



BTO Research Report No. 456

**Winter gulls in the UK: population
estimates from the 2003/04-2005/06
Winter Gull Roost Survey**

Authors

A.N. Banks, N.H.K. Burton, J.R. Calladine & G.E. Austin

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British Trust for Ornithology

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CONTENTS

	Page No.
List of Tables.....	3
List of Figures	4
EXECUTIVE SUMMARY	5
1. INTRODUCTION.....	7
2. METHODS	9
2.1 Coverage and Field Methods	9
2.2 Survey Design.....	9
2.2.1 Key sites.....	9
2.2.2 Inland and coastal sampling.....	10
2.3 Data Analysis.....	11
2.3.1 Population estimates and thresholds.....	11
2.3.2 Representativeness of counts at individual sites	12
3. RESULTS	15
3.1 Coverage	15
3.1.1 Forms returned.....	15
3.1.2 Coverage by area	15
3.2 Population Estimates and Thresholds.....	15
3.3 Representativeness of Counts at Individual Sites	17
4. DISCUSSION	19
4.1 Coverage and Assessment of Survey Methodology.....	19
4.2 Population Estimates and Thresholds.....	19
4.3 Representativeness of Counts at Individual Sites	22
5. RECOMMENDATIONS.....	25
Acknowledgements.....	26
References	27
Tables.....	31
Figures	38

List of Tables

	Page No.
Table 2.2.2.1 Area distribution across the initial 12-class stratification for Random Inland Tetrads in the UK, Channel Islands and Isle of Man.....	31
Table 3.1.1 Coverage of Random Inland Tetrads by stratum	32
Table 3.1.2 Coverage of Random Coastal Stretches by stratum.....	33
Table 3.1.3 Coverage of targeted Random Inland Tetrads by pre-survey stratum	34
Table 3.2.1 Raw totals of individual gull species, ‘small gulls’, ‘large gulls’ and ‘unidentified’ gulls recorded during the main counts used to produce population estimates.....	35
Table 3.2.2 Population estimates, with 95% confidence limits, for the five principal wintering gull species in the UK	36
Table 3.2.3 Population estimates, 1% national and 1% international importance thresholds for the five principal wintering gull species in Great Britain	37
Table 3.2.4 Sites in Great Britain supporting gull numbers exceeding the 1% national or international importance thresholds for at least one species during the main survey counts	38
Table 3.2.5 Sites in Northern Ireland supporting gull numbers exceeding the 1% all-Ireland importance threshold for at least one species during the main survey counts	40
Table 3.2.6 Sites which held at least 20,000 gulls in January 2004	41

List of Figures

	Page No.
Figure 2.2.2.1 Distribution of tetrads in the UK, Channel Islands and Isle of Man across the initial 12-class stratification for Random Inland Tetrads	43
Figure 2.2.2.2 Regions used in analyses	44
Figure 2.3.1.1 Schematic of the derivation of a single overall estimate for a given country or dependency for a given gull species	45
Figure 3.3.1 Effects of an increasing number of counts on the accuracy of the mean numbers of a. Black-headed Gulls and b. Common Gulls recorded at Bewl Water, Sussex over the winters of 2001/02 to 2004/05	46
Figure 3.3.2 Counts of a. Black-headed Gulls and b. Common Gulls at Bewl Water, Sussex between 2001/02 and 2004/05	47
Figure 3.3.3 Counts of a. Black-headed Gulls and b. Lesser Black-backed Gulls at Theale Gravel Pits, Berkshire in 2003/04.....	48
Figure 3.3.4 Counts of a. Black-headed Gulls (BH), b. Common Gulls (CM) and c. Lesser Black-backed Gulls (LB) at Pitsford Reservoir, Northamptonshire in 2003/04.....	50
Figure 3.3.5 Counts of a. Black-headed Gulls (BH), b. Lesser Black-backed Gulls (LB), c. Herring Gulls (HG) and d. Great Black-backed Gulls (GB) at Heaton Park Reservoir, Greater Manchester between 2003/04 and 2004/05	51
Figure 3.3.6 Counts of a. Black-headed Gulls (BH), b. Common Gulls (CM) and c. Lesser Black-backed Gulls (LB) at Hurleston Reservoir, Cheshire between 2003/04 and 2004/05	53
Figure 3.3.7 Counts of a. Black-headed Gulls (BH), b. Common Gulls (CM) and c. Herring Gulls (HG) at Seton Sands, Firth of Forth, Lothian in 2005	55
Figure 3.3.8 Counts of a. Black-headed Gulls (BH), b. Common Gulls (CM) and c. Herring Gulls (HG) in Swansea Bay (Mumbles to Brynmill) between 2003/04 and 2005/06	57

EXECUTIVE SUMMARY

1. This report provides population estimates derived from the 2003/04-2005/06 Winter Gull Roost Survey for the five principal species that winter in the UK, the Channel Islands and Isle of Man: Black-headed Gull *Larus ridibundus*, Common Gull *L. canus*, Lesser Black-backed Gull *L. fuscus*, Herring Gull *L. argentatus* and Great Black-backed Gull *L. marinus*.
2. The survey provides the first comprehensive estimates of winter gull populations in the UK, derived from counts undertaken at roost sites. Estimates were derived by combining counts from 'Key Sites' and estimates for the numbers of birds wintering away from these sites derived from stratified sampling. The survey covered the constituent countries of the United Kingdom (England, Northern Ireland, Scotland, Wales), plus the Crown Dependencies of the Channel Islands and Isle of Man.
3. Survey sites were categorised into a number of types. Inland and Coastal 'Key Sites' were major roosts identified from past surveys and bird reports as holding >1,000 gulls. Sample Random Inland Tetrads and Random Coastal Stretches were surveyed in order to estimate (through bootstrapping techniques) the numbers of birds wintering away from Key Sites both inland and on the coast.
4. The survey was run over a period of three winters between 2003/04 and 2005/06, with sites primarily covered by volunteers, with additional cover from professional staff. Sites were counted at dusk in January. Forms were returned for 1,460 sites (69%) of a total of 2,116 sites identified.
5. A total of 2,440,681 gulls of 13 species were recorded during the main counts used to produce population estimates: 1,222,345 inland and 1,218,336 on the coast. In addition to the five main species, other species counted were: Mediterranean Gull *Larus melanocephalus*, Little Gull *Larus minutus*, Ring-billed Gull *Larus delawarensis*, Caspian Gull *Larus (argentatus) cachinnans*, Yellow-legged Gull *Larus michahellis*, Iceland Gull *Larus glaucopterus*, Glaucous Gull *Larus hyperboreus* and Kittiwake *Rissa tridactyla*, though the sum total of these was only 1,801.
6. These counts were then used to produce estimates (with confidence limits) of the five principal species wintering in the UK (Table 3.2.2). The most abundant species was Black-headed Gull: 2,155,147 were estimated to occur in Great Britain (1,854,876 in England, 199,682 in Scotland and 100,836 in Wales), 44,336 in Northern Ireland, 7,565 in the Channel Islands and 1,753 in the Isle of Man.
7. Common Gull was the next most abundant species: 695,833 were estimated to occur in Great Britain (469,863 in England, 200,296 in Scotland and 25,133 in Wales), 9,559 in Northern Ireland, 7,702 in the Channel Islands and 35 in the Isle of Man.
8. Similar estimates were calculated for Herring Gull: 729,801 were estimated to occur in Great Britain (362,821 in England, 273,058 in Scotland and 93,613 in Wales), 13,559 in Northern Ireland, 10,828 in the Channel Islands and 10,106 in the Isle of Man.
9. 124,654 Lesser Black-backed Gulls were estimated to winter in Great Britain (114,369 of those in England, just 6,510 in Scotland and 3,838 in Wales), though only 459 were estimated to occur in Northern Ireland, 14 in the Channel Islands and seven in the Isle of Man.
10. Great Black-backed Gull was the least abundant species, with 75,860 estimated in Great Britain (53,361 in England, 18,113 in Scotland and 4,365 in Wales) and a further 750 in Northern Ireland, 732 in the Channel Islands and 566 in the Isle of Man.

11. Using the population estimates, new thresholds of national importance in Great Britain were calculated: Black-headed Gull 20,000, Common Gull 7,000, Lesser Black-backed Gull 1,200, Herring Gull 7,300 and Great Black-backed Gull 760. The estimates suggest that, in winter, Great Britain holds 51% of Black-headed Gulls, 40% of Common Gulls, 23% of Lesser Black-backed Gulls (*graellsii* race), 23% of Herring Gulls (*argentatus* and *argenteus* races) and 17% of Great Black-backed Gulls, in relation to estimated international populations. Individual sites of potential national and international importance for gulls in both Great Britain and Northern Ireland are highlighted.
12. Survey methods and coverage are evaluated, and recommendations for future monitoring and survey outlined. These are:
 - that annual data are collated from Key Sites to enable better indexing of species' UK population;
 - that further count data should also be collected at Key Sites in order to identify those worthy of statutory designation. Caution should be adopted in selecting sites where single counts provide the only data source; such counts should facilitate targeting of sites for increased coverage and better assessment of the regularity of site use, so as to improve confidence in selection of the most important roosts in national and international contexts.
 - that the Winter Gull Roost Survey is repeated at intervals of nine years (thus next in 2012/13-2014/15) so as to provide regular updates of the UK wintering populations of Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull.

1. INTRODUCTION

The UK provides essential habitat for gulls, in both breeding and non-breeding seasons, and there is thus considerable national interest in the species involved. Although internationally important numbers of gulls are held both during the breeding and non-breeding seasons, and although there have been long-standing surveys of both breeding and wintering numbers (Mitchell *et al.* 2004, Burton *et al.* 2003), no reliable national estimates of wintering numbers have been made for any of the key species or for gull assemblages in general.

Since a first survey of gulls using inland roosts in England in January 1953, gulls have been counted at winter roost sites in England, and since 1983 in the rest of the UK, every 10 years (Hickling 1954, 1967, 1977, Bowes *et al.* 1984, Burton *et al.* 2003). The first three surveys only covered inland sites, though in subsequent surveys coverage was extended to include coastal roost sites, such as estuaries, coastal cliffs and some off-shore islands.

Prior to the present survey, the last completed BTO survey took place in January 1993, comprising one-off counts of known roosts, during which over 2.5 million gulls were counted in Great Britain (Burton *et al.* 2003). A further 19,000 gulls were also counted in Northern Ireland, 3,850 in the Isle of Man and 8,500 in the Channel Islands. However, as some roosts were inevitably missed, particularly on the coast and in less populated regions such as northern Scotland, and no allowance was made for these uncounted areas, this and other previous surveys have underestimated the overall populations of wintering gulls; furthermore, the capacity to estimate numbers at unsurveyed roosts did not exist in past surveys.

The latest Winter Gull Roost Survey (WinGS) covered the winters of 2003/04 to 2005/06 and aimed to provide comprehensive population estimates for the five principal species that winter in the country: Black-headed Gull *Larus ridibundus*, Common Gull *L. canus*, Lesser Black-backed Gull *L. fuscus*, Herring Gull *L. argentatus* and Great Black-backed Gull *L. marinus*. The survey again covered known Key Sites – major roosts identified from past surveys and bird reports as holding >1,000 gulls – but also included stratified samples from inland (Random Inland Tetrads) and on the coast (Random Coastal Stretches) so as to be able to include estimates of the numbers wintering away from the Key Sites. Data from Key Sites from 2003/04 and previous surveys have already been used to calculate indices of wintering numbers (Burton *et al.* 2005).

Winter Gull Roost Surveys fulfil an important conservation objective, namely to update and revise population estimates for gulls wintering in the UK. The wintering population includes both resident breeders and immigrant birds from Scandinavia and other parts of continental Europe (Wernham *et al.* 2002). Gull species, unlike most waterbirds, are typically poorly monitored by other UK schemes such as the BTO/WWT/RSPB/JNCC Wetland Bird Survey (WeBS), as these counts are usually made in the day-time when many gulls may be feeding away from monitored wetland sites and because counts of such species are made on an optional basis. In order to ensure that changes in gull populations are not overlooked, it is therefore essential to monitor systematically winter gull numbers, at least periodically.

More accurate population estimates also allow the derivation of new thresholds for site designation. Typically, a site holding at least 1% of the wintering population for that country is deemed as of national importance for the species concerned. By determining realistic 1% thresholds for the five most abundant wintering gull species, protective designation of sites can be justified, in conjunction with knowledge of important breeding sites. The survey also provides the site specific count information against which threshold values can be compared for assessment of statutory protection requirements and which can contribute to future targets for monitoring purposes.

The current survey comes at an opportune time following the third comprehensive survey of breeding seabirds in Britain and Ireland, *Seabird 2000*, which identified some declines in the breeding numbers of gulls (Mitchell *et al.* 2004), and against which any changes in wintering numbers can be compared.

The new methodology employed by WinGS will also be used as the template for future surveys.

2. METHODS

2.1 Coverage and Field Methods

The Winter Gull Roost Survey in 2003/04-2005/06 was organised through the BTO's Regional Representative network with coverage of sites in all four constituent countries in the UK (England, Northern Ireland, Scotland and Wales), as well as in the Crown Dependencies of the Channel Islands and Isle of Man. The majority of counts were undertaken by volunteers, though BTO field staff were employed to increase cover of Key Sites in the first winter and subsequently of Random Coastal Stretches in less populated parts of the country.

Both inland sites, including reservoirs, gravel pits and lakes, and coastal sites, including estuaries, harbours, islands and near-shore coastal waters, were covered. Counts thus refer to winter gull populations associated with land. The population estimates presented in this report may underestimate the total populations of each species as counts exclude gulls which may have roosted offshore, not visible from land, but still within UK Territorial Waters (i.e. 12 nautical miles from shore).

The survey followed the same field methodology used by the 1953, 1963, 1973, 1983 and 1993 winter gull surveys (Hickling 1954; 1967; 1977; Bowes *et al.* 1984; Burton *et al.* 2003). Observers were asked to count or estimate the numbers of gulls at roosts at dusk during the month of January, though supplementary counts were also received from every other month of the year. Counts of gulls at roosts provide the best means to estimate total winter populations, as in contrast to the day when birds may be distributed widely across a variety of foraging habitats, roosting gulls tend to be restricted to wetland habitats (typically large inland water bodies or coastal near-shore waters). Thus sizeable proportions of species' populations may be counted at a relatively few Key Sites.

Forms included a map of the site to be surveyed and recommended methods of counting gulls. Counts of birds flying into roosts typically give more accurate estimates than counts of the numbers of birds already settled at a site, particularly if birds roost on choppy water (Burton *et al.* 2003). At larger roosts, particularly on large estuaries, several observers were stationed around the site to cover birds arriving on different flight-lines simultaneously. Counts at individual sites may have underestimated overall numbers if many birds arrived after dark. However, a pilot study (Austin *et al.* 2003) and previous observations by Shedd (1983) suggest that at many sites, there are only limited movements to and from roosts after dusk.

At some roosts, identification of individual species was not possible throughout the period of observation. In these cases, observers instead provided information on the numbers of unidentified 'small' gulls (Black-headed and Common Gulls) and unidentified 'large' gulls (Lesser Black-backed, Herring and Great Black-backed Gulls) counted. If it was not possible to identify birds to species or place them into one of these size classes, birds were classified as 'unidentified'. It is assumed that the numbers of species other than these five principal species that may have been present in these groupings were negligible.

2.2 Survey Design

Survey sites were split into four categories: **Inland** and **Coastal Key Sites**, **Random Inland Tetrads** and **Random Coastal Stretches**.

2.2.1 Key sites

Key gull roost sites were targeted in the first winter of the survey, with volunteers asked to survey sites ideally on the weekend of 17-18 January 2004 to avoid double counting. These **Inland** and **Coastal Key Sites** were identified prior to the start of the survey as being particularly important for gulls on the basis that previous Winter Gull Roost Surveys (between 1953 and 1993) or recent local bird reports had shown that they had held significant numbers of roosting gulls (arbitrarily over 1,000

birds). A total of 482 Key Sites were identified – 271 inland and 211 on the coast. Sites not covered in the first winter were again targeted in the subsequent two winters.

Supplementary counts of Key Sites were encouraged over the course of the survey, so as to be able to assess the representativeness of counts within winter and to examine seasonal patterns of change (see section 2.3.2).

2.2.2 Inland and coastal sampling

Although it has been possible to calculate trends in wintering numbers by comparing counts at Key Sites from 2003/04 and previous surveys (Burton *et al.* 2005), the summed counts from these sites only provide minimum estimates of the overall populations of gulls wintering in the country. In order to obtain more complete estimates (with confidence limits) of the total numbers of the five principal species wintering across Great Britain, Northern Ireland, Isle of Man and Channel Islands, WinGS also included samples from other areas away from these sites, both inland and on the coast.

Following the recommendations of Austin *et al.* (2003), a sample of **Random Inland Tetrads** (defined as the land within a 2 by 2 km square) was selected from a stratification based on winter gull distribution data derived from The Atlas of Wintering Birds in Britain and Ireland (Lack 1986; hereafter referred to as the Winter Atlas), freshwater cover data derived from the CEH Landclass 2000 database (Fuller *et al.* 2002) and coastal proximity. Use of this stratification aimed to minimise the magnitude of the confidence limits attached to the resulting population estimates while ensuring that the wide spectrum of UK habitats was surveyed.

The Winter Atlas covered the whole of Britain and Ireland at a 10 km resolution. The Winter Atlas maximum count data for gulls were imported into the WinGS GIS and numbers of all gull species summed for each 10 km grid square. These data were then smoothed by ‘kriging’ (a spatially aware data interpolation facility within ArcView GIS: ESRI 2003) and the resulting gull density surface classified into three categories representing Low (0-500 gulls/10 km grid), Medium (501-3,000 gulls/10 km grid) and High (>3,000 gulls/10 km grid) gull densities. Output resolution of the smoothed gridded output from this process was set to 2 km in order to coincide with the tetrads defining the boundaries of Key Sites. All tetrads within the UK were then assigned a value representing their category in this classification.

The CEH2000 data cover the whole of the UK at a 1 km resolution. The freshwater cover data were also imported into the WinGS GIS, summarised to a tetrad resolution, and re-classified according to percentage water cover into ‘No Water’, ‘Low Water’ (0%, <=5%) and ‘High Water’ (>5%).

It is possible that the numbers of gulls on tetrads in close proximity to the coast would be consistently different to tetrads further inland. Thus tetrads were further classified by coastal proximity using a 1 km buffer to the landward side of the coast. All tetrads that clipped this buffer were classified as ‘coastal’ while those which did not were classified as ‘inland’.

The gull density classification and the freshwater cover classification were superimposed on tetrads not in close proximity to the coast to give nine ‘inland’ strata and the gull-density classification alone was superimposed on the remaining tetrads to derive a further three ‘coastal’ strata. This gave an initial 12 strata classification (Figure 2.2.2.1) for the purposes of targeting sampling effort. Tetrads encompassing Inland Key Sites were excluded from the stratification for selection of the Random Inland Tetrads and subsequent extrapolation from the sample tetrads surveyed. The area distribution of UK tetrads across the strata (outwith Key Sites) is given in Table 2.2.2.1 (for further details of stratification, see Austin *et al.* 2003). In total, a sample of 701 Random Inland Tetrads was selected from the stratification.

Sample **Random Coastal Stretches** were selected following the first winter of counts once the majority of Coastal Key Sites had been covered and their boundaries mapped on GIS. Points were

selected at a regular interval along the country's coastline, forming a potential pseudorandom sample of 933 coastal stretches. Volunteers were asked to choose a suitable vantage point as close as possible to central grid references to undertake counts; they then provided boundaries of their chosen count sections on a map.

For the purposes of analyses, the coast outwith covered Key Sites was divided into two strata – one equating to coastlines that were expected to have been covered as Coastal Key Sites in the first year of the survey but which were not, and the other the remaining coast outwith this, where gull densities might have been expected to have been lower. The strata of Random Inland Tetrads and Random Coastal Stretches were also further split into 13 regions – north and west Scotland, east Scotland, south-west Scotland, north-west England, north-east England, Wales, the Midlands, East Anglia, south-west England, south-east England, Northern Ireland, Isle of Man and Channel Islands (Figure 2.2.2.2).

Subsequently, during analyses, the use of the Winter Atlas categories for Random Inland Tetrads was dropped, as densities of gulls did not differ appreciably between them once region, water cover and coastal proximity had been taken into account. Thus within regions, there were potentially four strata of Random Inland Tetrads – inland tetrads with high water coverage, inland tetrads with low water coverage, inland tetrads with no water coverage and coastal tetrads (*i.e.* those tetrads that clipped the boundary of a 1 km buffer inland from the coast).

Details of coverage of the final strata used in analyses are tabulated in the results.

2.3 Data Analysis

2.3.1 Population estimates and thresholds

For the purposes of calculating winter population estimates, only counts undertaken between December and February, either in the evening as gulls arrived at roosts or in the morning as gulls departed, were retained for analysis. Furthermore, supplementary counts, either from different dates or different times of day, were excluded. It is assumed throughout that counts at different sites were mutually exclusive. Targeting a single weekend in January 2004 for coverage of Key Sites promoted synchronicity of these counts and avoided repeat counting of the same birds at the most important and densely populated sites. Where multiple site counts existed, the count nearest to dusk on the Saturday of the target weekend was treated as definitive, all others as supplementary.

Population sizes for each of the five principal species were estimated using bootstrap techniques similar to those that have proven successful for estimating national and regional populations of waterbird species (*e.g.* Austin *et al.* 2001; Rehfisch *et al.* 2002; Rehfisch *et al.* 2003; Jackson *et al.* 2006; Austin *et al.* in review). With 999 repetitions, separate estimates were made of the total population size in each country or dependency (*i.e.* England, Wales, Scotland, Great Britain, Northern Ireland, the Isle of Man and the Channel Islands). Each of these overall estimates was obtained by summation of the total number of individuals recorded across all Key Sites and estimates for each stratum represented in each region contributing or equating to the country or dependency in question. The latter were derived for each stratum by taking a random sample with replacement from the survey data (Random Inland Tetrads and Random Coastal Stretches) for the given stratum until the cumulative land area (for inland strata) or coastal length (for near-shore strata) equated to the total for the entire country or dependency assigned to that stratum outwith the Key Sites (Fig. 2.3.1.1). With each repetition, an overall estimate for Great Britain was obtained by summing the estimates for England, Scotland and Wales. The 500th, 25th and 974th ascendant-ordered estimates were used to estimate respectively the median and lower and upper 95% confidence limits for the population for each of the four countries, two dependencies and Great Britain.

Data for both the Key Sites and random samples frequently included counts relating to unidentified gulls. This problem was tackled within the bootstrap estimations so as to minimise loss of information

regarding variation in proportions of different species between sites as captured by the survey. Thus during each repetition, a unique estimate was made for each region of the proportion of positively identified gulls known to belong to the species in question. Each estimate of this proportion was obtained by drawing a random sample with replacement of 100 (arbitrarily chosen as a large number relative to the average number of samples representing each stratum) from all key and random sample sites within the appropriate region, summing across species and calculating the proportion of this total belonging to the species in question. This was done separately for inland and coastal sites but otherwise without regard for strata. These estimates were then used to derive adjusted counts (C_{adj}) to include the total positively identified as the species in question (C) and an expected number of the species that had been recorded as either ‘small gulls’ (E_{small}) or ‘unidentified’ ($E_{unidentified}$) in the case of Black-headed and Common Gull, or ‘large gulls’ (E_{large}) or ‘unidentified’ for the other three principal species. *i.e.:*

for Black-headed and Common Gull:

$$C_{adj} = C + E_{small} + E_{unidentified}$$

and for Herring, Lesser Black-backed and Great Black backed Gull

$$C_{adj} = C + E_{large} + E_{unidentified}$$

where E_{small} , E_{large} & $E_{unidentified}$ are estimated from the sample with replacement as follows:

$$E_{small} = \text{small} \times \Sigma C / \Sigma \text{(counts for all positively identified small gulls)}$$

$$E_{large} = \text{large} \times \Sigma C / \Sigma \text{(counts for all positively identified large gulls)}$$

$$E_{unidentified} = \text{unidentified} \times (\Sigma C + \Sigma E_{small}) / \Sigma \text{(counts for all gulls identified to species or size-class)} \\ \text{or}$$

$$E_{unidentified} = \text{unidentified} \times (\Sigma C + \Sigma E_{large}) / \Sigma \text{(counts for all gulls identified to species or size-class)}$$

Population estimates were only calculated for the five principal species that winter in the UK. Raw totals are also presented for other species, though given the small numbers counted, it was not appropriate to provide extrapolated estimates.

The population estimates calculated for Great Britain were used to calculate thresholds – rounded-up 1% levels of the estimates – so that sites of national importance for each species might be identified in future.

As a major contribution to the identification of sites of importance for wintering gulls, a provisional list is drawn up using data from the main survey counts (*i.e. not* including supplementary counts). Estuaries were treated as discrete sites without subdivision in this analysis (to better enable comparison with previous surveys and to provide a reasonable match to the delimitation of protected sites).

We also list those sites which held at least 20,000 roosting gulls and thus might be deemed to be of importance for their assemblage of seabirds (see Stroud *et al.* 2001).

2.3.2 Representativeness of counts at individual sites

The calculation of 1% thresholds allows sites of potential national importance for each species to be identified. However, before firmly qualifying the status of these sites, it is important to understand the variation inherent in counts of gulls at roost sites and in particular, how many counts might be needed to achieve a representative estimate of the numbers using a site within a given period.

Although supplementary counts were encouraged over the course of the survey, for the majority of sites covered counts were only received for one date. Among Key Sites, only six were counted 10 times or more within one winter (for these analyses, also defined as December to February). Among these, one site (Bewl Water in Sussex) was counted far more frequently than any other site – 61 times across four winters (2001/02 to 2004/05) and 99 times in total. For this site, therefore, it was possible to assess how a mean taken from a sub-sample of counts might compare to the ‘actual’ winter mean, taken to be the mean from all 61 counts across the four winters. (Numbers occurring in each winter were similar enough for a single mean calculated across the four years to be considered representative – see Results). For the two principal species recorded at this site, Black-headed and Common Gull, therefore, we calculated mean counts taken from a random sub-sample for each of $n = 1$ to 61. (Note, only one mean was calculated for each n due to the excessive computational time that would have been required to calculate all the possible means). The differences between these estimated means and the ‘actual’ mean, weighted by the actual mean, were then plotted to indicate how the accuracy of the estimated means increased with sample size.

For sites where numbers of individual species averaged 100 or more, plots are also provided to show seasonal patterns in gull abundance.

3. RESULTS

3.1 Coverage

3.1.1 Forms returned

In total, 435 (90%) of 482 identified inland and coastal Key Sites were counted in the winters of 2003/04 to 2005/06 (either by volunteers or, for sites for which volunteers could not be found, by BTO field staff). Surveys of Random Inland Tetrads also took place between the winters of 2003/04 and 2005/06; in total, completed and usable forms were received for 520 (74%) of 701 sites. With the exception of nine sites on the Isle of Man, Random Coastal Stretches were covered in the winters of 2004/05 and 2005/06. In total, completed and usable forms were received for 505 (54%) of 933 sites.

The sum total, therefore, of completed and usable forms received was 1,460 from a total of 2,116 sites (69% of those identified).

3.1.2 Coverage by area

Coverage outwith Key Sites by sample Random Inland Tetrads (Table 3.1.1) and Random Coastal Stretches (Table 3.1.2) differed by stratum and region. Of the four strata defined for Random Inland Tetrads, proportional coverage of the total area of land available to gulls was highest for the ‘inland high water’ stratum (12% on average across all regions) – which was targeted as it was most likely to hold roosting gulls – and lowest for the ‘inland no water’ stratum (1%). Within regions, highest proportional coverage was achieved for the ‘inland high water’ stratum in south-east England (26%), whilst the greatest actual area covered was in the Midlands (12,800 ha in the ‘inland low water’ stratum). Lowest levels of coverage (<1%) were observed in Scotland and Wales.

The proportional area coverage of target tetrads averaged 75%, varying by strata (Table 3.1.3). Lowest percentages were recorded for the ‘inland high water’ strata, though the coverage difference between strata is likely to reflect the distribution of high water tetrads, many of these occurring in remote areas of upland Scotland.

The length of coast covered by sample Random Coastal Stretches was over 10% of the total length of coastline outwith Key Sites. Within the ‘Key Site’ stratum (coastlines that were expected to have been covered as Coastal Key Sites in the first year of the survey but which were not) percent coverage was highest in Northern Ireland and lowest in north and west Scotland. For the stratum that covered the rest of the coast, the greatest proportional coverage was obtained in north-west England and the lowest in south-west Scotland. Although 306 km of this stratum was visited in north and west Scotland – the highest total in the UK – this only represented 3.5% of the total due to the length of the coast in this region.

Confidence limits on population estimates may be reduced with low coverage as small samples may not fully capture actual variation.

3.2 Population Estimates and Thresholds

Over the three winters encompassed by the survey, a total of 2,440,681 gulls were recorded during the main counts used to produce population estimates: 1,222,345 inland and 1,218,336 on the coast. Raw count totals for all species recorded in the survey are shown in Table 3.2.1.

Previous surveys used such raw counts to provide minimum population estimates, but here, for the first time, more comprehensive population estimates have been generated by combining counts from ‘Key Sites’ and estimates for the numbers of birds wintering away from these sites derived from stratified sampling.

Estimates produced for the five principal species wintering in the UK for England, Wales, Scotland, Great Britain as a whole, Northern Ireland, the Channel Islands and the Isle of Man are shown in Table 3.2.2. These appreciably add to the previous 1993 estimates (Burton *et al.* 2003; Table 3.2.3) due to the sampling of areas outwith Key Sites, even though analysis of Key Site data indicate declines for some species (Burton *et al.* 2005).

Black-headed Gull was by far the most abundant species of gull in both Great Britain and Northern Ireland, estimated numbers exceeding those of the other four species combined. Approximately 86% of the estimated Great Britain population of 2,155,147 was found in England, 9% in Scotland and 5% in Wales.

Confidence limits of Common and Herring Gull estimates for Great Britain overlapped, reflecting broadly similar population estimates. England held approximately 68% and 50% of the respective British totals for these species, Scotland 29% and 37% and Wales 4% and 13%. Over 10,000 Herring Gulls were also estimated to occur in both the Channel Islands and Isle of Man.

Around 92% of Lesser Black-backed Gulls in Great Britain were estimated to be in England and just 5% and 3% in Scotland and Wales respectively. England likewise held the majority (70%) of British Great Black-backed Gulls, Scotland and Wales supporting just 24% and 6% respectively.

From the population estimates in Table 3.2.2, new national importance thresholds have been determined for site designation by rounding the 1% values of the total estimates for Great Britain. These 1% importance thresholds are displayed in Table 3.2.3. International importance thresholds, based on breeding population estimates and also given in Table 3.2.3, are taken from Wetlands International (2006) and follow Banks *et al.* (2006).

As a major contribution to the identification of sites of importance of wintering gulls, a provisional list is drawn up in Table 3.2.4 of those individual sites (treating estuaries as discrete sites without subdivision) in Great Britain which surpassed one or more of the 1% threshold levels during the main survey counts (i.e. *not* including supplementary counts) and so which could be considered as internationally or nationally important for at least one of the five principal wintering species. Similarly, Table 3.2.5 shows the sites in Northern Ireland that held gull numbers exceeding the all-Ireland threshold of significance as set out in Crowe (2005). Note, these lists are based on the raw counts of individual species and not estimated numbers based on counts of ‘small’, ‘large’ or ‘unidentified’ gulls, as use of the latter might lead to the inclusion of sites which do not in actuality pass thresholds. Sites which held seabird assemblages of at least 20,000 gulls, thus fulfilling an internationally recognised measure of importance (derived from the Ramsar Convention), are listed in Table 3.2.6.

In total, 34 sites passed individual species thresholds in Great Britain, as did a further five in Northern Ireland. Fifteen of these sites, plus a further 13 other sites, also held at least 20,000 gulls. It should be noted that the advised 1% threshold of international importance for Herring Gull relates solely to the *argenteus* race of the species. The international importance threshold is therefore lower than the 1% national importance threshold, which does not distinguish between races. Similarly, the 1% international importance threshold for Lesser Black-backed Gull is based on the *graellsii* race only, according to Ramsar guidance in both cases.

The Wash held the most gulls in the counts of Key Sites in January 2004, with an overall total of 124,907 gulls. Among inland sites, Chew Valley Lake held the most gulls in January 2004, with a total of 58,428 birds, though this total was exceeded by supplementary counts undertaken at Bewl Water which held a peak of 103,021 gulls in January 2005.

The reliability of a single count in determining a site’s importance for a species is assessed below and in the discussion.

3.3 Representativeness of Counts at Individual Sites

Figure 3.3.1 indicates how the accuracy of mean winter counts of Black-headed and Common Gulls at Bewl Water in Sussex changed with sample size. For both species, the absolute differences between the means estimated from sub-samples and the ‘actual’ mean were always less than one mean. For Black-headed Gull, four counts were needed for estimates to be within 20% of the actual mean and 19 counts to be within 10%. In contrast, for Common Gull, 20 counts were needed for estimates to be within 20% of the actual mean and 38 counts to be within 10%. It should be noted that these figures are meant as a guide only and that the exact relationship between the accuracy of the estimated means and sample size will vary according to the random selection process used in the methodology, between sites and according to overall sample size.

Variations in gull numbers across the year are shown for seven sites in Figures 3.3.2 to 3.3.8; for Bewl Water using counts from 2001/02 to 2004/05, for Theale Gravel Pits, Berkshire and Pitsford Reservoir, Northamptonshire for 2003/04, for Heaton Park Reservoir, Greater Manchester and Hurleston Reservoir, Cheshire for 2003/04 to 2004/05, for Seton Sands on the Firth of Forth for 2005 and for Swansea Bay (Mumbles to Brynmill) for 2003/04 to 2005/06. Plots are only shown for species which averaged 100 or more in number.

In most cases there were clear seasonal patterns in the numbers of the species found at each site. Black-headed Gull numbers peaked in midwinter at all seven sites with the exception of Seton Sands, where peaks occurred in March and October / November, *i.e.* during passage periods. Common Gull numbers also tended to peak in midwinter across all the five sites considered, though at Seton Sands and Bewl Water there were also further peaks in March. Lesser Black-backed Gulls, in contrast, clearly peaked in number in autumn (between August and October) as birds moved south on passage (see also Rossiter 1997). Herring Gulls were more sparsely recorded, though at two sites – Seton Sands and Swansea Bay – it was evident that numbers peaked in late autumn (October / November). For Great Black-backed Gull, there were only sufficient data to evaluate seasonal changes at one site – Heaton Park Reservoir. Here numbers of this species tended to peak in midwinter.

4. DISCUSSION

4.1 Coverage and Assessment of Survey Methodology

Coverage compared favourably with the previous Winter Gull Roost Survey in 1993. Then, only known gull roosts were surveyed and in total 716 sites were covered. In 2003/04 to 2005/06, a total of 482 Key Sites were targeted, of which 435 (90%) were surveyed. The additional 1,025 Random Inland Tetrads and Coastal Stretches surveyed raised the total number of sites visited to 1,460 between 2003 and 2006; effectively a doubling of survey effort.

The fact that only 55% of Random Coastal Stretches were covered suggests that there may have been an element of ‘survey fatigue’ amongst volunteers, as these were earmarked for coverage in the latest two winters of the survey. The comparatively low return rate for these sites is perhaps also reflective of a largely sparse and dispersed human population on many coasts, especially in north and west Scotland. However, overall coverage of 69% of all selected sites indicates an encouraging return.

Sample sizes for the various strata differed according to region, proximity to the coast and water coverage. The crucial consideration is whether each stratum captured sufficient variation to ensure that extrapolated regional estimates were representative. In the majority of regions, Random Coastal Stretches covered as much as 27% of the total length of coastline outwith Key Sites, meaning that confidence in the accuracy of estimates can be fairly high. In south-west and north and west Scotland, percentage coverage was much lower, due to the greater length of coast here and the low human population. In south-west Scotland, the length of coastline covered was higher than in any other region, but represented only 3% of the total length outwith Key Sites.

Although 75% of selected Random Inland Tetrads were surveyed, the large areas of land included in some strata meant that proportionally little of the total area was surveyed. In England and Wales, the inland high water stratum area was targeted as it was most likely to hold roosting gulls and proportional coverage was generally greater than 10%, providing satisfactory confidence in estimates. In low and no water strata, coverage was much lower, in part due to the enormous areas of land containing such habitat classification. However, in these strata numbers of roosting gulls were much lower, and thus the proportionally lower coverage was not of concern. Of more concern was the relatively low proportional coverage of the inland high water stratum in Northern Ireland, East Anglia and throughout Scotland. For these regions, confidence limits around estimates may be artificially tight and more sampling is likely needed to capture the full extent of variation.

Overall, the design of the survey and the methodology employed can be considered an improvement on previous Winter Gull Roost surveys. A perennial problem exists with ensuring representative coverage of Scotland, where a large area and coastline is inhabited by a relatively small human population. Even with professional survey coverage it was difficult to increase greatly proportional coverage as only one site could be visited each day at dusk. Information from the forthcoming BTO all-year atlas will enhance stratification of future winter gull roost surveys, by ensuring that the limited coverage that is likely in remote areas can be targeted appropriately.

4.2 Population Estimates and Thresholds

WinGS has provided the first comprehensive population estimates of winter gull populations in the UK. Previous surveys only covered known roost sites, and thus only provided minimum population estimates, and because of this it is difficult to determine temporal change of overall population size. Counts from Key Sites, though, have been used to index population change for these species (Burton *et al.* 2005).

It is also possible to examine differences in proportions of each species thought to comprise the sum total of gulls estimated. Comparison of the results for Great Britain from the present survey with those from the 1993 survey (Burton *et al.* 2003) suggests a decrease in the proportion of Black-headed Gulls

in the overall population from 65% to 57%, an increase in the proportion of Common Gulls from 17% to 18%, an increase in the proportion of Lesser Black-backed Gulls from 2% to 3%, an increase in the proportion of Herring Gulls from 15% to 19%, and no change in the proportion of Great Black-backed Gulls, 2% in both surveys. Although such comparisons are somewhat limited, the direction of change for all species is broadly similar as suggested by the indices reported by Burton *et al.* (2005).

The generation of new wintering population estimates for gulls in the UK updates understanding of these species in light of the most recent breeding census, *Seabird 2000* (Mitchell *et al.* 2004). By comparing breeding and wintering gull estimates it is possible to consider the likely scale of movements into and out of the UK post-breeding. In making such comparisons, it is recognised that estimates of breeding numbers are likely to include an unknown proportion of non-breeding immature and adult birds, and thus that the scale of the difference between breeding and wintering estimates is likely to be exaggerated. This may be lessened for species such as Lesser Black-backed Gull where some immature birds do not return to the UK until breeding age (Wernham *et al.* 2002), but of more concern for immatures of other species summering nearer to breeding colonies.

The likely scale of the influx of Black-headed Gulls in winter is highlighted by the differences in breeding and wintering estimates for Great Britain. Whilst 127,907 Apparently Occupied Nests (AON) (*e.g.* around 255,800 breeding adults) were recorded by *Seabird 2000* (Mitchell *et al.* 2004), wintering estimates numbered over 2.1 million birds, suggesting mass immigration over winter. Mackinnon & Coulson (1987) estimated that 71% of wintering Black-headed Gulls originated from the continent; these figures suggest the proportion may be even higher. Such migration occurs from a widespread range of northern and eastern European countries (Wernham *et al.* 2002), eastern and south-east England receiving most of the birds (Horton *et al.* 1984). This large movement into southern Britain is evident in differential distributions between countries between summer and winter. England holds an estimated 65% of the breeding population and 86% of the wintering population in Britain, whilst Wales holds 1% in summer and 5% in winter. By contrast, Scotland holds 34% in summer, but only 9% in winter. Northern Ireland supported an estimated 44,336 individuals in winter, with a further 7,565 in the Channel Islands and 1,753 in the Isle of Man, the combined totals making Black-headed Gull by far the most abundant winter gull in the UK and the two associated dependencies.

The distribution of breeding Common Gull in the UK is strongly biased to the north, with nearly 100% of AON in Britain recorded by Mitchell *et al.* (2004) in Scotland. There are limited post-breeding movements of native breeders and immature birds, mostly within northern Britain and Ireland. As with Black-headed Gull, there are also mass movements of continental breeders to the UK; eastern Britain in particular receives large numbers of Common Gulls (Wernham *et al.* 2002). Consequently, estimates of winter numbers are greatest in England (68% of the Great Britain total estimate), with 29% estimated in Scotland and 4% in Wales. The discrepancy between the 557 AON registered in Northern Ireland (Mitchell *et al.* 2004) and 9,559 Common Gulls estimated in winter highlights substantial winter movement into the province.

Lesser Black-backed Gulls breeding in the UK tend to move south after breeding, many wintering along the Atlantic coasts of southern Europe and Africa (Wernham *et al.* 2002). Although there is a reported growing tendency for this species to winter further north (Baker 1980; Wernham *et al.* 2002) and numbers wintering in the UK have increased greatly since the first winter gull roost survey in 1953 (Burton *et al.* 2005), differences between breeding and wintering estimates suggest that there is still considerable migration away from the UK. Mitchell *et al.* (2004) recorded 111,835 AON in Great Britain, which equates to approximately 223,670 individual breeding adults. The winter estimate for Great Britain was 124,654, implying that a large proportion of breeding individuals move out of the UK in the winter. Given that winter numbers in the UK are also bolstered by immigration of *graellsii* and *intermedius* races of Lesser Black-backed Gull from Iceland, the Faeroes and Scandinavia (Wernham *et al.* 2002), there would still appear to be much emigration from England, Scotland and Wales. The latter two countries, as well as Northern Ireland, were estimated to hold very few wintering birds despite harbouring sizable breeding colonies, though the species is far more common

in these countries than in earlier winter gull roost surveys. Additionally, although southerly movement is prevalent, wintering estimates for the Channel Islands numbered less than 25 birds.

Herring Gulls are largely resident in the UK between summer and winter and the UK wintering population thus comprises both the breeding population and birds entering the country from northern Europe. The majority of breeding Herring Gull in Britain occur in Scotland (50%) and England (40%), with 142,942 AON recorded in Britain as a whole. Most ringing recoveries of immigrant wintering Herring Gulls have been reported from the east of Britain (Wernham *et al.* 2002), though wintering estimates for Wales (93,613) are in excess of breeding estimates (nearly 14,000 AON; Mitchell *et al.* 2004), suggesting that there is also movement into western areas. There is some migration from north-west Britain into Northern Ireland, and this coupled with movements within Ireland contributes to an estimate of 13,559 Herring Gulls wintering in the province. Similarly large numbers were also estimated for the nearby Isle of Man (10,106) and the Channel Islands (10,828).

The Great Black-backed Gull is the least abundant species in the UK, both in breeding and non-breeding seasons. The breeding population is largely sedentary and movements from breeding sites are usually over relatively small distances and in response to feeding opportunities (Wernham *et al.* 2002). Within Great Britain, 85% of AON recorded were in Scotland (Mitchell *et al.* 2004), yet only 24% of the total winter population was found in that country. The discrepancy is probably explained largely by southward movements of birds from Scotland and westward migration of gulls from Norway and Russia in to England (Wernham *et al.* 2002). From an estimated 34,788 breeding adults in Great Britain (from a total of 17,394 AON; Mitchell *et al.* 2004), the wintering estimate of 75,860 again suggests a substantial influx of non-breeding Great Black-backed Gulls.

The large numbers of gulls estimated to be present in the UK in winter, totalling nearly 3.8 million birds in Great Britain and 69,000 in Northern Ireland, with a further 27,000 in the Channel Islands and 12,500 in the Isle of Man, warrant consideration for their conservation importance. For most of the five species, the UK is thought to harbour the majority of each of the estimated continental breeding populations in the winter (BirdLife International 2004), and is notably of increasing importance for the rising sedentary proportion of the native breeding *graellsii* race of Lesser Black-backed Gull. The requirement therefore exists to ensure that the UK sites supporting nationally / internationally important numbers of gulls are monitored and protected accordingly.

Information on breeding populations, used to derive international importance thresholds and designate sites, is variable between species. More confidence can be placed in thresholds for species such as Black-headed Gull and Lesser Black-backed Gull (7% and 0% of the population rated as comprising ‘poor quality’ data respectively) than those for Common Gull and Herring Gull (57% and 44% of the population rated as comprising poor quality data respectively: BirdLife International 2004). Although only 17% of the population of Great Black-backed Gull was considered to comprise poor quality data, 68% was based on data of ‘medium quality’.

Table 3.2.4 indicates that at least nine roost sites in Great Britain could be deemed nationally important for wintering Black-headed Gull, 14 for Common Gull, 11 for Lesser Black-backed Gull, just five for Herring Gull and 10 for Great Black-backed Gull, as they all held 1% or more of the estimated wintering populations of the species when surveyed in winter 2003/04. Thirteen further sites also held more than 20,000 roosting gulls and thus might be deemed to be of international importance for their assemblage of seabirds (Table 3.2.6; see Stroud *et al.* 2001). The numbers of individual species reported for these sites only represent raw counts and it should be noted that additional sites where there were counts of ‘small’, ‘large’ or ‘unidentified’ gulls may also qualify as nationally important for individual species. It is important therefore that other sites which might be thought to hold significant numbers of individual species should be resurveyed to gather more accurate data on their numbers.

The current level of protection for wintering gulls is extremely low, despite the great international importance of the UK for many gull species at this time of year. Of the 28 sites identified as holding

over 20,000 gulls and thus potentially qualifying as internationally important on the basis of their seabird assemblage, seven are currently offered no statutory protection (Table 3.2.6). Of the remaining sites, none of the six SSSIs include notification for wintering gulls, and only three of the 15 sites covered by SPAs include any designation for gulls, in all cases for breeding populations.

Nineteen other sites in Great Britain were also identified to support international or national numbers of individual gull species. Of these, six are covered by SPA designation (one for breeding gulls), eight by SSSI designation (two explicitly mentioning wintering gulls) and five are currently not protected (Table 3.2.4). In Northern Ireland, all five sites holding sufficient numbers of gulls to exceed importance thresholds carry SPA designations, but only one features notification for (breeding) gulls.

It should also be noted that, should sites be designated for their importance for wintering gulls, some should be considered together as functional units. For wintering waterbirds, for example, the ‘South West London Waterbodies’ are designated as a single Special Protection Area (SPA). This area comprises several important roost sites which gulls are likely to regularly move between, though the SPA itself does not include the two sites which support the largest roosts, the Queen Elizabeth II and Queen Mary Reservoirs (Table 3.2.4). An enlarged SPA that included these two sites would help protect the main gull roosts in the area, though would not fully encompass species’ foraging areas.

All nine sites identified as of national importance for Black-headed Gulls in Great Britain also automatically qualify as of international importance for the species due to the 1% threshold exceeding 20,000 (Table 3.2.4). Three sites were also identified as internationally important for Common and Lesser Black-backed Gull. Of the five sites with Herring Gull numbers exceeding the 1% international importance threshold, all but one held seabird assemblages totalling over 20,000 gulls. Notably, the Severn Estuary supports internationally important numbers of three species: Black-headed Lesser Black-backed and Herring Gull.

In Northern Ireland, no site held internationally important numbers of gulls (Table 3.2.5). Five sites (Belfast Lough, Lough Neagh, Outer Ards, Roe Estuary and Strangford Lough) exceeded the respective all-Ireland thresholds of significance (Crowe 2005) for various combinations of Black-headed, Common and Herring Gull, and thus could be considered of national importance for those species. As estimates of the wintering population in the whole of Ireland are not comprehensive, most thresholds are set at an arbitrary level of 500 (1,000 for Black-headed Gull; Crowe 2005). All-Ireland wintering estimates are based largely on extrapolations from breeding and immigration estimates, and most seem reasonable in light of the new estimates for Northern Ireland devised here. Black-headed Gull estimates of around 44,000, however, suggest that the all-Ireland figure of 100,000 wintering birds may be an underestimate. The presence of an estimated 9,500 Common Gulls in Northern Ireland also suggests that wintering populations in the whole of Ireland are likely to be nearer the upper range of the estimated 18,050-67,500 gulls (Crowe 2005).

In total, 13 species were counted during the survey. In addition to the five main species, these were: Mediterranean Gull *Larus melanocephalus*, Little Gull *Larus minutus*, Ring-billed Gull *Larus delawarensis*, Caspian Gull *Larus (argentatus) cachinnans*, Yellow-legged Gull *Larus michahellis*, Iceland Gull *Larus glaucopterus*, Glaucous Gull *Larus hyperboreus* and Kittiwake *Rissa tridactyla*. The total of these ‘other’ species was 1,801 – less than that recorded in the 1993 survey (Burton *et al.* 2003), though including two more species (Little Gull and Caspian Gull which in both the current and previous surveys may have been overlooked).

4.3 Representativeness of Counts at Individual Sites

While the single co-ordinated counts of WinGS and previous Winter Gull Roost Surveys have allowed national populations to be estimated, to be able to assess whether individual sites are suitable for statutory designation it is important to know whether or not the one-off counts used in the survey can be taken as representative of numbers over a longer period, *i.e.* whether sites ‘regularly’ support such numbers.

Within winter, the degree of variability in the numbers of gulls using roosts is likely to be primarily a reflection of the reliability of local food resources. In areas where rubbish tips and other human waste provide dependable sources of food, previous studies have shown that gulls may be strongly site-faithful both within and between winters (Horton *et al.* 1983; Coulson *et al.* 1984; Christmas *et al.* 1986; Gosling 1986). However, even in such areas, the numbers of gulls using individual roosts may be highly affected by the weather, disturbance (deliberate or otherwise) and at coastal sites, by the state of the tide. During the 1973 Winter Gull Roost Survey, for example, many inland roosts in Cumbria were deserted by gulls for sites on the coast because of the severe winter weather (Hickling 1977).

Figures 3.3.2-3.3.8, and previous analysis of counts from King George V & William Girling Reservoirs, Greater London / Essex (Meadows 1961) and Chelford Farmwood Pool, Cheshire (Barber & Barber 1986) presented by Burton *et al.* (2002), indicate that not only are there clear seasonal patterns in the abundance of gulls, but that peaks in gull numbers at individual sites may be brief. Thus, even within months there may be considerable variation in counts within and between winters (Steiof 2006).

Tables 3.2.4 and 3.2.5 indicate those sites considered to hold nationally important numbers of individual gull species during the current survey. Where comparisons between the 1993 and present surveys were possible for sites in Great Britain, 38% of sites exceeded importance thresholds for individual species on both surveys, whilst 24% had apparently declined in importance. A further 38% of sites were newly important for particular species (Table 3.2.4). Although there may be confounding factors (including accuracy of allocation of unidentified gulls), this suggests that over a third of British roost sites revealed important numbers on single counts in two separate decades. However, for non-breeding waterbird species, the number of individuals that a site regularly supports is normally defined as being the mean of the most recent five years' peak annual counts (Banks *et al.* 2006) and it is this 'five-year peak mean' that is generally used for site assessments (Stroud *et al.* 2001). The analysis of data for Bewl Water suggested that 10 or 20 counts may be needed before a representative winter mean is obtained and several counts would thus also be needed for a representative winter peak. Following the protocol used for site assessments for waterbirds, a better programme of counts that was capable of providing representative means or peaks over successive years may thus be needed before the status of individual sites for gulls could be accurately assessed.

The suitability of single counts in progressing site notifications may be limited, as the Bewl Water analysis indicates. However, single counts are useful in highlighting those sites that would benefit from more sustained monitoring, in order to ascertain regularity of roost site use. By targeting individual locations, resources can be best focused on securing longer-term data from those roosts sites potentially qualifying for statutory site protection.

5. RECOMMENDATIONS

Following this study, three main recommendations can be made to improve monitoring and understanding of wintering gull populations in the UK:

1. That annual data is collated from Key Sites (*i.e.* key gull roost sites) to enable better indexing of species' UK population trends. Indices of the numbers of gulls wintering in the UK could be derived from WeBS counts, though these may be limited in their accuracy: WeBS greatly underestimates total gull populations because counts are usually made in the day-time when many gulls may be feeding away from monitored wetland sites and as counts of gulls are optional.
2. That (more frequent and) annual counts are undertaken at Key Sites (and others which might be thought to hold significant numbers of individual species) to be able to identify those worthy of statutory designation. Use of a 'five-year peak mean' (or similar protocol) for defining the number of individuals that a site regularly supports, would considerably strengthen the assessment of the importance of individual sites for gulls. Decisions on data suitability and site designation should be the preserve of the Country Agencies, in conjunction with JNCC where SPA issues are involved, but further exploration of these matters is recommended.
3. That the Winter Gull Roost Survey is repeated at intervals of nine years (thus next in 2012/13-2014/15), as is standard, so as to provide regular updates of the UK wintering populations of Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull.

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Coastal / Inland (Coastal = tetrad within 1 km of the coast)	Inland Water Coverage (from CEH2000)	Gull density - from Winter Atlas (density measured as gulls/10 km sq)		
		Low <=500 / 10 km	Medium >500-3000 / 10 km	High >3000 / 10 km
Inland	None	INL 90,801	INM 92,249	INH 42,372
Inland	Low (<=5%)	ILL 14,973	ILH 15,547	ILH 11,261
Inland	High (>5%)	IHL 5,421	IHM 1,445	IHH 692
Coastal	N/A	IXL 16,178	IXM 12,704	IXH 8,272

Table 2.2.2.1 Area (km^2) distribution across the initial 12-class stratification for Random Inland Tetrads in the UK, Channel Islands and Isle of Man. Winter gull density is classified in terms of gulls / 10 km obtained from the smoothed Winter Atlas data. Freshwater coverage is classified as None, Low and Medium based on the percentage coverage for the four 1 km grid squares comprising the tetrad as recorded in the CEH2000 Land Classification. Tetrads are defined as Coastal when they clip the boundary of a 1 km buffer inland from the coast. IXH = Coastal High Gull Numbers; IXM = Coastal Medium Gull Numbers; IXL = Coastal Low Gull Numbers; IHH = Inland, High Water, High Gull Numbers; IHM = Inland, High Water, Medium Gull Numbers; IHL = Inland, High Water, Low Gull Numbers; ILH = Inland, Low Water, High Gull Numbers; ILM = Inland, Low Water, Medium Gull Numbers; ILL = Inland, Low Water, Low Gull Numbers; INH = Inland, No Water, High Gull Numbers; INM = Inland, No Water, Medium Gull Numbers; INL = Inland, No Water, Low Gull Numbers.

Region	Stratum	Total inland area (ha)	Area covered (ha)	Sampled (%)
East Anglia	IXX	116,061	1,840	1.59
	IHX	15,090	400	2.65
	ILX	198,689	2,400	1.21
	INX	1,604,984	5,200	0.32
NE England	IXX	135,397	3,035	2.24
	IHX	24,000	5,200	21.67
	ILX	302,800	5,200	1.72
	INX	1,891,200	7,200	0.38
NW England	IXX	130,841	2,287	1.75
	IHX	21,200	3,200	15.09
	ILX	177,600	3,200	1.80
	INX	826,400	3,600	0.44
Midlands	IXX	30,949	397	1.28
	IHX	32,891	6,400	19.46
	ILX	968,433	12,800	1.32
	INX	2,100,000	7,600	0.36
SE England	IXX	267,116	3,753	1.41
	IHX	18,414	4,800	26.07
	ILX	369,200	6,400	1.73
	INX	1,460,400	4,400	0.30
SW England	IXX	273,996	3,865	1.41
	IHX	10,993	1,600	14.55
	ILX	186,390	5,200	2.79
	INX	1,635,200	6,000	0.37
Northern Ireland	IXX	114,097	7,451	6.53
	IHX	61,337	3,567	5.81
	ILX	204,714	7,692	3.76
	INX	1,036,163	8,808	0.85
NW Scotland	IXX	949,273	3,277	0.35
	IHX	329,600	6,800	2.06
	ILX	664,000	2,000	0.30
	INX	1,200,400	2,800	0.23
SW Scotland	IXX	489,628	3,043	0.62
	IHX	83,313	4,400	5.28
	ILX	317,611	2,400	0.76
	INX	1,119,600	4,000	0.36
East Scotland	IXX	170,002	1,860	1.09
	IHX	87,313	3,200	3.66
	ILX	402,000	3,200	0.80
	INX	2,026,800	6,000	0.30
Wales	IXX	269,254	4,409	1.64
	IHX	30,000	3,200	10.67
	ILX	267,200	2,400	0.90
	INX	1,491,200	3,200	0.21
Isle of Man	IXX	23,761	565	2.38
	IHX	400	400	100.00
	ILX	2,400	800	33.33
	INX	30,800	800	2.60
TOTAL		24,169,110	192,249	0.80

Table 3.1.1 Coverage of all UK Random Inland Tetrads by stratum. IXX = coastal tetrads (*i.e.* those tetrads that clip the boundary of a 1 km buffer inland from the coast). IHX = inland tetrads with high water coverage; ILX = inland tetrads with low water coverage; INX = inland tetrads with no water coverage.

Region	Stratum	Total length of coast (km)	Length covered (km)	Sampled (%)
East Anglia	CXK	229.5	49.2	21.43
	CXX	189.0	44.4	23.48
NE England	CXK	367.9	89.4	24.29
	CXX	290.9	63.3	21.75
NW England	CXK	433.5	97.4	22.47
	CXX	103.0	27.5	26.73
SE England	CXK	809.7	96.7	11.94
	CXX	421.6	26.8	6.36
SW England	CXK	446.7	111.0	24.85
	CXX	1,024.6	139.1	13.58
Northern Ireland	CXK	277.4	80.1	28.87
	CXX	274.0	54.2	19.79
NW Scotland	CXK	75.8	5.2	6.81
	CXX	8,740.8	306.3	3.50
SW Scotland	CXK	179.6	12.5	6.97
	CXX	3,157.3	92.8	2.94
East Scotland	CXK	282.5	56.0	19.83
	CXX	441.6	68.0	15.39
Wales	CXK	366.7	44.5	12.13
	CXX	883.6	156.6	17.72
Channel Islands	CXX	152.6	10.6	6.97
Isle of Man	CXK	25.9	2.0	7.90
	CXX	124.1	18.5	14.89
TOTAL		19,298.3	1,652.1	8.6

Table 3.1.2 Coverage of all UK Random Coastal Stretches by stratum. CXK = stretches within coastlines that were expected to have been covered as Coastal Key Sites in the first year of the survey but which were not; CXX = stretches within the remaining coast outwith this.

Stratum	Area targeted (ha)	Area covered (ha)	Sampled (%)
INX	70,464	59,608	84.59
ILX	70,491	53,692	76.17
IHX	67,173	43,167	64.26
CXX	48,214	35,782	74.21
	256,342	192,249	75.00

Table 3.1.3 Coverage of targeted Random Inland Tetrads by pre-survey stratum. INX = inland tetrads with no freshwater ILX = inland tetrads with low freshwater coverage . IHX = inland tetrads with high freshwater coverage CXX = coastal tetrads (*i.e.* those tetrads that clip the boundary of a 1 km buffer inland from the coast).

Species	Inland	Coastal	Total
Black-headed Gull <i>Larus ridibundus</i>	641,395	534,616	1,176,011
Common Gull <i>Larus canus</i>	212,568	198,457	411,025
‘Small gulls’	189,086	126,042	315,128
Lesser Black-backed Gull <i>Larus fuscus</i>	48,219	13,576	61,795
Herring Gull <i>Larus argentatus</i>	82,331	211,211	293,542
Great Black-backed Gull <i>Larus marinus</i>	14,967	17,880	32,847
‘Large gulls’	33,193	32,550	65,743
‘Unidentified’	485	82,304	82,789
Mediterranean Gull <i>Larus melanocephalus</i>	20	258	278
Little Gull <i>Larus minutus</i>	0	11	11
Ring-billed Gull <i>Larus delawarensis</i>	0	3	3
Caspian Gull <i>Larus (argentatus) cachinnans</i>	2	3	5
Yellow-legged Gull <i>Larus michahellis</i>	59	51	110
Iceland Gull <i>Larus glaucopterus</i>	12	16	28
Glaucous Gull <i>Larus hyperboreus</i>	8	17	25
Kittiwake <i>Rissa tridactyla</i>	0	1,341	1,341
TOTAL	1,222,345	1,218,336	2,440,681

Table 3.2.1 Raw totals of individual gull species, ‘small gulls’, ‘large gulls’ and ‘unidentified’ gulls recorded during the main counts used to produce population estimates.

	Black-headed Gull	Common Gull	Lesser Black-backed Gull	Herring Gull	Great Black-backed Gull
England	1,854,876 (1,796,286 - 1,922,835)	469,863 (449,287 - 491,278)	114,369 (107,742 - 120,437)	362,821 (346,588 - 379,444)	53,361 (48,884 - 58,325)
Scotland	199,682 (188,437 - 211,796)	200,296 (185,410 - 215,034)	6,510 (5,742 - 7,294)	273,058 (252,574 - 293,613)	18,113 (16,751 - 19,653)
Wales	100,836 (87,741 - 116,973)	25,133 (21,686 - 29,121)	3,838 (3,321 - 4,453)	93,613 (75,238 - 116,885)	4,365 (3,897 - 4,852)
Great Britain	2,155,147 (2,093,327 - 2,225,476)	695,833 (669,581 - 721,158)	124,654 (118,055 - 131,148)	729,801 (696,424 - 762,731)	75,860 (71,209 - 80,704)
Northern Ireland	44,336 (37,813 - 51,822)	9,559 (7,464 - 11,988)	459 (280 - 552)	13,559 (10,797 - 16,776)	750 (588 - 926)
Channel Islands	7,565 (5,476 - 9,438)	7,702 (4,402 - 12,102)	14 (8 - 22)	10,828 (7,743 - 14,594)	732 (479 - 1,047)
Isle of Man	1,753 (598 - 3,159)	35 (15 - 60)	7 (3 - 12)	10,106 (8,630 - 11,542)	566 (461 - 680)

Table 3.2.2 Population estimates, with 95% confidence limits, for the five principal wintering gull species in the UK, its constituent countries, the Channel Islands and Isle of Man. Bracketed figures show lower and upper confidence limits respectively.

	GB Population estimate	Rounded estimate	1% national threshold	All-Ireland 1% national threshold	1% international threshold	1993 GB population estimate
Black-headed Gull	2,155,147	2,160,000	21,600 ¹	1,000	20,000	1,682,385
Common Gull	695,833	700,000	7,000	500	20,000	429,331
Lesser Black-backed Gull	124,654	120,000	1,200	500	5,500 ²	60,830
Herring Gull	729,801	730,000	7,300	500	5,900 ³	376,775
Great Black-backed Gull	75,860	76,000	760	500	4,400	43,108

Table 3.2.3 Population estimates, 1% national and 1% international importance thresholds for the five principal wintering gull species in Great Britain and Northern Ireland (all-Ireland thresholds from Crowe *et al.* 2005).

Rounding conventions are applied according to Stroud *et al.* (2004) (population estimates of less than 1,000 not rounded, thresholds rounded to the nearest 1; population estimates of 1,001-10,000 not rounded, thresholds rounded to the nearest 5; population estimates of 10,001-100,000 rounded to the nearest 1,000, thresholds rounded to the nearest 10; population estimates of over 100,001 rounded to the nearest 10,000, thresholds rounded to the nearest 100).

¹ 20,000 is the maximum national importance threshold as the site qualifies as internationally important at this level by virtue of absolute numbers.

² Threshold for *Larus fuscus graellsii* consistent with Ramsar guidance.

³ Threshold for *Larus argentatus argenteus* consistent with Ramsar guidance.

1993 (minimum) population estimates are taken from Burton *et al.* (2003). International importance thresholds, based on breeding population estimates, are taken from Wetlands International (2006) and follow Banks *et al.* (2006).

Site	(Old) County	Designation	BH	CM	LB	HG	GB
Belvide Reservoir	Staffordshire	SSSI*	3,500	1	3,000^c	560	55
Blithfield Reservoir	Staffordshire	SSSI	16,500 ^a	21	2,620^b	1,150	25
Blythburgh	Suffolk	SPA	7,000	8,000	200	50	0
Brogborough No. 1	Bedfordshire		2,007	103	58	1,188	953^b
Chelmarsh Reservoir	Shropshire		5,000	0	3,500^c	211	37
Chew Valley Lake	Avon	SPA	29,800^b	18,200^a	7,015^c	3,400	5
Coquet Island ¹	Northumberland	SPA*	65	70	2	2,100	980^c
Droitwich Westwood Great Pool	Herefordshire	SSSI	2,900	0	3,800^b	320	3
Dungeness	Kent	SPA	2,000	1,000	20	300	1,000
Eye Brook Reservoir	Leicestershire		11,300	16,100^c	4	1,500	500
Firth of Forth ^{1,2}	Central, Fife & Lothian Regions	SPA	26,835^b	14,647^b	28	12,313^c	376
Graffham Water ¹	Cambridgeshire	SSSI	14,470	570	150	2,440	1,050
Hoveringham	Nottinghamshire	SSSI	6,000	450	3	3,000	1,600^c
Humber Estuary ^{1,2}	Lincolnshire & Yorkshire	SPA	34,118^c	31,134^c	62	2,911	2,387^b
Llys-y-Fran Reservoir	Dyfed	SSSI	250	0	0 ^a	50	1,500^c
Loch of Skene	Grampian	SPA	320	17,284^a	0	1,460	27
Lound Gravel Pit	Nottinghamshire	SSSI*	6,300	925	40	855	1,176^b
Queen Elizabeth II Reservoir ¹	Surrey		21,820^c	56	1,612^c	5	7 ^a
Queen Mary Reservoir ¹	Surrey		16,836 ^a	756	6,656^c	8,279^c	44
Ribble & Alt Estuaries ^{1,2}	Lancashire & Merseyside	SPA*	21,491^b	4,480 ^a	810	19,592^b	302
Roughrigg Reservoir ¹	Strathclyde		151	0	179	15,144	3
Rutland Water ¹	Leicestershire	SPA	21,000^c	12,080^b	170	200	50

Table 3.2.4 Sites in Great Britain supporting gull numbers exceeding the 1% national (bold) or international (italics) importance thresholds for at least one species during the main survey counts (i.e. *not* including supplementary counts). BH = Black-headed Gull; CM = Common Gull; LB = Lesser Black-backed Gull; HG = Herring Gull; GB = Great Black-backed Gull. Designation: sites included in: SPA = Special Protection Area; SSSI = Site of Special Scientific Interest; *Notification includes breeding gull designation or seabird assemblage featuring gulls (SPAs) or explicit mention of wintering gulls (SSSIs). ¹ Totals for individual species are minimum figures and do not include estimates derived from numbers of ‘small’, ‘large’ or ‘unidentified’ gulls. ² Some coastal sites were incompletely counted. ^aSite no longer of (inter)national importance in comparison to 1993 survey. ^bSite retained (inter)national importance in comparison to 1993 survey. ^cSite newly of (inter)national importance in comparison to 1993 survey. Lack of superscript against figures exceeding current threshold indicates an absence of count data from 1993 for comparison.

Site	(Old) County	Designation	BH	CM	LB	HG	GB
Severn Estuary ^{1,2}	Gloucestershire, Avon, Somerset, Gwent, East Glamorgan	SPA	20,080^b	3,629 ^a	6,471^b	5,997 ^c	50
Solway Firth ^{1,2}	Cumbria, Dumfries & Galloway	SPA	13,732 ^a	12,486^b	13	3,034 ^a	64
South Cerney ¹	Gloucestershire & Wiltshire	SSSI	12,885	1,868	3,693^b	230	2
Stanford Reservoir	Leicestershire		9,250	8,110^c	95	273	165
Thames Estuary ²	Essex, Greater London & Kent	SPA	43,602^b	2,319 ^a	1,898^c	2,308 ^a	857^b
The Wash ^{1,2}	Lincolnshire & Norfolk	SPA	25,657^b	7,794^b	65	13,189^c	239 ^a
Theale Gravel Pits	Berkshire		5,272	304	3,794^b	176	3
Tophill Low Reservoir	Yorkshire	SSSI	2,350	11,150^b	0	70	223
Ullswater	Cumbria	SSSI	7,330	11,470^b	2	150	0
West Water Reservoir	Borders	SPA	0	10,050^c	0	1	22
Wheldrake Ings	Yorkshire	SPA	7,150 ^a	2,790	3	1,147	815^c
William Girling Reservoir	Greater London	SSSI	18,000	7,000^c	400	100	10

Table 3.2.4 Continued.

Site	County	Designation	BH	CM	LB	HG	GB
Belfast Lough ^{1, 2}	Antrim	SPA	11,486	1,010	1	699	46
Lough Neagh	Antrim, Armagh, Down, Londonderry, Tyrone	SPA*	1,821	307	54	182	0
Outer Ards ³	Down	SPA	572	521	0	684	61
Roe Estuary ²	Londonderry	SPA	1,300	1,050	0	6	6
Strangford Lough ^{1, 2}	Down	SPA	3,177	504	26	1,755	29

Table 3.2.5 Sites in Northern Ireland supporting gull numbers exceeding the 1% all-Ireland importance threshold (bold) for at least one species during the main survey counts. SPA = Special Protection Area. BH = Black-headed Gull; CM = Common Gull; LB = Lesser Black-backed Gull; HG = Herring Gull; GB = Great Black-backed Gull. ¹ Totals for individual species are minimum figures and do not include estimates derived from numbers of ‘small’, ‘large’ or ‘unidentified’ gulls. ² Some coastal sites were incompletely counted. ³ Includes most islands visible from mainland shore.

Site	(Old) County	Designation	BH	CM	LB	HG	GB	Total
The Wash ^{1,2}	Lincolnshire & Norfolk	SPA	25,657	7,794	65	13,189	239	124,907
Humber Estuary ^{1,2}	Lincolnshire & Yorkshire	SPA	34,118	31,134	62	2,911	2,387	72,188
Chew Valley Lake	Avon	SPA	29,800	18,200	7,015	3,400	5	58,428
Firth of Forth ^{1,2}	Central, Fife & Lothian Regions	SPA	26,835	14,647	28	12,313	376	57,196
Severn Estuary ^{1,2}	Gloucestershire, Avon, Somerset, Gwent, East Glamorgan	SPA	20,080	3,629	6,471	5,997	50	56,622
Thames Estuary ²	Essex, Greater London & Kent	SPA	43,602	2,319	1,898	2,308	857	50,998
Ribble & Alt Estuaries ^{1,2}	Lancashire & Merseyside	SPA*	21,491	4,480	810	19,592	302	47,160
Queen Mary Reservoir ¹	Surrey		16,836	756	6,656	8,279	44	43,716
Queen Mother Reservoir ¹	Berkshire		0	0	0	0	0	40,500
Rutland Water ¹	Leicestershire	SPA	21,000	12,080	170	200	50	33,501
Mersey Estuary ^{1,2}	Cheshire & Merseyside	SPA	14,616	483	300	350	230	32,606
Solway Firth ^{1,2}	Cumbria & Dumfries & Galloway	SPA	13,732	12,486	13	3,034	64	32,322
Draycote Water ¹	Warwickshire		0	0	0	0	0	29,965
Eye Brook Reservoir	Leicestershire	SSSI	11,300	16,100	4	1,500	500	29,404
Ouse Washes ¹	Cambridgeshire & Norfolk	SPA	7,480	452	760	1,879	130	27,534
William Girling Reservoir ¹	Greater London	SSSI	18,000	7,000	400	100	10	25,511
Morecambe Bay ^{1,2}	Cumbria & Lancashire	SPA*	12,067	6,175	147	5,580	185	24,769
Lackford ¹	Suffolk	SSSI	12,105	3,291	201	13	9	24,698
Poole Harbour ¹	Dorset	SPA*	17,707	2,467	176	1,160	476	24,385
Queen Elizabeth II Reservoir ¹	Surrey		21,820	56	1,612	5	7	23,700
Chasewater (Cannock Reservoir) ¹	Staffordshire		3,500	15	10	8	20	23,604
Fletton Brick Pit ¹	Cambridgeshire		15,770	677	3	996	140	22,786
Ferring to Goring ¹	Sussex		2,099	475	4	2,529	33	21,235
Breydon Water ¹	Norfolk	SPA	17,700	2,000	32	480	160	20,999
Strathclyde Park Loch ¹	Strathclyde	SSSI	12,600	3,200	45	4,600	390	20,837
Blithfield Reservoir	Staffordshire	SSSI	16,500	21	2,620	1,150	25	20,318
South Cerney ¹	Gloucestershire & Wiltshire	SSSI	12,885	1,868	3,693	230	2	20,272
Portsmouth Harbour ¹	Hampshire	SPA	14,836	769	70	1,061	206	20,015

Table 3.2.6 Sites which held at least 20,000 gulls in January 2004, sorted by total number of gulls. BH = Black-headed Gull; CM = Common Gull; LB = Lesser Black-backed Gull; HG = Herring Gull; GB = Great Black-backed Gull. Designation: sites included in: SPA = Special Protection Area; SSSI = Site of Special Scientific Interest; *Notification includes breeding gull designation or seabird assemblage featuring gulls (SPAs) or explicit mention of wintering gulls (SSSIs). ¹ Totals for individual species are minimum figures and do not include estimates derived from numbers of 'small', 'large' or 'unidentified' gulls. ² Some coastal sites were incompletely counted.

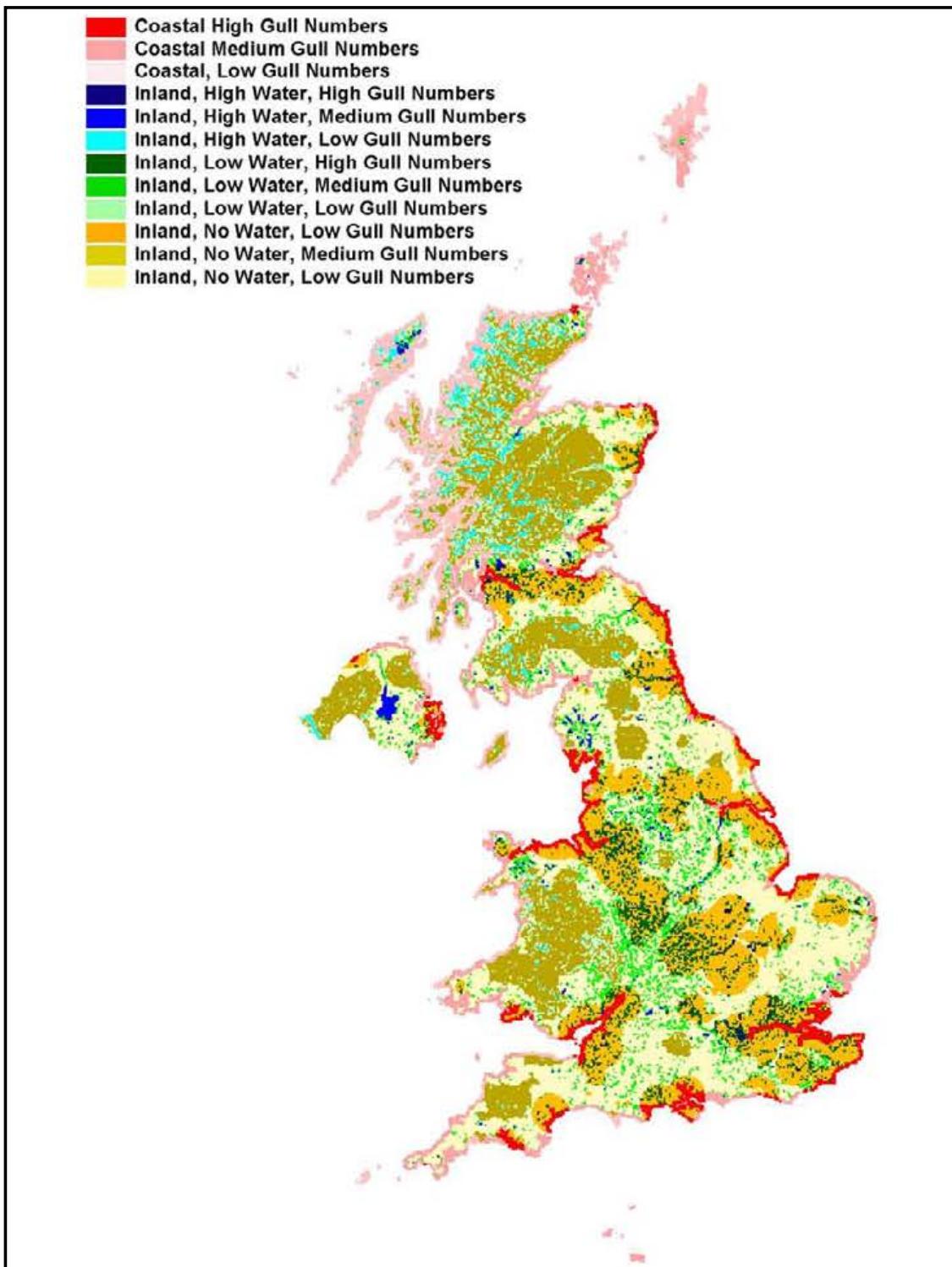


Figure 2.2.2.1 Distribution of tetrads in the UK, Channel Islands and Isle of Man across the initial 12-class stratification for Random Inland Tetrads. This stratification was derived by overlaying the three layers of information representing Winter Atlas gull density, freshwater cover and coastal proximity (see Austin *et al.* 2003). The frequency distribution of tetrads across the stratification is provided in Table 2.2.2.1.

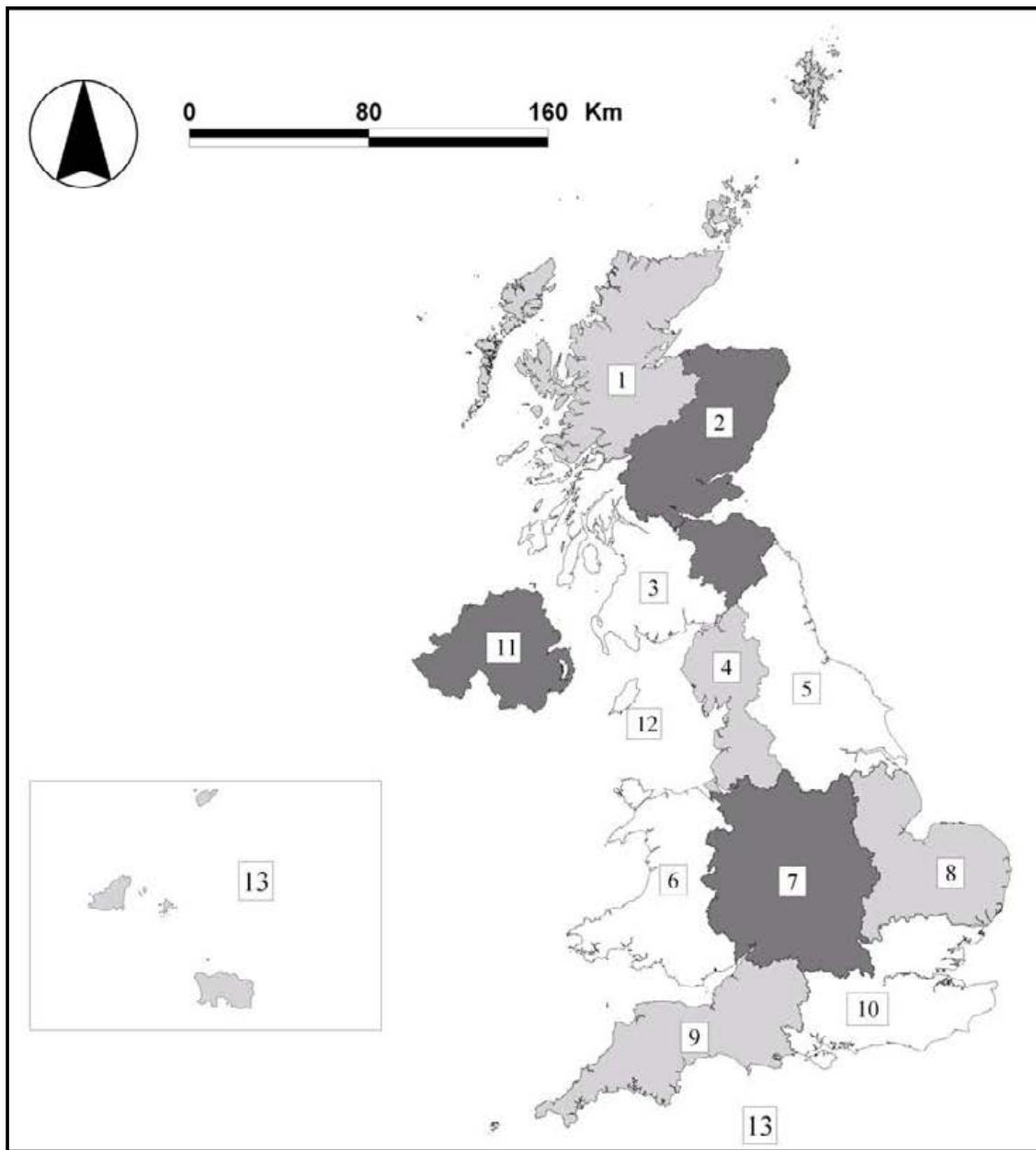


Figure 2.2.2.2 Regions used in analyses. 1 = north and west Scotland; 2 = east Scotland; 3 = south-west Scotland; 4 = north-west England; 5 = north-east England; 6 = Wales; 7 = midlands; 8 = East Anglia; 9 = south-west England; 10 = south-east England; 11 = Northern Ireland; 12 = Isle of Man; 13 = Channel Islands.

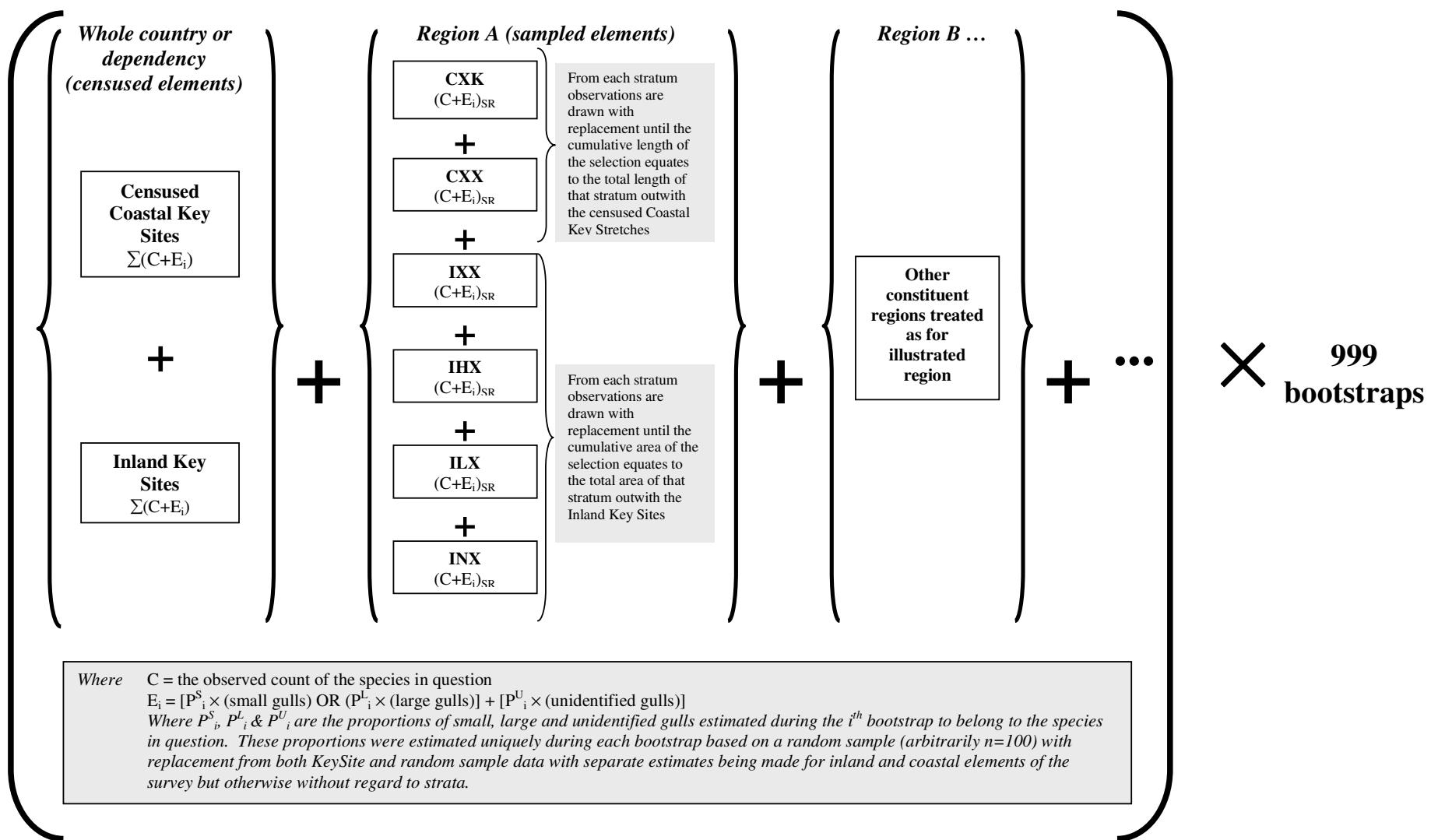
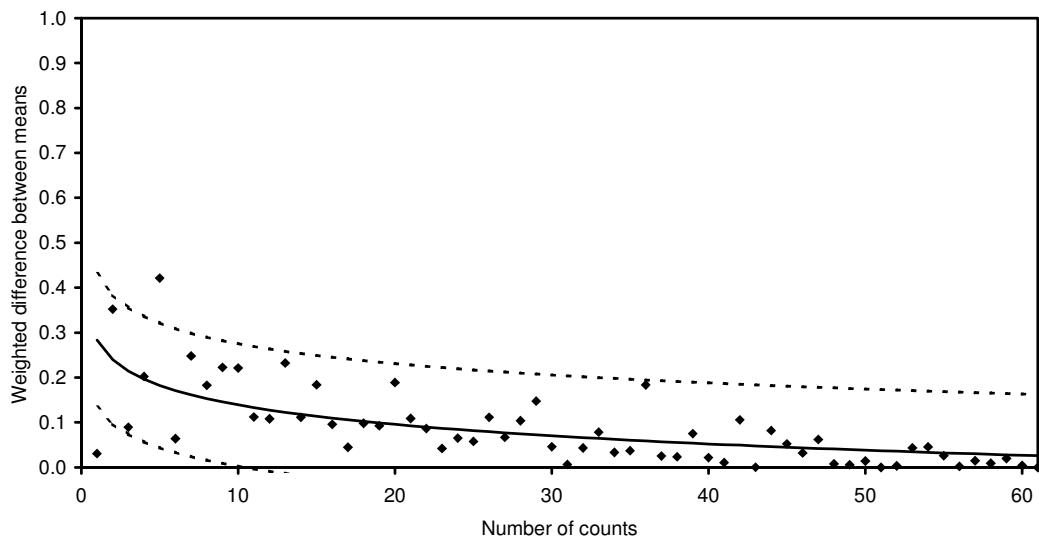


Figure 2.3.1.1 Schematic of the derivation of a single overall estimate for a given country or dependency for a given gull species. This process was bootstrapped to give 999 estimates. For each country or dependency, the population estimate and lower and upper 95% confidence limits were taken as the ascendant-ordered 500th, 25th & 974th values. Population estimates for Great Britain were similarly derived after first totalling the pre-ordered estimates for England, Scotland and Wales. See Tables 3.1.1 & 3.1.2 for definitions of strata.

a.

BH



b.

CM

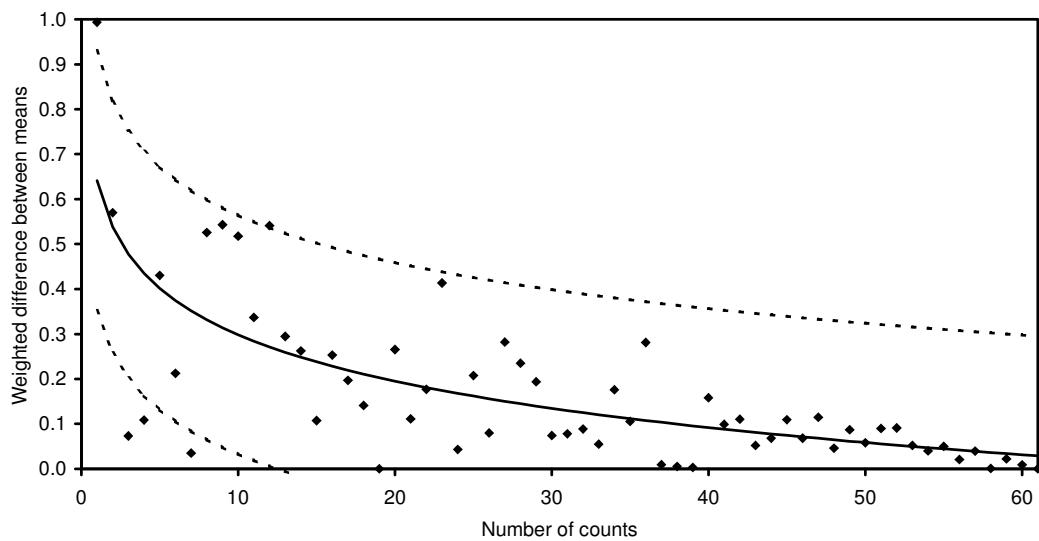
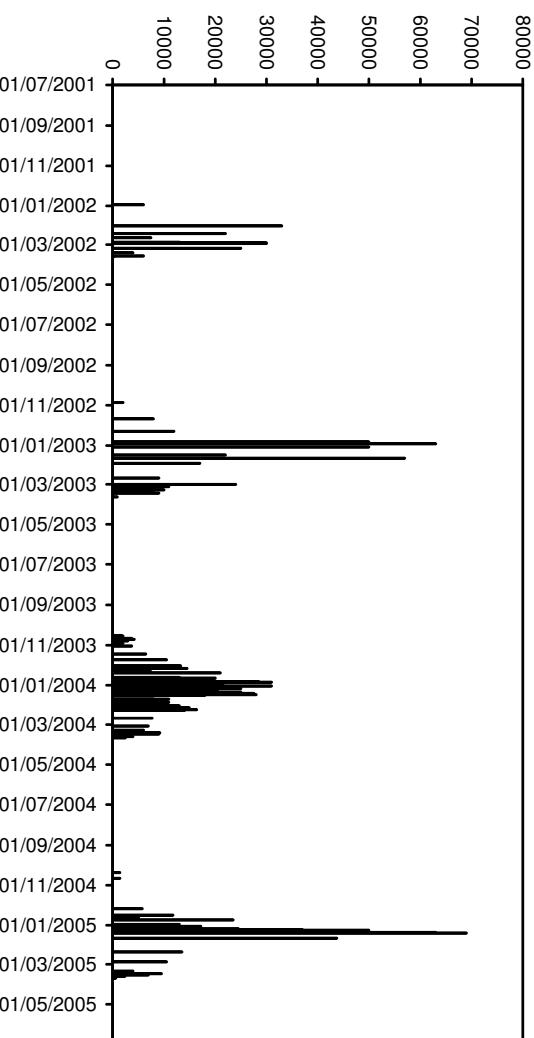


Figure 3.3.1 Effects of an increasing number of counts on the accuracy of the mean numbers of **a.** Black-headed Gulls (BH) and **b.** Common Gulls (CM) recorded at Bewl Water, Sussex over the winters of 2001/02 to 2004/05. Regression lines fitted to the data are shown with 95% confidence limits.

a.



b.

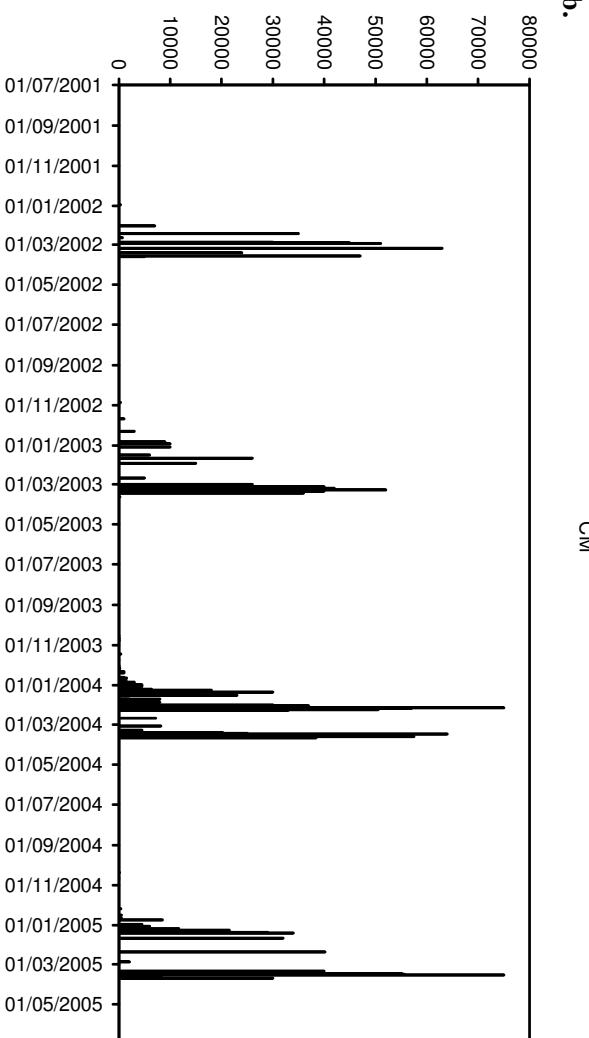
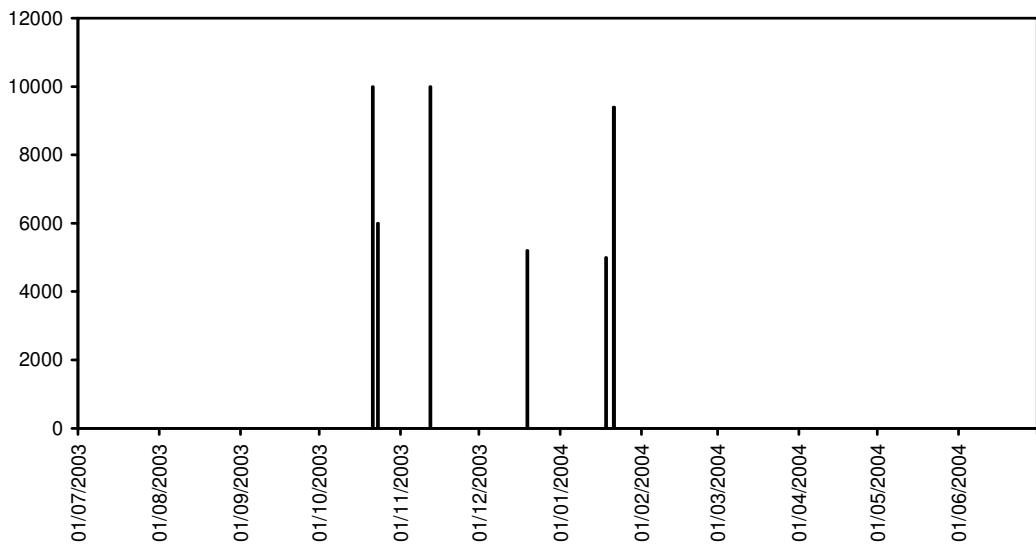


Figure 3.3.2 Counts of **a.** Black-headed Gulls (BH) and **b.** Common Gulls (CM) at Bewl Water, Sussex between 2001/02 and 2004/05.

a.

BH



b.

LB

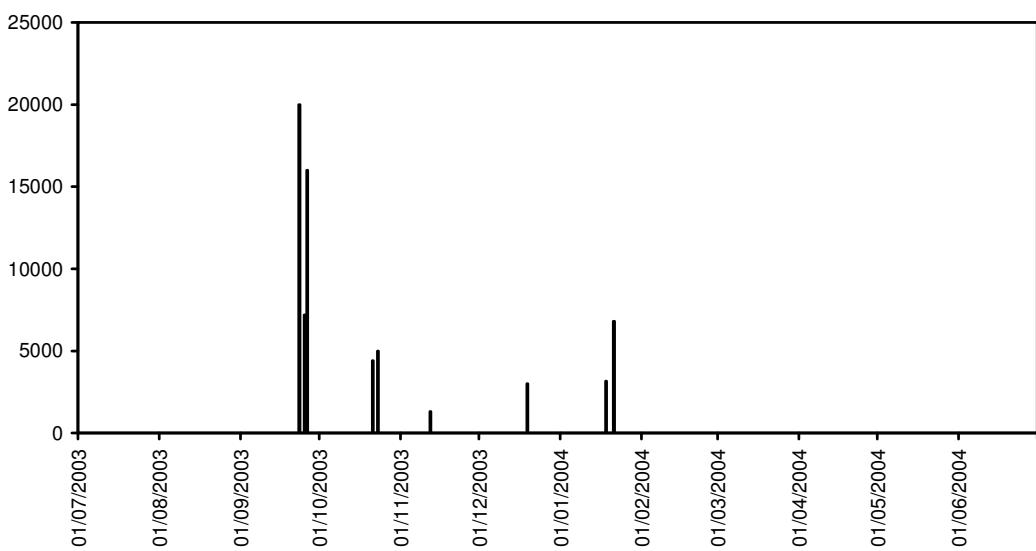
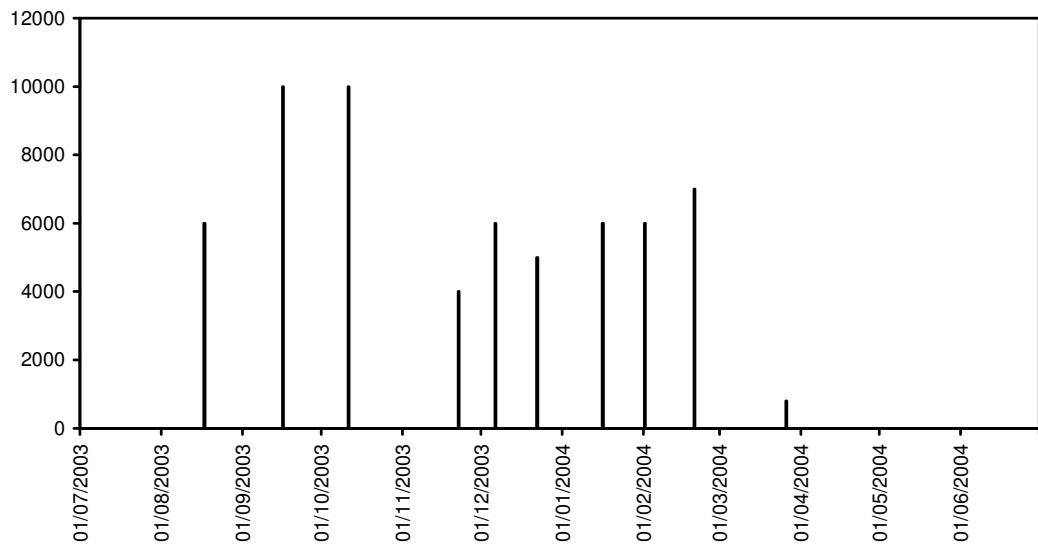


Figure 3.3.3 Counts of **a.** Black-headed Gulls (BH) and **b.** Lesser Black-backed Gulls (LB) at Theale Gravel Pits, Berkshire in 2003/04.

a.

BH



b.

CM

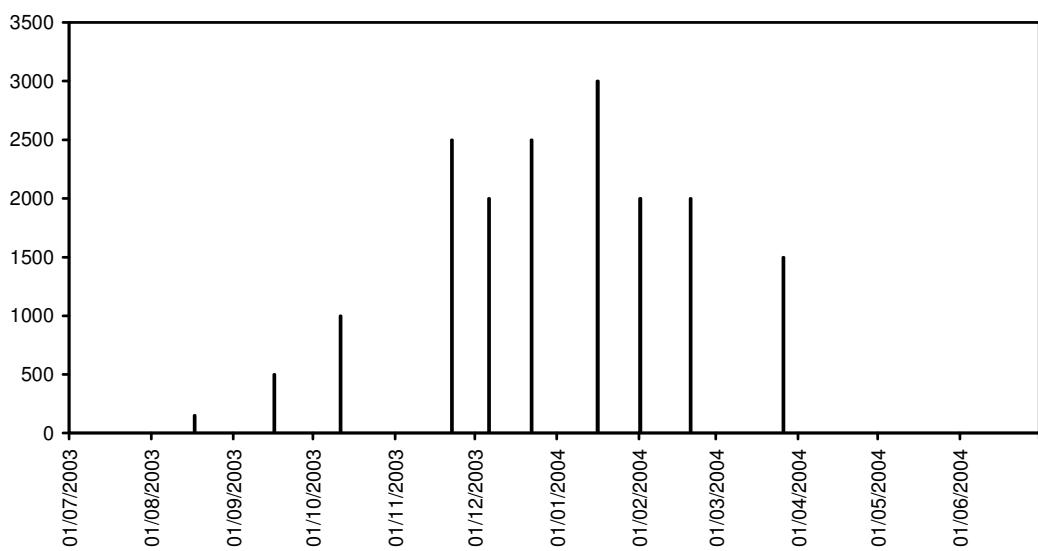


Figure 3.3.4 Counts of **a.** Black-headed Gulls (BH), **b.** Common Gulls (CM) and **c.** Lesser Black-backed Gulls (LB) at Pitsford Reservoir, Northamptonshire in 2003/04.

c.

LB

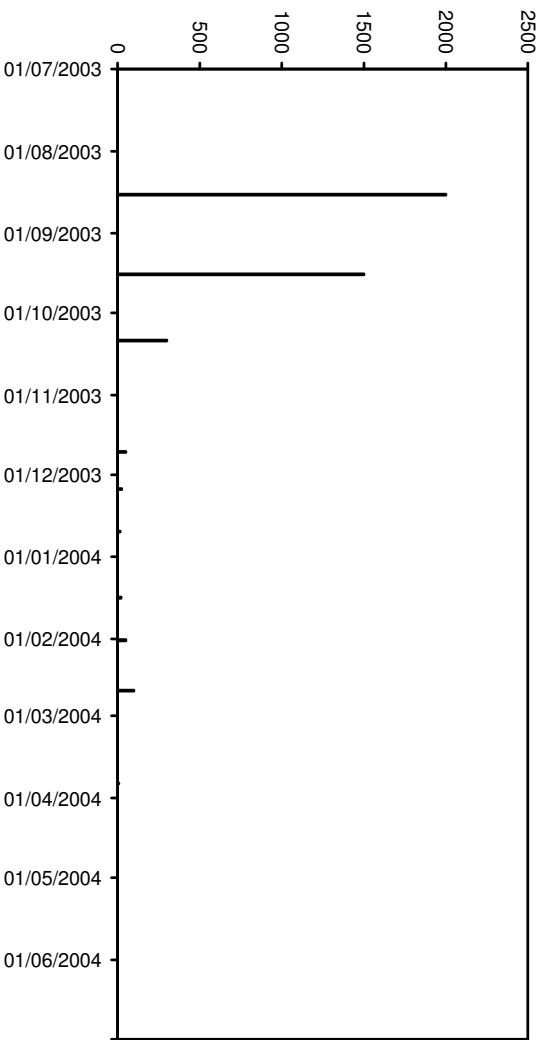


Figure 3.3.4 Continued.

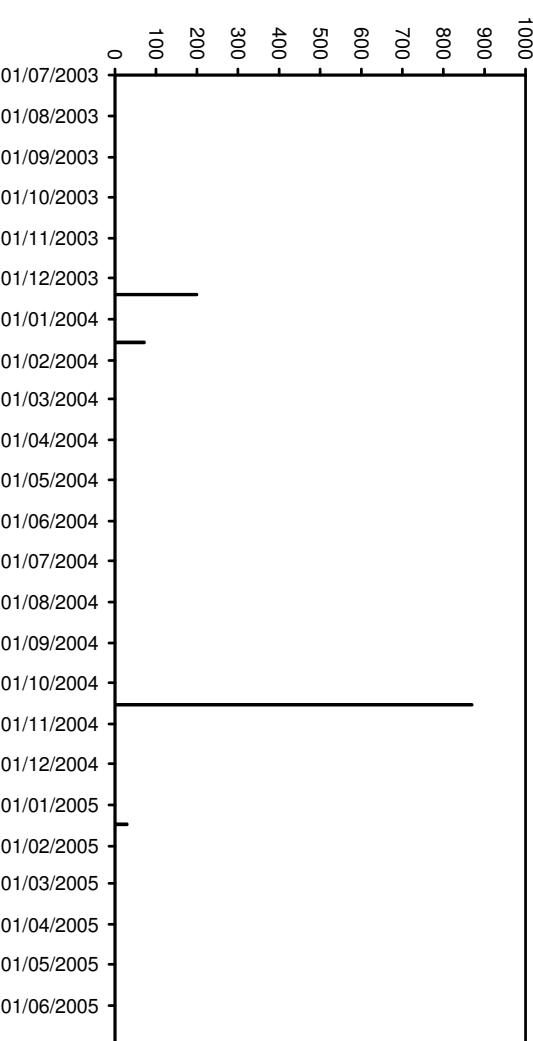
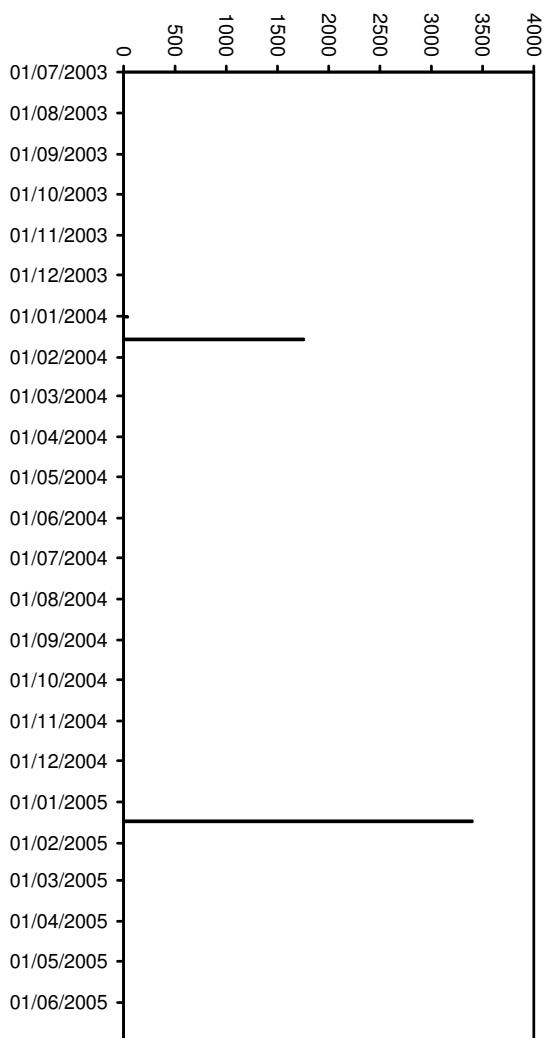
a.**b.**

Figure 3.3.5 Counts of **a.** Black-headed Gulls (BH), **b.** Lesser Black-backed Gulls (LB), **c.** Herring Gulls (HG) and **d.** Great Black-backed Gulls (GB) at Heaton Park Reservoir, Greater Manchester between 2003/04 and 2004/05.

c.



d.

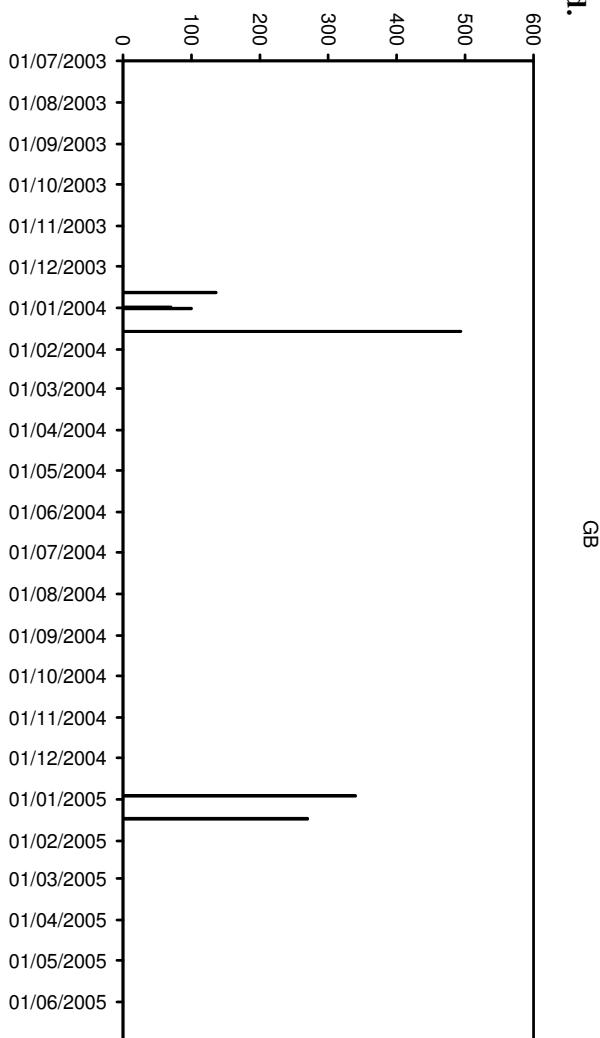
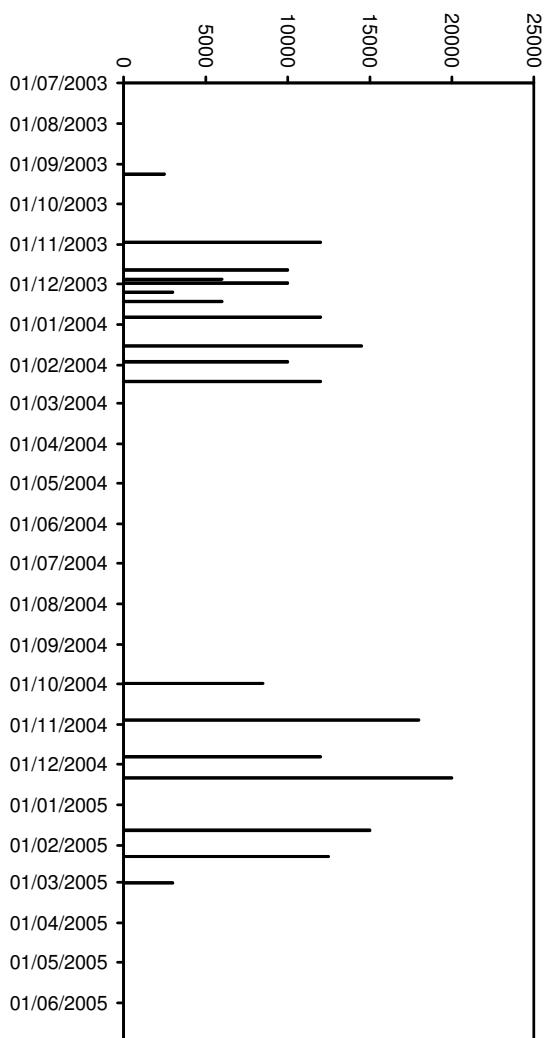


Figure 3.3.5 Continued.

a.



b.

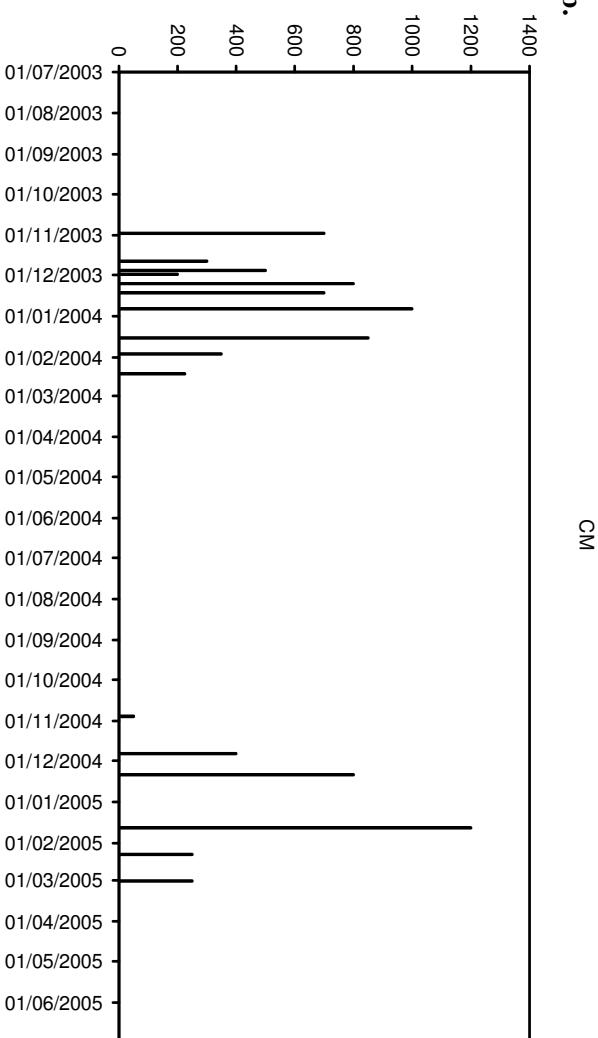


Figure 3.3.6 Counts of **a.** Black-headed Gulls (BH), **b.** Common Gulls (CM) and **c.** Lesser Black-backed Gulls (LB) at Hurleston Reservoir, Cheshire between 2003/04 and 2004/05.

c.

LB

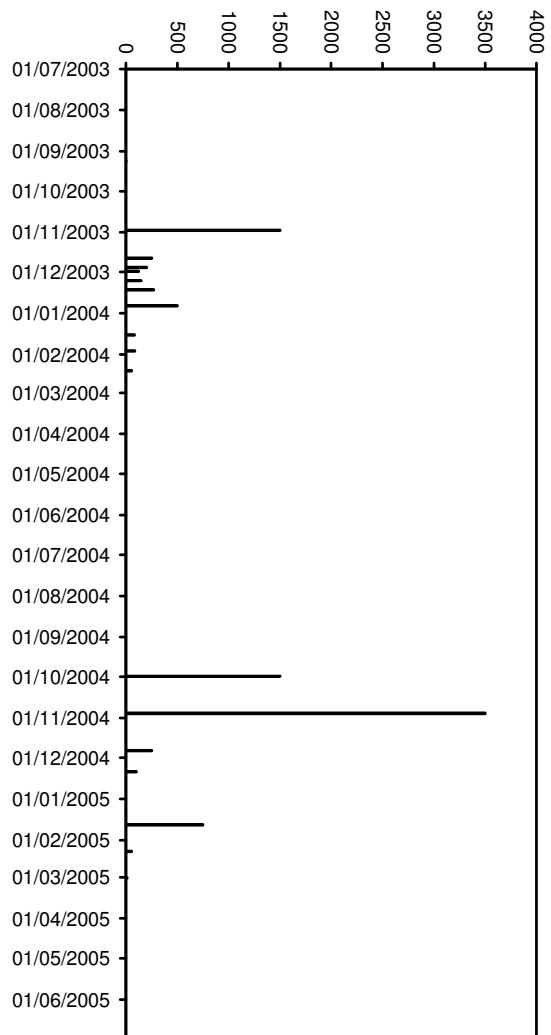
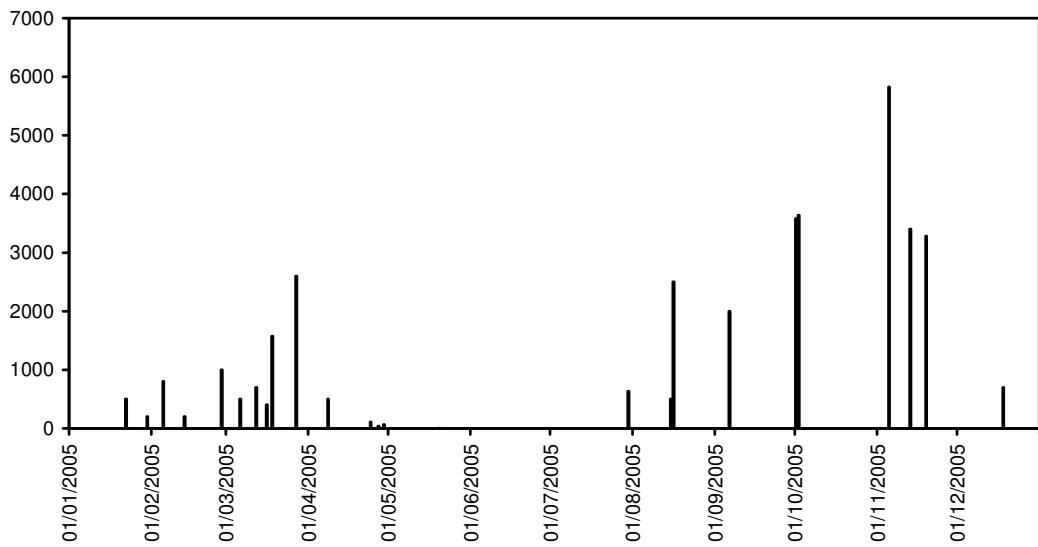


Figure 3.3.6 Continued.

a.

BH



b.

CM

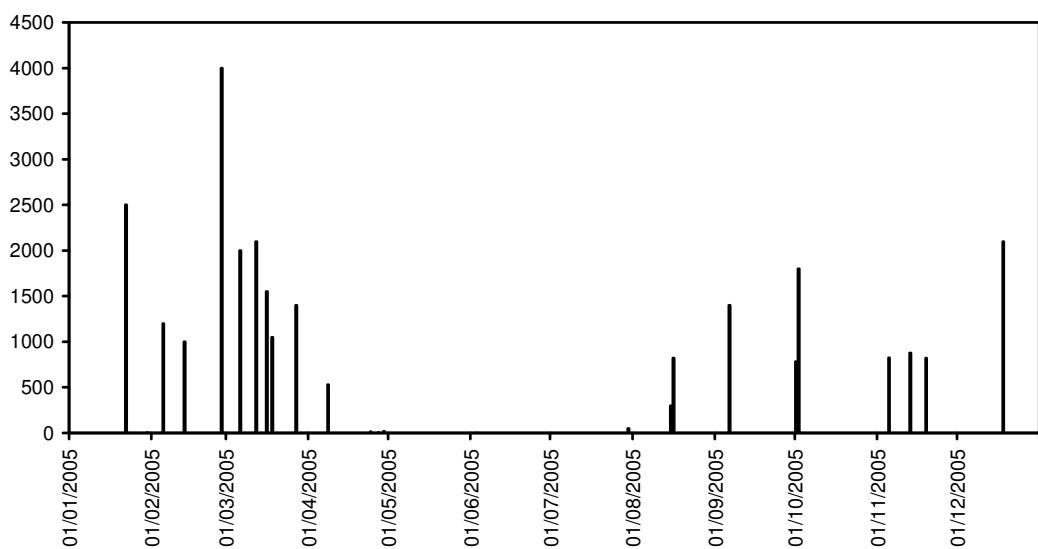


Figure 3.3.7 Counts of **a.** Black-headed Gulls (BH), **b.** Common Gulls (CM) and **c.** Herring Gulls (HG) at Seton Sands, Firth of Forth, Lothian in 2005.

c.

HG

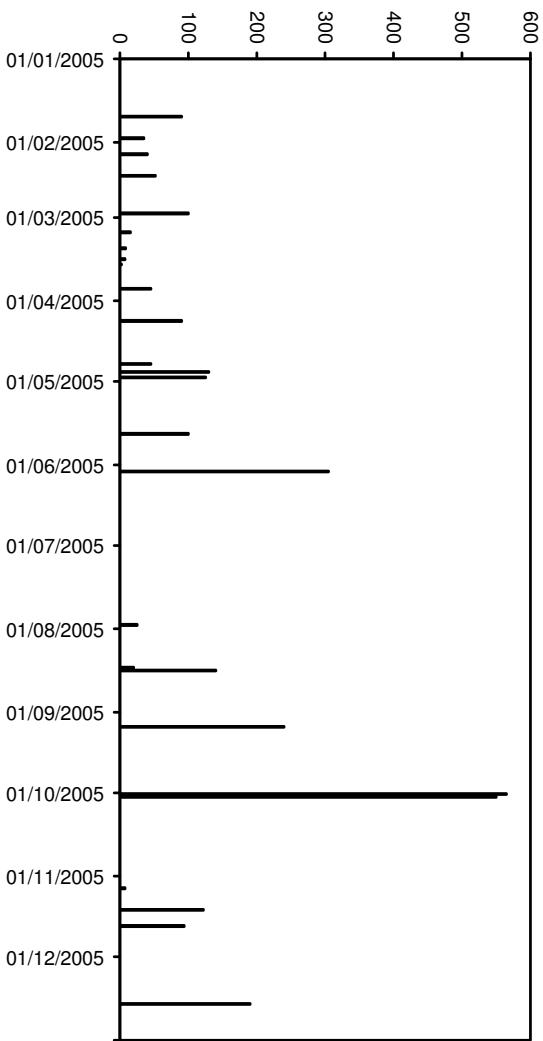
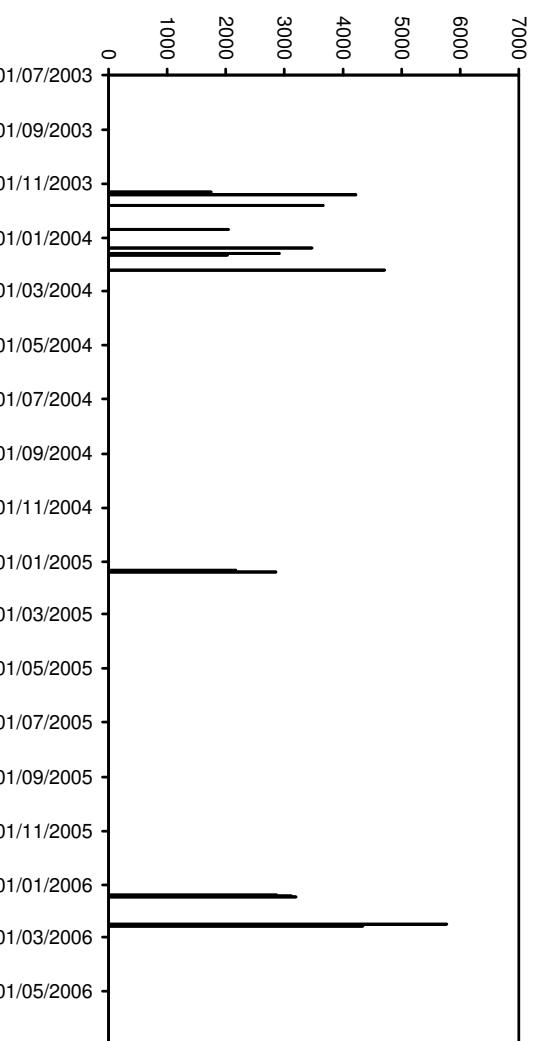


Figure 3.3.7 Continued.

a.



b.

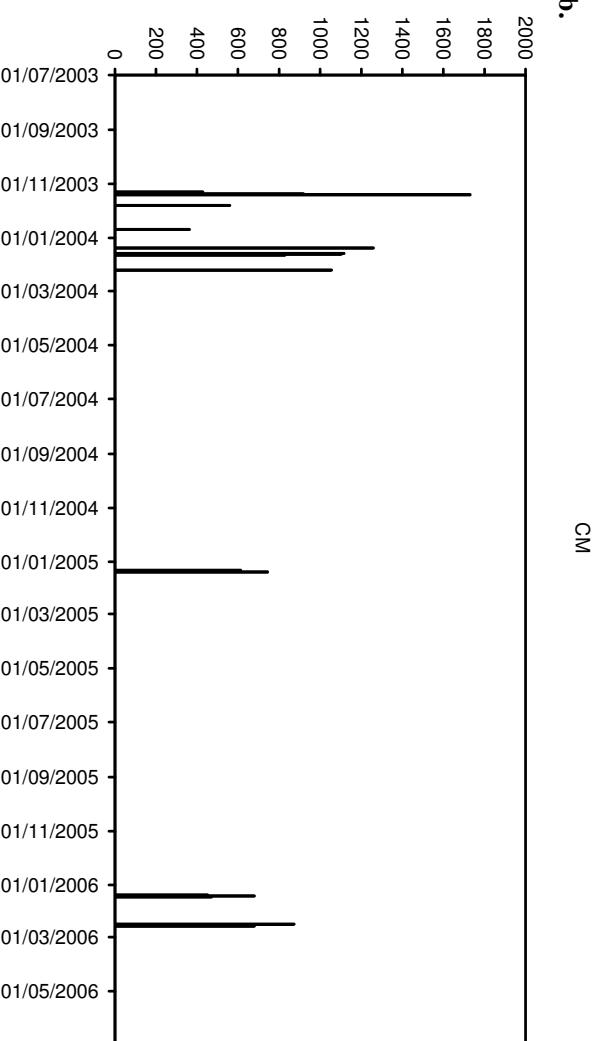


Figure 3.3.8 Counts of **a.** Black-headed Gulls (BH), **b.** Common Gulls (CM) and **c.** Herring Gulls (HG) in Swansea Bay (Mumbles to Brynmill) between 2003/04 and 2005/06.

c.

HG

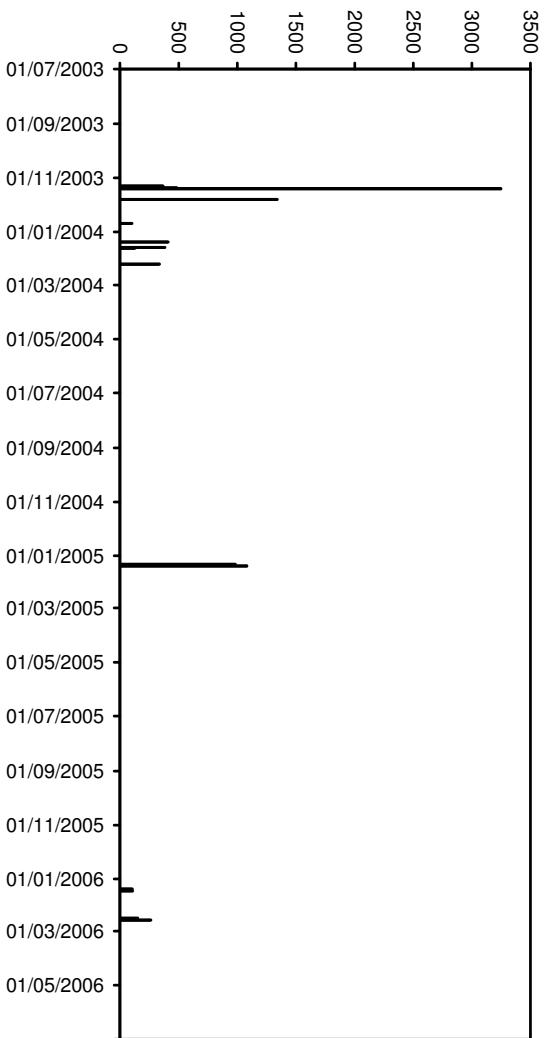


Figure 3.3.8 Continued.