THE MIGRATION OF WADERS THROUGH NORTH-EAST ICELAND

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Counts and observations of migrant high arctic waders were carried out from early May to mid August 1986 on an 18 km stretch of the Melrakkasletta coastline, north-east Iceland. Peak counts of spring migrant waders were 2 500 Turnstones, 1 865 Knots and 58 Sanderlings. Dunlins and Ringed Plovers nested locally, making it more difficult to assess accurately the numbers of migrants for these species. It is estimated that over 20 000 high arctic waders may use Melrakkasletta on spring migration. Observations of spring migrants' arrival and departure dates and flocks' departure directions tend to confirm the notion that high arctic waders passing through Iceland use differing migration strategies, depending on whether they are bound for north-west or north-east breeding sites. Autumn passage of waders through Melrakkasletta was negligible.

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INTRODUCTION

For many waders breeding in north-east Canada and north Greenland, particularly Knots *Calidris canutus* and Turnstones *Arenaria interpres*, west Iceland is known to be a major staging area on migration (Morrison and Wilson 1972, Morrison *et al.* 1971, Wilson 1981, and references therein). However, information on the importance of sites elsewhere in Iceland is fragmentary. Much of the southern coastline consists of extensive black volcanic sand beaches which probably provide little food for migrant waders (Wilson 1981). On the basis of a few visits and the relative scarcity of suitable intertidal feeding areas, Wilson (1981) concluded that relatively few waders breeding in the high arctic migrate through north and east Iceland. Subsequently, Wilson (1986) suggested that the Melrakkasletta peninsula in the north-east could be one of the most important sites for migrant waders in east Iceland, but that the numbers of passage birds were probably considerably lower than those in the west coast localities. However, Wilson's visits to Melrakkasletta were brief and occurred during the autumn migration period when other more extensively surveyed Icelandic sites are known to hold fewer waders than in spring (Wilson 1981).

In this paper we report the results of regular counts and observations of waders made on a stretch of the Melrakkasletta coastline from early May to mid August 1986, which indicate that the area is far more important as a staging post for high arctic waders than hitherto realised.

STUDY SITE AND METHODS

The study site was an approximately 18 km stretch of the north-eastern coastline of the Melrakkasletta peninsula in north-east Iceland (66° 30'N, 15° 57'W), from the northern harbour of Raufarhofn town in the south to Hringlon in the north (Figure 1). This coastline consists predominantly of sandy beaches and cobble beaches interspersed with rocky scars, and most of the strand-line has substantial deposits of tide-wrack resulting from seaweed being detached and washed up by wave-action during winter. Counts of waders were carried out from 9 May to 17 August 1986 from a four-wheel drive vehicle and on foot, and were not made at any particular time of day or stage of tide. Several flocks of waders were scanned for marked individuals, and notes were made of any incidental observations of migrating waders; such notes included flock size, species composition and compass bearing of flight direction. Compensation was made for the difference between magnetic north and true north by subtracting 20° to produce geographic bearings. No compensation was made for parallax as departing flocks usually flew overhead. The sexes of Turnstones were determined on the basis of plumage differences: the most reliable discriminatory features being that males have whiter heads and napes and more extensive ginger scapular patches than do females (Prater *et al.* 1977, Whitfield 1985, Hayman *et al.* 1986).

RESULTS

Turnstone *Arenaria interpres*

Turnstones do not over winter locally and were the first passage waders to arrive in the area: over 1000 birds were counted on the first day of observation (Figure 2). In past years Turnstones first arrived in the last week of April. In spring 1986 the peak count was of 2500 individuals on 20 May and by 5 June very few birds were present. The first spring passage birds were observed leaving on 14 May and fluctuations in the counts and records of departing birds suggest that turnover may have been considerable, particularly in the last week of May (Table 1). Several estimates of the sex-ratio of spring passage birds point to more males than females using the study area as a stopover. Also females appeared to leave later than males (Figure 2). Several ringed birds were seen in spring, including one male that

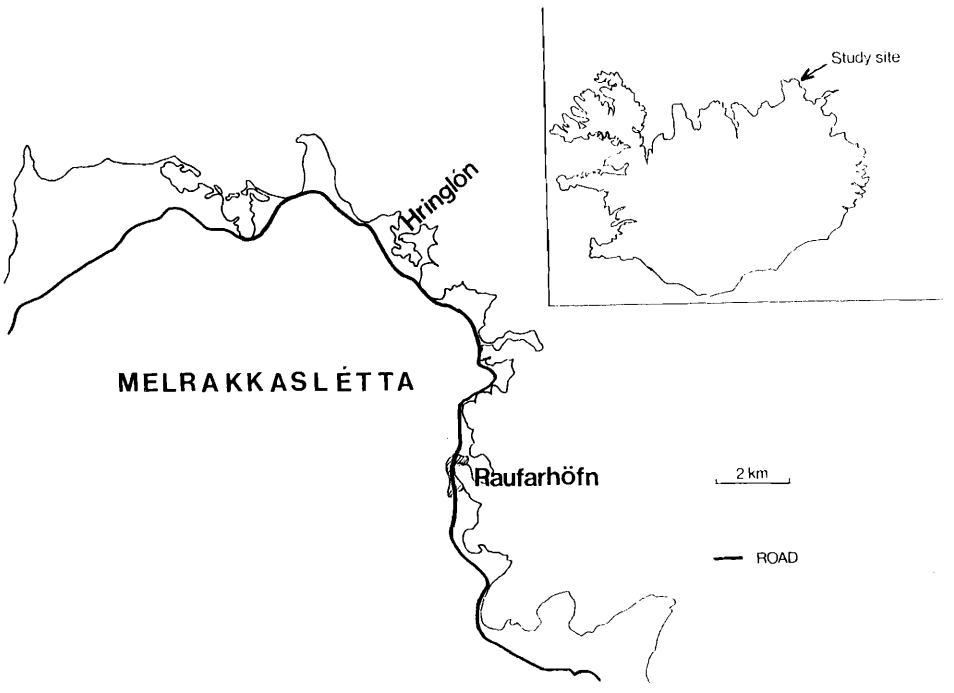

Figure 1. The study area. Waders were counted from Raufarhofn to Hringlon.

had been colour-ringed at Teesmouth, north-east England on 17 July 1985 (and seen there three times in the subsequent winter) which was observed on many occasions on the same small beach from 18 to 25 May. Most birds leaving the study area on continued spring migration flew in a NW direction and earlier departing birds left on a more westerly bearing than later departing birds (Figures 3 and 4). One or two birds in incomplete breeding plumage stayed throughout the summer.

Table 1. Numbers of migrant waders seen departing in spring.

	Date	No. of hours observations	No. of migrants seen departing T	K	D	S	RP
May	14	2	5	-	-	-	-
	17	5	3	-	-	-	-
	18	3	30	-	-	-	-
	19	6.8	25	-	-	-	-
	22	3	25	-	-	-	-
	23	3	70	-	-	-	-
	24	3	55	-	-	-	-
	25	1	-	15	-	-	-
	26	5	150	250	-	-	-
	28	3.8	740	778	-	-	32[1]
	29	6	192	99	8	-	-
	31	7.2	117	263	40	-	70
June	1	5.3	113	28	40	20	39[2]

[1] At least another 200 Turnstones and 200 Knots left study area outside observation period.
[2] When observations stopped there were at least 30 Turnstones, 275 Knots, 160 Dunlins and 40 Ringed Plovers on the study area showing strong signs of pre-departure behaviour.
T Turnstone, K Knot, D Dunlin, S Sanderling, RP Ringed Plover.

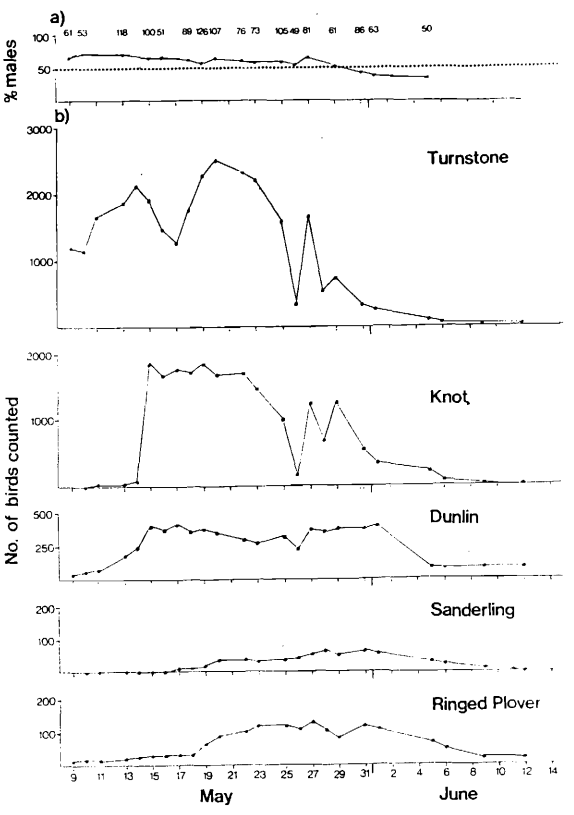

Figure 2. a) Changes in the sex-ratio in Turnstones during spring passage. The dashed line represents a 1:1 sex ratio, and figures above points refer to the number of sexed adults in the sample. b) Counts of waders during spring.

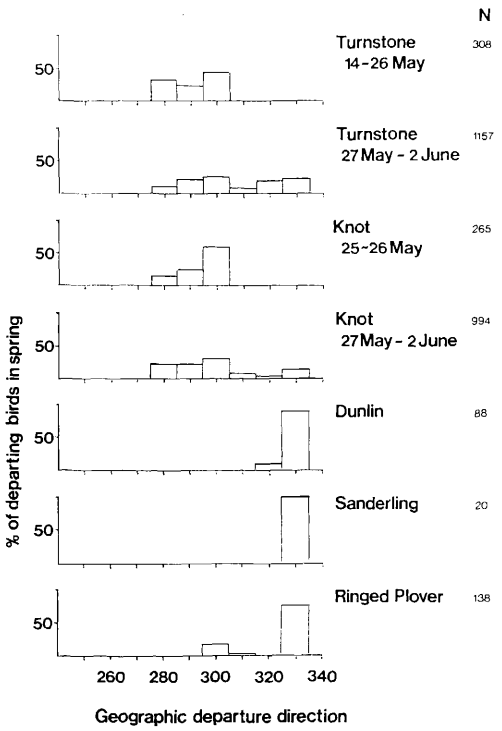

Figure 3. The directions (as a geographic bearing to the nearest 10°) taken by waders departing the study area in spring, expressed as proportions of the total numbers of birds seen leaving.

Relatively few birds were seen on autumn passage, the peak daily count being 59 on 31 July, and the first juveniles arrived between 2 and 7 August (Figure 5). The spring sex-ratio bias towards males was not apparent in autumn: instead there were initially more females present than males, although by August males appeared to predominate (Figure 5).

Knot *Calidris canutus*

The first major influx of spring passage Knots, around 1800 birds, was noted on 15 May (Figure 2). On 25 May birds were first observed leaving, and like most subsequent departing individuals were heading in a NW direction although some late departing birds flew off on a more northerly heading (Figure 3, and compare with Figure 4). The flight directions of Knots leaving north-east Melrakkasletta often coincided with those of Turnstones, and the two species were frequently seen migrating together, suggesting a common initial destination (Table 2). Several ringed Knots were seen; one carrying a leg-flag was first noted on 15 May and had been marked on 22 April 1986 on the Wattenmeer, W.Germany. Turnover appeared to be high in late May, as indicated by the variations in the daily counts and the relatively large numbers of birds observed departing from the coast (Table 1).

Negligible numbers of Knots used the study area on autumn passage, the maximum daily count being 159 on 22 July (Figure 5). No juveniles were seen in autumn.

Dunlin *Calidris alpina*

Locally breeding Dunlins *C. a. schinzii* used the shore as a feeding site, making it difficult to assess the numbers of passage birds for this species. The size-measurements and plumage of six Dunlins caught on the shore between 14 and 20 May were not significantly different from those of 22 birds caught later whilst breeding, suggesting that most or all of the shoreline individuals prsent during this time were local breeders. Later, however, it is likely that an increasingly higher proportion of passage birds were present (presumed to be *C. a. arctica* breeding in north-east Greenland, see Wilson 1981) as by the beginning of June the majority of locally breeding *schinzii* had probably completed clutches and consequently spent more time on their territories away from the shoreline (unpubl. data). We would estimate, therefore, that from 23 May to 1 June, when numbers of Dunlins were the same as in mid-May, between one-half and two-thirds of the Dunlins on the shore may have been passage *arctica*. The rationale behind this estimation is that half of the local *schinzii* will have been incubating, and off-duty *schinzii* spent about 20% of their time on territory. The first observation of Dunlins departing from the study area in spring was made on 29 May.

In mid June the numbers of Dunlins on the shore began to increase noticeably, and by the end of June and the first week of July about 300 were present on the shore. In mid July up to 400 individuals were regularly counted, and by the end of July there were around 300 present, over half of which were juveniles. Three lines of indirect evidence suggest that these Dunlin

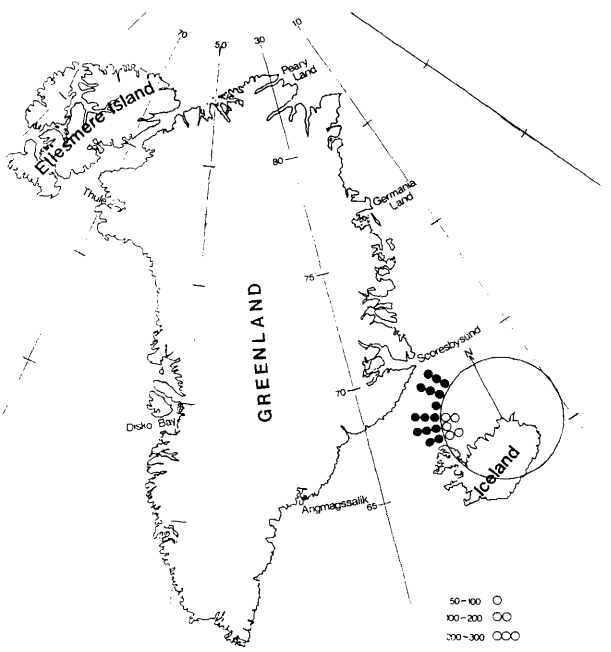

Figure 4. The departure directions taken by Turnstones leaving Melrakkasletta between 14-26 May (open circles) and 27 May - 2 June (closed circles). Turnstones nest on Ellesmere Island and on northern coastal Greenland from Scoresbysund to Thule. According to Alerstam *et al.* (1986) the most favourable route across the Greenland inlandice lies between the Angmagssalik and Disko Bay regions.

were locally breeding *schinzii*: (1) the timing of the appearance of adults was probably too early for them to be post-breeding passage *arctica*: (2) colour-marked local *schinzii* were seen in the shore flocks; (3) no passage *arctica* were seen arriving from the north, in contrast with autumn passage Knots and Turnstones, which were seen arriving. If any *arctica* did pass through the study site in autumn there must have been extremely few (see also Wilson 1986).

Sanderling *Calidris alba*

Relatively small numbers of Sanderlings were seen, particularly in autumn, and the highest daily count in spring was 58 on 31 May (Figures 2 and 5). Spring passage of this species was comparatively late, the first departing birds not being seen until 1 June. Several ringed individuals were observed.

Ringed Plover *Charadrius hiaticula*

As for the Dunlin, locally breeding Ringed Plovers fed on the shore. Breeding birds were confined to a 2 km coastal strip and the breeding population in the study area was about 35-40 pairs; at the end of May daily counts of this species were around 120 birds so this indicates that there may have been at least 40 high arctic passage birds on the shore each day (Figure 1). However, counts of birds leaving the area and migrating north-west suggest that this estimate was conservative (Table 1). The first departures in spring were noted on 28 May.

We could detect no autumn passage of high arctic individuals through the study site.

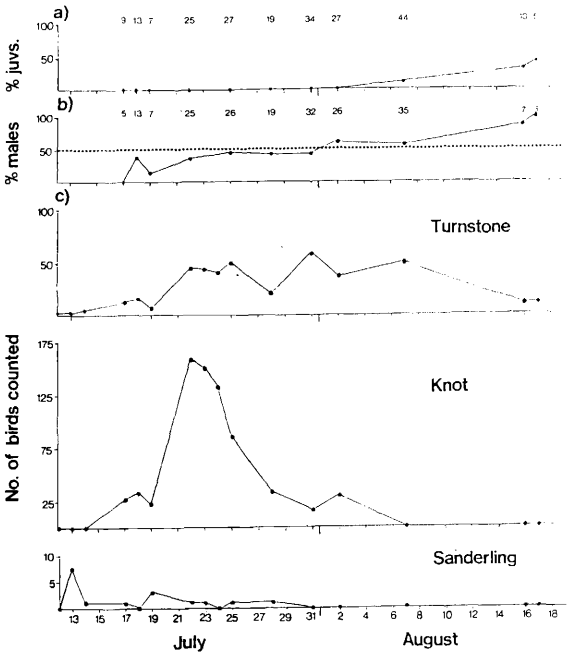

Figure 5. a) Changes in the age ratio of Turnstones during autumn passage. Figures above points refer to the number of birds aged. b) Changes in the sex ratio of Turnstones during autumn passage. The dashed line represents a 1:1 sex ratio, and figures above points refer to the number of sexed adults in the sample. c) Counts of known migrant waders in autumn.

Table 2. Mean single-species flock sizes and composition of mixed species flocks for departing Turnstones and Knots in spring.

	No. of birds in flock					
	Turnstone			Knot		
	x	SD	N	x	SD	N
a) Single-species flocks	24.3	15.5	23	25.3	15.7	12
b) Mixed-species flocks	27.0	27.6		29.1	28.0	30

Other species

Large numbers of Purple Sandpipers *Calidris maritima* were seen on the shore in spring (several daily counts were around 2000) but biometrics and retrap data, and the lack of any sightings of migrating birds, suggested that these birds were local breeders (results will be presented elsewhere in a paper on the local breeding avifauna). Golden Plovers *Pluvialis apricaria* also fed on the shore in small numbers but most of these were likely to be local breeders rather than Greenlandic birds. An adult Semipalmated Sandpiper *Calidris pusilla* was seen on 23 July, and a juvenile Ruff *Philomachus pugnax* on 25 July.

DISCUSSION

North-east Melrakkasletta is clearly a more important spring stopover area for migrant high arctic waders than previously thought, although our observations of the extent of autumn passage are in accordance with those made by Wilson (1986). Subjective impressions of wader migration gained in previous years were similar to those we have reported here for 1986. Whilst the absolute numbers of spring migrants are lower than those reported for comparable stretches of coastline in west Iceland (e.g. Morrison *et al.* 1972), the densities of waders were at least equivalent, given that the feeding areas in Melrakkasletta were at the most 12m wide. These feeding areas were the beds of rotting tide-wrack where the birds exploited the extremely high densities of larvae and pupae of seaweed flies *Coelopa* and small oligochaete worms, although a small mud-flat in the centre of the study area was also occasionally used by Knots and Dunlins. Based on our subjective assessment of the length of coastline which regularly has tide-wrack deposits we would estimate that during peak spring passage about 8000 Knots, 10 000 Turnstones and 240 Sanderlings may be present in Melrakkasletta. Since turnover appeared to be high in late May, particularly for Knots and Turnstones, the total number of spring migrants using the peninsula is probably in excess of these estimates. Numbers of migrant Dunlins and Ringed Plovers are more difficult to judge due to the presence of local breeding birds.

Wilson (1981) has argued that waders breeding in north Greenland and north-east Canada employ two main spring migration strategies involving Iceland:

a) birds breeding in north-west Greenland and

north-east Canada stage in Iceland for about three weeks;

b) many birds breeding in north-east Greenland put on fat reserves south of Iceland and either overfly or stop only briefly in Iceland.

Wilson suggested that Turnstones appear to use both strategies, Knots only strategy (a), and Dunlins, Sanderlings and Ringed Plovers only strategy (b). Use of strategy (a) should be apparent by birds arriving early in spring, staying to put on fat reserves and departing on more westerly flight directions. Strategy (b) should be apparent by birds arriving late in spring, staying briefly and departing on more northerly flight directions. The late arrival and departure times of passage Dunlins, Sanderlings and Ringed Plovers tends to point to their staging relatively briefly in late May, and the departure directions were more to the north compared with those of many Knots and Turnstones (Figures 3 and 4) suggesting breeding in north-east Greenland. The high turnover of Turnstones in the last few days of May suggests that some birds staged only briefly at this time, and the more northerly departure directions of many late May birds suggest that they too were heading for north-east Greenland. Some Turnstones, in contrast, arrived early in spring to stay longer, and the earliest departing birds headed more westwards than some later departing birds, perhaps suggesting that they were destined for more westerly breeding grounds (i.e. east or north-west Greenland and/or north-east Canada). Some of the earliest departing birds in mid May may have staged elsewhere, *e.g.* west Greenland (cf Salomonsen 1950, but see also Alerstam *et al.* 1986), before moving further north, judging by the differences in departure times from Melrakkasletta and arrival times in north-east Canada and north Greenland (Nettleship 1973, Meltofte 1985). There were signs that many early arriving Knots stayed on the study area for at least ten days and there was a tendency for the earlier departing Knots to leave on more westerly directions; these were indicators that many birds were employing strategy (a). High turnover in late May suggests that many Knots staged then only briefly, and at this time some birds appeared to leave on more northerly headings, indicative of strategy (b). Basing many of his conclusions on west Icelandic sites, Wilson (1981) proposed that Knots used only strategy (a), but, compared with west Iceland, Melrakkasletta lies on a more direct route from western Europe to north-east Greenland, so many Knots that breed in north-east Greenland may stage in east Iceland. Compared with Turnstones, however, fewer Knots left on the most northerly direction (Figure 3), so relatively fewer north-east Greenlandic (strategy (b)) Knots may have been present on the study site. Aside from this possibility of some Knots employing strategy (b), our limited observations thus seem to support Wilson's arguments. It should be borne in mind that the limitations of our data must temper the conclusions on migration routes and strategies. As well as the interpretation outlined above it is also possible that, for example, birds may have spent several days or even weeks in Iceland before flying only as far as east Greenland. Similarly, if any birds leaving Melrakkasletta later flew over the Greenland inlandice, our data do not allow any conclusions to be reached on the route taken (see Alerstam *et al.* 1986 and Figure 4).

As in other Icelandic sites (Wilson 1981), Melrakkasletta is a less important staging post in autumn. Whilst food supplies appeared to be lower in autumn as a result of many of the wrack-beds breaking down, they were still used by several hundred local post-breeding Dunlins and many local Purple Sandpipers, so this factor may not be entirely responsible for the negligible numbers of autumn migrant waders. Like other workers in Iceland we noticed that those autumn migrants which did pass through appeared to feed infrequently and spent much of their time roosting, so feeding conditions further north may have been sufficiently good to allow many high arctic waders to overfly Iceland on post-breeding migration (see also Wilson 1981, 1986).

Our preliminary observations need to be developed further and Melrakkaletta offers excellent opportunities for more detailed studies as feeding and roosting birds are easy to observe at short distances and would be easy to catch. Furthermore, several ringed birds were present, so providing opportunities for identifying the origins and destinations of migrant waders using north-east Iceland.

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