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Naturalised Barnacle Geese

Common Chiffchaff calls

BBRC review of Black-headed Buntings

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Naturalised populations of Barnacle Geese in the UK: an update on numbers, distribution and breeding

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Abstract A census in February 2023 showed that the population of naturalised Barnacle Geese *Branta leucopsis* in Britain and Northern Ireland was an estimated 5,800. This is a 456% increase since the only previous census, in 1991. Naturalised Barnacle Geese were found at 98 sites, with most birds present in England and smaller numbers in Scotland, Wales, Northern Ireland and the Isle of Man. Given such a rapid increase in this naturalised population, we recommend increased future monitoring, including colour-ringing.

Introduction

Britain and Ireland hosts three populations of Barnacle Geese *Branta leucopsis*: two are distinct, migratory populations, one of which breeds in Greenland and the other in Svalbard. Those migrating from Greenland winter chiefly on the west coast of Scotland and in Ireland, with 48% of the population wintering on Islay, Argyll (Mitchell & Hall 2020).

Those migrating from Svalbard winter principally at two sites in Britain: on the Solway Firth, Dumfries & Galloway/Cumbria, and around Budle Bay and Lindisfarne, Northumberland (L. Griffin pers. comm.).

Finally, there is a small but growing population in the UK of naturalised birds, which are present year-round. Most of this population is found in England and Wales, with smaller numbers occurring in Scotland and Northern Ireland. These populations are assumed to have originated from a mixture of escaped birds, immigrants from the Dutch, German and Russian population (see below), and injured birds that could not migrate to their breeding grounds and so remained in the UK.

To our knowledge, only one coordinated census of the naturalised population has previously been undertaken, in summer 1991 (Delany 1993), although this did not include Northern Ireland (fig. 1). In 2021, this naturalised population was estimated at around 4,000 birds (Frost *et al.* 2021). However, results of the survey in February 2023 have shown the population to be considerably larger – an estimated 5,800 birds.

Until recently, knowledge on the annual movements of the naturalised Barnacle Goose population was largely lacking. However, colour-ringing has shown that individuals from the naturalised population in Scotland mix with birds from the Svalbard and

Greenland populations on the wintering grounds and have, in some cases, joined migratory flocks on their return journeys north, suggesting that there is some plasticity in the populations (Mitchell *et al.* 2021; L. Griffin pers. comm). To date, no naturalised birds from England or Wales have been observed with migratory birds in the UK, and migratory birds appear to seldom join flocks of naturalised birds.

Birds ringed while moulting during the summer in Norfolk have been observed in wintering flocks of Barnacle Geese in the Netherlands and France, and birds ringed in Yorkshire have been sighted in Austria, France, Germany, Italy, Jersey, Poland, Sweden and Switzerland, with some of these birds subsequently resighted in Britain (K. Brides unpubl. data). Furthermore, there are a small number of records of Barnacle Geese that have been colour-ringed in the Netherlands and subsequently resighted in England (H. van de Jeugd pers. comm.).

A population of Barnacle Geese in the Netherlands, Germany and Russia has increased 30-fold since the 1980s (Jensen *et al.* 2018). Although the origin(s) of this population are not totally clear, it presumably arose in a similar way to the naturalised British populations, with escaped captive birds and/or birds from northwest Russia/Novaya Zemlya, which migrate southwest to winter in the Netherlands, establishing non-migratory populations (Jonker *et al.* 2013). Given the rapid rise in the number of birds in this population and the implications that brings, it is perhaps surprising that the naturalised British population has not received more attention.

Increasing numbers within naturalised populations have the potential to exploit new areas in search of adequate food sources, breeding and roosting sites, and can (re)merge with different populations at certain times of the year. This has occurred with Greylag Geese *Anser anser* in Britain and Ireland, where naturalised birds are now abundant in the same areas used by Icelandic-breeding birds during the winter. In the field, separation by visual identification alone is not possible; therefore, any assessments of population size, breeding success and conservation status of each population is challenging (Brides 2021). Equally,

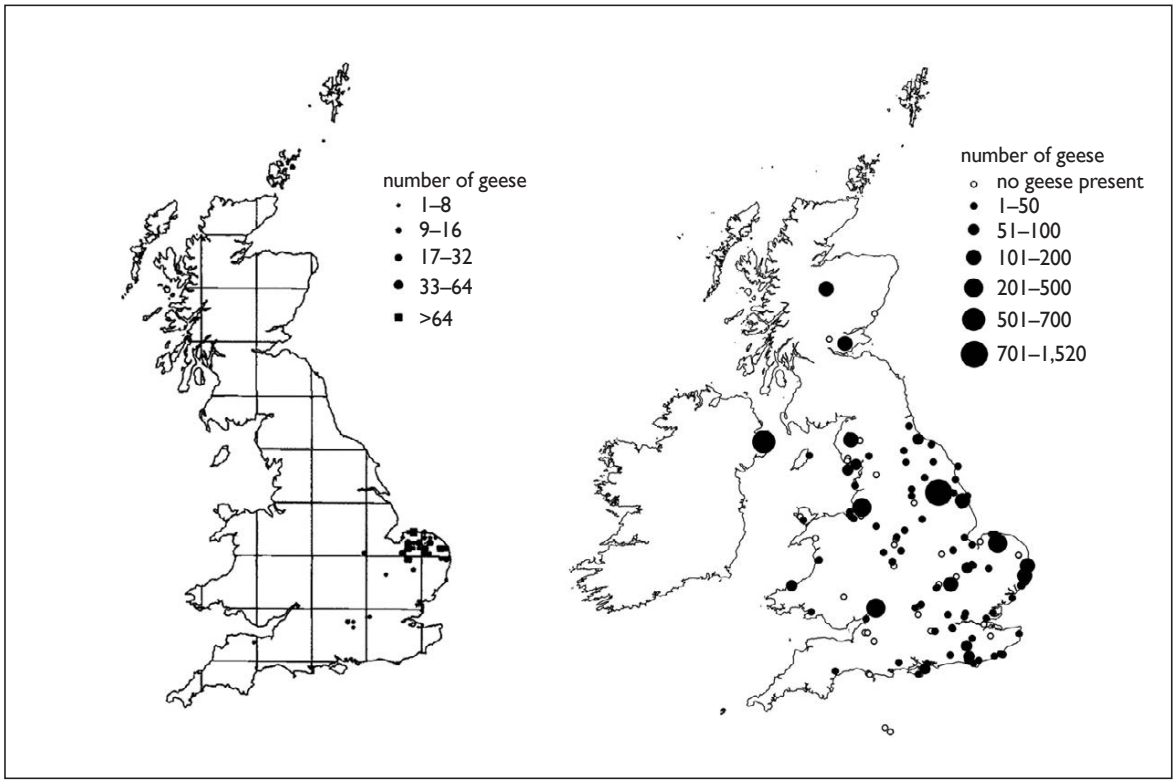

Fig. 1. Distribution and abundance of naturalised Barnacle Geese *Branta leucopsis* in the UK during the summer 1991 census (left) (Delany 1993) and winter 2023 (February) census (right). Note that the count undertaken at the Highland Wildlife Park, Highland, was in summer 2022; it is known that at least some of these birds winter on the Solway Firth alongside migratory birds.

Brian Small

29. Colour-ringed Barnacle Geese *Branta leucopsis*, Suffolk, November 2021.

when individuals break with their migratory traditions, new population structures can emerge that may affect gene flow (Jonker *et al*. 2013). Therefore, having good understanding of changes in movements, distribution, numbers and any interchange between populations is vital in population monitoring programmes and the conservation of species groups (Brides *et al.* 2022).

Evidence of impact, if any, that breeding non-natives have on other species, habitats, and any possible roles they play in acting as vectors for disease are of paramount importance in species conservation. While there is no evidence to date for the relatively small naturalised population of the Barnacle Goose in the UK having significant negative impacts on native species, or producing conflict with landowners, adequate monitoring programmes can play a vital role in predicting and understanding potential future impacts, especially if similar exponential rises in population sizes occur. In the UK and across Europe, impacts of the much larger migratory Barnacle Goose populations have principally been agricultural crop damage (including the economic cost of farmer compensation schemes) and air safety concerns due to bird strikes with aircraft (Jensen *et al.* 2018).

Owing to their tendency to frequent habitats away from wetlands while feeding, Barnacle Geese are not always detected adequately by general national waterbird monitoring schemes such as the Wetland Bird Survey (WeBS) and benefit from species-specific surveys. This paper presents the results of a census of Barnacle Geese in the UK, undertaken in February 2023, which aims to update the population-size estimate and, for the first time, determine the species' complete winter distribution in Britain and Northern Ireland, with additional information on birds on the Isle of Man and in the Channel Islands.

Methods

Census

To establish a preliminary distribution of Barnacle Geese in the UK, an online questionnaire was sent to all county bird recorders in April 2021. The questionnaire captured information on regular Barnacle Goose flocks within counties at different times of the year and also requested information on breeding colonies and moulting flocks. Data on the presence of Barnacle Geese was also sought from the WeBS database and eBird.org; data from 2012–21 were selected and arranged into two periods, winter (October to March) and summer (May to September). Monthly maxima counts at sites holding more than ten birds were highlighted and used to identify sites to include in the census. Finally, through colour-marking work undertaken by the Waterbird Colour-marking Group (WBCM), sites where colour-marked individuals had been observed were also added to complete the census sites list.

To achieve full coverage, identified sites were assigned to counters through personal contact with the UK birding network by the authors, and vacant sites were advertised on social media. Site information, a map of allocated and vacant sites and count methodology were placed on the WBCM website (https://waterbirdcolourmarking.org). Counters were asked to score the coverage of sites and accuracy of their counts by selecting the option that suited best from a choice of three ('precise', 'OK' and 'low'). Counts were collated through a bespoke online 'ShinyApp' developed within the R Project for Statistical Computing (www.R-project.org). Furthermore, birders who did not have assigned sites were encouraged via social media to look out for Barnacle Geese on the census weekend and either to report observations through the Shiny Application or to submit them via BirdTrack.

To produce an up-to-date census-derived population estimate and to better understand winter distribution of the population, counters were asked to cover their sites on the weekend of 18th/19th February 2023. These dates coincided with the February 2023 WeBS core count to align the census with that survey (see below) and to reduce effort needed by those birders/counters who also happened to be undertaking WeBS counts that month.

To attempt maximum coverage and ensure that no counts were missed, counts during the census weekend were requested from BirdTrack, eBird and WeBS and included in the overall total if considered not to cause any duplication. Counters were also asked to check flocks for colour-marked individuals to help better understand any movement that may have occurred during the census weekend, thus eliminating any potential double counting.

Table 1. Totals of naturalised Barnacle Geese *Branta leucopsis* by county in February 2023. Raw counts are shown with adjustments [-x] and estimated counts [+x]. Figures in parentheses indicate the number of sites counted.

site	count	site	count
Angus	0 (1)	Jersey	0 (1)
Bedfordshire	206 (10)	Kent	7 (7)
Berkshire	19 (3)	Lancashire	28 (3)
Buckinghamshire	30 (3)	Lincolnshire	2,038 (8)
Carmarthenshire	2 (1)		[-16]
Cambridgeshire	65 (5)	London	15 (3)
Ceredigion	55 (3)	Merseyside	277 (2)
Cheshire	27 (5)	Norfolk	509 (9)
Co. Down	657 (1)		[-36]
County Durham	55 (2)	North Yorkshire	125 (6)
Cumbria	297 (9)	Nottinghamshire	1 (1)
Derbyshire	18 (1)	Oxfordshire	36 (4)
Devon	1 (1)	Perth and Kinross	133 (2)
Dorset	1 (3)	Powys	0 (1)
East Riding of Yorkshire	9 (4)	Rutland	0 (1)
East Sussex	128 (7)	Somerset	0 (3)
Essex	33 (3)	South Yorkshire	0 (1)
Gloucestershire	280 (4)	Staffordshire	18 (5)
	[-44]	Suffolk	488 (11)
Guernsey	0 (1)	Surrey	0 (2)
Gwynedd	4 (3)	West Midlands	5 (3)
Hampshire	18 (4)	West Sussex	1 (1)
Hertfordshire	1 (1)	West Yorkshire	2 (2)
Highland	200 (1)		
	[+200]	**overall**	**5,896**
Isle of Man	9 (1)	**deductions**	**96**
Isle of Wight	98 (1)	**population estimate**	**5,800**

At one site – the Highland Wildlife Park, Highland – it was not possible to make a count and an estimation has been used (see table 1). It is known through colour-marking that some birds from the breeding population here winter on the Solway Firth with the Svalbard population of Barnacle Geese (Mitchell *et al.* 2021). Given there is no way to separate these birds from the Svalbard population, except through colour-marking, counts undertaken at the Highland Wildlife Park in summer 2022 have therefore been used and added to the overall total (see Discussion).

A determination process was used to assess whether counts were considered to be of birds from the naturalised or migratory populations. Any records received from Scotland were assessed for this likelihood, based on location and expert knowledge, so that any deemed to be from the migratory populations could be excluded (albeit none were excluded). No major movement, assessed through colour-marking and counts, of the Svalbard and Greenland populations was known to occur at the time of the census (L. Griffin and S. Percival pers. comms). All received records of Barnacle Geese from England and Wales were used, although no counts were received from north Cumbria and Northumberland, where there was a risk of including birds from the migratory Svalbard population.

Breeding success

To monitor breeding success, experienced observers made assessments of brood size and the proportion of young in a flock (juvenile birds are separable from older birds by differences in plumage character-

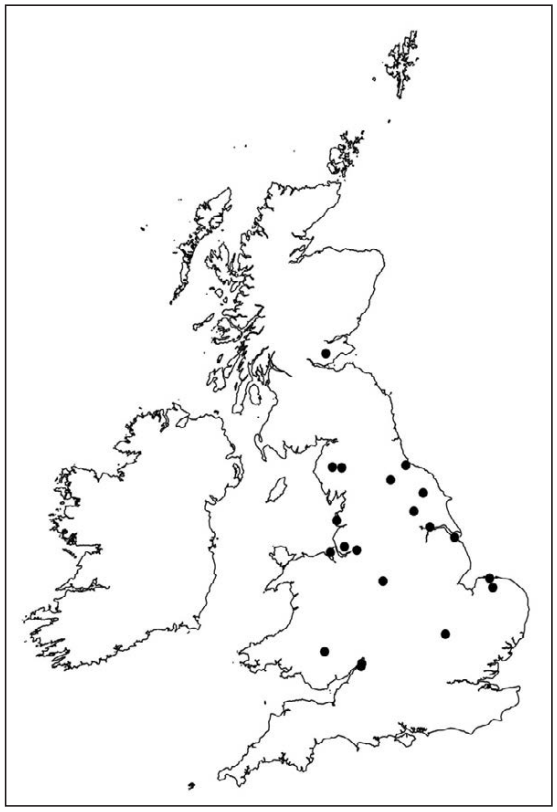

Fig. 2. Sites at which breeding assessments of naturalised Barnacle Geese were undertaken in 2022–24.

Table 2. Sites that supported >1% (>58 birds) of the naturalised Barnacle Goose population estimate in February 2023.

site	count	percentage of population
Alkborough Flats, Lincolnshire	1,520	26.2
Mahee Island, Strangford Lough, Co. Down	657	11.3
Great Ryburgh, Norfolk	430	7.4
Whitton Sands, East Riding of Yorkshire/Lincolnshire	384	6.6
Knowsley Safari Park, Merseyside	250	4.3
WWT Slimbridge, Gloucestershire	233	4.0
Highland Wildlife Park, Highland	200	3.4
Africa Alive, Kessingland, Suffolk	158	2.7
Minsmere, Suffolk	156	2.7
Derwentwater, Cumbria	138	2.4
Loch Leven, Perth & Kinross	133	2.3
Willington, Bedfordshire	113	1.9
Cleethorpes Boating Lake, Lincolnshire	112	1.9
North Warren and Thorpeness Mere, Suffolk	100	1.7
Seaview, Isle of Wight	98	1.7
Near Flookburgh, Cumbria	63	1.1

istics; see Baker 2016). Information collated via the questionnaire sent to county bird recorders helped to inform those breeding sites to include in the assessments. For each flock assessed, the following were recorded: i) total flock size, ii) number of juveniles and iii) number of juveniles in each family group. Data collected during July 2022, July 2023 and July 2024 were used to determine the annual proportion of young and the mean brood size of successful pairs (fig. 2, table 3).

Results

A total of 154 sites were covered during the census (fig. 1, table 1), with Barnacle Geese reported at 98. Good counting conditions (i.e. no conditions that may limit visibility, such as fog) during the census were reported for most sites. The results of the 110 sites that recorded an accuracy score for the count were 97 'precise', 13 'OK' and none 'low'.

Overall, 5,896 Barnacle Geese were counted during the census weekend. Taking into account adjustments needed to exclude duplicate counts (96 birds), a population estimate of 5,800 was derived (table 1). The bulk of the population – 4,740 birds (81.7%) – was in England, with 657 birds (11.3%) in Northern Ireland, 333 (5.7%) in Scotland, 61 (1.1%) in Wales and nine (0.2%) on the Isle of Man. No individuals were recorded on Jersey or Guernsey.

The new population estimate represents a 456% increase on the 925 birds counted during the 1991 census (Delany 1993), although the 1991 census did not include Northern Ireland (see Discussion).

Table 3. The percentage young and mean brood size of UK naturalised Barnacle Geese in 2022, 2023 and 2024.

	2022					2023					2024				
county	**number aged**	**% young**	**number of broods counted**	**mean brood size**	**number of sites**	**number aged**	**% young**	**number of broods counted**	**mean brood size**	**number of sites**	**number aged**	**% young**	**number of broods counted**	**mean brood size**	**number of sites**
Bedfordshire	104	7.7	-	-	1	103	0	-	-	1	111	6.3	3	1.33	1
County Durham	-	-	-	-	-	-	-	-	-	-	3	33.3	1	1.00	1
Cumbria	99	0	-	-	1	289	18.3	15	-	2	300	9.3	11	2.27	2
East Riding of Yorkshire	109	35.8	22	1.77	1	524	3.2	15	1.13	1	-	-	-	-	-
Gloucestershire	140	2.1	1	3.00	2	140	3.6	3	1.67	1	87	9.2	3	5.00	2
Lancashire	50	18.0	5	1.80	1	-	-	-	-	-	-	-	-	-	-
Lincolnshire	-	-	-	-	-	-	-	-	-	-	129	14.7	10	1.90	1
Merseyside	222	36.5	17	6.50	2	227	22.9	21	4.97	2	271	21.0	21	4.75	3
Norfolk	784	26.9	101	3.53	2	633	19.7	55	2.25	2	656	20.4	62	2.11	1
North Yorkshire	190	33.7	-	-	2	176	5.7	3	2.33	2	186	23.1	17	2.47	2
Perth & Kinross	160	3.1	2	1.00	1	124	0	-	-	1	-	-	-	-	-
Powys	67	20.9	5	2.80	1	44	6.8	3	1.67	1	42	14.3	3	2.00	1
Staffordshire	23	47.8	1	3.00	1	-	-	-	-	-	-	-	-	-	-
	1,948	**22.8%**	**154**	**1.90**	**15**	**2,260**	**11.7**	**115**	**2.06**	**13**	**1,785**	**17.0**	**131**	**2.24**	**14**

Principal concentrations

Barnacle Geese were recorded at 98 sites during the census, with a mean count of 60 individuals (median count of 13). The number of sites holding more than 1% of the 2023 population estimate (i.e. more than 58 birds) was 16 (fig. 1) and together they accounted for 81.8% of the total population estimate. The site with the highest count (Alkborough Flats, Lincolnshire) held 1,520 birds (26.2% of the population) (fig. 1, table 2). In the same broad geographical area, 384 birds were recorded from Whitton Sands, Yorkshire, and 112 birds were counted at Cleethorpes Boating Lake, Lincolnshire.

Within East Anglia, 509 birds were recorded from sites in Norfolk, and 488 from sites in Suffolk.

In Northern Ireland, a count of 657 was made at Mahee Island, Strangford Lough, Co. Down, and was the largest count outside of England.

Breeding

Breeding-flock surveys were undertaken at locations throughout Scotland, England and Wales during July 2022, July 2023 and July 2024 (fig. 2). Age was determined for a total of 1,948 individuals in 2022, 2,260 in 2023 and 1,785 in 2024, with assessments completed within 14, 13 and 14 flocks, respectively. The mean brood size of 154, 115 and 131 families, respectively, was also determined during these periods (table 3).

Juveniles made up 22.8% (binomial 95% Confidence Interval = 21.0–24.8%) of individuals within assessed flocks in 2022, 11.7% (10.4–13.1%) in 2023 and 17% (15.3–18.8%) in 2024. The mean brood size of successful pairs was 1.90 (± 0.92 SD) in 2022, 2.06 (± 1.09 SD) in 2023 and 2.24 (± 1.36 SD) in 2024 (table 3).

Discussion

The results presented here are the first attempt at a coordinated winter population census of the naturalised population of Barnacle Goose in the UK since the 1991 summer census (Delany 1993). Barnacle Geese were recorded at relatively few sites (98), while just 16 held more than 1% of the total population, and as long as numbers remain relatively low and distribution remains relatively restricted, the population should be fairly easy to census in future years. Delany (1993) suggested that the British naturalised population of Barnacle Geese should be monitored closely in the light of exponential increase in the then recently established (migratory) population of Barnacle Geese on the island of Gotland, Sweden (Larsson *et al.* 1988). The proportion of juveniles assessed in 1991 suggested that the Barnacle Goose population in the UK could be self-sustaining or capable of increase in the future. It is important to note that Delany (1993) did not include Northern Ireland in the 1991 census; thus, when comparing results from both censuses, in 2023 the population had increased by a minimum of 456%, and by 527% as an upper estimate assuming no birds were present in Northern Ireland in 1991. While birds were found at roughly the same number of sites in both censuses (89 in 1991 and 98 in 2023) (fig. 1), there was a marked distinction in the distribution of birds between censuses, with birds mostly recorded in east and southeast England during the 1991 census compared with the population being more widespread in 2023, especially in England (fig. 1).

Compared to the 1991 census, there appears to be a marked reduction in the number of occupied sites in Norfolk and Suffolk, although there are now a higher number of individuals concentrated in relatively few sites. While some of these observed differences may be driven by the different timing of the censuses (winter vs. summer), this concentration of individuals into fewer flocks was also apparent during breeding surveys in 2022–24. Recent colour-marking efforts have identified many of the Suffolk wintering birds as originating from large breeding colonies at Holkham Hall and Pensthorpe Natural Park, Norfolk. However, recent winter counts undertaken at Southwold, Suffolk, of over 1,300 birds (eBird, B. Small pers. comm.) exceed the combined summering numbers from Holkham and Pensthorpe Natural Park (630 birds), which currently constitute the vast majority of Norfolk-breeding Barnacle Geese. This suggests that the Southwold wintering flock may not be entirely made up of Norfolk-breeding birds, although the origin

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30. Barnacle Geese with Egyptian Geese *Alopochen aegyptiaca* and a Greylag Goose *Anser anser*, Holkham, Norfolk, July 2022.

of the additional individuals remains unclear. This unknown origin for a significant number of individuals is unique to this site, and to better understand the breeding origins of the entire Southwold wintering flock, including assessing whether any mainland European birds are present, will require concentrated capturing and ringing effort of wintering birds.

While the census described here was undertaken at a different time of the year (winter rather than summer), the summer population is expected to be slightly higher than the winter population within any given year, as the former includes new goslings of the year, some of which will die before the winter. Further, there is no evidence from an ongoing colour-marking study of the naturalised population in the UK that large numbers of wintering individuals in the UK are originating from continental breeding populations (the Southwold flock notwithstanding). The estimated population size reported here is therefore likely to represent a small underestimation of peak annual population size. However, given the large increase in population size compared to the 1991 census, the observed change will be largely unaffected by the relatively small seasonal fluctuation in numbers. Going forwards, particularly with more regular censuses and smaller changes in population size, consistency in timing will be required.

Future monitoring and research

Colour-ringing

The capture and ringing of Barnacle Geese in Britain and Ireland has primarily concentrated on the two migratory populations, both of which have been intensively studied over the years – the Greenland population since 1961 (D. Cabot pers. comm.) and the Svalbard population since 1973 (M. Ogilvie pers. comm.). Principally, cannon-netting has been used on the wintering grounds to deploy colour-marks on individuals from the Greenland and Svalbard populations, together with captures on the breeding grounds (mainly on Svalbard with smaller numbers in Greenland) where large numbers can be rounded up when flightless during their annual moult.

Until relatively recently, the naturalised population has received little attention by way of colour-marking on a large scale. Individual projects in Scotland, Wales and England provided fascinating insights into the movements of these 'resident' naturalised birds. Colour-ringing has shown that birds caught during winter at RSPB Ynys-hir, Powys, are connected to a breeding population in the Lake District, Cumbria, with birds moving some 230 km between the two areas (Dodd 2017).

A small number of birds colour-ringed in Bedfordshire have been recorded in France (M. Reed pers. comm.), while goslings hatched in Scotland have been sighted in Norway and Iceland, apparently having joined wild birds on migration (Mitchell *et al.* 2021).

In summer 2021, a large-scale colour-ringing programme organised and led by the Waterbird Colour-marking Group was launched and, to date, over 2,200 birds have been caught in England, Wales and Scotland. The study aims to bring about a clearer understanding of the movements of the naturalised population, documenting any interchange between UK sites or subpopulations and any other European populations. The latter will be particularly useful for contributing to and understanding future management requirements of different goose populations across Europe.

Breeding success

Population trends have been calculated by WeBS since 1978. However, there has been no national monitoring programme for naturalised Barnacle Geese in the UK previously. Information on breeding success, such as monitoring the reproductive success of colonies and counting juvenile to adult ratios and brood sizes in flocks, which have been afforded to migratory wildfowl populations over many years (e.g. WWT 2015, Woodward *et al.* 2024), would be beneficial. The collection of breeding assessment data is important and should be continued, as knowledge of breeding success twinned with population size and survival is vital to help inform the demographic drivers of population changes. Understanding these 'demographic rates' helps us determine why populations are changing and what actions may be effective in conserving or managing the population.

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31. Colour-ringed Barnacle Geese, Flamingo Land, Yorkshire, July 2023.

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32. Barnacle Geese (and a single Greylag Goose gosling) rounded up as part of large-scale colour-marking work to better understand movements, population interchange and survival, Holkham, Norfolk, July 2022.

Future censuses

Specially coordinated censuses to derive population estimates are often undertaken for wildfowl species, especially those which frequent non-wetland type habitats and have greater potential of being missed by national monitoring schemes (Brides 2021). For species which winter in countries that also host a resident breeding population of the same species, the best procedure would be to census the resident population whilst the migratory wintering populations are on their breeding grounds overseas, thus eliminating any potential error in counting non-target birds. Further, to eliminate risk of major movement occurring during censuses, monitoring could be undertaken during the species' annual moult, when birds are rendered flightless for a number of weeks of the year (around early July). However, the annual moult is a particularly vulnerable period for the birds, when flocks are often secretive, and they may not then lend themselves to being easily found.

The timing of the February census was perhaps not totally adequate for assessing numbers at some important wintering sites, given that colour-marking has now identified that some flocks are already back at their breeding sites by mid February (K. Brides unpubl. data). For example, sites such as Knowsley Safari Park, Lancashire & North Merseyside (250 birds recorded in February 2023), and Derwentwater, Cumbria (138), are breeding colonies rather than wintering sites (table 2). To assess winter-site importance and midwinter distribution, given that overlap with wintering migratory populations appears low in most areas, future censuses should be undertaken in November or December. The exception is in the Solway Firth, where naturalised birds from the Highland Wildlife Park, Highland, and Loch Leven, Perth & Kinross, coexist with migratory populations; here, counts at the breeding colonies during the summer would be required.

Demographic studies

More detailed demographic study of the naturalised population may help in understanding the demographic and environmental reasons for the large increase in population size over the last 30 years. Moreover, such work could help to project how large the population might become in future. Deploying a population model, such as a matrix model or integrated population model, to look at (i) which demographic rates contributed most to changes in population size, and (ii) how population size might change over time, would be particularly valuable. Having a good understanding of the sex ratio of the population, through captured birds for ringing, would also be advantageous and could help to shed light on the breeding performance of the various colonies.

Genetic studies

Investigating the population genetic structure of UK naturalised Barnacle Geese could prove critical for understanding the long-term implications of any altered migratory behaviour and potential interbreeding with other populations. While the origin of these geese is presumably largely from introduced or escaped individuals, their precise genetic provenance remains uncertain.

Genetic studies have proven effective in tracking clear lineage that can be traced back to a specific wild population of geese (e.g. Chen *et al.* 2023). These genetic approaches allow researchers to track historical introductions and potentially detect any divergence from native populations.

Furthermore, examining the genetic structure of these geese will not only assist in mapping their annual movements, but also in predicting future adaptations in response to environmental changes and human influences, both for naturalised and for wild populations. For example, Swedish-breeding Greylag Geese have shown a shift in migration patterns with some populations transitioning from migratory to resident behaviours owing to changes in agricultural practices and habitat availability (Nilsson & Kampe-Persson 2018; Månsson *et al.* 2022). This shift has led to the emergence of 'leapfrog migration', where migratory patterns are altered by the presence of resident populations that occupy traditional wintering grounds (Nilsson *et al.* 2022).

In the case of Barnacle Geese, genetic analysis could help determine whether the UK populations have retained the genetic characteristics of their presumed origin or whether they have been shaped by hybridisation with other European or escaped populations. These data could help determine whether the naturalised Barnacle Geese in the UK are experiencing genetic phenomena and help to identify any new adaptive traits developed in response to the UK environment. Additionally, genetic structure analysis could help in understanding whether interbreeding with native or migratory populations is occurring, which might influence migratory behaviour or ecological interactions.

Overall, understanding these dynamics is essential for the management and conservation of not only naturalised populations but also wild counterparts, as it could guide efforts to maintain genetic diversity and prevent maladaptation in changing environments.

Getting involved

Over 38% of the population is now colour-marked and birders are asked to check Barnacle Geese for colour-marks (yellow leg rings, blue leg rings and white neck collars) and report these to www.waterbirdcolourmarking.org. Any sites holding Barnacle Geese during the breeding season are also of interest, for possible future colour-mark deployment and inclusion in future age assessment surveys. Any local knowledge of the original provenance of flocks in the UK would be useful and gratefully received; please e-mail kanebrides@gmail.com with information or to suggest sites and flocks for further study.

Acknowledgments

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