Post-breeding phenology of waders in central NE Greenland

HANS MELTOFTE & THOMAS B. BERG

National Environmental Research Institute, Department of Arctic Environment, PO Box 358, DK-4000 Roskilde, Denmark. mel@dmu.dk

Meltofte, H. & Berg, T.B. 2004. Post-breeding phenology of waders in central NE Greenland. *Wader Study Group Bull.* 104: 22–27.

For the first time, post-breeding phenological graphs based on multi-year data for adult and juvenile waders are presented for a High Arctic area; Zackenberg in central NE Greenland (74°28'N, 20°34'W). Counts every third day during 20 July–3 September 1995–2003 in two delta areas under tidal influence produced useable data for Great Ringed Plover *Charadrius hiaticula*, Sanderling *Calidris alba*, Dunlin *Calidris alpina* and Ruddy Turnstone *Arenaria interpres*, while more casual observations were available for Red Knot *Calidris canutus*. The data are compared with and found to fit with passage data for the same populations in NW Europe, primarily Blåvands Huk in W Denmark.

INTRODUCTION

The arrival of waders on their Arctic breeding grounds has received much attention in the literature, though quantitative data except for first observation dates are few. Much less attention has been paid to departure phenology, since it takes place over a more prolonged period at a time when most breeding studies have finished (see Meltofte 1985 for High Arctic Greenland). In this paper we present, for the first time, systematic quantitative data on the post-breeding phenology of adult and juvenile waders obtained in the course of monitoring annual juvenile production at Zackenberg in central NE Greenland during 1995–2003 (see Meltofte 2003 and Meltofte & Berg 2003).

STUDY AREA AND METHODS

As part of the biological monitoring programme, BioBasis (see http://biobasis.dmu.dk), adult and juvenile waders and other waterbirds are counted annually every third day from 20 July to the end of the field season around 1 September (latest counts 3 September) in the present and the former deltas of the river Zackenbergelven on the south coast of Wollaston Forland (74°28'N, 20°34'W). The two delta areas consist of gravelly and stony alluvial flats with some sections of muddy substrate, particularly in the former delta (Fig. 1). Also in the latter area, dead seaweed tends to concentrate behind a sandbar. The entire stretch of coastline occupied by the two deltas and the muddy coast between them is 1,700 m, and the deltas are about 800 m long. The former delta resembles a miniature "wadden sea", while the present delta is the active delta of a major river carrying around 140–300 million tons of water, 20,000–50,000 tons of sediment and 2,000 tons of organic matter per season (Rasch & Caning 2003 and previous annual Zackenberg Ecological Research Operations reports). The old delta became cut off and turned into mudflats, when the meandering river broke through a gravel wall 1 km further west (see Fig. 1). This probably happened about 2,600 years ago (Christiansen *et al.* 2002). Potential food for waders is mainly crustaceans (amphipods) and nematodes, which have both been found in densities of >50m^{-2} of mudflat (Lahrmann & Meltofte in press.). We suspect much higher densities are found in the dead seaweed.

The counts, which were all made by the authors, were performed from low tide onwards and took about 1–1½ h to complete. Waders present were identified to age (adults and juveniles), using a 30× telescope, a tally counter and a dictating machine. To avoid observations against sunlight, counts were made at low tide before 1500 h (i.e. from about 0300 h). In case of poor weather conditions, the counts took place one day before or after the usual date. Besides counts from the deltas, our more casual observations of post-breeding flocks of waders on the tundra and in the deltas before 20 July are included.

Eurasian Golden Plover *Pluvialis apricaria*, Whimbrel *Numenius phaeopus*, Red-necked *Phaloropus lobatus* and Red *P. fulicarius* Phalaropes also breed in low numbers in High Arctic Greenland (Boertmann 1994) and are recorded at Zackenberg, but are not dealt with here.

RESULTS AND DISCUSSION

Waders arrive on the Greenland High Arctic breeding grounds during late May and early June (Meltofte 1985). Depending on local snow cover, egg-laying begins 1–4 weeks after arrival, i.e. sometimes not until late June or early July. However, most clutches initiated in late June and early July are probably second clutches produced after loss of the first clutch to predation or other failure. If a clutch or brood is lost late in June or beyond, the birds usually give up nesting and form post-breeding flocks together with birds that may not have attempted to breed at all. These flocks, which often comprise several species, roam to feed on the tundra and along the margins of ponds and streams until the coasts become ice-free in July. Thereupon they may also feed on the shore and around river mouths and coastal lagoons. Successful breeders leave the breeding grounds from shortly after hatching (mostly females) to a few days after the young fledge, i.e. mainly from early July to early August. Fledged juveniles are seen from late July, with the very earliest appearing by the third week of the month. They become independent and begin to show up on the coasts from the last

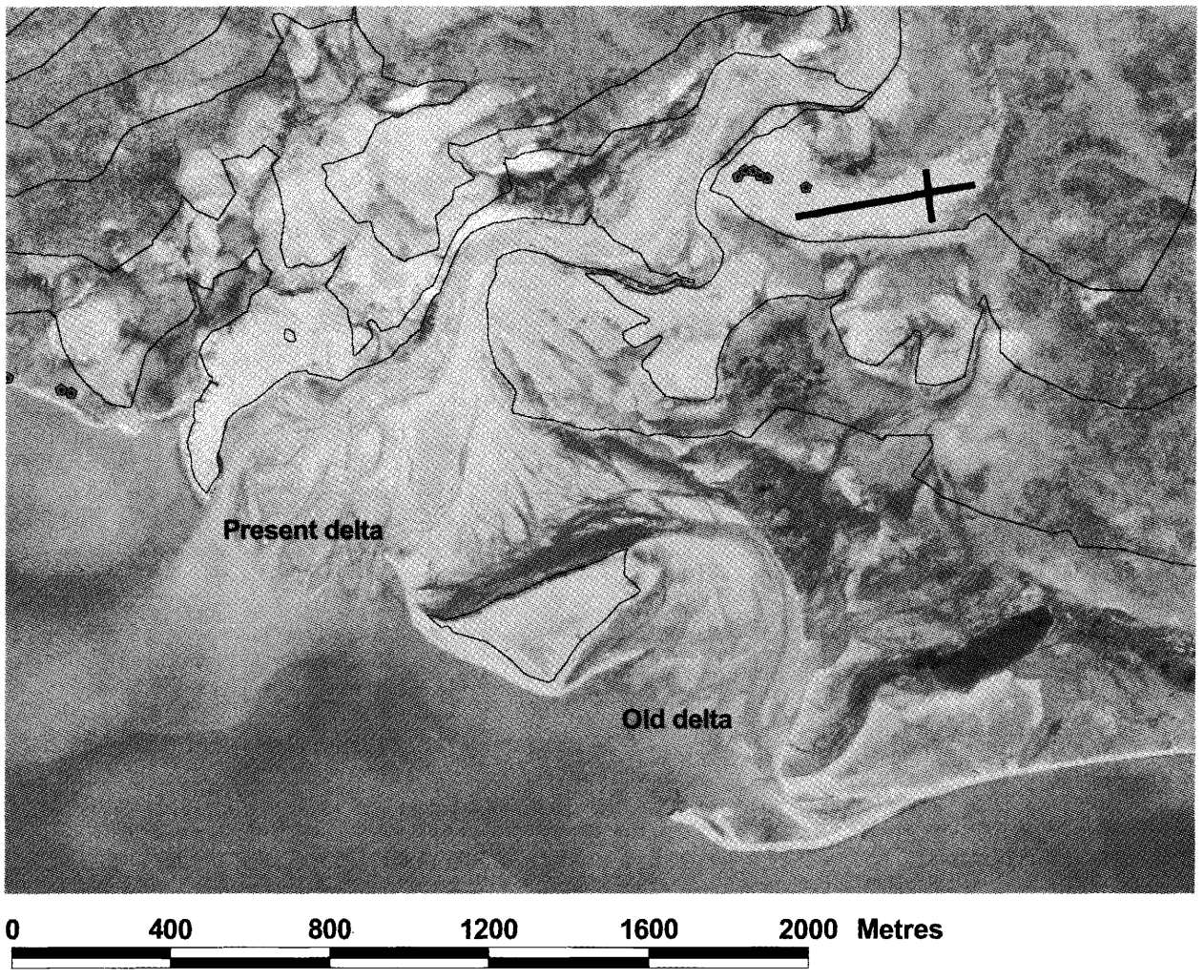

Fig. 1. Aerial photograph of the present and former deltas of the river Zackenbergelven on the south coast of Wollaston Forland, central NE Greenland. The waders primarily feed in the outer, tidal parts of each delta and along the tide edge between the two deltas. The research station and the runway are seen in the upper right corner. Ten-metre elevation contours are also shown.

week of July or early August. The result is that the bird-life on the tundra becomes very depleted in late July and early August, and only a few late breeders remain until late August (Meltofte 1985, 2001a, 2003, this study).

In the species accounts below, this pattern is described for individual species and discussed in relation to the appearance of the same birds on the staging and wintering areas in NW Europe. Unfortunately, detailed phenological information for NW Europe is scant (i.e. averages based on multi-year data with age-class separation). The main exception is that from Blåvand Bird Observatory in W Denmark (Meltofte 1993). Good data also exist from the North Sea coast of the Netherlands, but very little autumn migration of these species takes place there (Camphuysen & van Dijk 1983).

The waders feeding in the deltas of Zackenbergelven probably originate from a much larger area than the adjacent lowlands. However, several observations of both adults and juveniles carrying rings of local origin (few other wader chicks have been ringed in NE Greenland during these years) show that local birds use the area. However, flocks have also been seen to arrive from some height and land in the deltas, suggesting that they may have come some distance (Lahrmann & Meltofte in press).

Often a high amount of migratory unrest is seen among the post-breeders, which take off and fly around vigorously, calling or even singing. For example, in the Zackenberg deltas, post-breeding Dunlins may spend up to 20% of the time on the wing (Lahrmann & Meltofte in press), and there appears to be a high turnover among the staging birds as numbers vary considerably from one low tide to the next. During high tide, some birds may move inland to feed at lake and pond margins and on the tundra.

The earliest flocks heading south have been seen from the first days of July, and most movements of adults have been recorded from mid July until early August (Meltofte 1985, this study). Most migrating flocks observed were of <10 individuals, but up to 40 adults have been seen heading south or southeast (Meltofte 1985, this study). Similarly, flocks of migrating juveniles most often held <20 individuals. They have been reported flying south from early August. Some of the populations discussed here may head for a stopover in Iceland, while most apparently migrate direct to NW Europe, where the British estuaries and the Wadden Sea are of prime importance (Meltofte *et al.* 1994, Kirby *et al.* in prep.).

Great Ringed Plover *Charadrius hiaticula*

Ringed Plovers rarely form post-breeding flocks on the tundra, but feed dispersed until they depart directly from there or spend time on coastal mudflats before moving on. At the most, we recorded 11 adults in groups inland in July and early August.

The average numbers of adults in the deltas peak in early and mid August (Fig. 2), when we recorded up to 51. This relatively late peak is consistent with the fact that in the Ringed Plover both parents stay with the chicks until they have fledged (Cramp & Simmons 1983), and that the passage of Arctic birds (adults of both *psammodroma* and *tundrae*) peaks in early and mid August at Blåvands Huk, Denmark, i.e. later than in other Arctic species (Meltofte 1993).

The earliest juvenile was seen in the deltas on 30 July, but in most years they did not turn up until early August, showing a pronounced peak in mid–late August (Fig. 2). The departure of these birds again corresponds well with the passage at Blåvands Huk where juveniles of supposed Arctic origin peak from late August to mid September (Meltofte 1993). The highest number of juveniles counted in the deltas was 115, while only up to 5–7 juveniles were encountered on the tundra and at tundra pools and lakes during August.

Greenland Ringed Plovers winter in tropical W Africa (Lyngs 2003).

Red Knot *Calidris canutus*

Adult Red Knots usually depart directly from the tundra without visiting the coast, but small flocks of juveniles may appear at river mouths during August and early September (Meltofte 1985). At Zackenberg, we have encountered post-breeding flocks with up to 13 adult knots on the tundra and on the mountain slopes from 21 June to 16 July. However, off-duty breeders also form feeding parties, and we recorded up to six birds in mid and late June and the first half of July that we considered were probably in this category. In the deltas, we have recorded up to eight adults and 14 juveniles together in mid August, but otherwise, only few juveniles (max. 6, but none at all in some years) were seen in most years between 29 July and 3 September (the latter being our latest counts).

Breeding knots from High Arctic Greenland and Canada (*C. c. islandica*) winter in W Europe (Lyngs 2003) where adults (probably from both Greenland/Canada and from Siberia (*C. c. canutus*)) appear from early July, and their arrival peaks in late July and early August (Meltofte 1993, Meltofte *et al.* 1994). The juveniles follow in late August and early September with the first individuals most often seen around 10–15 August.

Sanderling *Calidris alba*

Post-breeding flocks of adult Sanderlings, usually mixed with other wader species, are often seen on the tundra. We recorded flocks of up to 17 Sanderlings from 27 June until early August and up to 30 on the coast from mid July. Our coastal counts show greatest numbers of adults at the beginning of the study period, around 20 July (Fig. 3), which suggests that even higher numbers might occur earlier. However, this peak is inflated by our highest single count of 70 on 20 July 2000 when a snowstorm had killed many young and induced the adults to move to the coast (see under Dunlin). In other years, peak numbers of up to 52 occurred in late July. Elsewhere in NE Greenland, large numbers of adults have also been recorded in post-breeding flocks in late July and early August with congregations of up to 300 (Meltofte 1985).

In the first few years, higher numbers of adults were recorded as late as mid August. However, we now consider that some of these were wrongly aged. Hence, adult numbers probably decrease continuously during late July and all of August. This is consistent with the passage of adults at Blåvands Huk, Denmark, where the first birds appear around 10 July and peak passage is during the second half of July and early August (Meltofte 1993).

Most years, juvenile Sanderlings appear on the coasts from the last week of July, but we also recorded small flocks (max. 9) inland during all of August. Numbers of juveniles in the deltas build up until the end of August, and we did not record their final departure during our study period (Fig. 3). However, in other parts of NE Greenland peak juvenile numbers have been up to 300 in late August (Meltofte 1985). This corresponds well with arrival of juveniles in W Denmark which starts in mid August and peaks in late August and early September (Meltofte 1993). Peak numbers of juveniles in the deltas were 120–140 in the best years.

Most Greenland Sanderlings winter on the coast of W Africa with smaller numbers in W Europe (Lyngs 2003).

Dunlin *Calidris alpina*

The Dunlins of NE Greenland make up an endemic subspecies, *C. a. arctica*, with an estimated total population of only 20,000–45,000 individuals (Meltofte 2001a). Due to this small number, little is known about their migratory phenology, since they become lost among the 2.2 million Dunlins staging and wintering in W Europe and W Africa, the latter being the wintering grounds of *arctica* (Lyngs 2003).

The first post-breeding flocks appear on the tundra in the last days of June, and during July, we encountered flocks of up to 10 adults on the tundra and at lake and pond shores. In years when ice in the deltas melts early, flocks may appear there from early July, and up to 25 were recorded prior to the start of the waterbird counts in the delta on 20 July. During 17–18 July 2000, a snowstorm raged, followed by rain and sleet for three days. This probably killed many newly hatched wader chicks and induced the adults to move to feed on the coast (Meltofte 2001b). Hence, we counted 99 adult Dunlins in the former delta on 18 July, 160 in both deltas on 20 July and 153 on 23 July. These high counts are included in Fig. 4. In other years, numbers have not been high until the count on 26 July, so that the normal peak of adults was very pronounced during the last two counts in July and the first two counts in August, when up to 112 adults were present.

In most years, numbers of juveniles build up on the deltas from the last week of July to a peak in the second half of August (Fig. 4) with a maximum of 152 juveniles recorded. Inland, juvenile Dunlins appear in small flocks at lake and pond margins in August and early September, when we found up to 13 at one pond. In other parts of NE Greenland, concentrations of up to 300 juveniles have been recorded in mid August (Meltofte 1985).

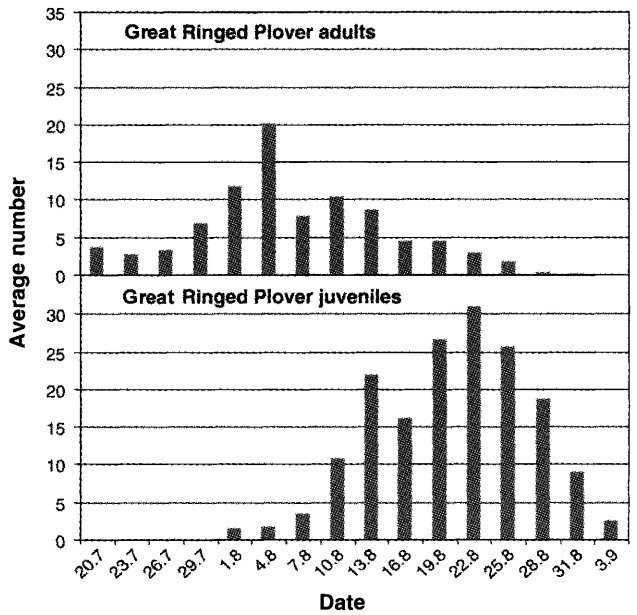

Fig. 2. Average numbers of adult and juvenile Great Ringed Plovers *Charadrius hiaticula* counted every third day during 20 July–3 September 1995–2003 in the present and former deltas of the river Zackenbergelven, central NE Greenland.

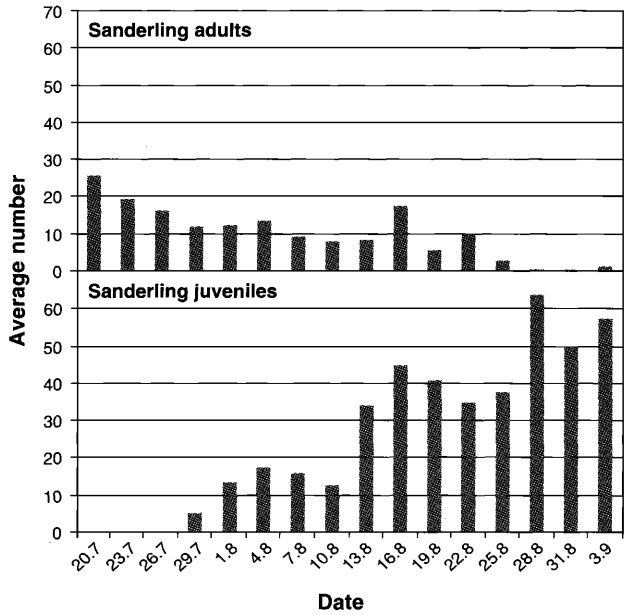

Fig. 3. Average numbers of adult and juvenile Sanderlings *Calidris alba* counted every third day during 20 July–3 September 1995–2003 in the present and the former deltas of the river Zackenbergelven, central NE Greenland (see caution in text about adult numbers in August).

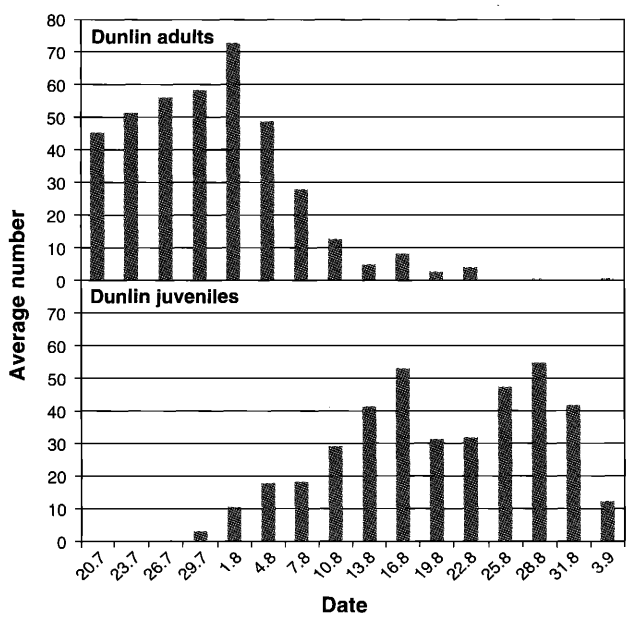

Fig. 4. Average numbers of adult and juvenile Dunlins *Calidris alpina* counted every third day during 20 July–3 September 1995–2003 in the present and the former deltas of the river Zackenbergelven, central NE Greenland.

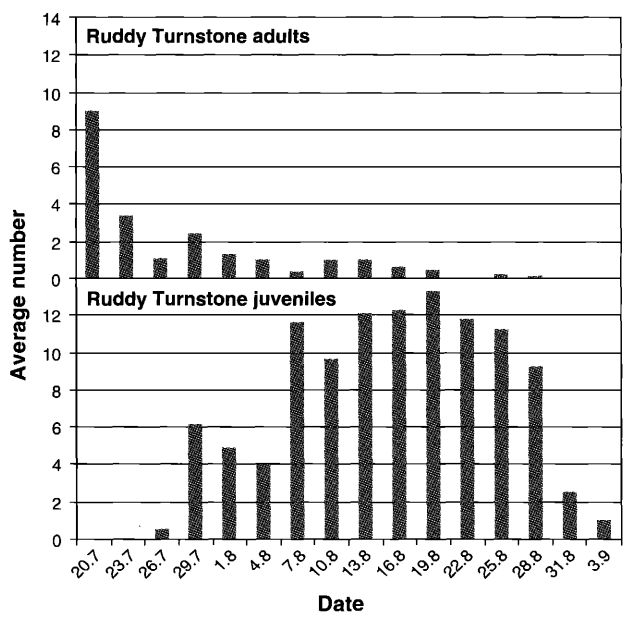

Fig. 5. Average numbers of adult and juvenile Ruddy Turnstones *Arenaria interpres* counted every third day during 20 July–3 September 1995–2003 in the present and the former deltas of the river Zackenbergelven, central NE Greenland.

Ruddy Turnstone *Arenaria interpres*

We recorded the first post-breeding flock of Turnstones on 21 June, but most years we did not see such flocks until the last days of June or early July. Maximum numbers have always been under 10 inland, while up to 25 were found in the deltas in mid July 2000 (after the snowstorm mentioned under Dunlin) and 20 in mid July other years. Otherwise, numbers of adults in the deltas were low (Fig. 5), but congregations of up to 100 adult Turnstones have been recorded in mid–late July in other parts of High Arctic Greenland (Meltofte 1985). Most adults are gone from Zackenberg by 1 August. The NE Greenland data fits well with that for Blåvands Huk, Denmark, and the Dutch North Sea coast,

where the first birds are seen around 10 July and the migration of Nearctic adults peaks in late July and early August (Camphuysen & van Dijk 1983, Meltofte 1993).

The first independent juveniles appear inland and on the coasts in late July, and numbers are high during most of August (Fig. 5). This seems a bit earlier than in our other main study species, probably a result of the generally earlier breeding in this species (similar to Red Knots; Meltofte 1985). In W Denmark, juveniles of supposed Arctic origin appear in numbers from mid August (Meltofte 1993).

Greenland Turnstones mainly winter in NW Europe (Lyngs 2003).

CONCLUSION

Our results show that the departure of waders from High Arctic Greenland generally fits well with arrival phenology in NW Europe in that the arrivals there peak about a week after the peaks in Greenland.

Waders of Siberian origin appear earlier on autumn migration in N Europe after seasons with breeding failure e.g. due to heavy predation on nests and young by Arctic foxes *Alopex lagopus* (Blomqvist *et al.* 2002). Large scale breeding failure has not yet been reported from High Arctic Greenland, and such differences in phenology have not been documented (Meltofte 1985).

Both adult Ringed Plovers and Dunlins appear to stay rather longer at Zackenberg than adults of Knots, Sanderlings and Turnstones. Moreover the relatively high numbers of Dunlins on the coastal mudflats and lagoons may indicate that this species is more dependent on those habitats for final fattening than the others, which mostly appear to depart directly from the tundra. Among juveniles, Sanderlings seem to stay longest, but this conclusion should be treated with caution when making comparisons with other species, such as Dunlin, since we only have counts from 3 September in two years.

In High Arctic Canada, juvenile waders have been found to carry little pre-migratory fat (Lindström *et al.* 2002). This may be quite different in High Arctic Greenland, since the birds have to cross the N Atlantic to Iceland or direct to NW Europe in one flight, as opposed to the Canadian birds that may be able to fly much shorter distances from one feeding site to the next.

Very few or no adults of our study species remain in NE Greenland when most juveniles leave during late August and early September (Table 1). Moreover the few adults present on these occasions often occurred in only one area, such as the old delta or the present delta, while the juveniles were spread more widely. Hence, even when adults were present, they were separated from many of the juveniles so that there would been little contact between them. Therefore it is most unlikely that the juveniles benefit from any adult guidance in finding the best staging and wintering areas during their first southward migration.

Table 1. Number and percentage of 3-daily counts of waders during 20 July–3 September 1995–2003 in the present and former deltas of the river Zackenbergelven, NE Greenland, that did not also include adults.

	Counts including juveniles		
	Total	No adults present (%)	
Great Ringed Plover	45	28	(62)
Red Knot	14	14	(100)
Sanderling	35	26	(74)
Dunlin	46	27	(59)
Ruddy Turnstone	44	41	(89)

POSTSCRIPT

Our comments on the lack of published information from the western seaboard of Europe on the phenology of wader migration by age-class will not have gone unnoticed. Most published studies on this subject relate to Scandinavia and central Europe. We find it hard to believe that such data from elsewhere do not exist, and hereby encourage researchers to work up such data for publication for the benefit of all.

ACKNOWLEDGEMENTS

The biological monitoring programme, BioBasis, is part of Zackenberg Ecological Research Operations facilitated by the Danish Polar Center on Zackenberg Research Station. The BioBasis programme is financed by the Environmental Protection Agency, Ministry of Environment, Denmark, and run by the National Environmental Research Institute, Department of Arctic Environment, Denmark. Jeroen Reneerkens and Peter Lyngs kindly criticised earlier drafts of the manuscript, and Brian J. McCaffery provided valuable comments as referee.

REFERENCES

Blomqvist, S., N. Holmgren, S. Åkesson, A. Hedenström & J. Pettersson. 2002. Indirect effects of lemming cycles on sandpiper dynamics: 50 years of counts from southern Sweden. *Oecologia* 133: 146–158.

Boertmann, D. 1994. An annotated checklist to the birds of Greenland. *Meddr Grønland* 38 (63 pp.).

Camphuysen, C.J. & J. van Dijk. 1983. Seabirds and estuary birds along the Netherlands coast, 1974–79. *Limosa* 56: 81–230 [in Dutch with English summary].

Christiansen, H.H., O. Bennike, J. Böcher, B. Elberling, O. Humlum & B.H. Jakobsen. 2002. Holocene environmental reconstruction from deltaic deposits in northeast Greenland. *J. Quaternary Sci.* 17: 145–160.

Cramp, S. & K.E.L. Simmons. 1983. *Handbook of the Birds of Europe, the Middle East and North Africa. Vol. 3. Waders to Gulls.* Oxford University Press, Oxford.

Kirby, J., R. West, D. Scott, N. Davidson, T. Piersma, H. Hötker & D.A. Stroud. in prep. *Atlas of wader populations in Africa and western Eurasia. Phase I.*

Lahrmann, D.P. & H. Meltofte. in press. Time allocation in Greenland High Arctic waders during summer. *Dansk Orn. Foren. Tidsskr.*

Lindström, Å., M. Klaassen, T. Piersma, N. Holmgren & L. Wennerberg. 2002. Fuel stores of juvenile waders on autumn migration in high arctic Canada. *Ardea* 90: 93–101.

Lyngs, P. 2003. Migration and winter ranges of birds in Greenland. An analysis of ringing recoveries. *Dansk Orn. Foren. Tidsskr.* 97: 1–167.

Meltofte, H. 1985. Populations and breeding schedules of waders, Charadrii, in high arctic Greenland. *Meddr Grønland, Biosci.* 16 (43 pp.).

Meltofte, H. 1993 Wader migration through Denmark: populations, non-breeding phenology, and migratory strategies. *Dansk Orn. Foren. Tidsskr.* 87: 1–180. [in Danish, with English summary].

Meltofte, H. 2001a. Wader Population Censuses in the Arctic: Getting the Timing Right. *Arctic* 54: 367–376.

Meltofte, H. 2001b. Birds. pp. 30–39 in Caning, K. & M. Rasch (eds):

Zackenberg Ecological Research Operations, 6th Annual Report, 2000. Danish Polar Center, Ministry of Research and Information Technology (80 pp.).

Meltofte, H. 2003. Birds. pp. 33–43 in Rasch, M. & K. Caning: *Zackenberg Ecological Research Operations, 8th Annual Report, 2002.* Danish Polar Center, Ministry of Research, Technology and Innovation. (80 pp.).

Meltofte, H. & T.B. Berg. 2003. *Zackenberg Ecological Research Operations. BioBasis: Conceptual design and sampling procedures of the biological programme of Zackenberg Basic.* 6th ed. National Environmental Research Institute, Department of Arctic Environment (69 pp.). Also on *http://www.dmu.dk/1_Viden/2_Miljoe-tilstand/3_natur/biobasis/biobasismanual.htm*

Meltofte, H., J. Blew, J. Frikke, H.-U. Rösner & C.J. Smit. 1994. Numbers and distribution of waterbirds in the Wadden Sea. Results and evaluation of 36 simultaneous counts in the Dutch-German-Danish Wadden Sea 1980–1991. *IWRB Publication* 34 / *Wader Study Group Bull.* 74, Special issue. Common Secretariat for the Cooperation on the Protection of the Wadden Sea (192 pp.).

Rasch, M. & K. Caning. 2003. *Zackenberg Ecological Research Operations, 8th Annual Report, 2002.* Danish Polar Center, Ministry of Research, Technology and Innovation. (80 pp.).

Wader censusing in the old delta looking to the northwest with the research station seen on the plateau to the right in the picture. Photo: Henning Thing, PolarPhotos.