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The avifauna of central Northeast Greenland, 73°15′N–74°05′N, based on a visit to Myggbukta, May–July 1979

Magnus Elander and Sven Blomqvist

Bioscience
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MAGNUS ELANDER and SVEN BLOMQVIST

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The high arctic avifauna of central Northeast Greenland between 73°15′N. and 74°05′N. is reviewed and various ecological and faunistic aspects are considered. The recent field data were collected during a stay at Myggbukta (73°29′N., 21°34′W.), from May to July 1979. A few records from 1982 (Elander & Ericson unpubl.) are included.

The coastal plain near Myggbukta harbour a comparatively dense population of birds, in particular some species of ducks, waders and skuas. The nesting habitat selection of eight species in the census area is plotted on vegetation type maps.

In 1979, 38 species were recorded in the study area. Eleven species were found breeding, and five species were most probably breeders in or close to the census area. Seven species new to the area were recorded in 1979, including the Wood Sandpiper (*Tringa glareola*, new to Greenland). In 1982, another two species new to the area were recorded. The total number of species in the study area now amounts to 56.

Selected meteorological data from Myggbukta between 1932 and 1958 are compared with the weather situation in 1979. It is concluded that the disappearance of snow and ice may affect the timing of arrival for certain lake dependent species.

Two topics were studied in more detail in 1979: (1) Food supply and pre-nesting behaviour among King Eider (*Somateria spectabilis*) and Long-tailed Duck (*Clangula hyemalis*), and (2) Mating systems, food resources and foraging behaviour among waders, with special attention to the genus *Phalaropus*. The potentially available food resources for these species were sampled and analysed qualitatively, and the larvae of midges *(Chironomidae;* mainly *Chironominae)* were also analysed quantitatively. The midge larvae were found to be almost the sole prey type initially available for all lake-feeding species. On this basis spatial niche segregation among King Eider, Long-tailed Duck, Dunlin *(Calidris alpina)* and Red-necked Phalarope (*Phalaropus lobatus*) is discussed.

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Introduction

The field data for the present paper was collected during the Swedish Northeast Greenland Expedition – Myggbukta 1979. The expedition members arrived at Myggbukta on May 16–17. Myggbukta is a former Norwegian radio station and weather observatory at 73°29′N, 21°34′W (Jelstrup 1932) (Fig. 1).

The purpose of the expedition was to conduct a general avifaunal survey in a selected study area between 73°15′N and 74°05′N, a poorly studied part of the Northeast Greenland National Park. More thorough studies were focused on two specific topics: (1) Food supply and pre-nesting behaviour among King Eider *(Somateria spectabilis)* and Long-tailed Duck *(Clangula hyemalis)* in a high arctic environment, and (2) Mating systems, food resources and foraging behaviour among waders, with special attention to the genus *Phalaropus,* in a high arctic environment. The results of the duck study will be published elsewhere.

The fieldwork, from May 17 to July 19, was carried out mainly in a 6.1 km^2 census area around the base-camp, but a few more extended excursions were also made. Apart from the recent observations, the species accounts below also include reviews of the scattered previous records from the present study area.

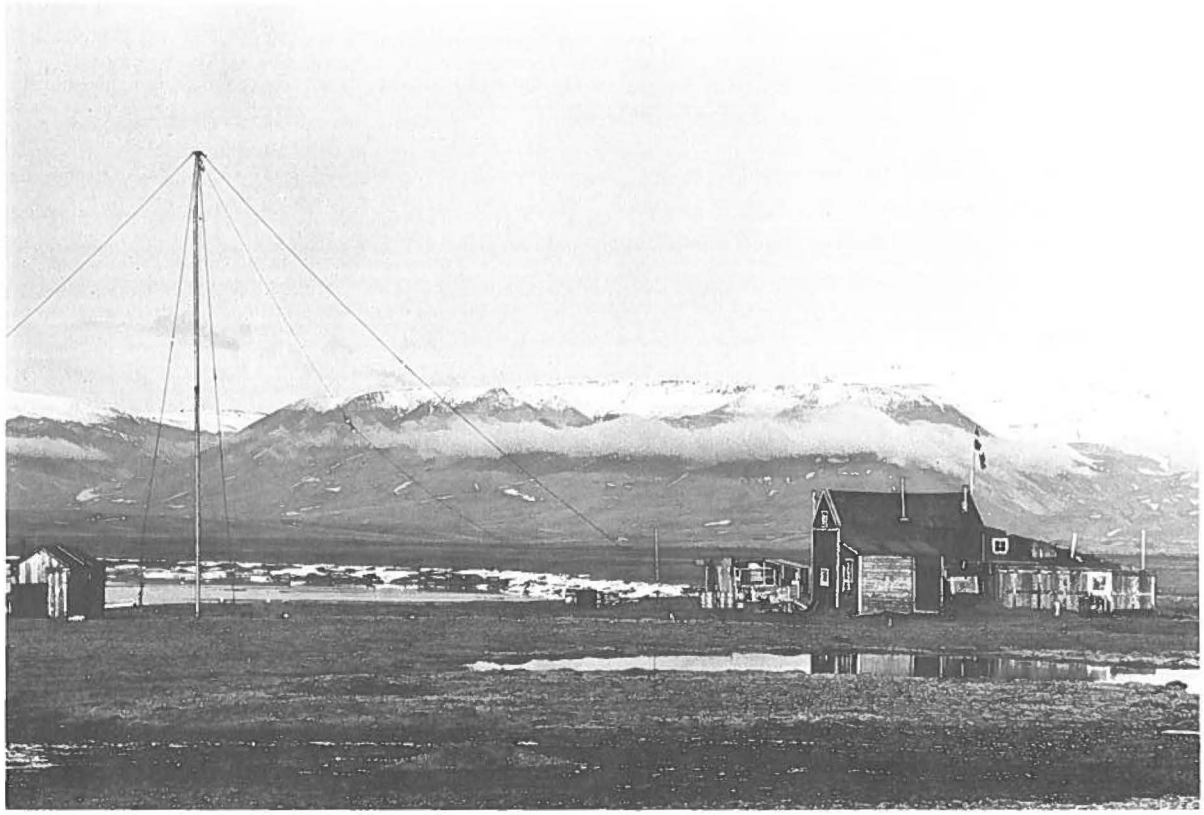

Fig. 1. Myggbukta, the former Norwegian radio and weather station, was used as the base-camp during the 1979 expedition. The Giesecke Bjerge, at a distance of approximately 15 km, are seen in the background. (Photo: M. Elander)

General Part

Earlier ornithological investigations

The outer coast of the present study area (Fig. 2) was first sighted on July 2, 1607 by H. Hudson, a British explorer on his way to Spitsbergen. He named the land Hold with Hope. The first descriptions of the bird life in this area come from The Second German North Pole Expedition 1869–70 with the *"Germania"*, under the command of Captain K. Koldewey (Finsch 1874). After wintering at Sabine Ø further north, the two zoologists of the expedition, A. Pansch and R. Copeland, made observations and collected birds at *inter alia* Jackson Ø, Hold with Hope, Kap Franklin and in the vicinity of Waltershausen Gletscher in the first half of August 1870. A few notes on the birds in the study area were made in the 1890's by two Danish expeditions (Bay 1894, Deichmann 1909) and one Swedish (Nathorst 1900).

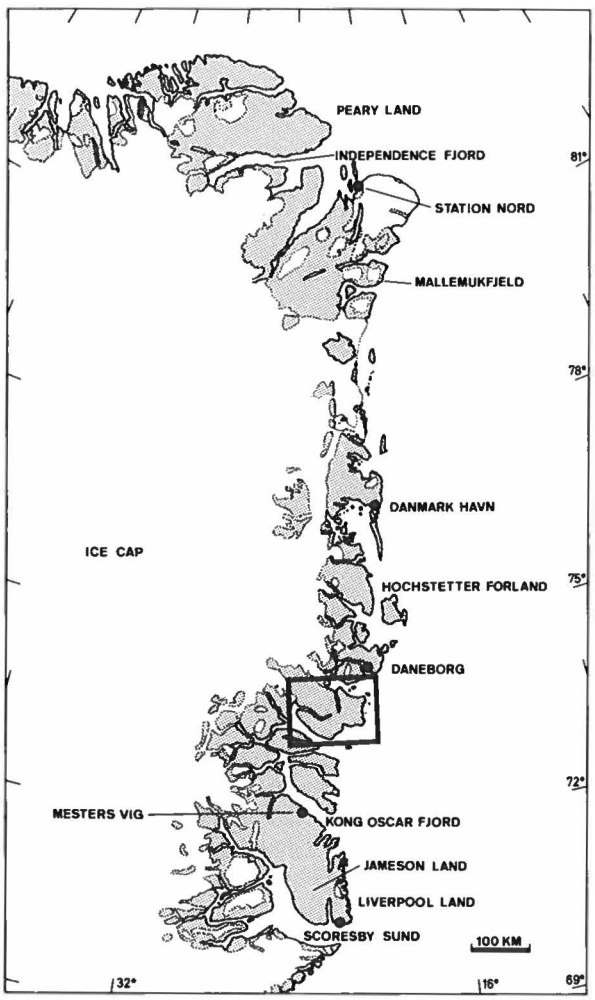

Fig. 2. Map of North and Northeast Greenland with the study area framed.

The first time zoologists were ashore for more than a few hours in the present study area was during the Swedish expedition 1900, with the *"Frithjof"* under the leadership of G. Kolthoff. Between July 31 and August 25 many observations and collections were made, mainly at Mackenzie Bugt and in Moskusoksefjord (Kolthoff 1901, 1903).

In the 1930's several expeditions with ornithologists visited the area. During three Norwegian summer expeditions, P. Løyning and E. Siggeson landed on the coast at various localities to make observations and collections (Schaanning 1933a). Some additional avifaunistic information was also obtained from wintering Norwegian trappers during 1928–31 by A. Hoel (Schaanning 1933a). In 1930 B. Løppenthin performed ornithological studies in the area during the Danish Godthaab Expedition (Løppenthin 1932). The last week of July was spent at Kap Stosch and the northeastern shore of Loch Fyne. The last week ashore was spent on the southern shore of central Moskusoksefjord between August 9 and 16. A few bird notes from Hold with Hope in the autumn of 1930, were gathered by the Danish trapper K. Knudsen (Knudsen 1933).

As a member of The Three Year Expedition to Christian X's Land 1931–34, the zoologist A. Pedersen wintered at Eskimonæs, the southern tip of Clavering Ø, in 1931–32. Ornithological observations were made in December 1931, when the present study area was traversed by dog-sledge. In the early spring 1932, a period was spent in Hudson Land, including Hold with Hope (Pedersen 1934).

The most comprehensive ornithological work from the present area was done by C. G. Bird and E. G. Bird during a one year study at Myggbukta from August 11, 1936 until autumn 1937 (Bird & Bird 1941) and additional observations were also made by O. Bang, a Norwegian trapper wintering at Myggbukta 1938–1939 (Bang 1944).

Since 1945 ornithological activities have been scarce in the area. Two British goose-counting projects, a six-man party for the periods August 1–4 and 14–16, 1956 and a two-man party in the period August 8–20, 1966, investigated the lowland areas between Loch Fyne, Moskusoksefjord and Mackenzie Bugt and tributary valleys, including a brief landing at Uglehøjene west of

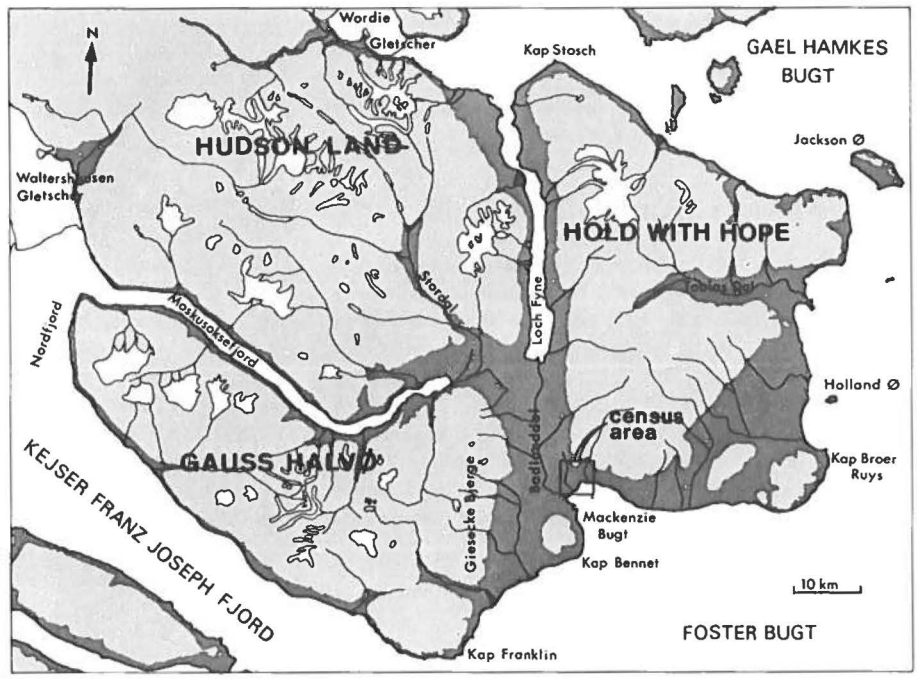

Fig. 3. Map of the study area with location of the census area. Dark shading: land below 200 m a.s.l.; intermediate shading: land above 200 m a.s.l.; light shading: glaciers.

Kap Brocr Ruys in 1956 (Goodhart & Wright 1958, Marris & Webbe 1969). Besides detailed goose figures, limited avifaunistic information was also obtained. Between mid-July and the end of August 1973, Hudson Land and Hold with Hope were traversed on foot during extensive geological/ornithological hikes (Hjort 1976). A fairly large area was surveyed for post-breeding and migrating birds.

The country north of Godthåb Golf and Gael Hamkes Bugt was investigated in 1964 (Rosenberg *et al.* 1970), but nothing comprehensive has been published for the area immediately south of Kejser Franz Joseph Fjord. Further south, from the Kong Oscar Fjord region, several expeditions have contributed to the knowledge of the bird fauna (*e.g.* Smart 1969, Smart & O'Brien 1971, O'Brien & Greenwood 1974, Green & Greenwood 1978, "Rapport 1979").

Description of the area

The study area in general

Hold with Hope, Hudson Land and Gauss Halvø compose the present study area (Fig. 3). The avifauna of the whole area is reviewed in the present paper, although only a small part of the area was investigated in 1979. The area treated extends from Kap Franklin at 73°15'N to Kap Stosch at 74°05'N. The eastern limit is the outer coast of Hold with Hope, with Jackson Ø as the easternmost point at 20°W. The western limit is given by a straight line between the snouts of the two majestic valley glaciers, Waltershausen Gletscher at 24°15'W and Wordie Gletscher at 22°30'W.

The study area forms a peninsula and is surrounded by the sea, except in the northwest. To the south is Kejser Franz Joseph Fjord and Foster Bugt, and to the southwest Nordfjord, a tributary to Kejser Franz Joseph Fjord. Off Hold with Hope is the Greenland Sea with its southward setting East Greenland Current, which carries drift-ice throughout the year. The northern coast of the study area is bordered by Gael Hamkes Bugt and Godthåb Golf.

There are a number of small local cirque glaciers in the area but the actual ice-sheet of the Greenland Icecap is not found closer than at some 70 km distance northwest of the western border of the study area. The largely mountainous landscape, with numerous peaks between 1000 m and 2000 m a.s.l., is intersected by two long and narrow fiords, Moskusoksefjord and Loch Fyne, and by valleys and extensive lowland areas. The wide and low Badlanddal together with the land around the head of the fiords, make up a large but fairly barren continuous lowland area. This extends southwards all the way to Mackenzie Bugt and includes the census area of the 1979 expedition. Immense Quaternary deposits of silt and sand give parts of Badlanddal a desert-like appearance. The only part of the study area with more extensive, vegetated, marshy areas and a concentration of small tarns and ponds, seems to be the southern Badlanddal, and especially the census area west of Myggbukta. Extensive lowland areas are found also at Ves-

Fig. 4. Central parts of the study area with the census area framed. An often used outlook beach-ridge is indicated. Aerial photo Geodætisk Institut (635/07126; 1950). Published with the permission of Geodætisk Institut (A.401/81). Copyright.

tersletten, a southern prolongation of Badlanddal; at Østersletten in the southeastern part of Hold with Hope; and in Tobias Dal, a valley intersecting the mountainous Hold with Hope in east-westerly direction. These areas are undulating dry tundras with few water-bodies and scarce vegetation. In Hudson Land, the rather narrow Stordal and tributary valleys are the major non-mountainous areas here. The very few large lakes in these tracts are found at the head of these valleys.

The vegetation in this high arctic district is generally composed of low growing chamaephytes and hemicryptophytes. There is a complete lack of taller bushes and trees. The distribution and ecology of the flora in the present study area were investigated thoroughly in the early 1930's (Gelting 1934). Gelting found that, among 44 very common and widely distributed species within the area, ten had a more northerly distribution centre, but not a single more southern element was found. This shows the northerly character of the area from a botanical point of view. Among the dwarf shrubs, *Dryas* spp. and *Salix arctica* are common everywhere but *Cassiope*

Fig. 5. Southward view across the census area, from the south slope of Ravnebjerg, with Mackenzie Bugt, Kap Bennet and Giesecke Bjerge in the background. Some 200 tarns and ponds are dammed by the well preserved beach-ridge system. (Photo: M. Elander)

tetragona and *Vaccinium uliginosum* are only abundant in the inner fiord region and almost lacking at the outer coast. The same applies to *Rhododendron lapponicum* as well as xerophilous species like *Kobresia myosuroides,* and *Carex rupestris.* The opposite is the case with hygrophilous species like *Eriophorum scheuchzeri* and *Alopecurus alpinus,* which are more common towards the outer coast. Most of the common and widespread species, however, were equally common in the more maritime and foggy east and in the more continental west. In addition to the species mentioned above, other characteristic dominants in these parts of Northeast Greenland are other grasses *Graminae* spp., sedges *Carex* spp., *Chamaenerium latifolium, Eriophorum* spp. and *Luzula arctica.* In the inner fiords *Betula nana* may be dominant and along the outer coast *Deschampsia arctica* and *Dupontia Fisheri.*

Flowering starts as early as the end of May, usually with *Saxifraga oppositifolia* and *Salix arctica.* Most species have started flowering before the end of June, but the main blooming season is in July and the beginning of August.

The census area

The flat coastal plain west of Myggbukta, comprising 6.1 km^2, was chosen as a census area for the bird studies (Fig. 4). The area is easily distinguishable with apparent natural borders. The eastern one is composed of the stream and the western half of the delta immediately east of Myggbukta. To the north the border is made up by the slopes of an extension of Ravnebjerg at an altitude of approximately 50 m. This is where the mountain becomes rocky and steep, and is less exploited by the birds. Ravnebjerg itself is a part of Tågefjeldene that covers most of southern Hold with Hope. The western limit is a small stream at the bottom of a totally barren stream plain, and the southern is the recent shoreline towards Mackenzie Bugt.

The relief in the landscape is dominated in the west by Giesecke Bjerge, a mountain ridge at a distance of about 15 km, with peaks reaching up to 1250 m a.s.l. The southeastern extension of Ravnebjerg obscures the view to the north but, with a peak reaching 270 metres a.s.l., its slopes offer good observation points from which the census area can be surveyed well by using a telescope. Looking southwards across Mackenzie Bugt,

the low and level islet Ternholme is seen at 2.5 km distance. Some 30 km further south, Bontekoe Ø with its steep northern shore can be seen in clear weather. To the southwest the rounded hills at Kap Bennet conceal the view towards Geographical Society Ø.

The main part of the census area is rather flat and lies mainly only a few metres above sea level (Fig. 5). The area declines gently from the foot of Ravnebjerg towards Mackenzie Bugt. It is composed of a well developed and preserved Quaternary beach-ridge system, resulting in a slightly terraced terrain. Along the foot of Ravnebjerg a distinct former shore-line runs in east–westerly direction (shown on Fig. 4). This beach-ridge was found suitable for viewing the census area.

The surface drainage is dammed by the numerous beach-ridges and leaves no less than some 200 small permanent or temporary water-bodies in the area. The permafrost renders infiltration and percolation more difficult, and the many ponds that dry out during the summer do so mainly through evaporation. A few rivulets drain the area and flow into Mackenzie Bugt. The water flow decreases markedly, however, when the snow-melt ends on Ravnebjerg. Only small amounts of flowing water were seen in the tiny rivulets discharging into the stream along the western border – so little that they do not even deserve to be named rivulets.

The tarns and ponds in the census area are all shallow. The maximum depth, about 1 m, was measured in the largest tarn in the north. Pebble, gravel and sand were common bottom substrates of the early drying and less productive ponds. Soft bottom sediments, with silt as the dominant grain size, were found in the more productive lacustrine environments. In the shallow parts of some water-bodies the bottom was covered, to a varying extent, by mats of moss. At the time of the ice break-up in the tarns and ponds, 5–10 cm of the soft bottom sediments had thawed, and two weeks later about 20 cm. The sediment surfaces of these soft bottoms were oxidized and often ochrous. A few cm below the surface the sediment was dark and more reduced. Evolution of gas bubbles from the sediment showed the presence of anaerobic microbial activity.

Certain small areas are almost totally lacking in vegetation (type I, Fig. 6), and the barren surface is covered by silt, and to a certain extent, coarser and less sorted sediments, *i.e.* moraine.

The dominating vegetation type in the census area is a fairly dry tundra, composed of a *Dryas-Cassiope* heath (type II, Fig. 6). This habitat has *Dryas octopetala* and *Cassiope tetragona* as dominating species but also frequent were *Salix arctica, Saxifraga oppositifolia, Silene acaulis, Papaver radicatum, Lesquerella arctica, Potentilla* spp., *Carex* spp. and *Lichenes* spp. Low lying parts in the northwest (type III, Fig. 6) are moist with a continuous moss cover, and thus with various mosses *Bryophyta* spp. as dominants, together with phanerogams of the *Cyperaceae* and *Graminae* families. Other frequent herbaceous species are *Dryas octopetala, Saxifraga oppositifolia, S. nathorstii* and *Draba* spp. Below the snow-drifts on Ravnebjerg, the slopes become distinctly more green and luxuriant than the surroundings, due to long-lasting irrigation. This habitat (type IV, Fig. 6) is dominated by *Bryophyta, Cyperaceae, Juncaceae* and *Graminae* spp.

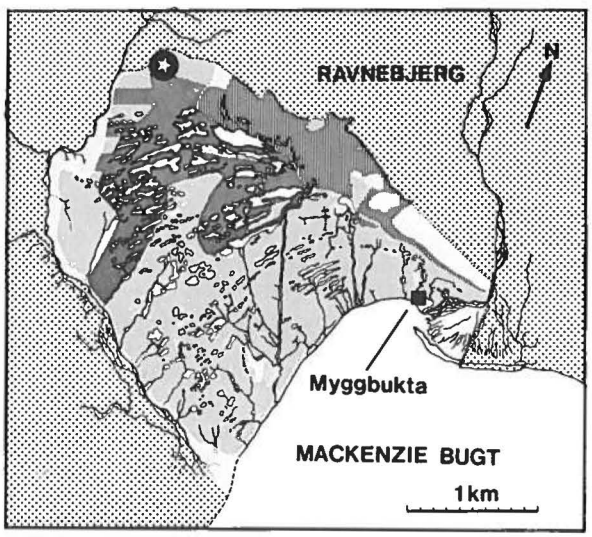

Fig. 6. Map of the census area showing vegetation types (for further details see text). The base camp and an occupied Arctic Fox den are indicated.

Climate, weather and marine conditions

General

Since the establishment of Myggbukta weather and radio station in 1922 and until the final close down in 1959 (Røstad 1960), meteorological observations were made more or less regularly. From the summer 1932 and onwards, the weather records were more continuous and systematically organized. Because of the Second World War, Myggbukta was closed between summer 1940 and summer 1946. The climate during the first decade of weather data collection, has been described and evaluated (Birkeland & Schou 1932). Specific data from the first years of observation can be found only at The Norwegian Meteorological Institute in Oslo, but otherwise all basic meteorological data is tabulated in Norsk Meteorologisk Årbok. A more extensive analysis has been presented by Hovmøller (1947). Synoptical treatments

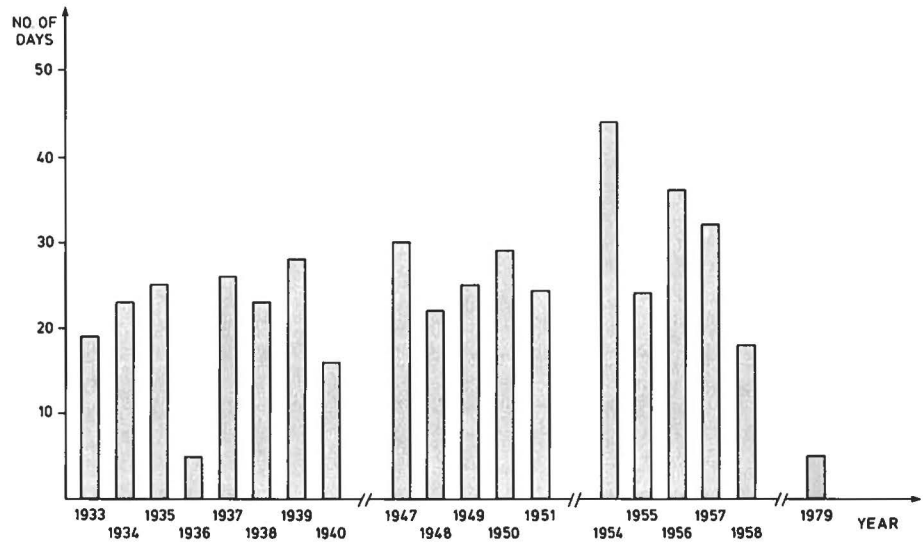

Fig. 7. The yearly number of days after 15 May with snow cover exeeding 75 per cent, as surveyed from Myggbukta.

of Greenland's climate, including data from Myggbukta, have been made by Petersen (1935) and Putnins (1970).

Myggbukta is situated within the High Arctic Region (*cf. e.g.* Johansen 1963, Salomonsen 1972). The winters are long and cold with ambient air temperature down to −50.9°C (Putnins 1970). Polar night prevails from early November until early February. Continuous frost occurs in the months from September until May. Midnight sun lasts from late April until middle of August. The warmest month is July (Putnins 1970). For the 21 years 1932–1940 and 1947–1958 an average July temperature of +3.6°C has been calculated. This is in accordance with the average of +3.7°C for the period 1922–1931 (partly based on geographically interpoled data, Birkeland & Schou 1932). Also during the summer months, cold spells with snowfall are common phenomenons in this part of Greenland (Hovmøller 1947).

The amount of precipitation at Myggbukta is relatively low. The period 1922–1932 had an annual average precipitation of 78 mm (Birkeland & Schou 1932). From the data given for the years 1933–1939 and 1946–1958, an annual average of 310 mm can be calculated. Since precipitation in general is difficult to quantify by gauges (Warnick 1953, Wilson 1954, Bruce & Potter 1957) and the problems are especially pronounced in arctic and other nival areas (Black 1954), with wind-caused snow drift, the obtained quantitative data generally has to be interpreted with care.

It is reasonable to regard ice and snow cover as a significant constraining physical factor for events in the spring and summer progression in arctic environments. In comparison with physical meteorological parameters routinely measured everywhere, *e.g.* wind, temperature, precipitation *etc.*, the extent of ice and snow cover is unfortunately more difficult to determine objectively. However, the records from Myggbukta include the data over 18 previous seasons, when the snow covered less than 75 per cent of the nearest surroundings, *i.e.* the present census area (Fig. 7).

Weather conditions during 1979

According to the average ambient minimum air temperature in June (−0.4°C) and the date when the snow cover declined below 75 per cent (earlier than May 20) (Fig. 7), 1979 was a year with an early spring. These observations may be compared with an average minimum temperature of −1.1°C for June during the years 1932–1939 and 1947–1958 and June 10 as the average data for partial snow uncovering (<75 per cent coverage) during the periods 1933–1940, 1947–1951 and 1954–1958 (Fig. 7). First day with minimum temperature above ±0°C occurred on June 4 (Fig. 8), which also is earlier than average. Mean date for the periods 1932–1939 and 1947–1958 is June 11.

The wind direction in the inner part of Mackenzie Bugt during May to July was influenced by a pronounced land and sea breeze. During the night, a weak northwesterly wind was common, but during daytime a stronger wind from southeast prevailed. Bad weather with snow falls, strong winds and/or fog occurred occasionally. Snow fell during June 9–12. Spells of fog occurred on 14, 19–20 and 25–27 June and on 6–8 and 16–18 July. Cyclones with rain and gale/storm winds passed on 22–23 June and on 9–11 and 14 July.

The snow cover in the census area was first surveyed on May 20. The eastern part close to Myggbukta was then mostly snow-free. The western part of the census area, however, was 90 per cent snow-clad. All tarns and

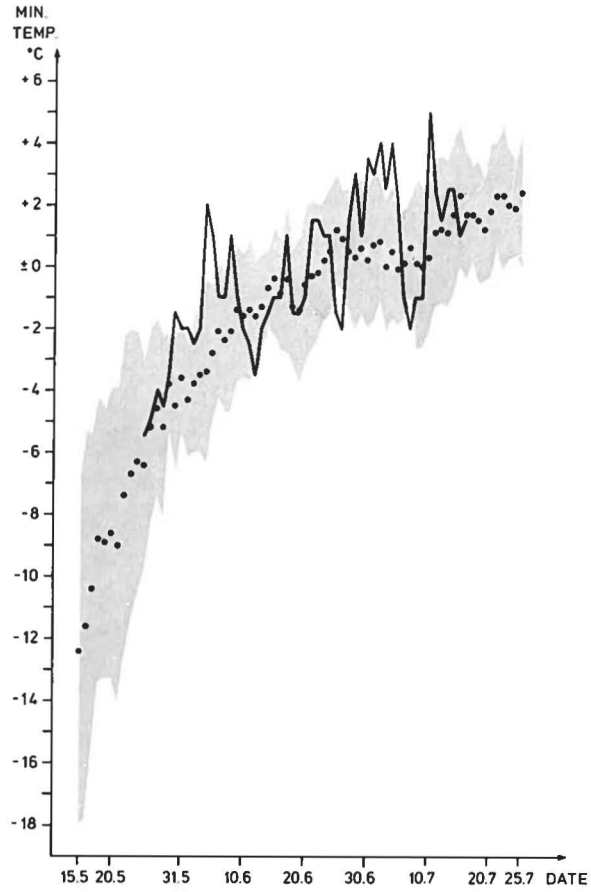

Fig. 8. A comparison of ambient 24 h/day minimum air temperature, as recorded at Myggbukta in 1979 (solid line), and the daily average minimum temperature (dots) from the periods 1932–1939 and 1947–1958 (n = 20). The shaded area denotes one standard deviation (± S.D.).

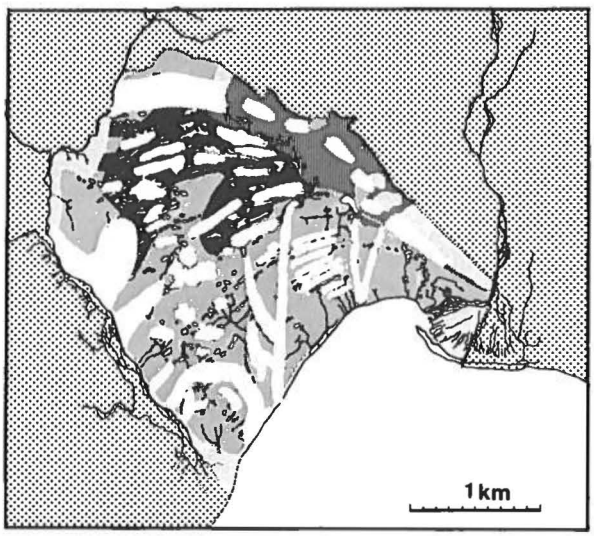

Fig. 9. Extension of snow cover (white areas) on 3 June 1979 in the census area. Note that snow persist only in stream depressions, on ice-covered ponds and tarns, and partly on the south slope of Ravnebjerg.

ponds in the area were still ice-covered. Not until a week later did the pond margins start to thaw.

A second snow-cover survey was carried out on June 3. Snow now remained only to a limited extent in the census area. It was mainly in depressions like stream/rivulet channels and ponds that snow was still present (Fig. 9). Ice-free parts of tarns and ponds occurred during the first days in June, starting in the northern part of the census area. On June 8 all tarns and ponds were completely ice-free. The small stream on the western border of the census area and the stream along the eastern border close to Myggbukta started to run strongly 4–5 and 7 of June, respectively. The melt-off of the coastal plain area west of the census area was slower than that of the census area itself. Snow-drifts on the southern slope of Ravnebjerg persisted until the end of June. Melt water from these snow-drifts flowed down the slope and provided tarns, ponds and marsh lands in the census area with water. Later, during July when the melt-off was over, many of the small ponds dried out.

Marine conditions

The amount of drifting pack ice (the East Greenland Ice or "Storisen") fluctuates considerably between years (Koch 1945 and Skov 1970). The edge of the firm land ice, however, seems to be fairly constant (Koch 1945). A regular feature along the coast is the presence of local areas with open water all year around, or at least from the early spring (Koch 1945 p. 45 and p. 342). When these clearings also are shallow they may provide good foraging sites for *e.g.* Eider *(Somateria mollissima)* and King Eider (*cf.* Manniche 1910, Schaanning 1933a, Pedersen 1942, Rosenberg *et al.* 1970, Meltofte *et al.* 1981b, Hjort *et al.* 1983). One such area was found close to the southeastern corner of Hold with Hope, south of Kap Broer Ruys (Fig. 10). The melt-off of the land ice generally starts in the inner ramifications of the fiord systems. This is due to a more continental climate, compared to the outer coast, with more intense insolation in the spring (Koch 1945).

When the expedition arrived at Myggbukta on May 17, Mackenzie Bugt was completely ice-covered. At the beginning of June the mouths of rivers and streams started to thaw. The mouths, and the shore leads, were, however, almost unexploited by ducks during the first three weeks of June. During a storm on 22–23 of June more leads were formed in the Mackenzie Bugt, and the fiord ice was no longer suitable for safe skiing. The final break up of the fiord ice occurred during a storm on 9–10 of July.

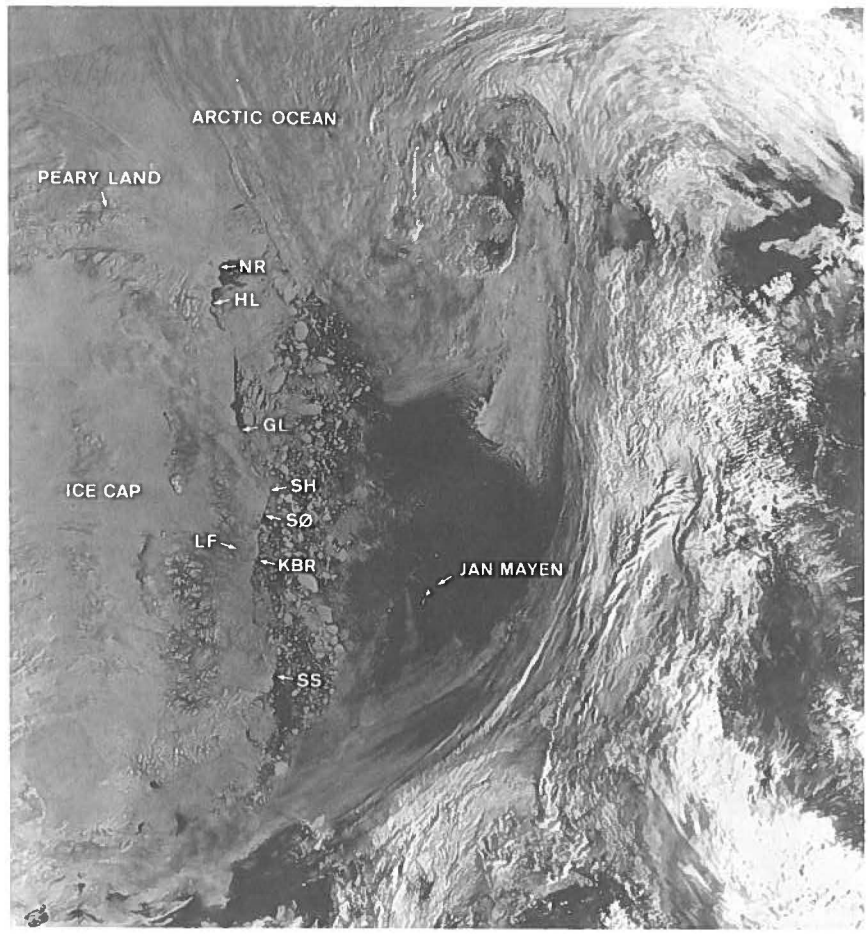

Fig. 10. Satellite imagery registered from NOAA-6, Orbit no. 9879, and received at Tromsø Telemetristasjon on 22 May 1981, showing the ice edge along the Northeast Greenland coast and the drift-ice in the Northeast Greenland Current. Areas available for pre-breeding birds are indicated. NR = Nordostrundingen; HL = Holms Land; GL = Germania Land; SH = Shannon; SØ = Sabine Ø; LF = Loch Fyne; KBR = Kap Broer Ruys; SS = Scoresby Sund.

Non-avian prey and predators

Mammals

The Collared Lemming *(Dicrostonyx groenlandicus)* was fairly abundant in 1979. In May and the first half of June, only a few were actually seen but their tracks were a common sight in the census area. From mid-June the lemmings were seen frequently. The density of lemmings in 1979 seemed to be less than that observed during the peak year 1976 on Hochstetter Forland (Meltofte *et al.* 1981b). Further south, at Mestersvig, 1979 was a peak year with a marked lower abundance during 1980 (Halliday & Higgs 1981). Many raptors, like Snowy Owls *(Nyctea scandiaca)*, Long-tailed *(Stercorarius longicaudus)* and Arctic skuas *(S. parasiticus)* were frequently seen feeding on lemmings, as were Arctic Foxes *(Alopex lagopus)*.

Arctic Foxes appeared frequently in the census area. One pair used a den in the northern corner of the area (Fig. 6). The pair was mixed in respect of colour phases – one was blue and one was white. The adults changed the winter fur successively at the turn of the months May–June. The litter comprised at least five blue and four white phase cubs. Besides lemmings the foxes predated bird's nests and occasionally also adult birds, *e.g.* King Eider and Barnacle Goose *(Branta leucopsis)*. In contrast to 1976 on Hochstetter Forland (Meltofte *et al.* 1981b), no predation on nests of Long-tailed Skua was recorded.

No Stoats *(Mustela erminea)* or Wolves *(Canis lupus)* were observed in 1979.

Limnic invertebrates

The bottom sediments of the fresh water tarns and ponds became accessible to *e.g.* waders and ducks in late May and the beginning of June, respectively. Sediment cores (D 9 cm) were collected with a Plexiglas cylinder. The macrofauna was retained by a sieve with a mesh gauge of 1 mm and subsequently analyzed qualitatively and quantitatively. At this time the benthic macrofauna consisted almost exclusively of larvae of midges, *Chironomidae* (>98.5% *Chironominae*, n = 3435). Emergence of imago midges started in mid-June and were abundant after June 21.

The zooplankton community of the lacustrine environments was sampled by horizontal hauls with a bag net (mesh gauge 1 mm), attached to a 3 m long stick. The planktonic macrofauna was negligible in the ponds two or three weeks after the disappearance of the pond ice. From about June 25 and onwards, two crustaceans appeared abundantly: *Daphnia pulex, (Cladocera),* was the most numerous species and also represented the largest biomass of the species involved. The Tadpole Shrimp, *Lepidurus arcticus, (Notostraca),* was also common at this time of the year, being represented by the first two larvae stages (Poulsen 1940b). These two species are known to be predominant among the East Greenland 'entomostracan' fauna (Poulsen 1940a p. 66, Røen 1962).

Species accounts

Systematic sequence, taxonomy and nomenclature are essentially according to Voous (1973 and 1977). An asterisk (*) denotes observations approved by the Rarity Committee of the Danish Ornithological Society. All times given are GMT, *i.e.* one hour later than local time.

Red-throated Diver *(Gavia stellata)*

The first observation was on June 5, when a single individual apparently reconnoitering the progress of thawing at the breeding grounds, flew over the census area. The next day one pair had alighted on an ice-free pond. On June 7 a third bird was foraging in the mouth of the stream along the western border of the census area. Two pairs were present June 10, a date when courtship display also was heard. A third pair arrived a few days later as one of the pair was seen June 14 and one on June 20. As the pairs could not be distinguished individually, the number of arriving pairs in the census area had to be estimated from the total number of birds observed. The arrival of Red-throated Divers coincided roughly with the appearance of ice-free ponds in the northern part of the census area and also with the arrival of other species dependent on open water, *e.g.* Long-tailed Duck, Eider and King Eider.

Arrival in early thawing years in high arctic East Greenland takes place from the end of May (de Korte 1974, de Korte & Bosman 1975) to mid-June (*e.g.* Meltofte 1975, 1977) and in late thawing years around mid-June (*e.g.* Meltofte *et al.* 1981b). Previous observations of spring arrival specifically at Myggbukta were on June 8, 1937 (Bird & Bird 1941) and June 7, 1939 (Bang 1944); these were two years with fairly late disappearance of snow (*cf.* Fig. 7). The Red-throated Divers did not seem to defend a food resource occurring at that time in a specific area, and two pairs could occasionally be seen together in the same pond. Since adults are ichthyophagous and no tarn or pond in the census area was deep enough to contain fish, the Red-throated Divers exploited the stream mouth west of the census area as a communal feeding place.

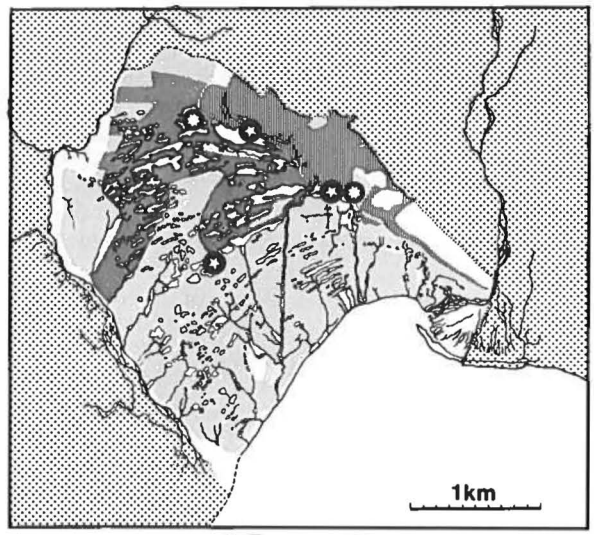

Fig. 11. Nest site selection of Red-throated Diver *(Gavia stellata)* in the census area at Myggbukta 1979. Star in filled circle: nest with early clutch initiation (23 June or earlier); asterisk in filled circle: nest with later clutch initiation (beginning of July). Vegetation type legends: see Fig. 6.

On June 23 a nest with one egg was found. The following day it contained two eggs. On June 24 another two nests were found (Fig. 11), one with two eggs. Incubation continued until July 2 when all three nests were found predated. During the next 10 days, one to three birds were seen regularly at different places around the census area. On July 12 two new nests were found, each fairly close to the predated nests (Fig. 11). There are reasons to believe that the late clutches were replacement clutches (*cf.* Schamel & Tracy 1985) but this was not proven since the birds were not, as mentioned above, identified individually. No check of egg numbers in the late clutches were made and their fate is unknown after July 19 when the expedition left the study area.

Four of the nests found were built-up structures consisting of mosses and other more or less decayed plants, that were picked up from the bottom of the ponds. The islets so formed were surrounded by water but, as the water level progressively lowered, the nests became accessible to mammalian predators. One nest was placed on the shore of a small peninsula in a pond.

Clutch initiation was slightly earlier in 1979 than previously reported from other East Greenland areas (June 28 to July 24; Manniche 1910, Bang 1944, Johnsen 1953, Meltofte 1977, Meltofte et al. 1981b).

The Red-throated Diver is distributed all along Northeast Greenland and was regarded as a particularly numerous breeder on Hold with Hope (Salomonsen 1950), a statement based on a limited material of observations (Kolthoff 1903, Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941). Two pairs nested in the present census area in 1939 (Bang 1944). Breeding in the area has subsequently been reported by Goodhart & Wright (1958), Marris & Webbe (1969) and Hjort (1976).

Fulmar *(Fulmarus glacialis)*

One single observation of a dark phase individual, heading west, was made June 16. The species is not uncommon in the drift-ice in the East Greenland Current (Kolthoff 1903 p. 75, Meltofte 1972, Elander unpubl.) but only occasionally occurs at the coast. In the present study area, single to a few birds have been recorded previously by Nathorst (1900), Løppenthin (1932), Bird & Bird (1941) and Johnsen (1953). Breeding at Kap Kolthoff, Nordfjord, was suggested by Marris & Webbe (1969).

The nearest known breeding places are in the Scoresby Sund district, 300 km to the south (de Korte 1973, Meltofte 1976b) and Jan Mayen (van Franeker & Wattel 1982).

Pink-footed Goose *(Anser brachyrhynchus)*

The first Pink-footed Goose was seen on May 17, at our arrival at Myggbukta. During the next two weeks, a regular passage of migrating Pink-footed Geese was noted but they were few in numbers. In all, about 70 birds were counted with a peak on May 31 (Fig. 12). The course of the spring migration in 1979 was very similar to that observed at Daneborg in 1964 (Rosenberg *et al.* 1970) but appeared to be at least a week later than at Scoresby Sund in 1974 (Meltofte 1976b). Simultaneous observations in 1979 at Hurry Inlet, 300 km south of Myggbukta, gave May 12 as the first day of arrival but a pronounced passage did not occur until May 21 (Hansen 1979). The migration peak was recorded on May 29, *i.e.* two days earlier than at Myggbukta (Fig. 12). The earliest day of arrival during the last two decades has generally been in mid-May (*e.g.* Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975); this seems to be the same as in the 1920's and 1930's (Schaanning 1933a, Bang 1944) or possibly a few days to a week earlier (*cf.* Pedersen 1926, 1930).

It is known that the Pink-footed Goose, like other arctic geese, initiates laying very shortly after arrival (Pedersen 1930, Bang 1944, Meltofte *et al.* 1981b, for a review see Newton 1977). The first egg was found on June 3, outside the census area on the southern slopes of Ravnebjerg, and on June 8, a nest with one egg was found close to a pond in the census area. A second nest was found on June 12 on an islet in a tarn in the northern part of the census area. Both nests were subsequently predated. These, together with the finding of a third empty (but freshly used) nest cup, indicated that three pairs attempted to breed in the census area. The first pairs with pulli were observed in the census area on July 18, when two clutches with three and four goslings, respectively, were seen.

Nests were found outside the census area, in Badlanddal, on the coastal plain east of Myggbukta and in a valley north of the station, but their fates were not followed.

On the basis of observations in the 1930's, the Pink-footed Goose was considered a very numerous and common breeder on *e.g.* Gauss Halvø, Hudson Land and Hold with Hope (Salomonsen 1950, based on Kolthoff 1903, Løppenthin 1932, Pedersen 1934, 1942, Bird & Bird 1941). Only a few nesting pairs were found around Myggbukta in 1939 (Bang 1944).

During later goose study expeditions in 1956 and 1966, yearlings were counted at various places in the present study area (Goodhart & Wright 1958, Marris & Webbe 1969) but less than 20 clutches were encountered each year. In July and August 1973 single pairs or small parties with goslings were again seen (Hjort 1976).

During the last week of June, the moult migration from Iceland started (Fig. 12). From June 24, the migration proceeded through the first two weeks of July, with a peak during the last days of June. In all, 1156

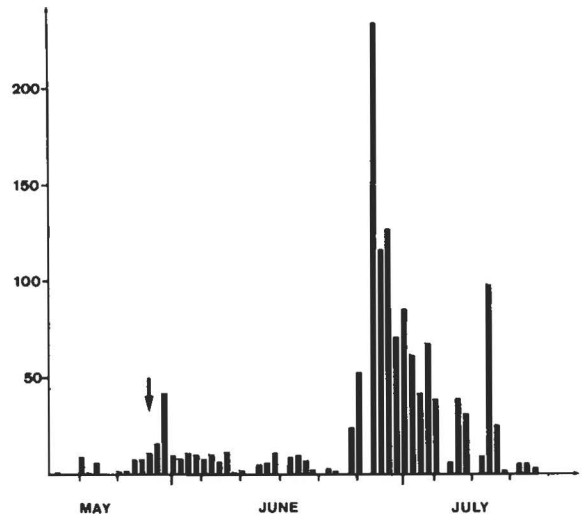

Fig. 12. Northward passage of Pink-footed Geese *(Anser brachyrhynchus)* at Myggbukta 1979. Migrants, temporarily resting birds as well as the sparse resident population, are included in the diagram. The arrow indicates the date of the spring migration peak in 1979 at Hurry Inlet, 300 km south of Myggbukta (Hansen 1979).

birds were counted flying northwards past Myggbukta. The flock size ranged from two to 100 birds, with a mean value of 15.

The moult migration of the Pink-footed Goose from Iceland to Northeast Greenland, first suggested by Taylor (1953), has previously been described in detail (Christensen 1967, Rosenberg *et al.* 1970, Meltofte *et al.* 1981b), and at least a thousand migrating birds have been counted per season at suitable localities. Moult migration was apparently non-existent in the late 1930's (Bird & Bird 1941, Bang 1944).

Flightless moulting birds were encountered from July 9 but very few were actually seen in the census area and in the southern parts of Badlanddal until July 19, when the present studies were finished. During the 20th century, flocks of moulting Pink-footed Geese have been observed, mainly in August, at many suitable places in the present study area, and in numbers up to 1100 birds (*e.g.* Goodhart & Wright 1958, Marris & Webbe 1969, Hjort 1976).

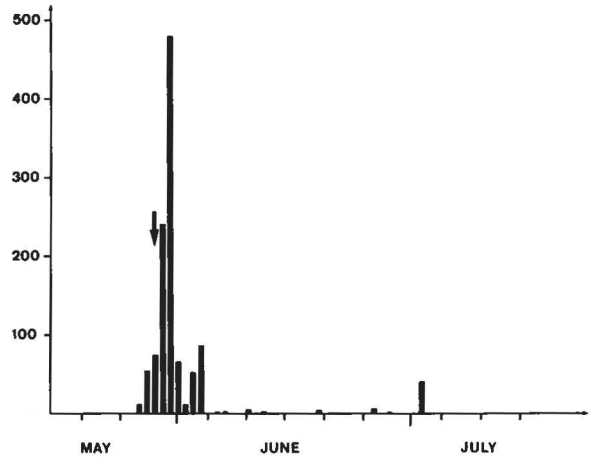

Fig. 13. Northward passage of Barnacle Geese *(Branta leucopsis)* at Myggbukta 1979. Migrants and temporarily resting birds are included in the diagram. The arrow indicates the date of the spring migration peak in 1979 at Hurry Inlet, 300 km south of Myggbukta (Hansen 1979).

Snow Goose *(Anser caerulescens)*

A single bird was seen flying eastwards together with Pink-footed Geese, at Myggbukta on July 4, 1979 and one was seen on June 27, 1982 (Elander & Ericson, unpubl.). Single Snow Geese or small flocks have previously been observed in Northeast Greenland half a dozen times (Salomonsen 1950, Meltofte 1976a, 1976b, 1977, Meltofte *et al.* 1981b). All records refer to the 1970's with the exception of one or two from Scoresby Sund (Salomonsen 1950, Meltofte 1976b). The nearest breeding grounds of the Snow Goose is in the Thule district, where the subspecies *A. c. atlanticus* occurs (Heyland & Boyd 1970). Birds observed on Hochstetter Forland were identified as belonging to this subspecies (Meltofte *et al.* 1981b).

Barnacle Goose *(Branta leucopsis)*

Spring arrival of the Barnacle Goose was somewhat delayed in 1979 compared to what has been described for earlier years (*e.g.* Rosenberg *et al.* 1970, Meltofte 1975). The first northbound flocks were sighted on May 27 and the passage peaked on May 31. When the migration ceased after June 4, 1079 birds had been counted (Fig. 13). This figure includes both birds actually flying northwards and birds temporarily resting in the census area. Arriving flocks often alighted to forage on the southern slopes of Ravnebjerg but, after a short rest, the geese continued to their breeding areas inland or further north (in accordance with Bang 1944). Simultaneous observations in Hurry Inlet (Hansen 1979), 300 km south of Myggbukta, also gave May 27, as the first day of arrival. The peak migration day was May 29, *i.e.* two days earlier than further north.

There is an unusually good documentation of the spring arrival of the Barnacle Goose in Northeast Greenland, from Scoresby Sund to Germania Land, covering the whole breeding range of the species. The mean date of first arrival, calculated from 32 observations in 25 different years between 1892 and 1976, is May 21 (Bay 1894, Manniche 1910, Madsen 1925, Pedersen 1926, 1930, 1942, Løppenthin 1932, Schaanning 1933a, Gelting 1934, Bang 1944, Johnsen 1953, Conradsen 1957, Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1976b, 1977, Meltofte *et al.* 1981b). The earliest date is May 16 and the latest is May 30.

No Barnacle Geese nested in the census area, obviously due to the lack of suitable breeding sites, and the species was only occasionally observed during June and July. Single birds and small flocks were seen on nine occasions. Two flocks of 29 and 10 birds on July 2, all with full flying capacity, were the last Barnacle Geese seen before the studies around Myggbukta were finished. Thus, we were not able to obtain information on the moulting and post-breeding of this species.

Breeding has previously been indicated within the present study area on several occasions (Kolthoff 1903, Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941), and although the species has been considered as a common breeding bird (Bird & Bird 1941) very few nests or broods have actually been encountered. During two more specialized goose counting expeditions in the 1950's and 1960's, only a few broods were encountered, although extensive areas were covered (Goodhart & Wright 1958, Marris & Webbe 1969). In 1973 small

numbers of broods were met with at several places (Hjort 1976), but apparently nowhere in any numbers.

The present study area including Hold with Hope, Hudson Land and Gauss Halvø is a congregation and moulting area for Barnacle Geese during July and August. Flocks of several hundred to more than a thousand have been reported since the beginning of this century (notably by Goodhart & Wright 1958, Jennov 1963, Marris & Webbe 1969, Hjort 1976).

Pintail *(Anas acuta)*

Two adult males were seen daily between June 12 and 17, feeding in ice-free ponds in the northern part of the census area. The species has previously been recorded three times in Northeast Greenland. An adult female was seen between June 14 and 20, 1937 (Bird & Bird 1941). At the mouth of Scoresby Sund a pair was observed on June 1 to 2, 1928 (Pedersen 1930) and an adult male on May 2, 1974 (Meltofte 1976b).

The nearest known breeding place for Pintail is on Iceland (Cramp & Simons 1977).

Eider *(Somateria mollissima)*

Spring arrival of the Eider in high arctic Northeast Greenland takes place from the end of April and during May (Salomonsen 1950). In 1979 the first Eiders were observed on May 22 and 23 at the ice edge south of Kap Broer Ruys (*e.g.* Rosenberg *et al.* 1970, Meltofte *et al.* 1981b, Hjort *et al.* 1983, for accummulation of Eiders in open-water areas before entering breeding grounds). In a mixed flock with King Eiders, a maximum of 250 male Common Eiders and 150 female *Somateria* spp. were counted. The birds were diving intensively for food, and courtship display was heard constantly. The flock was very dense and it was impossible to identify and count the females of the respective species to obtain accurate sex ratios.

At this time the nearest known breeding place, at Ternholme in Mackenzie Bugt, 30 km to the west, was completely icebound. Not until mid-June did a successive thawing and breaking-up of the ice cover around the islet start.

On June 5, the first eiders were seen around the census area at Myggbukta. A flock of 30 *Somateria* spp., most probably *S. mollissima,* made a quick reconnaissance flight. During the following days flocks of up to 60 birds were seen roaming about and they sometimes alighted in the mouth of the western border stream. There was generally a slight excess of males.

Between June 22 and July 11 stormy weather broke and finally removed the ice from Mackenzie Bugt, leaving Ternholme completely surrounded by water.

Most of the Eiders seen at the ice edge in late May were probably to breed on Ternholme, where a large number of old nest cups were found during a visit there on June 5. However, due to the ice conditions the islet became inaccessible to the authors from mid-June and no accurate figures of the breeding population could be obtained. Judging only from the number of post-breeding adult males that accumulated on the open water south of Myggbukta, the population on Ternholme amounted at least to 100 pairs. Nesting apparently started in the first days of July, as the first post-breeders, a flock of 15 males, were observed on July 6. A week later most females were obviously incubating and the post-breeding flock increased to 72 and 111 adult males on July 10 and 11 respectively. The flock off Myggbukta later disappeared and was not seen after July 13.

One or two pairs attempted to breed around the buildings at Myggbukta. One pair was seen almost daily from July 2 to July 11. The birds were foraging along the shore and performing courtship displays. Once copulation was observed. Nest site selection on foot was seen on July 11 and 13, on one occasion lasting up to four hours. Interference and aggressive behaviour from the nearby nesting Arctic Skuas were noted. No nests were found and the birds were not seen after July 13.

A one-year-old male was recorded on July 10, as the only immature bird that could be identified in 1979.

Small numbers of breeding Eiders have previously been reported from the study area (Løppenthin 1932, Schaanning 1933a, Pedersen 1934, Bang 1944, Bird & Bird 1941). Ternholme was apparently not inhabitated by Eiders at the beginning of this century (Kolthoff 1901 p. 144). In 1937 a few pairs were nesting here (Bird & Bird 1941), but in 1939 the species was not mentioned from Ternholme (Bang 1944).

The coastline along Hold with Hope is a congregation area for moulting Eiders, both females with young (Løppenthin 1932, Schaanning 1933a, Pedersen 1934) and males (Goodhart & Wright 1958, Hjort 1976). There are, however, no observations of flocks from the coast of Gauss Halvø or Kejser Franz Joseph Fjord.

King Eider *(Somateria spectabilis)*

The first King Eiders were encountered at the ice edge, south of Kap Broer Ruys, in late May. On May 22 a flock of 19 birds, approximately equal numbers of males and females, were seen. The next day, 40 males and an undetermined number of females were observed in a dense flock together with Eiders (see also under Eider p. 16), totalling some 440 *Somateria* spp. Intensive foraging and courtship display were noted. Concentrations of pre-breeding King Eiders at open water, suitably close to the breeding grounds, have earlier been re-

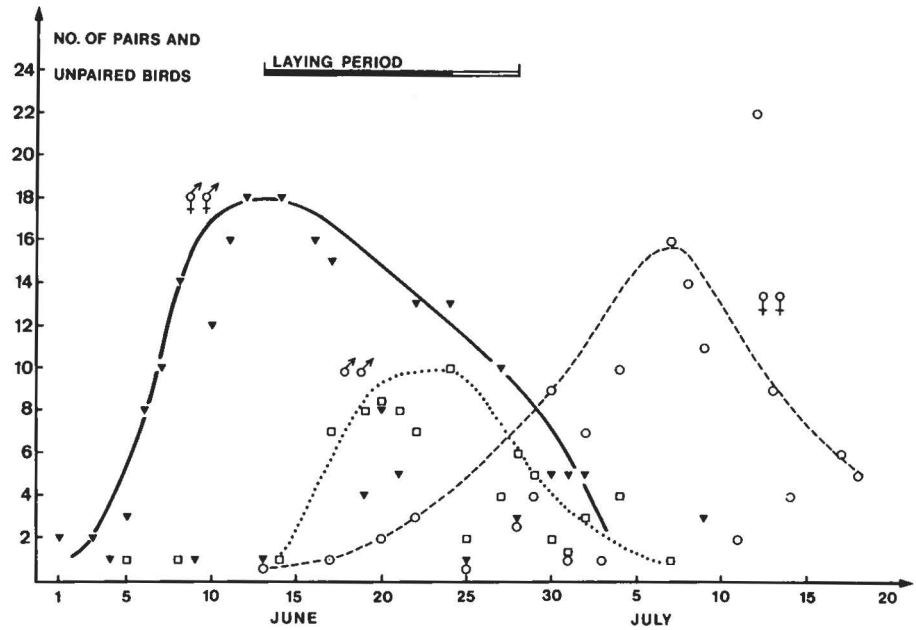

Fig. 14. Population composition and egg-laying period of King Eider *(Somateria spectabilis)* as observed in the census area at Myggbukta 1979. The eye-fitted curves show the maximum number of paired birds (solid line), unpaired males (dotted line) and unpaired females (stippled line) versus time.

corded in May around Sabine Ø (Rosenberg *et al.* 1970, Meltofte *et al.* 1981b) and further north, off Mallemukfjeld on Holms Land (80°N. lat.) in mid-May and at the beginning of June (Manniche 1910, Pedersen 1942). The same seems also to apply to King Eiders in the Canadian Arctic (Lamothe 1973).

In the nesting areas the first arrivals of the year were seen in the evening of June 1, when two pairs flew over the census area. On June 3, two pairs on reconnaissance were seen again and on June 4 two pairs finally alighted on ice-free ponds. The number of pairs gradually increased (Fig. 14) and by June 14 about 18 pairs were present, representing the total breeding population of the area. On two occasions, June 5 and 8, migrating pairs were actually seen arriving from the sea. The date of arrival corresponded well with the opening of ponds (*cf.* Lamothe 1973). The arrival was slightly earlier than previously recorded during early springs in Northeast Greenland (*cf.* de Korte & Bosman 1975, Meltofte 1975, 1976a, 1977) and two weeks earlier than in late springs (*cf.* Meltofte *et al.* 1981b). In 1939, a year with average disappearance of snow (*cf.* Fig. 7), the King Eiders arrived on June 9 (Bang 1944).

The sex ratio of the arriving birds was close to unity, and the birds appeared almost exclusively in pairs. On only two occasions were single adult males seen on the breeding grounds during the pre-laying period.

After arrival the King Eiders gathered in small flocks of up to 12 pairs, to forage and loaf. The flocking tendency was obvious, in contrast to the Long-tailed Ducks that appeared mostly dispersed in single pairs. The King Eiders tended to be distributed widely over the census area but were apparently non-territorial. They fed exclusively in shallow water and along the edges of tarns and ponds. During the first week of June they were seen mainly in the northernmost, and earliest thawing, ponds in the census area, but from June 10 their favourite haunt became a fairly large but shallow pond, only rarely exploited by the Long-tailed Ducks. Here up to 12 pairs were seen daily until the end of June. The maximum depth of the pond was 40 cm and the soft bottom sediment was initially rich in larvae of midges, *Chironomidae,* mainly *Chironominae.* The birds obtained their food not by diving, but by up-ending or dabbling in shallow water (*cf.* Lamothe 1973, p. 80–83) or by foot paddling and subsequent sieving. Larvae of midges was the main prey type also in other ponds and tarns exploited by King Eiders.

Large intersexual differences in the activity pattern were noted during the pre-nesting period of the King Eider (Fig. 15) (*cf.* Meltofte *et al.* 1981b). Our data and interpretation of the activity pattern of the King Eider will be described elsewhere (Blomqvist & Elander in prep.).

Copulation was recorded shortly after arrival. During a 24-hour continuous watch of a pair on June 6, three completed copulations were counted.

Pairs involved in nest site selection were noted from June 11 and the first clutch was initiated on June 13. The behaviour in connection with clutch initiation was

Fig. 15. King Eiders *(Somateria spectabilis)* during the pre-nesting period in the first half of June 1979. The male guards his mate and exerts courtship display while the female is feeding. (Photo: M. Elander)

very similar to that described from Bathurst Island in high arctic Canada (Lamothe 1973 p. 50–53).

From June 17 onwards the number of pairs counted in the census area decreased progressively and the number of single males increased correspondingly (Fig. 14), indicating onset of nesting. By June 27, approximately half of the population was estimated to have started incubation. In the first days of July, the last pairs were seen together, suggesting that laying had then been completed in the whole population.

Ten nests were found within the census area (Fig. 16) and an additional one outside, a few kilometres to the north in Badlanddal. The commencement of laying in 1979 was estimated from six clutches that were either found before completion or at hatching. Date of laying of the first egg ranged from June 13 to approximately June 28. There are no relevant previous data on the range of laying from Hold with Hope or neighbouring areas for comparison. The estimated laying period in 1979 was earlier than indicated by first records of eggs or by hatched clutches in early thawing areas in Peary Land (Johnsen 1953, Meltofte 1976a) and in Germania Land (Meltofte 1977, Meltofte *et al.* 1981b). At Myggbukta laying was initiated two weeks earlier in 1979 than

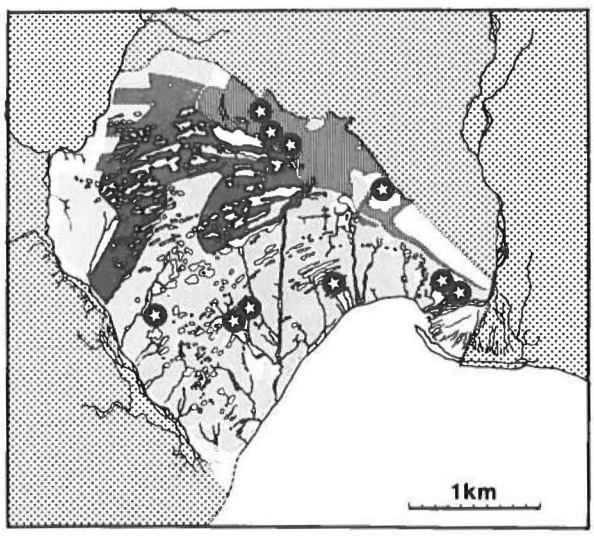

Fig. 16. Nest site selection of King Eider *(Somateria spectabilis)* in the census area at Myggbukta 1979. Star in filled circle: occupied nest cup. Vegetation type legends: see Fig. 6.

Table 1. Clutch size of King Eider *(Somateria spectabilis)*, a regional comparison.

Location	Year	Mean ± S.D.	Range	No. of clutches	Reference
Greenland					
Myggbukta	1979	5.43±0.53	5–6	7	This study
Peary Land	1949	5.50±0.58	5–6	4	Johnsen (1953)
Peary Land	1950	4.20±1.30	3–6	5	Johnsen (1953)
Peary Land	1968	5.00±0.00	5–5	2	Andersen (1970)
Svalbard	1969–71	5.30±0.67	4–6	10	Norderhaug (1977)
Canada					
Perry River region	1949	4.9	–	14	Hanson *et al.* (1956)
Adelaide Peninsula	1957	4.4	2–5	6	Macpherson & Manning (1959)
Prince of Wales Island	1958	4.1	1–8	32	Manning & Macpherson (1961)
Victoria and Jenny Lind Islands	1960–62	5.0 ±0.90	3–6	27	Parmelee *et al.* (1967)
Devon Island	1966–69	4.12±0.83	3–5	8	Hussell & Holroyd (1974)
Bathurst Island	1968	5.25±0.96	4–6	4	Taylor (in Lamothe 1973)
Bathurst Island	1969	4.6	3–6	7	Lamothe (1973)
Bathurst Island	1970	4.33±1.15	3–5	3	Taylor (in Lamothe 1973)
Bathurst Island	1971	4.36±0.93	3–6	14	Lamothe (1973)
Bathurst Island	1972	4.00±0.76	3–5	8	Lamothe (1973)

in 1939 (Bang 1944), a year with longer lasting snow cover, and almost three weeks earlier than during the late thawing spring 1976 on Hochstetter Forland (Meltofte *et al.* 1981b).

Clutch size ranged from five to six eggs with a mean egg number of 5.43 ± 0.53 (n = 7). When comparing our data with those obtained from other areas (Table 1) the small sample in this study must be taken into consideration as well as the fact that only completed and non-predated clutches are included. Eggs measured by vernier callipers to the nearest 0.1 mm from four different clutches (Table 2) were similar in size to those from other arctic regions.

Four or five of the original clutches still survived when the expedition left on July 19. Three were still being incubated and one had obviously hatched on July 18 but neither female nor ducklings were seen in the vicinity. Six or seven clutches were predated. At least two of these were robbed by avian predators, most likely Long-tailed or Arctic Skuas, as shell remnants were found in the nest cups. Four or five were apparently taken by Arctic Foxes. One of these nests might have been partially predated just after hatching, as a female of unknown origin with three surviving pulli were seen along the sea shore on the same day, suggesting that a fox had taken the others. Traces around the nest clearly showed fox predation. On one occasion a fox also caught the incubating female on the nest and the carcass was found on the fox den.

In summary, from a population of about 18 pairs, 10 to 11 were shown to breed within the census area. There is no evidence to suggest that the remaining pairs did not attempt to breed, but their further fate is unknown. Fox predation at an early stage of laying leaves almost

Table 2. Measurements of King Eider *(Somateria spectabilis)* eggs, a regional comparison.

Location	Mean (mm)	Range (mm)	No. of eggs (n)	Reference
Greenland				
Myggbukta	66.4×44.4	64.3–68.9×42.5–46.2	13	This study
Peary Land	66.1×43.6	62.1–68.4×42.9–44.6	5	Johnsen (1953)
Svalbard	65.3×44.7	61.9–71.2×43.0–46.9	41	Norderhaug (1977)
Canada				
Prince of Wales Island	64.1×44.1	63.0–68.1×43.5–45.0	4	Manning & Macpherson (1961)
Victoria and Jenny Lind Islands	64.4×43.2	61.7–67.0×39.9–44.2	12	Parmelee *et al.* (1967)
Bathurst Island	66.8×45.1	–	14	Lamothe (1973)
Miscellaneous				
Various collections:	67.6×44.7	61.3–79.5×41.5–52.0	152	Bent (1925)
	67.0×44.5	61–78 × 41–49	–	Schönwetter (1960)

no marks. Six or seven broods were certainly predated before hatching and, up to July 19, one or two clutches hatched.

The King Eider breeds from Scoresby Sund to Peary Land (Salomonsen 1950, 1967) and is regarded as a common breeding bird on *inter alia* Hold with Hope (Salomonsen 1950), a statement based on a sparse material of observation in the literature (Kolthoff 1903, Schaanning 1933a, Bird & Bird 1941). In June 1939, many pairs were seen around Myggbukta and three nests were found (Bang 1944). In August 1956, four clutches were encountered on three different places on southern Hold with Hope (Goodhart & Wright 1958).

Post-breeding adult males were seen in the census area from June 17. A maximum of ten males were counted on June 24, whereafter the number gradually decreased (Fig. 14). The last male in a lacustrine environment was seen on July 7. Apparently the post-breeding males later moved out to the sea shore and gathered at the mouth of the eastern border stream. Here the number peaked during the first days of July, when a maximum of nine birds were observed. The last male left the study area on July 9.

Post-breeding females gathered in flocks of two to 13 individuals from June 28 and onwards. They were found mostly in fresh water tarns and ponds and did not intermix with the post-breeding males. The number peaked around July 7 (Fig. 14) and post-breeding females were still present in the study area when the studies finished on July 19. From the study area flocks of post-breeding females have previously been reported in July and August (Kolthoff 1903, Bang 1944, Hjort 1976).

Long-tailed Duck *(Clangula hyemalis)*

The first birds arrived on June 5, when two pairs and a single male were seen together in the northern part of the census area. Three pairs were counted on June 6. On the same day two pairs and seven unsexed individuals were seen in open water leads in the ice far off the mouth of the western stream. Intensive courtship display and chasing were noted. An average of three pairs was counted between June 6 and June 12, whereafter the number progressively increased to seven pairs on June 16 (Fig. 17). During the arrival phase sex ratio was close to unity, apart from one or two single adult males that appeared regularly.

The date of first observation in 1979, June 5, is close to that observed in other early thawing areas in Northeast Greenland (*e.g.* Johnsen 1953, Røen 1965, Rosenberg *et al.* 1970, de Korte & Bosman 1975) and in accordance with previous first records at Myggbukta (June 5, 1937 and June 3, 1939) (Bird & Bird 1941, Bang 1944).

The pre-laying period at the breeding grounds was

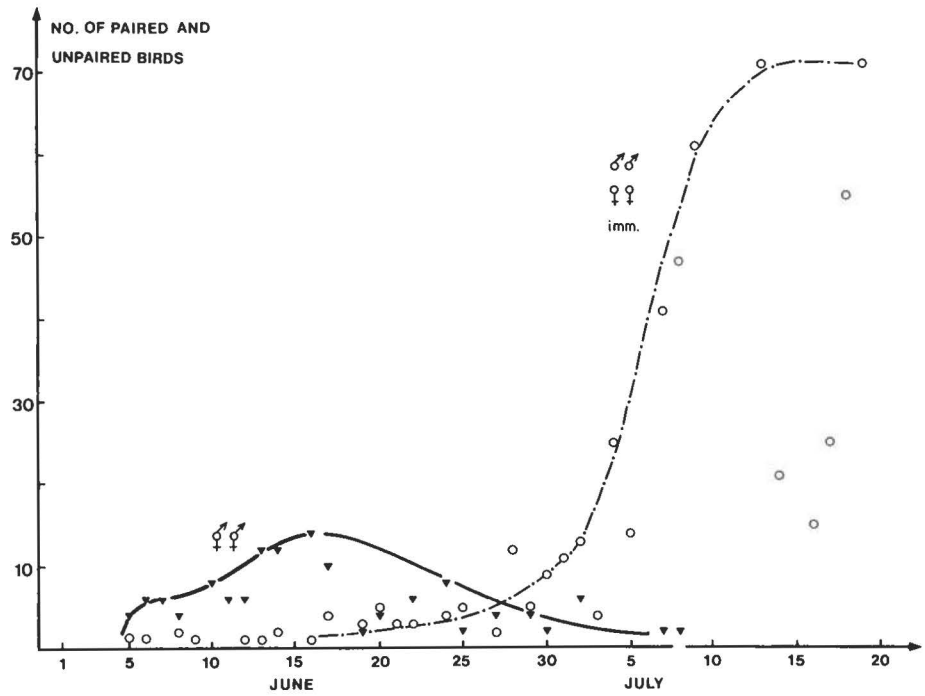

Fig. 17. Population composition of Long-tailed Duck *(Clangula hyemalis)* as observed in the census area at Myggbukta 1979. The eye-fitted curves show the maximum number of paired birds (solid line) and unpaired adult males, females and immature birds (stippled-dotted line).

Fig. 18. Chasing and fighting are common events among pre-nesting Long-tailed Ducks *(Clangula hyemalis)*. The photo shows an alien male attacking a female. This usually turned into a fierce flight chase, where her mate also participated. (Photo: M. Elander)

spent as solitary pairs but apparently not in separate and permanently defended areas, *i.e.* nesting territories *sensu* Noble (1939), contrary to the conclusion in Alison (1975).

The most utilized foraging and roosting place within the census area, was the largest and deepest tarn. Its area was 3.6 ha and the maximum depth was approximately one metre. The soft bottom sediment contained larvae of midges, *Chironomidae,* mainly *Chironominae.* Both sexes obtained these by diving. In mid-June up to four, and occasionally five, pairs of Long-tailed Ducks foraged simultaneously in this tarn. The pairs were spaced rather evenly over the tarn surface. They did not, however, seem to defend specific parts of the tarn, since the pairs apparently switched activity centres from time to time. Although no detailed study of the territoriality of the Long-tailed Duck was undertaken, there is reason to reconsider the well known and fierce chasing (Fig. 18) (*e.g.* Drury 1961) as being a consequence of the defence against raping attempts from neighbouring males rather than defence of a specific area as stated previously (Alison 1975).

The first sign of laying activities was recorded on June 17, when a female was seen performing nest site selection on foot. The number of pairs counted decreased progressively after mid-June, and after June 25 pairs were seen only occasionally. Correspondingly, the number of lone males seen increased from mid-June to at least five individuals and by the end of the month almost all males recorded appeared to be alone or among moulting post-breeding and/or non-breeding birds (Fig. 17).

A nest with five eggs was found in the southern part of the census area on July 2. Three days later the nest was predated. On July 9 another female was seen in suspected breeding circumstances in the southern part, and on July 12 the same applied to a third female in the eastern part, but no further nests were found. From the present material it is not possible to estimate any rate of attempted nesting in the population and consequently not the relative breeding success. The absolute breeding success appeared to be low, since not a single pullus was seen. Reproduction rate may, however, have been higher since single undiscovered clutches might have hatched after July 19, when the expedition left the study area.

The Long-tailed Duck is distributed all over Northeast Greenland and the maximum density *inter alia* ap-

pears to be reached between Mackenzie Bugt and Bessel Fjord, *i.e.* including the present study area (Salomonsen 1950), a statement based on a limited number of observations (Kolthoff 1901, 1903, Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941). At least six pairs nested on Ternholme on 27 June 1939 (Bang 1944). Subsequently only one brood has actually been encountered in the study area (Marris & Webbe 1969).

By the end of June open water appeared in the delta of the eastern border stream, just south of the buildings at Myggbukta. Here an increasing number of post-breeding adults and/or non-breeding immature birds gathered to moult (Fig. 17). Starting with a dozen birds at the turn of the months June–July, the number increased to about 70 in mid-July. Mackenzie Bugt is already known as a gathering area for moulting Long-tailed Ducks. A flock of 500 adult males was seen here on August 1, 1900 (Kolthoff 1901 p. 133) and smaller flocks have been reported on other occasions (Løppenthin 1932, Schaanning 1933a, Bang 1944, Hjort 1976). The inner parts of Loch Fyne and Moskusoksefjord are also known as suitable moulting areas (Kolthoff 1901 p. 189, Marris & Webbe 1969, Hjort 1976), as well as the outer coast of Hold with Hope (Hjort 1976).

Red-breasted Merganser *(Mergus serrator)*

A single adult male was seen at Myggbukta on July 9.

The Red-breasted Merganser is a scarce breeder in East Greenland (Salomonsen 1950). The species is rare but fairly regular around Scoresby Sund but there is only a single proof of breeding in this area (Salomonsen 1967). Further north the Red-breasted Merganser has been observed about a dozen times (Manniche 1910, Schiøler 1926, Pedersen 1942, Smart 1969, M. Elander unpubl. 1975, Ferns 1978, Kempf 1979) and breeding has been confirmed once (Bird & Bird 1941, *cf.* Salomonsen 1979a).

Gyrfalcon *(Falco rusticolus)*

Ssp. *candicans*

A single bird, probably immature, of the subspecies *candicans* was seen sitting on the aerial masts at Myggbukta on June 3. On June 5 it was searching for prey in the census area. On one occasion a fierce chase of a Glaucous Gull *(Larus hyperboreus)* was observed, but the gull finally escaped.

The Gyrfalcon has only been proved to breed within the present study area on a few occasions (Løppenthin 1932, Bird & Bird 1941). Although not only of local origin, the large number of juveniles birds that were seen and shot around Myggbukta in the 1920's and 1930's, may indicate that the Gyrfalcon was, at that time, a more common breeding bird than is indicated by the finds of nests. In 1928, 70 specimens were shot during two autumn months at Myggbukta (Schaanning 1933a), and in the summer of 1936 more than one hundred were shot (Bird & Bird 1941). All birds examined were immatures. Besides the birds shot, great number of falcons migrated through Myggbukta during the summers of 1936 and 1937 (Bird & Bird 1941). At Knudshoved, on northeastern Hold with Hope, a considerable passage of Gyrfalcons were noted in September and early October 1930 (Knudsen 1933). It appears that the Gyrfalcon was numerous in the beginning of the century, especially in connection with the lemming peak years 1906, 1928 and 1936–37. This is supported by observations and collections from neighbouring areas, both north and south of the study area (*cf.* Manniche 1910, Pedersen 1930, Schaanning 1933a). Correspondingly during a probable non-lemming period in 1930–31, only three Gyrfalcons were shot around Myggbukta (Schaanning 1933a) and only a few were seen during the summer and autumn of 1938, a year with scarce lemming occurrence (Bang 1944). Adult birds have been observed more sparsely, even during the years with high abundance at the beginning of the century (Kolthoff 1903, Bird & Bird 1941). During the last decades, there has been no ornithological activity during the autumn migration of the Gyrfalcon and only single birds have been encountered since World War Two (Marris & Webbe 1969, Hjort 1976, Sellar *et al.* 1981).

Rock Ptarmigan *(Lagopus mutus)*

The Rock Ptarmigan is a common breeding bird in Northeast Greenland, although with great variations in numbers between different years (Salomonsen 1967).

In late May and early June displaying males were seen at a few locations between Myggbukta and Kap Broer Ruys. In the census area a single pair was present throughout the summer. The male was seen regularly in the first half of June and occasionally until mid-July in the eastern part of the census area. Display was heard until July 1. The female was observed on July 8, but no evidence of breeding could be obtained.

The limited number of Rock Ptarmigans observed in 1979 resembles the results from 1956 and 1966, when no ptarmigans were seen at all in the areas visited (Goodhart & Wright 1958, Marris & Webbe 1969). During extensive hikes in July and August 1973, only one clutch was encountered (in Tobias Dal, July 26); an additional male on July 28 at Knudshoved; and a pair on August 6 at Myggbukta (Hjort 1976). The observations of Rock Ptarmigan during the last decades contrast greatly with the reports from the first half of the century. In the years 1929 to 1930, the Rock Ptarmigan occurred in exceptionally large numbers. In the two seasons 1928 to

1930, two thousand birds were shot by seven Norwegian trappers in neighbouring areas, from Vega Sund in the south to Godthåb Golf in the north (Schaanning 1933a). During 1930–31, 300 ptarmigans were shot around Myggbukta and 30 in Moskusoksefjord (Schaanning 1933a). The wind-blown and fairly snow-free plains behind Myggbukta apparently used to be an attractive winter haunt for Rock Ptarmigans and they were also abundant there during the snow-rich winter 1936–37 (Bird & Bird 1941).

Ringed Plover *(Charadrius hiaticula)*

The first two Ringed Plovers were seen in the census area on May 30, which is about a week later than average for nearby and somewhat southerly districts (Pedersen 1930, Bang 1944, Rosenberg *et al.* 1970, de Korte 1974, de Korte & Bosman 1975, Meltofte 1976b, Meltofte *et al.* 1981b). During the next few days more birds arrived and in the first half of June eight to twelve birds were recorded regularly in the census area (Fig. 19). Display was heard from June 3 and fighting was observed. One pair was seen several times in the central parts of the census area and at least two pairs stayed in the stream delta east of Myggbukta, but no conclusive evidence of breeding was obtained. In the northern part of the census area up to five birds foraged regularly in June but they probably nested at higher altitudes on the southern slopes of Ravnebjerg, an area where displaying birds were heard on several occasions in June. A suspected breeding record, with a pair of birds showing distraction behaviour in the first half of July in the northwesternmost part of the census area, could not be proven. Thus, it is uncertain if any breeding attempts at all were made within the census area, and the Ringed Plovers probably used the area mostly for foraging.

Judging from previous descriptions of the preferred breeding habitat for the Ringed Plover in Northeast Greenland (Meltofte 1979), the census area around Myggbukta is too well vegetated and partly too swampy to be favourable to the species. The Ringed Plover was, however, found in some numbers on drier and less vegetated locations both in Badlanddal and on Ravnebjerg with appurtenant valleys.

The Ringed Plover has been regarded by most authors as a very common breeder in the study area (Kolthoff 1903, Løppenthin 1932, Bird & Bird 1941, Goodhart & Wright 1958, Hjort 1976). However, actual proof of breeding, by the finding of nests or pulli, are scarce (Kolthoff 1903, Løppenthin 1932, Schaanning 1933a, Hjort 1976). Sightings and collections of Ringed Plovers have commonly been made from the last days of May to mid-September (Bird & Bird 1941, Bang 1944), from Kap Stosch in the north to Mackenzie Bugt in the south and Knudshoved in the east to Dybendal in the west (*e.g.* Løppenthin 1932, Marris & Webbe 1969).

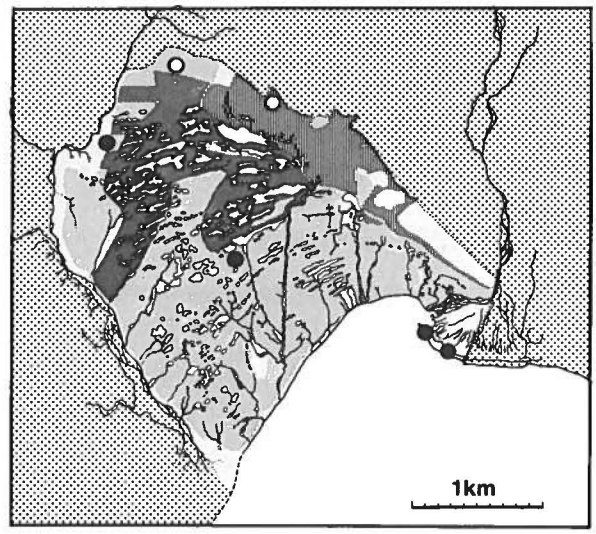

Fig. 19. Resident pairs or displaying males of Ringed Plover *(Charadrius hiaticula)* in the census area at Myggbukta 1979. Filled dot: stationary bird. Open dot: bird less regularly recorded. Vegetation type legends: Fig. 6.

The behaviour of the nesting Ringed Plover, with intense and loud alarm calling around human intruders and injury feigning often very far from the breeding spot (*e.g.* Meltofte 1979), make the nests very hard to find, unless special attention is paid to nest-searching. This may be an explanation as to why only relatively few nests have been found of the most commonly encountered wader species in the area.

Post-breeding flocks of up to ten individuals have been observed in mid-August (Marris & Webbe 1969) and southward migration in large numbers across Mackenzie Bugt were recorded in August 1900 (Kolthoff 1903). In the first week of August 1973, an intense migration of waders including the Ringed Plover was noted on the outer coast of Hold with Hope (Hjort 1976).

Golden Plover *(Pluvialis apricaria)*

Two sightings of single birds were made in the census area on June 16 and July 17, 1979 respectively, and single birds were seen on May 21 and 31 and on June 9, 1982 (Elander & Ericson, unpubl.). The Golden Plover is a regular visitor to the southern parts of Greenland (Nørrevang 1963). On the east coast several observations have been made north to Jameson Land. In 1973 and 1974 breeding was finally established on Jameson Land (de Korte 1975). Three nests were found and it was suspected that more pairs bred. North of Jameson Land, the Golden Plover has been found only occasion-

ally (Meltofte 1975, Ferns & Mudge 1976, Meltofte *et al.* 1981b). The species has previously been recorded a few times at Myggbukta (Bird & Bird 1941).

The nearest breeding grounds besides Scoresby Sund, is Iceland where the Golden Plover occurs abundantly.

Knot *(Calidris canutus)*

The first flocks of Knots were encountered on May 31, when 23 newly arrived birds stayed at Myggbukta and vocal display was heard frequently. A weak passage of Knots was noted in the first week of June, with a single flock migrating north and a few resting flocks recorded. The time of first arrival coincides well with the mean date, May 30, from 14 years of observation along the coast from Scoresby Sund to Danmarkshavn (Manniche 1910, Pedersen 1926, 1930, Bird & Bird 1941, Bang 1944, Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1979, Hansen 1979, Meltofte *et al.* 1981b). Two previous first observations from Myggbukta are dated May 31 (Bird & Bird 1941) and May 27 (Bang 1944). The mean date of arrival is in good agreement with the departure noted from possible staging areas in western Iceland (Wilson 1981) but the migration route of the Northeast Greenland Knots is not fully known.

During June single birds or small flocks regularly foraged in the census area and in the area to the west. On average, five Knots were seen during one day's censusing. Vocal display was heard until June 19. Birds performing distraction behaviour were encountered in the census area on several occasions from June 21 to July 4. However, with the scarce present knowledge of the breeding behaviour of the Knot (*cf.* Hobson 1972, Nettleship 1974) it is hard to evaluate the significance of our observations regarding possible breeding. The extreme difficulty in finding a Knot's nest is well documented (Feilden 1879, Manniche 1910, Ekblaw 1918, Pedersen 1934, Flint 1972) although the birds may be common. In June, Knots were encountered in three separate parts of the census area but no evidence of breeding could be obtained. Consequently, it is uncertain if any pairs attempted breeding here. It is quite possible that they were breeding on higher altitudes on Ravnebjerg and only frequented the census area for foraging. Five separate birds were seen on Ravnebjerg on July 1 and display was heard.

The Knot is considered as a breeder in all suitable localities in Northeast Greenland, being particularly abundant in *e.g.* Hudson Land and Hold with Hope (Salomonsen 1950), but in fact very few breeding records were made (Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941).

In 1979, post-breeding Knots were seen in the census area from June 28. Flocks of up to 35 individuals were recorded, and on July 9 two flocks of 25 and 15 birds showed obvious migratory restlessness. This is in accordance with previous observations from Germania Land (Manniche 1910), where it is stated that the first birds start southward migration in mid-July. Migrant flocks were seen along Foster Bugt in the first week of August 1973 (Hjort 1976). Late birds have been recorded around Myggbukta until August 31 (Bird & Bird 1941).

Sanderling *(Calidris alba)*

The first Sanderlings were seen on May 27 when three birds, apparently two males and a female, alighted west of the census area. During the last days of May a few more were seen but not until the first days of June did most of the Sanderlings arrive. Actual migration was seen on two occasions. On May 29 and June 12, flocks of three and 14 birds passed northwards. No accumulation of Sanderlings was noted in the census area during the migration period (*cf.* Dunlin p. 25). The time of arrival is in accordance with the mean date of arrival during 15 previous years of observation in neighbouring areas (Manniche 1910, Pedersen 1930, Bird & Bird 1941, Salomonsen 1950, Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1976b, 1979, Meltofte *et al.* 1981b). The mean date of arrival is also in accordance with the observed date of

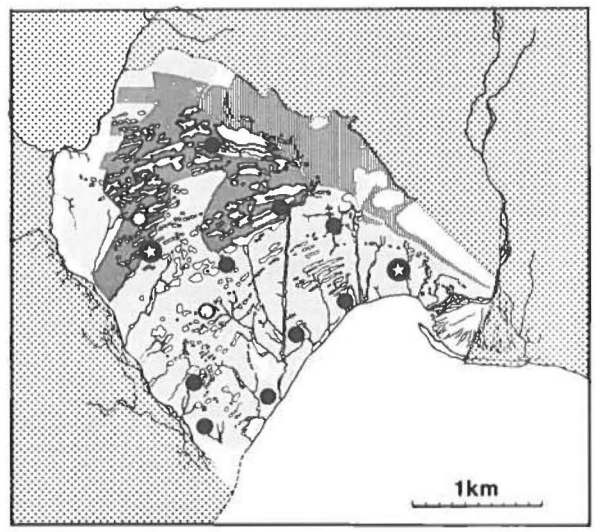

Fig. 20. Nest site selection and resident pairs or displaying males of Sanderling *(Calidris alba)* in the census area at Myggbukta 1979. Star in filled circle: nest. Filled dot: stationary bird. Open dot: bird less regularly recorded. Note the Sanderling's preferance for the dry *Dryas-Cassiope* heath (vegetation type II) compared with the congeneric Dunlin's *(C. alpina)* choice of more moist moss covered areas (vegetation type III, Fig. 23). Vegetation type legends: see Fig. 6.

departure from western Britain and Iceland (Wilson 1981). A direct migration route across the Norwegian Sea north of Iceland, is suggested by Wilson (1981) and supported by observations of the species during spring and autumn on Jan Mayen (Schaanning 1933b).

By the first days of June the local Sanderling population was present in full numbers. Vocal display was heard from June 1 until the first days of July. Pairing and dispersion of birds were apparent from June 2. From repeated censusing in June, 11 to 13 pairs were resident in the census area (Fig. 20). No efforts were made to obtain proof of breeding for the Sanderling. Our criterion for a resident pair was simply repeated records of a single bird or a pair.

Distraction behaviour, including birds running in a crouching posture with erect back feathers, was noted on several occasions from June 4. Flight pursuits were recorded in the beginning of June. Two full clutches were found on July 2 and July 3, respectively, both holding four eggs. At one nest, the sex of the incubating bird was studied, and it was found that both mates were attending the nest. This is in consistency with previous reports on Sanderlings from Northeast Greenland (Pienkowski & Green 1976, Meltofte 1979). In high arctic Canada, however, there is strong evidence for the existence of a multiple clutch system, where each mate incubates separate clutches (Parmelee 1970, Parmelee & Payne 1973). Sanderlings were also recorded from Badlanddal, where several pairs behaved as if they had clutches on July 12.

Flocks of four to twelve birds were seen from mid-June. No southward migration was observed before we left the study area on July 19.

The Sanderling is regarded as a common breeding bird in Northeast Greenland and particularly numerous on *e.g.* Hold with Hope and at Loch Fyne (Salomonsen 1950) in the present study area. Adults and/or juveniles have been encountered at most places in the study area (Kolthoff 1903, Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941, Bang 1944, Goodhart & Wright 1958, Hjort 1976) but possibly in lower numbers along the outer coast of Hold with Hope (Hjort 1976).

Most adults leave the breeding grounds before mid-August (Kolthoff 1903, Salomonsen 1967). Juveniles were observed on southward migration on August 25, 1900 (Kolthoff 1903), and the latest occurrence in the study area dates from September 14 (Bird & Bird 1941).

Pectoral Sandpiper *(Calidris melanotos)**

One individual appeared in the census area on June 4, 1979 and one or two were seen from May 24 to June 10, 1982 (Elander & Ericson unpubl.). The Pectoral Sandpiper breeds on the tundra of the Nearctic region from Hudson Bay to western Alaska, and in the Palaearctic region from Taimyr Peninsula eastward along the Siberian coast (Dementev & Gladkov 1969, Glutz von Blotzheim *et al.* 1975). There are previously 12 known occurrences in West Greenland (Salomonsen 1967). The only previous record from East Greenland is from Danmark Havn, June 13, 1975 (Meltofte 1977).

Purple Sandpiper *(Calidris maritima)*

One bird was seen in the census area on June 6, 1979 and one on May 28, 1982 (Elander & Ericson unpubl.).

A review of the present status of the Purple Sandpiper is given by Meltofte *et al.* (1981b). The species is regarded as belonging to the more maritime climate of the outer coasts in Northeast Greenland and is probably a scarce breeder north to Germania Land.

The Purple Sandpiper has previously been found five times in the present study area (Finsch 1874, Bird & Bird 1941, Bang 1944, Hjort 1976).

Dunlin *(Calidris alpina)*

The first Dunlins were seen on May 28. From about 20 birds the first day, the number of resting and feeding Dunlins in the census area gradually increased during the last days of May. A peak of up to 75 birds were recorded on June 2 to June 3. 71 were seen in a single flock. The migration ceased after the first week of June and the number of Dunlins stabilized in the census area (Fig. 21). Vocal display was heard from the first day of arrival to the turn of the months June–July.

The first date of arrival of Dunlins at Myggbukta in 1979 was very close to mean for Northeast Greenland (Manniche 1910, Pedersen 1926, Bird & Bird 1941, Bang 1944, Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1976b, 1979, Meltofte *et al.* 1981b). This corresponds well with the time when the late passing Dunlins leave western Britain (Wilson 1981). The migration route of the Northeast Greenland population is not fully known, but the abundant occurrence of the subspecies *C.a.arctica* on Jan Mayen (Schaanning 1933b) and the scarce occurrence on Iceland (Wilson 1981), may indicate a direct route across the Norwegian Sea.

A time-activity budget of newly arrived, pre-breeding Dunlins was measured. On June 1, a study of their activities was accomplished in the central swampy parts of the census area. To avoid any biasing effects due to possible circadian rhythms among the birds, the study was made continuously over 24 hours. The day started with foggy weather but it cleared up at noon. In the evening the sky became overcast and just before midnight there was a light snowfall. The wind was almost calm during the day and the ambient air temperature ranged from −2.0°C to +5.5°C. Activities of an average of nine birds

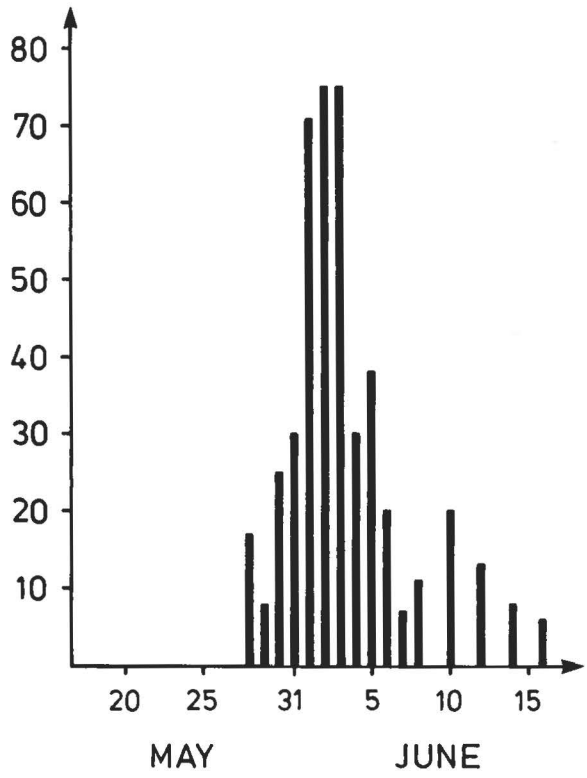

Fig. 21. Arrival and passage pattern of Dunlin *(Calidris alpina)* at Myggbukta 1979. Temporary resting birds and the resident population are included in the diagram.

were recorded simultaneously throughout all 24 hours. The observed flocks ranged from one to 71 birds. This study was made with binoculars (10×) or a telescope (25×) without using a hide but from a distance so that the birds were not disturbed. The birds could not be sexed in the field and thus, possible sexual differences could not be studied. The main activity of a flock was measured by a wrist-watch in about 20 minutes intervals. Simultaneously, minor activities among one or more birds were accumulated on two stop-watches and subsequently filed and subtracted from the main activity time.

Activities were separated into four categories: (1) feeding; (2) resting (loafing and sleeping); (3) comfort movements (preening and bathing); (4) courtship display. Calculations of the fraction of time spent in various activities are presented in Table 3. Feeding was the predominant activity and the birds were feeding exclusively along the shoreline of ponds and tarns to a water depth up to about 5 cm. No purely terrestrial foraging was observed. More than 90 per cent of the time was allocated to feeding. This may be compared to 80 per cent in a staging area in Denmark during spring migration (Petersen 1981) and to 45 and 70 per cent respectively for the male and female Semipalmated Sandpiper *(Calidris pusilla)* during pre-laying at the breeding grounds near Barrow in Alaska (Ashkenazie & Safriel 1979).

Short interruptions for resting were recorded during all hours of the day, ranging from a few seconds to 13 minutes. Only one more continuous period of general resting, amounting to about one hour, was observed. This was in the early morning and coincided with the hours when a thin sheet of new ice covered the preferred foraging places.

Preening was recorded all day in short periods, ranging from a few seconds to five minutes. Bathing was seen once.

Courtship display was heard irregularly and with low intensity but no chasing or flight pursuits were recorded. The total time spent on social interactions was negligible and it may be concluded that at this stage of the pre-breeding season the Dunlins were not paired and defended neither territories nor mates. Most of the birds studied were not resident in the census area.

The potentially available food resource for the newly arrived Dunlins was determined qualitatively and quantitatively. On June 3–4, sediment cores from the foraging spots of the birds were analyzed as described above (p. 12). The macrofauna obtained was almost exclusively larvae of midges, *Chironominae*. The average number of *Chironominae* larvae tended to increase with increasing water depth (Fig. 22); a trend which is statistically significant (rank correlation by Kendall's tau test, with large-scale approximation according to Conover 1980 p. 459; $\tau = +0.35$, $T = 635$, $n = 61$, $z = 3.95$, $p < 0.0002$). In a Dunlin study near Barrow in Alaska (Holmes 1966a), larvae of *Chironomidae* were not found to be a major food type until July.

The breeding population of Dunlins was estimated from repeated censusing during two weeks in June to be 12 to 14 pairs (Fig. 23). The largest concentration was noted in the central and northern marsh areas, quite dif-

Table 3. Time-activity budget of newly arrived, pre-breeding Dunlins *(Calidris alpina)* at Myggbukta, recorded on June 1, 1979.

	Total obs. time	Feeding	Resting	Comfort movements	Courtship display
Accumulated time (bird minutes)	12981	11904	573	503	0.25
% of time spent	100	91.7	4.4	3.9	–

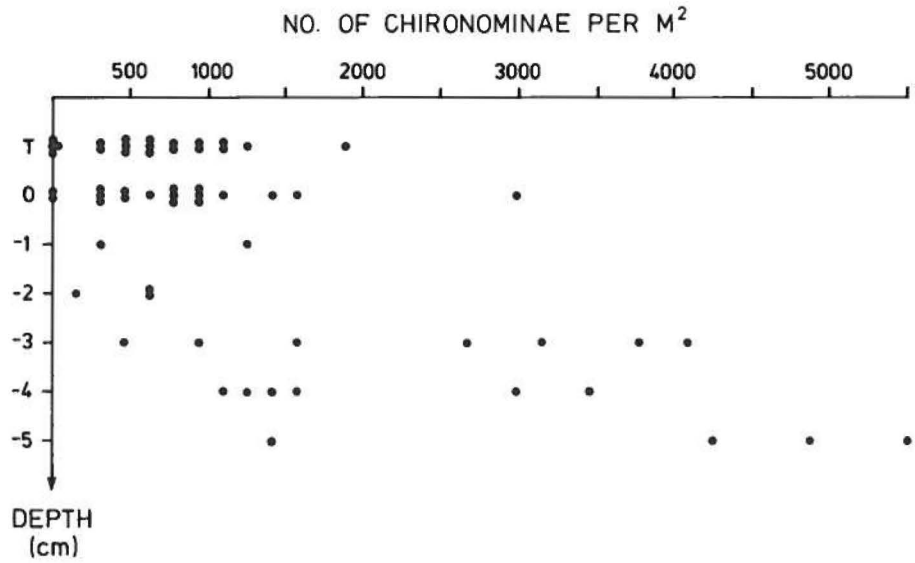

Fig. 22. Abundance of potentially available *Chironominae* larvae for newly arrived Dunlins *(Calidris alpina)*, as a function of increasing water depth. Sampled on foraging spots on 3–4 June, 1979, near Myggbukta. T = terrestrial (*i.e.*, the wet sediment just above the water line). For sampling technique see p. 12.

ferent from *e.g.* the Sanderling. Nests were not searched for. Nest-scraping was recorded on June 8. Dispersion of the birds was obvious from the second week of June, and almost no flocks were recorded until non-breeding birds and/or failed breeders appeared in late June and the beginning of July. Outside the census area, single Dunlins were seen in Badlanddal and in a valley on Ravnebjerg but never in concentrations similar to those found in the census area.

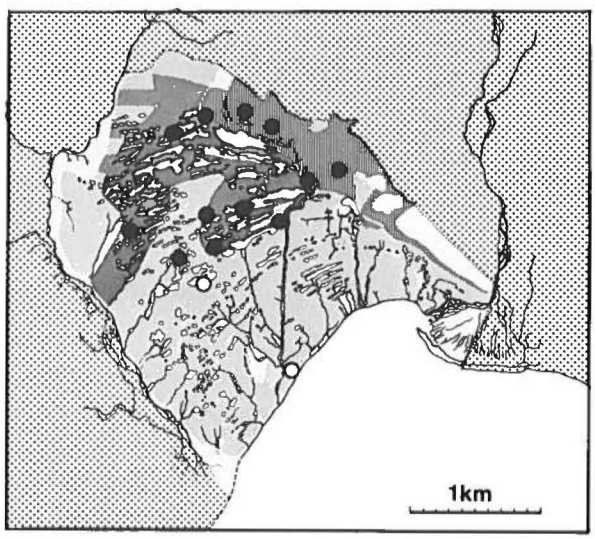

Fig. 23. Resident pairs or displaying males of Dunlin *(Calidris alpina)* in the census area at Myggbukta 1979. Filled dot: stationary bird. Open dot: bird less regularly recorded (*cf.* Fig. 20). Vegetation type legends: see Fig. 6.

Dunlin is regarded as a common breeding bird in the present study area (Salomonsen 1950) and particularly abundant around Mackenzie Bugt (Kolthoff 1903, Schaanning 1933a, Bird & Bird 1941, Bang 1944).

Whimbrel *(Numenius phaeopus)*

A single bird was seen in the delta just outside Myggbukta on June 6, a day with heavy snowfall. After a short rest, the bird left southwards.

The Whimbrel is only occasionally encountered in Northeast Greenland and breeding has never been established (Salomonsen 1967). Apart from a doubtful record of a *Numenius* sp. in Jameson Land in the Scoresby Sund district in 1928 (Pedersen 1930), the first observations originates from 1963 (Hall & Waddingham 1966). Later, the species has been observed in Jameson Land and Liverpool Land (de Korte 1973, 1974, de Korte & Bosman 1975, Hansen 1979, de Korte *et al.* 1981).

The nearest breeding grounds of the Whimbrel is in Iceland, where it is common. The species has been encountered regularly on Jan Mayen (Schaanning 1933b and refs. therein).

Redshank *(Tringa totanus)*

A Redshank was observed on May 31 and June 1 in the vicinity of Myggbukta. A field determination of subspecies was not possible, but the Icelandic subspecies

Tringa t. robusta, which is more likely to be found in East Greenland than the nominate subspecies, has been recorded with certainty only once in the present study area at Myggbukta on May 18, 1939 (Bang 1944).

Redshanks of undetermined subspecies have been seen on a few occasions in the Angmagssalik district (Salomonsen 1967), and on five occasions in Northeast Greenland (Bird & Bird 1941, Møhl-Hansen 1949, de Korte 1973, de Korte *et al.* 1981, Meltofte *et al.* 1981b).

Wood Sandpiper *(Tringa glareola)**

A single bird was seen and heard in the census area in the evening of June 17. When flushed the bird flew towards Badlanddal. A weak vocal display was heard.

This seems to be the first record of Wood Sandpiper in Greenland (*cf.* Salomonsen 1967). There are a few observations and one proved breeding of this species in Iceland (Garðarsson 1969, Pétursson & Skarphéðinsson 1983) but the nearest regular breeding places of the species are in Scandinavia (Glutz von Blotzheim *et al.* 1977).

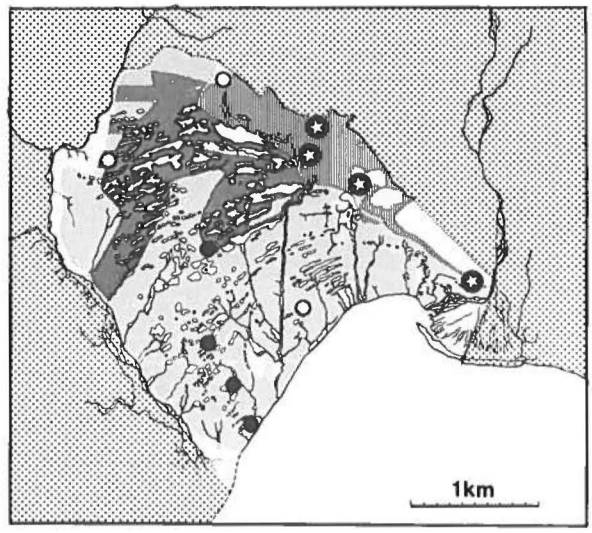

Fig. 24. Nest site selection and resident pairs or displaying males of Turnstone *(Arenaria interpres)* in the census area at Myggbukta 1979. Star in filled circle: nest. Filled dot: stationary bird. Open dot: bird less regularly recorded. Vegetation type legends: see Fig. 6.

Turnstone *(Arenaria interpres)*

The first passing spring migrants were seen on May 24, at the south coast of Hold with Hope, when a flock of ten Turnstones flew northwards. On May 26 a flock of seven crossed the census area. A weak north-bound passage continued until the first week of June. The arrival time corresponds well with the passage through Britain and the time of the sudden departure from possible staging areas in western Iceland (Wilson 1981). The date of first arrival is very close to the mean date from neighbouring areas (Manniche 1910, Bang 1944, Rosenberg *et al.* 1970, Meltofte 1975, 1979, Hansen 1979, Meltofte *et al.* 1981b).

From the first days of June, eight pairs, and possibly a few more, were resident in the census area (Fig. 24). Display was heard from May 30, and flight pursuits and fights were common in June. The first nest was found with four eggs on June 28, but the clutch was probably completed earlier. According to Bird and Bird (1941), the Turnstones normally commence laying in these areas the "the end of the first week" in June. Two more nests, each containing four eggs, were found in the census area on July 1 and July 3, respectively. On July 12 the first young, originating from a fourth nest, were seen. The fate of the other pairs remains unknown, as no separate efforts were made on nest-searching or collecting of data concerning nesting biology. Small numbers of non-breeding birds or failed breeders were noted in the last week of June.

Turnstones were seen outside the census area and they were numerous on the western slopes of Ravnebjerg. They were, however, absent in the drier parts of southern Badlanddal.

The Turnstone is a true high arctic breeder in Northeast Greenland and considered very common in *e.g.* Hudson Land (Salomonsen 1950) in the present study area. Actual proof of breeding has been obtained in many parts of the area by most visiting ornithologists (Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941, Goodhart & Wright 1958, Hjort 1976).

Autumn migration generally takes place from the beginning of August (Salomonsen 1967), but migrating birds have been seen in the present study area as early as July 20 (Hjort 1976). Juveniles may be present around Myggbukta until mid-September (Bird & Bird 1941, Bang 1944).

Red-necked Phalarope *(Phalaropus lobatus)*

The first Red-necked Phalarope, a female, arrived in the census area on June 2. Thereafter, a single female was seen alone almost daily until June 10, when two "pairs" arrived. One female and one male were caught on June 10 and colour ringed. The ringed female was seen regularly in the census area throughout June, but the male disappeared after being ringed. Four birds, two males and two females, were resident until June 30 and seen mainly as a group of one "pair" and an additional male or female. On June 14, an additional female

or possibly three more females appeared together with a single male. No birds were seen in July. Copulation was observed on June 30 but no further indication of breeding was obtained.

The arrival of the Red-necked Phalarope in Northeast Greenland seems to take place from the last days of May or during the first week of June (Pedersen 1930, Bird & Bird 1941, Bang 1944, Salomonsen 1950, Rosenberg *et al.* 1970, de Korte 1974, de Korte & Bosman 1975). Previous first records from Myggbukta are dated June 5 (Bird & Bird 1941) and June 7 (Bang 1944).

During the last ten years, an increased interest has been paid to the mechanisms in the evolution of different mating and parental care systems of waders – both from a theoretical and an ecological point of view (see *e.g.* Jenni 1974, Pitelka *et al.* 1974, Hildén 1975, Emlen & Oring 1977, Graul *et al.* 1977, Maynard Smith 1977, Ridley 1978, Pienkowski & Greenwood 1979, Myers 1981, Oring 1982, Lenington 1984, Oring & Lank 1984). The sex-role reversal of the Red-necked Phalarope and the Grey Phalarope *(Phalaropus fulicarius)* is well-known, and polyandry has been reported to occur among both species (Hildén & Voulanto 1972, Raner 1972, Schamel & Tracy 1977). In evaluations of causal models for the evolution of mating systems, (1) mechanisms for the sex-role reversal and polyandry and (2) their relation to the availability of food during pre-laying period come into focus. At Myggbukta attempts were made to collect field data on this topic. The potential planktonic phalarope food resource was determined qualitatively and semi-quantitatively by regular horizontal hauling with a bag net (mesh gauge 1 mm) (*cf.* Dodson & Egger 1980).

The feeding behaviour of the Red-necked Phalarope at Myggbukta was somewhat different from that of the Grey Phalarope. The Red-necked spent more time on surface-feeding and was never seen strictly edge-feeding (terms from Ridley 1980). Deep-feeding (up-ending), a behaviour which is said to be performed only occasionally by all three species of phalaropes (Höhn 1971), was often recorded for the Red-necked Phalaropes at Myggbukta. The birds were up-ending in shallow water to reach the epifauna of the bottom sediments. Initially, the potentially available food resource for the Red-necked Phalaropes was sparse compared to that for arriving Dunlins. The Red-necked Phalarope has a physical restriction from its bill, which is also reflected by its feeding behaviour. The bill is well suited for surface pecking but not adapted to penetrate the bottom sediments. At the time of arrival and during the pre-laying time, the surface water contained almost no net zooplankton or pleuston, and hatching of adult midges was not abundant until June 21. For 10–15 days after arrival, the Red-necked Phalaropes were thus, to a great extent, limited to feeding on the few chironomid larvae that could be found on the surface of the bottom sediment. The availability of these food items to up-ending or stirring up by spinning (*cf.* Michael 1938) was restricted by the water depth. The spinning behaviour was, however, rarely observed at Myggbukta. The food resource utilized by the Red-necked Phalarope seemed to be even more meagre during the pre-laying than that utilized by the Grey Phalarope (p. 30).

The planktonic food supply increased rapidly from about June 25, when the two phyllopods *Daphnia pulex* and *Lepidurus arcticus* appeared abundantly. An eruptive increase in number is a general phenomenon among cladocerans, with a life cycle characterized by hatching from resting eggs and parthenogenetic reproduction (Allan 1976, *cf.* also Stross *et al.* 1980). The observed pattern of occurrence at Myggbukta of *Daphnia pulex,* with an almost complete absence after the ice disappearance and a rapid increase at the end of June, corresponds also well with previous life cycle studies of the species in East Greenland (Poulsen 1940b).

The observed feeding behaviour of the Red-necked Phalarope in conjunction with the picture of the food resource outlined for the species at Myggbukta is suggestive. There seem to be two counteracting selection pressures working on the timing of breeding for the Red-necked Phalarope. A delaying factor is the initially very meagre accessible food resource for the pre-laying birds. This, in combination with a general selective premium of early breeding (*cf.* Perrins 1970) or a time constraint due to a short breeding season, might have influenced the evolution of sex-role reversal as a successful trade-off. By releasing the female from subsequent parental care duties, she may be able to make an earlier clutch initiation. Serial polyandry, in this hypothesis, is a secondary trait. To improve her reproductive output, and thereby to maximize her evolutionary fitness, the female may, after laying, utilize the eruptive food resource occurring later, and hence subsequently be both prepared and available for a second mating. These observations corroborate in some respects with a previously presented hypothesis (Graul *et al.* 1977). Emanating from a breeding season study of the Mountain Plover *(Charadrius montanus)* on the prairie in Colorado, USA, this hypothesis points out scarce food occurrence and short-term food fluctuations as selecting factors favouring sex-role reversal and serial polyandry. The study was, however, based on speculative indirect evidence regarding the food resources. Concerning the Red-necked Phalarope, our study does not imply that scarce occurrence of food and fluctuations in itself are causal factors, but rather the timing and the specific development pattern of the food supply.

It is known that there may be large fluctuations in a population of Red-necked Phalaropes between different years (Merikallio 1958, Hildén & Voulanto 1972) and the apparent decline in numbers at Myggbukta from the 1930's to 1979 may be either a temporarily low figure, or a result of a long term trend. At Lake Mývatn in Iceland, an impression of decreasing numbers during recent years has been reported (Garðarsson 1979).

The Red-necked Phalarope is locally a common

breeder in the Angmagssalik district, in southeastern Greenland, and distributed in lower numbers north to the inner parts of Scoresby Sund (Salomonsen 1967). The species is encountered irregularly and in small numbers in Northeast Greenland, from Scoresby Sund in the south to Peary Land in the north (Salomonsen 1967).

In the present study area, the first records of Red-necked Phalaropes originate from 1922 (Salomonsen 1950). Furthermore, two juveniles were observed at Kap Stosch in 1932 (Pedersen 1934), indicating breeding. After having been recorded scarcely in the area previously, the species was found breeding commonly near Myggbukta in 1937, with several nests being found (Bird & Bird 1941). In 1939, however, apart from a flock of 20 "phalaropes" on June 20, only a few birds were recorded here and no nests were found (Bang 1944). Gauss Halvø and southern Clavering Ø have been included in the normal breeding range of the species (Salomonsen 1979a) but this must be regarded as speculative.

Grey Phalarope *(Phalaropus fulicarius)*

A male seen on June 2, was the first Grey Phalarope to be observed in the census area. Between June 5 and June 14, one pair was seen almost daily. On June 16, three females and a single male were present but thereafter only a single female was seen, on June 17 and June 24. No indication of breeding was obtained.

Spring arrival of the Grey Phalarope at breeding grounds in Northeast Greenland generally takes place in mid-June, when the fresh water bodies start thawing (Manniche 1910, Rosenberg *et al.* 1970, Meltofte 1975, 1979, Meltofte *et al.* 1981b). A previous first record from Myggbukta is dated June 7 (Bang 1944). The relatively early arrival in 1979 was apparently connected with the unusually early thawing that year (*cf.* Fig. 7).

The food resources potentially available to the Grey Phalarope in the small water-bodies at Myggbukta were initially extremely limited. During the first three weeks of June, the surface layer of the ponds visited by the phalaropes revealed an almost complete absence of zooplankton and pleuston. No abundant emergence of *Chironomidae* occurred before June 21. Possibly, the feeding behaviour of the Grey Phalarope with pecking of prey items from the water surface (*cf.* Ridley 1980), was not very profitable during the first weeks after arrival. However, the Grey Phalaropes were sometimes seen edge-feeding (for terms, see Ridley 1980) and more terrestrial feeding was also observed, with probing of the vegetation close to the shore line. No determination of the potential terrestrial food resources were made, neither qualitatively nor quantitatively. No bill probing similar to that observed for *e.g.* Dunlins was, however, seen among the Grey Phalaropes and no deep-feeding with the birds up-ending was recorded. The bill of the Grey Phalarope is less adapted to efficient penetration of the sediments than *e.g.* that of the Dunlin. We obtained the impression that the edge-feeding was primarily aimed at the sparse epifauna of the bottom sediment and/or terrestrial prey that were visible to the Grey Phalarope. The feeding techniques of the Grey Phalarope on Svalbard with deep-feeding, edge-feeding and surface-feeding (Ridley 1980) are, with the exception of deep-feeding, very similar to those observed at Myggbukta.

The Grey Phalarope was first found breeding around Mackenzie Bugt in 1900 (Kolthoff 1903). Besides one bird shot in 1930 at Myggbukta (Schaanning 1933a) and a statement that the species was a breeder in Hudson Land in the early 1930's (Pedersen 1934) there are no records in the present study area until 1937. That year the species was shown to be a very common breeding bird at Myggbukta (Bird & Bird 1941). Thirty nests were found in the vicinity of the station. In 1939 several pairs were encountered here but only a single nest was found (Bang 1944). Thereafter the Grey Phalarope was not encountered in the area by any visitors until 1979.

The Grey Phalarope shows a very variable population density between different years (Schamel & Tracy 1977, Mayfield 1978, 1979) and the site tenacity seems to be much lower than that found amongst other wader species (Schamel & Tracy 1977). The fluctuations in the Canadian Arctic ranged from 0 to 14 nests per km^2 in 1970–1976 (Mayfield 1978, 1979), and 9 to 24 nests per km^2 were measured in Alaska in 1974–1975 (Schamel & Tracy 1977). It is therefore quite plausible that similar fluctuations may also occur in Northeast Greenland, and that the low population density in 1979 may be only temporary.

Arctic Skua *(Stercorarius parasiticus)*

Arctic Skua arrived at Myggbukta on June 2, when a single light phase bird was seen. A pair, both light phase individuals, appeared on June 5 and was thereafter seen daily until we left. Three birds involved in aerial display were noted on June 8. A nest with two eggs was found close to Myggbukta on June 17 (Fig. 25) and both mates shared incubation. The eggs were not hatched when we left the census area on July 19, although they had been incubated for at least 33 days. Normal incubation ranges from 24 to 28 days (Witherby *et al.* 1958). On two occasions, three birds were seen and on June 28 four Arctic Skuas were recorded. The additional pair probably nested somewhere along the coast east of the census area.

Arrival of the Arctic Skua in Northeast Greenland takes place from the last week of May and during the first week of June (Pedersen 1926, Løppenthin 1932, Bird & Bird 1941, Meltofte 1976b). In 1921 a bird was shot in "Hudson Land" on June 2 (Løppenthin 1932)

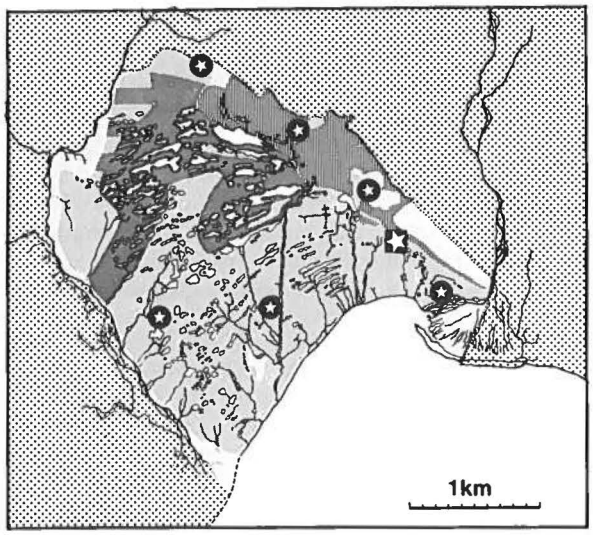

Fig. 25. Nest site selection of Arctic Skua *(Stercorarius parasiticus)* (star in a filled box) and Long-tailed Skua *(Stercorarius longicaudus)* (star in filled circle) in the census area at Myggbukta 1979. Vegetation type legends: see Fig. 6.

and, in 1937, the first birds of the year were seen at Myggbukta on May 24 (Bird & Bird 1941).

The nest in the census area was situated close to a small fresh water pond, 400 m from the sea. The territory was situated between two territories of Long-tailed Skuas (Fig. 25), and vigorous interspecific aerial fights were common. The distance between the nest of the Arctic Skua and those of the Long-tailed Skuas were 450 m in both cases. This is within the range found at Kaolak River in Alaska (Maher 1974).

The Arctic Skuas foraged in the census area, where lemmings were abundant, as well as along and off the coast. To split efficiently and consume a killed lemming the pair of Arctic Skuas used the co-operative technique previously described for the Long-tailed Skua in northern Scandinavia (Andersson 1971), and briefly mentioned for the three breeding skua species in Alaska (Maher 1974). The birds tore the prey apart using only their bills, in a manner that a single bird would not be able to. This co-operative behaviour is apparently feasible since their feet are not adapted to grip the prey while eating. The Arctic Skuas regularly visited Ternholme in Mackenzie Bugt, which harboured both a large colony of Arctic Terns *(Sterna paradisaea)* and of Eiders. The islet was inaccessible to us during the breeding period, and the distance of approximately 2.5 km from the coast did not permit any detailed observations of the skuas' visits there. Egg predation was, however, seen on the mainland and most probably occurred also on Ternholme. Single observations of kleptoparasitism against Glaucous Gulls were made on the mainland.

In Northeast Greenland the Arctic Skua is distributed from Scoresby Sund to Hochstetter Forland with a sparse population (Salomonsen 1967). In the present study area the species has been found breeding or supposed to breed at a few localities (Løppenthin 1932, Pedersen 1934, Marris & Webbe 1969, Hjort 1976), and at least one pair has nested at Mackenzie Bugt during the last century (Kolthoff 1903, Bird & Bird 1941, Bang 1944, Goodhart & Wright 1958, Hjort 1976).

With few exceptions, all Arctic Skuas in Northeast Greenland have been of the light colour phase. Dark phase individuals have only been encountered three times (Bang 1944, Summers *et al.* 1971, Hansen 1979).

Long-tailed Skua *(Stercorarius longicaudus)*

The first Long-tailed Skua was encountered on May 30. The number gradually increased and, by the first days of June, the breeding population was present in full numbers. Arrival of two birds were observed on June 3. Aerial display and the Gliding-cum-Long-Call (Andersson 1971) were noted frequently from June 5. Aggressiveness towards intruders such as humans, Arctic Foxes and Muskoxes (*Ovibos moschatus*) was noted from June 12.

The date of arrival of the first Long-tailed Skua in 1979 was close to the mean, May 31, from 19 years of observation in neighbouring areas (Manniche 1910, Pedersen 1926, 1930, 1942, Bird & Bird 1941, Conradsen 1957, Rosenberg *et al.* 1970, de Korte 1973, 1974, de Korte & Bosman 1975, Meltofte 1975, 1976b, 1977, Hansen 1979, Meltofte *et al.* 1981b). The species seems generally to arrive a few days earlier at Scoresby Sund in the south compared to Danmark Havn in the north. A previous first record from Myggbukta is dated May 29 (Bird & Bird 1941).

A total of six pairs nested in the census area (Fig. 25), giving a population density of 1.0 pairs per km^2, similar to that previously reported from other areas. From the Hurry Inlet area in the Scoresby Sund district, a maximum density of 0.9 pairs per km^2 was measured in 1975, a year of increasing lemming population following the 1974 minimum year (de Korte 1977). A population density of 0.8 pairs per km^2 was found in 1976 in Hochstetter Forland, a year with great local abundance of Collared Lemmings (Meltofte *et al.* 1981b). Similar densities have been reported from northern Sweden (Andersson 1976, 1981), northern Canada (Maher 1970) and Alaska (Maher 1974).

In 1979, Collared Lemmings were abundant in the census area (see p. 12), especially in drier parts, and were seen almost daily. The Long-tailed Skuas were often seen catching lemmings.

The first two clutches were found on June 17 but were probably initiated a few days earlier. Four out of six

clutches found were estimated to have been initiated around June 13 by counting back from hatching dates and given an incubation period of 25 days (Maher 1974). For one clutch the estimated date of initiation was June 18 and one could not be determined. Thus, there was a fairly synchronous start of breeding (*cf.* Andersson 1971). Laying dates for a population on Hochstetter Forland ranged from June 14 to 20 for first clutches (Meltofte *et al.* 1981b), and June 6 to 19 for a population at Hurry Inlet (de Korte & Bosman 1975). During these two studies, arrival dates were similar to that in 1979, and lemmings were abundant, most markedly so on Hochstetter Forland.

Five pairs had clutch sizes of two eggs and one pair had one egg. This gives a mean clutch size of 1.83 for this small sample. A mean clutch size of close to 2.0 has been noted during rodent peak years in northern Sweden, decreasing to between 1.37 and 1.73 in years of low rodent numbers (Andersson 1976).

The nests were efficiently defended against predators, and at least five out of six clutches hatched successfully. Fierce aggressive behaviour, primarily towards Arctic Foxes but also towards Arctic Skuas and Glaucous Gulls was observed. The benefits from distraction and provocation of hunting foxes are demonstrated by the successful hatching of a clutch only about 230 m from the Arctic Fox den. A much higher rate of egg predation was noted on Hochstetter Forland (Meltofte *et al.* 1981b).

Long-tailed Skuas were common also outside the census area and several pairs were encountered on the western slopes of Ravnebjerg as well as in a valley on that mountain.

The Long-tailed Skua is a common breeding bird in Northeast Greenland and particularly abundant in *e.g.* Hudson Land (Salomonsen 1950). The species has been found in the study area by most visitors (Bay 1894, Nathorst 1900, Kolthoff 1903, Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941, Bang 1944, Hjort 1976).

Black-headed Gull *(Larus ridibundus)*

Two adult Black-headed Gulls were observed on May 23 at the ice edge south of Kap Broer Ruys. In 1982 a single bird was recorded at Myggbukta on June 7 (Elander & Ericson unpubl.).

The Black-headed Gull is a recent immigrant to Greenland. Observed less than a dozen times before 1960, the number of records increased drastically during the 1960's and 1970's, and the species has since appeared regularly, with confirmed breeding, in southern and southwestern Greenland (Salomonsen 1979b).

In Northeast Greenland, the Black-headed Gull has appeared only occasionally (Scoresby Sund area: Salomonsen 1967, de Korte 1973, 1974, de Korte & Bosman 1975; Danmark Havn: Meltofte 1975).

Herring Gull *(Larus argentatus)*

Gulls with field characteristics similar to those of a Herring Gull were seen on a few occasions. An adult bird closely resembling a Herring Gull was seen at a close distance near Myggbukta on June 8. The extension of black on the wing-tips was, however, less pronounced compared to Scandinavian Herring Gulls. From below the wings were black only on the 3rd and 4th primaries. The bird had a light coloured iris, with red eye ring, and flesh coloured tarsi, possibly somewhat more red than those of an average Herring Gull. On June 9, three adults, with small individual variations in plumage but with mainly Herring Gull features, were observed outside Myggbukta, and on June 10 one adult bird flew over the census area.

Herring gulls have previously been recorded in Northeast Greenland on six occasions (de Korte 1973, Greenwood *et al.* 1974, Meltofte 1976b, Hansen 1979, Meltofte *et al.* 1981b).

The abundant hybridization between Herring Gulls and Glaucous Gulls on Iceland (Ingolfsson 1970) has resulted in a large proportion of birds in this area with field characteristics intermediate between the original species. In the northwestern parts of Iceland about one fifth of the gull population were found to be hybrids, and on the eastern parts of the island up to 97 per cent. Since many of these hybrids show wing-pattern similar to *Larus glaucoides kumlieni* and *L. thayeri*, positive field identification of these gulls, without provisos, are impossible (Hedgren & Larsson 1973).

The Herring Gull is occasionally observed also on the west coast of Greenland. All nine determined specimens belong to the North American subspecies *L. a. smithsonianus* (Salomonsen 1967). It seems most likely, however, that the Herring Gull-like birds found in Northeast Greenland, originate from Iceland and thus belong to the *Larus argentatus/hyperboreus* complex, rather than being visitors belonging to a North American species or subspecies.

Glaucous Gull *(Larus hyperboreus)*

Glaucous Gulls was encountered at the ice edge off Kap Broer Ruys on May 22 to 24. Up to 11 adults and one immature bird (3rd summer) kleptoparasitized a mixed flock of Eiders and King Eiders. Food piracy against eiders seems to be of frequent occurrence (Kumlien 1879, Hagerup 1891, Meinertzhagen 1959, Ingolfsson 1969, Prys-Jones 1973, Meltofte *et al.* 1981b). No nesting places were found on the south coast of Kap Broer Ruys.

In the census area, single adult birds or two birds together were seen almost daily throughout the summer. On a few occasions up to five adults were seen. Single immature birds were seen on three occasions in late

May and June and a flock of three immatures were observed on July 12. No nesting was recorded.

The Glaucous Gull is distributed over the entire east coast of Greenland north to Peary Land (Salomonsen 1967, Håkansson *et al.* 1981). In the present study area, breeding has been established at several localities (Finsch 1874, Bay 1894, Løppenthin 1932, Schaanning 1933a, Seidenfaden 1936, Bird & Bird 1941, Marris & Webbe 1969). In spite of observations of the Glaucous Gull at numerous places in the present study area over the years, the number of breeding pairs seems always to have been fairly small.

Ross's Gull *(Rhodostethia rosea)**

A single adult Ross's Gull was seen close to Myggbukta on July 4. The bird was in summer plumage with a distinct black neck collar but the pink colour of the body feathers was completely lacking. The bird stayed in the area for a few hours and was eagerly mobbed by both Arctic Terns and Long-tailed Skuas. The observation and a photo of this bird has previously been published (Blomqvist & Elander 1981).

Ross's Gull has been recorded only about 30 times from Greenland, including four records of breeding (review in Kampp & Kristensen 1980). In Northeast Greenland the species has previously been recorded twice (Møhl-Hansen 1949, de Korte 1974). Off the coast, at least 116 Ross's Gulls were observed in the pack ice of the northern Greenland Sea between August 23 and September 10, 1980 (Meltofte *et al.* 1981a).

Arctic Tern *(Sterna paradisaea)*

Arctic Terns arrived on June 14, when at least 40 birds were seen flying above Ternholme in Mackenzie Bugt. This coincided well with the time when the island became inaccessible to terrestrial mammals, including human beings, due to breaking up of the sea ice. By June 15, approximately a hundred Arctic Terns had arrived. However, it was impossible either to determine the exact size of the colony, or to study the breeding biology. The date of arrival is similar to those reported from Hochstetter Forland (Meltofte *et al.* 1981b) and Danmark Havn (Meltofte 1975) further north, but some ten days later than in the Young Sund area (Rosenberg *et al.* 1970).

A small number of Arctic Terns foraged occasionally in the stream delta at Myggbukta in June but no breeding was recorded.

On July 3, five or six birds were seen foraging terrestrially, apparently feeding on insects. This behaviour has been observed previously at Loch Fyne (Løppenthin 1932) and may be an indication of a scarce marine food resource.

The Arctic Tern is generally regarded as a scattered and fairly sparse breeder on the east coast of Greenland (Salomonsen 1967) but may be locally common. The colony on Ternholme in Mackenzie Bugt was already sizeable when first visited at the beginning of August 1900 (Kolthoff 1901, 1903). Although never censused, the island population seems to have been numerous ever since (Løppenthin 1932, Schaanning 1933a, Bird & Bird 1941, Bang 1944, Hjort 1976). Besides this single colony in the present study area, solitary pairs have been found at Loch Fyne (Løppenthin 1932, Schaanning 1933a, Marris & Webbe 1969, Hjort 1976), at Myggbukta (Schaanning 1933a), at Kap Bennet (Bang 1944) and along the outer coast of Hold with Hope (Hjort 1976). Some ten to 20 pairs nested at Kap Stosch in 1930 (Løppenthin 1932).

Snowy Owl *(Nyctea scandiaca)*

Snowy Owls were seen in the census area on only a few occasions. On June 5 a male was seen hunting, and in the first half of July a female or immature bird was seen perching on the cliffs of southern Ravnebjerg on four occasions.

Outside the census area two pairs were found breeding and the male of a third pair was heard calling in late May. One of the pairs was resident in a valley a few km north of Myggbukta. The male was heard calling regularly from the date of our arrival until June 1. The nest was found on May 26 with the female incubating. Hatching took place in mid-June, judging from the pulli, about a week old, that were found in the nest on June 22. The second nest was placed near peak 44 (*cf.* Topographical map, 1:250000) in Badlanddal and contained 6 pulli on June 24, with the last chick newly hatched.

The reproductive output of the Snowy Owl is known to be highly dependent on the abundance of microtine rodents, especially lemmings (Pitelka *et al.* 1955, Sutton & Parmelee 1956, Watson 1957, Hagen 1960, Andersson & Persson 1971, Portenko 1972). However, even in the summertime, the Snowy Owl is not strictly monophagic, and *i.a.* various species of birds, Arctic Hares (*Lepus arcticus*) and *Mustela* species as well as carrion may also be found in the diet (*cf.* Murie 1929, Pedersen 1930, Sutton 1932, Bird & Bird 1941, Wiggins 1953, Pitelka *et al.* 1955, Hagen 1960, Andersson & Persson 1971, Portenko 1972, Custer 1973, Williams & Frank 1979). The possibility of oligophagy also under conditions of lemming abundance was investigated in our study area in 1979. At the end of June regurgitated pellets were collected near the two nests. Seventy-two and 55 prey animals, respectively, were identified to be exclusively Collared Lemmings. Not a single trace of other prey was found.

The Snowy Owl used to be a very common breeding

bird in Northeast Greenland in the beginning of this century, especially during lemming peak years (*e.g.* Manniche 1910, Pedersen 1930, 1934). In more recent years, the overall number seems to have decreased. Even during seasons with lemming abundance, the population figures have not approached those reported in the earlier days (*cf.* de Korte & Bosman 1975, Meltofte 1975, Hansen 1979, Meltofte *et al.* 1981b).

In the present study area the Snowy Owl has been found breeding at several localities over the years (Kolthoff 1903, Løppenthin 1932, Knudsen 1933, Schaanning 1933a, Bird & Bird 1941, Meltofte *et al.* 1981b).

Wheatear *(Oenanthe oenanthe)*

At least one pair of Wheatears nested on the southern slopes of Ravnebjerg in the census area. The nest, with hatched young, was found on July 3. A second pair was seen regularly around Myggbukta from the end of May until the beginning of July, but no proof of breeding was obtained. There was possibly a third pair north of the station, where a male was seen May 31.

Outside the census area, a female was recorded twice from Kap Broer Ruys on May 23 and 24.

In East Greenland, the Wheatear is distributed in decreasing numbers north to Gael Hamkes Bugt (Salomonsen 1967) and possibly even to Peary Land (Håkansson *et al.* 1981), but the supposed population north of 74°N is apparently extremely sparse (Finsch 1874, Pedersen 1934, Meltofte 1972, 1975, Meltofte *et al.* 1981b).

Strong indication or proof of breeding in the present study area have been described by several authors (Kolthoff 1901 p. 187, Schaanning 1933a, Marris & Webbe 1969, Hjort 1976) and pictures the Wheatear as a fairly scarce but regular breeder in the area. The latest autumn records of Wheatear at Myggbukta is September 12 and 17 (Bird & Bird 1941, Bang 1944).

Raven *(Corvus corax)*

Single Ravens or two birds together were seen almost daily in May and the first half of June, but in July single Ravens were observed only occasionally. The birds usually only flew across the census area and no indication of breeding was obtained. Outside the census area, Ravens were seen between Kap Franklin and Kap Bennet and at Kap Broer Ruys during the second half of May.

The Raven is regarded as a regularly occurring species in Northeast Greenland at all times of the year, but is usually relatively scarce and nests were never found (Salomonsen 1950, 1967). There are, however, strong indications of breeding from various parts of the coast (Kolthoff 1903, Manniche 1910, Meltofte *et al.* 1981b). A pair with four barely fledged juveniles was encountered near the breeding site in a canyon east of the census area on June 10–11, 1982 (Elander & Ericson unpubl.) and is apparently the first proof of breeding in this part of Greenland. In the present study area, Ravens seem to have been fairly common in the late 19th century and in the beginning of the 20th (Finsch 1874, Kolthoff 1903). The species was numerous at Mackenzie Bugt in August 1900, and adult birds with fledged juveniles were seen on the shores (Kolthoff 1903). Because Ravens destroyed the catches of fox trappers a systematic extermination of the birds started in the late 1920's. In a few years Norwegian trappers killed about 200 Ravens along the coast, some 20 at Myggbukta (Schaanning 1933a). In the 1930's, the species had become almost a rarity and only single birds were seen (Løppenthin 1932, Schaanning 1933a, Pedersen 1934, Bird & Bird 1941, Bang 1944). The Raven has not recovered since and still only odd birds or two together may be observed (Marris & Webbe 1969, Hjort 1976).

Redpoll *(Carduelis flammea)*

The only record of Redpoll during the 1979 expedition was a bird seen at Myggbukta on June 1. The observation was not made under conditions permitting subspecies identification. An additional bird was heard on June 3.

Two subspecies may be discerned among the East Greenland Redpolls (Salomonsen 1950): *Carduelis f. rostrata* with its northern breeding limit around Scoresby Sund (Salomonsen 1967, Waterston & Waterston 1970), and *Carduelis f. hornemanni* breeding in the high arctic region north of Scoresby Sund (Salomonsen 1967).

Ssp. *rostrata*

The Greenland Redpoll *C. f. rostrata* has been reported once from the present study area: an adult female was collected at Moskusoksefjord on May 28, 1937 (Bird & Bird 1941).

Ssp. *hornemanni*

The Arctic Redpoll *C. f. hornemanni* is thought to be a fairly common breeder in the present study area (Bird & Bird 1941), although no nests have been found. The species is no doubt rare in the coastal areas (Salomonsen 1967) and most observations, including juveniles, are from the mountainous inland and the inner fiord regions (Finsch 1874, Løppenthin 1932, Schaanning 1933a, Pedersen 1934, Bird & Bird 1941, Marris & Webbe 1969, Hjort 1976, Sellar *et al.* 1981). The Redpoll possibly winters in the area, as there are November and December records (Pedersen 1934, Bird & Bird 1941).

Lapland Bunting *(Calcarius lapponicus)*

A newly dead female Lapland Bunting was found outside Myggbukta on June 5. In 1982, a single bird was seen at Kap Broer Ruys on May 20 (Elander & Ericson unpubl.).

The Lapland Bunting is a common breeding bird on the east coast of Greenland, north to Angmagssalik (Salomonsen 1967). Breeding has occurred occasionally in the Scoresby Sund district (Pedersen 1930, Bertram *et al.* 1934, Hall 1966, Waterston & Waterston 1971).

The only previous documentation on Lapland Bunting in the present study area consists of five birds collected at Myggbukta between April 20 and September 18, 1937 (Bird & Bird 1941). There are no indications of breeding reported.

Snow Bunting *(Plectrophenax nivalis)*

Snow Buntings normally arrive in Northeast Greenland as early as mid-April (Salomonsen 1967) but single years even in late March and beginning of April (Bang 1944). The species was already present when the expedition arrived at Myggbukta on May 17. During May and June, a few individuals were seen daily, foraging in the census area. The nearest nesting places were in rocky terrain on the slopes of southern Ravnebjerg, and there the species was abundant. A nest with three to four eggs was found on July 1. The first fledged young was seen on July 12, in full accordance with previous records from Mestersvig (Green & Summers 1975, Asbirk & Franzmann 1976).

Snow Buntings were seen at all places visited outside the census area.

The Snow Bunting is the most common breeding bird in Greenland and distributed all over Northeast Greenland. In the present study area the species has been seen by all visiting expeditions. Arrival of males has been recorded from late March to mid-April (Schaanning 1933a, Bird & Bird 1941, Bang 1944) and females from beginning of May (Bang 1944). After breeding, from the middle of August and onwards, the birds are seen in flocks of up to 60 (Goodhart & Wright 1958, Marris & Webbe 1969, Hjort 1976), and departure normally takes place in September. A few birds stay until November (Bird & Bird 1941, Bang 1944), and the species has been observed as late as December 10 in the area (Bird & Bird 1941).

Supplementary list of birds

Below are listed species which have been encountered in earlier years or by M. Elander and M. Ericson (1982: Myggbukta May 13–July 18; unpubl.) within the study area, but which were not seen in 1979.

Great Northern Diver *(Gavia immer)*

The species has previously been found breeding in the present study area (Bird & Bird 1941). Single adult birds have been recorded on a few occasions (Munsterhjelm 1937 p. 138, Goodhart & Wright 1958, Marris & Webbe 1969, Hjort 1976).

Whooper Swan *(Cygnus cygnus)*

The note from Clavering's expedition in 1823, that a few Swans were shot in Gael Hamkes Bugt on August 21 (Clavering 1830) is doubted by Salomonsen (1950). If the record is correct, the birds were most certainly Icelandic Whooper Swans.

White-fronted Goose *(Anser albifrons)*

Four adult birds were observed in Hudson Land on August 24, 1973 (Hjort 1976). Earlier reports (Kolthoff 1901 p. 138, Bird & Bird 1941) are doubtful.

Wigeon *(Anas penelope)*

A female Wigeon was collected at Myggbukta on June 25, 1939 (Bang 1944).

American Golden Plover *(Pluvialis dominicana)**

One bird was encountered on May 24, 1982 (Elander & Ericson unpubl.). The species is an occasional visitor to Greenland (Salomonsen 1967) and is previously recorded once from Northeast Greenland (Pedersen 1930).

Grey Plover *(Pluvialis squatarola)*

An adult male in summer plumage was shot at Carlshavn on Hold with Hope by a Danish trapper in June 1923 (Bird & Bird 1941, Salomonsen 1967). Another record (Bird & Bird 1941) is very doubtful.

Pomarine Skua *(Stercorarius pomarinus)*

Two birds were seen at Myggbukta and over Ternholme in Mackenzie Bugt on June 27, 1937 and one was seen on June 30, 1937 (Bird & Bird 1941).

Great Skua *(Stercorarius skua)*

An adult male was shot at Myggbukta on June 3, 1937 and a single bird was observed twice, on June 14 and 15, 1937 (Bird & Bird 1941). Single birds were seen north of Kap Broer Ruys on July 31, 1973 (Hjort 1976), and at Myggbukta on June 15, 1982 (Elander & Ericson unpubl.).

Sabine's Gull *(Xema sabini)*

Single or a few birds have been observed occasionally in the present study area (Pedersen 1934, Bird & Bird 1941, Marris & Webbe 1969). "Many" Sabine's Gulls gathered at a seal carcass on August 24, 1937 (Bird & Bird 1941). A single adult bird was recorded at Myggbukta on July 13–14, 1982 (Elander & Ericson unpubl.).

The first proof of breeding in the present study area was reported from the south coast of Gauss Halvø in 1976. Hatching was in progress on August 14 (Meltofte *et al.* 1981b p. 53). Regular breeding in Northeast Greenland is known to occur only on Sandøen in Young Sund and possibly on Renskæret at Danmark Havn (Salomonsen 1967).

Great Black-backed Gull *(Larus marinus)*

A subadult bird stayed at Myggbukta between June 9 and July 5, 1982 (Elander & Ericson unpubl.). The species has previously been recorded from Northeast Greenland (Bird & Bird 1941, Meltofte 1975, Meltofte *et al.* 1981b) and is nowadays regarded as a regular summer visitor in the Scoresby Sund area (Meltofte 1976b).

Kittiwake *(Rissa tridactyla)*

A few individuals were seen close to Bontekoe Ø in Foster Bugt on August 18, 1930 (Løppenthin 1932). The Kittiwake has rarely been seen close to the shore in Northeast Greenland, except at the breeding sites.

Ivory Gull *(Pagophila eburnea)*

An immature male bird was shot at Myggbukta on September 9, 1937 (Bird & Bird 1941), and three were seen in the pack ice off Kap Franklin on August 7, 1978 (M. Elander unpubl.).

Brünnich's Guillemot *(Uria lomvia)*

This species was apparently observed at Kap Broer Ruys on July 15, 1898 from the *"Antarctic"* during Amdrup's expedition to East Greenland (Deichmann 1909).

Black Guillemot *(Cepphus grylle)*

Two immature birds were collected at Mackenzie Bugt and Kap Franklin in the first half of September 1936, and more birds were seen (Bird & Bird 1941). Off the coast of Hold with Hope, a very big flock was seen on September 26, 1936, a single bird later in October (Bird & Bird 1941), and flocks of four were recorded on September 4, 1938 (Bang 1944) and ten birds in mid-July 1948 (Johnsen 1953).

Little Auk *(Alle alle)*

Non- or post-breeding birds have occasionally been seen off the coasts of the present study area (Deichmann 1909, Bird & Bird 1941, Bang 1944, Johnsen 1953, Marris & Webbe 1969).

Common Puffin *(Fratercula arctica)*

A single bird was recorded from Mackenzie Bugt on September 30, 1936 (Bird & Bird 1941).

House Martin *(Delichon urbica)*

A male specimen was collected in the kitchen of Myggbukta on September 17, 1937 after stormy weather (Bird & Bird 1941).

Willow Warbler *(Phylloscopus trochilus)*

One male specimen was collected at Myggbukta on September 18, 1937 after a strong northwesterly gale (Bird & Bird 1941).

Starling *(Sturnus vulgaris)*

A flock of five was seen at Myggbukta on October 5, 1936 after a heavy gale (Bird & Bird 1941). Two birds were collected.

Discussion

Status of the breeding populations at Myggbukta

Compared to other high arctic localities, the coastal plain near Myggbukta appears to be a very favourable area, with comparatively dense bird populations. This is true especially for some species of ducks, waders and skuas. The estimated abundance of the six most common species are tabulated (Table 4) and, as a comparison, figures from other areas in Northeast Greenland are included.

An estimated density of 1.1 pairs per km² of Long-tailed Ducks is the highest known in Northeast Greenland, and is comparable to previously reported densities of 1.1 pairs per km² in Hudson Bay in Canada (Alison 1975) and 0.7–1.1 pairs per km² in northern Sweden (Pehrsson 1977). Still higher population densities may be found in Iceland (Gardarsson 1979).

The present census area around Myggbukta seems to be an appropriate habitat for the King Eider, also in a circumpolar perspective. The estimated abundance of 3.0 pairs per km² is the highest density reported from Northeast Greenland. In a corresponding high arctic area on Bathurst Island in northern Canada, a density of 0.3 pairs per km² can be calculated (from data in Lamothe 1973) and, on low arctic coastal tundras in northeastern Siberia, densities between 0.5 and 10 pairs per km² have been reported (Uspenski 1972).

Turnstone and Sanderling generally prefer a more dry nesting habitat, and the present census area is probably too moist to be optimal. The estimated densities of 1.3 and 1.8–2.1 pairs per km², respectively, are lower than those from some of the most favourable areas in Northeast Greenland (Table 4). On Ellesmere Island in high arctic Canada, a Turnstone density of 3.0 pairs per km² has been reported (Nettleship 1973) and, on Bathurst Island, a Sanderling density of up to 2.3–3.1 pairs per km² has been found (Parmelee 1970).

The Dunlin abundance of 2.0–2.3 pairs per km² is fairly high compared to other areas in high arctic Northeast Greenland but, in comparison with low arctic and subarctic areas around the world, *e.g.* Alaska (Holmes 1966b, 1970, Norton 1973), northern Iceland (Wink 1973) and southern Finland (Soikkeli 1967), the density figures are moderate. A comprehensive survey on high arctic wader populations in North and Northeast Greenland is published by Meltofte (1985).

A discussion of the breeding densities of the Long-tailed Skua can be found on p. 31.

A case of spatial niche segregation

One of the main tasks of the present expedition was to study pre-nesting behaviour and social organization on the breeding grounds among selected precocial bird species – ducks and waders – and relate these to the potentially available food resources. In connection with these studies, it became evident that the almost sole prey type that was available initially for all lake-feeding species, was larvae of midges, mainly *Chironominae* (*cf.* p. 12). The chironomid larvae obviously constituted the prominent food resource for the pre-nesting King Eiders, Long-tailed Ducks, Dunlins and Red-necked Phalaropes. In addition to these four species, sediments containing the midge larvae were partly exploited also by Knot, Sanderling, Turnstone and Grey Phalarope. When different species utilize a single food resource, key ecological concepts such as interspecific competition, resource partitioning and niche theory come into focus (*cf. e.g.* Levins 1968, Vandermeer 1972, Cody 1974, Schoener 1974, 1982, Colwell & Fuentes 1975, papers in Whittaker & Levin 1975, Cohen 1978, Hutchinson 1978, Connell 1980, Pianka 1981, 1983, Simberloff 1982).

Table 4. Breeding densities (pairs per km²) of a selected set of bird species in Northeast Greenland.

Species	Location				
	Liverpool Land (de Korte 1977, de Korte *et al.* 1981)	Scoresby Land (Hall & Waddingham 1966, Ferns & Mudge 1978)	Hold with Hope (This study)	Hochstetter Forland (Meltofte *et al.* 1981b)	Germania Land (Meltofte 1977, 1979)
King Eider *(Somateria spectabilis)*	–	–	3.0	0.8–0.9	2.0
Long-tailed Duck *(Clangula hyemalis)*	–	–	1.1	0.5–0.6	0.2–0.4
Sanderling *(Calidris alba)*	0.3	0.1	1.8–2.1	1.6	2.9–3.3
Dunlin *(Calidris alpina)*	1.3	0.3	2.0–2.3	1.1–1.3	4.0–4.4
Turnstone *(Arenaria interpres)*	2.1	0.3	1.3	2.0–2.1	3.7
Long-tailed Skua *(Stercorarius longicaudus)*	0.6–0.9	0.3	1.0	0.8	0.4

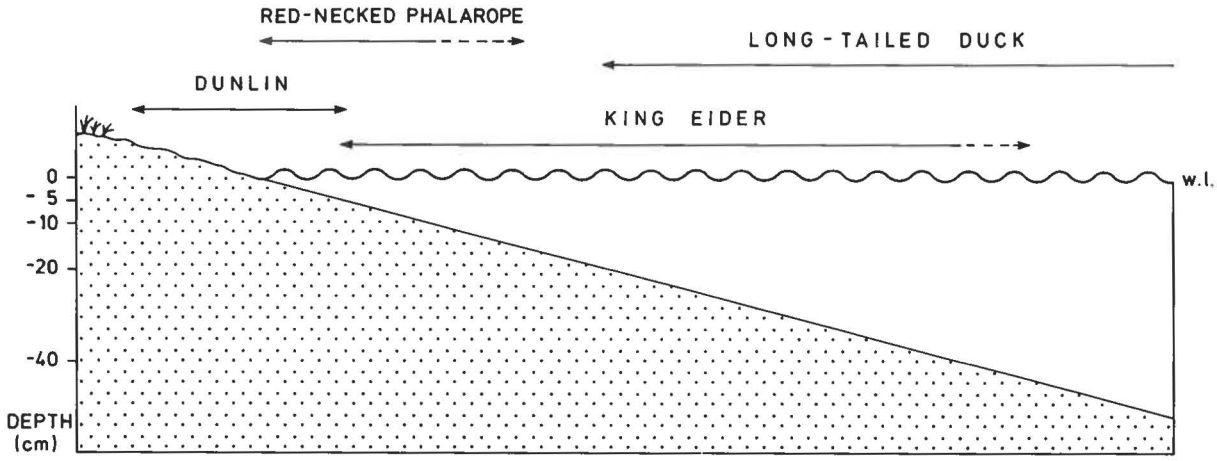

Fig. 26. Schematic picture of the apparent spatial niche segregation resulting in partitioned use of a sole food type, chironomid larvae, among newly arrived Dunlins *(Calidris alpina)*, Red-necked Phalaropes *(Phalaropus lobatus)*, King Eiders *(Somateria spectabilis)* and Long-tailed Ducks (*Clangula hyemalis)*, in the lacustrine environments at Myggbukta 1979.

From direct and detailed observations of the feeding behaviour of the four species first mentioned, an apparent spatial niche segregation could be discerned. The newly arrived Dunlins foraged by pecking and probing. They utilized the wet and larvae-containing sediments from just above the water line, down to a depth of approximately 5 cm.

The submerged part of the Dunlin's zone was also exploited by the Red-necked Phalarope. As mentioned above (p. 29) the Red-necked Phalaropes were apparently feeding to a large extent on larvae that were visible on the surface of the sediment and that could be reached by up-ending. In this way, they were effective down to a depth of approximately 10 cm, and probably somewhat deeper when using the spinning technique to stir up the surface sediments.

The lake-feeding King Eiders foraged exclusively by dabbling and up-ending or by foot paddling with subsequent sieving. The exploited zone extended from a depth of about 5 cm to approximately 40 cm, which is the birds' maximum range with the trunk vertical and the neck stretched to its full length. This range was probably extended somewhat when the foot-paddling technique was used to stir up the bottom sediments.

Long-tailed Ducks foraged almost exclusively by diving. This technique restricted their foraging possibilities, since it required a minimum water depth of about 20 cm, but it had no maximum range limitation in the shallow tarns and ponds in the census area.

The spatial distribution of the four species when exploiting a single common food resource, emanated basically from their use of different feeding techniques and their specific morphological restrictions. The zones actually used by the different species and the spatial niche overlaps are schematically outlined in Fig. 26.

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Appendix

Dates of earliest observation of a selected set of bird species at Myggbukta, during four years.

Species	1937[1]	1939[2]	1979[3]	1982[4]
Red-throated Diver *(Gavia stellata)*	8.6	7.6	5.6[a] 6.6	29.5[a] 6.6
Pink-footed Goose *(Anser brachyrhynchus)*	25.5	19.5	17.5	13.5
Barnacle Goose *(Branta leucopsis)*	24.5	17.5	27.5	15.5[b] 21.5
Eider *(Somateria mollissima)*	–	10.6	5.6	13.6[a] 17.6
King Eider *(Somateria spectabilis)*	13.6	9.6	1.6[a] 4.6	12.6
Long-tailed Duck *(Clangula hyemalis)*	5.6	3.6	5.6	6.6
Ringed Plover *(Charadrius hiaticula)*	28.5	23.5	30.5	21.5
Knot *(Calidris canutus)*	31.5	27.5	31.5	28.5
Sanderling *(Calidris alba)*	1.6	23.5	27.5	21.5
Dunlin *(Calidris alpina)*	31.5	27.5	28.5	21.5
Turnstone *(Arenaria interpres)*	29.5	19.5	24.5	21.5
Red-necked Phalarope *(Phalaropus lobatus)*	5.6	7.6	2.6	18.6
Grey Phalarope *(Phalaropus fulicarius)*	5.6	7.6	2.6	2.6
Long-tailed Skua *(Stercorarius longicaudus)*	29.5	–	30.5	29.5
Arctic Tern *(Sterna paradisaea)*	–	9.6	14.6	14.6
Wheatear *(Oenanthe oenanthe)*	5.5	5.5	–	–
Snow Bunting *(Plectrophenax nivalis)*	18.4 mid-April		–	–

1. Bird & Bird (1941). – 2. Bang (1944). – 3. This study. – 4. M. Elander & M. Ericson unpublished. a. Reconnaissance flight only. b. A single bird.

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Two copies of the manuscript, each complete with illustrations, tables, captions, etc. should be sent to the Secretary, Kommissionen for videnskabelige Undersøgelser i Grønland. 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 on these matters rests with the editor.

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Tarling, D. H. 1967. The palaeomagnetic properties of some Tertiary lavas from East Greenland. – Earth planet. Sci. Lett. 3: 81–88.

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