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I.S. FRANCIS and A.D. FOX

Introduction

The Greenland race of the White-fronted Goose *Anser albifrons flavirostris* nests in arctic west Greenland between 65° and 73°N and winters in the west of Scotland, Ireland and Wales. The world population has recently recovered from an estimated 14,400–16,000 in the late 1970s to approximately 22,000 following an exceptionally successful breeding season in 1985 (Ruttledge and Ogilvie 1979; Norriss and Wilson 1986; Greenland White-fronted Goose Study 1986).

A large proportion of the population is known to pass through Iceland in the autumn (Gardarsson 1975, 1976). Although Bauer and Glutz von Blotzheim (1968) asserted that the total population migrates through Iceland in spring, Boyd (1970) stated that most birds fly direct to Greenland, and according to Owen *et al.* (1986), the Greenland White-front is one of very few of the world's geese which does not have a significant intervening spring staging area. It is important to determine whether birds stage on spring migration since the energetic supplement derived from feeding on migration is known to have significant effects upon subsequent breeding success (see review by Thomas 1983). Staging can occur in west Greenland on the journey northwards (Fox and Ridgill 1985), but whilst it was known that Whitefronts did occur in Iceland in the spring (Saemundsson 1936; Timmerman 1949; Gudmundsson 1962; Gardarsson *in litt.*; Fox *et al.* 1983; Alerstam *et al.* 1986), details of how many birds stage there, for how long, and which habitats were important for feeding have not been previously published. The present paper makes a preliminary assessment of numbers of White-fronted Geese using Iceland in the spring, their distribution and habitat use.

Methods

The study was carried out between 19th April and 9th May 1986. A visit was made to the extreme south-east of Iceland to search for arriving geese and any feeding parties in that area. However, the majority of work was carried out in known autumn staging areas and areas from which there had been previous

spring ringing recoveries, in south Iceland (Olfus-Landeyjar) and west Iceland (Myrar-Snaefellsnes) (Figure 1). All traversable roads were explored by car and all geese counted on each side of the road. Occasional scans were made from vantage points with x30 and x20/40 telescopes, and all flocks were examined for yearling birds and darvic rings. Although roads inevitably linked areas of improved agricultural land, thereby introducing sampling bias, substantial areas of unimproved wetland were also traversed and similarly searched. Efforts were made to census different sections of each area on separate days; occasional back-checking of areas indicated that little short-term movement occurred. Any flock thought to have been previously counted was excluded from census totals.

Habitat details were recorded and all areas used by geese ascribed to general categories. Most geese utilised hayfields, but at the time of the census, some showed no signs of spring growth ("yellow improved hayfields") whilst grass growth in others was well advanced ("green improved hayfields"). Those hayfields with wet corners or standing water were also distinguished, although these all showed some spring growth.

Results

Departure from the British Isles

Normal departure dates from the wintering grounds are difficult to establish. The range of dates recorded for the last birds at British sites is 1st April–3rd May, but departures are most frequent between 15th and 22nd April. It is clear that departure is by no means simultaneous from over the wintering range and varies from year to year. Numbers at any one site can drop gradually over several days. It is not known whether migration north proceeds in small stages in the case of any birds. However, temporary staging in Scotland in autumn has been recorded for Irish neck-collared birds and there is some spring redistribution of birds between Irish sites (H.J. Wilson and D. Norriss pers. comm.), whilst Wexford collared birds were noted passing through South Uist, Scotland, in late April 1986 (D. Jackson pers. comm.).

7

Wildfowl 38 (1987): 7–12

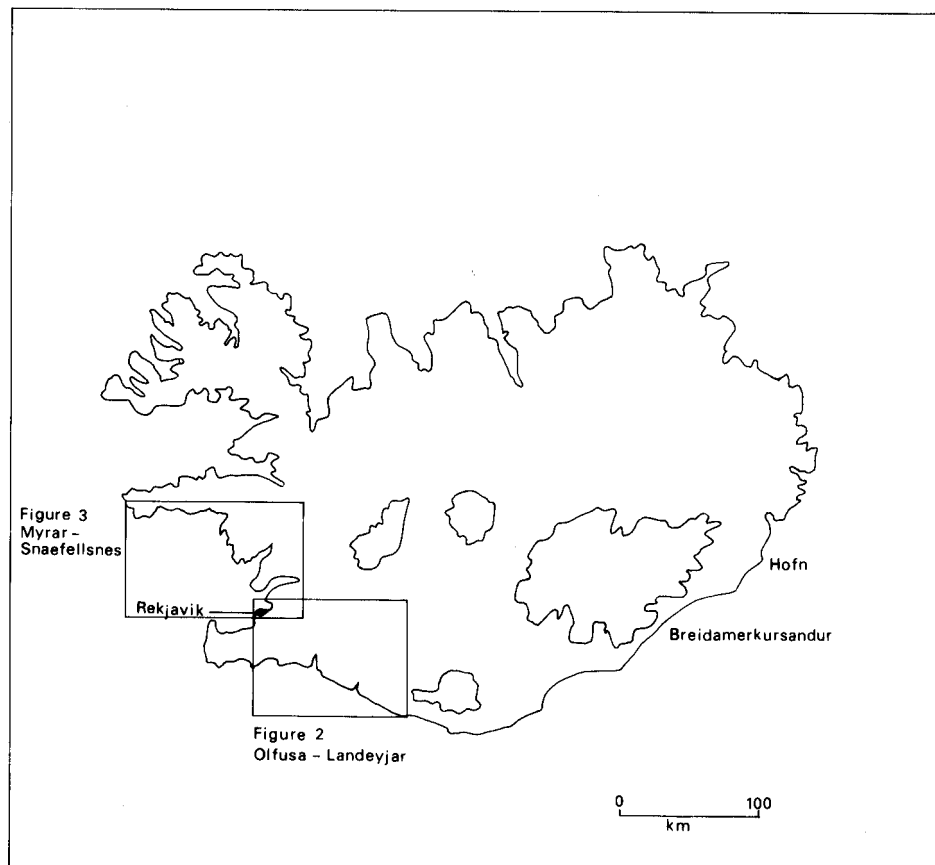


Figure 1. Map of Iceland showing areas discussed in the text.

In 1986, the first report of departing birds was of a flock of 29 seen heading north-west off Sula Sgeir on 18th April in 'fairly good' weather (Nature Conservancy Council Seabirds at Sea Team in litt.). Barnacle Geese *Branta leucopsis* began leaving Islay on 21st April, departures of 40, 25 and 87 Whitefronts were observed on the 24th (C.R. McKay, S. Percival pers. comm.) and on 27th April a major departure of 341 Whitefronts and many Barnacle Geese occurred. Most Whitefronts left Wexford on 23rd April and the Dyfi estuary, Wales, on 21st April.

Arrival in Iceland

It is not clear where the birds seen on 18th April off Sula Sgeir were headed, if they reflected any major movement. No birds were seen in the southern staging area (Landeyjar) on 19th April.

Two hundred and six Greenland White-fronted Geese were seen arriving from the sea at Breidamerkursandur, south-east Iceland (Figure 1) during 23rd–25th April 1986 (average flock size = 23). This total was part of a larger movement of Pink-footed Geese *Anser brachyrhynchus* and represents a minimum figure for Whitefronts since many unidentified geese passed through at extreme range. Weather conditions were generally settled, with light south-westerly and south-easterly winds. No geese landed, and no White-fronted Geese were found feeding in the vicinity of Hofn, south-east Iceland.

On the 29th and 30th, during census work close to the south coast several flocks were seen apparently arriving from the direction of the sea. It is possible that White-fronted and other geese could fly from the British Isles to Iceland remarkably quickly. Ogilvie (1978) and Owen (1980) quote published work on the flight

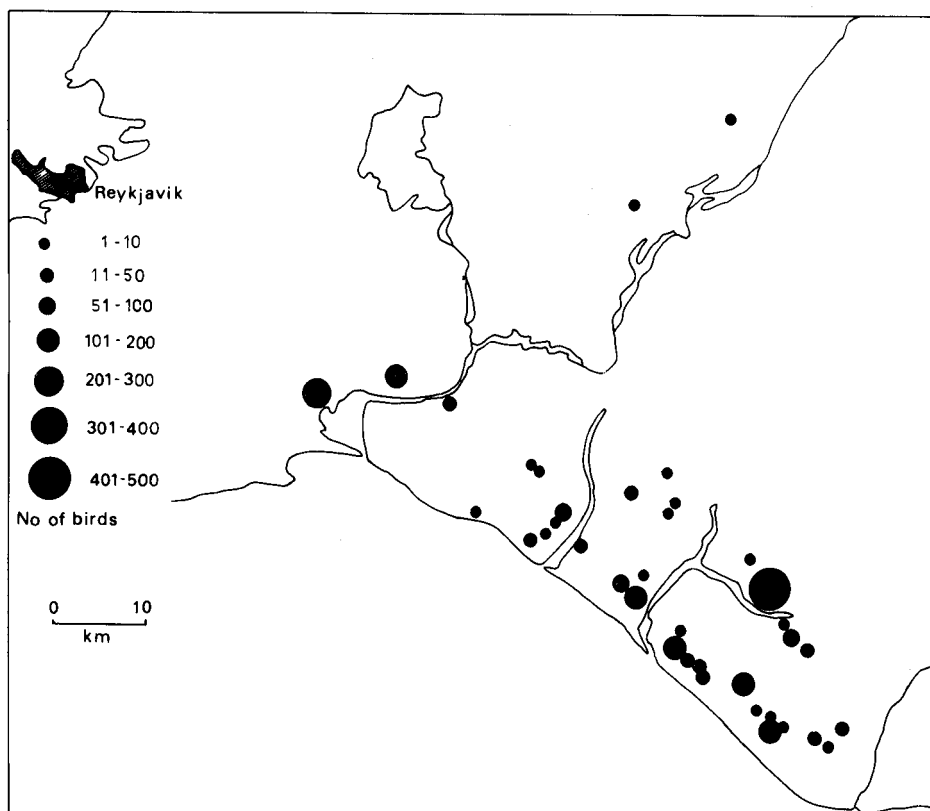


Figure 2. Distribution of Greenland White-fronted Geese, southern staging area, 28th April–2nd May 1986. Note that some flocks have been combined in certain cases for clarity.

velocities of geese on migration. Assuming an average velocity of 55 km h^{-1} and a favourable 40 km h^{-1} following wind, Whitefronts could travel the 1,300 km from Islay to south-east Iceland in under 14 hours.

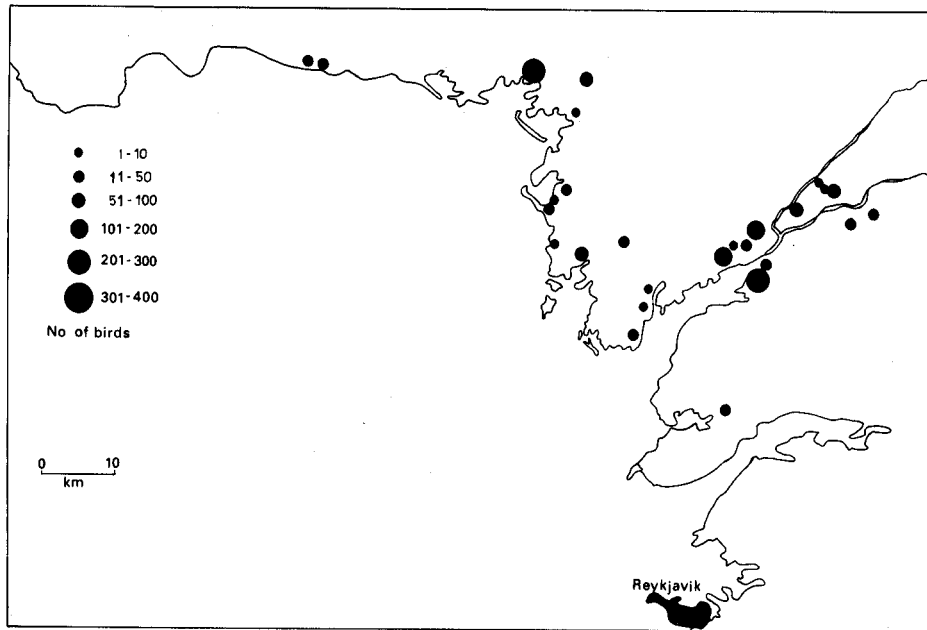
South Iceland staging area (Olfusa-Landeyjar)
28th April–2nd May

A total of 2,027 birds was found (Figure 2), with 16.1% young (n aged = 441). Mean brood size was 3.38 (s.e. = 0.31 n = 67). Four neck collar numbers were read from Wexford, Ireland, out of a total of six seen, and five birds with white leg rings (probably put on in west Greenland in 1979 and 1984) were seen, one of which was read. Of birds seen, 66% were feeding on improved hayfields, 25% on stubble and only 9% on *Carex* (sedge) dominated meadows or boggy lake edges.

West Iceland staging area (Myrar-Snaefellsnes)
2nd May–8th May

At least 1,438 birds were counted (Figure 3) with 28.7% young (n aged = 94). This may well suggest that family parties were staying later in Iceland. Average brood size was 3.54 (s.e. = 0.26 n = 37) and mean flock was 39.6 (s.e. = 7.0 n = 37). There were sightings of 35 neck-collared birds and 22 collars were read. One bird with a single white leg ring, probably ringed in Greenland, was also seen. Of birds feeding, 65% were on improved hayfields, with 35% on unimproved bogs and wet meadows.

A summary of the totals from the two areas is also given in Tables 1 and 2. The percentage young should not be taken as being representative of the population for the reason given above.

Figure 3. Distribution of Greenland White-fronted Geese, western staging areas, 2nd–8th May 1986. Note that some flocks have been combined for clarity.**Table 1.** Greenland White-fronted Goose census, SW Iceland 28th April–8th May 1986.

	Total	Ads	Juvs	%yng	Mean Brood	Mean Flock	No. of Darvics Neck	Leg
Southern staging area (Olfusa-Landeyjar)	2027	370	71	16.1	3.4	28.5	6(4)	5(1)
Western staging area Myrar-Snaefellsnes)	1438	67	27	28.7	3.8	39.6	35(22)	1(0)
Total	3465	437	98	18.3	3.5	32.4	41(26)	6(1)

(Figures in brackets = No. of rings read)

Table 2. Breakdown of White-fronted Goose census totals by habitat.

Category	Olfusa-Landeyjar		Myrar		Overall	
	Total	%	Total	%	Total	%
Green improved hayfield	1219		964			
Yellow improved hayfield	97					
Wet improved field/pools in improved field	40					
Total	1356	65.9	964	65.5	2320	65.7
Stubble/potato	517	25.1			517	14.6
Total on improved	1873	91.1	964	65.5	2837	80.4
Unimproved sedge wetland	10		46		56	
Wet mire/ <i>Carex</i> sp.	9		7		16	
Bog edge/water/lake edge	165		421		586	
Drier unimproved grassland			32		32	
Total on unimproved	184	8.9	506	34.5	690	19.6
Total assigned to habitat	2057		1470		3257	

Discussion

Numbers staging in Iceland in spring

Few details have been published concerning numbers of White-fronted Geese using Iceland in the spring. The total recorded in 1986 is likely to be a minimum figure for numbers present at this time of year. It is clearly possible that some birds may have been counted in both staging areas, so reducing the minimum figure, but since no individual marked birds were seen in both areas, it seems reasonable to assume that a proportion of the birds in each area was separate. The census method was necessarily crude and limited, and not all possible localities were examined (for example Medalland in Vestur Skaftefellssysla, south-east Iceland). For these reasons, it seems likely that a greater number of birds than the total recorded occurs in Iceland in the spring.

The total number of Greenland White-fronted Geese recorded in the British Isles in the April census of 1986 was 21,883; 10,016 in Britain, 7,940 at Wexford and 3,928 in the rest of Ireland (Norriss and Wilson 1986; Greenland White-fronted Goose Study 1986). This total means that at least 16% of the world population staged in Iceland in spring 1986 and sightings of marked birds show that birds from Wexford used both principal staging areas of Iceland.

Length of stop-over in Iceland

Nothing is known about how long an individual goose might remain in Iceland in the spring. Whitefronts are known to be present in small numbers until the end of May or even early June (A. Petersen pers. comm.) and as described above, arrival is normally around the third week of April. Three marked birds remained at Hvanneyri, Myrar, from 6th–8th May 1986 but no other marked birds were seen for a longer period, although this may itself indicate rapid turnover.

Habitat usage

The apparent preference of the geese was for improved hayfields (Table 2). Large areas of wetland were searched for geese, and although the tussocky nature of the vegetation made it much more likely that flocks were overlooked at a distance, the general absence from what seemed suitable habitat was striking. The area of unimproved bog and wetland is still large, despite much recent drainage, and the largely

road-based census undoubtedly biased sampling towards improved fields, which may have exaggerated their apparent importance to some degree. It is also not clear if unimproved wetland areas are important as roost sites at night as is the case in autumn (Gardarsson 1976).

Protection of White-fronted Geese in Iceland

Habitat

Large areas of wetland have been drained for agricultural improvement in recent years. In some areas this may be as much as 50–80% (Summers and Nicholl 1983). The effects of this reduction of wetland areas and increase in number of improved fields upon White-fronted Geese are not clear. The apparent preference of the geese for improved fields may reflect the availability of better grazing, or a change forced by loss of adjacent wetland habitat. Long-term population effects are very difficult to detect although one consequence may be increased accessibility of Whitefront flocks to humans, which would bring the risk of increased disturbance or shooting pressure.

Shooting

A number of White-fronted Geese ringed in Greenland in previous decades have been shot in Iceland (see summary in Fox *et al.* 1983), and 4% of birds ringed in central west Greenland in 1984 had been shot in Iceland by 1985. Almost all shooting occurs on the autumn migration, since spring shooting is illegal, though it undoubtedly occurs. No figures are available on the number of White-fronted Geese shot in Iceland, but one unofficial estimate from contact with members of the Icelandic Shooting Society was c.800 birds per season. The number of Whitefronts shot is thought to have declined due to publicity about their population decrease since the 1950s.

There are at present no moves towards the prohibition of shooting of Whitefronts in Iceland. While voluntary constraint is actively promoted by the Icelandic Shooting Society, its members constitute only a small proportion of all hunters, and for this reason, the true number of birds shot each year may be considerably higher than the estimate above. Many Whitefronts are undoubtedly shot by farmers, but they are rarely present for long enough or in sufficient numbers to constitute an agricultural problem, despite occurring in areas of the most intensive farming.

Conclusions

The energetic implications of spring staging in Iceland for breeding Greenland Whitefronts are substantial and it is clear from the present survey that a significant proportion (at least 16%) of the population passes through the country. More work is necessary to determine the breeding status of these birds, and to discover if Iceland functions as a staging area for potentially breeding adults. A detailed census would help confirm patterns of habitat use, assess turnover and establish more precisely the timing of migration. Such work could profitably be combined with visible or radar migration observations in the extreme west of Iceland or on the eastern coast of Greenland.

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Summary

A census of staging Greenland White-fronted Geese *Anser albifrons flavirostris* was carried out in south and west Iceland between 19th April and 9th May 1986. A total of 3,465 birds was recorded, with 2,027 in the south and 1,438 in the west. Although some interchange of birds between areas was possible, it is considered that the recorded total represents a minimum figure (16% of the population) for Greenland Whitefronts staging in Iceland in spring. Sightings of 41 birds neck-collared at Wexford, Ireland, indicated that Whitefronts wintering in Ireland stage in both south and west Iceland. Of the total number of birds found, 80% were feeding on improved hayfields and 20% on unimproved wetlands. The implications of this in the light of continuing extensive wetland drainage in Iceland are not clear but may increase the risk of disturbance and allow a larger total of White-fronted Geese to be shot than at present.

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