

## Observations on the Pink-footed Goose in Central Iceland, 1966

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### Summary

Eleven members of a Radley College Expedition spent from 31st July to 5th September 1966 in central Iceland. Until 16th August investigations were confined to the region west of the Hofsjökull, from Guðlaugstungur in the north to Hvitárnes in the south. Scattered areas of meadow in this area are used as moulting grounds for non-breeders. Details of food, behaviour and time of moulting of non-breeding birds are given. The use of separate areas by non-breeders undergoing moult may relieve pressure on available food in the breeding area.

Observations on the main breeding colony in Þjórsárver, which was inaccessible until the middle of August, are compared with those made in 1951 and 1953. A late cold spring had delayed the breeding cycle by about twelve days. Mortality due to predation was considerable during both early and late stages of the fledging period. Faeces, and viscera of fresh corpses, revealed a definite change in the pattern of feeding during August to a diet rich in soluble carbohydrate.

Newly-reported localities for breeding Pinkfeet in the area include a large colony on the Jökulfall river which flows south-west from the Hofsjökull and Kerlingarfjöll.

The arrival and flocking of Pinkfeet in the Ásgarð area are compared with observations made in 1954.

### Introduction

During the summer of 1966, a Radley College expedition was based for five weeks in central Iceland, ten days of which were spent in Þjórsárver við Hofsjökul. This famous oasis of vegetation holds the largest known breeding colony of Pink-footed Geese *Anser brachyrhynchus*. The expedition had been asked by the Wildfowl Trust to carry out preliminary investigations into the vegetation of the oasis and the food preferences of the geese.

The party of six senior boys, two undergraduates, two masters and a doctor, had intended to move into Þjórsárver as soon as possible after 31st July but, owing to the late summer, the glacial rivers were impossible to cross. Initially several areas of meadow at Fossrófulækur were investigated as moulting grounds or as scattered breeding localities for small colonies of Pinkfeet, and on 9th August the ornithologists spent two days in Guðlaugstungur, a huge area of meadow and marsh to the north of Hveravellir, where they saw several Pinkfeet and found evidence of isolated breeding. The party finally moved in Þjórsárver on 16th/17th August, establishing a camp on the eastern side of the hill Nautalda (see map). Between 17th and 25th August, analyses of the vegetation by point sampling were carried out, and collections made for laboratory analysis and herbaria. Details of predated birds were taken, and viscera and droppings collected for analysis. Notes were made on the observed food preferences of geese and goslings,

together with details of their behaviour. Enclosures of nylon netting, supported by bamboo corner posts, were set up for a short time to see if they survived the weather conditions and prevented geese from feeding on the enclosed area of vegetation. Soil borings were taken, which, from analysis of the pollen content and dated by ash from volcanic eruptions, may indicate changes in the vegetation over the last 500 years. As no ringing was carried out, it was impossible to estimate the size of the colony, but the whole of the area on the north side of the Þjórsá was covered and it is possible to make some comparisons with the observations of the 1951 and 1953 Wildfowl Trust expeditions (Scott, Fisher and Guðmundsson, 1953; Scott, Boyd and Sladen, 1955).

The party spent the remainder of the time at Fossrófulækur, where observations were made of the arrival and flocking of Pinkfeet in the area. The first snow fell overnight on 2nd/3rd September, covering the hills above 1,800 feet, and the party left on 5th September.

### Distribution of non-breeding Pinkfeet outside Þjórsárver, 1966

Pinkfeet probably do not breed until they are three years old. In 1951 yearlings and two-year-olds occurred in such small numbers in Þjórsárver as to indicate a separate moulting area for immature birds; in 1953 it was found that, although one-year-old birds were very scarce, two-year-olds comprised about 20% of the full-grown population and that these birds

remained in the colony throughout the breeding season (Scott, Boyd and Sladen, 1955). Since yearlings, which must total over 1,000 individuals, seem to be so scarce in the colony, they must moult elsewhere.

In 1966 no single area where the pre-breeders undergo moult was found but a number of scattered areas of variable size were occupied. Blurton Jones and Gillmor (1955) suggested that the autumn gathering of Pinkfeet in Ásgarð probably retraced the pattern of spring dispersal, and that it was likely that pre-breeders remained in these gathering areas to moult after the breeding birds had moved to the nesting grounds.

#### Sites of study (see map)

**Blágnípuver.** Two Pinkfeet were first seen here in flight on 3rd August. The most inaccessible northern part was occupied by a flock of about 70 flightless Pinkfeet. Goose droppings were found

scattered throughout Blágnípuver, which may indicate its use as a dispersal ground in spring, but great concentrations of droppings and moulted feathers in this small northern area, together with heavy cropping of the vegetation, indicated that it had been occupied by a flock for at least the whole of the flightless period of about 25 days (Scott, Boyd and Sladen, 1955).

**Hvítárnes.** This marshy area was visited on 6th August and held some 300 non-breeding adults. Scattered breeding colonies of Pinkfeet may occur along the gorges of the river Fróðá but this could not be established as the river Fúlakvísl was uncrossable.

**Neðri Seyðisárdrög.** Thirteen adults were seen in this oasis on 11th August.

**Guðlaugstungur.** Four separate flocks totalling 39 fully flighted adults were seen on 12th and 13th August in this much larger oasis. No goslings were seen, although a single old nest was found on

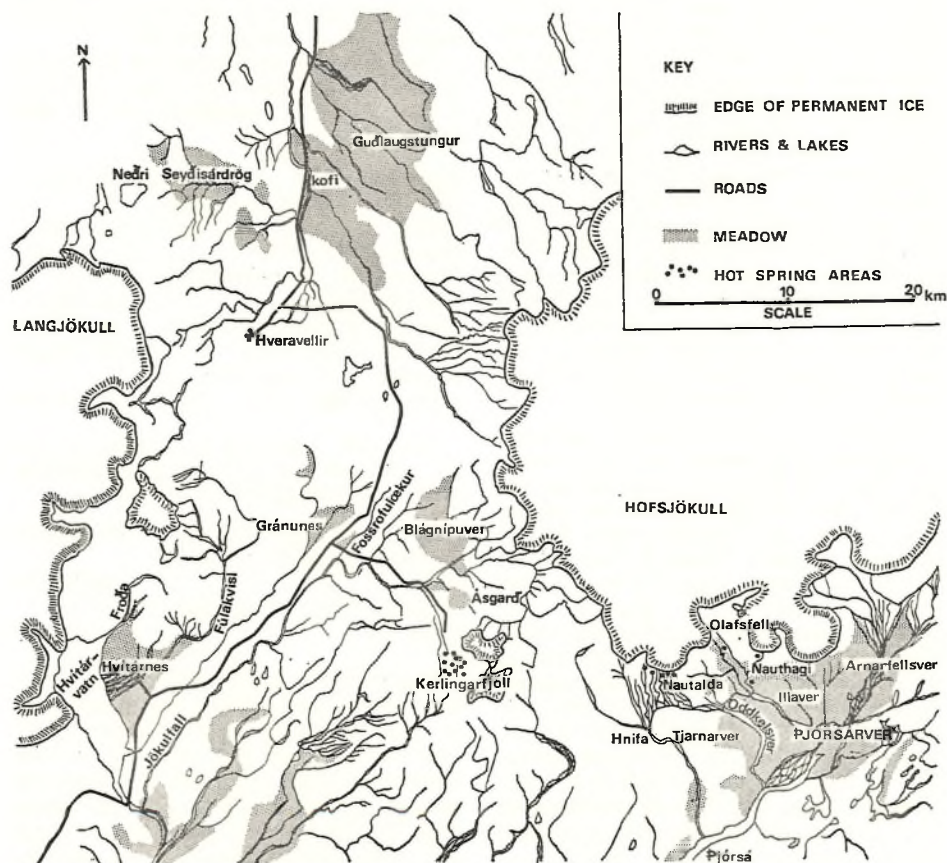


Figure 1. Map of central Iceland.

the roof of a hut (kofi) where the party spent the night.

#### Behaviour and time of moulting of non-breeding birds

Flightless non-breeding Pinkfeet are very wary. It was extremely difficult to approach the Blágnípuver flock closer than about 600 m. By contrast, the Hvítárnes non-breeders, visited two days later and mostly capable of flight, were easily approached to within 200 m. At intervals, flocks of about 50 birds would fly out over the lake for up to three minutes and then return to feed. This apparently random flying may play an important part in exercising the wing muscles after the inactive period of flightlessness.

All but two of the Blágnípuver flock were flightless on 4th August; by 6th, ten birds were fully flighted and 45, or 60%, were able to rise briefly into a strong headwind. On the same day, 70% of the geese at Hvítárnes were fully capable of flight. It seems likely therefore that by 10th August the majority of non-breeding Pinkfeet in central Iceland had regained flight, and certainly no flightless non-breeders were seen after that date. In Þjórsárver in 1951 and 1953 most of the *breeding* geese could fly by 4th August and these regained flight about one week later than the non-breeding birds. Thus in 1966 the non-breeders were undergoing their moult 10–12 days later than in 1951 and 1953. This might be explained by the lateness of the 1966 season, a view partly corroborated by the flightless condition of the Þjórsárver goslings.

The flocking of non-breeders to moult in scattered areas outside the main breeding colony of Þjórsárver may be an important aspect of behaviour which relieves pressure on the available food in the breeding grounds. There is no lack of suitable moulting areas in the central Highlands and it is probable that thorough exploration of the region round Hofsjökull would reveal several groups similar to that found in Blágnípuver. Taylor (1953a and b) has provided evidence that some moult-migration of non-breeding Pinkfeet to Greenland occurs after an exceptionally bad spring. It seems likely that most moulting of non-breeders takes place in the remote mountain oases round Hofsjökull and the evidence of Yeates (1955) appeared to support this view.

#### Breeding Pinkfeet in Þjórsárver

The party arrived in Þjórsárver on 17th August, by which date both adults and goslings were expected to be fully capable of flight. In fact, although all adult birds had regained flight, no goslings were seen flying until 18th August, and by 23rd August about 30% were still flightless.

Since all birds leave for the wintering grounds in the British Isles at the onset of cold, snowy weather, the breeding cycle, including moulting of adults and fledging of goslings, must be rather closely synchronised with the short sub-Arctic summer. This synchronisation helps to maintain the gregarious habit, the chief advantage of which is probably an increased awareness and defence against predators (Lack, 1954). The Icelandic summer permits some extension of the breeding season in the event of a late start, though Blurton Jones and Gillmor (1959) and Norderhaug, Ogilvie and Taylor (1965) have shown that in Spitsbergen, 12°–15° further north, the Pinkfoot breeding season can only just be accommodated by a normal summer.

The previous expeditions to Þjórsárver established the following dates for stages in the Pinkfoot breeding cycle in this colony:—

Eggs first laid	...	...	c.12th May
Peak date for clutch completion	...	...	25th May
Peak hatching date	...	...	22nd June
Majority of non-breeders regained flight	...	...	28th July
Majority of breeding adults regained flight	...	...	4th August
Majority of goslings achieved flight	...	...	6th–10th August

The 1966 season was unusual in that the melt was late and the dates of major events were recorded as follows:—

Non-breeders regained flight	10th August
All breeding adults regained flight by	...
Majority (70%) of goslings flying by	...
	23rd August

Among the remaining 30% of goslings, there was a remarkably wide discrepancy in size, and many were still very small. One freshly-killed bird collected on 23rd August weighed only 860 g. compared with an average of 2,280 g. for first winter birds reaching Scotland in October (Beer and Boyd, 1962). Assuming that birds of such small size, and probably only about three weeks old, would not be capable of

flight until around 20th September, they might well be unable to migrate before the winter snows, which are often heavy from 10th September.

Thus it seems that, even in Iceland, the success of the Pinkfoot is still dependent on favourable weather and that a delay of even a fortnight at the start of the breeding season may be crucial.

Many groups of between four and seven goslings of various ages were seen, unaccompanied by any adult. So common were these parties that they would hardly have passed unnoticed by the 1951 and 1953 expeditions had they occurred. Their presence might be related to the late season of 1966, but the actual mechanism whereby goslings lost or became separated from their parents is not known. Unaccompanied goslings were very tame and showed marked differences in behaviour from those accompanied by parents, particularly in reaction to danger, and this probably exposed them to a greater risk of predation, since parent birds are able to repel some attacks on their offspring.

#### Predation

Table I compares the numbers of predatory species seen in 1966 with those seen in 1951 and 1953.

The numbers of predators did not seem appreciably greater than in 1951 and 1953, but predation nevertheless appeared high, perhaps owing to the numbers of unattended goslings. Although the party arrived in Þjórsárver later than the two previous expeditions, when most of the goslings were about six weeks old, no decline in either the numbers or activity of predators was noticed. Predatory animals did not seem to move out of the oasis once the goslings were well-grown, and it appeared that healthy flightless goslings could readily be killed by Arctic Foxes *Alopex lagopus*, Great Black-backed Gulls *Larus marinus* and Iceland Falcons *Falco rusticolus*, while their remains provided food for predatory and carrion-feeding species such as Arctic Skuas *Stercorarius parasiticus* and Ravens *Corvus corax*. Snowy Owls *Nyctea scandiaca*, which were seen in 1951 and 1953, were not recorded in 1966.

Numerous corpses damaged by predators were found, 25 of which were sufficiently intact for age to be estimated from body dimensions (bill, skull, tarsus and wing). Six birds were less than five weeks old, whilst 16 were between five and seven weeks. Since this ratio (6:16) resembles the ratio of these two age groups seen in the population, 3:7, it

Table I. Species predatory on Pink-footed Geese in Þjórsárver.

Species	1951 (June 26 - Aug. 2)	1953 (July 9 - Aug. 7)	1966 (August 17 - 25)
White-tailed Eagle	One	None.	None.
Iceland Falcon	One or two pairs. Individuals seen on at least 12 occasions.	Individuals seen only twice.	One pair. Individuals seen on four other occasions. Sightings confined to Nautalda/Ólafsfell area
Arctic Skua	c. 10 pairs.	c. 10 pairs.	c. 10 pairs. Estimate of numbers: 8 pale 1 intermediate 13 dark.
Great Black-backed Gull	c.40.	less than 10.	c.20 (including 1 juvenile).
Snowy Owl	Probably one seen twice.	Probably one seen five times, but possibly two.	None.
Raven	None.	One only, seen once.	One pair. Individuals seen on two other occasions.
Arctic Fox	One seen, one heard. No earths occupied.	Vixen and one cub seen at earth 11 July	Nautalda: Two. Arnafellsver: Two (earth occupied). Lower Oddkelsver: Tracks found.

appears that losses were similar during both stages of the fledging period. This is somewhat contrary to the results obtained by the 1953 expedition when losses were found to be higher among younger birds. The 1966 results must be evaluated with caution, as the sample was small and many unmeasured corpses which had decayed may well have been of younger goslings. Even so, our observations indicated that predation during the second half of the fledging period was appreciable and may well have been increased because of the larger numbers of unattended goslings. The considerable number of dead goslings seen during nine days in Þjórsárver was itself of interest, as previous expeditions had reported so few.

Arctic Skuas were not seen to kill goslings, presumably because most of them were too old and large to tackle, but the Skuas frequently mobbed gulls which were hunting or eating goslings. The Great Black-backed Gull was a serious threat to young geese, but here also there appeared to be an upper limit to the size of gosling that it could kill. An Iceland Falcon was seen attacking a gosling and two other fresh corpses which we collected were almost certainly killed by this bird. Probably the most serious predator on larger goslings was the Arctic Fox. Six goslings, all found within a small area of Nautalda where two foxes were active, were killed in a manner typical of this species. The birds were attacked overnight and showed considerable scarring of the neck; four were headless but others were intact, with the exception of one on which a gull was feeding. These goslings were at least six weeks old and near to fledging, and five other freshly killed goslings of a similar age were thought to result from fox predation.

We found no evidence of the presence of Mink *Mustela vison* in Þjórsárver, although the species was breeding near Fossrófulækur and in Gránunes.

### Food

Samples of goose droppings and viscera of fresh corpses were collected whenever possible. Droppings were sealed, without preservative, in polythene bags, while the viscera were preserved in 15% formalin (Harrison, 1960). These specimens were analysed later by Dr. D. F. W. Pollard of the Wildfowl Trust (Table II). In addition, some direct observations of food preferences were made. Goslings unaccompanied by parents were often easily

approached and it was possible to see, for example, that one moss species was taken rather than another. In some areas, in particular in the moulting grounds used by non-breeders, the heavily grazed plant species were easily recognised and recorded.

The flock of about 70 geese in Blágnípuver in early August appeared to be feeding exclusively on the sedge *Carex bigelowii* Torr. (*C. rigida* Good) which grew abundantly in the marshes. A strip of vegetation approximately two metres wide round the tundra pools was most heavily grazed, the top 10 cm. of the plants, including young leaves and seeding heads, having been removed. The same sedge was also abundant in Hvítárnes, and analysis of droppings collected there showed that this food-plant featured prominently in the diet of non-breeders. Remains of mosses, grasses, *Juncus* sp. and occasionally *Equisetum variegatum* were also found in the faeces.

A definite change in the pattern of feeding during the month of August emerged. The sedge *Carex bigelowii*, which is abundant in all the marshy oases in central Iceland, featured prominently in the diet of adults, pre-breeders and goslings throughout the month. Mosses were also important for geese of all ages, but *Equisetum*, mentioned by Witherby *et al.* (1940) as an important food plant on the breeding grounds, occurred in only three samples out of 32, despite its frequent and widespread distribution. It may, however, be taken earlier in the breeding season when the shoots are young and tender.

From the middle of August the leaves and fruits of *Empetrum hermaphroditum* and *E. nigrum* became increasingly important in the diet. The fruits of these species ripened rapidly in a period of hot sunny weather between 19th and 22nd August, and this coincided with a movement of the geese from the marshes to the higher and drier areas of the oasis where *Empetrum* flourished.

Similar marked and abrupt changes in diet, even though the staple foodstuff remains abundant, have been noted in other species. Berries become favoured food of the Icelandic Greylag *Anser anser* after the moult (Kear, 1966) and indeed the only arctic or subarctic goose reported *not* to take berries in the autumn is the Lesser Whitefront *A. erythropus*. Many insectivorous birds take berries in the late summer. Recently Evans (1966) noted the importance of Blackberries *Rubus fruti-*



cosus and Elder *Sambucus niger* in the diet of the Blackcap *Sylvia atricapilla* and Garden Warbler *S. borin* in north-east England in autumn. He commented that such fruits were excellent sources of soluble carbohydrate, easily assimilated by birds and laid down as energy reserves in the form of fat for migratory flights. He suggested (Evans, pers. com.) that while the change in diet of the Pinkfoot might have arisen simply because it preferred *Empetrum* berries (which were not available earlier in the season) to *Carex* leaves, such a change in diet would certainly be advantageous to the bird in its physiological preparation for migration since *Carex* leaves supply few calories. The change from a diet consisting almost exclusively of *Carex* leaves and mosses to a more varied one which included *Empetrum* berries of a high sugar content, took place about three weeks prior to migration. It is interesting to note that the fruits and leaves of *Vaccinium uliginosum*, although common in the same localities as *Empetrum*, were rarely eaten by the geese, at least during August.

#### Breeding outside Þjórsárver

Some evidence was found of Pinkfeet breeding in small colonies in the central region around Hofsjökull. The largest of these colonies was along both sides of the gorge of the Jökulfall river, where 70 nests were found and some sites may have been missed on the inaccessible south side of the gorge. On the north side, eight nests occurred within a distance of 150 m., and on one almost isolated rock stack there were no less than four nest sites along a 15 m. flat top. At the base of this stack was a fox earth with a few bones and goose feathers littered round the entrance.

Blurton Jones and Gillmor (1955), who spent four weeks in the Ásgarð area during the gathering and departure of Pinkfeet in 1954, cited as evidence of scattered breeding in the area records of three family groups and the remains of a juvenile, killed before it could fly. It is probable that these birds came from the colony on the Jökulfall, but it is also possible that family groups with juveniles originated in Þjórsárver, as in a normal season they would have been flying for some ten days by the middle of August when they were seen. Some family groups left Þjórsárver, flying west, from 23rd August onwards and when the expedition party passed Ásgarð meadows on 25th August 1966, four feeding flocks of

adults and goslings totalling 70 birds were seen.

Although the Ásgarð and Blágnípúver area was thoroughly investigated, no other breeding places were found. The huge area of meadow, Guðlaugstungur, to the north of Hveravellir, is similar in character to Þjórsárver and seemed to be suitable as a breeding ground for Pinkfeet. The single nest on the roof of a kofi, apparently occupied during 1966, indicated that this area should be more thoroughly investigated.

#### Flocking and movement of Pinkfeet at Fossrófulækur 26th August — 4th September

The gathering and pre-migratory movements of Pinkfeet in this area were studied by Blurton Jones and Gillmor in 1954 and observations in 1966 merely provided some comparisons. The actual departure on migration was not seen and much of the fighting observed appeared to be movement from one feeding ground to another or to resting places towards evening. A mixed flock of between 15 and 33 adults and juveniles came every morning to feed on the dry ground round the oasis, arriving at about 08.00 hrs. from the east, and usually departing about noon, possibly disturbed by activities round the camp site. They were sometimes joined by smaller family parties. All flocks of geese seen in the Ásgarð—Fossrófulækur area were feeding on the raised, drier areas of vegetation, where a more varied plant association including *Empetrum* occurred; none were seen to feed in the marshy parts of the oases, such as Blágnípúver, where the moulting pre-breeders had been found earlier. Only on two occasions was movement witnessed which could be described as migratory: during three days of very cold weather around 31st August at Hveravellir, a skein of 26 Pinkfeet passed high overhead at 11.25 hrs flying south; the same night, at 22.00 hrs. a flock was heard, also heading south.

A most noticeable feature at Fossrófulækur was the many small flocks of geese seen flying in a bewildering variety of directions. Blurton Jones and Gillmor also noticed this, and suggested that such movements were social, in that they enabled small flocks to join up with larger ones prior to migration, and advantageous in that the gathering and movement might be important in stimulating the physiological development of the flight apparatus prior to migration. Similar

flight behaviour was observed in the large non-breeding flock of Pinkfeet at Hvitárnes which had just completed moult.

In conclusion, the Ásgarð area is evidently a major gathering ground where Pinkfeet can associate before leaving Iceland on migration.

#### Acknowledgements

This expedition would have been impossible without the financial assistance of

the Warden of Radley College, the Scott Polar Research Institute and firms and individuals, too many to mention here, who gave supplies and equipment free or at a reduced price. I am also very grateful to Dr. P. R. Evans and Hugh Boyd for their helpful criticism of the typescript of this paper, and to Dr. Janet Kear and Dr. Douglas Pollard, without whose advice and help these results could not have been achieved.

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