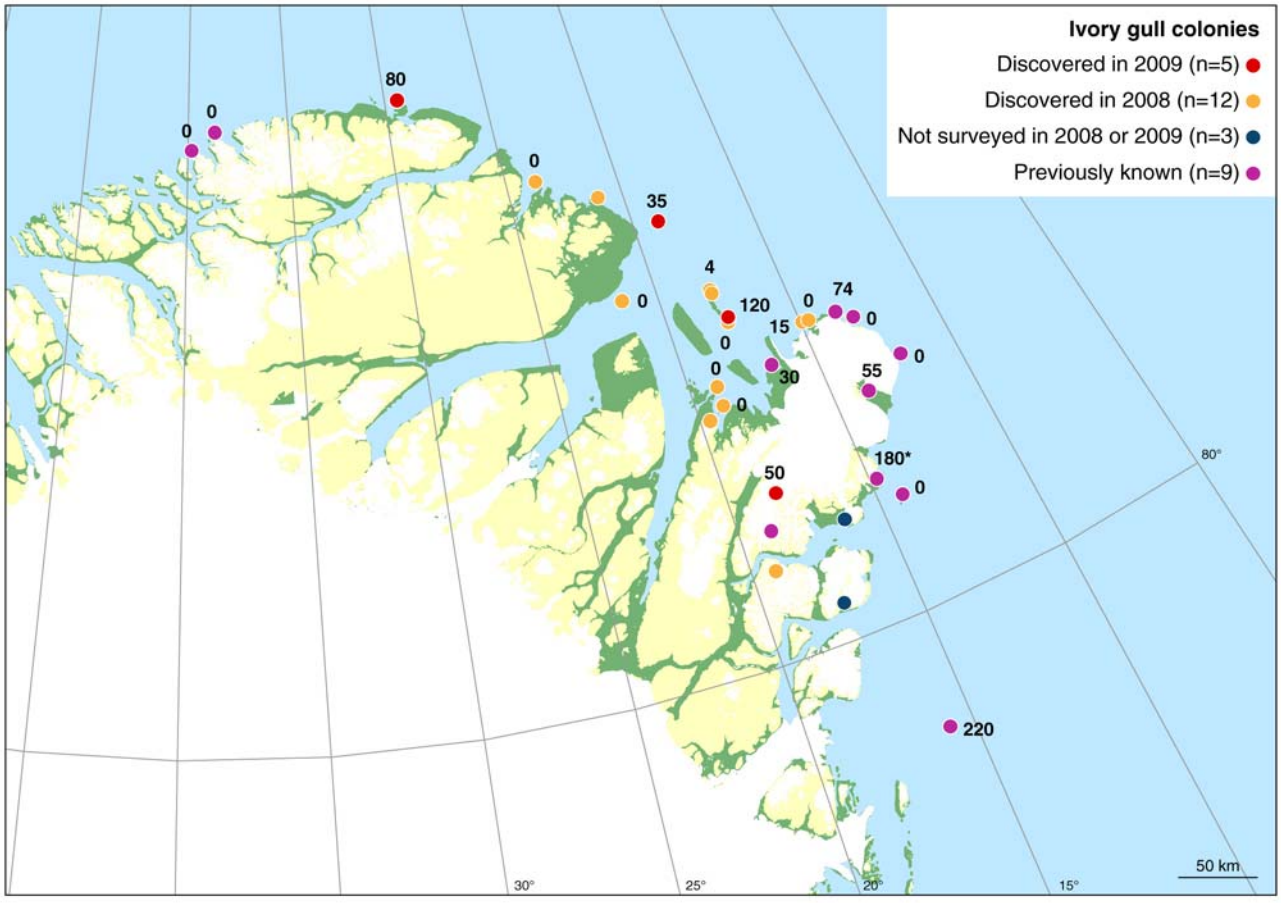


Figure 35. Distribution of breeding colonies of ivory gull in the surveyed area to the north of 78° N. Figures refer to observed number of individuals. Those without indication of number were not surveyed in 2009. * surveyed by O. Gilg (pers. comm.).

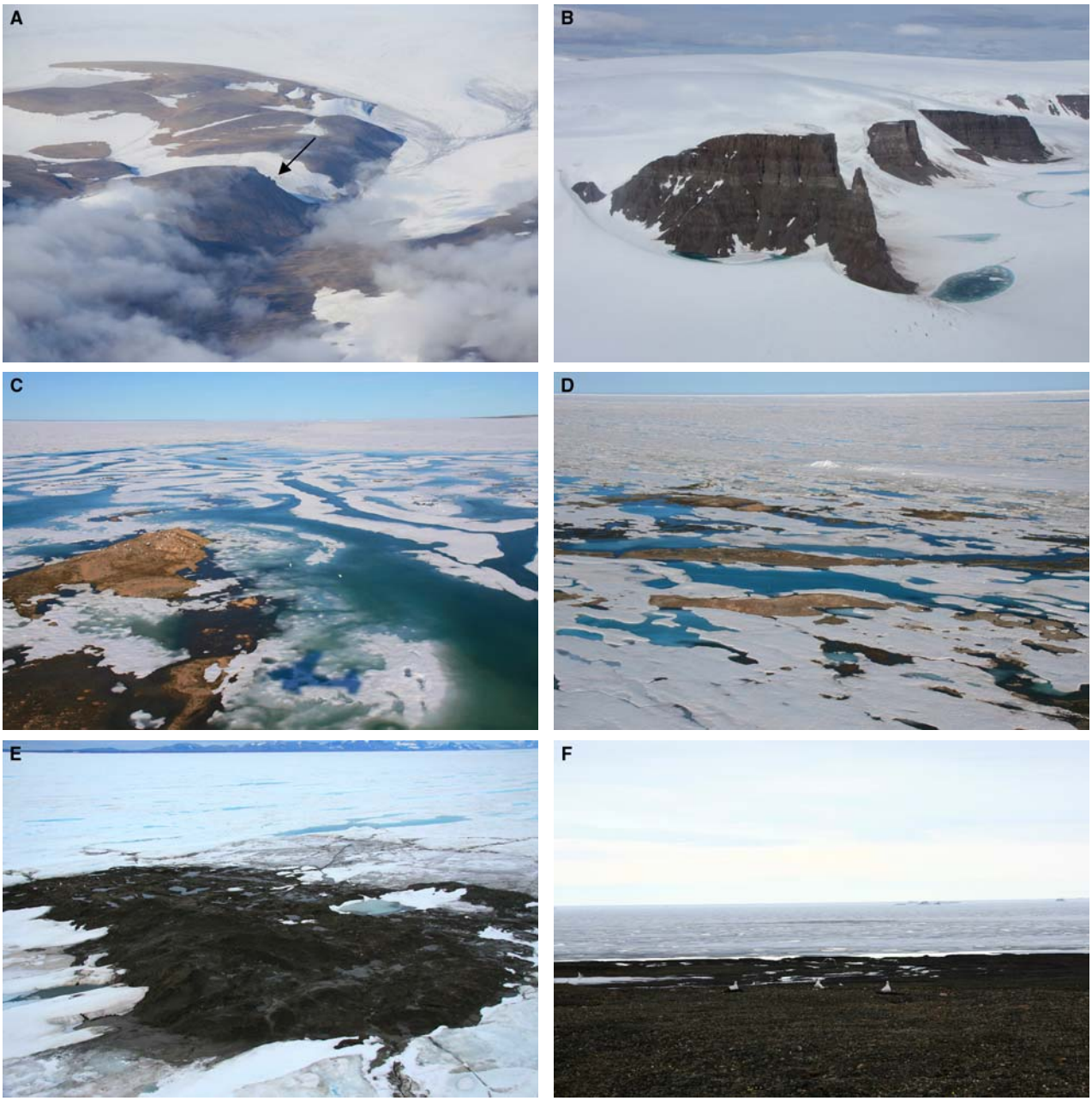


Figure 36. Different types of ivory gull colonies: A inland cliff, Kilen, code 81503, arrow shows position. B nunatak, "Hauges Nunatak" colony code 69504. C gravel hills in shallow water, Prinsesse Magrethe Ø, colony code 81517. D gravel banks in shallow water east of Kap Morris Jesup, colony code 83503. E debris covered ice floe, colony code 82507. F coastal plain at St. Nord, colony code 81505.

Most remarkable was the absence of breeding birds in the largest known Greenlandic colony on Henrik Krøyer Holme, a fact also noted by O. Gilg when he visited the islands in July 2009. Gilg therefore moved to the inland of Amdrup Land, where a colony with approx. 100 nests was situated (O. Gilg pers. comm.).

The colony on "Hauge's Nunatak" was unoccupied, as were the two colonies on Kap Kane and Kap Washington. No ivory gulls were seen at Nordostrundingen and at the site to the east of Nakkehoved, where single breeding have been reported in the 1980s (Hjort et al. 1983).

One of the new ivory gull breeding colonies was placed on a gravel covered ice floe in the mouth of Independence Fjord, just as the one found in

2008 (Boertmann et al. 2010). This latter colony could not be relocated and must have drifted away when the surrounding fjord became ice free in September 2008. The new colony was situated within the permanent ice barrier in the mouth of Independence Fjord and was certainly a different floe than the one in 2008.

Outside the breeding colonies, ivory gulls were observed along the ice edge to the north of Germania Land in the Northeast Water and a single bird in the open water to the north of Kap Washington. Ivory gulls were, as in 2008, present at the central part of Blosseville Kyst (n = 38) between Kap Barclay and Kap Beaupré (Figure 37).

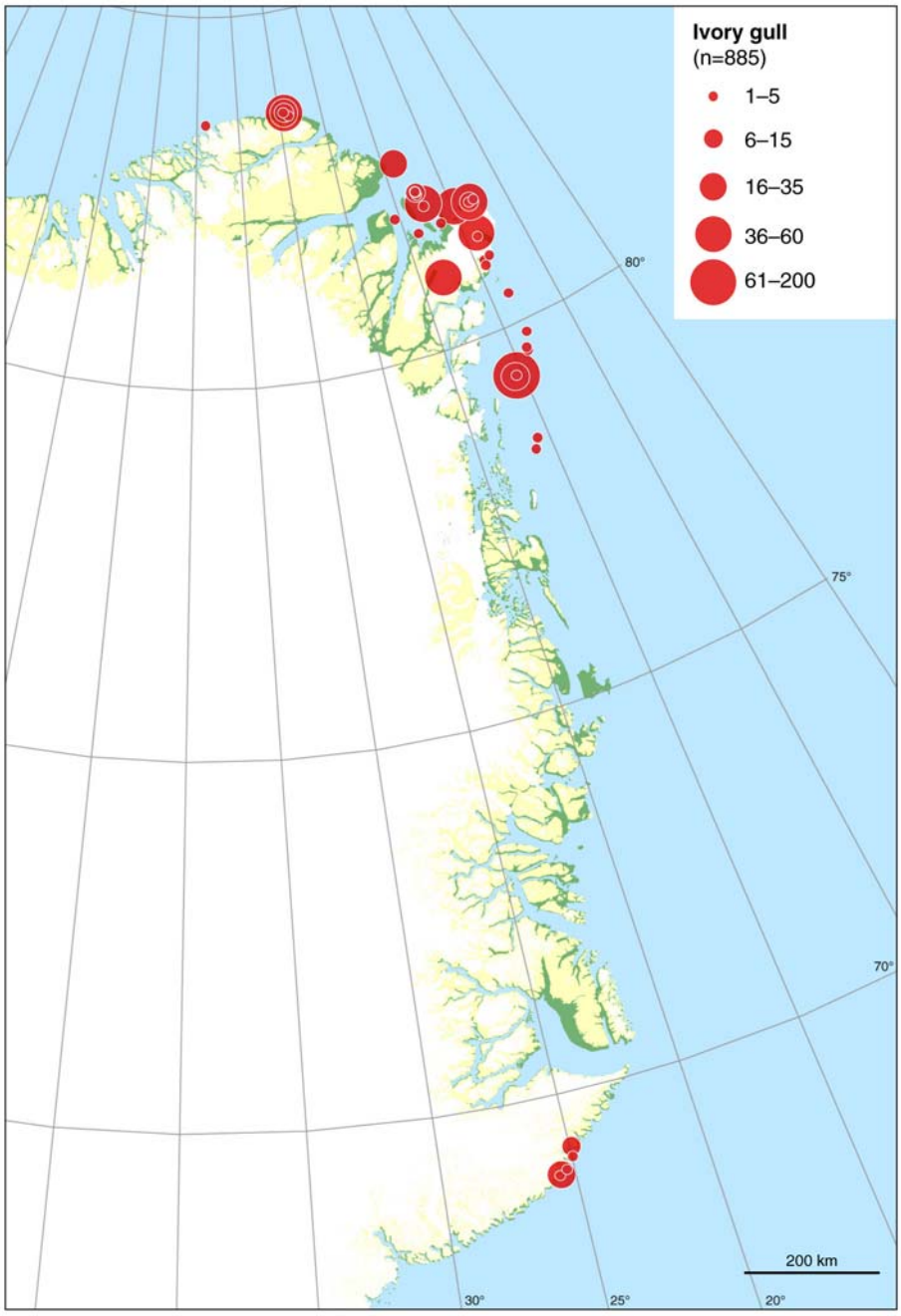


Figure 37. Distribution of ivory gulls seen during the surveys in July and August 2009. Birds at breeding colonies included.

3.4 Little auk colony survey

On 21 and 22 July the coasts of Liverpool Land and Volquart Boons Kyst were owerflown at an altitude of 7,000 feet (Figure 38). The entire coastlines were photographed, using a Canon PowerShot SX 1 IS. The versatile monitor of the camera made it possible to hold the camera in the bubble window and to take photographs almost vertically. On 21 July 703 images were taken of the Liverpool Land Coast and on 22 July 442 images were taken over the Volquart Boon Kyst. Figure 39 shows an example.

Figure 38. Routes flown during the photo surveys of little auks colonies on 21 and 22 July 2009.

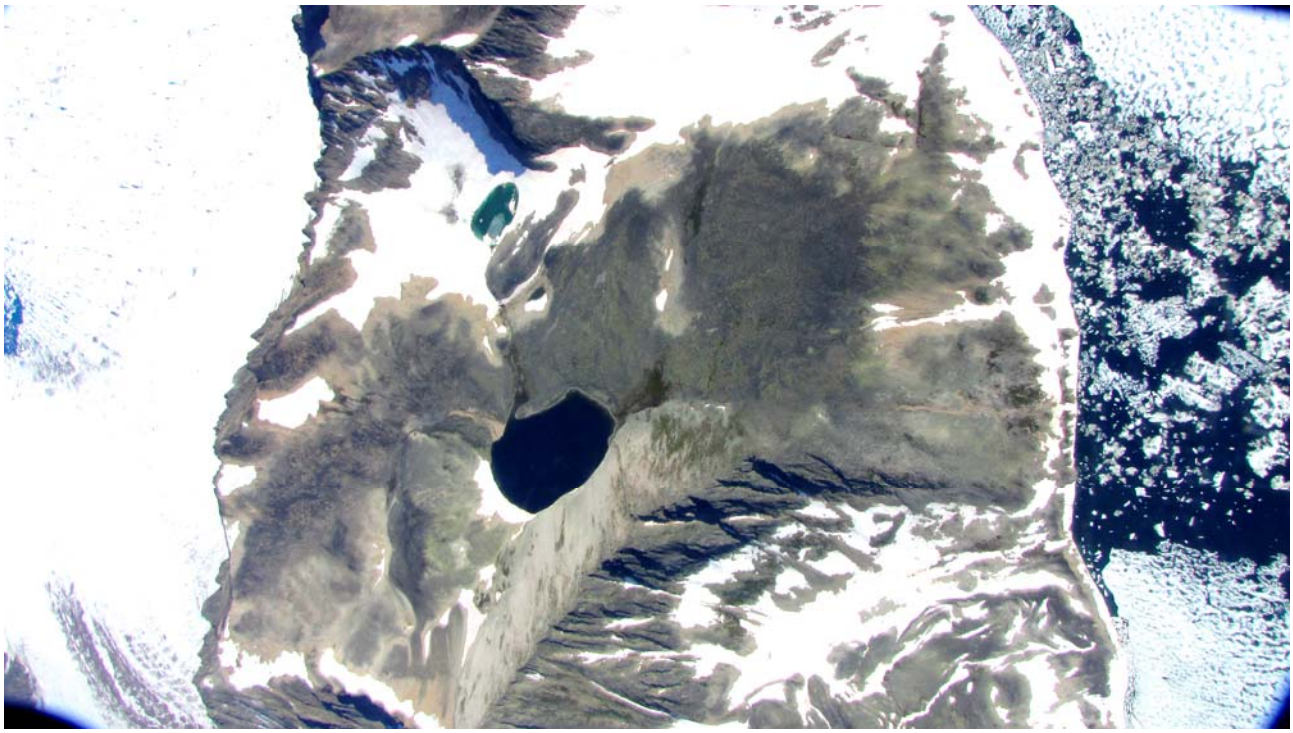


Figure 39. Example of a survey photo from the areas just west of Kap Höegh in Liverpool Land. North towards left. The pale slope at western edge of lake is the main colony.

3.5 Seabird breeding colony register

Data from a total of 74 seabird breeding colony sites were obtained during the 2009 survey (and during a subsequent walrus survey in the same area in mid-August 2009), with 22 being new to the register (Figure 40, Table 7).

One new site with breeding Sabine's gulls was located. This was situated on low gravel islets off the shore 50 km east of Kap Morris Jesup, where also breeding Arctic terns and ivory gulls were recorded. This must be the northernmost seabird colony in the world.

Table 7. Seabird colonies recorded and controlled in 2009 in Northeast Greenland. Note that some of the colonies have more than one species, why the total number of controlled colony sites is lower than the sum of colonies controlled.

Species	No. of colonies controlled	New to the colony register
Common eider	6	1
Glaucous gull	16	9
Lesser black-backed gull	1	0
Kittiwake	5	1
Sabine's gull	4	1
Ivory gull	21	5
Arctic tern	14	9

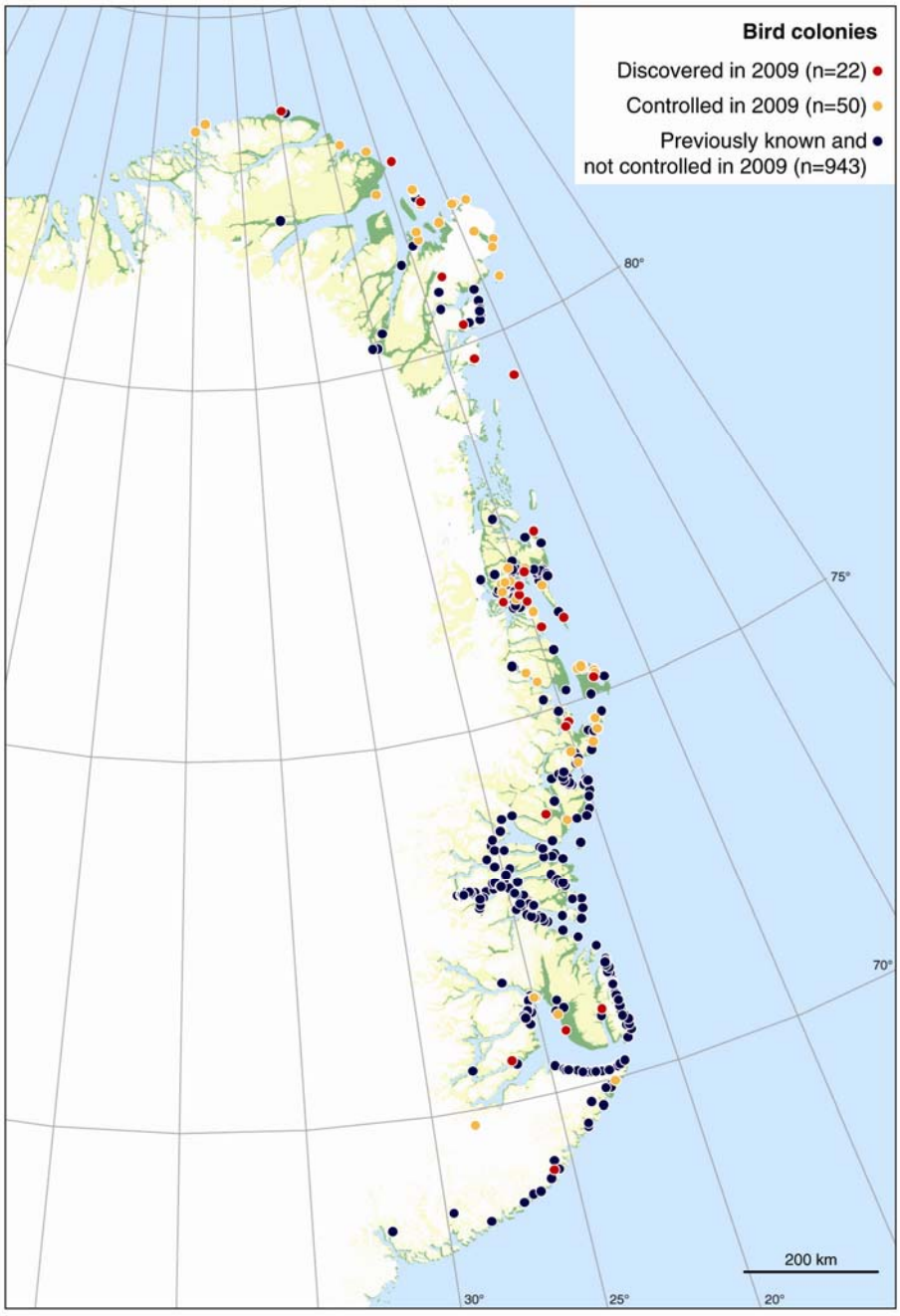


Figure 40. Distribution of seabird breeding colonies seen in July and August 2009. A few seen during a walrus survey in August are included (mainly in Dove Bugt).

3.6 Surveys based on NDVI images

Three of the North Greenland areas with high NDVI values (Figure 3) were overflown: Siriuspasset, Vitskøl Elv and northeast Mylius Erichsen Land. In addition the Frigg Fjord area was surveyed as this area is designated as a fauna and flora protection area (Aastrup & Boertmann 2009).

By North Greenland standards Siriuspasset is very lush and the vegetation covers extensive areas (Figure 41). Large numbers of moulting geese were located mainly in and at the rivers and in the deltas on the coast (n = 8517) and many muskoxen were also counted (n = 60).

Figure 41. Western part of Siriuspasset with I.P. Koch Fjord in the background.

The upper reaches of Vitskøl Elv were also comparatively lush (Figure 42). This area also held many pink-footed geese (n = 9178) and a few muskoxen were seen (n = 6).

The NDVI values from the northeastern part of Mylius Erichsen Land were not as high as in the two other areas surveyed. The landscape also looked drier and to be dominated by *Dryas* heaths; although there were many ponds and lakes (Figure 43). In total 1,376 moulting pink-footed geese were counted, but no muskoxen, although fresh tracks were seen.

The NDVI image do not reveal extensive lush areas in the Frigg Fjord-area, but they occur, at least locally (Aastrup et al. 1986). The survey gave an impression of an area generally with sparse vegetation except at lakes and rivers. Another reason to survey was the fact that Frigg Fjord is among the fauna and flora protection areas recently selected (Aastrup & Boertmann 2009). Along the river 1,014 moulting pink-footed geese were recorded, and 19 muskoxen were seen in the valley.

Figure 42. The upper reaches of Vitskøl Elv seen towards southeast.

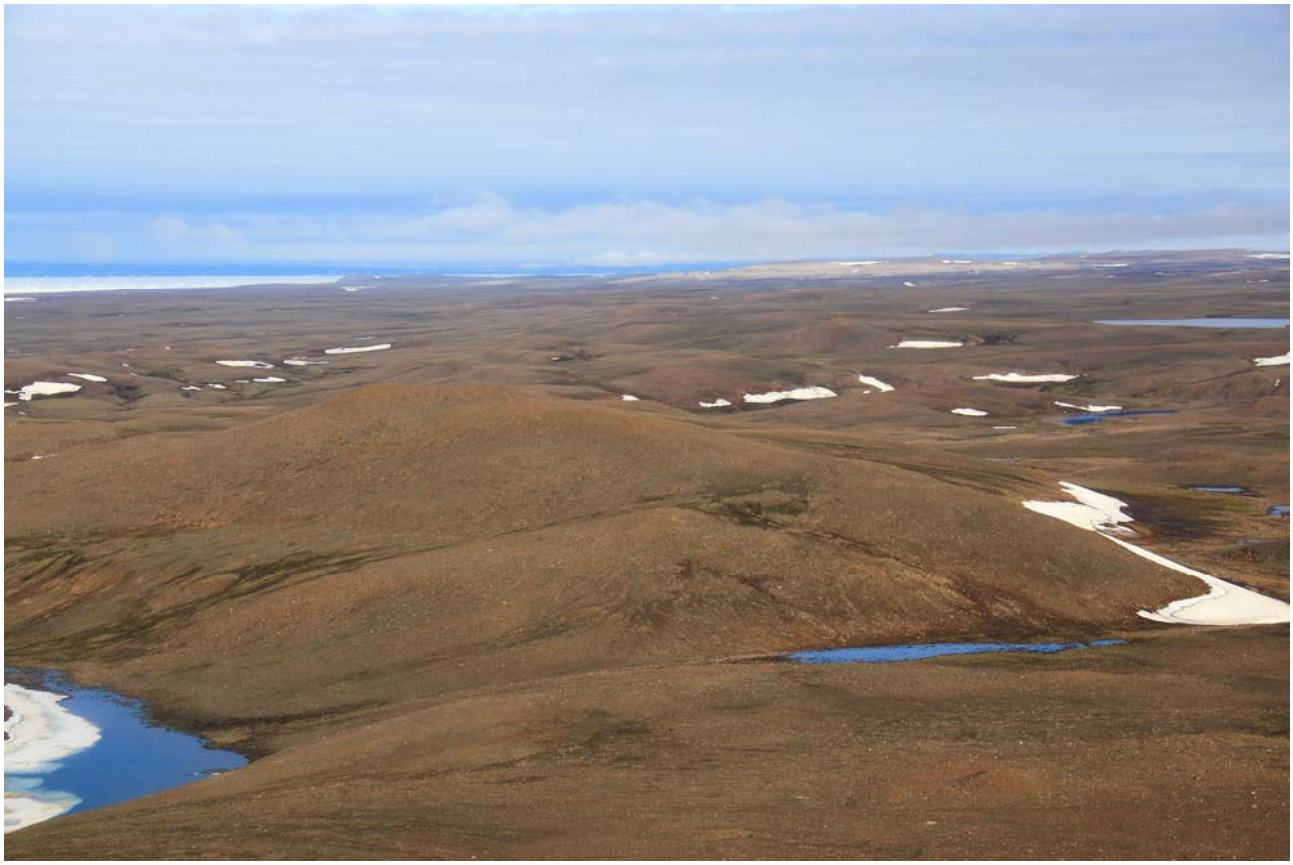


Figure 43. The northeastern lowland of Mylius Erichsen Land, seen towards northwest.

4 Discussion

4.1 Moulting geese

The first part of the survey was dedicated to moulting geese in Jameson Land, Hold-with-Hope and Wollaston Forland. The results will be reported in another context and are only briefly discussed here.

Numbers recorded in Jameson Land were distinctly lower in 2009 than those recorded in 2008 (Table 3). The reason is unclear.

The result of the distance sampling analysis in the Hold-with-Hope areas gave high geese numbers, particularly of pink-footed geese. The highest numbers were recorded on Østersletten, which has the most extensive goose habitats, with many ponds and marshes.

In Wollaston Forland the most important areas are in the northwestern part, where there are many ponds and lakes. Almost all recorded geese were seen here.

As in 2008 moulting geese were seen almost everywhere, along shores and at rivers and lakes. In Hudson Land and Ole Rømer Land moulting geese occurred at lakes at more than 200 m asl (upper Stordal).

Numbers of moulting pink-footed geese in North Greenland (Johs. V. Jensen Land and Peary Land) were surprisingly high. In the 1980s pink-footed geese were not know from these areas. In 1998 many thousand moulting geese were found in Conastable Bugt (K. de Korte pers. comm. cited in Boertmann & Glahder 1999), and since then reports of moulting pink-footed geese in North Greenland have increased. During this survey, very high numbers were seen in Siriuspasset and in upper Vitskøl Elv, and many were seen also along the north shore of Johs. V. Jensen Land (Constable Bugt). These shores appeared almost barren seen from the air, and the ice almost completely covered the sea (Figure 44). However, Hjort (1986) describe the vegetation of the shores of Constable Bugt as relatively vigorous compared to the coast further east.

Some parts of North Greenland were surveyed in 2008 but not in 2009. The number of moulting pink-footed geese in these areas total 6,540 birds (2,681 in Bliss Bay, 2199 in the Skjoldungeelv area, and 1,660 elsewhere).

Taken together, the two July surveys in 2008 and 2009 have revealed more than 30,000 moulting pink-footed geese in North Greenland lowland areas.

However many suitable areas remain un-surveyed and it is not known how far west the moulting geese occur in North Greenland. Considerable numbers may still occur unnoticed in North Greenland.

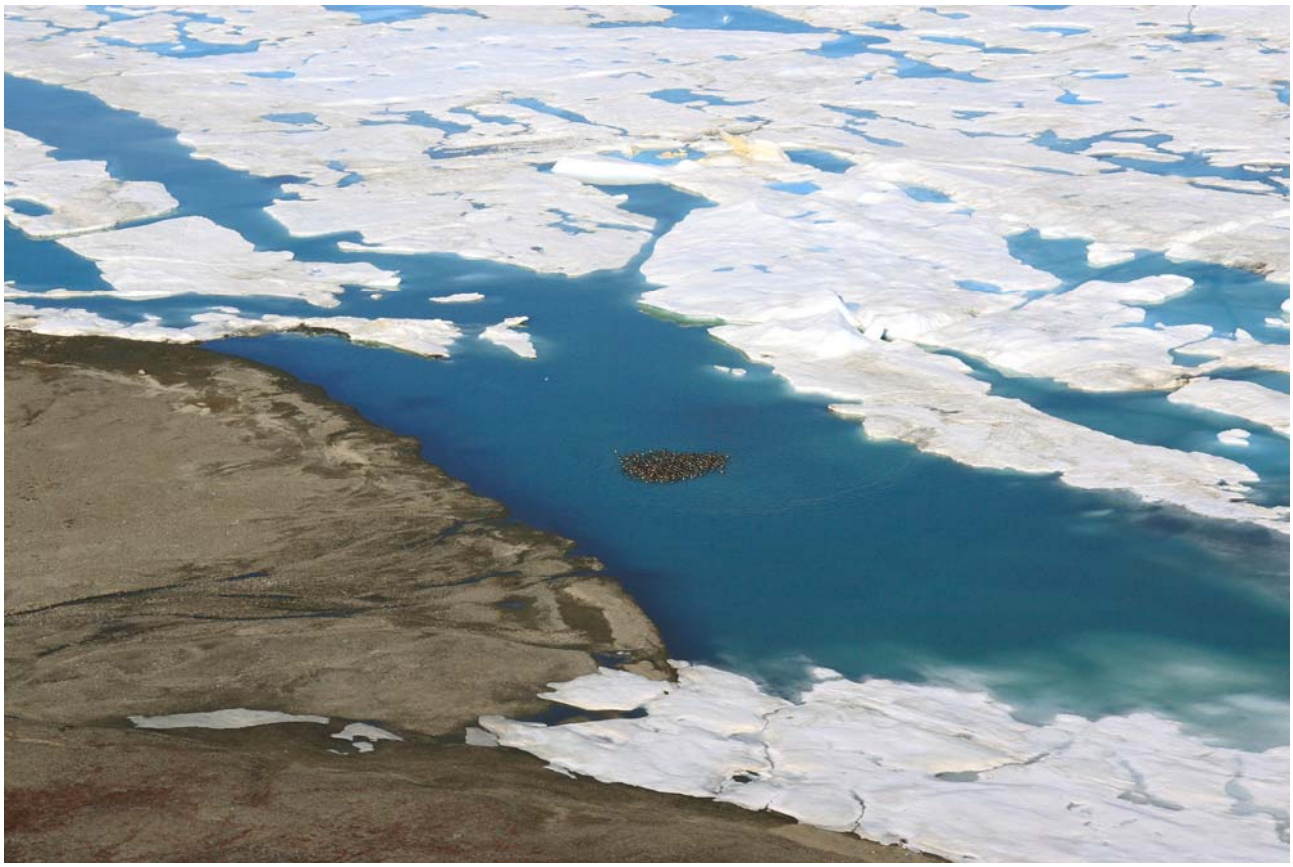


Figure 44. A flock of 305 moulting pink-footed geese off the north Greenland shore in Constable Bugt.

The low brent goose numbers recorded in 2009 compared to 2008 are puzzling, and require further study to explain.

4.2 Important moulting areas for seaducks

Although the coasts between Dove Bugt and Scoresby Sund were not surveyed to the same degree as in 2008, some of the moulting concentrations of long-tailed ducks were located again in 2009. Particularly the mouth of Dr. Augusta Dal in Wollaston Forland seems to be an important moulting site for the species. Blosseville Kyst was, however, surveyed as in 2009 and almost similar numbers of long-tailed ducks were recorded, and mainly in the same fjords as in 2008.

The moulting concentration of king eiders found in Knighton Fjord in 2008 was found again in 2009, when a slightly higher number of males were seen. This is the only known moulting site for the species in East Greenland, and all the fjords to the south of the site (which have not been surveyed) should be surveyed.

Common eiders were recorded in somewhat lesser numbers along Blosseville Kyst than in 2008. The proportion of males was also lower in 2009 compared to 2008, perhaps because a moult migration to the area was delayed?

4.3 Important breeding areas

A new breeding colony for kittiwakes, with at least 100 birds present, was discovered on the southern side of the mouth of Dijmphna Sund, just west of Kap Poul. This is only the second breeding site in the Northeast Water for this species. The other is on Mallemukfjeld, approx. 20 km to the northeast of the new colony.

The seabird colony discovered 50 km to the east of Kap Morris Jesup is also very important, holding significant numbers of ivory gulls, some Sabine's gulls and Arctic terns as well as possibly breeding common eiders. This colony situated at 83° 38′ N must be the northernmost seabird colony in the world.

4.4 Important areas for marine mammals

In addition to the important areas described after the 2008 surveys, another habitat seems extremely important after the 2009 survey. This is the ice edge between Germania Land (Île de France) and the Northeast Water. This ice edge is usually persistent throughout the summer (Schneider & Budéus 1997), and in 2009 concentrations of narwhals and even more importantly a bowhead whale accompanied by a calf (approx. 3 months old) were observed (Boertmann & Nielsen in press). This is only the second observation of reproduction in recent decades in this very small stock of baleen whales in this part of the range. The first observation was a young whale seen off Blosseville Kyst in 2008 (Boertmann et al. 2009d). The otherwise most recent observation of reproduction from this stock is from the early 1980s when calves were reported among a congregation of in total 11 whales at the Franz Joseph Land archipelago of Russia (Belikov et al. 1984).

4.5 Important terrestrial areas

The survey over the inland areas confirmed the NDVI maps and the designation of the flora and fauna protection areas (Aastrup & Boertmann 2009). Particularly Siriuspasset seemed to be an "oasis" of relatively vigorous vegetation and high numbers of muskoxen previously recorded were confirmed (Boertmann & Forchhammer 1992).

The fauna and flora protection areas designated in 2009 (Aastrup & Boertmann 2009) should now be supplemented with the ice edge between Île de France and the Northeast Water and with the long valley of Vitskøl Elv in Peary Land.

4.6 Ivory Gulls

In total 29 colony sites were checked during the aerial surveys in 2008 and 2009. Seventeen of these were new (12 in 2008 and 5 in 2009). Two of the sites were empty both years (81506 and 81508). A few more sites (n = 4) are known from the region; although three of these only represent a record of a single nest in one single year (Gilg et al. 2009). The fourth, lo-

cated on an inland plain in Amdrup Land, was visited by O. Gilg (pers. comm.) in July 2009, and 180 adult birds and 98 nests were present here.

Two of the sites controlled in 2009 are situated south of 78° N, one on a remote nunatak to the south of Gåsefjord (Scoresby Sund). It was occupied as late as 2007 (Gilg et al. 2009) but empty on 22 July 2009. The other is in Trækpasset on Store Koldewey where a single pair was observed in 1976, but no birds have been seen at later occasions, incl. during the 2008 and 2009 surveys (Gilg et al. 2009).

Fifteen colonies north of 80° N were controlled both in 2008 and 2009, and the status shown in Table 8.

Table 8. Status of ivory gull colonies visited both in 2008 and 2009. Sites unoccupied both years are not included.

Occupied in 2008, but not in 2009	5
Not occupied in 2008, but in 2009	4
Strongly reduced (80-92%) in 2009 compared to 2008	3
Unchanged between years	3

The morphology of 28 colonies north of 78° N is listed in Table 9.

Table 9. Morphology of 28 breeding sites for ivory gull in Northeast Greenland north of 78° N. Including one inland colony seen by O. Gilg (pers. comm), marked with asterisk.

Inland colonies	
Canyon	1
Steep Cliff	1
Nunatak (steep cliff)	3
Plain	1*
Coastral colonies	
Mainland	
Steep cliff	3
Coastral plain	3
Island	
Gravel heaps	7
Ice floe	2
Coastal plain	7

Many of the colonies at the coasts were situated on low gravel heaps and ridges in very shallow waters and with up to 45 km to open waters. They were all surrounded by sea ice during the surveys. These small hills probably become snow free earlier than most other coastal areas and are therefore attractive as nesting substrate. They are probably pushed up by ice floes which more or less rest on the sea floor (C. Hjort pers. comm.).

In 2009 another colony on a debris-covered and floating ice floe was found. The floe was frozen into the barrier of consolidated ice in the mouth of Independence Fjord and did not become free floating in September, in contrast to the colony located in 2008. The colony found in 2008 had disappeared in 2009 and had probably drifted into the fjord.

Figure 36 shows examples of ivory gull colonies surveyed in 2009.

4.7 Miscellaneous observations

The great skuas observed at Kilen, Nordostrundingen, Turner Ø (Blosseville Kyst) and perhaps also Henrik Krøyer Holme may indicate breeding. Particularly those birds which behaved territorially towards the aircraft support this presumption. Until now, no proved breeding record has been obtained form Greenland, but in addition to these 2008 and 2009 records from East Greenland, an observation from Upernavik District in 1993 also indicated breeding (Boertmann & Mosbech 1999). It is probably just a matter of time before breeding will be confirmed.

The observations of whooper swans confirm an increasing trend in Greenland, and breeding for this species may also be expected in years to come.

Common scoters have now been observed three times in Northeast Greenland, and all observations were pairs seen in the breeding season. This fact may indicate occasional breeding. The nearest breeding population is found in Iceland.

New questions and missing coverage

Numbers of pink-footed geese in North Greenland were surprisingly high and they occurred in high numbers in the westernmost areas surveyed – Siriuspasset. This raises the question of how far west in North Greenland the moulting pink-footed geese occur. The NDVI map shows (Figure 3) that lowland areas with relatively vigorous and continuous vegetation are found on Nares Land and to a limited degree in Wulff Land, but further west vegetation cover becomes very sparse. Pink-footed geese may very well occur as far west as Wulff Land at least in low numbers.

The ice edge between Île de France and the Northeast Water seems to be an extremely important habitat for bowhead whales and narwhals. However, fog, both in 2008 and 2009, prevented surveys of the entire extent of this area, and a full survey of this interesting habitat is needed to assess the conservation value.

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