Factors affecting the distribution of geese in the British Isles

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Geese are highly traditional in their use of wintering and breeding areas. Not only do birds use the same areas, often the same fields, every year but the same individuals appear (Boyd 1955). In a situation where suitable roosts and feeding habitat are patchily distributed, separated sometimes by hundreds of miles, it is obviously advantageous to the individual and the population to follow established traditions.

Most British geese now feed on managed grassland or arable crops, and it is sometimes not obvious why geese are found in one area rather than another that seems equally suitable. In order to try and discover the basis for traditional attachments, we must look at the British situation before man drastically altered the scene by deforestation. Figure 1 shows the approximate pattern of deforestation from Neolithic times, when well over 95% of the British Isles was wooded. Before this time, there must have been great pressure for species specialization in feeding, which avoided interspecific competition for the limited open areas. Even though each species has developed specialized feeding apparatus, each remains flexible enough to adopt the whole range of feeding methods. Thus at some stage of its life cycle each species obtains food by grazing, digging or rooting and seed-stripping. It may be that, for part of the winter, species co-existed in estuarine situations eating the same abundant food sources, and specialized only at critical times.

Discounting vagrants, and the introduced Canada Goose *Branta canadensis*, six species of geese winter in Britain, and there is evidence from fossil records that each of these was present in the Pleistocene epoch, more than 10,000 years ago (Howard 1964).

Based on the existing habits of each species, their feeding apparatus, and on historical evidence, an attempt can be made to allocate each one to a habitat which existed before deforestation and speculate as to its former distribution.

Bean Goose *Anser fabalis*

Historical records on the status of Bean Geese in Britain are rather confused because it was not usually distinguished from the Pink-footed Goose. The species was named in 1787 (in Britain), the specific name referring to its habit of gleaning bean fields. Cereals were grown in Europe before 2,000 B.C. and the Bean was probably the first goose to capitalize on waste grain. The long thin bill of the species suggests that it is naturally a prober, feeding on underground plant organs in soft substrates of marshlands and bogs. It may also have stripped seeds from the standing heads of grasses and sedges. It may have wintered in northern Britain, where it was a common goose at the end of the last century (Berry 1939), but it is likely to have spread from the continent with the increase in cereal growing. Its decline in recent years may be due to competition with native species, recently adapted to feeding on agricultural land, but more likely it is due to a retreat to areas closer to the breeding grounds, where food became more abundant with the creation of the Dutch and German polders.

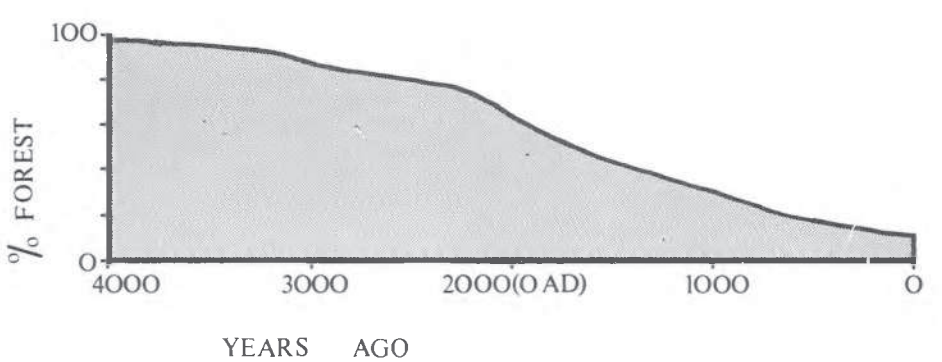

Figure 1. The clearance of forests in the Bristish Isles. Adapted from Godwin 1956.

Pink-footed Goose *Anser brachyrhynchus*
The Pinkfoot has probably always wintered in Britain, although its distribution has radically altered. Kear (1965) documented recent changes in distribution, attributable to its adaptation to arable feeding and to the increase of arable farming (particularly cereal growing) in Scotland. The distribution of this species was probably changing long before the present century, when it became less abundant in southern estuaries such as the Severn and Wash. The Pinkfoot's short bill is adapted for grazing, perhaps combined with seed-stripping as suggested by Reed (1976). It would have found short herb or *Puccinellia* swards on saltmarsh, principally in the dynamic sandy west coast estuaries such as the Severn, Ribble, Morecambe Bay and Solway.

White-fronted Goose *Anser albifrons*
Two sub-species now winter, with non-overlapping distributions. The Greenland breeding *flavirostris* still frequents boglands over most of its winter range, although the majority rely almost entirely on arable land and sown pastures. There is no doubt that the Greenland Whitefront was always a bog goose, feeding on *Eriophorum* roots and *Rynchospora* bulbils, as well as grazing surrounding rough grassland (Pollard and Walters Davies 1968). The distribution of this race closely follows that of British bogs, although the numerical distribution has changed drastically, with a large proportion of the population wintering on the Wexford Slobs, where the sub-species was 'scarce in comparison with the Greylag' in the early part of this century (Kennedy *et al.* 1954).

The European *albifrons* is similar to the Pinkfoot in bill-size and pecking rate, and is found in some of the areas formerly frequented by Pinkfeet. It is probable that this race did not visit Britain regularly in the past but was able to expand its range after the decline of the Pinkfoot in southern Britain.

Greylag *Anser anser*
The Greylag is the only native breeding goose of the British Isles, although it has declined as a breeding bird in the last few hundred years consequent on the drainage of the large marshlands such as the East Anglian and Lancashire fens. As well as these sedentary residents, a migratory population breeding in Iceland winters here. The Greylag still feeds on *Scirpus* roots in the Netherlands (e.g. Zwarts 1972) and this may have been its major food in Britain. *Scirpus* beds would have been found in most of the larger estuaries of Great Britain, as well as on the Wexford Slobs and in other estuarine habitats in Ireland. The Greylag was an extremely abundant goose in Ireland before the drainage of some of its main haunts (Kennedy *et al.* 1954). This species probably also retreated to Scotland with increasing arable farming in the same way as the Pinkfoot. It may be significant that the Greylag's decline in Ireland coincided with its increasing use of turnips as a winter food in Scotland (Kear 1962).

Barnacle Goose *Branta leucopsis*
The Barnacle has the shortest bill of any British goose, adapted to graze very short swards. The species also feeds on the stolons of white clover and on seeds (Owen and Kerbes 1971). In the Netherlands, *Salicornia* seeds make up a large part of its diet in some seasons. The Barnacle was probably restricted to exposed islands and headlands on the west coast of Ireland, the Hebrides and mainland of northern Scotland, where short '*Plantago*-swards' would have been maintained by exposure and sea-spray, and machair grassland was available. Machair was probably not wooded because of the shallow, well-drained soil. It would have provided a herb-rich sward where the birds grazed, probed and fed on the seed heads. The Svalbard population, now wintering in the Solway, may not have existed for more than a few hundreds of years. The bird has increased in Svalbard in the present century and was probably not abundant there until recently (Norderhaug 1970 and pers. com.). The Barnacles' apparent lack of subspeciation also indicates a recent separation.

Brent Goose *Branta bernicla*
The Brent still feeds on coastal mudflats, on *Zostera* and *Enteromorpha*, and before the drastic decline in the former in the 1930s the distribution of the goose closely followed that of *Zostera*. Two races occur in Britain, which breed in completely separate areas, while their winter ranges are almost completely isolated geographically. Erratic breeding performance may have always been a limiting factor on numbers, which may mean that the two populations never have been in competition for winter food.

Other species
There is no reason to suppose that any other species formerly wintered in Britain,

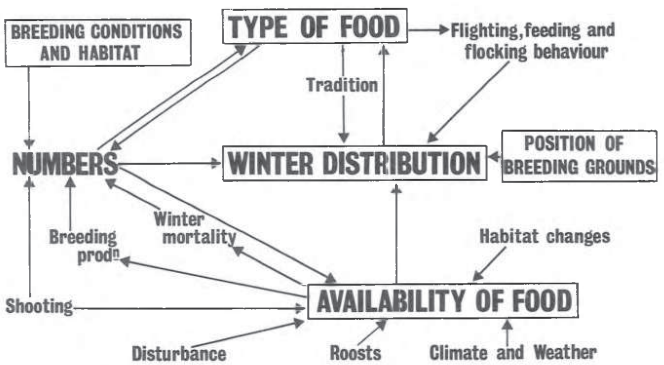

Figure. 2. The factors influencing past and present winter goose distribution in the British Isles. The type of food is that traditionally used. The direction of arrows indicates the direction of influences.

and native species do seem to be adapted to every winter feeding niche that was available before deforestation.

Factors affecting present goose distribution

The main factors presently affecting the distribution of geese are summarized in Figure 2, which, however, makes no attempt to indicate the relative importance of the various factors. As indicated above, the distribution of their traditional foods is still a major determinant of the winter range of most species, although the geese may have largely abandoned the original food sources.

Traditional food

The food type governed the development of flock behaviour in the different species and some variability is noticeable in present populations. Greylag and Pinkfeet use the same habitats and foods in central Scotland, often also using the same roosts. They do not usually compete for feeding areas, however, because they have different flighting habits, the Pinkfoot flying further from the roost than the Greylag (Newton and Campbell 1973). This probably reflects the greater necessity for wintering Pinkfeet to wander in the past, in search of their patchily distributed traditional foods. The Greenland Whitefront, although found in large concentrations at the Wexford Slobs and on Islay, usually remains in small feeding flocks. In blanket bogs, its food was probably obtained from small wet flushes unable to accommodate more than one or two families. The Barnacle's rather volatile behaviour probably arises from the fact that its food was found in small patches, on small islands or cliff ledges, necessitating constant movement.

Position of the breeding grounds

The position of the breeding grounds is of some significance, although the British Isles are small enough not to present any travelling problems for these highly mobile birds. In general, the nearest suitable habitat to the breeding grounds is used. Presumably the two races of Brent Geese wintering in Britain are separate because of the position of their breeding grounds.

Tolerance of low temperatures

Large birds are better able to withstand cold weather than small ones, and there are considerable temperature differences in different parts of Britain. There is no evidence that this has influenced geese as the smallest species (the Brent) has wintered in large numbers as far north as the Moray Basin.

Food availability

Habitat and food availability in the broad sense are undoubtedly the most important factors influencing present as well as past distribution. Both will continue to alter with changes in disturbance and agriculture, and with various forms of development and drainage.

With by far the greater part of Europe forested, winter food was in the past likely to have been the main factor limiting goose numbers (except possibly the Brent). Changes have undoubtedly occurred in the breeding grounds, but the fact that the major adaptations in the bill structure are for feeding conditions outside the breeding grounds (most species have rather similar summer diets) suggests that winter conditions were more important. Past population levels of most species in Britain (the Greylag may have been an exception) were probably much less than at present, and winter mortality through starvation more usual. The creation, by forest clearance, of further open areas was undoubtedly to the benefit of geese. With increasing restrictions on shooting seasons, the loss of interest in hunting and egg collecting because of improvements in human diets, and the creation of refuges, the numbers of four species have more than doubled in the last twenty years. Improvements in agriculture, increasing the nutritive value of grassland, and the adoption of field feeding, have undoubtedly had a beneficial effect.

Figure 3 summarizes the habitats used by British Geese before deforestation and at present. The chief impression is of the crowding of many species on to the same lowland habitats, and this trend continues.

The benefits and hazards of arable feeding are discussed in Reed (1976) and will not be developed here. The main questions arising from the ideas put forward in this paper are:

(*a*) Can we predict the future distribution of British geese if numbers continue to increase?
(*b*) What are the implications of future breakdown of traditions? Are species likely to come into competition if their ranges increasingly overlap?
(*c*) Which species might suffer if such competition takes place?

At present, there is more suitable habitat in Britain than geese to fill it, and as the tradition of most species is to use the regions in which their former foods were found, conflict rarely occurs. The Brent Goose, and to some extent Greenland Whitefront and Barnacle, still use their traditional habitat and food, but even in the Brent Goose inland feeding is becoming more frequent. The rapid decline in numbers, following decreasing *Zostera* stocks in the 1930s, may indicate that the Brent Goose is unable to adapt to long-term inland feeding. One possible reason is that its digestive system cannot cope successfully with grass, and that it slowly loses weight when feeding inland. On present evidence, Brent do not seem to adopt inland feeding in preference to *Zostera*, and use grass only in periods of food shortage.

Both Barnacles and Greenland Whitefronts have a sizeable proportion of

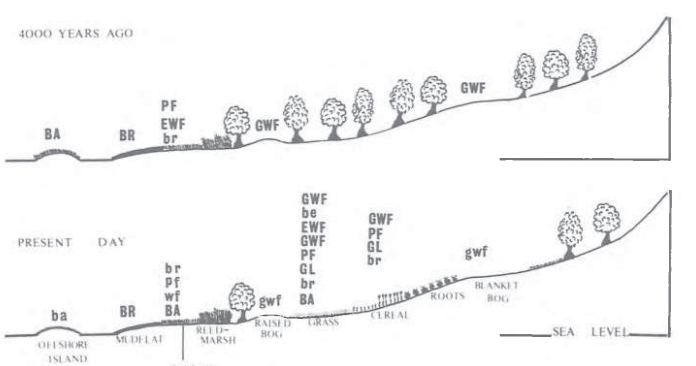

Figure 3. Diagrammatic representation of the habitats of British geese (a) before and (b) after deforestation.

Abbreviations: GL: Greylag, BE: Bean, PF: Pinkfoot, GWF: Greenland Whitefront, EWF: European Whitefront, BA: Barnacle, BR: Brent. Capital letters indicate major food sources, small letters secondary habitats. Brackets include species which may not have visited Britain before deforestation.

their populations wintering on single sites in non-traditional feeding areas. One of the consequences of this is that traditional habitats become (at least relatively) less important.

The Greylag and Pinkfoot populations are likewise contracting their ranges, but unless numbers continue to increase or measures are taken to discourage them from major sites, they are not likely to colonise new areas in the near future.

Although in the case of Pinkfeet and Greylags traditional separations have broken down and they occupy identical areas, there seems to be no trend in this direction in other species. The presumably innate differences in feeding methods and flocking habits are not likely to be modified in response to the changed circumstances as they are presumably advantageous to both species.

If competition should occur on agricultural grassland, the shorter-billed goose species will presumably be at an advantage because they can feed efficiently on short swards. On other foods, differences in bill structure might again separate the species.

Thus there seems no reason to suspect that drastic changes in British goose distribution are imminent. However, the increasing trend towards inland arable feeding does introduce the possibility of greater interaction and competition in future. Conservation measures should not be based solely on total numbers of birds using any area, as this leads to further concentration and may cause desertion of traditional haunts, as has happened with the Greenland Whitefront (O. J. Merne pers. com.). If future agricultural policy forces large numbers from these important sites, we may find that traditional areas no longer exist.

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Summary

From examination of historical evidence and deduction from the present distribution and habits of British geese, an attempt is made to picture their distribution before deforestation. A flow diagram is presented which indicates the relationships between the various factors affecting distribution. The major factors are the traditional diet of the species and the availability of habitat and foods. Independent variations in the condition and geographical position of the breeding grounds are important for some species.

There seems no likelihood of imminent distributional shifts, but continuing increase in inland arable feeding in all British geese may result in competition between species if attachments to traditional areas break down. Conservation should strive to maintain populations on traditional habitats, as well as protecting the largest possible number of individuals.

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