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# Observations on waders (Charadriidae) at Scoresby Sund, East Greenland

*J. de Korte, C. A. W. Bosman and H. Meltofte*

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# Observations on waders (Charadriidae) at Scoresby Sund, East Greenland

J. DE KORTE, C. A. W. BOSMAN and H. MELTOFTE

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Populations of waders in three census areas at Scoresby Sund, central East Greenland, were studied during the three breeding seasons of 1973, 1974 and 1975. Ringed Plover (*Charadrius hiaticula*), Golden Plover (*Pluvialis apricaria*), Turnstone (*Arenaria interpres*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*) and Sanderling (*Calidris alba*) bred in the census areas, while Purple Sandpiper (*Calidris maritima*) and Red-necked Phalarope (*Phalaropus lobatus*) bred elsewhere in the region. Population densities were very low, compared to other areas further north in high arctic Greenland. Extensive, deep and late-thawing snow cover prevents waders from utilizing large areas in June. Time of breeding showed a high correlation with the snow melting conditions in the respective areas and years. Breeding success was generally low; only Ringed Plover had more than 50% nest and egg survival. Nest failures were probably mostly due to predation by Arctic Foxes (*Alopex lagopus*). Observation and examination of individuals from post-breeding flocks in the second half of July indicated that these flocks contained mainly non-breeders, but failed and successful breeders were also present. Measurements on eggs, pulli and adults are presented.

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# Introduction

The main purpose of the Netherlands Greenland Expedition in 1973 (de Korte, T. M. van Spanje), 1974 (de Korte, D. G. Rebel) and 1975 (Bosman, de Korte) was the study of the ecology of the Long-tailed Skua (*Stercorarius longicaudus*) (de Korte 1977). The work on waders in 1973 and 1974 was supplementary. In 1975 Bosman carried out a programme, with the main aim of collecting data on phenology and to obtain measurements of waders. This was part of research conducted at the Free University in Amsterdam, to ascertain the origin of waders which spend the winter at, and migrate through, the Netherlands Wadden Sea.

# General part

## Study areas

We had two main study areas: the south-east corner of Jameson Land, Kap Stewart (Figs 1 and 2), and the north-east coast of Hurry Inlet, Kærelv (Figs 1 and 3). In 1973 the base camp of the expedition was on Rathbone Ø (Fig. 1) from 1 May until 9 June and at Kap Stewart from 13 June until 30 August. In 1974 the base camp was at Kap Stewart from 22 May until 24 July and near Kærelv from 25 July until 2 September. That year Meltofte was employed at the meteorological station at Kap Tobin from 12 March until 11 September (Meltofte 1976b) and stayed at Kap Stewart from 16 July until 25 July. In 1975 the base camp was at Kærelv from 16 May until 21 August. That year in June and July trips were made to Ugleelv and Gåseelv.

Southeast Jameson Land is an extensive tundra region with low hills and heather-clad ridges. From the south coast to the north over a distance of 17 km the land rises gently from sea level to incidental heights of 600 m. The coast of Hurry Inlet consists of steep cliffs. In the higher parts the southward running rivers have created wide valleys (e.g. Modiolaelv at a height of 350 m) which have a luxuriant vegetation on the mostly gentle slopes. The vegetation is characterized by *Cassiope tetragona* while in some places *Dryas octopetala* predominates. In the southern part near Kap Stewart the vegetation is sparser, covering about 70% of the land, and extensive clay slopes and gravel plains occur (Fig. 4). The richer vegetation is dominated by *Cassiope tetragona* and *Salix arctica*. Marsh habitats are scattered over the whole area. They are mostly situated beneath

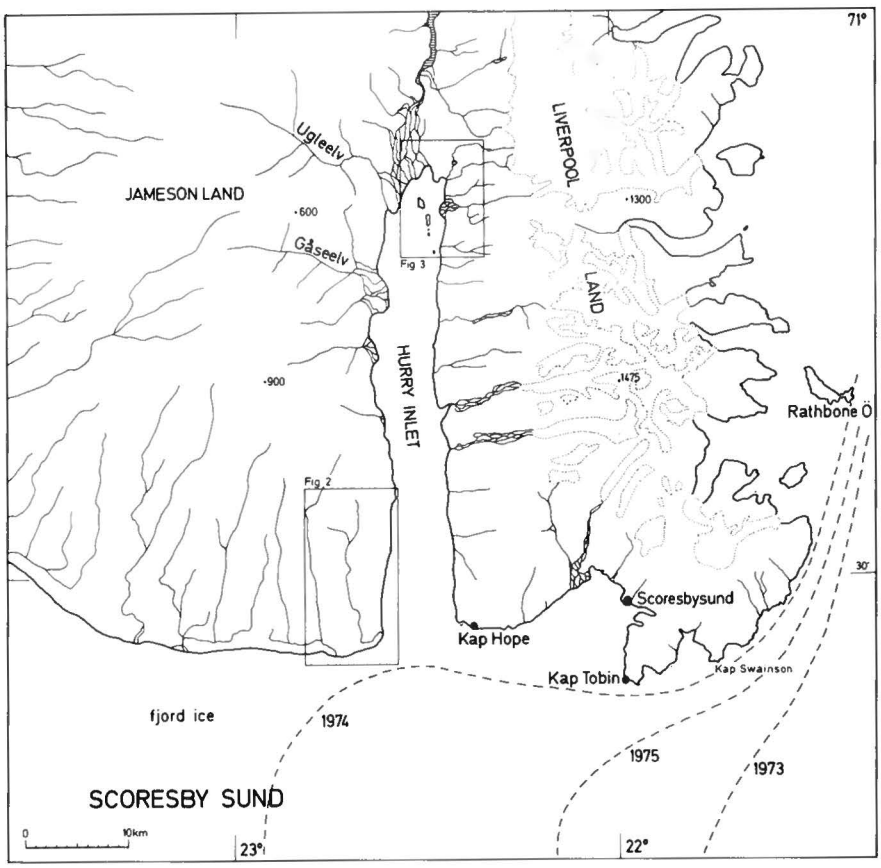


Fig. 1. Map of southern Jameson Land and Liverpool Land, with localities referred to in this paper. The areas covered by Figs 2 and 3 are framed. The border between the unbroken fjord ice and the drifting polar ice is shown for June 1973, 1974 and 1975, respectively (dashed line). Heights in metres.

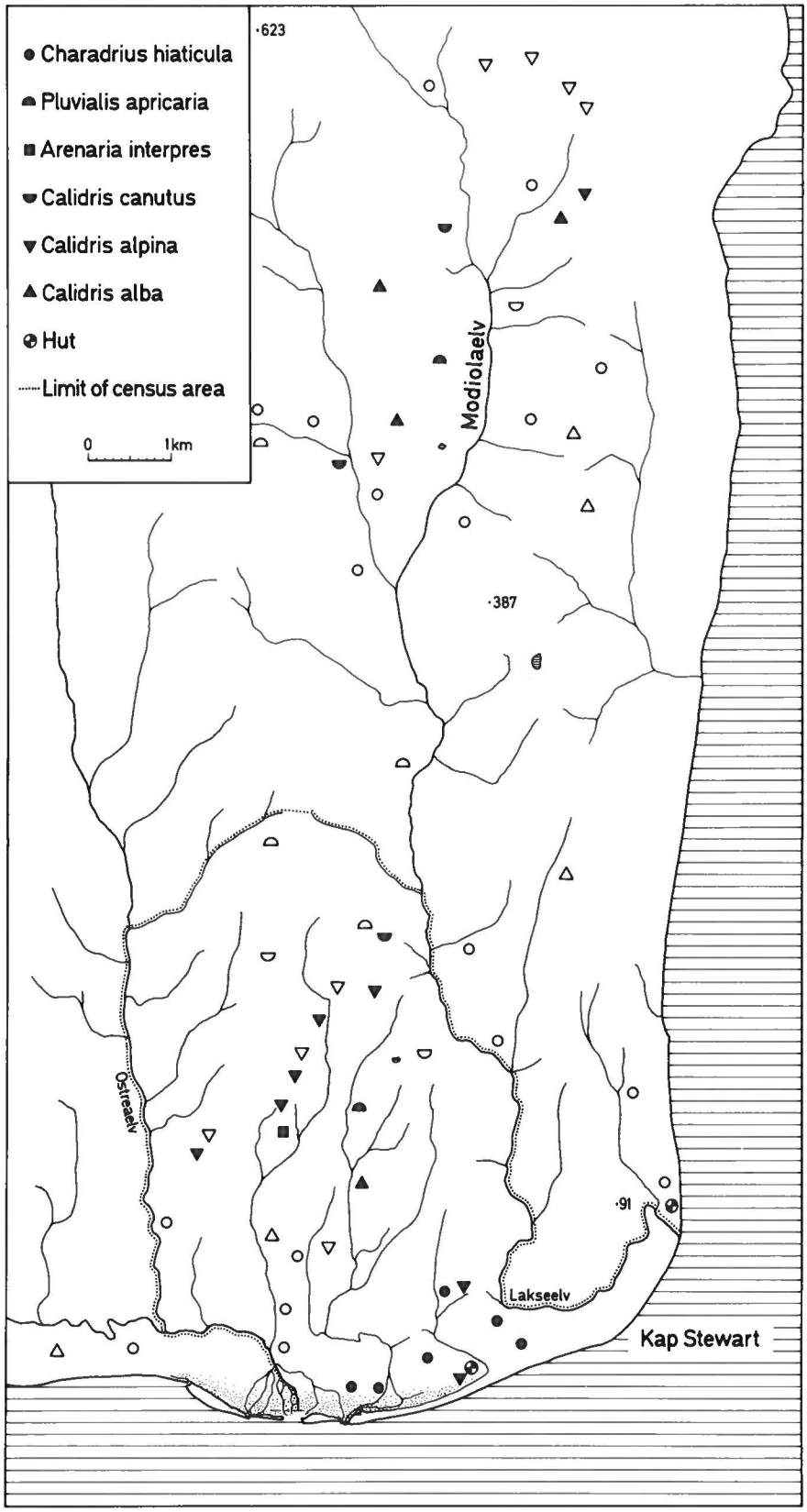


Fig. 2. Map of the study areas at Kap Stewart and Modiolaelv showing nests and pulli found (closed figures) and supposed breeding places (open figures) of waders in 1974.

snow-fanes, which produce meltwater during summer. No lakes and only a few tarns are found. In this region we had a census area of about 27 km², limited by the south coast, the rivers Ostreaelv and Lakseelv and two of their tributary streams (Fig. 2).

The northeast coast of Hurry Inlet is a strip of gently undulating tundra, entirely below 100 m above sea level (Fig. 3). This strip is bordered in the east by the steep mountains of Liverpool Land (Fig. 5), reaching heights of more than 1000 m. The vegetation is mostly characterized by *Dryas-Cassiope* associations. Marshes are found near tundra ponds. Gravel plains occur along the sides of the westward running rivers and are made up of old moraine material. In the northern part of this area, a few km north of Bodal, there are some small lakes. In the southern part we had a census area of about 7 km², limited by the sea, the river Kærelv, a tributary of the Kalkdal river and the contour of 100 m altitude in the east (Fig. 3).

## Climate

The climate of Scoresby Sund is high-arctic. The border between the high-arctic zone (continental character) and the low-arctic zone (atlantic character) runs just south of Scoresby Sund.

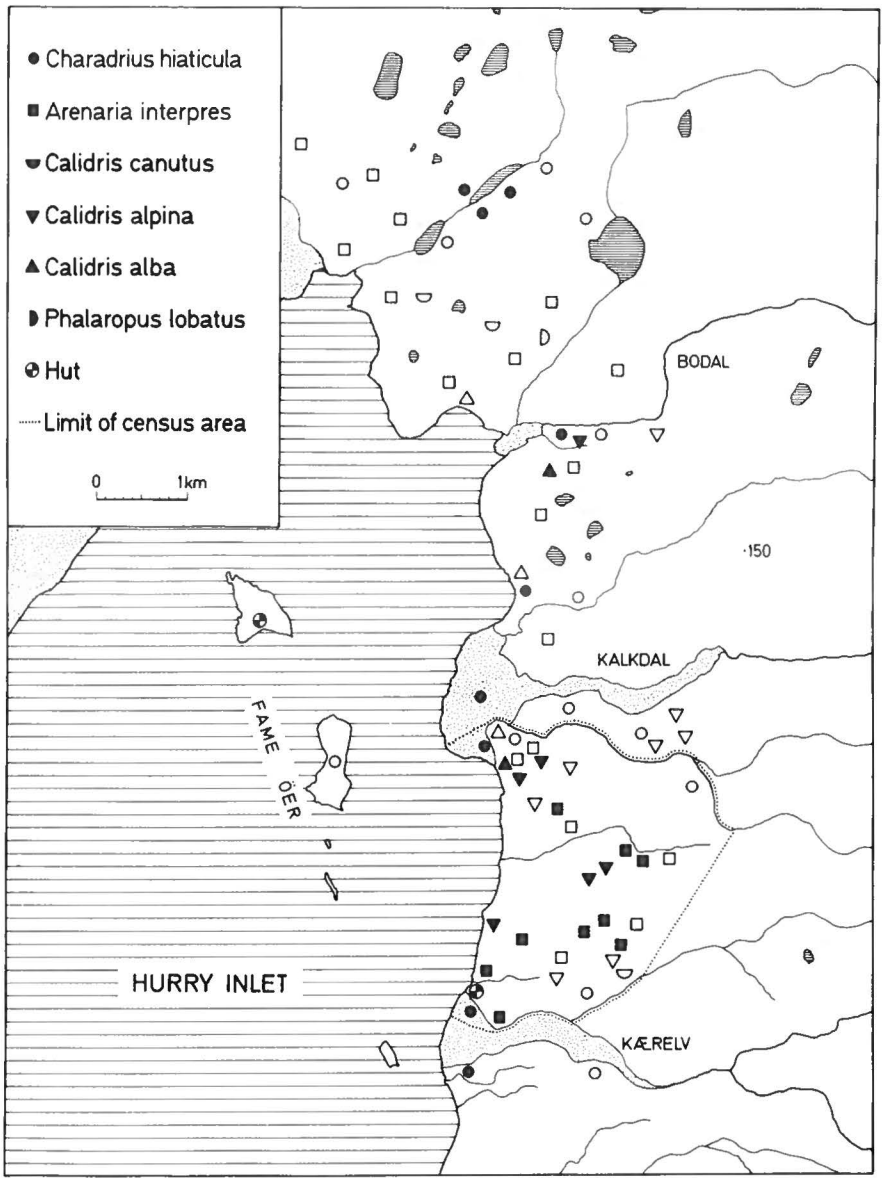


Fig. 3. Map of the study area at Kærelv showing nests and pulli found (closed figures) and supposed breeding places (open figures) of waders in 1975. Extensive delta areas are dotted.

Fig. 4. View over the Kap Stewart area with Lakseelv running south. In the background Scoresby Sund, 17 June 1974. Photo J. de Korte.

Along the outer coast of Liverpool Land the climate is more maritime than inland towards Jameson Land. Generally the weather is much influenced by the presence of the open sea. Easterly winds bring moisture to the land. This may result in heavy snow fall in winter and rain and fog lasting for many days in summer. In 1973 the ice-edge was more than 30 km from Kap Stewart (Fig. 1) and consequently evaporation from the sea was suppressed, while in 1974 the open water reached to within one km of the shore. In 1975 the ice-edge had an intermediate position compared with 1973 and 1974. In 1973 a warm foehn wind quite often blew from the west. This was not the case in 1974 and was infrequent in 1975. In spring and summer 1974 fog and precipitation initiated by easterly winds coming from the open sea occurred so frequently that we were not able to work on the tundra at Kap Stewart on about half of the days in June and July. Our estimates of snow cover in different areas and years are given in Fig. 6. Generally the disappearance of snow cover at Kap Stewart in June 1974 was about one week later than in 1973.

Generally in spring and summer the temperature is higher and the precipitation is lower in inland valleys. This is demonstrated by the snow cover estimates of 1974. The difference between Kap Stewart and Modiolaelv is striking. Spring comes earlier inland than along the coast. Further inland the difference becomes even more pronounced (cf. Meltofte 1976b).

Northeast Hurry Inlet has more stable weather than Kap Stewart as it lies in the lee of the mountains of Liverpool Land. Still the weather in 1974 was also very unstable here, although sunnier than at Kap Stewart in the same year. In 1975 the weather in northeast Hurry Inlet was sunnier than in 1974. The snow cover at Kærelv in 1975 disappeared about three weeks earlier than at Kap Stewart in 1974. At Kap Stewart the rivers started to run in the fourth week of May in 1974. At Kærelv this happened in the third week of May in 1975. Here some shallow lakes were one third ice-free on 21 May (Fig. 7).

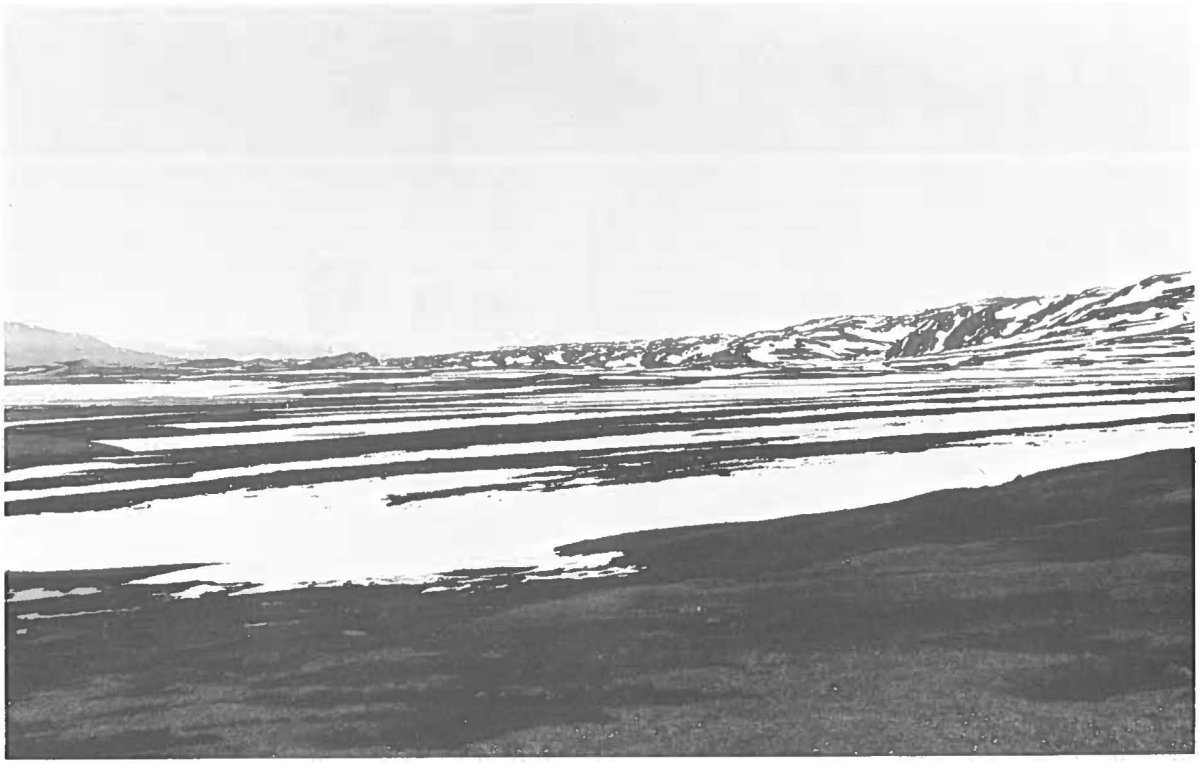

Fig. 5. View over the Kærelv area looking north, Hurry Inlet to the left, 20 June 1975. Photo C. A. W. Bosman.

## Non-avian prey and predators

In 1973 (Kap Stewart) the first mosquitoes were seen on 27 June, in 1974 (Kap Stewart) on 1 July and in 1975 (Kærelv) on 20 June.

In 1973 there was at least one den with a litter of Arctic Fox (*Alopex lagopus*) in the census area near Kap Stewart and one more within a distance of 500 m. In 1974 no such occupied dens were found and only roaming individuals were seen. This was also the case in 1975 near Kærelv, where on 29 June, 1 and 5 July a fox was caught in the census area. Also thereafter at times single foxes were seen strolling through the area.

Sight observations of Collared Lemming (*Dicrostonyx groenlandicus*), the observed density of its snow nests and the analysis of stomach contents of Long-tailed Skuas give us the impression that the lemming population was rapidly declining in the spring of 1973, that 1974 had a lemming minimum and that the population was rising again in 1975.

## Methods

In 1973 and 1974 our methods were rather haphazard as we did not especially search for waders. In 1975 the wader studies were done more systematically. In spring

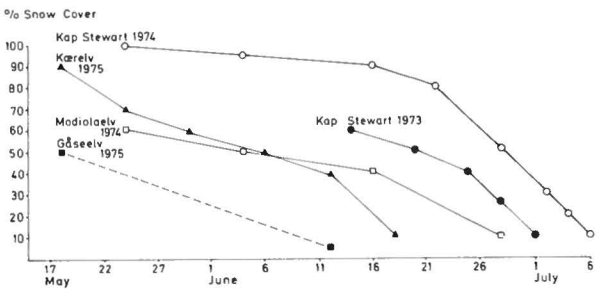


Fig. 6. Snow cover percentage at Kap Stewart in 1973 and 1974, at Modiolaelv in 1974, and at Kærelv and Gåseelv in 1975.

Fig. 7. Shallow lake near Bodal on 23 May 1975. During late May newly arrived waders foraged here. Photo J. de Korte.

observations on migration were made. During breeding time nests were sought and when found eggs were measured and weighed. Adult birds were caught with a wire cage trap placed over the nest. The birds were ringed with metal rings of the Zoological Museum, Copenhagen. A total of 134 (56 adults and 78 pulli) waders of six species was ringed in the three seasons. In 1975 30 adults were also marked with colour tapes on the tarsus for individual recognition in the field. For more extensive study, especially regarding gonads, a total of 49 waders of six species was collected and their stomach contents, female gonads and 41 skins were brought to Amsterdam for examination and permanent storage.

All waders caught and collected were weighed and measured in the field. Spring balances of 30 g, 100 g or 300 g were used for weighing. Bill length is the chord from base of feathering and wing length the maximum chord.

Age of pulli was estimated from weight and culmen measurements (Soikkeli 1967, Parmelee 1970, Meltofte 1976a, 1979, Green et al. 1977). Adults were sexed, when possible, using plumage characteristics.

The maps of the census areas have been drawn from aerial photos, and the dimensions are not exact.

Greenlandic bird names listed are those used in East Greenland.

# Wader species observed

## Ringed Plover (*Charadrius hiaticula*)

Greenlandic: Tûjuk

Arrival and dispersal on breeding grounds. – First observations: 1973, 23 May, one along the ice-edge near Rathbone Ø flying north and one on Rathbone Ø; 1974, 17 May, two at Kap Tobin, 27 May, one seen west of Kap Stewart; 1975, 24 May, five at a thawing lake at Bodal (Fig. 7). The spring migration of small groups and single birds flying north was noticed in 1973 until 8 June

(Rathbone Ø), in 1974 until 10 June (Kap Stewart) and in 1975 until 7 June (Kærelv). During heavy snow fall on 1 June 1974 a flock of about 50 was standing in the snow at Kap Tobin and about 100 at Kap Stewart, at both places together with other wader species.

From the first day of their arrival the resident birds displayed intensive territorial courtship behaviour. Pairs had already been formed in the last week of May. On 17 June 1973 during a spell of bad weather with rain and wind Ringed Plovers again gathered in a flock of about 25 birds feeding near the huts at Kap Stewart. In 1974 small groups (at most six) foraged in the lagoon near Kap Stewart until the middle of June. These birds were probably waiting for their breeding sites to thaw. At that time there were still many 1973 territories in this area covered by snow. In 1975 we did not see such groups at Kærelv in June. Probably the resident birds present at that time had already occupied territories, which were snow free some weeks earlier than at Kap Stewart in 1974.

Breeding habitat. – The nest sites were generally in open gravelly or stony areas with a very poor vegetation. We found only two nests on moist ground. All nests were less than 100 m from a small stream or a moist vegetated site.

Breeding density. – In 1974 we found six pairs with eggs or pulli in our census area at Kap Stewart (Fig. 2). We presumed at least another four pairs to be breeding there, making a total of at least 10 breeding pairs on 27 km². So the breeding density was about 0.4 pairs per km². All pairs were found on the coastal plain or on ridges within a few kilometres from the coast. Here the snow cleared early and the vegetation was sparse. The number of breeding pairs in the valley of Modiolaelv was estimated to be at least nine, i.e. about the same density.

In 1975 we found nine pairs with eggs or pulli near Kærelv (Fig. 3). In the census area proper (c. 7 km²) we found only two. At least three other pairs were presumed to breed here, making a total of at least five pairs and a breeding density of 0.7 pairs per km². In the whole area surveyed near Kærelv we estimated the number of breeding pairs to be at least 21, or about one pair per km².

Breeding cycle, eggs and young. – Table 1 presents data on all nests found, and in Table 2 data and estimates of age of pulli older than one day are given. Assuming an incubation period of 25 days (Prater 1974), two clutches were completed in the second and third week of June in 1973 (Kap Stewart). In 1974 (Kap Stewart) six clutches were completed in the third and fourth week of June and the first week of July. This year the two sites at which we had found nests a year earlier, were still snow covered on the same date, and not occupied. In 1975 (Kærelv) nine clutches were completed in the first, second and third week of June and one in the first week of July.

Of a total of 12 nests found, two had a complete clutch of three eggs and 10 had four (Table 1). Both three-egg clutches were found near Kap Stewart. We obtained measurements of 31 eggs (eight nests) (Table 14).

We obtained fresh egg weights only for nest 2 (Table 1). On 20 June the three eggs had a mean weight of 11.0 g and on 15 July, one day before hatching, 8.5 g.

The mean weight of 14 approximately one day old Ringed Plover pulli was 7.5 g (6.3–8.2 g) and mean bill length was 7.5 mm (7.0–8.0 mm).

Breeding success. – We followed nine clutches. Of these, three, containing 12 eggs, disappeared before hatching, probably by predation. The others, containing 24 eggs, all hatched except for one egg (Table 1). This egg contained a complete embryo with a bill of 7.5 mm. Nest survival to hatching was 67%, while 23 of the 36

Table 1. Data on 12 Ringed Plover nests from Kap Stewart and Kærelv areas.

| Nest no. | Locality | Date found | Clutch size | Mean egg weight g | No. of young hatched | Hatching date |
|---|---|---|---|---|---|---|
| 1 | Kap Stewart | 14.6.1973 | 4 | | 0 | empty 24.6 |
| 2 | – – | 20.6.1973 | 3 | 11.0 on 20.6 | 3? | 16.7 |
| 3 | – – | 4.7.1974 | 4 | | 0 | empty 11.7 |
| 4 | – – | 9.7.1974 | 4 | 10.4 on 9.7 | 4 | 15.7 |
| 5 | – – | 20.7.1974 | 4 | | 4 | 23.7 |
| 6 | – – | 22.7.1974 | 3 | | ? | no cracks 25.7 |
| 7 | – – | 24.7.1974 | 4 | | 4 | ca. 26.7 |
| 8 | Kærelv | 12.6.1975 | 4 | | 0 | empty 28.6 |
| 9 | – | 24.6.1975 | 4 | 10.4 on 24.6 | 4 | 8.7 |
| 10 | – | 30.6.1975 | 4 | 10.0 on 1.7 | 4 | 4.7 |
| 11 | – | 11.7.1975 | 4 | | 4 | 13.7 |
| 12 | – | 12.7.1975 | 4 | 10.6 on 13.7 | 3 | 15.7 |

Table 2. Data on eight Ringed Plover pulli from Kap Stewart and Kærelv areas.

| Locality | Date found | Weight g | Bill mm | Estimated hatching date |
|---|---|---|---|---|
| Kap Stewart | 22.7.1974 | 11.5 | 9.5 | 20.7 |
| Kærelv | 25.7.1974 | 20.0 | 10.0 | 19.7 |
| – | 6.8.1974 | 44.5 | 14.0 | before 18.7 |
| – | 12.7.1975 | 36.0 | 13.0 | 28.6 |
| – | 16.7.1975 | 23.6 | 11.7 | 8.7 |
| – | 28.7.1975 | 41.5 | 12.3 | 11.7 |
| – | 4.8.1975 | 14.9 | 10.5 | 31.7 |
| – | 4.8.1975 | two flying | | before 13.7 |

eggs (64%) hatched. In the cases of failure the nest was simply found empty. The old birds sometimes still showed distraction behaviour near the empty nest.

Post-nesting movements. – During the whole month of July and the first half of August we noticed some single adults without young almost daily on the mud flats of the lagoon near Kap Stewart and of the Kalkdal river. From 4 August groups of up to 10 juveniles were also observed at these sites. At the same time there were also unattended juveniles on the tundra inland at several places. At Kærelv (1974) we saw two parents accompanying a young until 27 August, about two weeks after fledging. On 28 August the adults had left. The juvenile was still at the same place with some other young Ringed Plovers on 2 September when we left.

Weights and measurements. – Eight adults caught in their territories had a mean weight of 60.9 g (Table 3). The two males collected in Scoresbysund village during a spell of bad weather on 18 June 1973 were lean and weighed on average 26% less.

## Golden Plover (*Pluvialis apricaria*)

Greenlandic: Ángilik

The observations on this species in 1973 and 1974, with special regard to breeding have been published (de Korte 1975).

Arrival. – First observations: 1974, 17 May one at Kap Tobin, 30 May three pairs on snow free patches inland near Kap Stewart; 1975, 25 May a pair near Kærelv and single birds on 27 May and 11 June. These were the only observations in 1975.

Breeding density. – In 1974 we found one pair with eggs in our census area at Kap Stewart (Fig. 2). Another two pairs were presumed to breed there. So the breeding density in this census area was 0.1 pairs per km².

Breeding cycle. – In 1973 a clutch of four eggs at Kap Stewart hatched on 8 July. Assuming an incubation period of 31 days (Glutz et al. 1975) this clutch had been completed on 7 June. In 1974 a clutch of four was completed between 2 and 4 July and another clutch of four at Modiolaelv after 17 June.

Post-nesting movements. – In 1973 we saw a few pairs on the tundra until the middle of August, when we left the area. In 1974 we saw a pair and a few single adults until 22 July.

## Turnstone (*Arenaria interpres*)

Greenlandic: Talivfak

Arrival and dispersal on breeding grounds. – First observations: 1973, 23 May one flying north along the ice-edge near Rathbone Ø; 1974, 23 May, 12 at Kap Tobin flying west and 1 June eight near Kap Stewart during a heavy snow fall together with other wader

Table 3. Measurements of 10 adult Ringed Plovers.

| Ring no. | Date | Locality | Sex | Breeding status /gonads mm | Weight g | Wing mm | Bill mm | Incubation patches |
|---|---|---|---|---|---|---|---|---|
| Collected | 18.6.1973 | Scoresbysund village | m. | testis 3.3 × 10.0 | 47.0 | 133 | | ÷ |
| – | 18.6.1973 | – – | m. | testis 4.6 × 10.4 | 42.5 | 136 | | ÷ |
| 8151201 | 23.6.1973 | Kap Stewart | f. ⎫ | pair of | 54.0 | 132 | | + |
| 8151202 | 23.6.1973 | – – | m. ⎭ | breeding birds | 59.5 | 130 | | + |
| 8151222 | 11.7.1974 | – – | f. | breeding bird | 65.0 | 136 | | + |
| 8153034 | 23.7.1974 | – – | f. | – – | 62.0 | 130 | 15 | + |
| Collected | 6.6.1975 | Ugleelv | m. | testis 4.1 × 7.7 | 57.0 | 133 | 14 | ÷ |
| 8151250 | 12.6.1975 | Kærelv | f. ⎫ | pair of | 64.5 | 133 | | + |
| 8151251 | 12.6.1975 | – | m. ⎭ | breeding birds | 62.0 | 135 | 14 | + |
| 8151274 | 13.7.1975 | – | ? | breeding bird | 63.0 | 136 | 14 | + |

species; 1975, 23 May one heard near Kærelv. Migration northwards of single birds and small groups of up to 16 was noticed in 1973 until 3 June (Rathbone Ø), in 1974 until 10 June (Kap Stewart) and in 1975 until 2 June (Kærelv). At Kærelv pairs were seen from 27 May. In the first week of June pairs became settled in territories on the tundra, which at that time was about 50% snow free (Fig. 6). Unsettled and migratory Turnstones were seen at this time mostly along some thawing lakes north of Bodal. On 17 and 18 June 1973 about 20 Turnstones foraged near the huts at Kap Stewart during a period of rain.

Breeding habitat. – Turnstones found at Kap Stewart and Kærelv nested on well-drained clay and *Cassiope* hummocked slopes and flat tundra. In Gåseelv we found them also on a dry slope among *Dryas* hummocks. All nests were less than 150 m from marshes, ponds or streams.

Breeding density. – In 1974 we found one nest in the census area near Kap Stewart (Fig. 2), while in 1973 Turnstones definitely did not breed in this area.

In 1975 we found nine pairs with eggs or pulli in the census area at Kærelv (Fig. 3). Another six pairs were presumed to breed here, making a total of 15 pairs on 7 $km^2$ or two pairs per $km^2$. North of the census area we estimated the density of breeding pairs to be about the same. In the valley of Gåseelv and Ugleelv we saw several pairs on the gentle slopes between the river and steep mountains on both sides in the middle of June 1975. In Ugleelv from the mouth to nine km inland on a strip about 0.5 km wide, eight pairs were found along the south bank of the river. In Gåseelv we found a similar density along the north bank of the river.

Breeding cycle, eggs and young. – Table 4 presents data on 10 nests found. Nine had a complete clutch of four eggs. It is possible that the two-egg clutch was incomplete when found on 23 June. A pullus from a brood of three on 22 July 1975 (Kærelv) weighed 44 g and had a bill of 15.8 mm indicating an age of seven days. Assuming an incubation period of 22 days (Nettleship 1973), eight clutches near Kærelv (1975) were completed in the second, third (peak) and fourth week of June.

We obtained measurements of 38 eggs (10 nests) (Table 14). Fresh egg weights were obtained only for nest 4; mean 17.6 g.

Mean weight of seven about half-a-day old pulli was 10.6 g (10.3–11.0 g), mean bill length was 10.9 mm (10.5–11.9 mm).

Breeding success. – We followed nine clutches. Of these six, containing 22 eggs, disappeared before hatching, probably by predation. The others, containing 12 eggs, hatched with the exception of one egg (nest 10, Table 4). This egg was pecked and had a fully developed embryo with a bill of 10.8 mm, but lacked the egg tooth. Nest survival to hatching was 33%, while 11 of 34 eggs (32%) hatched. In the cases of failure the nest was found empty.

Two pulli of nest 10 were found dead nine days after hatching (bill lengths 11.8 and 12.0 mm, indicating an age of two days). Probably they had died during a spell of cold, rainy weather two days after they had hatched.

Post-nesting movements. – In 1974 and 1975 groups of 2–20 adult Turnstones were seen foraging in rocky places along the coast near Kærelv from the second week of July until the second week of August. A male and a female were shot in a flock of seven at Kærelv on 22 July 1975 (Table 5). The female had never laid eggs, while the breeding status of the male is uncertain. The adult flocks were together with groups of 2–13 juveniles from the last week of July in 1974 and from the first week of August in 1975. All adults had disappeared by mid-August, but the juveniles stayed along the coasts. Juveniles were seen in largest numbers in the second and third week of August. In 1973 and 1974, when we

Table 4. Data on 10 Turnstone nests from Kap Stewart, Gåseelv and Kærelv areas.

| Nest no. | Locality | Date found | Clutch size | Mean egg weight g | No. of young hatched | Hatching date |
|---|---|---|---|---|---|---|
| 1 | Kap Stewart | 7.7.1974 | 4 | | 0 | empty 9.7 |
| 2 | Gåseelv | 14.6.1975 | 4 | | ? | ? |
| 3 | Kærelv | 18.6.1975 | 4 | | 0 | empty 30.6 |
| 4 | – | 19.6.1975 | 4 | 17.6 on 19.6 | 0 | empty 10.7 |
| 5 | – | 20.6.1975 | 4 | 14.6 on 27.6 | 4 | 30.6 |
| 6 | – | 20.6.1975 | 4 | 14.8 on 20.6 | 0 | empty 6.7 |
| 7 | – | 23.6.1975 | (2) | | 0 | empty 24.6 |
| 8 | – | 24.6.1975 | 4 | | 0 | empty 11.7 |
| 9 | – | 27.6.1975 | 4 | 15.7 on 27.6 | 4 | 13.7 |
| 10 | – | 2.7.1975 | 4 | 15.0 on 2.7 | 3 | 15.7 |

Table 5. Measurements of 24 Turnstones.

| Ring no. | Date | Locality | Sex | Breeding status /gonads mm | Weight g | Wing mm | Bill mm | Incubation patches |
|---|---|---|---|---|---|---|---|---|
| Collected | 23.5.1973 | Rathbone Ø | m. | testis 4.2 × 8.2 | 79 | 151 | | ÷ |
| Found dead | 3.6.1974 | Kap Tobin | m. | | 68 | 151 | 22 | ÷ |
| 710427 | 7.7.1974 | Kap Stewart | m. | breeding bird | 101 | 154 | | + |
| Collected | 1.6.1975 | Kærelv | f. | ov. swollen and twisted, foll. 4.1 | 114 | 163 | 23.4 | ÷ |
| 756051 | 18.6.1975 | – | f. | breeding bird | 109 | 166 | 24.1 | + |
| 756052 | 19.6.1975 | – | f. | – – | 117 | 157 | 25.3 | + |
| 756053 | 20.6.1975 | – | m. | – – | 106 | 158 | 20.2 | + |
| 756054 | 20.6.1975 | – | m. | – – | 122 | 160 | 21.6 | + |
| 756055 | 20.6.1975 | – | m. | – – | 102 | 155 | 23.2 | + |
| 756056 | 21.6.1975 | – | m. | – – | 100 | 160 | 23.3 | + |
| 756057 | 28.6.1975 | – | f. | – – | 110 | 166 | 23.4 | + |
| 756058 | 28.6.1975 | – | f. | – – | 114 | 168 | 23.1 | + |
| 756059 | 28.6.1975 | – | ?⎫ | pair of | 107 | 162 | 23.6 | + |
| 766060 | 30.6.1975 | – | ?⎭ | breeding birds | 106 | 160 | 22.9 | + |
| 756065 | 2.7.1975 | – | f. | breeding bird | 113 | 154 | 27.0 | + |
| 756066 | 6.7.1975 | – | m. | – – | 108 | 155 | 23.0 | + |
| 756067 | 8.7.1975 | – | m. | – – | 104 | 149 | 22.7 | + |
| Collected | 22.7.1975 | – | m. | testis 1.9 × 5.8 | 121 | 156 | 23.0 | + |
| – | 22.7.1975 | – | f. | ov. straight, rather thick, foll. 1.5 | 102 | 163 | 21.8 | + |
| – | 9.8.1975 | – | ? | juvenile | 99 | 151 | 21.1 | ÷ |
| – | 11.8.1975 | Fame Øer | m. | juvenile testis 0.7 × 3.0 | 133 | 154 | 22.1 | ÷ |
| – | 11.8.1975 | – – | m. | juvenile testis 1.7 × 4.5 | 125 | 156 | 22.8 | ÷ |
| – | 11.8.1975 | – – | f. | juvenile, foll. <0.1 mm | 91 | 145 | 19.6 | ÷ |
| – | 11.8.1975 | – – | f. | juvenile, foll. <0.1 mm | 132 | 155 | 22.0 | ÷ |

had to leave our study areas in the first week of September, juveniles were still foraging in small groups along the stony coasts.

Weights and measurements. – We obtained weights and measurements for 19 adults, either collected or caught for ringing (Table 5). The mean weight of eight adult males on territories was 105.2 g, and of seven adult females on territories 111.3 g.

## Whimbrel (*Numenius phaeopus*)

Greenlandic: Sârfârssugssuaq

Both in 1973 and 1974 we saw a single Whimbrel on 14 June flying north along Kap Stewart. In 1975 a single bird was seen on the tundra near Kærelv on 12 and 22 June.

## Redshank (*Tringa totanus*)

In 1973 a Redshank was foraging in the lagoon near Kap Stewart on 24 and 25 June. On 11 August a single bird flew south near Kap Swainson (Magnus Elander pers. comm.). In 1975 a Redshank was seen together with a few Red-necked Phalaropes (*Phalaropus lobatus*) in the delta of Gåseelv on 14 June. On 21 and 22 July a single bird was foraging in the delta of Kærelv together with other species of waders.

## Knot (*Calidris canutus*)

Greenlandic: Qajordlak

Arrival and dispersal on breeding grounds. – First observations: 1973, 3 June two on Rathbone Ø; 1974, 24 May one west of Kap Stewart and a few at Modiolaelv; 1975, 26 May one near Bodal. Song-flight display was seen for the first time on 4 June 1975 near Kærelv and continued until the end of June. Near Kap Stewart (1973, 1974) this display was seen until the middle of July. At Modiolaelv (1974) and at Gåseelv (1975) we saw this display in the middle of June but not at Modiolaelv in the second week of July.

Two males collected from a flock of nine on 17 June 1973 at Kap Stewart, during a spell of bad weather, were in breeding condition.

Breeding habitat. – We did not actually find nests of Knots, but we could ascertain territories and we also

found adults with young. Near Kap Stewart and at Modiolaelv the habitat was gentle slopes with a mixed vegetation of *Dryas* and *Cassiope* alternating with bare spots of gravel. Near Kærelv the habitats were covered with *Dryas* hummocks and as a whole were drier than near Kap Stewart and Modiolaelv.

Breeding density. – In 1973 and 1974 at least three pairs held territories in the Kap Stewart census area (27 km²). In the valley of Modiolaelv there were also at least three pairs in 1974. In our census area near Kærelv (7 km²) there was at least one pair in 1975. In the whole area surveyed near Kærelv there were at least three pairs with territories. As it is known that breeding Knots live a very secluded life, more pairs may have been present.

Breeding cycle and young. – Three times in 1974 we found an adult with young (Table 6). Assuming an incubation period of 22 days (Nettleship 1968), two clutches were completed in the second and third week of June at Modiolaelv and one in the last days of June at Kap Stewart.

Post nesting movements. – In July 1973 and 1974 we saw on the tundra near Kap Stewart single adults or small groups numbering up to 11. Such groups may include both 'off duty' breeders and post-breeders. In August 1973 all Knots had deserted the tundra and only a few juveniles were seen along the lagoon near Kap Stewart at the end of the month. In 1974 from 10 to 31 August we saw single juveniles and groups of three along the coasts near Kærelv. In 1975 juveniles were seen for the first time near Kærelv on 22 July. Until our departure on 20 August groups of up to five juveniles were seen.

Weights and measurements. – Five adults were measured (Table 7). The two males of 17 June 1973 were collected during a spell of bad weather. The male collected on 30 June 1973 had been ringed as an adult on 5 May 1969 at Wolferton (52°49'N, 0°25'E), England (ring no. London CR 92266).

Table 6. Data on three Knot broods from Modiolaelv and Kap Stewart areas.

| Locality | Date found | No. of young | Weight mean g | Bill mean mm | Estimated hatching date |
|---|---|---|---|---|---|
| Modiolaelv | 14.7.1974 | 3 | 16.3 | 13.1 | 12.7 |
| – | 15.7.1974 | 2 | 56.5 | 19.3 | 4.7 |
| Kap Stewart | 21.7.1974 | 3 | 16.0 | 14.0 | 19.7 |

## Purple Sandpiper (*Calidris maritima*)
Greenlandic: Sârfârssuk

In 1973 one on Rathbone Ø on 4 June, one near Kap Stewart on 19 June and 29 August. In 1974 one at Kap Tobin on 22 May and four at Kap Stewart on 29 May. In June, July and August single birds occurred at Kap Tobin, Scoresbysund village and at Kap Swainson. Breeding was indicated near Kap Tobin. In the last week of August groups of up to four were seen on the coasts of Fame Øer. This species was not seen in 1975.

## Dunlin (*Calidris alpina*)
Greenlandic: Isitoq

Arrival and dispersal on breeding grounds. – First observations: 1973, 23 May one flying north along the ice-edge near Rathbone Ø; 1974, 18 May one at Kap Tobin and 24 May four at Modiolaelv. During heavy snow-fall on 1 June 32 gathered at Kap Stewart together with other wader species. In 1975, 21 May two at a thawing lake near Bodal. Migration to the north of single birds was noticed in 1973 until 6 June on Rathbone Ø. In 1974 (Modiolaelv) and 1975 (Kærelv) single birds were foraging on snow free patches on the tundra in the last week of May. In 1975 (Kærelv) from 26 May onwards they were displaying and establishing territories in snow free places. In the first week of June pairs had been formed.

Table 7. Measurements of five Knots.

| Ring no. | Date | Locality | Sex | Breeding status /gonads mm | Weight g | Wing mm | Bill mm | Incubation patches |
|---|---|---|---|---|---|---|---|---|
| Collected | 17.6.1973 | Kap Stewart | m. | testis 7×11 | 97 | 169 | | + |
| – | 17.6.1973 | – – | m. | testis 7×11 | 93 | 178 | | + |
| London CR 92266, collected | 30.6.1973 | – – | m. | testis 6×9 | 124 | 175 | | + |
| 710431 | 14.7.1974 | Modiolaelv | ? | breeding bird | 123 | 170 | | + |
| Collected | 22.7.1975 | Kærelv | m. | juvenile, testis 1×3 | 116 | 162 | 30 | ÷ |

Table 8. Data on nine Dunlin nests from Kap Stewart and Kærelv areas.

| Nest no. | Locality | Date found | Clutch size | Mean egg weight g | No. of young hatched | Hatching date |
|---|---|---|---|---|---|---|
| 1 | Kap Stewart | 7.7.1974 | 4 | 8.6 on 7.7 | 3 | 16.7 |
| 2 | – – | 9.7.1974 | 4 | | 0 | empty 11.7 |
| 3 | – – | 9.7.1974 | 4 | | 0 | empty 11.7 |
| 4 | Kærelv | 18.6.1975 | 4 | 8.4 on 18.6 | 4 | 3.7 |
| 5 | – | 19.6.1975 | 4 | | 0 | empty 30.6 |
| 6 | – | 21.6.1975 | 4 | | 0 | empty 26.6 |
| 7 | – | 23.6.1975 | 4 | 9.7 on 23.6 | 3 | 11.7 |
| 8 | – | 26.6.1975 | 4 | 8.9 on 26.6 | 3 | 14.7 |
| 9 | – | 1.7.1975 | 4 | | 0 | empty 4.7 |

During the whole month of June 1973 and 1974 single birds or small groups of up to ten were foraging in the lagoon near Kap Stewart. During a spell of bad weather 16 fed near the huts at Kap Stewart, 17–19 June 1973. In 1975 small groups fed along some lakes at Bodal until the middle of June. Two females collected from feeding groups on 21 June 1973 had laid eggs that year (see Table 10).

Breeding habitat. – Dunlins found at Kap Stewart, Modiolaelv and Kærelv nested in very moist habitats, the nests being situated in a mixed hummock of grass and *Salix* surrounded by running water during most of the incubation period. Often this was beneath a snow fane or at the base of a slope. At the end of the incubation period the nest surroundings were usually much drier than earlier in the cycle.

Breeding density. – In 1974 we located seven pairs with eggs or pulli in the census area at Kap Stewart (Fig. 2). At least another four pairs were presumed to breed here, making a total of at least 11 pairs on 27 km² or 0.4 pairs per km². In 1975 in the census area near Kærelv (Fig. 3) we found five nests, and at least another four pairs were breeding here, making a total of nine pairs on 7 km² or 1.3 pairs per km². Near the mouth of Gåseelv we estimated a similar density of breeding pairs.

Breeding cycle, eggs and young. – Table 8 presents data on nine nests found, and in Table 9 data and estimates of age of pulli older than one day are given. In addition, on 1 July 1973 and on 19 July 1974 near Kap Stewart, we found a nest of four that had just hatched. Assuming an incubation period of 22 days (Soikkeli 1967), one clutch had been completed in the second week of June 1973 at Kap Stewart. In 1974 (Modiolaelv) one clutch was completed in the third, and four clutches (Kap Stewart) were completed in the fourth week of June. In 1975 (Kærelv) four clutches were completed in the second, third and fourth week of June.

We obtained measurements of 36 eggs (nine nests) (Table 14). The mean weight of 16 pulli younger than one day was 6.4 g (5.8–7.0 g), and mean bill length was 10.4 mm (9.8–10.9 mm).

Breeding success. – Of nine nests found, five clutches disappeared before hatching. Of the remaining four clutches, one hatched completely, and of the others, three eggs per clutch hatched. In two cases the embryo had not grown to hatching state and in one case the egg had no embryo. Nest survival to hatching was 44% while 13 of the 36 eggs (36%) hatched. In the cases of failure the nest was simply found empty, though intact.

Post-nesting movements. – In the first half of July groups of up to six Dunlins fed in the lagoon near Kap Stewart (1973, 1974) and along the coast near Kærelv (1975). Groups of up to 13 were seen at the lakes near Bodal (1975). Two marked Dunlins having eggs at that time were foraging in a group of five on 1 July 1975 (Kærelv).

In the second half of July flocks of up to 50 adults (23 July 1974) were seen in the lagoon near Kap Stewart and up to 20 (22 July 1975) along the coast near Kærelv. Between 19 and 23 July 1974 we collected eight Dunlins from these flocks (Table 10). The straight oviduct of four females showed that they were non-breeders. Four males had small testes, but not smaller than found at that time in breeding Dunlins in northern Alaska (Holmes 1966). The incubation patches of all eight birds were small and more or less covered with down and newly growing feathers, and the skin of the patches was smooth and not especially vascularized, also indicating they were non-breeders. One female collected on 20 July 1974 from a group of four, of which some sang, had a swollen, twisted oviduct indicating she had been

Table 9. Data on three Dunlin broods from Modiolaelv and Kap Stewart areas.

| Locality | Date found | No. of young | Weight mean g | Bill mean mm | Estimated hatching date |
|---|---|---|---|---|---|
| Modiolaelv | 14.7.1974 | 4 | 12.1 | 12.9 | 11.7 |
| Kap Stewart | 16.7.1974 | 4 | 7.5 | 11.6 | 15.7 |
| – – | 17.7.1974 | 2 | 17.6 | 12.6 | 14.7 |

breeding that year. Her incubation patches were well developed, with wrinkled, vascularized skin and only a few new feathers starting to grow along the edges. A Dunlin, carrying a new metal ring of the Danish type, was seen in a flock on 23 July 1974 and probably had been ringed as a breeding bird in the same season. On five occasions between 22 and 30 July 1975 (Kærelv) we saw at least four different Dunlins, marked as breeders, foraging in the flocks along the coast. For instance on 27 July one that had lost its eggs on 30 June, and on 28 July one that had left the nest with three young on 12 July.

During the first week of August 1975 (Kærelv) numbers along the coast increased to 35. Between 10 and 15 August only some single Dunlins were seen, whereafter none appeared until we left on the 21st. At Kap Stewart (1973) they were not seen any more in the last week of August.

Weights and measurements. – We collected 15 adults and caught another 19 breeding birds on the nest for ringing (Table 10). Mean weight of 19 adults caught on nest was 42.9 g. The male from 31 May 1975 was ringed on 13 September 1963 at Morbihan (47°35'N 02°45'W), France (ring no. Paris JR 6310).

## Sanderling (*Calidris alba*)

Greenlandic: Siorarsiôq

Arrival and dispersal on breeding grounds. – First observations: 1973, 3 June three flying north at Rathbone Ø; 1974, 24 May one flying west at Kap Stewart, 26 May one at Kap Tobin; 1975, 23 May three at a small lake near Bodal. In 1974 (Kap Stewart) migration to the north of small groups of up to 21 was seen until 31 May. On 1 June a flock of 23 was standing in the snow on the fjord ice in a heavy snow fall together with other waders. In 1975 (Kærelv) migration northwards of groups of up to 31 was seen until 7 June.

Near Kærelv (1975) courtship display was seen from 3 June and on 6 June pairs had established territories on the tundra at Ugleelv.

Table 10. Measurements of 36 Dunlins.

| Ring no. | Date | Locality | Sex | Breeding status /gonads mm | Weight g | Wing mm | Bill mm | Incubation patches |
|---|---|---|---|---|---|---|---|---|
| Collected | 21.6.1973 | Kap Stewart | f. | one ruptured foll. | 43.0 | 120 | | + |
| – | 21.6.1973 | – – | f. | four ruptured foll. | 43.5 | 118 | | + |
| 8151204 | 1.7.1973 | – – | ? | breeding bird | 41.5 | 114 | 27 | + |
| 8151219 | 7.7.1974 | – – | ? | – – | 42.5 | 116 | | + |
| 8151220 | 9.7.1974 | – – | ? | – – | 45.5 | 115 | | + |
| 8151221 | 9.7.1974 | – – | ? | – – | 45.0 | 114 | | + |
| 8151237 | 14.7.1974 | Modiolaelv | ? | – – | 39.5 | 112 | | + |
| 8151242 | 16.7.1974 | Kap Stewart | ?⎫ | pair of | 41.5 | 114 | | + |
| 8151243 | 16.7.1974 | – – | ?⎭ | breeding birds | 42.0 | 112 | | + |
| 8153025 | 19.7.1974 | – – | ? | breeding bird | 50 | 117 | 30 | + |
| Collected | 19.7.1974 | – – | f. | ov. swollen and straight | 45 | 116 | 29 | + |
| – | 20.7.1974 | – – | f. | ov. swollen and twisted | 46 | 115 | 30 | + |
| – | 20.7.1974 | – – | m. | testis 1×3 | 40 | 115 | 25 | + |
| – | 22.7.1974 | – – | f. | ov. narrow and straight | 57 | 115 | 29 | + |
| – | 22.7.1974 | – – | f. | ov. narrow and straight | 48 | 115 | 29 | + |
| – | 22.7.1974 | – – | m. | testis 2.3×4.5 | 36 | 110 | 27 | + |
| – | 23.7.1974 | – – | f. | ov. swollen and straight | 37 | 115 | 31 | + |
| – | 23.7.1974 | – – | m. | testis 1.6×2.8 | 40 | 111 | 25 | + |
| – | 23.7.1974 | – – | m. | testis 1.7×3.2 | 46 | 113 | 26 | + |
| – | 24.5.1975 | Kærelv | m. | testis 4.2×8.5 | 42 | 115 | 27 | + |
| – | 31.5.1975 | – | f. | ov. swollen and twisted, foll. 5.6 mm. | 47 | 121 | 31 | + |
| – | 31.5.1975 | – | m. | testis 5.1×9.9 | 42 | 113 | 25 | + |
| 8151252 | 18.6.1975 | – | ?⎫ | pair of | 46.5 | 113 | 29 | + |
| 8151253 | 19.6.1975 | – | ?⎭ | breeding birds | 41.5 | 114 | 26 | + |
| 8151254 | 19.6.1975 | – | ?⎫ | pair of | 47.5 | 119 | 28 | + |
| 8151255 | 20.6.1975 | – | ?⎭ | breeding birds | 41.5 | 115 | 27 | + |
| 8151256 | 21.6.1975 | – | ?⎫ | pair of | 39.0 | 112 | 26 | + |
| 8151257 | 23.6.1975 | – | ?⎭ | breeding birds | 44.0 | 115 | 29 | + |
| 8151258 | 23.6.1975 | – | ?⎫ | pair of | 43.5 | 116 | 32 | + |
| 8151262 | 26.6.1975 | – | ?⎭ | breeding birds | 39.5 | 114 | 26 | + |
| 8151263 | 26.6.1975 | – | ?⎫ | pair of | 43.0 | 116 | 31 | + |
| 8151264 | 27.6.1975 | – | ?⎭ | breeding birds | 41.5 | 114 | 26 | + |
| 8151259 | 3.7.1975 | – | ? | breeding bird | 41.0 | 113 | 25 | + |
| Collected | 7.8.1975 | – | m. | juvenile, testis 1.0×2.4 | 41.5 | 114 | 26 | ÷ |
| – | 7.8.1975 | – | m. | juvenile, testis 1.0×2.5 | 40.0 | 113 | 28 | ÷ |
| – | 11.8.1975 | – | m. | adult, testis 1.4×3.2 | 36.0 | 116 | 21 | + |

Table 11. Data on eight Sanderling nests from Kap Stewart, Gåseelv and Kærelv areas.

| Nest no. | Locality | Date found | Clutch size | Mean egg weight g | No. of young hatched | Hatching date |
|---|---|---|---|---|---|---|
| 1 | Kap Stewart | 28.6.1973 | 3 | | ? | ? |
| 2 | – – | 28.6.1973 | 3 | | ? | ? |
| 3 | – – | 4.7.1973 | 4 | 10.1 on 4.7 | ? | 5.7 |
| 4 | – – | 9.7.1973 | 4 | | ? | ? |
| 5 | – – | 2.7.1974 | 4 | | 0 | empty 7.7 |
| 6 | Gåselev | 14.6.1975 | 4 | | ? | ? |
| 7 | Kærelv | 24.6.1975 | 4 | 9.3 on 24.6 | 3 | 4.7 |
| 8 | – | 28.6.1975 | 4 | 10.5 on 28.6 | 0 | empty 10.7 |

A few single Sanderlings were seen at times foraging in the lagoon near Kap Stewart and along the coast near Kærelv in June. On 17 and 18 June 1973 about 20 gathered near the houses at Kap Stewart during a spell of bad weather. Three females were collected (Table 13), all of them having ruptured follicles, indicating that they had already laid eggs that year. In May and the first week of June a small number of the birds were still not in full nuptial plumage.

Breeding habitat. – Sanderlings found near Kap Stewart, Kærelv and Gåseelv nested on dry, rather level ground, sparsely covered with a low vegetation of *Dryas* and *Salix*. The nests were less than 100 m from streams.

Breeding density. – In 1973 we found four pairs with eggs or young near Kap Stewart. In 1974 we found one in the census area and presumed another pair to breed there (Fig. 2). At Modiolaelv (1974) we found three and presumed at least two other pairs to be breeding (Fig. 2). In the census area near Kærelv (1975) we found one and presumed one more (Fig. 3), giving 0.3 pairs per km². Along the south bank of Ugleelv from the mouth to 11 km inland we estimated densities of up to two territories per km².

Breeding cycle, eggs and young. – In three seasons we found a total of eight nests (Table 11). Four clutches were complete when found. Nests 1 and 2 were visited only once, so it is possible that their clutches of three eggs had not yet been completed. Nest 8 had three eggs on 28 June and four on 30 June.

In Table 12 data and age estimates of pulli are presented. In addition we found three newly hatched pulli on 3 July 1973 near Kap Stewart. Assuming an incubation period of 24 days (Parmelee 1970), two clutches were completed in the second week of June in 1973 (Kap Stewart), besides one later on. In 1974 (Modiolaelv) three clutches were completed in the third week of June. In 1975 (Kærelv) two clutches were completed in the third and fourth week of June; at Gåseelv and Ugleelv one in the first half of June and one in the first week of June respectively. We obtained measurements of 30 eggs (eight nests, Table 14). Fresh egg weights were obtained only from nest 8; mean 10.5 g. Eggs from nest 3 averaged 10.1 g one day before hatching. Three pulli, less than 22 hours old, weighed 6.4, 6.6 and 6.9 g, respectively and all had a bill length of 10.1 mm.

Breeding success. – Of eight nests found, we followed only three. Two of these, containing four eggs each, disappeared before hatching. In the other nest three eggs hatched, the fourth egg was dry inside and no embryo could be seen.

Post-nesting movements. – From the first days of July we saw some foraging Sanderlings daily in the lagoon near Kap Stewart (1973, 1974) and along the coast near Kærelv (1975). A marked breeding bird having young at that moment was seen along the coast together with three other adults on 4 July 1975. At the same place, on the same day we collected a female, which according to the oviduct was a breeder (Table 13). Numbers increased during July, and in the second half of the month we saw flocks of up to 45 near Kap Stewart (18 July 1974) and up to 150 near Kærelv (22 July 1975).

A male and a female collected from these flocks on 19 July 1974 had new feathers growing on the incubation patches and the oviduct of the female was only

Table 12. Data on five Sanderling broods from Modiolaelv, Ugleelv and Kærelv areas.

| Locality | Date found | No. of young | Weight mean g | Bill mean mm | Estimated hatching date |
|---|---|---|---|---|---|
| Modiolaelv | 13.7.1974 | 4 | 9.1 | 11.3 | 11.7 |
| – | 13.7.1974 | 1 | 7.3 | 10.4 | 12.7 |
| – | 14.7.1974 | 2 | 17.6 | 12.6 | 10.7 |
| Ugleelv | 9.7.1975 | 1 | 34.5 | 18.3 | 26.6 |
| Kærelv | 11.7.1975 | 3 | 6.8 | 10.8 | 10.7 |

moderately swollen and twisted indicating that she had been breeding earlier, but perhaps not this year. The testes of the male were poorly developed. A single male collected on 23 July 1974 had fully developed incubation patches, and also larger testes. The breeding status of two males shot in post-breeding flocks on 21 July 1975 is unknown, but they had relatively small testes. In the last week of July numbers decreased both at Kap Stewart (1974) and at Kærelv (1974, 1975). In July only adults were seen.

Near Kærelv (1974, 1975) the numbers again increased from early August, when the juveniles appeared. In 1974 a maximum of 150 was counted on 23 August. After that time only single birds and small groups of up to eight were seen. In 1973 there were still some near Kap Stewart when we left on 29 August. After the first week of August only juveniles were present.

Weights and measurements. – We collected 10 adults and caught another 10 breeding birds for ringing (Table 13). The collected birds are rather heterogeneous with respect to both time of collection and their condition, so their weight varies considerably. Mean weight of 11 breeders, all recorded during the last week of June and the first half of July was 58.2 g.

It turned out to be impossible to judge from the plumage, with any accuracy, whether a Sanderling was a male or female. A brightly coloured bird collected on 19 July 1974 thought by us to be a male turned out to be a female and a dull coloured bird from 23 July 1974 thought to be a female was a male.

## Grey Phalarope (*Phalaropus fulicarius*)

Greenlandic: Kajuaraq

Two females and one male were seen on 19 and 21 June 1973 in the lagoon near Kap Stewart. On 6 July 1975 a female was seen on a pond on the tundra near Kærelv.

## Red-necked Phalarope (*Phalaropus lobatus*)

Greenlandic: Nalûmassortoq

In 1973 a pair was seen on 19 June in the lagoon near Kap Stewart. In 1974 on 2 June a female and on 7 June a pair were seen foraging along the ice edge in the fjord near Kap Stewart. Until the first week of July a pair and a few single birds fed in the lagoon. In 1975 on 7 June a pair and a group of six was seen on some ponds near Bodal. We presumed some pairs to breed there. A nest with four eggs (mean measurements 29.8 × 21.4 mm) was found on 15 June at Gåseelv. It was among grass close to a pond with stagnant water. On 4 August 1975 we saw some juveniles on the ponds near Bodal for the first time.

Table 13. Measurements of 23 Sanderlings.

| Ring no. | Date | Locality | Sex | Breeding status /gonads mm | Weight g | Wing mm | Bill mm | Incubation patches |
|---|---|---|---|---|---|---|---|---|
| Collected | 17.6.1973 | Kap Stewart | f. | two ruptured foll. | 49.5 | 129 | | + |
| – | 17.6.1973 | – – | f. | one ruptured foll. | 50.5 | 130 | | + |
| – | 17.6.1973 | – – | f. | one ruptured foll. | 51.5 | 130 | | + |
| 8151203 | 28.6.1973 | – – | ? | breeding bird | 58.5 | 126 | 25 | + |
| 8151212 | 3.7.1973 | – – | ? | – – | 58.0 | 137 | 26 | + |
| 8151213 | 4.7.1973 | – – | ? | – – | 67.0 | 126 | 26 | + |
| 8151216 | 10.7.1973 | – – | ? | – – | 58.5 | 127 | 24 | + |
| 8151223 | 13.7.1974 | Modiolaelv | ? | – – | 44.0 | 125 | | + |
| 8151229 | 13.7.1974 | – | ? | – – | 55.0 | 128 | | + |
| 8151232 | 14.7.1974 | – | ? | – – | 57.5 | 128 | | + |
| Collected | 19.7.1974 | Kap Stewart | f. | ov. moderately swollen and twisted | 62.0 | 127 | 25 | + |
| – | 19.7.1974 | – – | m. | testis 1.2×3.2 | 68.0 | 122 | 25 | + |
| – | 23.7.1974 | – – | m. | testis 2.6×4.6 | 51.0 | 128 | 24 | + |
| – | 6.6.1975 | Ugleelv | m. | testis 5.8×11.7 | 51.0 | 122 | 25 | ÷ |
| 8151260 | 24.6.1975 | Kærelv | ?⎫ | pair of | 62.5 | 131 | 26 | + |
| 8151261 | 25.6.1975 | – | ?⎭ | breeding birds | 58.5 | 126 | 23 | + |
| Collected | 4.7.1975 | – | f. | ov. swollen and twisted | 61.0 | 129 | 25 | + |
| 8151271 | 6.7.1975 | – | ? | breeding bird | 60.0 | 132 | 25 | + |
| Collected | 21.7.1975 | – | m. | testis 1.6×4.5 | 65.0 | 123 | 25 | + |
| – | 21.7.1975 | – | m. | testis 1.4×4.0 | 47.5 | 126 | 24 | + |
| – | 7.8.1975 | – | ? | juvenile | 50.0 | 122 | 24 | ÷ |
| – | 7.8.1975 | – | m. | juvenile, testis 1.0×2.5 | 47.0 | 121 | 23 | ÷ |
| – | 7.8.1975 | – | m. | juvenile, testis 1.2×2.9 | 47.0 | 124 | 24 | ÷ |

Table 14. Measurements of eggs of four wader species at Scoresby Sund 1973–1975. Numbers of measured clutches are given in brackets (N).

| | N | Length (mm) mean | Length (mm) range | Length (mm) S.D. | Width (mm) mean | Width (mm) range | Width (mm) S.D. |
|---|---|---|---|---|---|---|---|
| *Charadrius hiaticula* | 31(8) | 34.8 | 32.1–37.0 | 1.25 | 25.4 | 24.6–26.1 | 0.43 |
| *Arenaria interpres* | 38(10) | 40.2 | 37.6–43.9 | 1.64 | 28.4 | 26.6–30.4 | 0.94 |
| *Calidris alpina* | 36(9) | 33.6 | 31.0–36.0 | 1.04 | 23.6 | 22.7–24.3 | 0.46 |
| *Calidris alba* | 30(8) | 35.0 | 32.8–37.5 | 0.93 | 24.8 | 23.7–25.7 | 0.65 |

# Discussion and summary

## Arrival and dispersal on breeding grounds

The dates of initial observation for all years reported from the Scoresby Sund area are listed in Table 15. With the exception of a few early records at Kap Tobin in 1974, these dates are very similar to those found for the rest of Northeast Greenland (cf. Meltofte 1975, 1976a). The main influx of waders took place at the end of May and the beginning of June, and migrating birds were observed until early June. Territorial and courtship displays were observed from late May and early June. Pre-breeding groups and singles were found at the lagoon at Kap Stewart and at thawing ponds near Kærelv until mid-June. During heavy snow fall on 1 June 1974, 163 waders of four species (Ringed Plover, Turnstone, Dunlin and Sanderling) gathered at Kap Stewart and 57 at Kap Tobin. They stood inactive in flocks in the snow. During a spell of bad weather with rain and wind 90 waders of the same species plus Knots, gathered around the houses at Kap Stewart on 17, 18 and 19 June 1973. Two male Knots and three female Sanderlings collected from these flocks were breeders. These birds may have left their territories due to bad weather, as was observed at Danmarks Havn, further north (Meltofte 1979).

## Breeding densities and habitats

The population figures found in our three census areas are absolute minimum figures. Only clearly breeding pairs have been included, so a number of territorial but non-breeding or failed pairs may have been excluded. But even considering these precautions, the densities are very low compared with areas further north in Northeast Greenland (e.g. Rosenberg et al. 1970, Meltofte 1979), but similar to those found in Ørsted Dal just a hundred kilometres north of Hurry Inlet (Ferns & Mudge 1976) (Table 16). The country here in the southern parts of Northeast Greenland is much more fertile than further north, but the snow cover is more extensive, deeper and long lasting, and thus prevents the waders from utilizing large areas (cf. Meltofte 1976a, 1979). This probably also accounts for the extremely low numbers of Turnstones in southern Jameson Land compared with the Kalkdal area and the valleys of Ugleelv and Gåseelv, and also for the distribution of Ringed Plovers within the Kap Stewart census area (cf. Fig. 6 and the text).

The breeding habitats found in this study are very similar to those described for these species elsewhere in the high arctic. For further discussion on the distribution and breeding habitat of Purple Sandpiper, e.g. in the Scoresbysund district, see Meltofte et al. (1981).

Table 15. Dates of initial observation in the Scoresbysund district. Unprecise statements are given in brackets. SCO: the district in general. Data from Bay 1894, Pedersen 1926, 1930, Tcherniakofsky 1939, and this study.

| Species | SCO 1892 | SCO 1925 | SCO 1928 | SCO 1929 | SCO 1933 | Rathbone Ø 1973 | Kap Tobin 1974 | Jameson Land 1974 | Kærelv 1975 |
|---|---|---|---|---|---|---|---|---|---|
| *Charadrius hiaticula* | 25.5 | 27.5 | 26.5 | 24.5 | 15.5 | 23.5 | 17.5 | 27.5 | 24.5 |
| *Pluvialis apricaria* | | | 28.5 | | 25.5 | | 17.5 | 30.5 | 25.5 |
| *Arenaria interpres* | (25.5) | 23.5 | 19.5 | 24.5 | | 23.5 | 23.5 | 1.6 | 23.5 |
| *Calidris canutus* | | 9.6 | (26.5) | (24.5) | | 3.6 | 26.5 | 24.5 | 26.5 |
| *Calidris maritima* | | 4.6 | (26.5) | (24.5) | | 4.6 | 22.5 | | |
| *Calidris alpina* | | 27.5 | (26.5) | (24.5) | 20.5 | 23.5 | 18.5 | 24.5 | 21.5 |
| *Calidris alba* | | | 26.5 | 2.6 | (29.5) | 3.6 | 26.5 | 24.5 | 23.5 |
| *Phalaropus fulicarius* | | | (30.5) | | | | | | |
| *Phalaropus lobatus* | | | 30.5 | | | | | 2.6 | 7.6 |

Table 16. Population densities (pairs per km²) of waders in three census areas in Jameson Land and Liverpool Land 1973, 1974 and 1975.

| | K. Stewart 27 km² | | Kærelv 7 km² | Ørsted Dal[1] 260 km² |
|---|---|---|---|---|
| | 1973 | 1974 | 1975 | 1974 |
| *Charadrius hiaticula* | – | 0.4 | 0.7 | 1.0 |
| *Pluvialis apricaria* | 0.1 | 0.1 | 0 | 0 |
| *Arenaria interpres* | 0 | 0.04 | 2.1 | 0.3 |
| *Calidris canutus* | 0.1 | 0.1 | 0.1 | 0.1 |
| *Calidris alpina* | – | 0.4 | 1.3 | 0.3 |
| *Calidris alba* | 0.1 | 0.1 | 0.3 | 0.1 |
| *Phalaropus lobatus* | 0 | 0 | 0 | – |
| All waders | – | 1.1 | 4.5 | 1.8 |

1. After Ferns & Mudge 1976.

## Breeding cycles and success

Differences in the onset and peak period of egg-laying in different years and areas were highly correlated with snow melt conditions in respective years and areas and confirm results from elsewhere in high arctic Greenland (Meltofte 1976a, Green et al. 1977). The waders bred earliest at Kærelv and Modiolaelv, and later at Kap Stewart, especially in 1974. Taking all areas and all years into consideration the period between first and last dates of egg-laying was five weeks for Ringed Plover, four weeks for Golden Plover, three weeks for Sanderling and Dunlin and two weeks for Turnstone and Knot.

Breeding success was generally low, only Ringed Plover had more than 50% nest and egg survival. Little is known about the breeding success of waders in Northeast Greenland, but a higher success was generally found both at Danmarks Havn and on Hochstetter Forland (Meltofte 1979, Meltofte et al. 1980). Nest failures were probably mainly due to predation by Arctic Fox and to a lesser extent by Raven (*Corvus corax*) and Long-tailed Skua (*Stercorarius longicaudus*). Also Ermine (*Mustela erminea*) may have taken eggs. To what extent our visits to the nests increased predation is unknown. We may have guided foxes to the nests, but visits at nests were not found to have any greater effect elsewhere in Northeast Greenland (Meltofte et al. 1981). Fledging success is unknown.

## Post-breeding flocks and non-breeders

Small groups and single individuals of Ringed Plovers, Dunlins and Sanderlings fed in the lagoon at Kap Stewart and along the coast at Kærelv during late June and the first half of July. Observations in this period of two marked breeding Dunlins and one Sanderling, besides the oviduct of one collected Sanderling, showed that they were breeding birds on feeding excursions from their territories.

In the second half of July and in early August flocks of Turnstones, Dunlins and Sanderlings gathered at the same places. One female Turnstone and four female Dunlins collected in the flocks, were non-breeders. This was probably also the case for four male Dunlins and one male Sanderling, while one female Sanderling had laid eggs, although perhaps not in the same season. One newly ringed, and at least four colour marked Dunlins joined the flocks after having left their territories. So these flocks apparently contained mainly non-breeders, but also failed and successful breeders that had left their territories. Little is known about the relative number of non-breeding waders in high arctic Greenland, either one-year-old or older birds, but most waders do mate and occupy territories during the incubation period (Meltofte 1976a, 1979). Further north in Peary Land and at Danmarks Havn such flocks gather already from the last days of June and peak during the first half of July, but at Hochstetter Forland they also reached a maximum during the second half of July (Meltofte et al. 1981).

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# Meddelelser om Grønland, Bioscience

1979

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

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

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

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

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

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

1980

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

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

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

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

1980

3. H. Meltofte, M. Elander and C. Hjort:
»Ornithological observations in Northeast Greenland between 74°30′ and 76°00′ N. lat. 1976« 53 pp.

The results of one summer's work in central Northeast Greenland are presented. The avifauna in the country traversed on several extensive survey trips is described. More intensive studies were made in an 18.2 km² census area on southernmost Hochstetter Forland. Here the populations were followed throughout the breeding season, and information on arrival, pre-laying period, population densities, habitat and nest site selection, breeding schedule, clutch size, hatching success, re-nesting, non-breeders, moult, post-breeding activities and departure is given. Special attention is given to *Clangula hyemalis, Somateria spectabilis, Anser brachyrhynchus, Arenaria interpres, Calidris maritima, Calidris alpina, Calidris alba, Phalaropus fulicarius* and *Stercorarius longicaudus*. An extremely high predation pressure was caused by *Alopex lagopus*, and this is discussed in relation to lemming abundance and environmental conditions.

1981

4. Peter Milan Petersen:
»Variation of the population structure of Polygonum viviparum L. in relation to certain environmental conditions«. 19 pp.

Populations of *Polygonum viviparum* L. have been studied at Godhavn in Greenland (69° 14′ N, 53° 31′ W), at 30 sites within an investigation area of approx. six km². At each site, the age structure of the population was described after the individuals had been classified on the basis of the morphology of the rhizome. Other population parameters investigated are the total number of individuals (1 – 2,860 per m²), number of recently established individuals (0 – 1,720 per m²), number of flowering individuals (0 – 850 per m²), number of bulbils produced (0 – 17,870 per m²), and dry weight of standing crop (0.6 – 281 g per m²); the numbers in the brackets give the total range for the 30 sites. The flowering individuals have been characterized by the age class in which flowering first occurs, the mean dry weight of the vegetative parts (0.06 – 0.94 g) and the mean number of bulbils (9± 4 – 114 ± 46). – The environmental parameters studied include height above sea level, slope and direction of slope, soil water content, loss on ignition, bulk density, pH, exchangeable K, 0.2 N $H_2SO_4$-soluble P, C/N, soil temperature, time of disappearance of the snow, soil movement, and degree of cover of the vegetation. The sites have been assigned to six groups which are defined with emphasis on those factors which are assumed to be limiting: 1. Sites with soil movement, 2. Sites where the snow is late in disappearing, 3. Sites with waterlogged soil, 4. Well-drained sites on level or slightly sloping ground, 5. Steep slopes, exposed to the sun, and 6. Sites where competition for light is an important factor. Within each of the groups, the sites show a number of common features, especially as regards relative values referring to the population structure, and various features characterizing the plants. It is suggested that the large variation in the population parameters mentioned above occurs mainly because individuals of *Polygonum viviparum* of a different age are in a different way and to a different degree influenced by the environmental conditions. At the same time, the bulbil gain from and loss to the surroundings is stressed as important for the size of a population.

1981

5. Ole G. Norden Andersen:
»The annual cycle of temperature, salinity, currents and water masses in Disko Bugt and adjacent waters, West Greenland. 33 pp.

All available data on bathymetry, temperature, salinity and currents up until and including 1975 are used in describing the seasonal changes and dynamics of the hydrography of Disko Bugt, the Vaigat and adjacent glacier and non glacier fjords. From a winter situation with well mixed ÷1.75°C cold water in the upper c. 100 m.

steep halo- and thermoclines develop during the summer between freshened and heated surface water leaving Disko Bugt and deeper more saline water entering from the West Greenland Current. Huge ice bergs have a decisive cooling effect upon the upper 150–200 m affecting the outflowing current as well as the inflowing water which is responsible for the high bottom temperatures and salinities (up to 3.5°C and 34–34.5‰ at 300–500 m) found the year round, and which contributes to raising the temperature in the upper 200 m in the summer, especially in the southern and eastern part of the bay and even into the Vaigat. Surface temperatures reach 12°C in the offshore waters of the bay where salinities may drop to 30‰, and inshore in the more diluted waters of Disko Fjord temperatures may even reach 14°C, whereas in the glacier fjords, where surface salinities come close to zero, 4°C is the highest temperature recorded and subzero temperatures are found even in July. An extensive upwelling of W Greenland water occurs in the northern part of the bay during the summer and fall and similar phenomena occur in Disko Fjord, driven by winds and apparently linked to tidal rhythms. Although TS diagrams show that deep Disko Bugt water and Baffin Bay water is of common origin, no water seems to enter Disko Bugt from Baffin Bay or from the Baffin Current.

1981

6. Ole G. Norden Andersen:
»The annual cycle of phytoplankton primary production and hydrography in the Disko Bugt area, West Greenland. 65 pp.

The distribution and size of phytoplankton production and biomass in relation to physical and chemical parameters in the upper 50 m at Godhavn and in Kangikerdlak in the inner part of Disko Fjord was investigated through 2½ years (1973–75). Some data from other parts of Disko Bugt are presented.

In both locations the hydrography alternates between an unstable winter situation with isothermal (÷1.75°C) and isohaline (33.5–34.0‰) conditions throughout, and a highly stable summer situation when dilution and heating, especially of the upper 20–30 m, raise the temperature at the surface to 9.9°C and at 50 m to 3.8°C at Godhavn, and to 12°C and 3.5°C respectively in Kangikerdlak. Salinities drop correspondingly to 30.6‰ in Kangikerdlak.

The 1% depth for green light is greatly reduced beneath ice and snow. During the ice free period at Godhavn it varies from 12 m during the spring phytoplankton bloom to more than 60 m from Oct. through the winter. In Kangikerdlak the 1% depth reaches only 40 m in winter, and outflowing turbid fresh water creates 1% depths of as little as 4–5 m in June–Aug.

At Godhavn $NO_3$-N reaches highs of 10.05 µgat/liter and 10.15 µgat/liter at 0 and 50 m respectively in winter, whereas during the summer, depletion to less than 0.01 µgat/liter occurs in the upper 40 m and to 1.0 µgat/liter at 50 m. $PO_4$-P is similarly reduced from 0.8 µgat/liter and 1.1 µgat/liter to less than 0.01 µgat/liter in the upper 20 m and to 0.21 µgat/liter at 50 m. The N:P ratio drops from 13 to less than 0.01 in the upper 30 m and to 1.0 at 50 m. In Kangikerdlak depletion of $NO_3$-N is similar to conditions at Godhavn, whereas $PO_4$-P reaches a low of 0.1 µgat/liter only, while in mid summer it reaches 1.88 µgat/liter at the surface, giving an N:P ratio which is below 0.1 in the upper 5 m only.

At Godhavn primary production is about 90 $gC \cdot m^{-2} \cdot yr^{-1}$ (75–104 g) with a maximum of about 5.5 $gC \cdot m^{-3} \cdot yr^{-1}$ at 5–10 m, whereas in Kangikerdlak production was concentrated near the surface with about 6.0 $gC \cdot m^{-3} \cdot yr^{-1}$ and a total of 35 $gC \cdot m^{-2} \cdot yr^{-1}$ at most. Production at Jacobshavn off the glacier fjord is probably greater than at Godhavn, whereas at Christianshåb and Egedesminde it is definitely lower.

Phytoplankters larger than 56 µ contribute about 50% of annual and up to 90% of daily production.

Due to the great stability, production usually extends no deeper than compensation depth, and most of the chlorophyll is usually in the nutrient rich water below this depth, where it sinks, is consumed, or degrades into phaeopigment. P/B is highest where there is least chlorophyll. Light reduces production in the upper 5–10 m, and inhibition may extend to 30 m. Correlations between production, P/B, or P/B/light and nutrients reveal possible saturation values of 0.08–0.78 µgat $NO_3$-N/liter and 0.17–0.22 µgat $PO_4$-P/liter. $PO_4$-P seems to be the limiting nutrient in some cases, although $NO_3$-N is most quickly and thoroughly depleted.

Dark fixation at Godhavn is about 24 $gC \cdot m^{-2} \cdot yr^{-1}$, and at Kangikerdlak about 15 $gC \cdot m^{-2} \cdot yr^{-1}$. 55–60% of dark fixation is presumed to be biotic and 16–64% is associated with particulate matter larger than 56 µ.

Although oxygen is never at a minimum in Disko Bugt, saturation as well as absolute $O_2$ values and pH show profiles in the bay that clearly reflect the high degree of stratification compared to waters south of the bay.

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

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

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In the list of references the following usage is adopted:

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

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

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

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