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AGE OF FIRST PAIRING AND BREEDING AMONG GREENLAND WHITE-FRONTED GEESE¹

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The Greenland White-fronted Goose (*Anser albifrons flavirostris*) breeds in west Greenland and winters in Britain and Ireland (Salomonsen 1950). The population fell from 17,500–23,000 in the 1950s to 14,300–16,600 by the late 1970s (Ruttledge and Ogilvie 1979) and is currently estimated to be 26,700 as of November 1989 (Warren 1990).

Due to its scattered wintering distribution and low productivity, this sub-species remains threatened in western Europe and there is a need to model population processes in order to provide a firm basis for conservation management. Fundamental to our understanding of the population processes amongst such long lived individuals are data relating to age-specific breeding success and survival (Owen 1980, Raveling 1981). Age of first pairing and breeding is likely to be one of the most important determinants of goose population productivity (Boyd 1956).

The proportion of young in the Greenland White-fronted Goose population each winter is low when compared with other races of *Anser albifrons*, although clutch size and consequently brood size tend to be greater (Owen 1980, Fox and Stroud 1988). Egg predation appears to be a major factor influencing nesting success (Fox and Stroud 1988). Hence, the population seems to be characterized by relatively few pairs returning to the wintering grounds with young each year. Using a population of individually marked birds, we attempted to assess whether the low proportion of successfully breeding pairs of Greenland White-fronted Geese is due to deferred breeding.

METHODS

Between November 1983 and March 1991, 790 Greenland White-fronted Geese had been captured at their single most important wintering site at Wexford Slobs in southeast Ireland (52°22'N, 06°25'W). Birds were caught on plots of unharvested cereals using cannonnets and each marked with a metal leg band, a white plastic leg band (bearing a black three symbol code) and an orange neck collar (bearing the same code in

black). Leg bands can be read in the field using 20–60× telescopes up to 300 m and collar codes are legible up to 800 m. Birds were aged using plumage characteristics (principally the lack of white facial frons and absence of belly bars, Cramp and Simmons 1977), categorized as juveniles (<1 year old) or adults and sexed by cloacal examination.

In 1983, the National Parks and Wildlife Service also instigated a regular program of resighting at Wexford Slobs, an area of intertidal flats converted to intensive agricultural use, crossed by roads. One person devoted three or four days each week to recording the presence of marked birds and their social relationships. All roads throughout the Wexford Slobs were traversed and the position, presence of mate, goslings, siblings and associates of marked birds recorded in standard format. Definitive pairings could only be determined for (1) geese of known age for which all family members were ringed and (2) geese of known age with unringed family members but seen with a gosling/goslings of their own in at least one winter. Although this restricted the sample size considerably, the technique ensured that family relationships (i.e., extended parent-offspring and sibling-sibling associations, Warren 1990) were not confused with genuine pairings. Successful breeding was only recorded when pairs were observed with offspring on more than one occasion during the winter. Since assessment of breeding status required multiple confirmation of the existence of a pair-bond, a known bird was considered either paired or of unpaired status at the end of each winter. Only geese seen in every consecutive year up until they were first paired or first bred were used in the analysis.

Resighting data from other wintering resorts throughout Britain and Ireland were generated through a network of observers who regularly checked local flocks for collars and leg-rings, although not as intensively as at Wexford. To March 1991, this program had generated over 15,800 resightings and provided important information on site loyalty (Wilson et al. 1991; Warren et al., in press).

Age classifications are as follow: age "0" refers to birds in their first year, age "1" to birds in their second year, age "2" to birds in their third year, etc.

RESULTS

Age of first pairing. Sixty-six geese ringed as juveniles were recorded as paired to a mate at some stage of the study. Mean age of first pairing was 2.46 years (± 0.08

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TABLE 1. Age (in years) of first pairing and breeding amongst Greenland White-fronted Geese marked as juveniles at Wexford Slobs, Ireland. "N" indicates the number of birds of that age: (i) first paired having previously been unpaired and (ii) first breeding having previously not bred. Figures in parentheses denote sex (number of male, female, unknown sex).

Age	Numbers first paired at this age N (M, F, ?)	Numbers first breeding at this age N (M, F, ?)
0	0	0
1	6 (5, 1, 0)	0
2	30 (14, 10, 6)	8 (6, 0, 2)
3	23 (9, 11, 3)	10 (2, 8, 0)
4	7 (2, 2, 3)	8 (6, 0, 2)
5	0	2 (1, 1)

SE, Table 1). No data were available on birds older than seven years. There was no significant difference between the sexes in the distribution of age of first pairing (Mann-Whitney $W = 739.5$, $P = 0.209$).

Age of first breeding. Twenty-eight of the 66 juveniles (42%) were recorded as having bred successfully, the mean age of first successful breeding being 3.15 years (± 0.17 SE, Table 1). No data were available on birds older than seven years.

Brood size at age of first breeding. Brood size was 3.5 for birds breeding successfully for the first time at the age of 2 (i.e., at the beginning of their third year). For birds breeding for the first time in later years, brood size was larger (3.9 at the age of 3, 4.0 in subsequent years, Fig. 1).

DISCUSSION

Most geese are sexually mature in their second or third year, at which stage they breed freely in captivity (Owen

1980). Initial pair formation therefore occurs in the winter or spring of their second or third year. Pair formation is initiated mainly during the spring in the Lesser Snow Goose (*Anser caerulescens caerulescens*) (Prevett 1972) and Barnacle Goose (*Branta leucopsis*) (Owen 1980), but during the winter in Canada Geese (*Branta canadensis*) (Raveling 1969). However, since most studies have been carried out on the wintering grounds, the importance of courtship on staging and summering areas has probably been underestimated (Owen et al. 1988). There are few data on age of first pairing from the wild, but Boyd (1954) found that three out of twenty nine three-year old or older European White-fronted Geese (*Anser albifrons albifrons*) were unpaired, and one out of twenty were single in their fourth winter or later.

It was not possible to determine the exact timing of pairing in this population. However, the resighting data suggests that pairing usually occurs away from the wintering grounds, since eleven geese of known age bred in their first summer of pairing but had associated with their parents and siblings only, up until the timing of departure in the preceding spring. However, two Greenland White-fronted Geese wintering in Scotland are known to have paired during the winter (D. A. Stroud, pers. comm.).

Multiple observations of collared birds indicate that Greenland White-fronted Geese are largely monogamous for as long as their mate survives. There have been four definite cases of "divorce" (approximately 6% of 67 pairs formed), an incidence similar to that among Barnacle Geese (4%, Owen et al. 1988).

There are no comparable data relating to age of first breeding among unmarked birds or from birds marked only with leg-bands in this population. However, the data presented here are comparable with age of first breeding amongst other *Anser* geese. Prevett (1972) found 25% of two year old Lesser Snow Geese, 50%

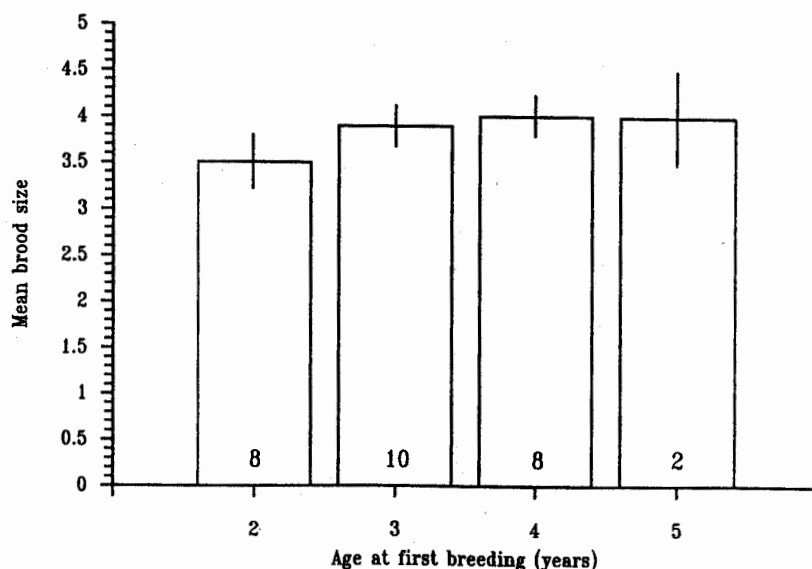


FIGURE 1. Mean brood size of first successful breeding in Greenland White-fronted Geese collared as juveniles at Wexford Slobs, south-east Ireland. Bars indicate \pm standard error, integers indicate sample size.

of three year old and 90% of four year old geese attempt to breed, although the majority of two year olds tend to desert or lose their nests and so are unsuccessful. However, this study cannot identify those geese which attempt to breed but are unsuccessful, even though the effects on overall population dynamics are the same. Boyd (1954) found no European White-fronted Geese less than three years old were parents, which is contrary to the findings in this study. Many *Branta* species can breed successfully in captivity at two years of age, with many two year old captive Barnacle Geese nesting successfully at Slimbridge (Owen 1980). There is even a record of a yearling Canada Goose laying fertile eggs (Hall and McGilvrey 1971). However, in this study, birds paired in their second winter were not recorded with young in their first year of pairing. Furthermore, birds breeding for the first time in their third and fourth years were less successful than those breeding first in subsequent years. There appears, therefore, to be a link between age and hence experience and recruitment in this population, as speculated for other species (Raveling 1981, Ratcliffe et al. 1988).

Boyd (1956) calculated that Pink-footed Geese (*Anser brachyrhynchus*) had to be up to 90% more productive if young birds bred first at three years old rather than at two years, hence the age of pairing and first breeding is an extremely important population parameter affecting productivity. This is especially so for Greenland White-fronted Geese since only a very small proportion of pairs manage to breed successfully each year, despite large brood sizes when compared to other White-fronted Goose populations (Owen 1980, Fox and Stroud 1988). In this paper, we have shown that Greenland White-fronted Geese are at least capable of pairing and breeding successfully as soon as they are sexually mature and that restrictions on successful breeding are linked to factors other than the timing of maturation.

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