Meddelelser om Grønland

Ornithological observations in Northeast Greenland between 74°30′ and 76 N. lat., 1976

Hans Meltofte, Magnus Elander and Christian Hjort

Bioscience
3 · 1981

Meddelelser om Grønland

The series *Meddelelser om Grønland* started in 1879 and has since then brought results from all fields of research in Greenland. It has now been split into seperate series:

Bioscience
Geoscience
Man & Society

The series should be registered as *Meddelelser om Grønland, Bioscience (Geoscience, Man & Society)* followed by the number of the paper. Example: *Meddr Grønland, Biosci.* 1, 1979.

The new series are issued by Kommissionen for videnskabelige Undersøgelser i Grønland (The Commission for Scientific Research in Greenland).

Correspondence
All correspondence and manuscripts should be sent to the Secretary, Kommissionen for videnskabelige Undersøgelser i Grønland. Øster Voldgade 10, DK-1350 Copenhagen K. Questions concerning subscription to all three series should be directed to the publisher.

Publisher
Nyt Nordisk Forlag – Arnold Busck A/S, Købmagergade 49, DK-1150 Copenhagen K. Tlf. +45.1.111103.

Meddelelser om Grønland, Bioscience

Meddelelser om Grønland, Bioscience invites papers which contribute significantly to the study of flora and fauna and of ecological problems pertaining to all Greenland environments. Papers primarily concerned with other areas in the Arctic or Atlantic region may be accepted, if the work actually covers Greenland or is of direct importance to the continued research in Greenland. Papers dealing with environmental problems and other borderline studies may be referred to either of the series *Bioscience, Geoscience* or *Man & Society* according to emphasis and editorial policy.

Editor
C. Overgaard Nielsen, Institute of General Zoology, Universitetsparken 15, DK-2100 Copenhagen Ø. Telephone: +45.1.354111.

Instructions to authors. – See page 3 of cover.

Ornithological observations in Northeast Greenland between 74°30′ and 76°00′ N. lat., 1976

Hans Meltofte, Magnus Elander and Christian Hjort

MEDDELELSER OM GRØNLAND, BIOSCIENCE 3 · 1981

Contents

Ornithological observations in Northeast Greenland between 74°30′ and 76°00′ N. lat., 1976

Meltofte, H., Elander, M. and Hjort, C. Ornithological observations in Northeast Greenland between 74°30′ and 76°00′N. lat., 1976. Meddr Grønland, Biosci. 3, 53 pp. Cpenhagen 1981–02–25.

The results of one summer's work in central Northeast Greenland are presented. The avifauna in the country traversed on several extensive survey trips is described. More intensive studies were made in an 18.2 km^2 census area on southernmost Hochstetter Forland. Here the populations were followed throughout the breeding season, and information on arrival, pre-laying period, population densities, habitat and nest site selection, breeding schedule, clutch size, hatching success, re-nesting, non-breeders, moult, post-breeding activities and departure is given. Special attention is given to *Clangula hyemalis, Somateria spectabilis, Anser brachyrhynchus, Arenaria interpres, Calidris maritima, Calidris alpina, Calidris alba, Phalaropus fulicarius* and *Stercorarius longicaudus.* An extremely high predation pressure was caused by *Alopex lagopus,* and this is discussed in relation to lemming abundance and environmental conditions.

Hans Meltofte, Møllegade 23, 3. tv., DK-2200 Copenhagen N, Denmark. Magnus Elander, Carl Barks väg 28, S-163 58 Spånga, Sweden. Christian Hjort, Hessle, Munkarp, S-243 00 Höör, Sweden.

Received 1978–12–13
Accepted 1980
ISBN 87–17–02861–2
ISSN 0106–1054

Introduction

Between 26 May and 26 August 1976, the Swedish-Danish Northeast Greenland Expedition worked on Hochstetter Forland (Fig. 1). After a transit stay in Mesters Vig from 19 May, we were flown by helicopter via Daneborg to Hochstetter Forland and Germania Havn on 26 and 27 May, respectively. Ornithological studies were made by HM and ME near the expedition's base camp, the former Danish trapping station Nanok (75.09 N/19.49 W), while CH, Lena Adrielson, Hans Bruch and Jan Mikaelsson studied Quaternary geology on extensive hikes in the neighbouring areas (Figs 2 and 3). Breeding birds were censused in an 18.2 km^2 area around Nanok (Fig. 5). HM specialized on studies of waders (*Charadriidae*), Pink-footed Geese (*Anser brachyrhynchus*), and Long-tailed Skuas (*Stercorarius longicaudus*), while ME concentrated on King Eiders (*Somateria spectabilis*) and Long-tailed Ducks (*Clangula hyemalis*). Careful notes were kept of birds observed on all the geological hikes.

HM and ME finished their work on 16 August and were taken by helicopter to Mesters Vig. The rest of the party left the study area on 26 August.

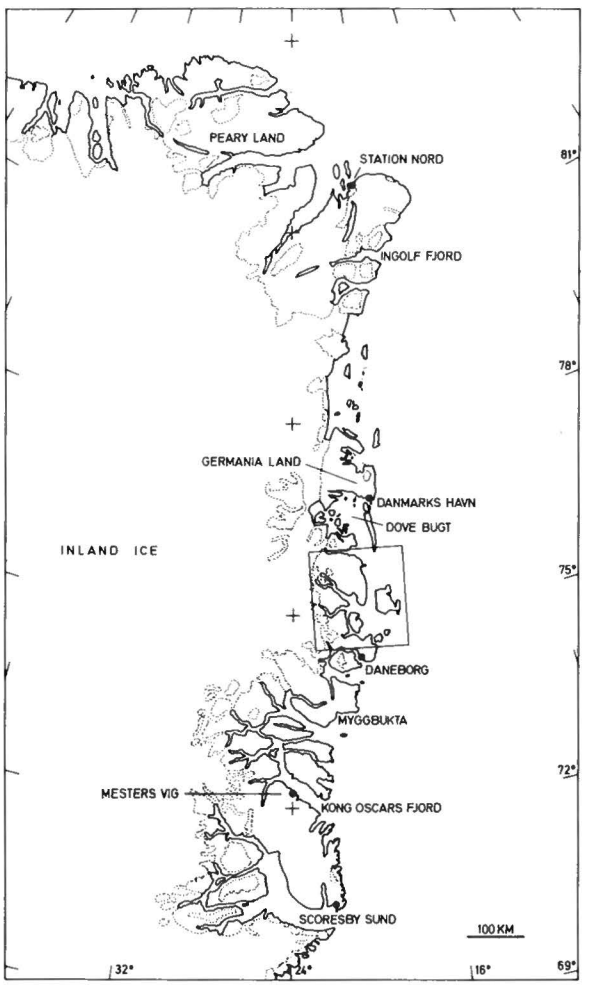

Fig. 1. Map of Northeast and North Greenland with the study area framed.

General Part

Earlier investigations

Before 1976, Hochstetter Forland had only been visited twice by zoologists. Alwin Pedersen (1934) stayed at Kulhus near Peters Bugt during 1932–33 and travelled into surrounding areas. In 1938, C. G. Bird stayed at the Norwegian trapping station Jónsbú at the head of Peters Bugt and published some information on the bird life there (Bird & Bird 1940, 1941). Løppenthin (1932) reported observations on bird-life made in the area by trappers living at Nanok in 1929–30. In 1964, the

Fig. 2. Map of the study area showing survey trips and the fjord ice edge towards the drift-ice in the last days of May 1976. More survey trips within Hochstetter Forland are shown on Fig. 3. Heights in metres.

northernmost part of Wollaston Forland, Sabine Ø and Hvalrosø were visited by Rosenberg et al. (1970). The second German Northpole Expedition stayed at Germania Havn on Sabine Ø 1869–70, and made notes on birds (Finsch 1874). Sabine Ø and nearby islands were visited on several later occasions (Nathorst 1900, Kolthoff 1903, Deichmann 1909, Schaanning 1933). A few records from the area are presented by Knudsen (1933), Pedersen (1942), and Jennov (1945, 1963).

The country north of 76° was investigated by Manniche (1910), Pedersen (1942), and Meltofte (1975, 1977a, 1979), while the country south of the present study area was last investigated by Rosenberg et al. (1970) in 1964. Most of these reports contain mainly faunistic information, but also notes on avian breeding biology, etc.

Description of the Area

The study area in general

The study area in the widest sense extended from Sabine Ø in the south to Store Koldewey in the north – about 160 km (Fig. 2). The most westerly areas studied were Kildedalen and Femdalen along Ardencaple Fjord, and the eastern limit was the outer coast – reached on Sabine Ø, at Kap Sussi on northeastern Shannon and on southern Store Koldewey. The major part of the work was carried out on Hochstetter Forland (Fig. 3) and on Shannon.

The landscape in these parts of East Greenland is characterized by the contrast between the high mountain range in the west, the Caledonides, and the flat foreland areas east thereof.

The Caledonides here are mainly built up by gneisses and of less metamorphosed but intensely folded sediments. The highest peaks reach between 1500 and 1700 m, and the mountains form an impressive background in the west. They are transected by fjords and valleys. Within the study area these are represented by Ardencaple Fjord and Bessels Fjord, the largest valleys being Kildedalen and the valleys of Agnetes Sø and Langsø.

The low and generally flat foreland areas east of the Caledonides include Hochstetter Forland, Shannon and, to some extent, the easternmost part of Kuhn Ø and a narrow strip of land along the coast north of Haystack. Here the rocks are unfolded though tectonized sediments, mainly relatively soft shales and sandstones. The only mountains on Hochstetter Forland are Muschelbjerg (404 m) and Ailsa (196 m), both being outcrops of older and harder rocks. On Shannon, Meyersteins Bjerg (305 m) on the northeasternmost peninsula is the highest mountain, consisting of slightly metamorphosed sediments and gneisses. But there are also many larger and smaller hills of basalt on Shannon, like Tellplatte (196 m) and Enehøj (82 m).

The Ardencaple Fjord has been subject to intense

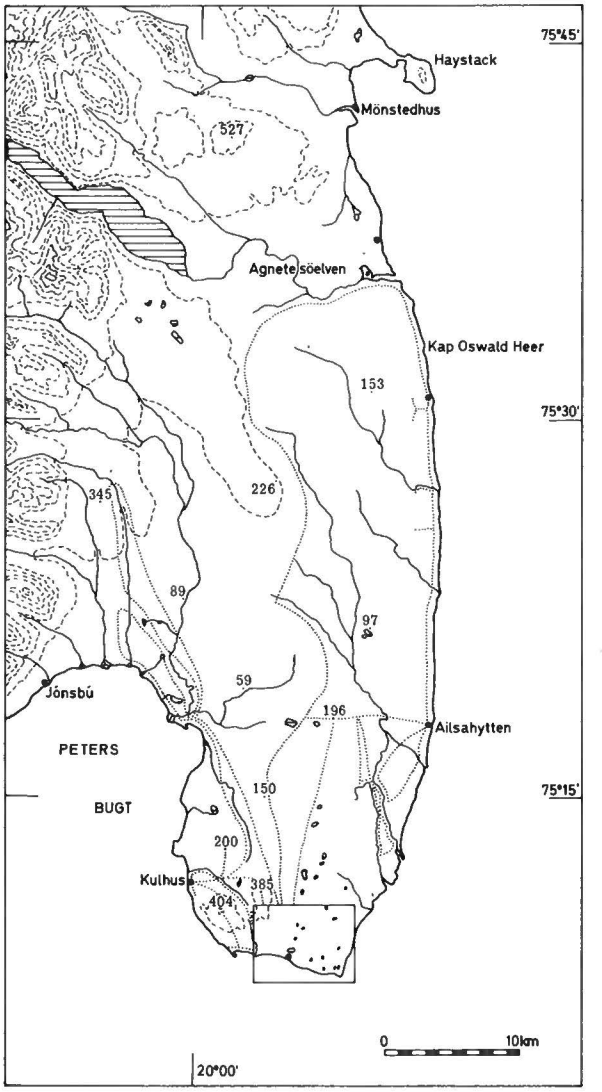

Fig. 3. Map of Hochstetter Forland showing survey trips not included in Fig. 2, with the census area framed. Huts and houses are plotted. Heights in metres.

glacial erosion, which has given it very steep, often vertical walls. The only larger valleys are Kildedalen (Fig. 4) and Femdalen. Especially Kildedalen, and notably the outer part of it, is characterized by extensive glacial deposits. Due to the very continental climate, these areas become snow-free comparatively early, and were almost bare during mid-June when the snow-cover on e.g. southern Hochstetter was largely unbroken. Besides a few larger lakes there are some water-filled dead-ice hollows. The vegetation is rather scattered, with a near to total coverage only found near running water or below snow drifts.

Except for the northeastern peninsula and for the southeastern equivalent (not visited by us), Shannon

Fig. 4. The valley of Kildedalen seen from the east on 14 June 1976. The valley is almost snow-free, only large snow drifts on the lee side of the moraine ridges remain.

can be said to consist of a low plateau of shales and siltstones bounded by a series of basalt hills or basalt covered hills, sometimes with steep sides. In the north, inside the basalt cliffs which form the coast east of Kap Copeland, lie large barren areas with boulder-fields, marine silt or with the weathered shales reaching the surface. Some shallow lakes occur, but the vegetation is extremely poor and the characteristic plant on these soliflucted plains is *Saxifraga flagellaris*. On the north-eastern peninsula, on Meyersteins Bjerg, the boulder-fields cover most of the landscape and vegetation is almost lacking. However, some limited marsh areas occur on the slopes. In the extremely flat central parts of the island the rivers and streams flow eastwards from a water-shed near the west coast. The tundras become gradually moister towards south; typical plants on the dry plains of marine silt or outcropping shale being *Salix arctica, Dryas octopetala, Papaver radicatum* and *Pedicularis hirsuta*. With increasing supply of water follows an increasing abundance of Bryophytes. Over sizable parts of the drier areas the vegetation may cover less than 10 % of the ground.

The south coast west of Kap David Gray and most of the west coast of Shannon is similar to the flat central areas of the island, although with beach ridges and shore terraces playing a larger role.

The topography of Hochstetter Forland is not one of great contrasts. A system of moraine ridges, with associated sediments, follows the coast of Peters Bugt. Towards the north this irregular landscape changes into slowly undulating hills, usually covered by till and with a dry tundra vegetation of e.g. *Salix arctica* and *Dryas octopetala*. These heaths which in the west sometimes reach above 200 m extend all the way to the east coast and north to Agnetesøelven where, again, they change into a more irregular glacial landscape. This landscape, dominated by moraine ridges, dead-ice hollows, thick silt deposits and raised deltas, stretches north to Haystack and, although with less distinct features, along the coast up to Bessels Fjord.

Small lakes and ponds are common on Hochstetter Forland, especially on the very flat tundras east and northeast of Muschelbjerg, and in the areas with glacial deposits and dead-ice hollows around Peters Bugt and up in the north, southeast of Agnetes Sø. There are no larger lakes on the foreland sensu strictu.

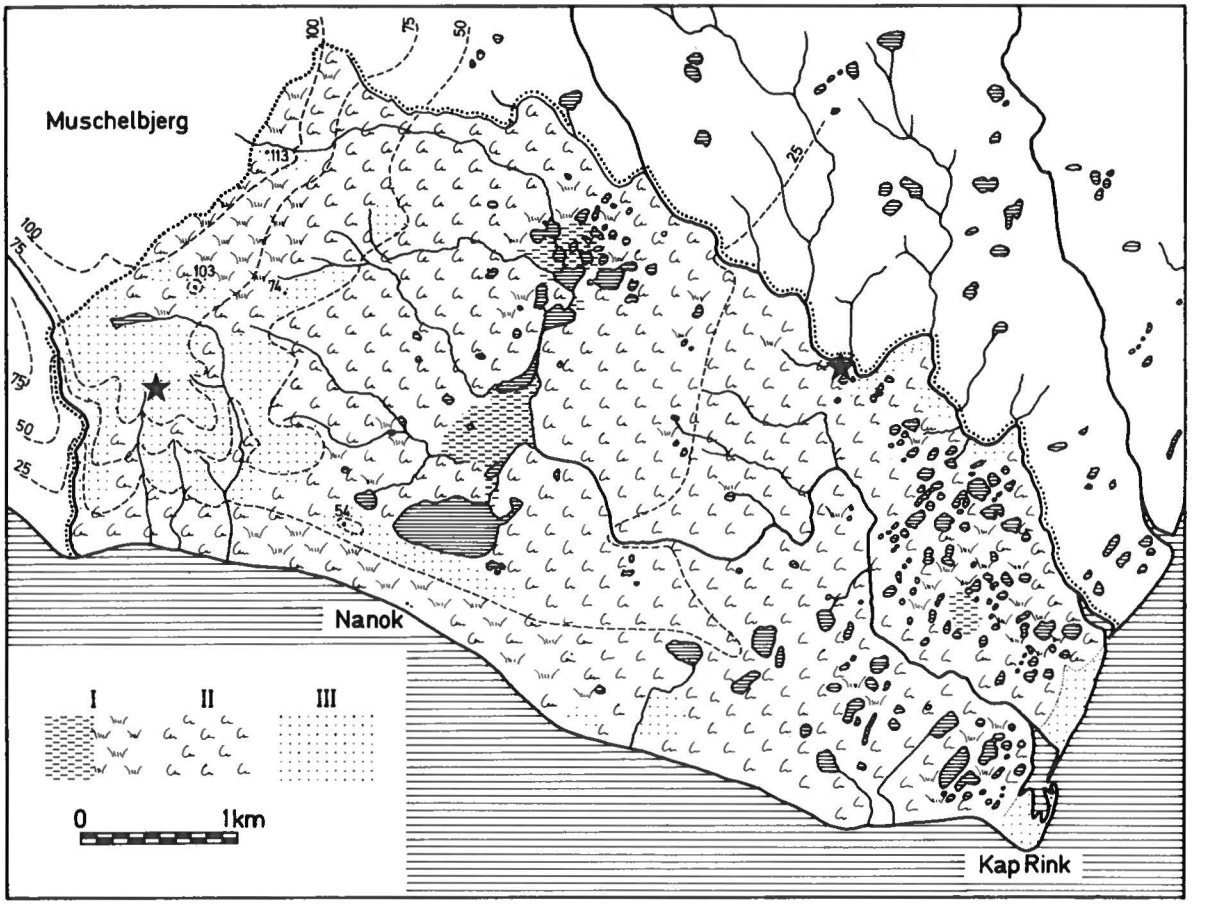

Fig. 5. Map of the census area showing vegetation and topography. The two stars denote occupied fox dens. I: more or less boggy marsh vegetation, II: arctic heath, III: sparsely vegetated gravelly terrain. See the text for further explanation. Heights in metres.

The census area

The census area on southernmost Hochstetter Forland (Figs 3 and 5) is bordered by the sea in the east and south and by a medium sized river in the north. The western boundary follows the slopes of Muschelbjerg and a river-gorge ending close to the sea. The area has an east–west extension of up to 7 km and a north-south one of 2–3 km. In all it comprises 18.2 km².

The land is very flat and rises slowly from sea-level in the east to a maximum of 113 m in the west. The south coast is somewhat steeper. The only hills are some moraine ridges and other kinds of glacial deposits.

These parts of Hochstetter Forland are characterized by many lakes and ponds. The largest and deepest (1–2 m) of these lakes is situated just north of Nanok. From there one area with ponds extends up to the northern boundary of the census area (Fig. 6), and is drained by the river flowing east through the central part of the area. Another pond area lies near the east coast, where old beach-ridges dam a large number of small water bodies – all thawing late. During the summer they gradually dried out, mainly through evaporation.

In the western and higher areas there is only one small and rather barren pond. But it thawed early and was an important roosting and feeding place for waterfowl in June, although it was later abandoned and no breeding occurred there.

The immediate surroundings and areas between the ponds and lakes are usually boggy with an often luxuriant cover of Bryophyta. Characteristic vascular plants along the ponds are *Pleuropogon sabinei* and different species of *Eriophorum*. The only hydrophyte found was *Hippuris vulgaris*.

The main river flowing east through the central part of the area drains into a barren lagoon, sheltered from the sea by a beachridge.

The western half of the south coast (Fig. 7) and the slopes of Muschelbjerg above the 50 m curve consti-

Fig. 6. The central pond and marsh area seen from the north on 1 July 1976. The mountains of Kuhn Ø is seen in the background.

tuted an important habitat. These slopes, exposed towards the south or southeast, were the first to become snow-free and the vegetation cover is extensive, sometimes even luxuriant, owing to a continuous supply of melt water from perennial snow-fans. Apart from Bryophyta this area is rich in *Salix arctica,* Juncaceae, Cyperaceae and Graminae. Characteristic plants were also different species of *Draba, Oxyria digyna, Polygonum viviparum* and *Saxifraga hirculus.* The latter gave a yellow shade to the slopes of Muschelbjerg in July. On the more elevated parts here *Dryas* was the characteristic flower.

The extensive flat and late thawing areas on both sides of the central lake and pond system consist of moderately moist, rather well drained tundras. The vegetation cover is almost complete but rather poor. Lichens and *Carex* species are abundant, as well as *Salix arctica. Saxifraga oppositifolia* and *Dryas* were common but never dominant. Locally other *Saxifraga* species, *Papaver radicatum* and *Potentilla* species were found.

Windswept, and for that reason early snow-free places, lie scattered throughout the census area. The most extensive area of this type is an almost unvegetated raised delta in the west below Muschelbjerg. Also the elevated southern banks of the eastward flowing rivers and several other places lying somewhat higher than the surroundings were early snow-free and later became very dry (Fig. 9). The vegetation here is characterized by *Dryas* with other typical species being *Saxifraga oppositifolia, Papaver radicatum, Lesquerella arctica* and *Salix arctica.* To this can be added different species of *Draba, Potentilla* and Graminae and, on especially favourable localities, *Cassiope tetragona, Vaccinium uliginosum* and *Campanula uniflora.*

Climate and weather

Hochstetter Forland is situated well within the high arctic region, with a typical relatively dry climate, short cool summers and very cold, long winters. Continuous frost prevails from early September until late May in most years, and temperatures below –40°C occur most winters. Midnight sun lasts from late April until mid-August, and continuous dark from early November

Fig. 7. The slopes at Nanok on 17 June 1976. Pink-feet are nesting on many of the low snow-free mounds. The Nanok station is seen and Lille Pendulum Ø northeast of Sabine Ø is visible more than 50 km away.

until early February. Annual precipitation at Danmarkshavn Weather Station 200 km further north (76.46N/18.46W) averaged 132 mm during 1949–75, of which 22% fell during the summer months June to August.

Weather conditions in the summer of 1976 were probably quite close to average for Northeast Greenland. In Table 1, it is seen that May and especially July were warmer than average at Danmarkshavn Weather Station, but that June was cooler than the mean. Summer precipitation June to August amounted to 27 mm, compared with a mean of 29 mm 1949–76.

Table 1. Monthly mean temperatures at Danmarkshavn Weatherstation May to August 1976 compared to means 1949–76.

	1949–76	1976
May	–6.6	–4.5
June	0.9	–0.3
July	3.7	5.9
August	2.3	2.1

When we arrived at Nanok, the thaw had apparently started some days previously. At Mesters Vig thaw started (start of almost daily positive maximum temperatures) on 18 May, which is exactly the average (Meltofte 1976a). At Danmarkshavn thaw started on 21 May, but was interrupted by continuous frost 1–8 June.

Spells of bad weather with cold, wind, snow or rain occurred throughout the summer. While we were at Mesters Vig such weather with snow raged from 21 to 25 May. From 31 May to 2 June, 10–20 cm new snow fell over Hochstetter Forland. There was fog especially during June. During late June and the first half of July, the weather was especially fine, with few clouds, warm and calm days.

Snow cover

The snow cover in the spring of 1976 was generally thicker and more extensive than normal in most of Northeast Greenland. On the southern half of Hochstetter Forland, snow covered close to 100% of

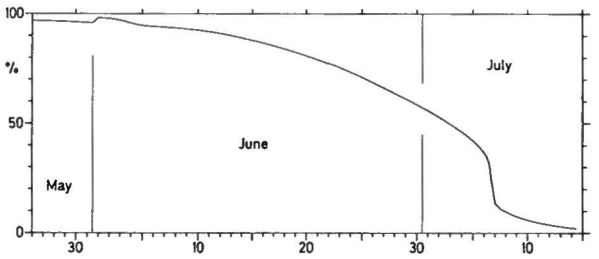

Fig. 8. Graph showing the decrease of snow cover in the census area from our arrival in late May until mid-July.

the land, only narrow stripes on ridges and part of the cliffs of Muschelbjerg were snow-free. On the lake north of Nanok, the snow cover measured 60–70 cm in late May. A 110 cm thick snow cover at a pole at Nanok disappeared almost linearily from late May until about 1 July. Fig. 8 shows the disappearance of the snow cover within the census area, while the snow cover on 10 June and 1 July respectively is mapped in Figs 9 and 10.

Melt water had started to irrigate the well vegetated slopes below Muschelbjerg on 29 May. The gravelly and silty elevated delta and the moraine ridges in the south-western corner of the census area were fairly snow-free, but barren and virtually no vegetation grew there. The pond there already showed a lot of open water on 31 May. On 10 June, only 8% of the area was free of snow (Fig. 9). On 13 June, heavy thaw started, water was running in many places, e.g. upon the snow in the western streams, and the snow was water-soaked in many places. Some very small ponds along the northern river were ice-free on 14 June. On 17 June, all the rivers started to run heavily, the snow on the plains turned to water-soaked swamps, and the snow-free margins along the rivers increased considerably. Around 22 June, extensive snow melt took place on the western slopes and on the central plains. New streams and ponds appeared, but the plain was still only about 10–15% snow-free. In the central marsh and pond area only a few per cent was snow-free on 23 June. The slopes along the south coast appeared mainly snow-free on 23 June. During late June, ponds, small lakes and streams appeared all over the census area, and on 1 July, the landscape was a mosaic of snow, ponds, marshes, ridges and streams (Figs 6 and 10). The western parts were only 10–15% snow-clad, whereas the central and eastern parts were 70–80% covered. Average overall snow cover was 60%.

On 6–7 July, a heavy foehn blew. The temperature reached +16°C and on 7 July about 95% of the census area was snow-free. By the middle of July, the snow melt had ceased and the rivers were reduced to silent streams. Some small ponds dried up during the second half of July and several more during August. Open water appeared along the shores in the lake north of Nanok about 7 July and on 24 July this lake was almost ice-free.

The neighbouring country north of the census area remained mainly snow-clad until the foehn 6–7 July. Snow cover was less extensive further north on Hochstetter Forland, and thaw apparently started earlier there. The large rivers at the head of Peters Bugt had just started running on 10 June and Agnetesøelven

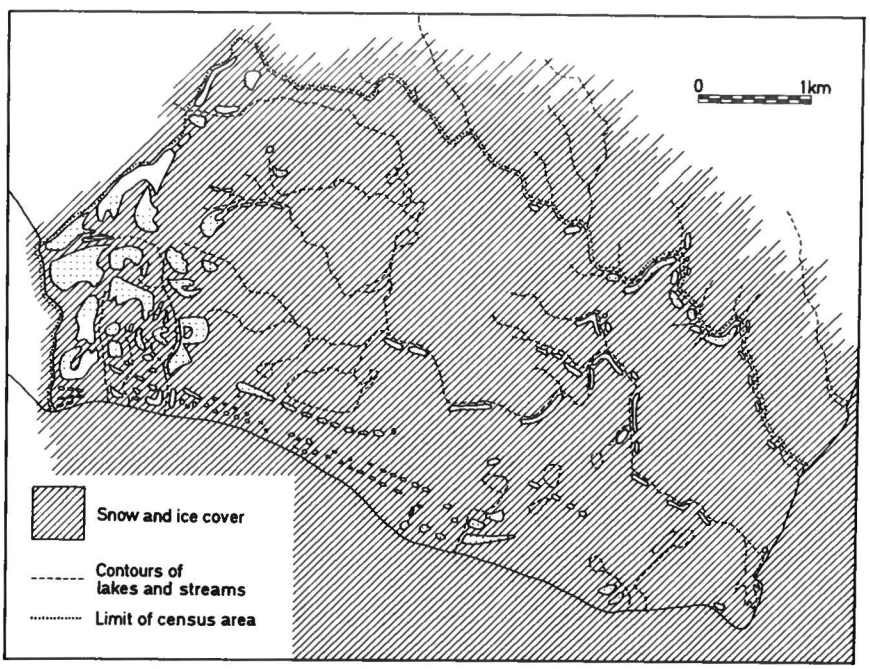

Fig. 9. Extension of snow cover on 10 June 1976 in the census area. Note that only the barren gravelly delta terraces in the westernmost part of the area and some low ridges along the largest rivers, besides small parts of the slope below Muschelbjerg and patches along the south coast are snow-free.

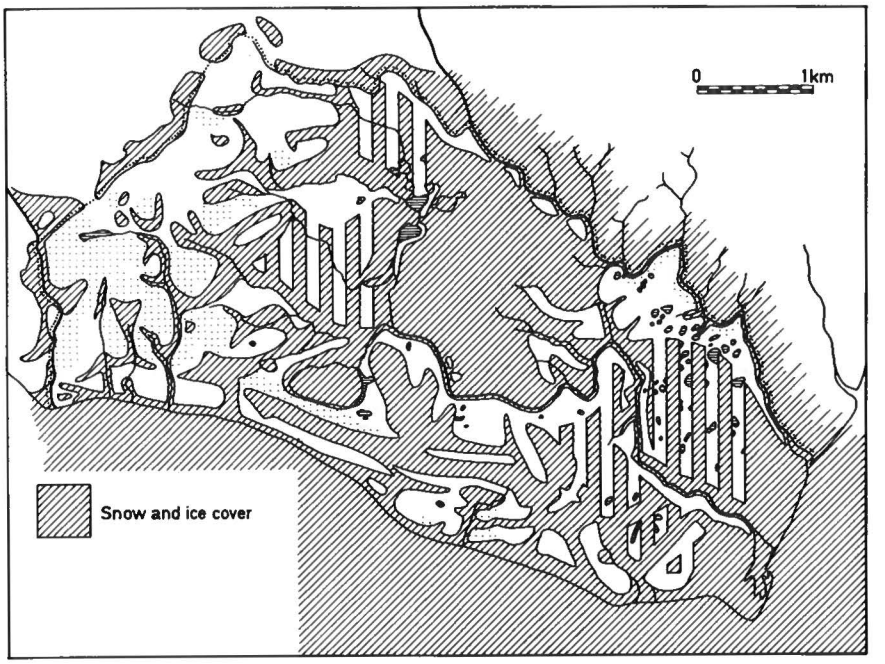

Fig. 10. Extension of snow cover on 1 July 1976 in the census area. Bars denote areas with a patchy half covering snow layer. All rivers and streams are running, but some lakes and ponds and the sea are still ice and snow covered.

started 11–14 June. By the middle of July, most lakes on Hochstetter Forland were still ice covered with open water only along the shores.

The central parts of Shannon island were completely snow-clad on 10 June, but by early July most of the snow had disappeared. Some rivers on western Shannon were flowing on 14 June. Kildedalen and Femdalen were almost free of snow by the middle of June, the rivers had started to flow long since and on 18 June there was open water at the river mouths in the lakes in Kildedalen.

Sea and fjord ice

When we flew north on 26 May, open water was present along the outer coast of Wollaston Forland and at Sabine Ø, Lille Pendulum Ø and east of Shannon (Fig. 2). During early July, open water formed outside the river mouths in Peters Bugt and along the east coast of Hochstetter Forland (cf. Fig. 15). During a storm on 26 July, open water formed outside Nanok. Ardencaple Fjord was ice-free on 27 July, and the ice in Peters Bugt broke up during the last days of the month. The rest of the ice around Hochstetter Forland broke up completely in the days 3 to 9 August. In southernmost Dove Bugt, on the other hand, only a few open leads were seen as late as 20 August, and when CH and LA flew across the mouth of Bessels Fjord on 16 August there was no open water visible (the shore leads excepted) along those approximately 25 km of the fjord which could be overlooked.

Non-avian prey and predators

The first flying Diptera were noted on 30 June. From 5 July hatching increased considerably, but the maximum was not reached until after the middle of the month, whereupon huge quantities were present until the end of the month. The numbers of flying insects decreased with recurrent night frosts during early August.

1975 had been a "lemming year" in Northeast Greenland (Meltofte 1977a). During the first days after our arrival in Hochstetter Forland in 1976, Lemmings (*Dicrostonyx groenlandicus*) were apparently abundant. Many tracks and holes were found, and many lemmings were seen. During the snow melt in June, large numbers crowded on the dry spots in the terrain, up to 15 were counted on one single spot. Many were taken by skuas, Glaucous Gulls and falcons. After snow melt had ceased and most of the terrain was clear of snow, we saw fewer although more than 25 could be seen in a few hours, and the predators evidently had plenty of food throughout the summer. Large numbers of lemmings and tracks were also found at Albrechts Bugt, on eastern Kuhn Ø, and at Peters Bugt during late May and early June. However no tracks were noted in Kildedalen and Femdalen during mid-June, and only a few were seen on Hochstetter Forland and Shannon during the hikes in July and August. Lemmings were common at Danmarks Havn in 1976.

Arctic Foxes (*Alopex lagopus*) were seen most days in the census area. There were two dens within the area and one just north of it (Fig. 5). Cubs were born in all of

them during June; the den at the northern river held at least eight cubs. Single foxes were regularly encountered in all places visited. A few tracks of Ermines (*Mustela erminea*) were found in and around the census area, on Kuhn Ø and in Kildedalen during June. One stayed at Nanok from early July until we left, and another was seen there in July. One Polar Bear (*Thalarctos maritimus*) crossed the census area around 1 July, and two others were seen on the fjord ice in June and July. Many tracks were found on Shannon, but elsewhere only a few were seen. One bear was observed at the mouth of Bessels Fjord in August.

Itinerary and methods

The extensive hikes outside the census area are mapped on Figs 2 and 3. ME and LA stayed on Sabine Ø 27–29 May and from there skied via Albrechts Bugt and Kuhn Ø to Nanok, arriving on 7 June (Fig. 2). CH, HB, and JM visited the country east of Peters Bugt 31 May to 4 June (Fig. 2), and CH and LA travelled through Kildedalen and Femdalen 10–23 June (Fig. 2). The outer coast of Hochstetter Forland to and around Agnetesøelven, was visited by HB and JM 8–24 June (Fig. 2). Central Hochstetter Forland and again Agnetesøelven and the outer coast was visited July 1 to 15 by LA and JM (Fig. 3), and Shannon island 3–22 July by CH and HB (Fig. 2). Peters Bugt and the country north thereof were again visited by HB and JM 28 July to 6 August (Fig. 3), while CH and LA walked through inner Hochstetter Forland to Agnetes Sø and Mønstedhus, and along the coast to Bessels Fjord during 30 July to 26 August (Fig. 2). CH and LA also visited the southern tip of Store Koldewey island by helicopter on 16 August.

HM worked in the census area almost daily for two to six hours in the period 27 May to 16 August – a total of 242 hours; May-June 102 hours, July 112 hours, and August 28 hours. All observations of birds were mapped and as much information as possible concerning flocks, movements, pairs, sex, age, courtship, song and other behaviour was collected. HM usually walked through the area in a moderate speed, looking over the surroundings carefully. Often a good viewpoint was used to look over an area without disturbing the birds. Only part of the area was investigated each day, and the whole area was covered regularly within a few days. Until 1 July, many trips were on skis. Search for waders' nests was most intensive from about 20 June onwards, but ceased at the end of the month because many of the nests found were predated shortly after discovery. Search for nests was again intensified after hatching had started in mid-July.

Nests found were visited regularly, and information on habitat, contents, and birds present recorded. Pulli were ringed and aged using weight and culmen measurements based upon data by Soikkeli (1967), Parmelee (1970), Meltofte (1976a, 1979), and Green et al. (1977). With one exception, no adult waders were caught on nest because we were afraid our activities would guide foxes to the nests. We did not usually approach closer than a few metres to the nests, and only few eggs were touched. Most trips took place during afternoon, evening, and night hours. Further discussion on method of wader censusing is given by Meltofte (1979).

ME also worked in the census area almost daily from 10 June to 16 August. A total of 195 hours of field studies were distributed as follows: June 82 hours, July 87 hours and August 26 hours. Two to eight hours per day were spent on foot or on skis and the methods of observations and documentation were similar to HM. However, ME paid special attention to the King Eider and the Long-tailed Duck and consequently a larger proportion of his observation time was used on these two species. In late June, 16 hours were spent on behavioural studies of pre-breeding King Eiders from a hide.

An additional 54 hours of field study (June 25 hours, July 19 hours and August 10 hours) were spent in the area immediate north of the census area (Fig. 15). These studies were concentrated on waterfowl and complemented the main studies in the census area.

In summary, this paper is based on 453 hours of field studies within the census area, 54 hours in its immediate surroundings and an unestimated amount of time during the in all more than 1000 km hikes.

In the list of species, observations made in the census area and its closest surroundings are generally mentioned first. Observations from the rest of the study area follow.

All times given are local times; which is one hour later than GMT. On all maps the top edge is north.

Species Accounts

Red-throated Diver (*Gavia stellata*)

On spring migration Red-throated Divers generally reach Northeast Greenland in late May and the first three weeks of June. In the southern parts, around the mouth of Scoresby Sund, transit birds are seen from the last week of May to mid-June (de Korte 1974, Meltofte 1976b). Further north, pre-breeding Red-throated Divers have only been seen occasionally at openwater areas at the outer coast (Pansch in Finsch 1874, Manniche 1910). In 1976, foraging birds were seen on two occasions at sea between Sabine Ø and Hvalrosø, namely one pair on 28 May and three pairs on 29 May.

The species has previously been reported from Hochstetter Forland. In 1933, some pairs bred successfully there (Pedersen 1934, 1942). In 1938, "great numbers" of adults were seen in Peters Bugt, but no nests or young were encountered (Bird & Bird 1941). In 1929, the last birds were seen on Hochstetter Forland on 15 September (Løppenthin 1932).

Arrival at the breeding sites takes place as soon as the ice conditions permit and open water areas are available for feeding. This is normally in mid-June (e.g. Manniche 1910, Pedersen 1934, Johnsen 1953, Rosenberg et al. 1970, Meltofte 1975, 1976a, 1977a). The first pair and a single bird flew over the census area on 14 June, but elsewhere on Hochstetter Forland, divers were seen from 11 June (see below). One or two pairs had arrived by 18 June. On 29 June three pairs were present, representing the total breeding population (Fig. 11). Indication of an additional pair was attained in July but not proved. Population density was of 0.16 pairs/km^2.

After arrival the divers lay on the small fish-free freshwater ponds on the mainland. Other activities of the pre-breeding birds were complex courtships on the water and quacking display flights. Copulation was observed twice in late June far from nest-sites found later. Copulation once preceded nest exploratory behaviour. One bird occupied an islet in a pond while the other broke thin ice cover surrounding it. Both birds snatched nest building material from the bottom of the pond, but made no attempt to collect it. The nearest nest to this pond was approximately one kilometer away and it was not found until a week later.

All three pairs in the census area initiated breeding. The nests were placed in ponds and were built-up structures of decayed vegetation, mostly mosses. Egg-laying started in the first nest about 29 June. The clutch of two eggs was predated by 14 July. Two other clutches each of one egg were initiated about 9 and 18 July, and predated by 14 and 31 July, respectively. Thus, all clutches in the census area were predated,

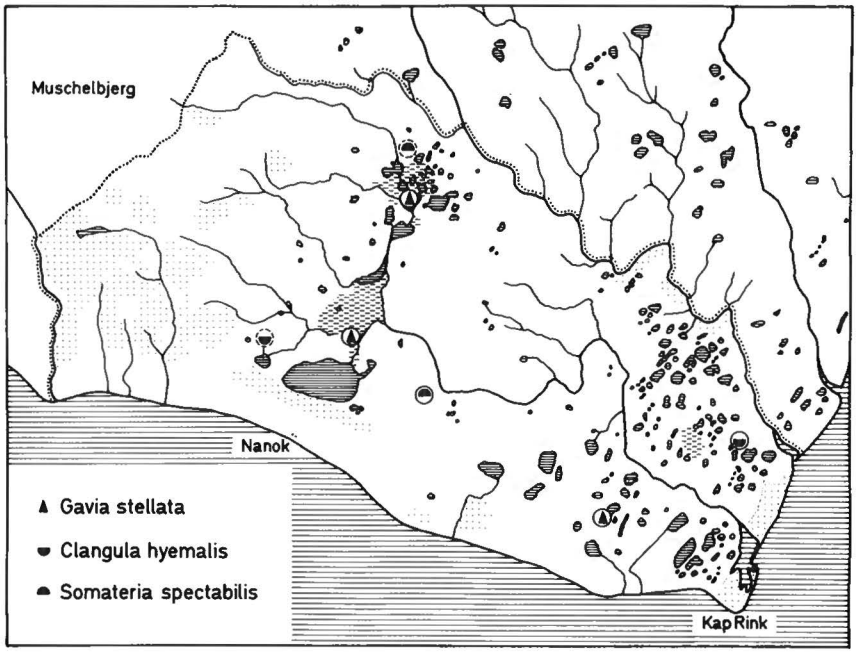

Fig. 11. Nests and broods of Red-throated Diver, Long-tailed Duck and King Eider encountered in the census area. Nests are circled, initial observation site of broods are dashed circled.

most probably by Arctic Foxes. One of the nests was initially inaccessible to mammalian predators but as the water level fell protection was lost. No replacement clutches were laid.

The divers remained in the census area throughout the summer and up to ten post-breeding birds were seen daily near Nanok, often in display flights or fishing. They alternated between lakes and after 4 July estuaries and along the coasts. The lake north of Nanok was visited from 14 July. This was the only lake in the census area containing Arctic Char (*Salvelinus alpinus*). This fish was also found in quantities outside the river mouths. The divers remained in pairs throughout the summer, and no decrease in the number had been noted when we left on 26 August.

Outside the census area, Red-throated Divers were seen at most of the places we visited. The first pair arrived at Hochstetter Forland on 11 June and the same day one bird was seen at Ardencaple Fjord. A total of 27–29 pairs were encountered during the breeding season. Including the census area 19–20 pairs resided on southern Hochstetter Forland, 7–8 pairs were encountered on western Shannon during July and one pair was seen in Kildedalen mid-June. No nests were found outside the census area and no young were seen. Some broods may have been overlooked, but nevertheless reproduction by Red-throated Divers on Hochstetter Forland must have been negligible in 1976.

During August up to 14 were seen regularly at the estuary by Mønstedhus and pairs were also seen feeding on several lakes and along the coasts.

Great Northern Diver (*Gavia immer*)

This species breeds more or less regularly along the east coast as far north as the Scoresbysund district (Bay 1896, Salomonsen 1967, Meltofte 1976b) and breeding has also been proved further north, in Kejser Franz Josephs Fjord (Munsterhjelm 1937, p. 138), at Loch Fyne (Bird & Bird 1941) and on Ymers Ø (Salomonsen 1967) and perhaps also in Strindbergs Land (Pedersen 1934). Besides this they have been observed by most ornithologists working in the fjord region, from Gael Hamkes Bugt (74°N) and southwards (e.g. Nathorst 1900, Deichmann 1909, Pedersen 1926, 1930, Løppenthin 1932, Hall 1966, Hall & Waddingham 1966, Marris & Webbe 1969, Hjort 1976). The two northernmost observations have been made by Manniche (1910) on the southern coast of Germania Land and by Meltofte (1976a) in Peary Land.

With this picture of its distribution in mind and with the negative comments as to its possible occurrence on Hochstetter Forland made by Pedersen (1934, 1942) we were surprised to find them regularly as probably not uncommon breeders in the area.

On 12 June, two birds were observed flying about two km west of the former Norwegian trapping station on the coast just north of Agnetesøelven. The day after seven pairs were encountered together in the mouth of this river. In the Ardencaple Fjord area, on 18 June, one pair was observed on a large unmapped lake in the valley which links Kildedalen to Femdalen and another pair was seen in the northernmost of the large lakes in Kildedalen the day after.

One pair was seen fishing near Nanok during 25–28 July. Two different birds were on small lakes near Peters Bugt on 30 July. At least one bird was seen at small lakes several km southeast of Agnetes Sø on 3–4 August. One bird was observed in the shore lead off Kap Oswald Heer on 5 August.

Although we did not find any nest or young, the many observations of paired birds, newly arrived at lakes where the ice was just beginning to break or waiting at the river mouth on the coast, clearly indicate that the species does breed – and probably in some numbers too. These observations also suggest that most of them breed at large lakes within the mountain range west of the foreland areas, although some pairs may breed at smaller lakes on Hochstetter Forland. This agrees with breeding habits in southern and western Greenland (Salomonsen 1967). Pedersen (1934, 1942) did not observe the species in or near the area covered by us so the population may have increased and spread northwards since the 1930's.

Fulmar (*Fulmarus glacialis*)

Our only observation was of four grey birds (type B of Løppenthin 1932) seen flying west some km inland from Mønstedhus on 9 August, a very foggy day.

The nearest known breeding areas are about 500 km away in the Scoresbysund district (Pedersen 1930, de Korte 1973, Meltofte 1976b), at a few localities around Ingolf Fjord and Holm Land (Manniche 1910, Pedersen 1942 and appendix of this paper) and on Jan Mayen. However, it is a very common bird in the drift ice and not uncommonly seen also along the coast (Løppenthin 1932, Pedersen 1934, Bird & Bird 1941, Marris & Webbe 1969, Meltofte 1975, 1977a).

Long-tailed Duck (*Clangula hyemalis*)

Spring migration of the Long-tailed Ducks and their arrival at Northeast Greenland takes place during the second half of May and in the first half of June. At the mouth of Scoresby Sund the first birds generally arrive 20–30 May with small variations in date from year to year depending on the actual ice conditions (Pedersen 1930, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1976b). In contrast to eiders (*Somateria mol-*

lissima & spectabilis) prebreeding Long-tailed Ducks appear only in pairs or small parties. The duration of the spring migration is relatively short and there seems to be no accumulation of birds at the outer coast before they enter the breeding grounds.

No birds had yet arrived at Hvalrosø off Wollaston Forland 1–7 May 1964 (Rosenberg et al. 1970). In 1976 one pair was encountered at the ice-edge at Sabine Ø on 28 May and that was the only pair observed during our stay there. Previous spring observations at the outer coast were three birds at the ice-edge on Shannon on 24 May, 1971 (in Meltofte 1975), and two birds in an open water area at Mallemukfjeld (80°N lat.) 8 June 1907 (Manniche 1910).

The species was previously recorded on Hochstetter Forland when birds were seen in June 1930 (Løppenthin 1932). In 1933 and 1938 breeding was proved (Pedersen 1934, Bird & Bird 1941), although 1938 was apparently a poor breeding season and only one nest was found. No details on population densities or breeding success were given.

In 1976, the first pair of Long-tailed Ducks was seen in the census area on 10 June and the main immigration occurred a few days later. At this time more than 90% of the area was snow-clad and the only open water was one or two small meltwater ponds. Visible migration was noted on a few occasions when single pairs were seen heading west or northwest in a relatively high altitude i.e. on 14 and 17 June. On 14 June eight pairs were present in the census area and by 17 June the whole population had arrived, with a total of 11 pairs and 1–2 additional single males. 9 to 11 pairs remained throughout the breeding season, giving a population density of 0.49 – 0.60 pairs/km^2. This is significantly lower than the mean figure over several seasons in northern Sweden (0.91 pairs/km^2 in Pehrsson 1977) and in the Hudson Bay area in Canada (1.1 pairs/km^2 in Alison 1975).

The population contained more males than females. One or two solitary males which did not belong to the breeding pairs were seen regularly 15–26 June.

The main activities of the pre-breeding birds were resting and foraging. Contrary to the King Eiders (*Somateria spectabilis*) both sexes foraged to about the same extent. Low intensity courtship display was performed, especially during the first days after arrival, but no copulations – neither attempted nor completed – were noticed.

Within a few days of arrival, the pairs had dispersed over the census area. Even the smallest patch of meltwater upon the snow attracted the birds. Here the males apparently defended territories and aggressively chased away other pairs. However, the birds were not yet stationary and they were often seen flying around. On a few occasions pairs were seen feeding in the tide cracks in the fjord ice along the coast.

On 20 June the first signs of breeding activities were noticed. A duck was seen performing 'nest site exploratory behaviour' (Meltofte 1978) while her mate was inactive in a neighbouring pond. The following day, one duck (probably the same) simulated nest building, lying on the flat shore of the pond among King Eiders. At this time the snow cover in the census area was still extensive. From the last days of June, the number of males appearing alone increased indicating that incubation had started. This coincided well with the appearance of larger snow-free areas. On 3 July the census totalled four pairs and nine single males suggesting that up to seven pairs, or $^2/_3$ of the population, had started breeding. One incubating female was found on 5 July (Fig. 11), but her nest with six eggs was flooded by 18 July after a day of rainy weather. Only one clutch hatched successfully within the census area. On 2 August a female attended five newly hatched pulli and on 10 August the family was several km further east in the census area. If incubation lasts 26.0 days and one egg is laid per day (Alison 1975), laying must have started around 2 July. Four pairs seen until 12 July apparently made no attempt to breed. The breeding success of the five other pairs is unknown, but the abundance of Arctic Foxes suggests a high predation rate (cf. discussion under King Eider).

From mid-July the pairs split up and after 21 July no pairs were seen together. Males gathered in small flocks to moult on the lakes and in the estuaries. The number of males slowly decreased in the census area, but three or four were seen in the lake north of Nanok until we left in mid-August.

Non-breeding females and failed breeders were present from mid-July. Single birds or small flocks moved around between the lakes and the estuaries in the census area, very often separate from the males. This is in accordance with studies from the Hudson Bay area in Canada (Alison 1975).

Long-tailed Ducks were seen at most places visited by the expedition. Arrival in mid-June was almost simultaneous all over Hochstetter Forland and in the Ardencaple Fjord region. Two pairs were observed on 12 June and the next day four pairs were encountered at Agnetesøelven. The first pair in the inner fjord region was seen in Kildedalen on 14 June. Nearly all the birds occurred in pairs. Only one or two additional solitary males were seen with certainty before breeding started.

In summary we counted 30–35 pairs during the breeding season in the area we visited, including the census area. There were 2–3 pairs in Kildedalen, about 25 pairs on southern Hochstetter Forland and no more than 5 pairs on western Shannon (see further below under post-breeders). The only proof of breeding, except in the census area, was from Shannon where two females were incubating on 19 July close to a small lake at the west coast. However, single males were seen at several places in late June and the beginning of July, possibly indicating breeding. Breeding success was extremely low and no broods were seen outside the census area, although large parts of the coastal areas from

Bessels Fjord to Peters Bugt were checked during August.

Large flocks of moulting Long-tailed Ducks, almost invariably males, are known to occur in many places between Peary Land and Scoresby Sund (e.g. Kolthoff 1903, Manniche 1910, Johnsen 1953, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1977a, Hjort 1976).

In 1976 post-breeding flocks of Long-tailed Ducks occurred from mid-July until we left on 26 August. The flocks consisted mainly of moulting adult males with smaller numbers of non-breeding females, failed breeders and possibly one-year-old birds. Along the east coast of Hochstetter Forland north of the census area and up to Ailsahytten a total of 170 birds (c. 90% males) were counted on 21 July. Although no correlation between the size of the population and the number of moulting males was made, it is plausible to assume a somewhat larger breeding population on southern Hochstetter Forland outside the census area than indicated by the more or less random observations during the breeding season. On Shannon a total of 26 post-breeders were seen in the second half of July and at Mønstedhus a maximum of 193 (at least 85% adult males) moulting birds was seen 7–24 August.

Eider (*Somateria mollissima*)

The Eider breeds in Northeast Greenland at least as far north as Germania Land both colonially and in isolated pairs (Salomonsen 1967). Within the study area there was one well-known breeding colony at Hvalrosø (reviewed by Meltofte 1978). On 27 May 1976, large flocks of *Somateria* sp., probably numbering a few thousand, were seen from the helicopter in the open water off Wollaston Forland. During our visit to Sabine Ø 27–29 May pre-breeding Eiders were seen along the ice-edge around Sabine Ø. A total of at least one thousand was estimated, but no precise counts or sex-ratio determinations could be made, since the Eiders were mixed with King Eiders (*S. spectabilis*) and the flocks were diving or flying around almost continually.

The Eider has previously been reported from Hochstetter Forland. Løppenthin (1932) refers to the Danish trapper van Hauen, who saw 60 birds along the coast of Hochstetter Forland on 18 June 1930. Breeding was proved that year and the last female with young was seen 12 September. Pedersen (1934) considered the species to be a solitary breeder along the coast of Hochstetter Forland, but during his visit in August 1938 only single birds were seen (Pedersen 1942). However, 1938 was perhaps an unfavourable season because Bird & Bird (1941) saw only a few flocks of Eiders and did not note any attempts of breeding.

In 1976 the following observations were made by us north of Sabine Ø. One pair was seen in an open crack in the ice at the mouth of Ardencaple Fjord on 22 June, one male and three females at Kap Copeland on Shannon on 4 July and a maximum of 37 adult males, two immature males and eight females at Kap David Gray 14–16 July. A solitary predated nest, which according to the fresh down had belonged to this species, was found on 9 July among old beach ridges about one km from the coast northeast of Kap Copeland.

The many Eiders observed by us in the open water off Wollaston Forland and Sabine Ø during the pre-breeding period mainly belong to the population breeding at Daneborg, where the colony around the sledge dogs and houses now holds more than 1300 pairs (Meltofte 1978).

King Eider (*Somateria spectabilis*)

The spring migration to the breeding grounds in Northeast Greenland has already started at the beginning of April and is controlled by the actual ice conditions along the coast. At the mouth of Scoresby Sund, the first King Eiders arrive during the first days in April (Pedersen 1930). Very few spring observations have been made at the ice-edge further north. At the outer coast of Wollaston Forland, at Hvalrosø, where open water due to sea currents often occurs, a flock of 103 King Eiders were seen 3–5 May, 1964 (Rosenberg et al. 1970) . In another well known open water area further north (80°N. lat.) at Mallemukfjeld, great numbers were seen in the middle of May 1939 and in the beginning of June 1907 (Manniche 1910, Pedersen 1942).

In late May 1976 there was open water along the outer coast of Wollaston Forland and at the southeast corner of Sabine Ø (Fig. 2). During our helicopter flight on 27 May from Daneborg to Germania Havn on Sabine Ø, large flocks of eiders (*Somateria* sp.), in all a few thousand, were seen. During the following days, 27–29 May, a total of 1100–1200 King Eiders were counted along the ice-edge around Sabine Ø. As the King Eider flocks were mixed with Eiders (*Somateria mollissima*), no sex-ratio could be established, because the birds were frequently diving either for food or to escape the close attendance of Glaucous Gulls (*Larus hyperboreus*). An attempt to determine the sex-ratio in a resting mixed flock of 360 King Eiders and Eiders gave an overall value for the two species of 53% males. When censusing large mixed flocks, a sex-ratio of fifty-fifty was assumed and the total numbers of each species were obtained simply by estimating the number of males and multiplying by two.

In contrast to the flock observed earlier in May by Rosenberg et al. (1970) which contained 66% males, all pre-breeding flocks observed by us had a sex ratio close to unity.

The main activities of the King Eiders at Sabine Ø

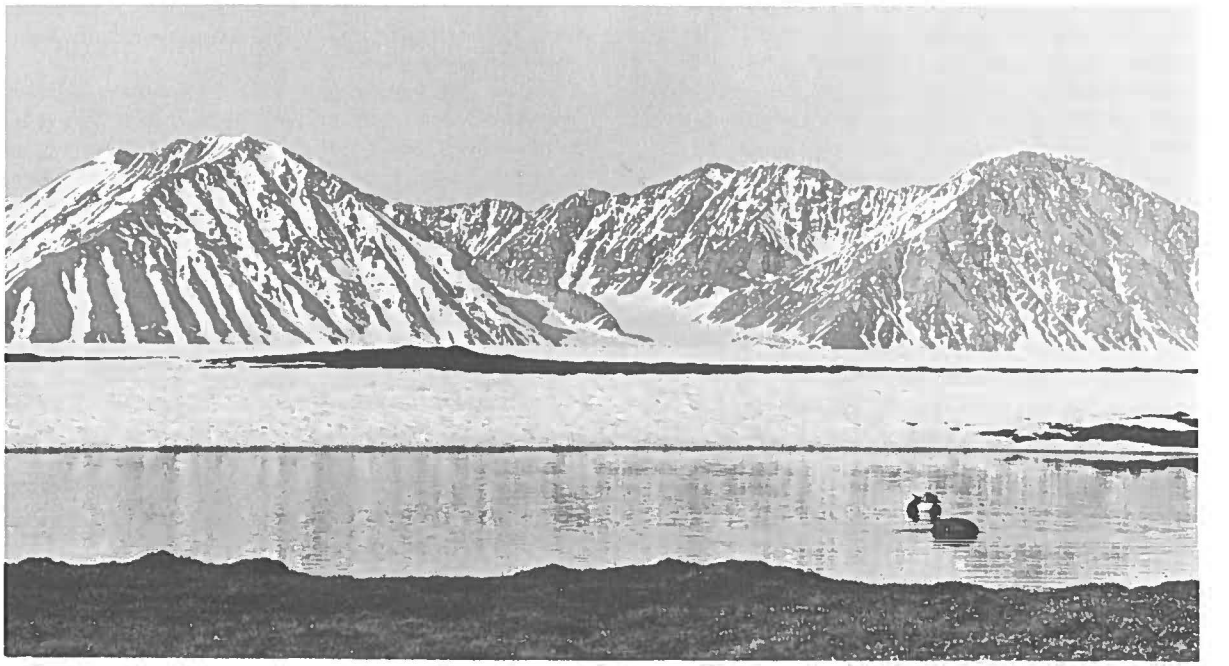

Fig. 12. Pair of King Eiders on a pond in the census area on 20 June 1976. The mountains of Kuhn Ø are seen in the background 20 km away.

were courtship display, which were heard constantly, and foraging. The birds showed no migratory tendencies.

King Eiders have been reported earlier from Hochstetter Forland (Løppenthin 1932, Pedersen 1934, Bird & Bird 1941). Løppenthin mentions a few observations from June 1930, but says nothing about breeding. Pedersen, on the other hand, describes successful breeding of several pairs in 1933, but gives no figures of the size of the population. Bird & Bird (1941) mention 1938 as a non-breeding year for the King Eider. The birds arrived but made no attempt to breed.

In 1976, the King Eiders arrived in pairs at the breeding grounds in mid-June. Arrival was almost synchronous along the coast from Hochstetter Forland to Peary Land. On 10 June the first pair was seen from Nanok flying west above the fjord ice towards Peters Bugt. The staff at Danmarkshavn Weather Station saw the first two pairs 9 June and Sirius reported six birds from Kap Harald Moltke in Peary Land on 11 June. On the same day, three pairs arrived north of the estuary of Agnetesøelven. The main part arrived a few days later. On 15 June approximately 40 pairs rested or migrated at Hochstetter Forland a few kilometres north of the census area and on 17 June some 17 pairs had alighted at the mouth of Agnetesøelven about 40 km further north.

Table 2. Distribution of activities of mated King Eiders (*Somateria spectabilis*) during the pre-breeding period at the breeding grounds. Observed from a shelter at a pond in the census area 20–26 June. A total observation time of 52 hours for males and 51 hours for females are worked up in per cent.

Activity (in %)	♂	♀
Sleeping	47	48
Inactivity	34	3.2
Plumage-preening	4.3	4.5
Foraging	3.8	37
Courtship display	9.0	2.3
Attempted copulation	0.1	0.1
Nest preparation behaviour	0.0	1.6
Moving on ground	2.2	3.5

The first pair alighted in the census area 14 June, and on 15 June the main part arrived. On this day five pairs were actually seen arriving from southeast and were later seen resting on a fresh-water pond. On 17 June the number of King Eiders in the census area reached 10 pairs, a level that was maintained for one-and-a-half week. This number may represent the breeding population. By 27 June the number of pairs increased and a total of 15 pairs and three additional males were counted. This was not a temporary increase as shown by the census 3 July, when a total of 14 pairs, three single males and 2–3 single females was counted. When all birds are included the population density is 0.82–0.93 pairs/km².

The first two weeks of the pre-breeding period at the breeding grounds i.e. up to 1 July the King Eiders were mostly inactive (Table 2). Long periods of inactivity and

sleeping were only occasionally interrupted by foraging (almost exclusively by the females – Fig. 12) or short reconnaissance flights. Occasionally the males exhibited courtship display, but never with the same intensity as earlier in May at the ice-edge. A few attempted copulations were observed but none were completed.

At the turn of the months June – July, the birds showed the first signs of breeding activities. At this time, the snow cover was still extensive (Fig. 10) and the central and eastern parts of the census area were 70–80% covered. However, snow melting was intense during the first week of July and after the foehn storm, 7 July about 95% of the area was free from snow. The initiation of breeding coincided with the appearance of more extensive snow-free areas. From 30 June to 5 July pairs or single females exhibited 'nest site exploratory behaviour' (Meltofte 1978). In all 7–8 pairs were seen on foot searching for a suitable nest site or behaved as if breeding was initiated. On 1 July, a female was sitting on an old nestcup apparently incubating, but we never found any evidence of breeding at this spot. Only two clutches hatched, and one nest was found (Fig. 11). It contained five eggs 24 July and the clutch hatched 30 July, but the chicks were taken by a fox before they had left the nest. The second female was observed with five newly hatched pulli 3 August. With an incubation period of 23–24 days (Parmelee et al. 1967, Norderhaug 1977) and one egg laid per day, the laying of these clutches were started 2–5 July.

The fate of the other pairs in the census area is unknown, but the late appearance of suitable nesting conditions may have prevented some pairs from breeding (cf. Lack 1933). The numerous occurrence of foxes is likely to have been a stress factor to the King Eiders and eventually caused some pairs to give up breeding. Disturbances from Arctic Foxes, Long-tailed Skuas (*Stercorarius longicaudus*) and on one occasion, a Glaucous Gull (*Larus hyperboreus*) were actually observed.

Heavy predation pressure, primarily from Arctic Foxes combined with late snow clearance from nesting grounds and fox induced stress factors may explain the low breeding frequency and success in 1976. Only 12–13% of the females in the census area (two out of 15–17) successfully incubated. Complete non-breeding was reported for King Eiders in Northeast Greenland in 1907 (Manniche 1910), 1938 (Bird & Bird 1940, 1941) and 1939 (Pedersen 1942).

Less than one week after initiation of breeding the pairs started to break up and the males gradually left. The last male was seen in the census area on 14 July. Non-breeding females and failed breeders gathered in flocks from 1 July to the beginning of August. From 18 July onwards, the number of females often exceeded the number included in that of the census area. A maximum of 36 females were present in open water along the south coast on 30 July. The origin of these 'excess birds' was unknown, but presumably they came from neighbouring areas and finally left to moult. The last King Eiders left the census area by 4 August, apart from the female attending young that was present in the same cluster of ponds until 10 August.

Outside the census area, King Eiders were seen all over Hochstetter Forland and on Shannon. No King Eiders were observed in the Ardencaple Fjord region during mid-June. In all, including the census area, about 40 pairs were observed on southern Hochstetter Forland (inside the area covered by Fig. 15) throughout the breeding season. On western Shannon four pairs and a few single females were possibly breeding during July. However, brooding females are easily overlooked and this figure may be an underestimate. A flock of ten males were seen at Kap David Gray on 15 July.

Apart from the census area no successful breeding was recorded in the area covered by the expedition. However, broods were reported at Danmarks Havn. On 15 July, seven females were attending two broods on Lille Skibssø and on 20 July two males and 21 females with 4+5 pulli were seen.

The last males were observed 21 July when five (four of them in early stages of eclipse plumage) rested among non-breeding females at the outer coast of southern Hochstetter Forland. No specific moulting areas are known for the east coast population and no migration of males was observed.

Small flocks of non-breeding females and/or failed breeders were seen on the rest of Hochstetter Forland and on Shannon from the beginning of July and onwards. Except from a single female at Mønstedhus (13 and 18 August) no King Eiders were observed after the first days in August outside the census area.

Pink-footed Goose (*Anser brachyrhynchus*)

When we arrived at Nanok on 26 May, Pink-feet had probably been present for some time. We saw them at Mesters Vig when we arrived there on 19 May, and on 20 May the species was observed at Daneborg. During 26–30 May, stationary pairs were seen on snow-free spots in the census area and a total of 41 migrated north in parties of up to seven individuals. A few groups also flew north during early June. On the well-vegetated and partly snow-free slopes towards Muschelbjerg, 36 Pink-feet grazed during the last days of May and another 40 individuals were dispersed in pairs and small groups mainly in the western part of the census area. After snowfall in early June, up to 68 Pink-feet grazed among groups of Musk-oxen on the newly snow covered slopes towards Muschelbjerg. The geese grazed in scrapes made by the oxen. During the following days similar concentrations occurred on the same slopes and also west of Nanok, but by 10 June apparently only non-breeders remained in the flocks. Totals including non-breeders amounted to at least 90 individuals during

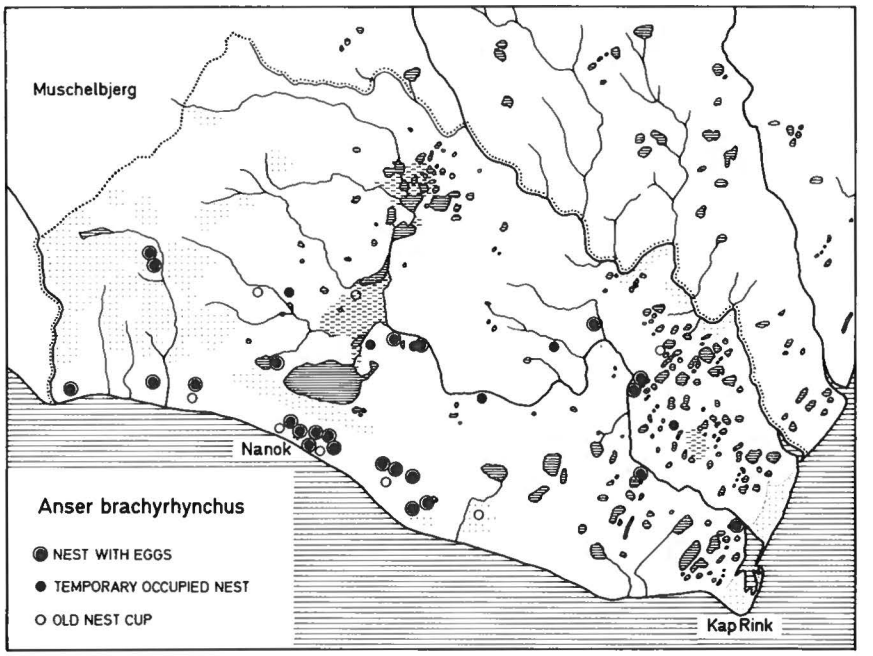

Fig. 13. Breeding pairs and nest-cups of Pink-feet in the census area. The temporary occupied nest-cups were either just visited by pairs or breeding was attempted but failed very early.

early and mid-June in the census area. Of these, 20–40 were probably non-breeders.

A total of 24–30 pairs nested in the census area (Fig. 13). 12–14 nests were emptied by foxes. Of these at least two were predated more than once, as egg laying was continued after the first robbery. Of the ten clutches which hatched at least 2–4 had been predated at least once during egg laying, but egg laying continued. These clutches were of *3,* 4, 4 and *5* eggs, respectively (the definitely predated ones are italicized). The other successful clutches were of 3, 4, 4, 4, 5 and 7 eggs. Two further nests were unsuccessful. One, situated close to Nanok, was probably disturbed too often by us and by foxes. Six eggs were laid, but one egg rolled out early, and was replaced by a stone. After 18 days of incubation the pair started to graze intensively around. Two eggs in the nest were covered with down, the rest had rolled down a gorge. A few days later, all eggs had rolled out, and the pair left. Two eggs contained no embryos, two others more than half-grown embryos. The other unsuccessful clutch held five eggs, and was incubated for at least 40 days. On 25 July the pair left (flying) after having covered the eggs with down. Four eggs contained no embryos, the fifth had a crack and was addled. This failure may be due to early fox disturbance.

Egg laying was started in all nests between the last few days of May and about 10 June. Most clutches, if not all, were completed before 16 June. The successful clutches hatched during the period 3 to 15 July.

Mean clutch size late in the incubation period was 4.5, including the partially predated nests. If after predation during egg laying, clutches are continued in other nests, the total number of breeding pairs are slightly less than estimated.

All nests were situated on level terrain. Most were situated on small mounds or ridges, because such sites were the only snow-free spots during egg laying. However, the more extensive snow-free areas in the westernmost part (Fig. 9) were completely devoid of the geese. This may be due to the fact that these areas were predominantly barren of vegetation, but nevertheless, the preference for nesting on small isolated snow-free spots was obvious. Two pairs nested on mounds less than 100 m from these extensive snow-free areas and like all other nests these were situated in vegetated areas. At the time of egg laying the mounds appeared as snow-free spots measuring a few metres across. Most, if not all nest-cups had been used in previous years and besides the occupied nest sites, 13 old nest-cups were found. Of these, at least six were visited by pairs during early June, and breeding may have been attempted in some of them hence the exact number of breeding pairs could not be estimated. Ten nests (occupied and unoccupied) were situated on frost-heaved mounds, 0.5–1.0 m high and about five m across (Fig. 14). Most nests were not placed on top of the mounds, but on the sides or in small depressions. One old nest-cup was situated within a Musk-ox skeleton and one pair nested one metre from one of the houses at Nanok. Besides down, most nest-cups contained dry *Carex* plants, which grew around most nests. Eighteen pairs (of 30) nested in groups of two or more (Fig. 13). Minimum distances between two nests were 9 m (perhaps only one of them

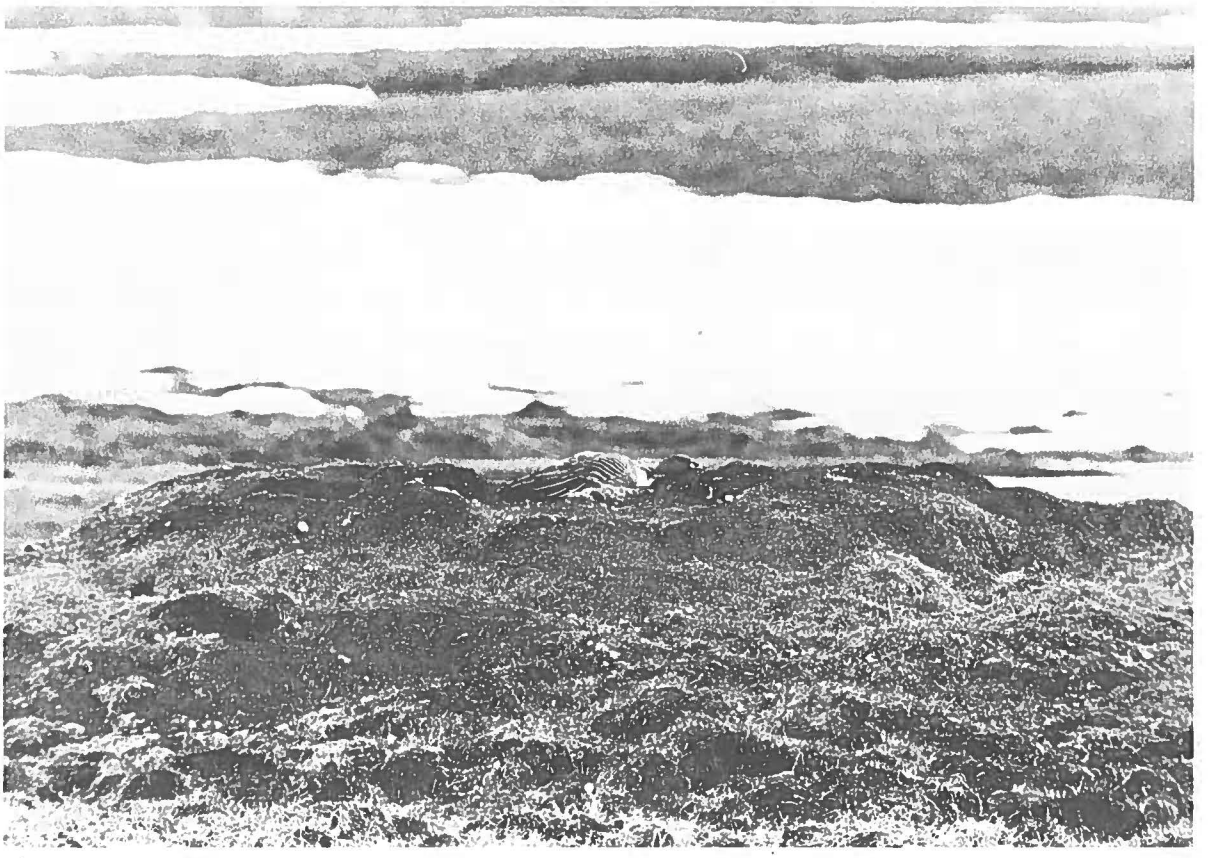

Fig. 14. Pink-footed Goose crouching on her nest on a frostheaved mound on 2 July 1976.

occupied this year), 43, c. 50, 80, 90 and 106 metres. With the exception of the two nests, only nine metres apart, each snow-free spot/mound only held one nest.

Closely outside the census area, one nest was found in the valley between the northern and southern peaks of Muschelbjerg.

Anti-predator reactions

That Pink-feet are capable to defend nest and young against foxes has been reported several times earlier (e.g. Løvenskiold 1954, 1963, Jones & Gillmore 1959, Nyholm 1965), but the actual confrontation has not been described earlier.

With one exception egg thieving by foxes took place during or just after laying, i.e. until mid-June. One was predated on 24 June. To illustrate the timing and progress of these robberies, the following instances are described in detail.

– 3 June at 10 p.m. An Arctic Fox took at least two eggs (all eggs?) from a nest northwest of Nanok. The Pink-foot pair apparently attempted to chase or lure the fox away by flying close above him, alighting with wings spread and hissing. The fox sometimes ran after them whereupon they flew. On each occasion the fox ran away with one egg in its mouth. On the day before fox tracks led to this nest. On 9 June a pair was again seen at the nest. On 12 and 13 June, they were apparently incubating, but the next day, the nest was empty and fox tracks were found around it. Pairs appeared at the nest until 19 June.

– 3 June at 10.30 p.m. The same fox took at least two eggs from a nest northeast of Nanok. One of the eggs was buried about 200 m away. As the fox appeared, the geese crouched on and by the nest. At a distance of about 50 m from the nest, the fox started to run fast, directly towards the geese, with his head low and the tail straight. The Pink-foot pair at once stood up in an erect posture with their wings spread and held sidewards in a vertical position. As the fox reached the geese, they flew and alighted in the snow 10–30 m away. This behaviour was repeated each time the fox took an egg. After taking the last egg, the fox defecated in the nest. As the fox left, it passed close by the nest northwest of the house, but ignored the geese there, who took up threat posture (as described above) in front of their previously plun-

dered nest. On all occasions, the geese returned to the nests as soon as the fox had left. They were seen at the nest again two days later, but then abandoned it.

– 14 June at 8 p.m. The fox attacked a solitary pair in the same way as described above. The geese stood up before the fox attacked (the predation may have started before the observations started). The fox pursued the geese on the snow. Another pair of Pink-feet appeared and flew low over (mobbed?) the fox, and the fox jumped more than one metre in the air, and nearly reached the geese. The fox left with one (the last) egg. The pair was seen on the nest a few hours later, but then left.

– 14 June at 10 p.m. Five pairs of Pink-feet defended their nests successfully against a fox. One pair failed. The fox attacked as described above, but the geese stood firm in threat posture in front of the nests, and the fox turned off. On some occasions, one of the pair flew away while the other stayed. The fox pursued the geese on the snow and jumped in the air for geese flying low over him. One male like some others, left the female on the nest to join other pairs being attacked about 500 m away. On his way from these pairs, the fox passed the lonely incubating female. She gave alarm calls, and the male came flying back and alighted just in front of the fox, close by the female, and the fox turned off. Direct confrontations between fox and geese did not take place during the observations, but many breast feathers were scattered around some of the nests.

– 17 June at 10 a.m. After having buried an egg of unknown origin, a fox passed within 25 m from two successful nests. One pair stayed concealed, while the other pair took in threatening posture. The fox did not take any notice.

– 18 June at 2 a.m. A fox passed within five metres from the last pair mentioned under 14 June. The pair took in threatening posture and hissed. The fox turned off, but lay down ten metres away, rolled himself in the snow and looked upon the geese for a while, whereupon he ran off.

– 23 June at 12 a.m. A fox passed a nest within two metres. The pair crouched, but at last the male stood up and spread his wings for a second. The fox passed by without any reaction. About ten metres away he rolled himself and went on.

Besides the above mentioned, breast feathers, and on one occasion even larger feathers, were found at three predated and one successful nest.

To conclude, it appears that foxes were able to chase most geese off their nests during egg laying, but once the geese had started incubation, they defended their nests, usually with success. Almost every single snow-free spot was scrutinized by foxes daily, but perhaps the foxes were more hungry during early June, while the high amount of lemmings appearing later may have contributed to the success of the geese then. Two successful nests were situated less than 500 m from a fox den (Fig. 5).

Neither Glaucous Gulls nor Ravens were seen to interfere with the Pink-feet.

Another observation of interest was on 5 July when a Musk-ox grazed very close to a nest. The birds crouched, but as the bull nearly stepped into the nest the geese went off. Both geese ran towards the bull displaying threat posture. The bull attacked one of the geese, and they ran off with wings spread just in front of the Musk-ox. This happened a few times until the ox was 10–15 m from the nest. Then the geese returned and incubation was continued.

During egg laying, geese left the nest when people approached within about 100 m, sometimes more. But after about five days of incubation we could pass within 50 m without the geese being flushed. The birds crouched as soon as somebody appeared, the female on the nest and the male usually about a metre away, with their necks and heads stretched low over the ground (Fig. 14). Later, when clutches were examined during late June and early July, most geese did not leave their nests until we were five or ten metres away. The male usually left a little earlier. When flushed from the nest, the female would often run away, hissing and with her wings spread. On one occasion, a few days prior to hatching, a goose performed distraction-like behaviour 25 m from the observer after having left the nest at a distance of 5–10 m. She went back to the nest as soon as the observer went a small distance away.

On several occasions, the male was seen grazing 50–100 m away from the nest, but most often he stayed close to it. When taken by surprise away from nest, the male either crouched where he was or flew back to the nest. Apart from the occasions mentioned under 'unsuccessful pairs', nests were only found unattended once out of about 180 visits. The eggs were down-covered, and hatched in about one week. The pair had stayed nearby, but flew off. However, in two other nests, the first egg was found covered with old nest-down and moss, and no birds were present. On three other occasions only the incubating bird was present. No obvious difference in breeding success could be stated between pairs breeding singly or in groups.

Fledging period

After hatching, the families gradually moved to the coast in the easternmost part of the census area. Perhaps our daily visits to the area may have prevented them from staying in the central marsh. Five broods, probably hatched within the census area held 2, 3, 4, 4, and 5 pulli. Besides these broods, some families from outside passed through the census area. On 7 July, two families with five and four pulli, respectively, stayed in the area. On 6 July, a pair with two pulli were seen just north of the area, and on the same day, two families with one and four pulli were seen at the lakes northeast of Muschelbjerg. Thus, the mean clutch size of ten less than one week old broods was 3.4. Hatching success

could not be determined as the foxes probably took any unhatched eggs. On two occasions, deep holes were dug in the nest-cups by foxes just after hatching.

Pairs with young were extremely shy. They usually ran as soon as people appeared, the adults with neck and head stretched forward and their body flattened. One family with four goslings, a few days old, ran out across the fjord ice more than one kilometre in front of the observer. Three young got stuck for a while in a crack and were left behind, calling intensively. The adults and one young kept running for kilometres across the ice. On another occasion, one family was encountered in the central marsh. Here they crouched among the hummocks, and did not flush until the observer approached within 30 m. Then they ran away, the male behind the young, hissing and with his wings spread.

Mean clutch and brood size found here in 1976 is of the same order as found in the 11,000 nest colony in Thórsárver on central Iceland (e.g. Inglis 1977). However, the overall breeding success was lower on Hochstetter Forland in 1976 due to the heavy fox predation. Also on Iceland, Arctic Foxes, although few in number, predated Pink-foot nests, but furthermore Arctic Skuas, Great Black-backed Gulls, and Ravens took eggs. Generally, the nests are situated much closer in the Iceland colony.

The fledging success on Hochstetter is unknown.

Populations

An estimated total of 40 potentially breeding pairs were found on the southernmost part of Hochstetter Forland, i.e. in and around the census area. Including non-breeding immatures, the total population here amounted to about 100–120 individuals.

Outside the census area and its surroundings only a few breeders were found. During May and the first half of June, small groups of Pink-feet were observed on Sabine Ø (maximum 40), in Albrechts Bugt (4 individuals), on eastern Kuhn Ø (15–30), at the head of Peters Bugt (25), in Kildedalen-Femdalen (in all about 50 birds and two nests on a rocky slope in Kildedalen, and some other pairs apparently breeding too). More than 100 were seen along the east coast of Hochstetter Forland and Agnetesøelven. Except for Kildedalen, no nests were found. On Shannon, one pair with goslings was observed at Kap Copeland on 4 July.

On northern Wollaston Forland, Rosenberg et al. (1970) found 5–7 pairs breeding at Kap Schumacher, and one solitary pair at Albrechts Bugt in 1964. In 1930, no breeding was found around Nanok, but several Pink-feet were seen during June (Løppenthin 1932). Pedersen (1934) reported many breeding at streams by Peters Bugt in 1932, but gave no details. Pedersen (1942) saw no Pink-feet on northern Hochstetter Forland in August 1938. Bird & Bird (1940, 1941) reported that many immature Pink-feet stayed on Hochstetter Forland, but that only few were breeding in 1938.

In accordance with observations further north (Meltofte 1975, 1977a) the species has apparently increased and expanded northwards during this century. This applies both to the breeding population and to the number of moulting immature Icelandic birds (see below), and corresponds to a considerable increase of the wintering population on the British Isles (Boyd & Ogilvie 1969, Ogilvie & Boyd 1976).

The moult migration

In the period 17 June to 7 July, a total of 1278 north-migrating Pink-feet were counted at Nanok (Table 3). A total of 95 migrating across Peters Bugt were counted on 23 June and an equal number passed along the east coast of Hochstetter Forland on 21–22 June. Birds were seen migrating at all hours of the day and night. The total number observed migrating at and near Nanok, probably only make up a minor part of the actual number of birds passing. Flocks ranged 3–54, averaging 16. Some flocks alighted in the census area as soon as they arrived, and many resting flocks were observed during these days. A few individuals, even in the earliest flocks, lacked single primaries, and on 3 July, the first flightless geese were encountered in the easternmost part of the census area. Here, in the bogs and ponds, the geese concentrated during July. When disturbed, they fled out into the open water along the coast and outside the estuaries, and out across the ice. The concentrations of moulting Pink-feet on southern Hochstetter Forland during the second half of July are plotted on Fig. 15. The figures are maximum numbers but it is improbable that double registrations were

Table 3. Daily totals of moult migrating Pink-feet observed 17 June to 7 July 1976 at Nanok.

June	17	28
	18	41
	19	
	20	
	21	
	22	29
	23	
	24	44
	25	30
	26	116
	27	394
	28	11
	29	36
	30	205
July	1	137
	2	94
	3	43
	4	
	5	27
	6	
	7	43
		Sum 1278

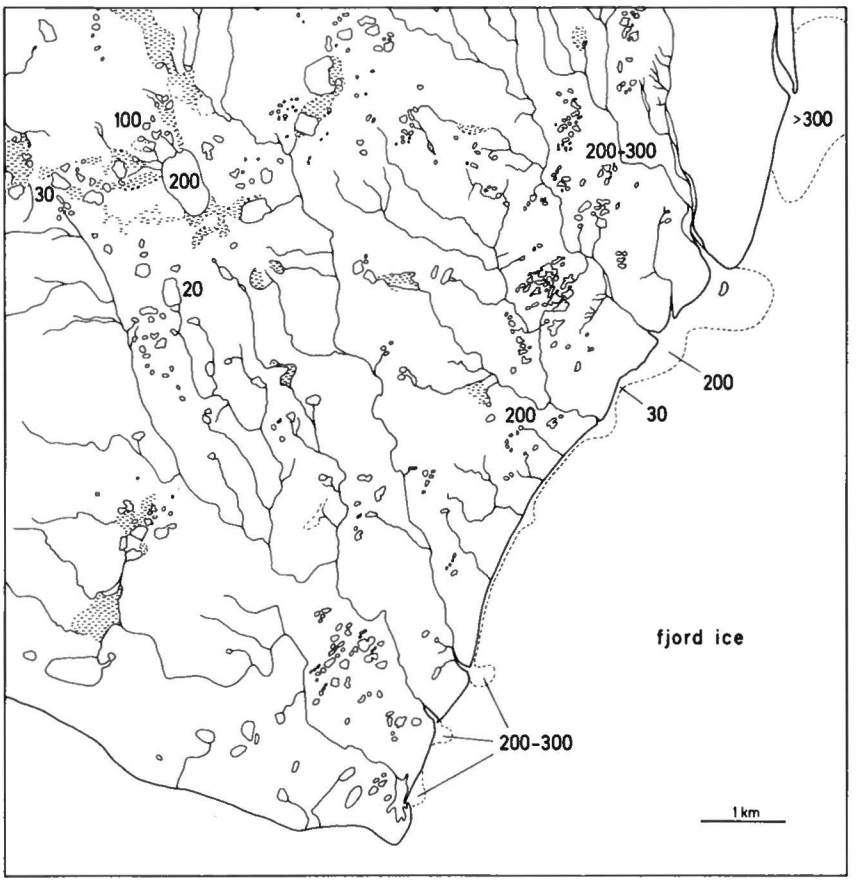

Fig. 15. Map of southeasternmost Hochstetter Forland showing moulting flocks of Pink-feet. Open water outside the rivers and along the coast on 21 July 1976 is shown. The census area is situated in the southern part of the map.

made. The total for the area was about 1600 individuals. Many old shed flight feathers were found in the central marsh areas of the census area, but no geese moulted there during 1976, perhaps because of our activities.

Further north more than 1000 were found moulting at lakes, rivers and along the east coast of Hochstetter Forland north to Agnetesøelven and at Peters Bugt during July. Another 500 birds, capable to fly, were observed north of Agnetesøelven during August. Thus, a grand total of about 3000 was observed moulting on Hochstetter Forland in 1976. Only about 60 were observed on Shannon during July. These are minimum figures because many potential moulting areas were not visited.

By mid-July most birds were flightless, but small groups and local pairs were flying throughout July. As late as 19 July, 13 Pink-feet arrived from the south. From the last days of July onwards, successively more birds had finished primary moult and started to fly. Thus 200 out of 300 individuals were flying on 31 July.

Throughout August flocks of up to 300 birds grazed in the marshes in and around the census area, and by mid-August the southward migration started. Thus, in the period 15–26 August, a total of 936 Pink-feet migrated south at Mønstedhus and along the coast from there north to Bessels Fjord, and 722 migrated past Nanok (Table 4). Flocks ranged 6–225, averaging 35.

Table 4. Daily totals of south migrating Pink-feet observed 15–26 August 1976 around Mønstedhus and Nanok.

Date	Mønstedhus	Nanok
15	7	
16	150	25
17	303	221
18	81	240
19		
20	219	24
21		140
22		22
23		
24		50
25	151	
26	25	
Sum	936	722

Greater Snow Goose (*Anser caerulescens atlanticus*)

Three Snow Geese stayed together with the flocks of moulting Pink-feet on the southeastern coast of Hochstetter Forland, from 8 July until we left. They shed their flight feathers in mid-July and had regained their flying capacity by 14 August. They were clearly larger and more long-legged than the Pink-feet. The nearest breeding grounds of the species (subspecies) are in northwesternmost Greenland and on Baffin Island (Snyder 1957, Salomonsen 1967). Snow Geese have been seen several times in North and Northeast Greenland (Johnsen 1953, Andersen 1970, Grant 1972, Meltofte 1975, 1976b, 1977a, and appendix of this paper).

Brent Goose (*Branta bernicla*)

Ssp. bernicla

One bird belonging to the nominate dark-bellied subspecies, which breeds in Eurasia and which has never before been found in Greenland (Salomonsen 1967), was observed together with Pink-feet in the census area on 23 and 25 June.

Ssp. hrota

No birds belonging to the light-bellied subspecies were recorded. In Greenland this form now seems to breed only along the northwesternmost coasts, although previously it also bred along the east coast south to Scoresby Sund (Pedersen 1930, Salomonsen 1967) – although probably irregularly. In our study area Nathorst (1900) saw four Brent Geese on Sabine Ø 7 July 1899, and around 1921 they were breeding on Hvalrosø (Schiöler 1925 – photos). Here also Jennov (1945) found two pairs breeding, in 1931, together with Barnacle Geese. Pedersen (1934, 1942) stated that Norwegian trappers found five pairs breeding on a low island in a delta in Peters Bugt on 6 June 1933, and that he saw old nest-cups himself. Bird & Bird (1941), referring to personal communication with the same trappers, doubted this statement. Pedersen (1934, 1942) also stated that trappers regularly saw Brent Geese south of Haystack during the summers 1933 and 1938, and he assumed that they were breeding there too.

In the first half of this century Brent Geese were regularly seen on migration along the coasts of Northeast Greenland, but this migration now seems to have ceased entirely, and so has breeding in Northeast Greenland and Peary Land (Meltofte 1975, 1976a). According to Salomonsen (1967), the population from the north coast migrates south along the west coast to the Disko area, from where they cross the Inland ice to the Angmagssalik district, where they are common in September.

Barnacle Goose (*Branta leucopsis*)

When we arrived at Hochstetter Forland on 26 May, the Barnacle Geese had already been there for more than one week. On 18 May, a Sirius sledge party observed "several" at Kap David Gray on southern Shannon and the following day 28 were encountered at Nanok. On 20 May, "several" were seen both at Daneborg and Danmarks Havn. Between 26 and 29 May, a total of 216 Barnacle Geese were recorded migrating north at Nanok, with the flocks ranging 1–30 and averaging 8. A few small flocks of unidentified geese flew north even later and some Barnacle Geese also passed with the flocks of Pink-feet migrating north, between 18 June and 5 July. Small groups stayed within the census area during late May and early June, mostly on the slopes below Muschelbjerg. The maximum number seen was 13. After 10 June, only a few were noted.

A breeding colony was situated on the coastal cliffs of Muschelbjerg, about four km west of the census area. A total of 21 individuals was counted here on 23 June and some more heard. The first pair with young appeared in the census area on 1 July, but a pair without young had been seen since 29 June. One new family was observed on 5 July and another on 14 July. These three broods numbered 2, 2 and 4 goslings. Two families stayed on the lakes in the southeastern part of the census area throughout July and the first half of August, while four pairs with a total of only three goslings stayed on the coast northeast of the area – more than 10 km from the supposed breeding site. Thus, a total of at least six pairs, probably all from the colony on Muschelbjerg, dwelt in the census area. Another four pairs, with 1 + 2 + 2 + 3 goslings, were encountered at some ponds north of Kulhus on 2 August making the total at least 10 pairs.

When disturbed, the families with young swam out to the centre of a lake or pond, or ran overland to another lake. When running, the adults kept belly, neck and head low. On one occasion, a pair with four goslings tried to conceal themselves on the shore of a pond. When the observer approached within 50 m, the family swam across the pond and ran away from the opposite side. Both during swimming and running, the adults kept themselves flat. Generally, Barnacle Geese seem to be less shy and less prone to panic than Pink-feet.

Outside southern Hochstetter Forland, Barnacle Geese were seen in many places. On Sabine Ø up to 60 were seen in late May, clearly birds breeding on Hvalrosø, and two were observed in Albrechts Bugt and 15 on eastern Kuhn Ø. Sirius sledge parties observed 40 at Mønstedhus on 26 May and 15 on Bass Rock northeast of Sabine Ø on 27 May. In the last place, they were

obviously breeding. In Kildedalen and Femdalen about 30 were encountered during mid-June, and about 50 were observed along the east coast of Hochstetter Forland during the same period. No breeding colonies were found in these last mentioned places.

On Shannon about 20 pairs were encountered along the north coast from Kap Copeland and eastwards during July. At least 14 of these attended broods on 3–5 July. About 180 moulting Barnacle Geese were seen on northern Shannon during the same period. The flocks ranged 10–78. A total of eight pairs attended broods (three goslings in one brood, the others ranging 1–5) and one pair stayed on a cliff at Kap David Gray 14–15 July. Along the west coast of the island, one pair with three goslings and a total of 34 moulting birds were encountered 18–21 July. Thus about 30 breeding pairs and 214 non-breeders were observed on Shannon during July. The colonies on the north coast and at Kap David Gray were on basalt cliffs.

No Barnacle Geese were seen on the hike through Hochstetter Forland in July, but one pair with two goslings was found a little south of Agnetes Sø on 3 August. Two flocks (13 + 38) stayed at Agnetesøelven on 4–5 August. One pair with one fledged juvenile was met with some kilometres north of Mønstedhus on 13 August, and two pairs attending two and four juveniles along the coast north of Haystack on 17 August. Thus, the grand total of Barnacle Geese found breeding on and near Hochstetter Forland and on Shannon comes to about 45 pairs. The mean size of 12 broods was 2.5, and the range 1–5.

From 10 August onwards flocks numbering 27–200 individuals appeared on southernmost Hochstetter Forland. They remained within and north of the census area until at least 26 August, when we left. At Mønstedhus and along the coast north to Bessels Fjord, 185 were counted during mid-August, in flocks of up to 40. On southern Hochstetter and around Mønstedhus, a total of 254 Barnacle Geese were seen migrating south along the coast, from 15 August until we left (Table 5). The flocks ranged between 6–48, averaging 18. However, like the migrating flocks in spring, these totals represent only some of the birds actually passing because our coverage was not complete.

Table 5. Daily totals of south migrating Barnacle Geese observed 15–26 August 1976 around Mønstedhus and Nanok.

Date	Mønstedhus	Nanok
15	6	
16	6	
17	18	
18	24	6
19		
20		
21		6
22		
23		
24		118
25	70	
26		
Sum	124	130

The literature contains little exact information on Barnacle Geese along this part of the coast. A colony on Hvalrosø has been known for many years (Deichmann 1909, Løppenthin 1932). Here, 7–8 pairs were supposed to breed in 1931 (Jennov 1945) and 20–25 pairs in 1932 (Pedersen 1934). Probably, this colony did not exist in 1870, as no Barnacle Geese were seen there during visits in June and July (Pansch in Finsch 1874). Barnacle Geese have also been reported breeding on Kuhn Ø and in Ardencaple Fjord (Pedersen 1934), near Peters Bugt, along the north coast of Wollaston Forland and in Lindemans Fjord (Jennov 1963). Barnacle Geese were only seen twice at Peters Bugt in 1938 (Bird & Bird 1941). The colony found by us on Muschelbjerg can not have existed in 1932, as it would hardly have escaped notice by Pedersen or by the trappers, all living only a few kilometres from the site. Pedersen (1934) just found one solitary pair on Hochstetter Forland, nesting on a steep sandy slope towards a small river.

In our rather vast main study area, traversed many times by two teams during three months (Figs 2 and 3) and with more or less continuous observations by one stationary team at Nanok, the number of breeding pairs located was about 45 – which is not many. However, Hochstetter and Shannon are very flat areas and there are few suitable breeding cliffs. On Shannon, where basalt cliffs occur, the population of breeding Barnacle Geese is clearly larger than on Hochstetter, a thing which is reflected also by the number of non-breeders. On Hochstetter Forland sensu strictu, there are virtually no suitable cliffs and the only good ones, those on Muschelbjerg in the south, harboured a colony of about 10 pairs.

It is also notable that so few Barnacle Geese were encountered along Ardencaple Fjord and in its side valleys, where suitable breeding cliffs abound. Only about 30 birds were seen, and we found no indication of breeding. Both Kildedalen and Femdalen, the two largest and probably also the best vegetated valleys along the fjord were visited during mid-June when Barnacle Geese are always noisy and breeding places easy to detect. The reason for their low numbers here may be that this fjord basin and these valleys are in fact quite barren – due to aridity. The same situation applies to the Pink-feet, although that species was slightly more common there.

In all, about 550 adult and immature Barnacle Geese were encountered in the main study area (75°–76°N) during the summer including both breeding birds and flocks of non-breeders. Distinct migrants are excluded. 125 were seen on Sabine Ø and Hvalrosø, northernmost Wollaston Forland and eastern Kuhn Ø during late May/early June. The grand total is thus not very large, and may be compared with numbers met with in

the areas north of Kejser Franz Josephs Fjord (Hjort 1976) or with such from Ørsted Dal near Kong Oscars Fjord (e.g. Ferns & Green 1975). However, it may well be larger now than during the 1930's. A considerable increase in the numbers of this species during later years has been noted elsewhere in northern and central East Greenland (Meltofte 1975, 1977a), and this corresponds to a threefold increase of the winter population of Greenlandic Barnacle Geese in the British Isles between 1959 and 1973 (Ogilvie & Boyd 1975).

As noted, the southward migration of Barnacle Geese had already started by mid-August, with the first birds passing Mønstedhus on the 15th and the first ones Nanok on the 18th (Table 5). This early migration should be considered with the contemporaneous, but much more pronounced passage of Pink-feet (see that species), because it indicates an earlier move south by at least parts of the more northerly populations than for southerly breeding geese. As the birds do not leave for Iceland until the very last days of August or during the first week of September (Glue 1972, Hjort unpublished), the birds from the north may be assumed to rest and gather in the more southerly areas before leaving Greenland (Gillmor & Jones 1959, Meltofte 1976b). Birds flying south over Hochstetter Forland in August were obviously not aiming straight for Iceland because of their low altitude and tendency to alight for rest and food at suitable places encountered during the flight. Their behaviour gave the impression of a gradual retreat at relative leisure, sometimes accelerated by a spell of bad weather; as on 16 August and the days thereafter when weather cleared after a cyclonic passage with snow and goose migration gathered impetus (see under Pink-feet).

Gyr Falcon (*Falco rusticolus*)

Ssp. candicans

Two immature birds were present near Nanok throughout June. During July and August, five observations were made here, and on two occasions single birds of unspecified age were seen along the east coast of Hochstetter Forland. Birds of unspecified age were also encountered three times in the Peters Bugt area, between late May and early August. One pair of adults remained close to the hut south of Kap Oswald Heer 10–11 June.

The total number of records is not impressive, especially for the second successive summer with plenty of lemmings. Pedersen (1934) found it breeding west of Hochstetter Forland.

Ssp. obsoletus

One seen at Kap David Gray on Shannon 14 July is probably the northernmost record to date of this subspecies on the east coast. Earlier, it has been seen on Hold With Hope (Hjort 1976) and on northern Traill Ø (Hjort unpublished), and it occurs regularly as far north as Scoresby Sund where it probably also breeds (Pedersen 1930, Salomonsen 1967). Løppenthin (1932) mentions a large and very dark falcon seen by a trapper on Hochstetter Forland which may have belonged to this subspecies.

Rock Ptarmigan (*Lagopus mutus*)

The Rock Ptarmigan is a common breeding bird in Northeast Greenland, but the numbers vary both locally and between different years (Salomonsen 1967). The species has previously been reported from Hochstetter Forland. A few observations in late December and in January in the early 1930's (Løppenthin 1932, Pedersen 1934) indicate that small numbers winter in these areas (see also Gelting 1937). Pedersen considered the species to be a rare breeding bird on southern Hochstetter Forland in 1933, being more common in the mountains further west.

Ptarmigans were present in the census area on our arrival, and two or three pairs and perhaps an additional male were regularly seen there until mid-June (Fig. 16). Yet, males most often occurred singly from early June until 1 July. Another pair was seen twice in late May on the slopes below Muschelbjerg. Males displayed regularly until late June, breeding was not proved, but may very well have been attempted. No young hatched within the census area. On 23 July, a single male in summer plumage was seen – the only one recorded after 1 July in the census area.

During the extensive survey trips in late May and early June, ptarmigans were found almost everywhere. On southern Sabine Ø, four males were encountered and on eastern Kuhn Ø at least two pairs and five males were seen. In the Ardencaple Fjord area a total of eight pairs and three single males were counted, with the majority in Kildedalen. Including the census area, pairs and single males representing a total of about 25 pairs were seen during the summer on Hochstetter Forland. After mid-July, however, only a few were seen. On Shannon, two pairs without young and nine single males were seen during July. During the short excursion on the southern part of Store Koldewey on 16 August, four individuals were observed.

An incubating female with a clutch of 7–8 eggs was encountered 15 June south of Agnetesøelven. A female with five chicks at Mønstedhus on 12 August and two juveniles on southern Hochstetter Forland on 23 August were the only proof of successful hatching in the whole area investigated by the expedition. In addition, the behaviour of one pair near Peters Bugt on 30 July indicated the presence of pulli.

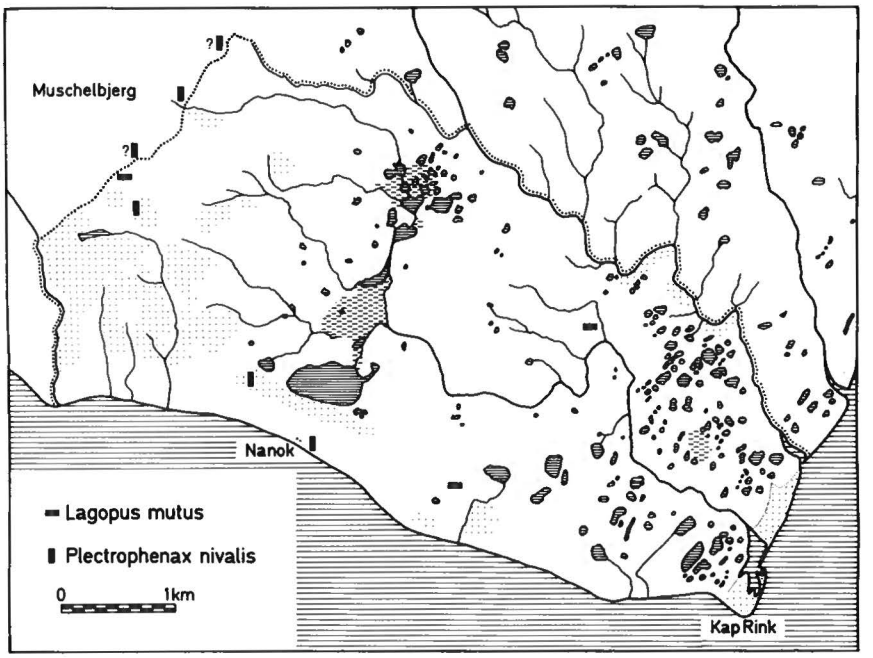

Fig. 16. Pairs of Rock Ptarmigan and singing males of Snow Bunting in the census area. A few birds outside the area are also plotted.

Ringed Plover (*Charadrius hiaticula*)

We saw the first Ringed Plovers on 23 May at Mesters Vig. In the census area, single birds were seen almost daily following our arrival until larger numbers appeared by 8 June. The early birds were not stationary, and alarm calls were not heard until 5 June. On 7 June, males were singing, and mated birds appeared on the next day. During the rest of June, several non-stationary birds were seen, and pairs and singing males occurred at sites where no birds later bred.

On 2 June, a flock of 37 waders, which included Ringed Plovers, migrated south during heavy snowfall southeast of Kuhn Ø.

Only 6–7 pairs were found within the census area (Fig. 17), corresponding to 0.3–0.4 pairs/km². A few pairs were found just north of the area and one pair near the top of northern Muschelbjerg. Three nests all with four eggs were found. They were all very late and perhaps relaid clutches. Two were found on 21 July, the third on the 27th. One hatched on 2 August, the others were predated by 31 July and 5 August, respectively. One egg in the hatched clutch was infertile. Song flights ceased during early July, and at the same time the unsuccessful breeders started to leave the area.

The nests were situated on gravelly 'islands', one of them in a big riverbed in a place that dried out late. All pairs were found at the few unvegetated sites in the area.

During mid- and late July, stragglers again appeared in the area, some of them in pairs. During mid-August, groups of up to ten adults and juveniles fed by the lagoon and on irrigated slopes.

Outside the census area, a few Ringed Plovers were found at most of the places visited. Several pairs were encountered in Kildedalen during mid-June and a nest with two eggs was found there on 14 June. Only a few were seen on Hochstetter Forland during early and mid-July on extensive hikes. Several pairs bred around Muschelbjerg and Kulhus, and at the head of Peters Bugt. About ten individuals were seen on northern Hochstetter Forland during early August, and a few migrated south along the coast here during mid-August. 10–15 pairs were encountered on Shannon during July.

Our observations contrast strongly to the reports of Pedersen (1934) and Bird & Bird (1941) who stated that Ringed Plovers bred in great numbers on Hochstetter Forland. Pedersen even claimed that the population level here was higher than in any other part of Northeast Greenland, and reported ten pairs breeding per km². Even though we found several pairs in the gravelly areas around Kulhus and Peters Bugt, where the above authors stayed, these areas are not representative of Hochstetter Forland as a whole, and the population estimates made by Pedersen seem quite unrealistic, although conditions may have changed since then.

Golden Plover (*Pluvialis apricaria*)

Two adult birds, distinctly coloured and obviously belonging to the northern subspecies *altifrons*, were encountered on 20 July on the west coast of Shannon about halfway between Kap Tramnitz and Kap Copeland. Their behaviour did not indicate breeding.

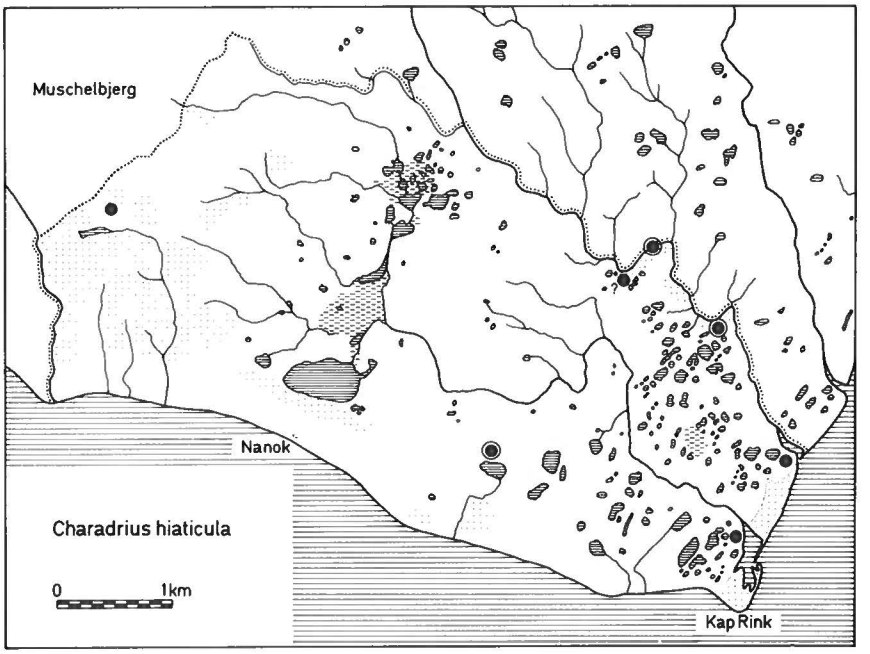

Fig. 17. Pairs of Ringed Plover in the census area. Further explanation in Fig. 11.

This species has been observed regularly in the Scoresbysund district and breeding had long been suspected there (Pedersen 1930, Bertram et al. 1934, Hall 1966) before de Korte (1975) finally proved it. North of Scoresby Sund, adult birds have been seen in Ørsted Dal near Kong Oscars Fjord (Ferns & Mudge 1976) and at Myggbukta and Loch Fyne (Bird & Bird 1941), and a juvenile one was observed at Danmarks Havn in September 1969 (Meltofte 1975).

Turnstone (*Arenaria interpres*)

We saw the first Turnstones on 24 May at Mestersvig. During late May, furious territorial fights, including aerial pursuits and ground displays took place on the small snow-free spots on the slopes east and west of Nanok. North migrating flocks passed Nanok until 30 May. A total of 43 migrating individuals were observed. Flocks ranged 1–12, averaging 5. Mixed flocks with Knots were seen. On 2 June during the bad weather, flocks migrated south or southeast. At Nanok 11 Turnstones and 18 Knots passed southeast, and east of Kuhn Ø one flock of 37 medium sized waders, one of five Turnstones and one of six Turnstones and one Knot passed over the fjord ice. The birds flew at an altitude of about 50 m in snowfall and low visibility.

Even though a few pairs were already established on territory during late May, most individuals and pairs did not appear in the census area until about 10 June. Many individuals appeared to be wandering around during mid-June. During the first half of June, up to ten Turnstones regularly fed on rubbish at Nanok. Alarm calls were heard from early June and Long-tailed Skuas were mobbed from 10 June onwards. Copulation was observed on 10 June.

36–39 pairs were found within the census area, giving 2.0–2.1 pairs/km². 21 nests were found, besides one just outside the census area (Fig. 18). In addition pulli of a further three pairs were found. At least two of the 21 clutches were probably replacements of earlier predated clutches. Including pairs behaving as having nest or young, a total of at least 32 pairs bred or attempted to breed inside the census area; the rest may have attempted too.

Fifteen clutches hatched (first young) as follows:

	Clutch size
July 9	4
10	4
11	4
12	3
17	4
20	4
20	4
22	3
22	4 (relay)
23	4
23	4
24	4
24	3
25	4
28	2 (probable relay)

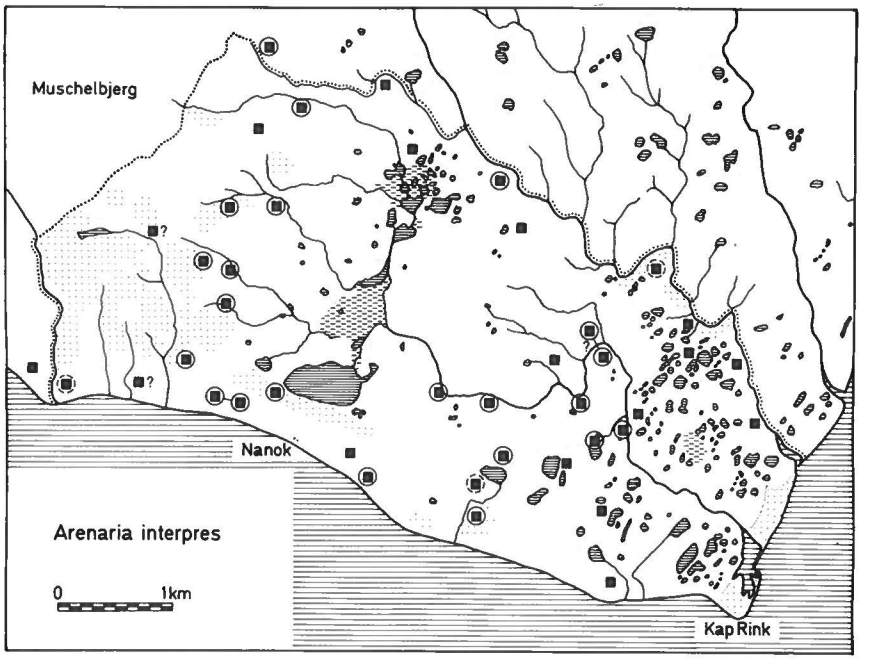

Fig. 18. Pairs of Turnstones in the census area. A few pairs just outside the area are also plotted. Further explanation in Fig. 11.

A further four nests were found with four eggs on 22, 23, 25 and 26 June, respectively (including the one just outside the census area), and one with three eggs on 23 June. But all of them were predated within a few days. One clutch of four eggs hatched or was predated by 12 July. One clutch of two eggs was predated after 18 July.

Estimated hatching data of three broods were:

	Number of young found
July 9–11	1
17–18	1
18–19	1

Summarizing these data: five clutches, and probably six more, hatched or would have hatched about 9–12 July, and 14 hatched or would have hatched 17–28 July. In the first group, nine clutches averaged 3.9 eggs per clutch (one further three-clutch was perhaps not complete). In the second group twelve clutches averaged 3.5. In the first group five out of nine nests found in June were predated, in the second group, one out of 12 nests. In all six out of 22 nests were predated, but at least three more may also have been predated near hatching because on some occasions hatching date was determined by pipped eggs and an empty nest a few days later. Only one egg was infertile. One pair relaid about 100 m from the initial nest, the other (probable) renesting took place about 200 m from the first one.

It seems reasonable to conclude that most of the clutches in the late group were relaid after heavy fox predation of first clutches. Some may have been laid by late established pairs. It is unlikely that many other pairs – if any – hatched young in the early period. It was estimated that 16–24 pairs produced young which lived for one week or longer. Thus most of the successful nests belonged to the late group.

13 nests were situated on wet or dry *Dryas*-heath; eight in sparsely vegetated clay and gravel areas; one on a *Salix*/Bryophyta hummock in marsh habitat. Most nests were in *Dryas/Carex* tussocks on level ground, but one was situated in one of the dry *Salix*-hummocked areas. Comparison of Figs 9 and 18 show that most pairs were found near the early snow-free patches but not on the very earliest snow-free westernmost dry flats and vegetated slopes below Muschelbjerg.

After hatching most families moved around within half-a-kilometre from the nest, but some from the western slopes moved over one km from nests down to the central marsh. By 25 July, most females had left and a few females left already before hatching, leaving care to the male. The last female (and pair) was seen on 29 July. Most males left during early August, and the first independent juveniles were seen on 2 August. On 14 August a few males still attended juveniles. The number of juveniles increased rapidly in the census area during early August. The broods often kept together. 20 were seen in one flock on 7 August.

Flocks of post-breeding adults started to form by 8 July. They fed on favourable sites, often in flocks with Knots, Sanderlings, and Dunlins. At least 100 post-breeders were in the census area on 18 and 21 July. Most of them fed in the boggy areas in the easternmost part, thus 70 fed on the exposed bottom of a pond which had just drained through a frost crack. On

31 July, about 40 were counted, but none were seen later.

Turnstones were found in all other areas visited. 15–20 were encountered in Kildedalen and Femdalen during mid-June, and an average of one Turnstone per kilometre was seen on Hochstetter Forland during the first half of July. Far smaller numbers were found on Shannon during the same period.

Singlers and groups of juveniles migrated south along the coast at Mønstedhus throughout August.

The species was reported to breed in large numbers on Hochstetter Forland both by Pedersen (1934) and Bird & Bird (1941). Pedersen gave about five pairs per km².

Knot (*Calidris canutus*)

A total of 32 Knots was observed migrating north at Nanok 26 to 29 May in small groups (maximum 14) often with Turnstones. During snowfall on 2 June 18 migrated southeast at Nanok and about ten migrated south over the fjord ice east of Kuhn Ø (cf. Turnstone and Ringed Plover). When the weather cleared during the following morning, 15 flew north along the outer coast of Hochstetter Forland.

Single birds often sang in the census area from the date of our arrival. From 7 June onwards, more appeared and groups of up to ten fed on irrigated slopes. 4–7 pairs occurred during mid-June and singing, alarm calling and flight pursuits low over the ground was observed. Three or four pairs stayed in the southwestern part of the census area and on the slopes of Muschelbjerg outside the census area. Up to four pairs were seen in the northeastern part of the census area. After 18 June no groups were seen. On 23 June the last song was heard and during late June and the first half of July, a few birds were seen irregularly – some of them passing over the area. One adult gave alarm calls in the northeastern part of the area on 8 July and one in the southwestern corner on the 15th. Here one adult with four 8–10 day old pulli was found on 28 July. Apparently at that time the young were able to cross the river which bordered the area towards the west so their nest may have been outside the census area. Thus only one or two pairs of Knots may actually have bred within the census area. The other pairs disappeared shortly after mid-June.

The first post-breeding group appeared on 4 July when two Knots were seen with six Sanderlings, but until the middle of the month only small groups were seen. On 18 and 21 July about 50 Knots fed in flocks of up to 31 individuals in the area of the north-eastern marsh together with flocks of Turnstones and Sanderlings. 19 were seen on 25 July and the last seven on 31 July.

On 3 August eight juveniles appeared in groups (broods) of one's and two's – two were attended by two adults, and until mid-August similar groups fed in the census area.

Outside the census area Knots were encountered regularly in all parts of the district visited, except for Kildedalen and Femdalen where none were seen during mid-June. One flock of 14 and one of about 30 were seen on 1 June near Peters Bugt, during snowfall. About 100 Knots were counted along 75 km on central Hochstetter Forland during the first half of July. Most birds appeared in groups of up to eight individuals on the tundra and were probably breeders. No Knots were seen along the outer coast of Hochstetter Forland at this time. Less than ten breeders were encountered on Shannon, but many birds migrated across the island during early July. On the 9th, a flock of 104 fed in a marsh northeast of Kap Copeland and flocks of up to 40 were regularly seen flying south over the northern part. No Knots were found on central Shannon, but flocks of 6, 12 and 50 individuals were encountered along the west coast on 19–20 July. Several Knots migrated south along the east coast of Hochstetter Forland in small groups during 7 to 15 August.

One Knot in a small flock seen on Shannon on 9 July carried a green colour ring on the right leg and a metal ring on the other. According to A. J. Prater (in litt.) it had been ringed in February/March 1970 at Morecambe Bay in England.

Knots were stated to breed commonly on Hochstetter Forland by both Pedersen (1934) and Bird & Bird (1941). Pedersen gave a population density of about three pairs per km².

Purple Sandpiper (*Calidris maritima*)

One pair giving wing-lift display was seen on Sabine Ø 28 May. A total of four birds, singing, displaying and alarm calling and probably representing three pairs were encountered on Meyersteins Bjerg and at Kap Sussi on northeasternmost Shannon on 7 July. These localities are all on the extreme outer coast.

The species has been found several times in the present study area. On Sabine Ø four specimens were collected during August and September 1869 and one on 21 June 1870 (Finsch 1874). Reports of flocks of 20–30 individuals in late May and pairs in early June are doubtful. Nathorst (1900) observed one on Lille Pendulum Ø east of Sabine Ø 6 July 1899, and Deichmann (1909) saw one on Sabine Ø 10 July 1900. A few were collected on Shannon and Sabine Ø by trappers in the 1920's, and among these was a male shot on the nest on Sabine Ø 30 June 1919 (Løppenthin 1932). Pedersen (1934) observed and collected juveniles on Hochstetter Forland during the first half of August 1932–33, and assumed that the species bred there.

The Purple Sandpiper is a common breeder in low arctic southern and western Greenland, but occurs in much smaller numbers along the east coast north of Scoresby Sund where is has been found as far north as Germania Land. Fig. 19 shows where it has been observed and where there have been indications or proof of breeding (Finsch 1874, Bay 1894, Nathorst 1900, Deichmann 1909, Manniche 1910, Pedersen 1926, 1930, 1934, 1942, Løppenthin 1932, Schaanning 1933, Bird & Bird 1941, Hall 1966, Salomonsen 1967, Rosenberg et al. 1970, de Korte 1973, 1974, Meltofte 1975, 1976b, 1977a, Ferns & Mudge 1976, Hjort 1976, Hjort unpublished and Elander unpublished). Obviously the species generally occurs on the outer coast. Within the fjord region, where the climate is more continental and where species like the Knot (*Calidris canutus*), Sanderling (*Calidris alba*) and Dunlin (*Calidris alpina*) may reach high population densities, the Purple Sandpiper is only found occasionally. Thus in East Greenland north of 70°N it uses a marginal zone with comparatively harsh climate, long-lasting snow cover and poor vegetation. Other waders breed within the zone but less densely than further inland.

On western Svalbard, where the Purple Sandpiper is by far the commonest wader and where the Knot, Sanderling and Dunlin are scattered rare breeders (Løvenskiold 1964), the climate is very like that on the extreme outer coast of Northeast Greenland. Løvenskiold (1964) and particularly Bengtson & Fjellberg (1975) have pointed out the importance of littoral zone food resources for the Purple Sandpipers as a necessary complement to those of the tundra. It is possible that the extreme barrenness and the late thaw of the littoral zone in high arctic Northeast Greenland accounts for the low population density of the species there. Most records in Northeast Greenland are from Scoresby Sund which is the only part of central and northern East Greenland where both climate and marine life are similar in quality and quantity to those of western Svalbard. At Scoresby Sund Purple Sandpipers often feed in the littoral zone (Meltofte unpublished).

Fig. 19. The occurrence of the Purple Sandpiper (*Calidris maritima*) in northern East Greenland. Small circles indicate up to ten observations, large ones more than ten. When filled, the circles show that breeding has been proved, when half filled where there have been indications of breeding. It should be noted that practically no ornithological information is available from the country between Germania Land and Peary Land.

Dunlin (*Calidris alpina arctica*)

We saw the first Dunlin at Mestersvig on 25 May, but in the census area only few were present before about 7 June. During the last days of May one was heard singing and a few more were seen. One sang on 5 June. On 8 and 10 June flocks of up to 16 fed on the irrigated slopes in the westernmost part of the census area, pairs were seen and song display occurred. However, most pairs did not establish territories until the second half of June, some apparently not until very late in the month, following the late snow melt in the central marsh and plain areas.

20–24 pairs were recorded in the census area (Fig. 20), giving 1.1–1.3 pairs/km². Nests of seven and the young of another pair were found. Judging from behaviour at least eight more pairs bred or attempted to breed; the rest may very well have done so too.

Three clutches of four hatched (first young) on 23, 23 and 25 July, and one brood (only one young found) was estimated to have hatched on 18 July.

Two clutches were complete (four eggs) when found on 26 June, but both were predated early. Two other nests held unstarred eggs on 11 and 19 July respectively, but hatching date was not determined. In summary, given 22 days incubation, these eight clutches hatched or would probably have hatched about 15–25

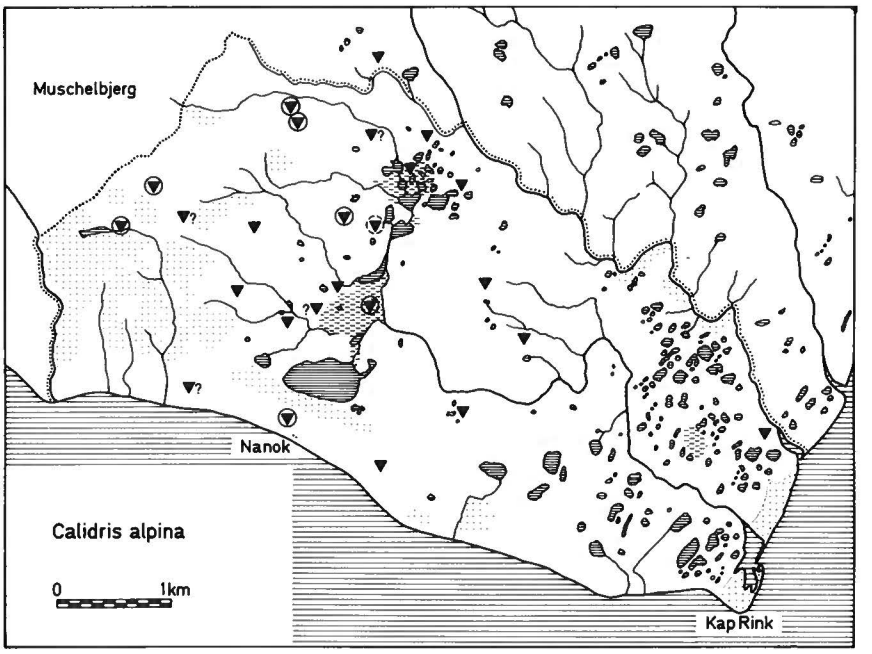

Fig. 20. Pairs of Dunlin in the census area. One pair just outside the area is also plotted. Further explanation in Fig. 11.

July. Six clutches held four eggs, one only three. No infertile eggs were found.

The seven nests were all on hummocks of marsh vegetation; four of them on very wet irrigated sites, the others on drier ground. Fig. 20 shows that most pairs nested in and around the central marsh and on the slopes west and south thereof. Only one pair was found in the eastern part of the area.

A flock of 11 post-breeders appeared on 18 July, but a few joined flocks of Sanderlings already from 10 July. Until 3 August flocks numbering up to 25 Dunlins associated with Sanderlings and Turnstones. A maximum of 40 were counted on 25 July.

The number of breeders in the census area decreased during mid- and late July. After early August only few adults remained. Breeding success was unknown, but at least 9–11 adults attended young during late July and early August. On 14 August, one adult still attended four juveniles.

Outside the census area about 20 pairs were encountered in Kildedalen and Femdalen during mid-June. But only about ten individuals were counted on the dry tundras of central Hochstetter Forland during the first half of July. None were seen along the east coast. On Shannon the species was found at many suitable localities. A few migrated south at Mønstedhus during mid- and late August.

Pedersen (1934) and Bird & Bird (1941) stated that Dunlins did not breed in any large numbers on Hochstetter Forland. Pedersen stated that no more(!) than 3–4 pairs bred per km² in suitable areas.

Sanderling (*Calidris alba*)

A few Sanderlings were seen daily at Nanok from the day of our arrival. Single individuals migrated north 28–29 May. On 31 May a flock of eight migrated north and a total of 34 fed in the census area. Of these, 25 were in one flock on the well vegetated slopes towards Muschelbjerg. Song flight was noted from 30 May and the first solitary pair appeared on 4 June. On the 8th more pairs were present and song, flight pursuits and ground display increased considerably.

A total of about 30 pairs were recorded in the census area (Fig. 21), giving 1.6 pairs/km². This figure is less reliable than those given for the other species, as Sanderlings are quite puzzling birds to census. Six nests and a further six broods of pulli were found, besides one pair displaying on an empty nestcup on 5 July. A further two individuals behaved as if they had young. The extent of breeding or attempted breeding could not be stated, but it is not likely that more than a few more actually succeeded to hatch young.

Three nests were found with only one egg on 21 and 23 June and 3 July respectively. Egg laying continued as follows:

Nest 1:

June 21 at 04.30:	1 egg – pair present
22 at 15.00:	2 eggs – no adults seen (both eggs weighed 10.4 g)
23 at 17.45:	3 eggs – no adults seen
26 at 15.30:	4 eggs – two adults seen

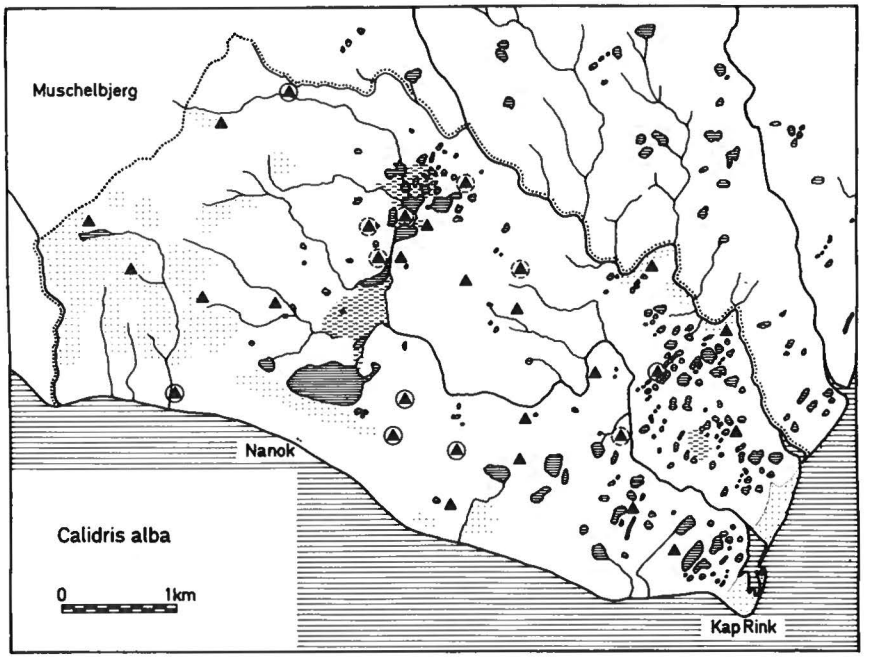

Fig. 21. Pairs of Sanderling in the census area. Further explanation in Fig. 11.

July 15 at 18.00: 4 dry pulli still present in the nest-cup and one adult attending.

The incubation period at this nest was about 21 days in contrast to a general stated duration of about 24 days (Parmelee 1970).

Nest 2:

June 23 at 20.00:	1 egg – pair present (see below)
26 at 17.30:	3 eggs – female present
July 2:	predated

Nest 3:

July 3 at 22.00:	1 egg – female present
4 at 19.00:	2 eggs – no adults seen
5 at 18.00:	3 eggs – no adults seen (egg weights 10.3, 10.6 and 10.7 g)
7 at 01.30:	4 eggs – female incubating
11:	predated

One nest contained four eggs on 25 June (predated by 5 July), another held three eggs during 14–23 July (empty by the 25th), and still one held three eggs on 27 July, but was empty the next day.

Six broods were estimated to have hatched as follows:

	Number of young found
July 12	4
12–14	4
14	2
14	1
20	4
August 1	1

Given average incubation period of 24 days, eight clutches hatched or would have hatched during 12–21 July, two later than 24 and 27 July, respectively, and one on 30 July and one on 1 August. Three definitely complete clutches held four eggs, two only three. Both of the latter were started late in the season. Five out of six nests were predated.

The following observations at nest 2 on 23 June deserves special mention:

It was a cold evening (overcast and about 0°C), but the snow melt was very intensive during this period. A pair of Sanderlings walked around on a recently exposed snow-free spot in the northwesternmost part of the census area. The male performed short flight displays low over the ground, including short runs on the ground with fluttering wing-beats. Hereupon, a neighbouring (unmated?) male arrived and attacked. The birds fought each other for at least ten minutes, by short flight pursuits at a height of less than half-a-metre, but most of the time by direct fight using bill, legs and wings. They tried to grasp each other with their bills (some feathers fell off) and to get up upon each other's backs, but only succeeded in doing this for a few moments. Several times the birds either stood side by side and 20–40 cm from each other or ran a little with their heads low and their backfeathers erected. Sometimes, they stood very close facing each other in an erect position keeping the tips of their bills very close. The fight continued for a while, until interrupted by the observer when the intruding male flew off in the direction from which he arrived. Many details of the fight were very similar to those described by Holmes (1973, p. 113–115) for Western Sandpipers (*Calidris mauri*).

Shortly after the males had started to fight, the female flew to the edge of the snow-free spot, where she walked a short distance and settled on a nest-cup. Here she sat for 5–10 minutes, high on the nest, neck stretched, watching the observer. Then she rose, and standing by the nest, picked leaves from the ground about ten times, dropping them in the nest. She did not walk carrying the material, but just turned her neck when she put it into the nest. Then she flew back to the male who had finished the fight, 30–50 m away. The nest contained only one egg and many dry *Salix* leaves. It was situated only 30 cm from the edge of the melting snow and was surrounded by small snow patches.

Parmelee (1970) says that Sanderlings do not add nest material to the nest-cups and that the dry *Salix* leaves often reported as nest material are blown there. It seems quite likely that on the occasion described the egg was laid while the observer watched and that the nest material was added after the laying, perhaps partly to cover the egg. At Danmarks Havn, nest material was apparently added to one nest to keep the eggs above water in the nest bottom (Meltofte 1979).

Fierce fights like that described, were seen several times, and less wild confrontations were common throughout the breeding season. Flight pursuits involving two males or two males and one female were regularly seen until 10 July whereafter also song flight ceased. On several occasions the male of a feeding or displaying pair was seen to fly up and pursue passing single birds (males?). Apparently, there was a surplus of males holding territory during June and early July. The most stationary of these have been included in the population estimate.

During June pairs comprised about half of registrations of Sanderlings in the census area (one pair counting one registration – see Meltofte 1979), but by early July only few pairs occurred. However, some of the birds in the post-breeding flocks were apparently mated.

The breeding biology of this species is still not fully understood. In the Canadian high arctic, Parmelee (1970) and Parmelee & Payne (1973) found a multiple clutch system, but neither Pienkowski & Green (1976) at Mesters Vig in Northeast Greenland, nor Meltofte (1979) at Danmarks Havn in 1975 found evidence of this. The observations at Nanok did not clearly answer this question. On 13 visits to three nests during the incubation period different individuals appeared to be present at all of them on different visits, however it was not always easy to sex the birds with certainty when they were seen alone. Two other nests were found with females present on single occasions. After egg laying, no pairs were seen together at any nests. Four broods were attended by females, and two by males. Most, if not all broods seen, were only attended by one adult. Other adults giving alarm calls or just staying nearby, were probably attacked by the attendants.

When people approached, the incubating bird most often ran off the nest and then flew away, low over the ground with rapid wing beats, when the observer was about 50 m away. On three occasions, at two different nests, the bird sat tight on the nest until the observer was 1–4 m away; on the latter occasions the eggs were near to or hatching. The birds gave alarm calls or distraction behaviour on all but one occasion, when the bird left quietly. On one occasion, a special distraction behaviour – 'the fly away trick' – was performed by a female Sanderling at nest (Meltofte 1977b). Another incubating Sanderling was seen to leave the nest about 50 m in front of an approaching fox, and fly away low over the ground, with rapid wing beats, apparently directly from the nest and alight 100–200 m away. Here, the bird stood silently while the fox passed, and less than five minutes later flew back to incubate.

The nests were situated in *Dryas, Salix* and *Carex* vegetation, often close to melting snow and on damp ground. The breeding sites were on extensive well-vegetated tundra or in less vegetated and more exposed habitats. From Fig. 21, it can be seen that the Sanderlings were more widely and evenly dispersed in the census area than the other wader species, and they were the first to occupy snow-free spots in the late thawing central and easternmost areas during late June.

Post-breeding groups and flocks of Sanderlings occurred in the census area from 4 July, when three groups of 4–6 individuals rambled. One of the groups included two Knots. Groups of increasing size were seen almost daily throughout July, and the numbers peaked during the second half of the month, with an estimated total of 100–150 individuals present on 18 July. Flocks, most often of 5–30 birds, often mixed with similar numbers of Turnstones and Dunlins. As mentioned earlier, some birds in the flocks were mated. During early August only small groups of adults remained.

The first unattended juveniles were observed on 1 August, but it was another week before more were seen. Broods often stayed together, but sometimes a few broods merged. A few of the broods were attended by adults. 11 out of 17 juvenile broods observed during the first half of August contained four young, but these figures are not fully reliable, since small broods might have mixed.

Outside the census area, Sanderlings were encountered in all places visited. Flocks of 25–30 individuals gathered at Peters Bugt during adverse weather on 1 June. Only a few individuals were encountered in Kildedalen and Femdalen during mid-June. An average of one Sanderling per three kilometres was counted on central Hochstetter Forland during the first half of July, and even fewer occurred along the outer coast. Two nests with four eggs each were found on 3 and 4 July, respectively. All observations were of 1–4 individuals. On 3 August, at Agnetes Sø, one brood was almost fledged.

On Shannon similar numbers of breeders were seen during the first three weeks of July (i.e. about 50 in 200

km). Two nests with four eggs each were found on 6 and 11 July, respectively. Two 2–4 day old broods were encountered on 18 July, besides one about one week old brood on 20 July. Many post-breeding flocks occurred here. On 11 July, three large flocks totalling about 300 individuals, besides several smaller flocks, were observed on the central part of the island. The large flocks showed migratory restlessness. Several times during the day they were seen rising into the sky, circling upwards calling constantly, and then flying around at some hundred metres altitude, persistently calling. Whereafter the flocks broke up and the birds alighted and went on feeding or resting.

The first five south migrating Sanderlings were seen between Hochstetter and Shannon already on 3 July. Many small flocks migrated south over Shannon later in July, and past Mønstedhus 7–15 August. Flocks numbered 2–15 individuals.

Pedersen (1934) stated that at least ten pairs of Sanderlings bred per km² on Hochstetter Forland in 1932.

Grey Phalarope (*Phalaropus fulicarius*)

By 27 May, the first Grey Phalaropes were seen at Sabine Ø, where two individuals foraged in the open sea along the coast. No phalaropes arrived at Nanok until 10 June, the date on which the first Long-tailed Ducks and King Eiders also appeared. This day, two females were seen and on 13 June, a flock of six individuals migrated northwest by Nanok at 9.30 p.m. and 3–5 birds stayed in the census area. Only a few of them were males. On the 15th two pairs arrived from southeast shortly after each other, around 4 p.m. and alighted on the open ponds, where five pairs and four individuals were already present. From then on Grey Phalaropes, mainly in pairs, stayed on the few open ponds in the census area until late June when more open ponds appeared and the birds dispersed. On the westernmost pond in the census area, where no phalaropes bred, pairs remained until 22 June.

Thus, like the waterfowl, the first phalaropes arrived at open waters along the outer coast. From there they entered the breeding grounds as soon as the first ponds started to thaw. The first groups to arrive were predominantly females, but later the birds arrived in pairs (see discussion p. 46).

9–11 pairs were recorded within the census area (Fig. 22), giving a density of 0.5–0.6 pairs/km². Four pairs were found breeding and another three pairs behaved as if breeding was attempted. The status of the other pairs is unknown. The pairs were distributed between the boggy ponds in the central and eastern parts of the area, in habitats very similar to those described from northern Siberia where densities of up to 100–200 pairs/km² (1–2 pairs/ha) were found in optimal areas (Kistchinski 1975).

Copulation was observed on 29 June, and four females fought fiercely on 3 July. One nest, with three eggs, situated in the wet grass at a pond margin, was found on 13 July. Both mates were present, the male incubating, and the female staying nearby. The nest was found predated the next day. Four two-day-old pulli

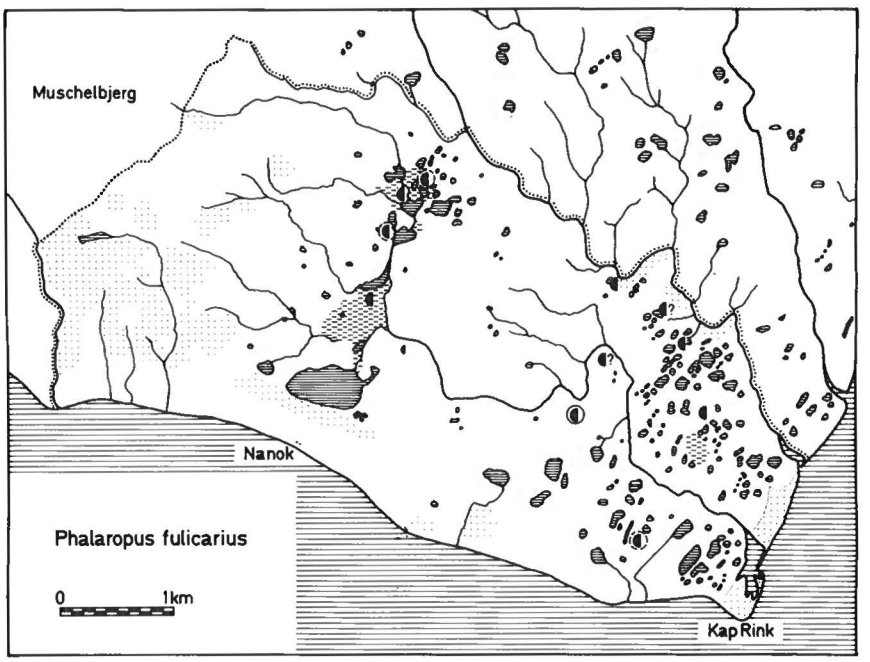

Fig. 22. Pairs of Grey Phalarope in the census area. Further explanation in Fig. 11.

were found on 24 July, four about 9–10 day old ones on 27 July and four about five-day-old ones on 29 July. Given an incubation period of 23–24 days (Pedersen 1942), these clutches were completed during 25 June to 2 July. Unfortunately the status of the nest found is not known with certainty, but as the female was still present it may have been incomplete. The fledging success is unknown, but at least three males were still giving alarm calls during the first days of August. The two-day-old brood was found again two days later 6–700 m from the place of ringing.

During late June and early July, 40–50% of the registrations of phalaropes concerned pairs (one pair counting one registration). Singles were mainly females. Except for the pair at the nest on 13 July, the last pairs broke up around 11 July, and a group of five females on the 14th were the last females observed. From then on the males appeared singly or in parties of up to four alarm calling together with young. One male joined a post-breeding flock of eight Dunlins on 24 July, and some other males apparently did not attend young during this period. One male in heavy body moult was seen on 19 and 23 July, and three in early body moult on 27 July. The last Grey Phalarope was heard on 10 August.

Outside the census area, Grey Phalaropes were encountered in all areas with suitable habitats. A few pairs and single individuals were seen in the areas north of the census area and around Agnetesøelven during June and July. On Shannon 31 individuals were encountered in the northern and central parts of the island during 4 to 12 July.

Pedersen (1934, 1942) stated that the species was a common breeder on Hochstetter Forland and Shannon, while Bird & Bird (1941) found it bred "sparingly"; a statement probably based only upon observations made around Peters Bugt. Løppenthin (1932) mentioned an observation of 20 individuals on one pond on Hochstetter Forland 11 June 1930, the assumed day of arrival that year.

At Daneborg, three juveniles were seen on the beach on 17 August 1976.

Great Skua (*Stercorarius skua*)

One bird was observed in the census area on 3 August, being fiercely attacked by two pairs of Long-tailed Skuas (*Stercorarius longicaudus*). This seems to be the northernmost observation to date in East Greenland. Earlier it has been observed immediately north of Kejser Franz Josephs Fjord (73°30'N); twice at Myggbukta (Bird & Bird 1941) and once near Kap Broer Ruys (Hjort 1976). Salomonsen (1967) also mentions a record from the mouth of Kong Oscars Fjord. It is a regular summer visitor to Scoresby Sund (Pedersen 1930, Salomonsen 1967, de Korte 1973, 1974, Meltofte 1976b).

Arctic Skua (*Stercorarius parasiticus*)

According to Salomonsen (1967) the Arctic Skua is a scattered breeding bird from Scoresby Sund north to Hochstetter Forland. The species has previously been mentioned twice from Hochstetter. The northernmost breeding so far was found at Peters Bugt in 1932 or –33 (Pedersen 1934) and one pair was observed near Kap Rink on 7 August 1938 (Pedersen 1942).

In 1976, single adults or two birds together were observed regularly on southern Hochstetter Forland from 7 July to 13 August. In all 12 were seen there, all of the light-coloured phase. One lightphase bird was seen on Shannon on 22 July and one immature bird at Mønstedhus on 26 August.

There was no indication of breeding.

Long-tailed Skua (*Stercorarius longicaudus*)

The first Long-tailed Skua seen passed Nanok westwards on 27 May. From 31 May, pairs and singles were seen daily. Display was noted from 3 June and territories were apparently established in the first few days of arrival. Copulation was seen on 8 June and most birds had apparently arrived by that time. However, one pair immigrated from southeast on 11 June. Aerial and ground displays occurred regularly, and foxes were mobbed from mid-June onwards. The first egg was found on 15 June on a snow-free spot north of the census area.

At least 14–15 pairs defended territories within the census area, giving a density of 0.8 pairs per km² (Fig. 23). This is a similar or even higher density than found in Scandinavia (Andersson 1976), on Ellesmere Island (Maher 1970), and at Scoresby Sund (de Korte 1977). Nests of 11 pairs were found, and at least one more pair apparently attempted to breed. Due to heavy predation by foxes only one early laid clutch (of at least six clutches initiated 14–20 June) hatched, and at least nine pairs either initiated egg laying later or more likely laid replacement clutches (from about 27 June). One pair relaid twice, but all three clutches were predated. Including the late clutches, only three out of 13 nests hatched. Fox predation was actually observed twice (see discussion p. 48). According to Andersson (1971) egg laying is well synchronized in years with much food, and this favours the interpretation of the late clutches as replacement ones.

Clutch size was recorded in 13 nests. Two early clutches were of two eggs. Of the late clutches three were of two eggs and six of only one egg. But of the one-egg clutches five may have been incomplete. Among these was the second relay on 15 July. Two clutches of unknown status held two eggs. The early

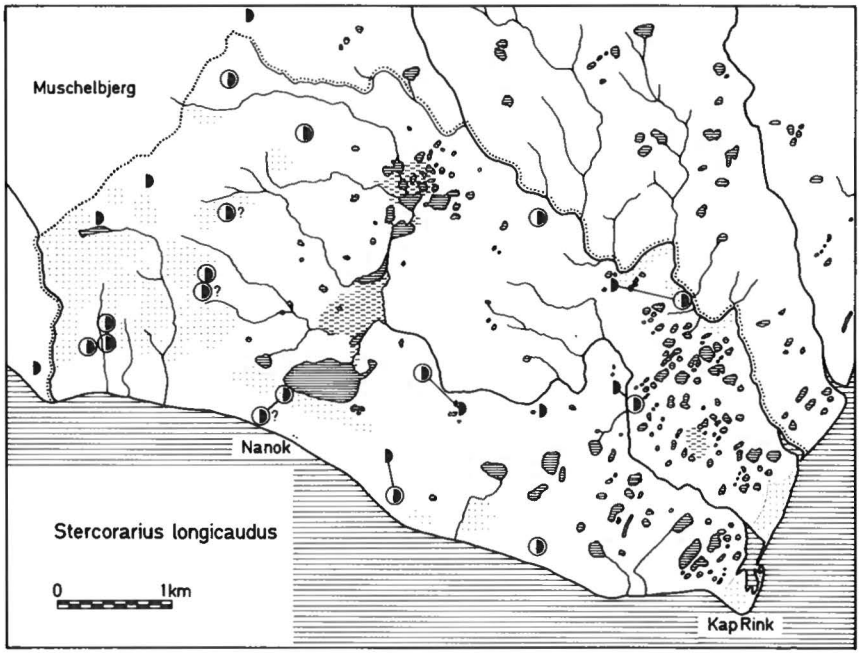

Fig. 23. Pairs of Long-tailed Skua in the census area. A few pairs just outside the area are also plotted. Further explanation in Fig. 11. Nest sites connected with a line are first clutches and probable replacements by the same pair.

clutch hatched on 10–11 July, and the two late clutches on 29–30 July and 2–3 August, respectively. The lack of more exact information on laying dates and true clutch size etc., is due to the fact that nests were predated just after laying, or just after we had found them. The one and only juvenile seen in the census area appeared on 5 August, in a flock with eight adults.

Territories were well spaced and nests situated about one kilometre or more apart (Fig. 23). Most of the 13 nests found with eggs were placed on well-vegetated slopes or plains. Only three were in tufts of vegetation on predominantly barren clay plains. Most nests lay among *Dryas,* some in frost cracks or between hummocks. A few lay on moist sites, only a few metres from retreating snow patches. Re-nesting took place within 300 m from the former nest on four occasions where both nests were supposedly located (Fig. 23).

Distraction behaviour (injury feigning) was observed on two occasions. Most often at least two birds mobbed the observer when close to a nest or young, but on three occasions out of 27 visits, the birds flew quietly around or left the site.

Long-tailed Skuas were seen taking lemmings on several occasions. A dead lemming was found at a skua roost on 15 June, and on that day several lemmings were seen sitting close to a standing skua without the skua taking any notice of them. This illustrates the abundance of food during June. Skuas, apparently hunting for wader chicks during July, skimmed the terrain half-a-metre above the ground. On one occasion, four skuas walked around close to a Dunlin's nest from which the young had just left. On only one occasion a skua was seen searching for food over the fjord ice. Long-tailed Skuas find food on the fjord ice when lemmings are scarce (de Korte 1974, Meltofte 1975).

Foxes crossing skua territories were readily mobbed, but with little obvious effect. Furthermore, Long-tailed Skuas were seen mobbing Gyr Falcons, Great Skua, Arctic Skuas, Snowy Owl, and Ravens.

During the middle of July, after having lost their clutches, some skuas left their territories and started to wander around. But, most pairs stayed close to their territories and continued ground and aerial display together with neighbouring pairs and stragglers, at least until mid-August. They often gathered in flocks of up to about ten birds, and continued mobbing foxes and giving alarm calls. Numbers decreased rapidly by mid-August.

A significant immigration of immature Long-tailed Skuas was noted from late June onwards. The first, a one-year-old arrived on 26 June. A few were seen at intervals during late June and July. On 11 July, three immatures were present in the census area and at midnight, another four arrived from the south. During late July, only one was seen and the last was observed in the area on 3 August. In all, at least 25 observations of immature birds were made in the census area. Of these, at least four were one year old, the others two or three years old (cf. Witherby et al. 1944).

Outside the census area, Long-tailed Skuas were en-

countered regularly in all areas visited. In Kildedalen and Femdalen, where no lemmings or their tracks were seen, only 5–10 skuas were recorded during mid-June. There was an average of about one skua per kilometre on the 150 km hike through Hochstetter Forland during the first half of July. A similar density was found on the more than 200 km hike on Shannon during the first three weeks of July. No nests or young were found, but many birds showed breeding behaviour. However, from mid-July onwards, many skuas wandered about. On 15 July, a flock of twelve flew in from the east at Kap David Gray, and a few were seen over the ice during the following days. During July, at least two, more than one-year-old immatures, were noted. From 6 to 11 August, a total of 45 individuals migrated south along the coast at Mønstedhus, in flocks of up to 12 birds. Among these, one juvenile and one more than one-year-old were seen on 7 August. One migrated south at Nanok on 5 August. Finally, one pair attended one fledged juvenile on Store Koldewey on 16 August.

Ivory Gull (*Pagophila eburnea*)

One adult was seen in the census area on 26 June. This was the only observation made in 1976, but during the aerial reconnaissance of the expedition area made on 24 July 1974, when we flew low through the Trækpasset valley on Store Koldewey, two adult Ivory Gulls were standing together on a ledge on the sheer rock wall southeast of the lake. The distance was about 100 m and binoculars were used, but no nest could be seen. However, the presence of these two birds together on a cliff some km from the coast must indicate breeding. To date the species has only been found breeding near Danmarks Havn just north of Store Koldewey (Manniche 1910), and at Station Nord much further north (Salomonsen 1961) but it is a regular summer visitor all along the northeast coast and probably breeds at other sites too. See Wright & Matthews (1980).

Greater Black-backed Gull (*Larus marinus*)

One immature bird was encountered in the census area on 23 June and another immature bird (not the same specimen) was seen on 3 July over the ice between Hochstetter and Shannon.

The species is nowadays a regular summer visitor to Scoresby Sund (Meltofte 1976b) and several observations have also been made further north along the coast, up to Danmarks Havn (Bird & Bird 1941, Meltofte 1975, Hjort unpublished and appendix of this publication).

Herring Gull (*Larus argentatus*)

On 3 July, one adult bird was seen over the ice between Hochstetter Forland and Kap Copeland on Shannon. This is the northernmost observation so far made on the east coast. Earlier the species has only been recorded from Scoresby Sund where, according to Meltofte (1976b), it is an erratic summer visitor. Salomonsen (1967) mentions about ten observations all from the west coast and all those examined belonging to the American subspecies *smithsonianus*. The subspecies breeding in e.g. Norway and Iceland is the nominate *argentatus* and the most likely race to occur on the east coast.

Glaucous Gull (*Larus hyperboreus*)

Glaucous Gulls arrive in central East Greenland by mid-April (Pedersen 1930, Meltofte 1976b) and in more northerly parts of the coast a few weeks later (e.g. Meltofte 1975, 1977a).

In 1976, the species was first encountered by a Sirius team at Port Arthur in Dove Bugt on 8 May. At Danmarks Havn, the first birds were seen on 9 May and at Kap Harald Moltke in Peary Land on 19 May.

Thus, the Glaucous Gull was already present in the study area when we arrived in late May. During the stay on Sabine Ø 27–29 May up to 20 adult birds were seen foraging along the iceedge. The birds eagerly mobbed the eiders (*Somateria mollissima & spectabilis*) from which they tried to snatch freshly caught bivalves etc. Unfortunately, the ice conditions did not permit a visit to Hvalrosø, where a large colony of Glaucous Gulls (50–60 pairs) has been known since at least 1870 (Finsch 1874). A colony of about the same size was still present in the early 1930's (Løppenthin 1932, Pedersen 1934). In 1964, 25 adults were seen at Hvalrosø on 3 May (Rosenberg et al. 1970).

In late May and during the first days of June 1976, adult birds were encountered in most places visited. Single birds or small parties were seen at Falskebugt on northern Wollaston Forland, on Kuhn Ø, in Peters Bugt and in the census area on Hochstetter Forland. There were 21 birds at a small garbage dump outside Nanok on 26 May, but they dispersed upon our arrival. During June, gulls were often seen standing on snow watching for lemmings. An average of about five adults were regularly seen occupied with this activity within the census area. A maximum of 20 were counted on 31 May and at midsummer up to 17 birds could be seen. This last increase in the number of gulls coincided with intense snow melting, when many lemmings had to abandon their flooded tunnels. In July and August, 1–4 Glaucous Gulls were regularly foraging along the coast or over the fjord south of Hochstetter Forland.

No Glaucous Gulls nested within the census area, and

the nearest breeding place found was on the steep cliffs of southern Muschelbjerg, where at least two pairs bred. One pair was brooding on 23 June and one attending a downy unfledged young on 2 August. On the latter day, another adult bird behaved as if young were present. One adult with two fledged juveniles were seen at Nanok on 16 August, and on 21 August two adults with four juveniles were observed.

Single birds or small parties of adult Glaucous Gulls were seen throughout the summer at all places visited by the expedition. But the only proved breeding, except for that on Muschelbjerg, was at Kap David Gray on Shannon where 2–3 pairs were found on nests on 13 July.

The first immature birds observed were two single individuals in first-summer-plumage on 31 May and 8 June, respectively. From late June until we left, small numbers of immatures appeared regularly. Both one, two and three-year-old birds were present. During the second week of August up to 15 immature birds stayed together with adults at Mønstedhus.

The Glaucous Gull has previously been found breeding at suitable places on Shannon, in Grandjeans Fjord (e.g. on Ullas Ø) and in Ardencaple Fjord (Pansch in Finsch 1874, Løppenthin 1932, Pedersen 1934), but Hochstetter Forland has been considered a poor breeding area for this species.

Common Gull (*Larus canus*)

One adult in bad physical condition visited the rubbish dump at Nanok from 7 to 10 June. This seems to be the first one recorded on the east coast. Salomonsen (1967) mentions four observations, all made along the southern half of the west coast.

Kittiwake (*Rissa tridactyla*)

The only record was of one adult near Hvalrosø on 27 May. Like the Fulmar (*Fulmarus glacialis*), the breeding areas nearest to the study area are at Mallemukfjeldet, approximately 80°N, about 500 km to the north (Manniche 1910, Pedersen 1942), in the Scoresbysund district (Pedersen 1930, de Korte 1973, Meltofte 1976b) and on Jan Mayen. However, it occurs in the drift ice and has been recorded now and then along the coast between Scoresby Sund and Mallemukfjeldet (Løppenthin 1932, Pedersen 1934).

Arctic Tern (*Sterna paradisaea*)

The Arctic Tern has been known as a scarce solitary breeder on Hochstetter Forland (Pedersen 1934), and a few colonies have been reported. In 1930 (Løppenthin 1932) and 1932 (Pedersen 1934) single nests were found. In the summer of 1938 about 20 pairs stayed in Peters Bugt without breeding (Bird & Bird 1941). In 1870 and 1899, the species was found breeding on Hvalrosø (Pansch in Finsch 1874, Nathorst 1900).

In 1976 the first terns were seen at Nanok on 11 June, when two single birds migrated towards northwest. On the same day one bird also alighted in the census area. From 15 June onwards four birds, apparently two pairs, regularly foraged in the census area, both on snow-free parts of the land and along the tidal cracks in the fjord ice.

In the beginning of July the lagoon in the southeastern part of the census area became partially free from ice and snow and offered a suitable breeding habitat for the terns. On a beach ridge bordering the lagoon one bird was incubating a clutch of two eggs on 8 July, and a few days later the second pair behaved as if breeding had been initiated, but no proof was obtained. On 25 July, one bird was still brooding, but on 31 July, no terns, neither adults nor young, were seen and the clutch had evidently been predated. Two or three terns and on one occasion nine birds, were present along the coast of the census area until late August.

Arctic Terns were met with on many places on Hochstetter Forland and on Shannon, although only in small numbers. Along the coast of Hochstetter Forland south of Ailsahytten, single birds were seen and on one occasion a party of three. In Peters Bugt four terns were seen at the turn between July and August. The only inland occurrence was southeast of Agnetes Sø, where the abundance of small lakes in dead-ice-hollows attracted the terns. In this area a total of 5–6 pairs were seen, and breeding of at least some pairs seemed very likely. However, the only proof of breeding outside the census area came from Mønstedhus, where a small colony of five pairs was found. On 7 August, one of these pairs attended two a-few-days-old pulli of which one was fledged on 25 August. The other was taken by a Raven. Nests or young of the remaining four pairs were never found. On Shannon Arctic Terns were seen along the southwest and west coast, in all about ten birds, but there was no indication of breeding.

Black Guillemot (*Cepphus grylle*)

The only observations made during the expedition were at Hvalrosø on 27–29 May, where at least 50 birds were seen flying close to the steep cliffs on the northern part of the island. Since the observations were made from Sabine Ø, more than two kilometres away, no exact information on the present status of the breeding colony could be obtained.

That colony was discovered in 1870 (Finsch 1874), when as most 50–60 birds were seen. In 1932, at least

40 pairs nested here (Pedersen 1934) and on 3 May 1964 a flock of 20 birds were observed (Rosenberg et al. 1970).

Snowy Owl (*Nyctea scandiaca*)

One or two immature owls appeared regularly within and around the census area throughout the summer. A total of ten observations were made here. Single birds were also seen at Kap Maurer on Kuhn Ø on 5 June, near the mouth of Agnetesøelven on 14 June, northeast of Kap Copeland on Shannon on 9 July and in Albrechts Bugt on northernmost Wollaston Forland on 16 August. There were no indications of breeding.

The low number of owls observed, the maximum total seen in three months time being only about six birds, is unexpected in view of the abundance of lemmings.

Earlier Snowy Owls have been seen regularly on Hochstetter Forland and Shannon, and breeding has been proven several times (Løppenthin 1932, Pedersen 1934, Jennov 1945). Single observations have also been made during the winter (Pedersen 1934, Jennov 1945).

Raven (*Corvus corax*)

The Raven is a regular visitor to, or a scarce breeder in Northeast Greenland north to Germania Land. However, no real proof of breeding seems to have been obtained north of Kong Oscars Fjord, although Manniche (1910) had strong indications that the species then bred in Germania Land.

The Raven has previously been mentioned also from Hochstetter Forland and Shannon (Pansch in Finsch 1874, Løppenthin 1932, Jennov 1945, Meltofte 1975) but there have been no indications of breeding.

In 1976 one or two birds were regularly seen in the census area during late May and early June. On one occasion three birds were seen together. Except for a few observations in the second half of June, no birds were seen again until 18 July. On 21 July one juvenile was observed, and on 23 July, a group of three newly fledged juveniles foraged outside Nanok, indicating that breeding had taken place – possibly on Muschelbjerg, where one Raven was sitting on the southwestern bluff of the mountain on 23 June. From late July 1–3 Ravens were seen at intervals at Nanok until we left.

Apart from the observations on southernmost Hochstetter Forland, single Ravens, or occasionally two or three birds together, were seen at Peters Bugt, along the east coast of Hochstetter Forland and on northern Shannon. In all 20 observations were made outside the census area (June: 5, July: 4, August: 11).

In 1974, one Raven was encountered near the mouth of Agnetesøelven on 4 November (Ulrik Capito pers. comm.).

Wheatear (*Oenanthe oenanthe leucorrhoa*)

On the east coast the Wheatear has been known as a regular breeder north to Gael Hamkes Bugt (74°N) and the Young Sund area (e.g. Pedersen 1934, Rosenberg et al. 1970, Meltofte 1972). Marris & Webbe (1969) encountered one adult and two juveniles at Lindemans Fjord on northwestern Wollaston Forland, Pansch collected one adult and two juveniles on Hvalrosø and Shannon already in 1870 (Finsch 1874), and Pedersen (1934) found it breeding both on southernmost Hochstetter Forland and west thereof. Bird & Bird (1941) never saw living specimens on Hochstetter, but found mummified birds at some of the trappers' huts. Occasional Wheatears were seen in Germania Land by Manniche (1910) and Pedersen (1942), and Meltofte (1975, 1977a) recorded several birds there during spring migration time in 1969, 1970 and 1975, and also had indications of breeding – at least during 1969. North of Germania Land there are records of stray birds from Jökelbugten (Meltofte 1975), Independence Fjord (Salomonsen 1967) and even from the north coast of Peary Land (Grant 1972).

We saw the first Wheatears in Mesters Vig on 20 May, and at Daneborg two were seen on 21 May. Within the study area three observations were made during the time of spring migration: single birds occurred at Germania Havn on Sabine Ø on 28 and 29 May and at Nanok on 1 June. One mummified bird from the previous year was found in Kildedalen.

Breeding was proved on northernmost Hochstetter Forland, close to Mønstedhus, where one alarm calling pair were seen with food in their bills on 8 August. On the same day, two newly fledged juveniles were encountered several km from that place, and on 12 August, three juveniles were seen several km further south. Together, these birds represented at least two, very probably three breeding pairs. They all dwelt in rocky areas sheltered from the prevailing cold easterly winds and with a comparatively rich vegetation.

West of Nanok, three juveniles were seen together on 14 August, and one with down still remaining on its neck hunted insects around that station on the same day. A juvenile was seen here again on the 17th.

Later in August there were Wheatears at Mønstedhus, near Agnetesøelven, and at Ailsa and Ailsahytten. Most of them were juveniles, and the total number of observations outside the census area during the second half of August was six birds.

Meltofte (1975) suggested that the species had expanded northwards during the recent decades, but the Wheatear has been met with by all earlier workers in the area north to Germania Land, and was probably already breeding at 75°N in 1870 (Finsch 1874), and definitely so during the 1930's (Pedersen 1934). The

northern limit of regular occurrence and breeding apparently lies around Dove Bugt, rather than around Gael Hamkes Bugt as suggested by Salomonsen (1967).

White Wagtail (*Motacilla alba*)

One male was observed in Germania Havn on Sabine Ø on 27 May. The species has been seen several times at Scoresby Sund during the breeding season (Pedersen 1926, 1930), and at least five individuals were reported from Zackenberg northwest of Daneborg between 28 May and 2 June 1955 (Conradsen 1957). However, it seems possible that the latter observer was confused by Wheatears (*Oenanthe oenanthe*). The White Wagtail is a sparse but regular breeder in the Angmagssalik district (Salomonsen 1967).

Arctic Redpoll (*Carduelis flammea hornemanni*)

Single Redpolls were heard within the census area on 3 and 7 June. Between 17 and 19 June, a total of three birds were seen in the Ardencaple Fjord area; in Femdalen, Kildedalen and the valley between these two. Later in the summer, on 23 August one bird was observed about 10 km west of Mønstedhus. Out of the six birds recorded, three were seen under conditions permitting subspecies identification – all these belonged to *ssp. hornemanni.*

The two records from the census area fall within the end of the spring migration period, which lasts from April to the beginning of June (Salomonsen 1967, Rosenberg et al. 1970, Meltofte 1975, 1977a). Pedersen 1934) saw redpolls on Hochstetter Forland from early April to the end of May, but after that time they were only met with in the mountain areas to the west – where he regarded them as being common breeders.

The Arctic Redpoll has been found north to Peary Land (Johnsen 1953) and been proved to breed at Danmarks Havn (Meltofte 1975). A study of the literature does however indicate that its main breeding area on the east coast extends from Scoresby Sund to Young Sund and with a distinct preference for the more continental westerly parts of this region. In the south, at least as far north as Kong Oscars Fjord, it occurs alongside the more southerly distributed subspecies *rostrata* (Waterston 1970).

Lapland Bunting (*Calcarius lapponicus*)

A male was seen in Germania Havn on Sabine Ø 27–29 May, and one bird was encountered in the census area on 1 July.

The species breeds regularly as far north as the Angmagssalik district (Salomonsen 1967, Ray 1973) and irregularly in the Scoresby Sund district (Pedersen 1930, Hall 1966). It has been recorded several times further north: at Myggbukta (Bird & Bird 1941) and Daneborg (Pedersen 1934, Rosenberg et al. 1970), on Sabine Ø and Shannon (Finsch 1874), on Hochstetter Forland (Pedersen 1934) and north to Germania Land (Manniche 1910, Pedersen 1942, Meltofte 1975, 1977a).

Snow Bunting (*Plectrophenax nivalis*)

Spring arrival of the Snow Bunting in Northeast Greenland takes place in April and early May, the males 2–3 weeks in advance of the females (Manniche 1910, Rosenberg et al. 1970, Meltofte 1975, 1977a). Thus they were already present when we arrived at Mesters Vig 19 May and at the study area on 26 May. During our transit visit to Mesters Vig there were pre-breeding flocks in the immediate vicinity of the station. Up to 50, mostly males, were seen foraging among the houses or roosting on the roofs.

According to Pedersen (1934) the Snow Bunting was a less numerous breeding bird on Hochstetter Forland than at other places he visited and he suggested that this is due to lack of suitable nesting places. This was confirmed in 1976.

In 1976 remnants of pre-breeding flocks were seen in the last days of May. During June three males held territories within the census area and were seen displaying until the first week of July (Fig. 16). Females were seen only on a few occasions and it seems probable that at least one of the males was unpaired. Single males were seen now and then elsewhere in the area. We found no indications of breeding, and during the first week of July the last Snow Buntings left the census area. A single female was seen on 6 July: it was the last observed. Another 3–4 males sang regularly on the eastern slopes of Muschelbjerg, along the border of the census area. No females were noted there and no breeding was indicated.

Snow Buntings were encountered at all other places visited, although in varying numbers depending on the suitability of the habitat. Thus, the species was seen around the hut at Germania Havn on Sabine Ø 27–29 May and at Falskebugt and Albrechts Bugt on northern Wollaston Forland on 30 and 31 May, respectively. At Albrechts Bugt the ridge previously censused by Rosenberg et al. (1970) in 1964, was investigated and on 31 May 3–4 pairs were counted compared to the 3–5 birds, mostly males, encountered on 24–29 June, 1964 (Rosenberg et al. 1970). However, the habitat in this area did not appear to be suitable for breeding, but is probably an early snow-free foraging area. On the partially snow-free fringe of eastern Kuhn Ø, around Kap Maurer about 20 individuals were seen 3–4 June, and

singing males were heard on northern Kuhn Ø. In the Ardencaple Fjord region, Snow Buntings were numerous, especially in the Kildedalen – Femdalen area. One nest with five eggs was found in Femdalen on 17 June.

The distribution of Snow Buntings on Hochstetter Forland was sparse except on the slopes of Muschelbjerg where it was commoner. During an approximately 75 km long hike through the central parts of Hochstetter Forland in the beginning of July, an average of one bird per four kilometres was encountered. This figure is not the result of a proper line-transect, but it gives an idea of the population density in this area.

On Shannon the species was seen in July around Meyersteins Bjerg and the basalt terrain around Kap Copeland and Kap David Gray. No birds were encountered on the central lowlands or along the west coast of the island.

Breeding was proved both on Hochstetter Forland and on Shannon. On Muschelbjerg a nest with four eggs was found on 27 June, and on 13 and 15 July, two pairs with fledged young were seen at Kap David Gray. Juveniles were seen at Peters Bugt in late July and at Kulhus on 2 August. From mid-August flocks of up to 25 Snow Buntings, including juveniles, were seen both on southern Hochstetter and along the coast north of Haystack.

Supplementary list of birds

Below are listed species which have earlier been encountered within the study area, but were not seen in 1976.

Red-breasted Goose (*Branta ruficollis*)

Two birds were seen on Sabine Ø in late May or June 1922 (Knudsen 1933).

Scaup (*Aythya marila*)

According to Løppenthin (1932) five birds were seen at Hochstetter Forland on 22 September 1929. Salomonsen (1967) questions the accuracy of this observation.

Steller's Eider (*Polysticta stelleri*)

One pair was seen, and the male shot, at Sabine Ø on 14 June 1922 (Knudsen 1933).

Red-breasted Merganser (*Mergus serrator*)

One male was shot near Sabine Ø on 17 June 1922 (Schiøler 1926), and another male seen at Mønstedhus on 13–14 August 1938 (Pedersen 1942).

Red-necked Phalarope (*Phalaropus lobatus*)

One bird was shot on Shannon in 1921 (Salomonsen 1950).

Iceland Gull (*Larus glaucoides*)

Reported several times from the area, beginning with Finsch (1874) and ending with Pedersen (1934). The latter stated that about ten pairs bred on Ullas Ø in Grandjeans Fjord in 1933 and that several young birds stayed on southern Hochstetter Forland in September 1932. Of these, two were shot. Salomonsen (1950) doubts if the species bred on Ullas Ø.

Sabine's Gull (*Xema sabini*)

Single birds have been seen at Bass Rock in 1930 (Løppenthin 1932) and in Peters Bugt in 1933 and 1938 (Pedersen 1934, Bird & Bird 1941).

Little Auk (*Plotus alle*)

Flocks have been encountered during the breeding season off Lille Pendulum Ø (Nathorst 1900) and off Shannon (Pedersen 1942, Jennov 1945). Pedersen (1942) saw mostly non-breeding immatures and suggested that breeding occurred on Meyersteins Bjerg and Tellplatte on Shannon. Jennov (1945) thought the peninsula south of Kap Pansch on the same island was a likely breeding locality. In the first half of July 1976 we visited almost all those parts of Meyersteins Bjerg and Tellplatte which may be suitable as breeding places for Little Auks, but did not see any birds. There was nothing to suggest recent breeding, like areas with comparatively rich vegetation suggesting the former deposition of guano. Although we did not visit the Kap Pansch area, we think it quite likely that the Little Auks seen early in summer in the ice off these coasts are non-breeders summering there. In late August adults, often accompanied by juveniles, are seen (Hjort unpublished). These are the result of post-breeding dispersal and early southward migration of birds from Svalbard which winter off Southwest Greenland (cf. Salomonsen 1967).

Short-eared Owl (*Asio flammeus*)

One bird was shot at Kap Rink in June 1931 (Løppenthin 1932, Pedersen 1934).

Blackbird (*Turdus merula*)

Six birds were observed and two shot, on Bass Rock on 22 November 1922 (Knudsen 1933).

Discussion and summary

Faunistic

When our observations are compared with earlier reports, especially from the 1930's, a few striking differences can be seen. *Gavia immer, Anser brachyrhynchus,* and *Branta leucopsis* have apparently increased, while *Branta bernicla* has disappeared completely. The changes in geese have already been reported several times from nearby areas, but a population of *Gavia immer* was not known to exist so far north.

Pedersen (1934) presented figures for population densities of waders on Hochstetter Forland which are much higher than we found in the census area. Pedersen gave no details of his methods and his figures seem to be only rough estimates and perhaps unreliable. The breeding populations in our census area are neither representative of our general study area nor for Hochstetter Forland itself. Breeding birds are not evenly distributed, but vary considerably according to snow cover and habitat. The census area and its surroundings had the highest densities recorded for most species, especially *Clangula hyemalis, Somateria spectabilis,* and *Phalaropus fulicarius* all of which favoured the many ponds and tarns on southernmost Hochstetter Forland. On the other hand, *Charadrius hiaticula* was scarce in the census area, but more numerous in drier areas around Peters Bugt, in Kildedalen and in Femdalen. *Calidris canutus* was more numerous on the more elevated, rolling tundras of central Hochstetter Forland than in the census area.

Arrival and pre-laying period

Due to the extremely extensive and long-lasting snow cover on southern Hochstetter Forland, the main influx of waders took place very late in 1976. The pioneers arrived in late May, but it was after mid-June before most populations were complete, and late June before all individuals were apparently settled. Pre-breeding flocks of geese and waders fed on the snow-free and well-vegetated irrigated slopes below Muschelbjerg and west of Nanok, during late May and early June. Until mid-summer, the slopes east and west of Nanok were utilized as a common feeding area for the waders. *Arenaria interpres* also fed on rubbish at Nanok during this period. Otherwise, the waders concentrated on the snow-free spots, e.g. along the large rivers (cf. Fig. 9), until more land became uncovered in late June. The later influx of waders may have taken place from more favourable pre-breeding haunts (cf. Rosenberg et al. 1970, Meltofte 1975, 1976a, 1979). Some wader individuals/pairs, especially *Charadrius hiaticula* and *Calidris canutus* visited the census area during the pre-breeding period but did not breed there.

During the snowfall in the first days of June flocks of waders concentrated on snow-free spots, like observed near Peters Bugt. Both at Nanok and east of Kuhn Ø mixed flocks of waders, i.e. *Charadrius hiaticula, Arenaria interpres,* and *Calidris canutus,* were seen flying south in heavy snowfall on 2 June. When the weather cleared during the next morning, flocks migrated north again. Reversed spring migration has not been reported earlier from Northeast Greenland.

Waterfowl arrived on usual dates. Large concentrations of eiders (*Somateria mollissima* et *spectabilis*) had gathered in the open water off the ice edge at Sabine Ø and Wollaston Forland in the last days of May. A few *Gavia stellata, Clangula hyemalis,* and *Phalaropus fulicarius* were also seen there. *Phalaropus fulicarius* has not previously been noted arriving on the outer coast of East Greenland prior to occupation of the breeding grounds, as they are known to do elsewhere (Höhn 1965). Occupation of the breeding grounds took place during mid- and late June for these species. After the main influx in mid-June, the birds stayed in the few ice-free ponds, until they dispersed following the appearance of more open ponds during late June. The very early ice-free pond in the westernmost part of the census area (Fig. 9), where no waterfowl bred, was an important feeding and roosting site for several *Gavia stellata, Somateria spectabilis, Clangula hyemalis* and *Phalaropus fulicarius* until late June.

Breeding schedule

Onset of breeding in the census area took place later for most species than is the case in more favourable, i.e. earlier snow-free areas in Northeast Greenland. However, with only one year of observation, it is not possible to state whether this year differed from average. 1976 was a year of much snow and the land may have been uncovered later than usual, but normally southern Hochstetter Forland is almost completely covered during winter and spring. Conditions at Danmarks Havn in 1976 were apparently more favourable than normal and *Somateria spectabilis* bred earlier there than hitherto found (Meltofte 1977a). The few broods of *Somateria spectabilis* and *Clangula hyemalis* which hatched in the census area, did so in the later part of the breeding season, as it is known from other areas, but not extraor-

dinarily late. *Gavia stellata, Anser brachyrhynchus,* and *Branta leucopsis* bred at normal time, while the waders initiated breeding from a few days to more than one week later than found in more favourable areas (cf. Hjort 1976, Meltofte 1976a, 1979, Green et al. 1977, de Korte et al. in print). However the wader breeding season was very long, and many pairs laid as late as the latest stated earlier from high arctic Greenland. For some wader species the high number of late clutches were or were probably repeats following heavy predation by Arctic Foxes (see below under predation). The same applies to *Stercorarius longicaudus,* which otherwise initiated breeding normally.

The estimated ranges of clutch initiation of the waders in the census area were: *Charadrius hiaticula* late June – 8 July, *Arenaria interpres* 13 June – 2 July, *Calidris alpina* 20–30 June, *Calidris alba* 15 June – 5 July, and *Phalaropus fulicarius* 22–28 June.

Breeding success

Breeding success was generally low. Success of nests found in the census area was: *Gavia stellata* 0% (n = 3), *Anser brachyrhynchus* 42% (n = 24), *Charadrius hiaticula* 33% (n = 3), *Arenaria interpres* 68–73% (n = 22), *Calidris alpina* 60–71% (n = 7), *Calidris alba* 17% (n = 6), and *Stercorarius longicaudus* 23% (n = 13). Single clutches of *Clangula hyemalis, Somateria spectabilis, Phalaropus fulicarius,* and *Sterna paradisaea* failed. Except for *Anser brachyrhynchus,* only few pairs of waterfowl bred successfully. Thus, only one *Somateria spectabilis* brood was produced by 15–17 pairs, and only one brood by 9–11 pairs of *Clangula hyemalis.* Most of the wader nests found contained late clutches, which had a higher survival rate than earlier ones. Thus, hatching success of early clutches was lower than indicated by the above average figures, and many pairs apparently did not relay after an initial failure. The survival of young is unknown, but e.g. the many groups of four juvenile *Calidris alba,* may indicate low mortality.

Most nest failures were due to fox predation, but *Stercorarius longicaudus* may have predated some wader nests and young. *Larus hyperboreus* and *Corvus corax* were not frequent in the census area during the incubation period. Fox predation was apparently most important during the early part of the breeding season, when the snow cover was extensive and the potential nesting ground thus very limited (see the chapter Fox predation and Byrkjedal 1980).

Non-breeders and immatures

With few exceptions, this study did not supply much new information on proportions of non-breeders in arctic bird populations. Such studies are still highly needed. Especially among the geese and also in some other waterfowl species, substantial proportions of the populations found on the breeding grounds are known to be immature non-breeders. In the present study area, this applies to *Anser brachyrhynchus, Branta leucopsis* and probably also to *Gavia stellata.* But of the other waterfowl species (excluding *Somateria mollissima*), only few non-breeders have been reported from the breeding grounds in normal years (i.e. except for years with extensive non-breeding). In the present census area only 40–50% of the population of *Somateria spectabilis* and 67% of the population of *Clangula hyemalis* were estimated to have attempted breeding. The rest may have been younger non-breeders, or breeders that gave up because of unfavourable conditions; e.g. psychological stress introduced by the many foxes (cf. Meltofte 1978).

Practically all of the *Lagopus mutus* and *Plectrophenax nivalis* which displayed in the census area during June apparently left without attempting or succeeding to breed. Most of the *Falco rusticolus* and all *Nyctea scandiaca* observed in the entire study area, were apparently non-breeders. In spite of the lemming peak, no breeding of these two species was ascertained.

Parallel with the abundance of lemmings, a notable influx of immature *Stercorarius longicaudus* was witnessed from late June until mid-July.

Post-breeding flocks and departure of the waders

The first groups of post-breeding waders occurred in the census area in early July, but until the middle of the month, only small flocks were seen here. Numbers peaked 18–25 July, and the last flocks were seen during the first days of August. Maximum daily totals recorded in the census area were: *Charadrius hiaticula* small numbers, *Arenaria interpres* at least 100, *Calidris canutus* 50, *Calidris alpina* 40, *Calidris alba* 100–150, and *Phalaropus fulicarius* 5. The flocks fed in the boggy areas, especially by the numerous ponds in the late snow-free easternmost part of the census area, where only a few pairs of waders bred, but where large numbers of moulting *Anser brachyrhynchus* stayed.

On Shannon, large flocks of *Calidris canutus* and *Calidris alba* were encountered during July. Thus, on the 9th, a flock of 104 *Calidris canutus* fed in a bog on northern Shannon and flocks of up to 40 were regularly seen flying south. On 11 July, three large flocks of *Calidris alba* totalling about 300 individuals were observed on the dry tundras of central Shannon, where they showed a high degree of migratory restlessness.

Most adult waders had left by early August, and throughout that month flocks of juveniles migrated south along the east coast of Hochstetter Forland.

Fox predation

It has often been stated that mammalian predation of eggs of ground nesting birds are especially pronounced the year after a rodent peak. Pehrsson (1977) found that larger numbers of *Clangula hyemalis* young hatched during rodent peak years than during minimum years, and interprets this as an effect of predator shift. Our experience of Arctic Fox (*Alopex lagopus*) on Hochstetter Forland in 1976, does not support this general interpretation.

Lemmings were superabundant in the census area especially during early summer, but nevertheless we found an extremely heavy predation on nests. This was the case with *Gavia stellata, Anser brachyrhynchus,* waders and *Stercorarius longicaudus,* and was probably also involved in the extremely low reproduction of *Clangula hyemalis, Somateria spectabilis* and *Lagopus mutus.*

It is well known that numbers of rodent-dependent predators fluctuate strongly in relation to rodent abundance. The Arctic Fox, by far the most important mammalian predator in Northeast Greenland, undergoes multiple population fluctuations (cf. Macpherson 1969). The spring population is highest in the year following a rodent peak, and then rapidly decreases. Thus, the observed differences in breeding success of ground nesting birds may simply reflect the abundance of mammalian predators; even though search-image phenomena may play a role too.

The breeding strategy of *Stercorarius longicaudus* utilizes the few rodent peak years, but our observations indicate that their breeding success is also dependent on a small or at least moderate fox population. We experienced the extraordinary situation of two successive lemming peak years, and the breeding success of the skuas was extremely low.

In 1975, only a few bird nests were predated at Danmarks Havn (Meltofte 1977a, 1979). Lemmings were also abundant this year, and foxes not uncommon, but the predation pressure was low although nearly all nests and eggs were touched by the observer at Danmarks Havn, while we rarely approached closer than some metres from nests on Hochstetter Forland in 1976. Still, there was one big difference between the conditions at the two places. At Danmarks Havn less than 40–10% of the ground was snow covered during the main egg laying and incubation periods in 1975, while the corresponding figure from the census area on Hochstetter in 1976 was 90–60% during egg laying and the early part of the incubation period. During that time, the foxes just walked from one small snow-free spot to the next in search of nests.

We think it likely that fox predation is well correlated with the total effort of foxes per snow-free unit area, and that the type of prey largely depends on accessibility (see also Byrkjedal 1980).

In a speculative paper Larson (1960), ventured to explain the distribution in Greenland of especially waders as due to differences in food preferences by foxes in the high and low arctic parts of the country. *Charadrius hiaticula, Arenaria interpres, Calidris canutus, Calidris alpina arctica, Calidris alba,* and *Phalaropus fulicarius* are absent or scarce in most of the low arctic part of Greenland, while they are common in the high arctic part. In *Calidris maritima* and *Phalaropus lobatus* the opposite is the case. Lemmings are only found within the high arctic part, and Larson argued that the white "lemming foxes" of that region are so specialized in preying on this rodent that the waders are relatively safe from this predator, while the blue "coast foxes" of low arctic Greenland are specialists in preying on birds and eggs. The two low arctic wader species should be better adapted to avoid fox predation. We think this is unlikely!

The climate of low arctic Greenland, besides being milder, is characterized by more unstable weather conditions with much more precipitation and a much more luxuriant vegetation than in high arctic Greenland. Annual precipitation is more than six times as large in southwest Greenland as in the north. The high arctic waders are well adapted to the high arctic environment in which they live, with its extremely low and often sparse vegetation, and also dependent on the presence of wind-swept snow-free feeding areas upon arrival. Such conditions exist only sporadically in low arctic Greenland, and to us it seems reasonable that the distribution of high arctic birds is due more to the conditions in the high arctic, to which they are adapted, than to differing food preferences between two ecological types of the same predator species – the Arctic Fox! Immigration routes may also be involved, e.g. in the geese (Nørrevang 1963).

Acknowledgements

To our co-expeditionists Lena Adrielsson, Hans Bruch and Jan Mikaelsson who contributed many valuable observations. To Sirius who helped us with housing, transport and radio equipment, allowed us to draw on their provisions at Nanok and Mønstedhus and also supplied much ornithological information. They were, as always, very stimulating company! To the personnel at Danmarks Havn, who were our radio link with the world outside Greenland. To the personnel at Mesters Vig, where we stayed on our way from and to Iceland, and to the Royal Danish Air Force for delivering and taking out mail. The Greenland Geological Survey (GGU) is especially thanked for their generous help with transport back from Hochstetter, for lending us radio equipment, taking out mail etc. Flugstödin brought us comfortably from Iceland to Mesters Vig and back again, and the helicopter crews of Greenlandair Charter AS made a good and flexible job north of Mesters Vig. The list of individual persons helping us in one way or another would be too long to print – thus please receive our collective thanks!

The ornithological part of the expedition program was financed by the Danish Natural Science Research Council, the Nordic Council for Ecology and the Nordic Council for Wildlife Research.

Economic support during preparation of the manuscript was given by the Danish Natural Science Research Council.

The manuscript was critically read by G. H. Green, who also corrected our English.

Epilogue

For many years the low, well vegetated and boggy tundras of Hochstetter Forland had been a 'Shangri La' in the imagination of ornithologists working in Northeast Greenland. But the extensive and late thawing snow cover had not been taken into consideration. We found moderate populations and a late and poor breeding season for many species. A total of 82 nests was found by us. But there were others searching for nests that year too, and only about 35 of our nests hatched successfully. The others played a more basic role in the local eco-system. And when we left in late August, only the harsh laughter of the many foxes was heard over the waste tundras – they had a good season!

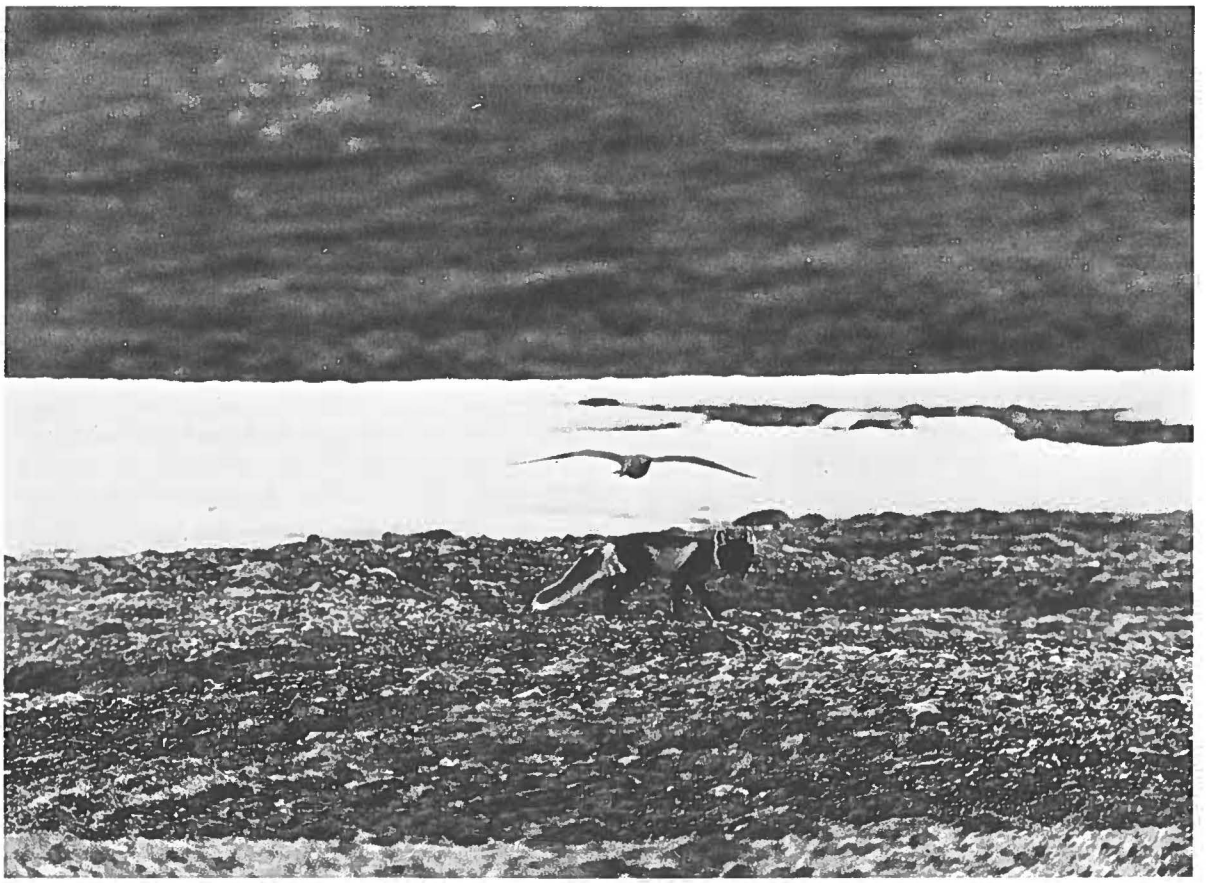

Fig. 24. In search of nests on the tundra, readily mobbed by Long-tailed Skuas. Near Nanok on 25 June 1976.

References

Andersen, O. G. N. 1970: Ornithological Observations on the 5th Pearyland Expedition in the summer of 1968. With a Review. (Danish, with English Summary). – Dansk orn. Foren. Tidsskr. 64: 104–112.

Andersson, M. 1971: Breeding Behaviour of the Long-tailed Skua *Stercorarius longicaudus* (Vieillot). – Ornis Scand. 2: 35–54.

Andersson, M. 1976: Population ecology of the Long-tailed Skua (*Stercorarius longicaudus* Vieill.). – J. Anm. Ecol. 45: 537–560.

Bay, E. 1894: Hvirveldyr. *in* Den østgrønlandske Expedition, udført i Aarene 1891–92. – Meddr Grønland 19, 1.

Bengtson, S.-A. & A. Fjellberg 1975: Summer food of the Purple Sandpiper (*Calidris maritima*) in Spitsbergen. – Astarte 8: 1–6.

Bertram, G. C. L., D. Lack & B. B. Roberts 1934: Notes on East Greenland Birds. – Ibis 13(4): 816–831.

Bird, C. G. & E. G. Bird 1940: Some Remarks on Non-breeding in the Arctic, especially in North-east Greenland. – *ibid.* 14(4): 671–678.

Bird, C. G. & E. G. Bird 1941: The Birds of North-east Greenland. – *ibid.* 14(5): 118–161.

Boyd, H. & M. A. Ogilvie 1969: Changes in the British-wintering population of the Pink-footed Goose from 1950 to 1975. – Wildfowl 20: 33–45.

Byrkjedal, I. 1980: Nest predation in relation to snow-cover – a possible factor influencing the start of breeding in shorebirds. – Ornis Scand. 11: 249–252.

Conradsen, F. R. 1957: Ornithologiske iagttagelser ved Daneborg, N.Ø. Grønland. – Dansk orn. Foren. Tidsskr. 51: 12–18.

Deichmann, H. 1909: Birds of East Greenland. *in* Carlsbergfondets Expedition til Øst-Grønland, udført i Aarene 1898–1900. – Meddr Grønland 29, 4.

Ferns, P. N. & G. H. Green 1975: Observations of Pink-footed and Barnacle Geese in the Kong Oscar Fjord region of north-east Greenland, 1974. – Wildfowl 26: 131–138.

Ferns, P. N. & G. P. Mudge 1976: Abundance and breeding success of birds in Ørsted Dal, East Greenland, 1974. – Dansk orn. Foren. Tidsskr. 70: 21–33.

Finsch, O. 1874: Vögel. – Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870. 2: 178–239. Leipzig.

Gelting, P. 1937: Studies on the food of the East Greenland Ptarmigan, especially in its relation to vegetation and snow-cover. – Meddr Grønland 116, 3.

Gillmore, R. & N. G. B. Jones 1959: A goose-watching visit to northern Iceland. – Wildfowl Trust 10th Ann. Rep.: 114–117.

Glue, D. E. 1972: Observations on the passage of migrant geese and waders in northwest Iceland. – Bird Study 19: 252–254.

Grant, C. T. 1972: Ornithology Report. *in* Joint Services Expedition, North Peary Land 1969. – Report.

Green, G. H., J. J. D. Greenwood & C. S. Lloyd 1977: The influence of snow conditions on the date of breeding of wading birds in north-east Greenland. – J. Zool., Lond. 183: 311–328.

Hall, A. B. 1966: The Breeding Birds of an East Greenland Valley, 1962. – Dansk orn. Foren. Tidsskr. 60: 175–185.

Hall, A. B. & R. N. Waddingham 1966: The Breeding Birds of Ørsteds Dal, East Greenland, 1963. – *ibid.* 60: 186–197.

Hjort, C. 1976: Notes on the bird fauna of Hudson Land and Hold With Hope, Northeast Greenland, 1973: – *ibid.* 70: 35–44.

Holmes, R. T. 1973: Social behaviour of breeding Western Sandpipers *Calidris mauri.* – Ibis 115: 107–123.

Höhn, E. O. 1965: Die Wassertreter. – Neue Brehm-Bücherei.

Inglis, I. R. 1977: The breeding behaviour of the Pink-footed Goose: Behavioural correlates of nesting success. – Anim. Behav. 25: 747–764.

Jennov, J. G. 1945: Moskusoksebestanden i Nordøstgrønland og nogle spredte iagttagelser og betragtninger vedrørende dyrelivet i Nordøstgrønland. – København.

Jennov, J. G. 1963: Bemærkninger om antallet af Bramgæs (*Branta leucopsis* (Bechst.)). – Dansk orn. Foren. Tidsskr. 57: 221–228.

Johnsen, P. 1953: Birds and Mammals of Peary Land in North Greenland. – Meddr Grønland 128, 6.

Jones, N. G. B. & R. Gillmore 1959: Some observations on wild geese in Spitsbergen. – Wildfowl Trust 10th Ann. Rep.: 118–132.

Kistchinski, A. A. 1975: Breeding biology and behaviour of the Grey Phalarope *Phalaropus fulicarius* in East Siberia. – Ibis 117: 285–301.

Knudsen, K. 1933: Ornithologiske Notitser fra Nordøst-Grønland. – Dansk orn. Foren. Tidsskr. 27: 93–95.

Kolthoff, G. 1903: Bidrag till Kännedom om Norra Polartrakternas Däggdjur och Fåglar. – K. Sv. Vet.-Akad. Handl. 36 (9): 31–92.

Korte, J. de 1973: Nederlandse Groenland Expeditie 1973, Preliminary Avifaunistical Report. – Report, 10 pp.

Korte, J. de 1974: Nederlandse Groenland Expeditie Scoresbysund 1974, Preliminary Report on Fieldwork. – Report, 8 pp.

Korte, J. de, C. A. W. Bosman & H. Meltofte in print: Observations on waders (Charadriidae) at Scoresby Sund, East Greenland. – Meddr Grønland.

Korte, J. de 1977: Ecology of the Long-tailed Skua (*Stercorarius longicaudus* Vieillot, 1819) at Scoresby Sund, East Greenland. Report of the Nederlandse Groenland Expeditie Scoresbysund 1973, 1974 and 1975. Part one: Distribution and Density. – Beaufortia 25: 201–219.

Korte, J. de & C. Bosman 1975: Nederlandse Groenland Expeditie 1975, Preliminary Report on Fieldwork. – Verslagen en Technische Gegevens No. 6, Amsterdam (10 pp).

Korte, J. de, C. A. W. Bosman & H. Meltofte 19XX: Observations on waders (Charadriidae) at Scoresby Sund, East Greenland. – Meddr Grønland.

Lack, D. 1933: Nesting Conditions as a Factor controlling Breeding Time in Birds. – Proc. Zool. Soc. Lond.: 231–237.

Larson, S. 1960: On the influence of the Arctic Fox *Alopex lagopus* on the distribution of arctic birds. – Oikos 11: 276–305.

Løppenthin, B. 1932: Die Vögel Nordostgrönlands zwischen 73°00′ und 75°30′N.Br. – Meddr Grønland 91, 6 (127 pp).

Løvenskiold, H.L. 1954: Studies on the avifauna of Spitsbergen. – Norsk Polarinstituts skrifter 103: 1–131.

Løvenskiold, H. L. 1963: Avifauna Svalbardensis. – Oslo.

Macpherson, A. H. 1969: The dynamics of Canadian arctic fox populations. – Can. Wildlife Serv. Report Series – No. 8.

Maher, W. J. 1970: Ecology of the Long-Tailed Jaeger at Lake Hazen, Ellesmere Island. – Arctic 23: 112–129.

Manniche, A. L. V. 1910: The terrestrial Mammals and Birds of North-East Greenland. Biological Observations. – Meddr Grønland 45, 1.

Marris, R. & A. H. F. Webbe 1969: Observations of Birds in East Greenland, 1966. – Dansk orn. Foren. Tidsskr. 63: 161–170.

Meltofte, H. 1972: Ornithological Observations in the Norwegian Sea, the Greenland Sea, and NE Greenland, July-August 1972. – *ibid.* 66: 108–112.
Meltofte, H. 1975: Ornithological Observations in Northeast Greenland between 76°00′ and 78°00′N. Lat. 1969–71. – Meddr Grønland 191, 9 (72 pp).
Meltofte, H. 1976a: Ornithological Observations in Southern Peary Land, North Greenland, 1973. – *ibid.* 205, 1 (57 pp).
Meltofte, H. 1976b: Ornithological observations from the Scoresby Sund Area, East Greenland, 1974. – Dansk orn. Foren. Tidsskr. 70: 107–122.
Meltofte, H. 1977a: Ornithological observations in Germania Land, Northeast Greenland, 1975. – *ibid.* 71: 81–94.
Meltofte, H. 1977b: 'Fly-away trick' of some arctic waders. – Brit. Birds 70: 333–336.
Meltofte, H. 1978: A breeding association between Eiders and tethered huskies in Northeast Greenland. – Wildfowl 29: 45–54.
Meltofte, H. 1979: The population of waders *Charadriidae* at Danmarks Havn, Northeast Greenland, 1975. – Dansk orn. Foren. Tidsskr. 73: 69–94.
Munsterhjelm, L. 1937: Bland isbjörnar och myskoxar på Nordostgrönland. – Stockholm.
Nathorst, A. G. 1900: Två somrar i Norra Ishafvet, senare delen. – Stockholm.
Norderhaug, M. 1977: Studies of the King Eider (*Somateria spectabilis*) in Svalbard. – Norsk Polarinst. Årbok 1976.
Nyholm, E. S. 1965: Ecological observations on the geese of Spitsbergen. – Ann. Zool. Fenn. 2: 197–207.
Nørrevang, A. 1963: Considerations on Avifaunal Connections Across the North Atlantic. – Dansk orn. Foren. Tidsskr. 57: 99–109.
Ogilvie, M. A. & H. Boyd 1975: Greenland Barnacle Geese in the British Isles. – Wildfowl 26: 139–147.
Ogilvie, M. A. & H. Boyd 1976: The numbers of Pink-footed and Greylag Geese wintering in Britain: observations 1969–1975 and predictions 1976–1980. – Wildfowl 27: 63–75.
Parmelee, D. F. 1970: Breeding behavior of the Sanderling in the Canadian High Arctic. – Living Bird 9: 97–146.
Parmelee, D. F., H. A. Stephens & R. H. Schmidt 1967: The birds of southeastern Victoria Island and adjacent small islands. – Nat. Mus. Can. Bull. 222 (229 pp).
Parmelee, D. F. & R. B. Payne 1973: On multiple broods and the breeding strategy of arctic Sanderlings. – Ibis 115: 218–226.
Pedersen, A. 1926: Beiträge zur Kenntnis der Säugetier- und Vogelfauna der Ostküste Grönlands. – Meddr Grønland 68, 3.
Pedersen, A. 1930: Fortgesetzte Beiträge zur Kenntnis der Säugetier- und Vogelfauna der Ostküste Grönlands. – *ibid.* 77, 5.
Pedersen, A. 1934: Die Ornis des Mittleren Teiles der Nordostküste Grönlands. – *ibid.* 100, 11.
Pedersen, A. 1942: Säugetiere und Vögel. – *ibid.* 128, 2.
Pehrsson, O. 1977: Duckling production of Long-tailed Duck, *Clangula hyemalis* (L.) in relation to spring weather and small rodent fluctuations. – Thesis, Univ. Gothenburg.
Pienkowski, M. W. & G. H. Green 1976: Breeding biology of Sanderlings in north-east Greenland. – Brit. Birds 69: 165–177.
Ray, H. P. C. 1973: Some Notes on the Birds Observed in the Kungmiut and Tugtilik Areas of East Greenland during the Summer of 1967. – Dansk orn. Foren. Tidsskr. 67: 43–52.
Rosenberg, N. T., N. H. Christensen & B. Gensbøl 1970: Bird observations in Northeast Greenland. – Meddr Grønland 191, 1 (87 pp).
Salomonsen, F. 1950: Grønlands Fugle, The Birds of Greenland. – København.
Salomonsen, F. 1961: The Ivory-Gull (*Pagophila eburnea* (Phipps)) as a Breeding-Bird in Greenland. – Dansk orn. Foren. Tidsskr. 55: 177–180.
Salomonsen, F. 1967: Fuglene på Grønland. – København.
Schaanning, H. T. L. 1933: Zoological Results of the Norwegian Scientific Expeditions to East-Greenland I. 1. A Contribution to the Bird Fauna of East Greenland. – Skrifter om Svalbard og Ishavet 49: 1–24.
Schiøler, E. L. 1926: Danmarks Fugle med Henblik paa de i Grønland paa Færøerne og i Kongeriget Island forekommende Arter. Vol. III. – København.
Snyder, L. L. 1957: Arctic Birds of Canada. – Toronto.
Waterston, G. & I. 1970: Greenland Redpoll (*Carduelis flammea rostrata* (Coues)) breeding in High Arctic Region. – Dansk orn. Foren. Tidsskr. 64: 93–94.
Witherby, H. F., R. F. C. R. Jourdain, N. F. Ticehurst & B. W. Tucker 1944: The Handbook of British Birds. Vol. V. – London.
Wright, N. J. R. & D. W. Matthews 1980: New nesting colonies of the Ivory Gull *Pagophila eburnea* in southern East Greenland. – Dansk orn. Foren. Tidsskr. 74: 59–64.

Appendix

This list presents scattered observations from outside the present study area.

Fulmar (*Fulmarus glacialis*). "Some hundreds" were seen at Mallemukfjeldet (about 80°N. lat.) on 8–9 May 1975 (Sirius pers. comm.).

Swan Sp. (*Cygnus Sp.*). A swan appeared at Daneborg in mid-June 1969 (Sirius pers. comm.).

Snow Goose (*Anser caerulescens*). One was seen together with three Barnacle Geese at Zackenberg near Daneborg on 7 June 1970. The day after two individuals were seen at Daneborg (Sirius pers. comm.). Four were seen at Mesters Vig on 10 June 1974 (Henning Thing in litt.).

Redshank (*Tringa totanus*). We saw one at Mesters Vig on 19 May 1976.

Ivory Gull (*Pagophila eburnea*). "A few" were seen at Zackenberg on 7 June 1970 (Sirius pers. comm.). At Station Nord "many" (about 50) were seen in August 1974 (Sirius pers. comm.). In 1976 the first birds appeared on 10 May and on 13 June there were 27 (crew of Station Nord pers. comm.). East of Station Nord (at S. Henius Land and Nakkehoved) a Sirius sledge party saw 13 and 10 on 8 and 9 May 1976, respectively.

Great Black-backed Gull (*Larus marinus*). One adult stayed together with Glaucous Gulls at the rubbish dump of Mesters Vig on 25 May 1976, and an about two-year-old bird was present at Daneborg on 17 August 1976 (own observations).

Sabine's Gull (*Xema sabini*). When we visited Sandøen at Daneborg on 17 August 1976, three pairs were encountered. One pair had one egg, one pair had at least one less than one-week-old pulli, and the third pair showed site tenancy close by. On Gauss Halvø K. Birkenmajer and K. Maehl found one pair breeding on 14 August 1976 near the mouth of Margrethedal (about 73°N. lat.). The nest was situated among pebbles about 30 m from the coast and one metre above sea level on the about 50 m broad coastland. It held two eggs (one broken) and one about 2–3 day old pulli (Maehl in litt.).

Arctic Tern (*Sterna paradisaea*). On Sandøen, about one thousand terns resided on 28 July 1973. About two-thirds of the nests held two eggs, the rest only one. A few young had hatched (Jørgen Søe Westergaard in litt.). When we visited Sandøen on 17 August 1976, an estimated total of at least 400 pairs resided on the island. We found at least 100 pairs with up to one-week-old pulli. The only clutch found held one pipped egg.

Snowy Owl (*Nyctea scandiaca*). In 1974 one pair had about five pulli at Stordal, Hudson Land (about 73.45°N. lat.) (Greenland Geological Survey, pers. comm.).

Arctic Redpoll (*Carduelis flammea hornemanni*). One pair attended four juveniles on Ella Ø on 1 August 1973 (Jørgen Søe Westergaard in litt.).

Meddelelser om Grønland, Geoscience

1979.

1. C. K. Brooks:
»Geomorphological observations at Kangerdlugssuaq, East Greenland«. 21 pp.

The Kangerdlugssuaq area is mainly comprised of two contrasting rock groups: on the one hand the easily-eroded lavas and sediments of late Mesozoic to early Tertiary age and on the other the highly resistant Precambrian gneisses. Intermediate between these two types in terms of behaviour with respect to erosion are the Tertiary plutonic complexes and the basaltic areas along the coast which have been intruded by intense dyke swarms.

In the late Mesozoic the area was a peneplain, and low relief apparently persisted throughout the volcanic episode as there is good evidence that the lava plateau subsided during its formation. During this period ocean-floor spreading gave rise to the embryonic Danmark Stræde. Shortly after the volcanic episode the Kangerdlugssuaq area became the centre of a massive domal upwarping which has been a dominant feature of the land-forms up to the present day. The original surface of the dome has been reconstructed on the basis of topographic and geological evidence to show that it was elliptical in form with a major axis of at least 300 km in length and a height above present sea-level of about 6.5 km. However, subsequent isostatic effects are not considered in deriving these figures. The updoming is estimated to have occurred about 50 m.y. ago.

Several kilometres thickness of sediments and lavas were eroded off this dome at an early stage exposing the gneissic core, which still stands in alpine peaks up to about 2.7 km altitude in the central part, and dumping ca. 50000 km³ of sediment on the continental shelf. The erosion was effected by a radial, consequent drainage system, relicts of which can still be found. Kangerdlugssuaq itself may owe its origin to a tectonic line of weakness formed in response to doming, but there are also good arguments for its being purely erosional. The erosion of the dome was probably fluviatile but all trace of this stage has been obliterated the subsequent glaciation.

In the period between the Eocene and the early Miocene, possibly around 35 m.y. ago, the entire area underwent epeirogenic uplift raising the undeformed parts of the original lava plateau to around 2.5 km above sea-level. At present this plateau is undergoing dissection from the seaward side, but considerable areas are still preserved under thin, horizontal ice-caps.

A brief description of the various types of glaciers, an impermanent, ice-dammed lake and the areas of ice-free land is given. In the Pleistocene, the Kangerdlugssuaq glacier was considerably thicker than at the present time and extended far out over the shelf, excavating a deep channel here. Finally some observations on the coastlines are presented.

1979.

2. Sven Karup-Møller and Hans Pauly:
»Galena and associated ore minerals from the cryolite at Ivigtut, South Greenland«. 25 pp.

Silver- and bismuth-rich galena concentrates have been produced for more than 70 years as a byproduct in the dressing of the crude cryolite from Ivigtut, South Greenland.

Concentrates from the years 1937 to 1962 contained from 0.44 % Ag and 0.74 % Bi to 0.94 % Ag and 1.93 % Bi. Conspicuous increases in the content of these elements appeared twice within this time interval, namely in 1955 and in 1960. Thus it seems that crude cryolite from specific areas within the mine carried galena high in silver and bismuth. This promoted a detailed study of the common Ivigtut galena and associated sulphides.

An outline of the geological setting of the deposit is given. The deposit is divided into two main bodies – the cryolite body and the quartz body. Both are subdivided into units characterized by their content of siderite and fluorite. Galena samples from these units and from rock types surrounding the deposit have been studied.

Galena from units characterized by siderite follows the compositional pattern found in the galena concentrates, whereas the sparse galena mineralizatiions from units characterized by fluorite contain much smaller amounts of silver and bismuth, less than 0.2 %. However, within the fluorite-bearing units, two peculiar parageneses reveal high contents of silver and bismuth expressed by the presence of particular minerals such as marildite-aikinite and gustavite cosalite respectively.

Further trace element studies on selected galena samples emphasize Sn and Te as chemically characteristic of the galena and of the sulphide-carbonate phase of the deposit.

The temperature of formation of the main part of the deposit is placed at 550–400°C, and between 300 and 200°C certain parts of the fluorite cryolite and the fluorite zone.

1980

3. John C. Rucklidge, Charles Kent Brooks and Troels F. D. Nielsen: »Petrology of the coastal dykes at Tugtilik, southern East Greenland«. 17 pp.

Dolerite and lamprophyre dikes from Tugtilik in the southern part of the onshore exposure of the East Greenland coastal dike swarm are described. The dolerites, which are earlier, are similar to other tholeiites from the dike swarm and the plateau basalts and also to many Icelandic tholeiites. Transitional varieties have been identified from the Angmagssalik district. The lamprophyres have a nephelinitic composition and are rich in phenocrysts and xenocrysts. In one case, abundant low pressure inclusions occur. Rocks identical to these lamprophyres have not previously been described from Greenland but are well known, for instance, in the African Rift.

Meddelelser om Grønland, Bioscience

1979.

1. Erik L. B. Smidt: »Annual cycles of primary production and of zooplankton at Southwest Grenland«. 53 pp.

Annual hydrographic observations, measurements of primary production, and samplings of zooplankton were undertaken in Southwest Greenland waters in the 1950s and –60s. In the coastal area and at the entrance to Godthåbsfjord winter cooling normally extends to the bottom, resulting in a vertical mixing of the water and an effective replenishment of nutrients at the surface. The subsequent production rate is, therefore, high with an average annual gross production calculated to about 160 g C m^{-2}. In the inner fjord regions the stratification is normally much more stable with persisting warm bottom water, and the production is, therefore, lower here than in the coastal area. The seasonal variation in the relations between daylight, primary production, phosphate, and quantity of zooplankton is, presumably, representative of the coastal waters at SW Greenland. A maximum in primary production in spring is normally followed by another maximum in late summer. The number of animals in the microplankton samples from the upper 30 m (the productive layer) is at its maximum simultaneously with the second maximum of the primary production, while the maximum of the macroplankton biomass (taken by stramin net) extends until late autumn in the coastal and outer fjord regions.

A maximum of the macroplankton biomass during winter in the deep water layers in the inner Godthåbsfjord, caused by inflow of warm bottom water, stable stratification and cooled outflowing surface water acting as a barrier to the ascent of the animals, is assumed to be normal to the open, non-threshold, W Greenland fjords.

Seasonal vertical migration of the zooplankton is indicated by Hensen net hauls from different depths. There is a concentration of zooplankton in the upper water layers in April–September and a deeper concentration from autumn to spring.

Annual cycles of various animal groups are described for holoplankton and meroplankton, separately. Holoplankters are normally dominant, copepods being the most numerous group. Meroplankters, especially bottom invertebrate larvae, are relatively numerous in the microplankton in spring and summer with *Balanus* nauplii dominant in spring and lamellibranch larvae in the following months. In a special section on fish eggs and larvae it is shown *l.a.* that cod eggs and larvae are normally concentrated in the upper 50 m, where they are much exposed to temperature variations, while eggs and larvae of American plaice occur also in deeper water. This may partly explain why the cod stock is more vulnerable to low temperatures.

It is shown that the epipelagic plankton fauna in the survey area in terms of growth and mode of development is more similar to the arctic than to the boreal fauna. It could therefore be termed subarctic, which also corresponds to the environmental conditions in the area.

1980

2. Jean Just:
»Amphipoda (Crustacea) of the Thule area, Northwest Greenland: Faunistics and Taxonomy«. 61 pp.

The material reported on was collected in the Thule area, NW Greenland, in 1968 and includes 105 species. Four of these, *Aceroides goesi, Bathymedon antennarius, Monoculodes vibei* and *Parametopa crassicornis,* are new to science. An additional 6 species are new to Greenland, while 9 species have previously been found in E Greenland but not in W Greenland. Four genera, *Lembos, Arrhinopsis, Arctopleustes* and *Parametopa,* are recorded from Greenland for the first time.

Specimens belonging to 15 additional taxa are for various reasons not referred to species. Major taxonomic problems, warranting broadly based revisions, are outlined in the genera *Byblis, Gitanopsis, Ischyrocerus, Tmetonyx, Monoculodes* and *Stenula.* Three different forms of *Paroediceros lynceus* are discussed.

All known amphipod species from the Thule area are included in an annotated list. Forty-nine taxa are discussed and figured.

Meddelelser om Grønland, Man & Society

1980

1. Isi Foighel:
»Home Rule in Greenland«. 18 pp.

By Danish Act of 29 November, 1978, Home Rule was established in Greenland within the Unity of the Danish Realm. The Act was prepared by a Danish-Greenlandic Commission.

The Act on Home Rule is discussed with special reference to the historical and political background.

By the establishing of Home Rule, powers which hitherto had been vested in the Danish Government and Parliament were transferred to the Greenlandic authorities. The scope of these powers and their legal characteristics are outlined.

Home Rule makes no changes in the international competence or in the relationship between Greenland and the international or interregional organizations. Greenland's membership of the EEC creates some special problems.

The question of ownership of the natural resources was of great importance in the debate in the Home Rule Commission. The Act contains a solution which seeks to give the Danish Government as well as the Greenlanders equal rights in the decision-making procedure, in the administration, and in the sharing of the revenue.

Furthermore, the financing of the Home Rule system, the language problem, the organizing of fishing and trade are being dealt with.

Instructions to authors

Manuscripts will be forwarded to referees for evaluation. Authors will be notified as quickly as possible about acceptance, rejection, or desired alterations. The final decision rests with the editor. Authors receive two page proofs. Prompt return to the editor is requested.

Alterations against the ms. will be charged to the author(s). Twenty five offprints are supplied free. Order form, quoting price, for additional copies accompanies 2nd proof. Manuscripts (including illustrations) are not returned to the author(s) after printing unless especially requested.

Manuscript

General. – Manuscripts corresponding to less than 16 printed pages (of 6100 type units), incl. illustrations, are not accepted. Two copies of the ms. (original and one good quality copy), each complete with illustrations should be sent to the Secretary.

All Greenland place names in text and illustrations must be those authorized. Therefore sketch-maps with all the required names should be forwarded to the Secretary for checking before the ms. is submitted.

Language. – Manuscripts should be in English (preferred language), French, or German. When appropriate, the language of the ms. must be revised before submission.

Title. – Titles should be kept as short as possible and with emphasis on words useful for indexing and information retrieval.

Abstract. – An English abstract should accompany the ms. It should be short, outline main features, and stress novel information and conclusions.

Typescript. – Page 1 should contain: (1) title, (2) name(s) of author(s), (3) abstract, and (4) author's full postal address(es). Large mss. should be accompanied by a Table of Contents, typed on separate sheet(s). The text should start on p. 2. Consult a recent issue of the series for general lay-out.

Double space throughout and leave a 4 cm left margin. Footnotes should be avoided. Desired position of illustrations and tables should be indicated with pencil in left margin.

Underlining should only be used in generic and species names. The use of italics in other connections is indicated by wavy line in pencil under appropriate words. The editor undertakes all other type selection.

Use three or fewer grades of headings, but do not underline. Avoid long headings.

References. – Reference to figures and tables in the text should have this form: Fig. 1; Figs 2–4, Table 3. Bibliographic references in the text are given as: Shergold (1975: 16) and (Jago & Daily 1974b).

In the list of references the following usage is adopted:

Journal: Macpherson, A. H. 1965. The origin of diversity in mammals of the Canadian arctic tundra. – System. Zool. 14: 153–173.

Book: Marsden, W. 1964. The lemming year. – Chatto & Windus, London: xxx pp.

Chapter (part): Wolfe, J. A. & Hopkins, D. M. 1967. Climatic changes recorded by Tertiary landfloras in northwestern North America. – In: Hatai, K. (ed.), Tertiary correlations and climatic changes in the Pacific. – 11th Pacific Sci. Congr. Tokyo 1966, Symp.: 67–76.

Title of journals should be abbreviated according to the last (4th) edition of the World List of Scientific Periodicals (1960) and supplementary lists issued by BUCOP (British Union-Catalogue of Periodicals). If in doubt, give the title in full.

Meddelelser om Grønland, Bioscience should be registered under *Meddelelser om Grønland.* Example (with authorized abbreviations): *Meddr Grønland, Biosci.* 1, 1979.

Illustrations

General. – Submit two copies of each graph, map, photograph, etc., all marked with number and author's name. Normally all illustrations will be placed within the text; this also applies to composite figures.

All figures (incl. line drawings) must be submitted as glossy photographic prints suitable for direct reproduction, i.e. having the format of the final figure. Do not submit original artwork. Where appropriate the scale should be indicated in the caption or in the illustration.

The size of the smallest letters in illustrations should not be less than 1.5 mm. Intricate tables are sometimes more easily reproduced from line drawings than by type-setting.

Colour plates may be included at the author's expense, but the editor should be consulted before such illustrations are submitted.

Size. – The width of figures must be that of a column (77 mm), 1½ column (120 mm) or of a page (160 mm). Remember to allow space for captions below full page figures. Maximum height of figures (incl. captions) is 217 mm. Horizontal figures are preferred.

If at all possible, fold-out figures and tables should be avoided.

Caption. – Captions (two copies) to figures should be typed on separate sheets.

Meddelelser om Grønland

Bioscience 3 · 1981

Meddelelser om Grønland

Bioscience
Geoscience
Man & Society

Published by
The Commission
for Scientific
Research
in Greenland

1981

AIO Tryk as, Odense