



**THE NATURALISED GOOSE SURVEY
2000**

WWT Research Report

Authors

Helen Rowell, Robin Ward, Colette Hall & Peter Cranswick

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The Wildfowl & Wetlands Trust

Slimbridge
Gloucestershire
GL2 7BT

Tel 01453 891900

Fax 01453 891901

Email research@wwt.org.uk

Reg. charity no. 1030884

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SUMMARY

During 2000 a survey of naturalised geese was carried out in Britain. The survey focused primarily on Canada Goose and re-established Greylag Goose, but also included all other species of introduced geese, including escapes, exotics and hybrids.

The main aims of the survey were to assess the population size and distribution and to assess productivity during 2000 in these populations.

The survey used a site-based approach to survey moult sites between 22 June and 21 July 2000. Volunteer counters were asked to survey the sites they regularly monitored as part of the Wetland Bird Survey (WeBS), as well as any additional sites not usually surveyed for WeBS but which were known to hold naturalised geese.

The survey recorded a total of 54,587 Canada Geese and 25,640 re-established Greylag Geese. These totals are similar to those recorded through WeBS, but the Canada Goose total was significantly lower than that estimated by the stratified sample survey carried out in 1999. Totals of 693 Barnacle Geese and 575 Egyptian Geese, along with smaller numbers of 13 other introduced or escaped species, were also recorded.

No fewer than 22 types of hybrid between these species were found, mostly in small numbers, but there were 88 Canada x Greylag Geese.

1 INTRODUCTION

There are large naturalised populations of Canada Goose *Branta canadensis* and Greylag Goose *Anser anser* in Britain and both increased rapidly during the latter half of the last century (Pollitt *et al.* 2003). They are regarded in many areas as a nuisance. For example, Canada Geese have been found to be responsible for water eutrophication and ground erosion (Allan *et al.* 1995), and are also considered to be a potential vector of both human and wildlife diseases (Watola *et al.* 1996). Both species can be serious agricultural pests (Owen *et al.* 1986), and are a particular air traffic hazard (Rehfishch *et al.* 2002). A large number of other non-native goose species are now found in Britain, along with many types of hybrids, and numbers of both of these are increasing. Canada Geese have hybridised with at least 16 species of Anatidae, and are aggressive when defending their nests and have killed ducks, Moorhen *Gallinula chloropus* and Coot *Fulica atra* (Rehfishch *et al.* 2002).

The Canada Goose was first introduced to Britain in the 17th century. Numbers remained low until the 1950s, when wildfowling, assisted by the then Wildfowl Trust, transported the species across the country in order to try to relieve local conflict (Kirby *et al.* 1999), and unknowingly created centres for a population explosion (Delany 1992). There have been four previous surveys of Canada Geese: in 1953 (Blurton-Jones 1956), between 1967-69 (Ogilvie 1969), in 1976 (Ogilvie 1977) and in 1991 (Delany 1992). Detailed local studies have also been carried out, for example in Nottinghamshire (Parkin & McMeeking 1985) and in Yorkshire (Thomas 1977; Garnett 1980). The species is also counted through the Wetland Bird Survey (WeBS), a scheme that monitors non-breeding waterbirds in the UK. Its principal aims are to identify population size, determine trends in numbers and distribution, and to identify important sites for waterbirds (Pollitt *et al.* 2003). It has been suggested that much of the growth of the Canada Goose population in Britain may be occurring on new or small sites that are not usually surveyed by WeBS or that have not been surveyed for long enough to contribute to the national indices (Pollitt *et al.* 2003). To address this, a survey using a randomised stratified sampling technique was carried out in 1999 to estimate the change in numbers more closely. The results of this survey indicated that there may be a minimum of 82,000 birds in southern Britain alone (Rehfishch *et al.* 2002).

The Greylag Goose is Britain's only native breeding goose. In the past it was widespread and could be found as far south as the East Anglian Fens, but the population declined as a result of persecution and habitat destruction. It currently numbers around 10,000 birds, which can be found in the Outer Hebrides and adjacent coastal areas of Scotland and also in Sutherland and Caithness (Mitchell *et al.* 2000). Successful attempts were made in the 1930s and from the late 1950s until the early 1970s to re-establish the Greylag Goose as a wild nesting bird in parts of its former range in Britain (Harrison 1959; Delany 1992). This population has shown a long-term increase in numbers since the late 1970s and WeBS counts show that numbers are continuing to rise steadily. However, WeBS (i.e. winter) counts of Greylag Geese are complicated by the fact that there are three different populations in Britain at this time: the Northwest Scotland (or Native) population that is primarily found in the Outer Hebrides, Tiree, Coll and Sutherland; the re-established population covered by this survey; and the larger migrant Iceland population that winters predominantly in Scotland and northern England. The accuracy of estimates of these populations is compromised by uncertainties over the true origins of Greylag Geese in some areas, as birds from different populations, particularly re-established and Iceland Greylag Geese, can be present at the same sites. Therefore, a more accurate estimate of the re-established population would be achieved by counting them during the summer months.

WeBS indices (see Underhill & Prys-Jones 1994; Kirby *et al.* 1995 for the techniques used) give a reliable indication of population trends for both Canada and Greylag Geese. As the indices are based on counts at a sample of sites, however, they under-estimate both population totals and distribution. Therefore, periodic national surveys are desirable (Delany 1992).

The Naturalised Goose Survey 2000 focused primarily on the Canada Goose and re-established Greylag Goose, but also included all other species of introduced geese in Britain, including escapes, exotics and hybrids. The survey was carried out during late June and early July, partly because this is the time when migrant birds are not present in Britain and cannot be mistaken for naturalised birds. The aims of the survey were to:

- provide an update of numbers and distribution since the last national survey in 1991;
- provide key information on population size and important sites that complements other national waterbird monitoring schemes such as WeBS; and
- estimate productivity in these populations during 2000.

More detailed analyses are continuing, and the final results of the survey may differ from the results presented here.

2 METHODS

The 2000 survey followed similar methodology to the 1991 survey. A site-based approach was used to survey moult sites in late June/early July. These timing and methods used were chosen as:

- i) they would provide a comparison with previous surveys;
- ii) they would allow the recording of both adults and juveniles as the survey would coincide with the period when young are sufficiently large that they will have passed the first couple of weeks of their life (when mortality is higher) but are still conspicuously smaller (or at least show plumage differences) from the adults;
- iii) this is when migrant geese are not present in Britain and therefore could not be confused as naturalised birds of the same species; and
- iv) this is when the birds concentrate at predictable moult sites, and, as they are mostly flightless, they do not move around between sites.

A letter was circulated to Wetland Bird Survey Local Organisers which explained the survey aims and methods and requested their participation. The majority agreed to help, and organisers for most regions where this was not possible were soon recruited.

Local Organisers were provided with lists of the 'best' naturalised goose sites in their areas based on past counts. Local Organisers and counters were asked to cover their usual WeBS sites, sites in their region that were not usually surveyed by WeBS but were included on their list of 'best' sites, and any other sites they knew of that held naturalised geese (such as town parks and small ponds in cities). Recording forms and instruction sheets were distributed in April 2000. As the survey was to involve recording numbers of adults and juveniles, it was asked for counts to be made between 22 June and 21 July. If sites could not be visited during this time, however, counts made outside these dates were still welcome as they may have been of use. One form was completed for each site, on which details of the site location, date, times and numbers of adults, goslings and unaged birds of each goose species or hybrid were entered. Where possible, counters were also asked to identify the number of goslings in each family and record the number of broods of each size in the relevant columns. If any broods had joined together as a crèche, counters were also asked to record the number of goslings in each crèche. If the site was tidal or close to tidal waters, counters were asked to indicate the state of the tide during the counts. The recording of coverage was essential to interpret counts properly. Counters were therefore asked to indicate whether they felt their counts provided an accurate reflection of goose numbers at the site at the time of their visit (OK), or if other factors prevented them from recording a significant number of the geese present (LOW). If the count was considered low, the factors that affected the count were given. Information on whether goose numbers had been controlled (e.g. egg pricking) at each site was also collected.

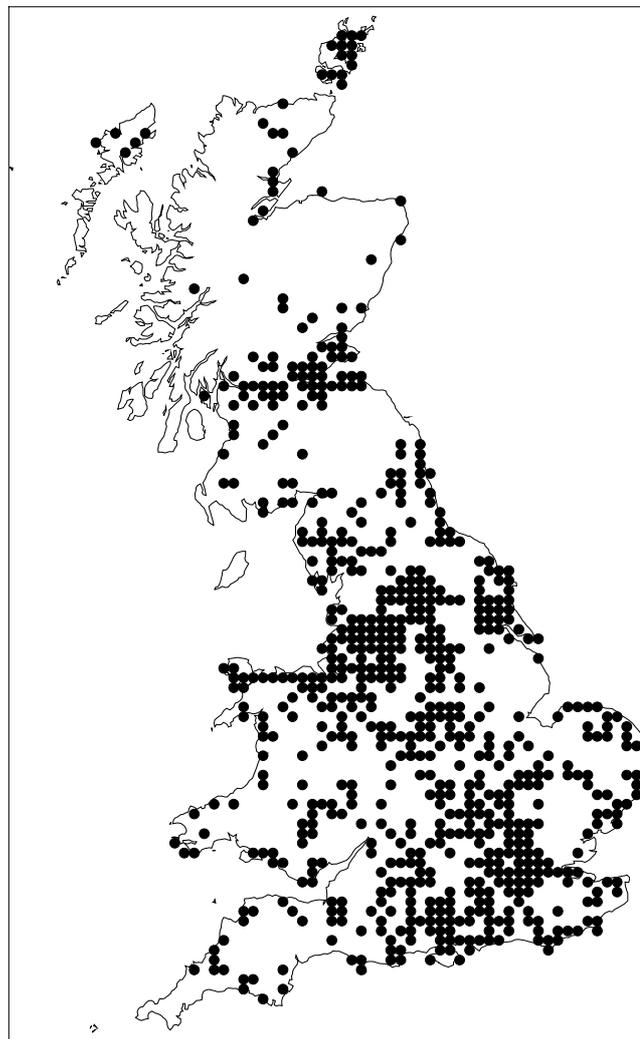
3 RESULTS

3.1 Coverage

A total of 1,594 sites within 703 10 km squares were visited during the survey period (Fig. 1). Coverage was not achieved in the following regions: Avon, the Isle of Man, Argyll West Mainland, Islay/Jura/Colonsay, Mull/Lismore/Coll/Tiree, Berwickshire, Roxburgh, Tweeddale/Ettrick and Lauderdale, Skye and the Western Isles South and the Shetland Isles. Nil returns were received from the following regions: Grampian Moray and Highland southwest.

The number of nil returns received gives an indicator of the quality of coverage achieved by the survey. A total of 577 of the sites visited (36%) did not hold any birds, and 155 (22%) of the 10 km squares shown in Fig. 1 represent nil returns.

Figure 1. 10 km squares visited during the Naturalised Goose Survey, June-July 2000



3.2 Abundance and distribution of introduced geese

A total of 17 species of introduced goose were recorded in the survey, along with a great variety of hybrids (Table 1). Their concentration at moult sites at the time of the survey means that their distribution at other times of the year is under-estimated.

Table 1. The number of adult and juvenile geese counted during the Naturalised Goose Survey, June-July 2000

	Adults	% Adults	Juveniles	%Juveniles	Unaged	Total
Species/Race						
Canada	42,066	77.1	7,500	13.7	5,021	54,587
Greylag	15,518	60.5	4,777	18.6	5,345	25,640
Barnacle	564	81.4	129	18.6	0	693
Egyptian	219	38.1	145	25.2	211	575
Snow	54	62.8	10	11.6	22	86
Bar-headed	48	92.3	4	7.7	0	52
Pink-footed	31	93.9	2	6.1	0	33
Emperor	14	100	0	0	0	14
Swan	9	100	0	0	0	9
Unidentified	6	100	0	0	0	6
Dark-bellied Brent	4	100	0	0	0	4
White-fronted	4	100	0	0	0	4
Red-breasted	3	100	0	0	0	3
European White-fronted	2	100	0	0	0	2
Lesser White-fronted	2	100	0	0	0	2
Bean	1	100	0	0	0	1
Greenland White-fronted	1	100	0	0	0	1
<i>Species totals</i>	<i>58,546</i>		<i>12,567</i>		<i>10,599</i>	<i>8,1712</i>
Hybrids						
Canada x Greylag	54	61.4	34	38.6	0	88
Greylag x Swan	45	95.7	2	4.3	0	47
Greylag x unknown	46	100	0	0	0	46
Unidentified hybrid	27	93.1	2	6.9	0	29
Greylag x Snow	10	50.0	10	50.0	0	20
Canada x unknown	12	92.3	1	7.7	0	13
Greylag x White-fronted	12	100	0	0	0	12
Greylag x Chinese	7	70	0	0	3	10
Canada x Barnacle	7	87.5	1	12.5	0	8
Greylag x Bar-headed	6	100	0	0	0	6
Barnacle x Emperor	5	100	0	0	0	5
Canada x Chinese	4	100	0	0	0	4
Canada x Snow	2	100	0	0	0	2
Barnacle x Snow	2	100	0	0	0	2
Snow x unknown	2	100	0	0	0	2
Canada x Bar-headed	1	100	0	0	0	1
Canada x Emperor	1	100	0	0	0	1
Barnacle x Bar-headed	1	100	0	0	0	1
Barnacle x unknown	0	0	0	0	1	1
Bar-headed x Emperor	1	100	0	0	0	1
Bar-headed x Snow	1	100	0	0	0	1
Emperor x Snow	1	100	0	0	0	1
<i>Hybrid totals</i>	<i>247</i>		<i>50</i>		<i>4</i>	<i>301</i>
Domestics						
Domestic	474	91.3	32	6.2	13	519
Domestic x Greylag	150	82.4	19	10.4	13	182
White domestic	165	91.7	15	8.3	0	180
Chinese	52	85.2	9	14.8	0	61
Domestic x Canada	12	80	3	20	0	15
Domestic x Chinese	3	100	0	0	0	3
<i>Domestic totals</i>	<i>856</i>		<i>78</i>		<i>26</i>	<i>960</i>
Grand totals	5,9649		12,695		10,629	82,973

3.2.1 Canada Goose

A total of 54,587 Canada Geese was counted at 856 sites in 473 10 km squares. This indicates a mean population density during the moult of 64 birds per site, or 115 per occupied 10 km square. Fig. 2 illustrates their distribution and indicates relative abundance at each site. The species was most common in Hampshire, Sussex and Kent and north through England to Cumbria. The highest densities occurred in the lower catchment of the Thames, and high densities were also found in the Midlands and northwest England (including West Yorkshire).

Table 2 lists the 50 most important sites for Canada Geese. These were widely distributed through the areas of high density, with notable outliers in Scotland on the Beaulieu Firth and the Cromarty Firth, in Dorset at Poole Harbour, in Devon on the Taw-Torridge Estuary and in Cornwall at Colliford Reservoir. Over two thirds of these sites are reservoirs, gravel pits, city parks and other man-made sites. These 50 sites represent just 6% of the sites that held the species, but they held 40% of the number recorded during this survey. As in 1991, counts lower than the median were more frequent than counts that were higher: 420 sites (49% of those holding the species) held fewer than 25 birds, and 264 (31%) held 10 or less. Fig. 3 summarises the frequency distribution of flock size among Canada Geese at all the sites holding the species that do not appear in Table 2. Clearly, the majority of the sites surveyed held only small numbers of birds, as was the case in 1991.

Table 3 shows counts broken down by age and region. A total of 49,566 birds (91% of those recorded) were aged. Of these, 15% were juveniles. The proportion of juveniles recorded in 2000 was lower than that recorded in 1991, when 23% of the aged birds recorded were juveniles. The variation in the proportion of juveniles counted in each area was highly significant ($\chi^2=745.13$, d.f.=12, $P<0.001$).

By the time of the survey, just over half of the broods had amalgamated to form crèches, and 46% of juveniles were recorded in discernable broods. Fig. 4 shows the frequency distribution of brood size among Canada Geese (and also among Greylags) for birds counted during this survey. A total of 3,445 birds were separated into 877 broods, and mean brood size was 3.92 (s.e. 0.07). There was a highly significant difference between brood sizes of Canada Geese in different regions (ANOVA, $F_{12, 864}$, $P<0.01$). It varied from 3.27 in Cambridgeshire, Lincolnshire and Northamptonshire to 4.67 in Wales (see Table 4).

3.2.2 Greylag Goose

This survey concentrated on the re-established population of Greylag Goose, and did not cover comprehensively the remnant NW Scotland population. A total of 25,640 Greylag Geese was found at 459 sites in 307 10 km squares. This indicates a population density during the moult period of 56 birds per site, or 84 per occupied 10 km square. Fig. 5 illustrates the distribution and relative abundance of Greylag Geese at each site. The highest numbers were found in Norfolk and in the area within the county boundaries of Buckinghamshire, Northamptonshire, Bedfordshire and Cambridgeshire. Elsewhere, there were large numbers in Cumbria, Anglesey, Yorkshire, the east Midlands and in southeast England. The species has a scattered distribution over much of Scotland and most of Wales, and is virtually absent from southwest England.

Table 5 lists the 50 most important sites for re-established Greylag Geese in 2000. These represent 11% of those sites holding the species, and held 57% of the number recorded by this survey. Just over half consisted of reservoirs, gravel pits and other man-made sites. As with Canada Geese, low counts occurred far more frequently, and 255 sites (56% of those holding the species) held fewer than 25 birds, and 178 (39%) held ten or less. Fig. 6 summarises the frequency distribution of flock size among Greylag Geese at all sites not appearing in Table 5. The majority of sites clearly only held small numbers of birds.

A total of 20,295 (79%) Greylag Geese were aged and, of these, 24% (4,777 birds) were juveniles. A total of 2,067 juveniles were counted in 522 discernable broods (this was 43% of the juvenile total) giving a mean brood size of 3.88 (s.e. 0.17).

Figure 2 The distribution and abundance of Canada Geese counted during the Naturalised Goose Survey, June–July 2000

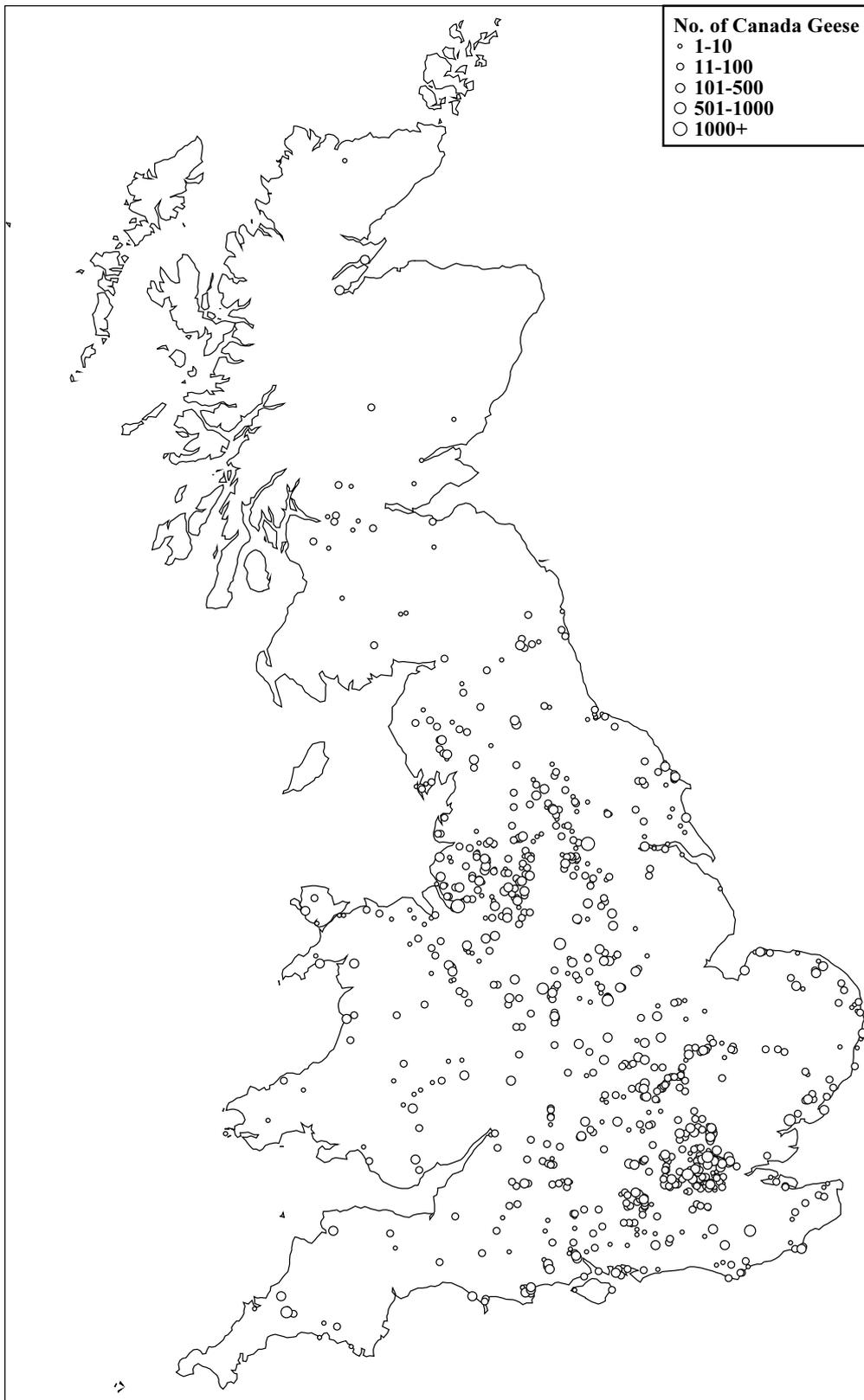


Table 2. Counts of Canada Geese at the 50 most important sites during the Naturalised Goose Survey, June–July 2000

Region	Site name	Adults	Juveniles	Unaged	Total
Merseyside	Mersey Estuary	1,350	0	0	1,350
North Yorkshire	Fairburn Ings	644	11	633	1,288
Gt London	R Thames: Lambeth Bridge-Hampton Court Lock	883	43	17	943
Gt London	Walthamstow Reservoirs	881	26	0	907
Essex	Abberton Reservoir	893	4	0	897
East Sussex	Bewl Water	850	22	0	872
Cornwall	Colliford Reservoir	858	0	0	858
Hertfordshire	Lee Valley Gravel Pits	699	35	3	737
Leicestershire	Watermead Gravel Pits	541	0	74	615
Derbyshire	Carsington Water	484	92	0	576
Staffordshire	King's Bromley Gravel Pits	509	22	0	531
Hereford & Worcs	Pirton Pool	467	27	0	494
Highland SE	Beaully Firth	488	0	0	488
Powys South	Llangorse Lake	472	10	0	482
Highland SE	Cromarty Firth	472	0	0	472
Cumbria South	Windermere	233	78	159	470
Gt London	Mayesbrook Park Lakes	411	20	0	431
Cumbria South	Killington Reservoir	390	34	0	424
Staffordshire	Croxall Pits	354	61	0	415
Northumberland	Colt Crag Reservoir	0	0	400	400
Derbyshire	Rother Valley Country Park: Main Lake	357	0	0	357
Surrey	R Thames: Hampton Court Lock-Walton Bridge	0	3	353	356
Nottinghamshire	Clumber Park Lake	342	7	0	349
Shropshire	Ellesmere	329	0	0	329
Northamptonshire	Thrapston Gravel Pits	308	21	0	329
Hertfordshire	Stanborough Lakes	309	8	0	317
Berkshire	R Thames: Henley Bridge-Hambledon Lock	245	66	6	317
Staffordshire	Belvide Reservoir	275	40	0	315
Gt Manchester	Rumworth Lodge Reservoir	155	135	20	310
Essex	Horsey Island	184	108	0	292
Buckinghamshire	Caldecotte Gravel Pits	245	6	38	289
Warwickshire	Kingsbury Water Park	46	202	38	286
Berkshire	R Thames: Hambledon Lock-Hurley Lock	186	59	41	286
Buckinghamshire	Linford Gravel Pits	0	0	285	285
Devon	Tor-Torridge Estuary	283	1	0	284
Derbyshire	Markeaton Park Lake	269	14	0	283
Humberside	Hornsea Mere	246	13	0	259
Northamptonshire	Daventry Reservoir	250	8	0	258
Dorset	Poole Harbour	239	7	0	246
Cheshire	Cholmondeley Park	244	0	0	244
Gt Manchester	Platt Fields Park Lake	170	72	0	242
Hampshire	Eversley Gravel Pits	193	48	0	241
Kent	Dungeness RSPB Reserve	177	64	0	241
West Yorkshire	Bretton Park	213	24	0	237
Northamptonshire	Earls Barton Gravel Pits	139	97	0	236
Northamptonshire	Wickstead Park Lakes	194	40	0	234
Buckinghamshire	Willen Lake	218	12	0	230
Gt Manchester	Pennington Flash	214	10	0	224
Hertfordshire	Colne Valley Gravel Pits	168	45	0	213
Gt Manchester	Stamford Park lake	165	47	0	212
Totals		18,242	1,642	2,067	21,951

Table 3. The percentage of juvenile Canada Goose in each region during the Naturalised Goose Survey, June-July 2000

Region	Adult	Juvenile	Unaged	Total	%Juveniles
Cornwall, Devon, Somerset	1,385	47	206	1,638	3
Dorset, Hampshire	2,693	462	297	3,452	15
Sussex, Kent, Surrey	2,618	537	673	3,828	17
Herts, Bucks, Beds, Berks, London	8,987	1,377	735	1,1099	13
Oxfordshire, Wilts, Gloucs	1,337	325	13	1,675	20
Wales	1,420	349	70	1,839	20
Essex, Suffolk, Norfolk	2,885	635	341	3,861	18
Cams, Lincs, Northants	1,769	624	69	2,462	26
Leics, Notts, Derbys	4,061	481	78	4,620	11
Cheshire, Salop, Hereford, Staffs, Warwicks, W. Midlands	4,500	949	387	5,836	17
Lancs, Yorks, Humberside, Merseyside, Gt Manchester	7,611	1,269	1,315	10,195	14
Cumbria, Northumb., Cleveland, Durham, Tyne & Wear	1,665	402	771	2,838	19
Scotland	1,135	43	66	1,244	4
<i>Total</i>	<i>42,066</i>	<i>7,500</i>	<i>5,021</i>	<i>54,587</i>	<i>15</i>

Figure 3. Frequency distribution of flock size among Canada Geese counted during the Naturalised Goose Survey, June-July 2000

Only sites with fewer than 250 birds are shown; for sites with 250 or more, see Table 2

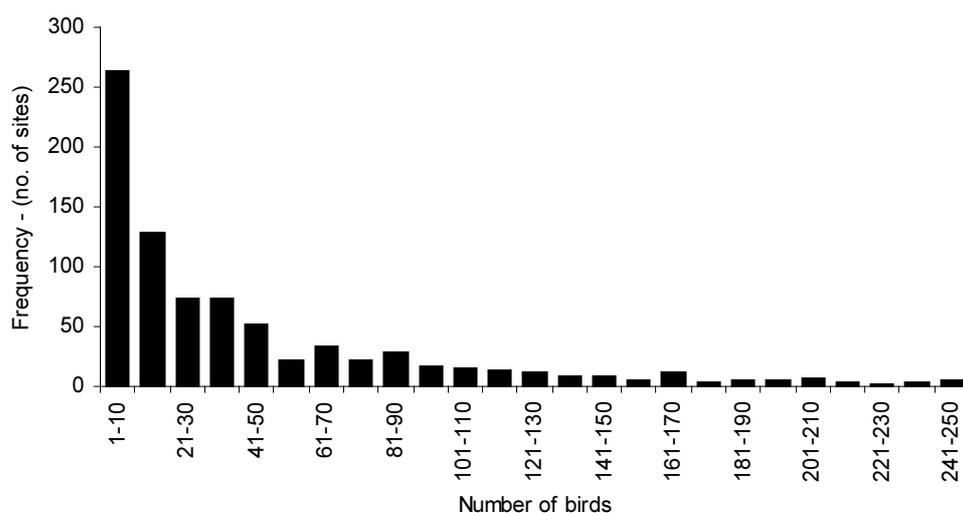


Figure 4. Frequency distribution of brood size among Canada and Greylag Geese counted during the Naturalised Goose Survey, June-July 2000

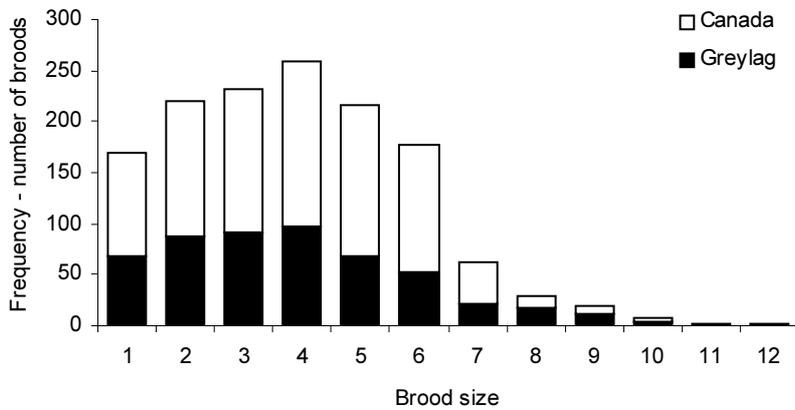


Table 4. Mean brood size of Canada Geese in each region (+/- 1 standard error), during the Naturalised Goose Survey, June-July 2000

Region	Mean	S.E.
Cambs, Lincs, Northants	3.27	0.30
Cheshire, Salop, Hereford, Staffs, Warwicks, W.Mid	3.71	0.19
Cornwall, Devon, Somerset	3.70	0.80
Cumbria, Northumb., Cleveland, Durham, Tyne & Wear	3.62	0.25
Dorset, Hampshire	4.31	0.29
Essex, Suffolk, Norfolk	4.56	0.25
Herts, Bucks, Beds, Berks, London	3.62	0.14
Lancs, Yorks, Humberside, Merseyside, Gt Manchester	4.01	0.13
Leics, Notts, Derbys	4.32	0.28
Oxfordshire, Wilts, Gloucs	3.75	0.33
Scotland	3.60	0.40
Sussex, Kent, Surrey	4.02	0.26
Wales	4.67	0.24

Figure 6. Frequency distribution of flock size among Greylag Geese in Britain, June-July 2000

Only sites with fewer than 250 birds are shown; for sites with 250 or more see Table 5

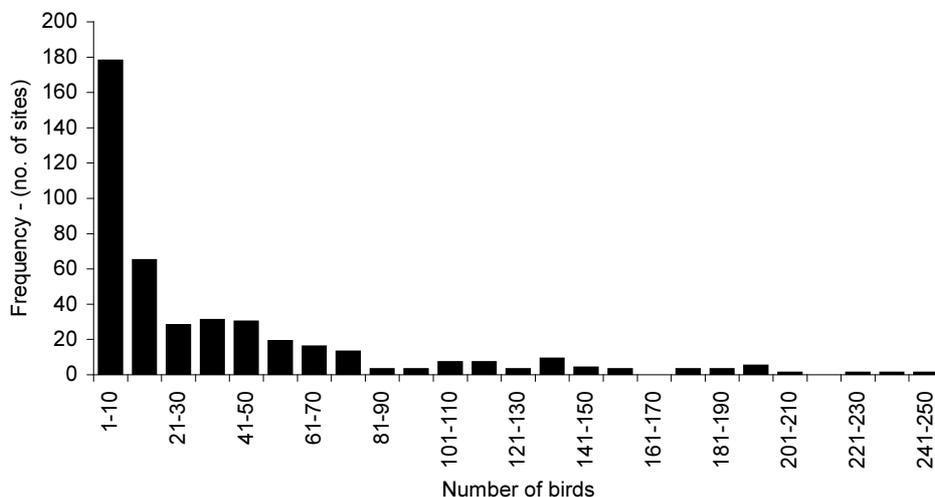


Figure 5. The distribution and abundance of re-established Greylag Geese counted during the Naturalised Goose Survey, June-July 2000

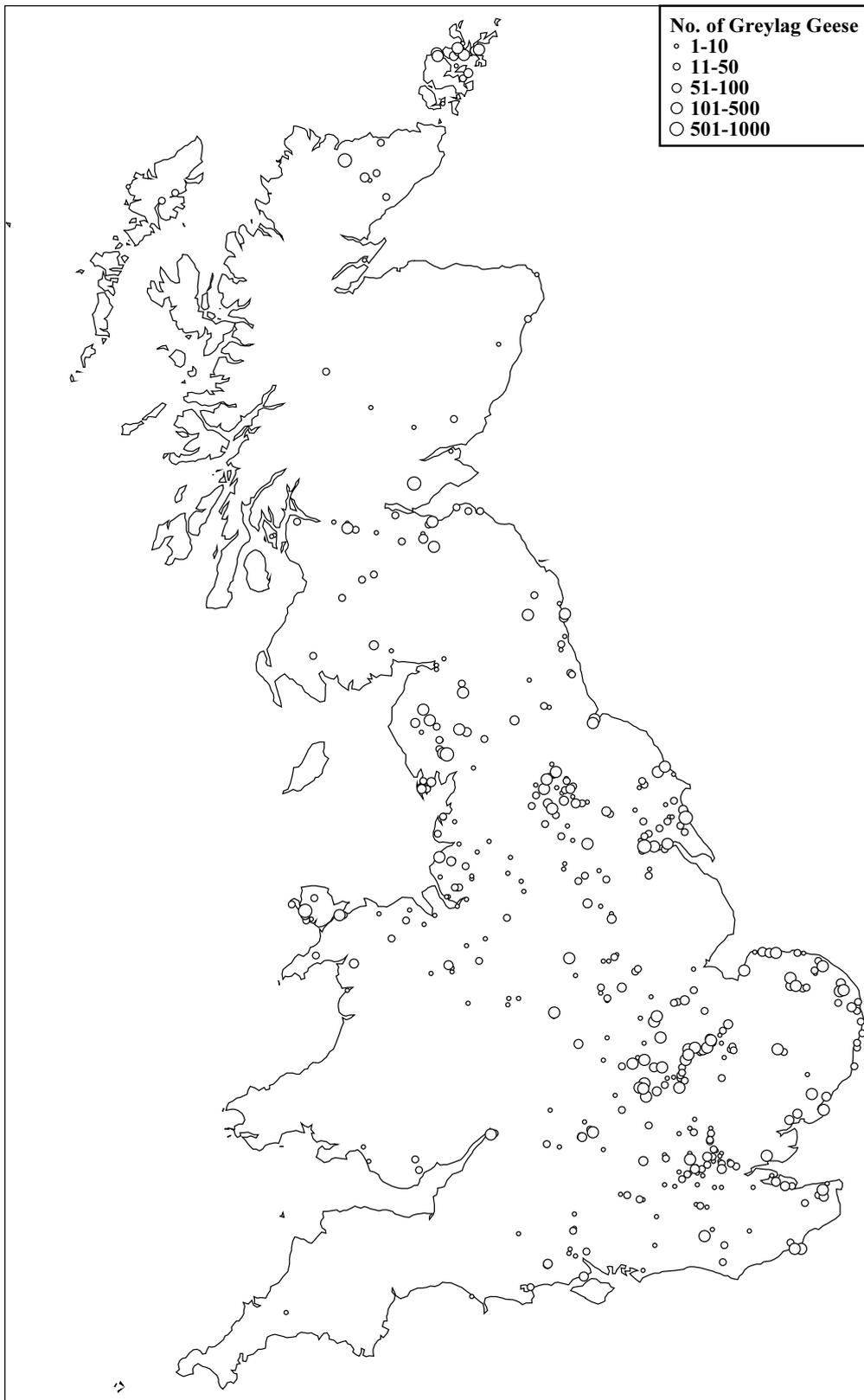


Table 5. Counts of re-established Greylag Geese at the 50 most important sites during the Naturalised Goose Survey, June-July 2000

NWC Region	Site name	Adults	Juveniles	Unaged	Total
Humberside	Hornsea Mere	792	42	0	834
Highland North	Loch Loyal	775	27	0	802
Anglesey	Llyn Traffwll	746	20	0	766
Humberside	Humber Estuary	84	106	404	594
Cumbria South	Windermere	95	128	367	590
Perth & Kinross	Loch Leven	180	233	126	539
Cambridgeshire	Little Paxton Gravel Pits	379	103	0	482
Buckinghamshire	Willen Lake	367	53	0	420
Norfolk	North Norfolk Coast	0	0	398	398
Suffolk	Livermere	335	37	0	372
Suffolk	Alton Water	243	38	90	371
Northamptonshire	Thrapston Gravel Pits	298	65	0	363
Essex	Horsey Island	193	147	0	340
Lothians	Gladhouse Reservoir	202	136	0	338
Northamptonshire	Blatherwyke Lake	322	13	0	335
Cumbria North	Haweswater Reservoir	0	0	319	319
Bedfordshire	Southill Lake	240	64	0	304
Northamptonshire	Earls Barton Gravel Pits	204	89	0	293
Lothians	Duddingston Loch	292	0	0	292
Buckinghamshire	Caldecotte Gravel Pits	277	8	0	285
Norfolk	Sennowe Park Lake Guist	33	27	223	283
Cumbria North	Bassenthwaite Lake	248	12	0	260
Cumbria North	Derwent Water	0	0	259	259
Cumbria North	Abbots Moss	190	64	0	254
Orkney	Holm of Huip	0	0	250	250
Oxfordshire	Port Meadow	230	3	0	233
Kent	Dungeness RSPB Reserve	169	56	0	225
Northamptonshire	Clifford Hill Gravel Pits	73	133	0	206
Cambridgeshire	Barleycroft Gravel Pits	99	101	0	200
Orkney	Kili Holm	0	0	200	200
North Yorkshire	Fairburn Ings	199	0	0	199
Orkney	Island of Egilsay	34	12	150	196
Cambridgeshire	Godmanchester Gravel Pit	118	77	0	195
Lanarkshire/Strathkelvin	Hogganfield Loch	186	0	0	186
Kent	Scotney Pit	151	33	0	184
Norfolk	The Wash	184	0	0	184
Buckinghamshire	Newport Pagnell Gravel Pits	39	17	124	180
Orkney	Loch of Swannay	68	106	0	174
Northumberland	Caistron Quarry	143	30	0	173
Norfolk	St. Benet's Levels	116	44	0	160
Cambridgeshire	Buckden/Stirtloe Pits	102	53	0	155
Northamptonshire	Deene Lake	103	48	0	151
Northumberland	Hauxley Haven	0	0	149	149
Norfolk	Swanton Morley Gravel Pits	15	39	94	148
North Yorkshire	Fewston Reservoir	77	45	20	142
North Yorkshire	Gouthwaite Reservoir	131	10	0	141
Greater London	Brent Reservoir	140	0	0	140
Merseyside	Southport Marina	86	54	0	140
Cleveland	Albert Park	0	0	137	137
Cumbria South	Esthwaite Water	0	0	137	137
Totals		8,914	2,263	3,437	14,614

3.2.3 Barnacle Goose

Altogether, 693 Barnacle Geese *Branta leucopsis* were found at 75 sites in 70 10 km squares. Fig. 7 shows their distribution and relative abundance. The county with the highest number (212) was Cumbria, where the species was found at seven sites, most notably at Thwaite Flat and Roanhead Ponds, where the flock numbered 126 adults and 5 juveniles. The county with the second highest total was Hampshire, where 113 Barnacle Geese were counted at five sites, the most important of which was Stratfield Saye (48 adults and 45 juveniles). Essex held the third largest county total with 56 birds at three sites, the principal one being Horsey Island (45 adults and 9 juveniles). Gloucestershire held the fourth highest county total (50 birds at three sites) with the majority at Frampton Pools, whilst Lancashire held the fifth highest county total (46 birds at four sites). Elsewhere, the species was found at seven sites in North Yorkshire, four sites in Humberside, three sites in three counties, two sites in a further ten counties, and at single sites in 13 counties from Orkney to Cornwall.

All of the Barnacle Geese recorded were aged and, of these, 19% were juveniles, 57% of which were in discernable broods. The mean brood size was 3.5 (n=21).

3.2.4 Egyptian Goose

A total of 575 Egyptian Geese *Alopochen aegyptiaca* was found at 43 sites in 35 10 km squares. Fig. 8 shows that the majority were in Norfolk (at 16 sites), where 444 (77% of the total) were counted. Sixty-four were found at seven sites in Suffolk, and there is evidence that the species bred successfully in both of these counties. Elsewhere, 12 birds were found on the River Thames between the A404 road bridge and Bourne End (Berkshire), 11 at Spade Oak Gravel Pit (Buckinghamshire), 11 at three sites in Surrey, nine at three sites in Greater London, nine at two sites in Greater Manchester, four at three sites in Hampshire, four at two sites in Merseyside, three at two sites in Essex, two in Nottinghamshire, one in North Yorkshire and one in Cornwall. Away from Norfolk and Suffolk, successful breeding was only recorded on the River Thames between the A404 road bridge and Bourne End, where 2 juveniles were present with 10 adults.

A total of 63% of the population was aged and, of these, 40% were juveniles, 51% of which were in discernable broods. The mean brood size was 2.3 (n=32).

3.2.5 Snow Goose

Altogether, 86 Snow Geese *Anser caerulescens* were found at 17 sites, each in a different 10 km square (Fig. 9). The largest flock, of 22 birds, was at Thamesmead Lakes (Greater London). A flock of 13 was recorded at Eversley Gravel Pits (Hampshire), 10 were on the University of York lake (North Yorkshire), and flocks of nine were recorded on Blenheim Park Lake (Oxfordshire) and at Stratfield Saye (Hampshire). A further two sites held four, one site held three, three sites held two and six sites held single birds. Only 10 juveniles, 16% of the aged population, were seen.

3.2.6 Bar-Headed Goose

The distribution and abundance of Bar-headed Geese *Anser indicus* is shown in Fig. 10. A total of 52 were recorded during the survey. The species was found in eight counties, including a total of nine in Derbyshire. The only record of breeding was at Stratfield Saye, Hampshire, where a pair was recorded with four juveniles.

3.2.7 Pink-footed Goose

A total of 33 Pink-footed Geese *Anser brachyrhynchus* were found at 20 sites in 19 10 km squares (Fig. 11). The distribution was similar to that during the winter, when over 240,000 Greenland/Iceland birds over-winter in Britain, principally in eastern and southern Scotland, Lancashire and Norfolk. There were six Pink-footed Geese in Angus, four in Lancashire and in Essex (where one pair bred at Horsey Island, producing one gosling), and three in the Lothians. Two were recorded in six other counties, and singles were recorded in a further four counties. One juvenile was recorded without any adults at Watermead Gravel Pits (Leicestershire), indicating that the species had bred nearby.

Figure 7. The distribution and abundance of Barnacle Geese counted during the Naturalised Goose Survey, June-July 2000

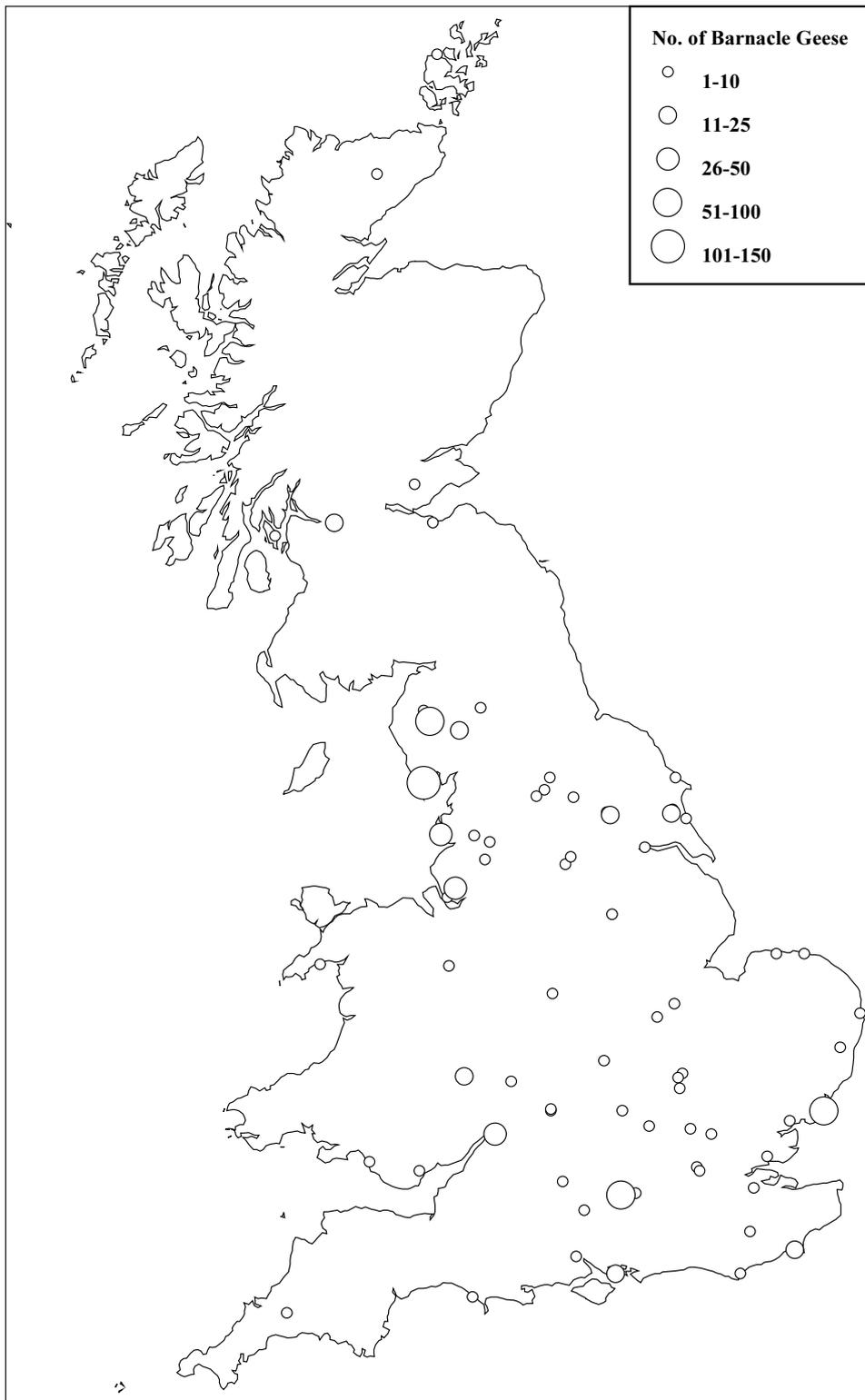


Figure 8. The distribution and abundance of Egyptian Geese counted during the Naturalised Goose Survey, June-July 2000

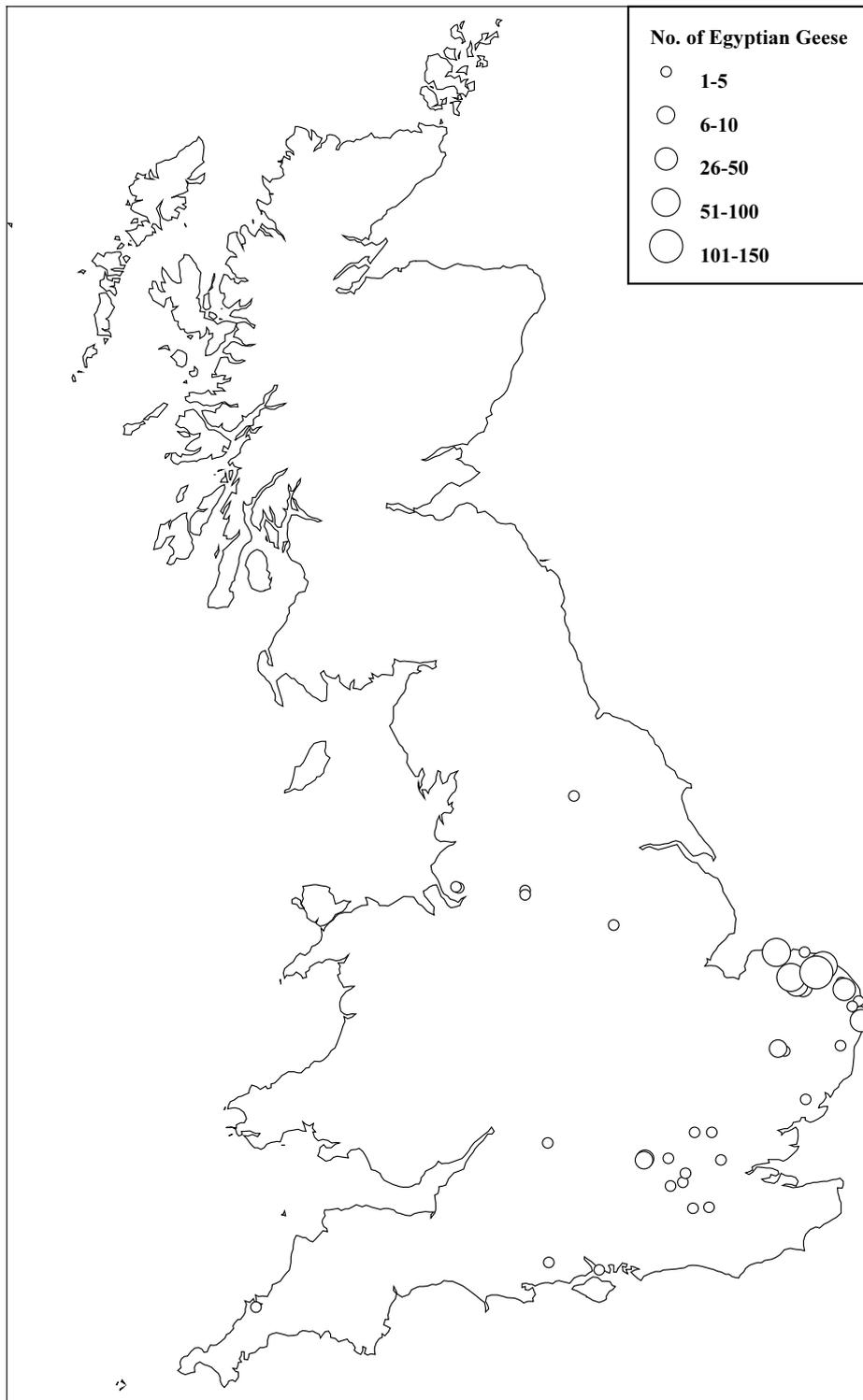


Figure 9. The distribution and abundance of Snow Geese counted during the Naturalised Goose Survey, June-July 2000



Figure 10. The distribution and abundance of Bar-headed Geese counted during the Naturalised Goose Survey, June-July 2000



Figure 12. The distribution of White-fronted Geese and Lesser White-fronted Geese counted during the Naturalised Goose Survey, June-July 2000. Each symbol represents a single bird.



3.2.8 Emperor Goose

Altogether, 14 Emperor Geese *Anser canagicus* were found during the survey, all of which were adults. The majority (11) were found on Horsey Island in Essex. Elsewhere, there were single birds at Scotney Pit (Kent), Aber Ogwen and The Spinnies (Caernarvon), and on the Menai Straights between Beaumaris and Tubular Bridge (Anglesey).

3.2.9 Swan Goose

A total of nine adult Swan Geese *Anser cygnoides* were recorded during the survey. Three were in Cumbria and singles were in six other counties.

3.2.10 Unidentified Goose

A total of six unidentified geese were recorded at two sites in Derbyshire and at single sites in Greater Manchester, Cheshire and Wiltshire.

3.2.11 Dark-bellied Brent Goose

There were three adult Dark-bellied Brent Geese *Branta b. bernicla* on Horsey Island (Essex), and a single adult at Winterley Pond (Cheshire).

3.2.12 White-fronted Goose

A total of seven adult White-fronted Geese *Anser albifrons* (two European *A. a. albifrons*, one Greenland *A. a. flavirostris* and four of unknown race) were recorded during the survey. Both European birds were in Humberside, at Melton Ponds and the Humber Estuary. The Greenland bird was on Loch Loyal (Highlands). The remaining four birds were at Victoria Park Lakes (Greater London), Ardingly Reservoir (West Sussex), Charlton Gravel Pits (Hampshire) and Colliford Reservoir (Cornwall).

3.2.13 Red-breasted Goose

Three adult Red-breasted Geese *Branta ruficollis* were recorded at Roath Park Lake (Glamorgan).

3.2.14 Lesser White-fronted Goose

There were two records of single Lesser White-fronted Geese *Anser erythropus*, at Ibsley and Mockbeggar Lake (Hampshire) and at Port Meadow (Oxfordshire).

3.2.15 Bean Goose

A single adult Bean Goose *Anser fabalis* was seen at Port Meadow in Oxfordshire.

3.2.16 Hybrid geese

A total of 301 hybrid geese of 22 different varieties were found at sites across Britain during the survey. The majority of sites held low numbers of hybrids.

The most common type of hybrid was between Canada Goose and Greylag Goose: a total of 88 were recorded, of which 54 were adults (61%) and 34 were juveniles (39%). The second most common hybrid was between Greylag Goose and Swan Goose, with a total of 47 birds, with those between a Greylag Goose and an unknown goose, a total of 46 birds, being the third most common type. Numbers of the other varieties of hybrids were generally low (see Table 1).

3.2.17 Domestic geese

A total of 960 domestic geese were found during the survey. The majority of English counties held domestic geese, and they were also recorded in three Scottish regions and in two Welsh counties. Most records (73%) did

not specify the variety involved, but a total of 52 Chinese Geese (the domesticated form of the Swan Goose) were recorded. Domestic geese hybridise freely with Greylag Geese (from which most domestic varieties are derived), and a total of 182 domestic x Greylag Goose hybrids were recorded (150 were adults and 19 were juveniles). Domestic geese will also occasionally hybridise with Canada Geese (a total of 15 birds of this hybrid were recorded).

4 DISCUSSION

4.1 Canada Goose

The number of Canada Geese counted during the survey was 14% lower than in 1991-92, suggesting that the population had declined at an average rate of 1.9% per year.

Table 6 shows the estimates of Canada Goose population size derived from the five national surveys to date. The national population appears to have increased at a rate of 6.8% to 8.3% per year up to the early 1990s. Since then, it appears to have declined by around 1.9% per year. Index values produced using WeBS data have shown that a long-term trend of stability occurred during the 1990s (Musgrove *et al.* 2001), however, peak national totals recorded by WeBS over this time have shown an increase. This highlights the main inadequacy of this indexing technique, as sites where much of the population expansion is occurring are not included in the current index calculations due to an insufficient run of data (Musgrove *et al.* 2001).

Table 6. Canada Goose population estimates from five national surveys (Blurton-Jones 1956; Ogilvie 1969; Ogilvie 1977; Delany 1993)

	1953 (max counts)	1967-69	1975-76	1991-92	2000
Population	3, 906	10,510	19,190	63,581	54,587
% change between surveys		169%	83%	231%	-14%
Average % change per year		6.8%	7.8%	8.3%	-1.9%

The population recorded by the 2000 survey is similar to that estimated though WeBS in 2000/01: WeBS estimated the population at 54,557 birds (Pollitt *et al.* 2003). However, it has been suggested that much of the recent growth in the British Canada Goose population has occurred on small ponds and park lakes (Pollitt *et al.* 2003). If birds in these locations successfully breed, they are likely to moult at the breeding site in order to protect their flightless young (Delany 1992). Many of these sites are not covered by WeBS, resulting in an under-estimate of the national population, and it is probable that the methods used in the 2000 survey will have also meant that some of these small sites will have been missed. Under-estimation may also have occurred due to the fact that geese are often more wary during the moult than at other times. Therefore, they may have been missed during counts because they were hidden from view on islands or in surrounding vegetation (Delany 1992).

In contrast to this survey, a randomised stratified sample survey carried out in 1999 to address the problems of sites being missed, estimated that the Canada Goose population in southern Britain had increased by 29% since a 1991-92 survey, an average annual increase of 3.6% per year (Rehfishch *et al.* 2002). This still suggests that the rate of population increase has slowed, but the 1999 survey looked at southern Britain only.

The main problem with site-based surveys, such as the 2000 survey, is that incomplete coverage can result in under-estimates, the extent of which may be difficult to assess (Delany 1993). Several regions (mostly in Scotland) received no coverage during the survey, and although many of these are known to hold relatively few introduced geese, some birds will have been missed. The survey total for Wiltshire is also known to be low (P. Cranswick pers. comm.).

The total number of sites covered (1,594 sites in 703 10 km squares) was lower than in 1991-92, when 2,226 sites within 835 10 km squares were covered (Delany 1993). In 2000, a total of 856 sites within 473 10 km squares recorded Canada Geese, compared with 1,210 sites in 603 10 km squares in 1991-92. This may not necessarily reflect a contraction in the range of Canada Geese in Britain as coverage as a whole was lower than in 1991-92, and it seems likely that some Canada Goose sites have been missed. There was a small increase in population density recorded: the 1991-92 survey found a mean population density of 105 Canada Geese per occupied 10 km square, whilst the 2000 survey found this had grown to 115 birds per occupied square, an increase of 10%.

Fig. 13 illustrates the regions used in this analysis to compare regional Canada Goose population totals to those of 1991. Table 7 shows that the population increased in six of the 13 regions and declined in the remaining seven regions. In this comparison, it must be considered that changes have occurred in county boundaries since 1991

and the regions used for the 2000 analysis differ slightly from those used in 1991 (see below Table 7). This may partially explain the decreases seen in some regions. Differences in coverage between the two surveys may also account for some of the apparent changes in regional populations.

Figure 13. Regions used in the analysis of Canada Goose data from the Naturalised Goose Survey, June-July 2000



Table 7. Comparison of Canada Goose totals in different regions between the 1991 and 2000 surveys

Region	1991 total	% of 1991 total held in region	2000 total	% of 2000 total held in region	Difference between % held in 1991 and 2000
Cornwall, Devon, Somerset	1,175	1.9	1,638	3.0	1.1
Dorset, Hampshire*	2,338	3.8	3,452	6.3	2.5
Sussex, Kent, Surrey†	5,388	8.9	3,828	7.0	-1.8
Herts, Bucks, Beds, Berks, London*	13,930	22.9	11,099	20.3	-2.6
Oxfordshire, Wilts, Gloucs	3,312	5.4	1,675	3.1	-2.4
Wales*	2,079	3.4	1,839	3.4	0.0
Essex, Suffolk, Norfolk	7,089	11.7	3,861	7.1	-4.6
Cambs, Lincs, Northants	2,959	4.9	2,462	4.5	-0.4
Leics, Notts, Derbys	6,366	10.5	4,620	8.5	-2.0
Cheshire, Salop, Hereford, Staffs, Warwicks, W. Midlands*	5,764	9.5	5,836	10.7	1.2
Lancs, Yorks, Humberside, Merseyside, Gt Manchester	7,733	12.7	10,195	18.7	6.0
Cumbria, Northumb., Cleveland, Durham, Tyne & Wear	1,613	2.7	2,838	5.2	2.5
Scotland	1,088	1.8	1,244	2.3	0.5
<i>Total</i>	<i>60,834</i>	<i>100</i>	<i>54,587</i>	<i>100</i>	<i>0</i>

Regions marked with an asterisk are affected by county boundary changes:

Dorset, Hampshire now includes NE Hants, which was included in Herts, Bucks, Beds, Berks, London in 1991

Sussex, Kent, Surrey now includes N Surrey, which was included in Herts, Bucks, Beds, Berks, London in 1991

Wales now includes Montgomery, which was included in Cheshire, Salop, Hereford, Staffs, Warwick, W. Midlands in 1991

The greatest change in the proportion of the national population was seen in the Lancashire, Yorkshire, Humberside, Merseyside, Greater Manchester region, where the proportion of the population held increased by 6% between 1991 and 2000. This increase could be due to greater coverage in this region during 2000, the result of an increasing tolerance of the species of the urban environment or the creation of new habitat, such as gravel pit complexes. The greatest decline in the proportion of the national population held was seen in East Anglia (Essex, Suffolk, Norfolk) where it fell by 4.6%. Again, the declines may be partly explained by coverage differences between the surveys, or increased levels of control, e.g. by licensed shooting or egg pricking.

4.2 Greylag Goose

The number of re-established Greylag Geese counted during the survey was 31% higher than in 1991-92, indicating that the population increased at an average rate of 3.36% per year.

The population recorded by the 2000 survey is similar to that estimated from WeBS counts in 2000/01: WeBS estimated the population at 25,550 birds (Pollitt *et al.* 2003). This also fits with the long-term upward trend of re-established Greylag Geese shown by WeBS annual indices (Pollitt *et al.* 2003). Again, there are problems of under-estimation associated with the survey methods. The 2000 count is likely to be an under-estimate due to gaps in coverage, particularly in Scotland and other remote areas where there are few observers.

The 2000 survey results do not show an expansion in the range of the re-established Greylag Goose, but the effect of the population increase has been a rise in population density. The 1991-92 survey found a mean population density of 61 Greylag Geese per occupied 10 km square; by 2000 this had grown to 84 birds per occupied square, an increase of 38%.

As in 1991, many sites in 2000 supported large numbers of both Canada and Greylag Geese. There was a difference in overall breeding success between the two species, with the proportion of juveniles being, on average, considerably higher in Greylag Geese (24%) than in Canadas (15%). A similar pattern was seen in 1991. The mean brood size and frequency distribution of brood size was very similar in both Canada and Greylag Geese. This was also found to be the case in 1991.

4.3 Other species and hybrids

The numbers of most of the other species recorded during the survey were lower than in 1991-92. The total number of Barnacle Geese was 25% lower and the number of Egyptian Geese was 37% lower. Again, this may be due to differences in coverage between the two surveys. However, the number of juvenile Barnacle Geese recorded in 2000 was higher than in 1991-92. This could be the result of more birds being aged by counters in 2000, as all were aged during this survey. The only other species' recorded as having bred successfully were Egyptian, Snow, Bar-headed and Pink-footed Geese, and these small populations may have the potential for an increase in numbers. The number and variety of hybrids found attest to the difficulty that many escaped or introduced exotics have in finding a mate of the same species or form.

It is possible that at least some of the birds recorded were individuals from wild populations present in Britain during the winter that failed to leave in the spring, probably as a result of disease or injury. Some, however, are likely to have been associated with, or escaped from, waterfowl collections (Delany 1992).

5 RECOMMENDATIONS

The populations of Canada Goose and re-established Greylag Goose in the UK are now too large and widely dispersed to determine population size effectively using a site-based survey alone. It is recommended that future surveys adopt a randomised stratified sample approach in order to reduce the number of sites that need to be visited, and provide confidence limits on derived population estimates.

Given the current difficulties with monitoring the population status of the three Greylag Goose populations in the UK, a more detailed understanding of the abundance and distribution of NW Scotland and, particularly, re-established Greylag Geese is highly desirable. It is recommended that co-ordinated counts of NW Scotland and re-established Greylag Geese are conducted more frequently, and at least every five years.

Annual reproductive success is a key determinant of abundance, but it is poorly monitored for the two key populations covered by this census. It is recommended that a survey that provides an annual estimate of reproductive success for Canada Geese and re-established Greylag Geese is designed and implemented.

It is imperative that appropriate consultation is undertaken with all relevant stakeholders in advance of future censuses of naturalised geese in the UK to ensure that they are as comprehensive and effective as possible.

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