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Waterbirds on English Sites of Special Scientific Interest: A review of the use made by non-breeding waterbirds of the English SSSI network

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EXECUTIVE SUMMARY

- Natural England is undertaking a comprehensive review of the coverage of species and habitats by SSSIs. As part of this work, information is required on the coverage of breeding and non-breeding bird populations. The latter is addressed by this report.

- Digital SSSI boundary data were matched spatially to Wetland Bird Survey (WeBS) Core Count sites, Non-estuarine Coastal Waterbird Survey (NEWS-II) count stretches and BirdTrack visit locations in order to determine which data from those schemes could be used to characterise numbers of non-breeding waterbirds supported by the SSSI network within England.

- Estimates were based as far as was possible on data from WeBS using the five-year mean of peak winter counts across all sites. These were supplemented where possible by data from NEWS for open coast SSSIs where Core Count data were not available. Additionally, for non-coastal SSSIs where no Core Count data were available, data from BirdTrack were used where these appeared to be sufficiently complete to approximate an analysis similar to that used for the Core Count data.

- Core Count data and NEWS data were also used to derive estimates for total numbers of each waterbird species in England, following methods currently being used to generate revised population estimates for Great Britain.

- We report the percentage of total numbers of each species of waterbird across England that are supported by the SSSI network. Fifty species for which we are relatively confident of the results are reported in the main body of the report. Details for a further 31 species recorded regularly by WeBS during the five-winter period 2004/05 to 2008/09 are available in a Microsoft Excel Workbook that forms part of this report.

1. INTRODUCTION

Natural England is undertaking a comprehensive review of the coverage of species and habitats by SSSIs. As part of this work, information is required on the coverage of breeding and non-breeding bird populations. The latter mostly involve waterbirds, which are well monitored by the Wetland Bird Survey (WeBS).

Here we report on data collected by WeBS for sites that are coincident with English SSSIs (regardless of statutory interest features), supplemented by data collected by the most recent Non-estuarine Waterbird Survey 2006/07 (NEWS-II) and the BTO run BirdTrack scheme, with the principal aim being an assessment of the proportion of the English total of each waterbird species that occurs on the SSSI network.

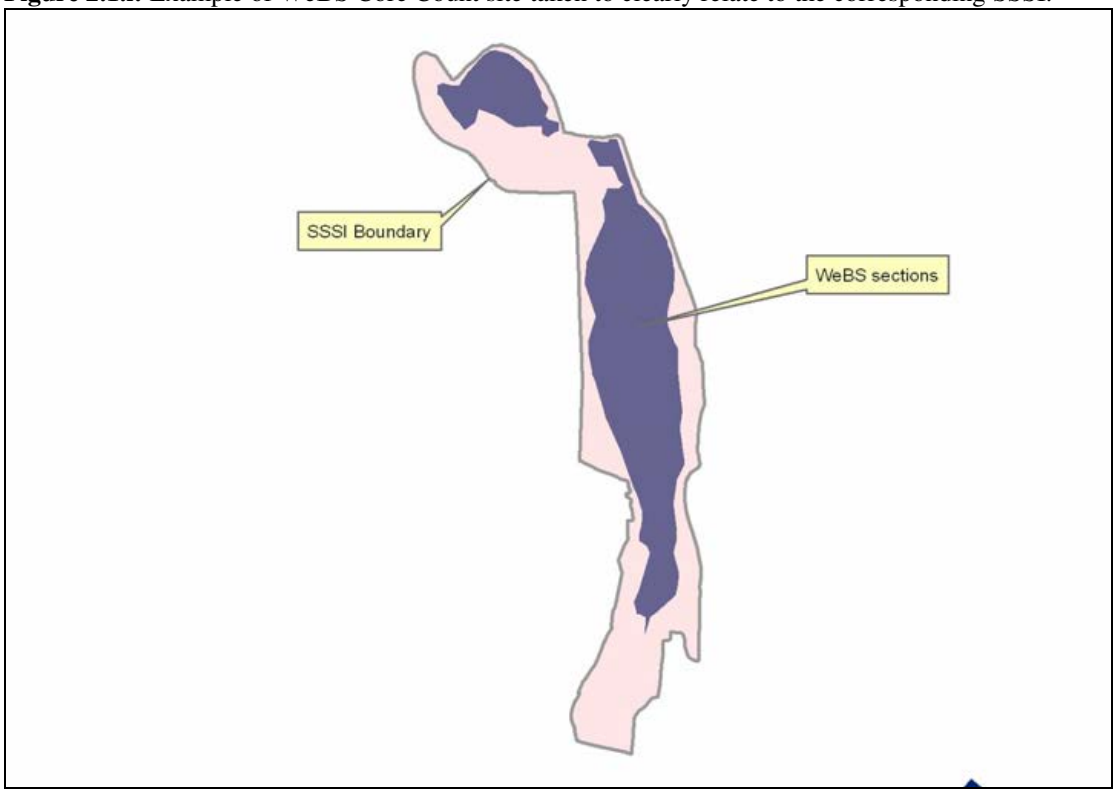
To facilitate this work, a comprehensive assessment was made of the spatial coverage of the SSSI network by the WeBS Core Counts survey and coverage of the SSSI network along the open coast by NEWS. This has, therefore, had the incidental benefit of identifying gaps in the WeBS coverage of the SSSI network which thus become high priority for obtaining future coverage.

2. METHODS

2.1 Assessment of spatial coverage of SSSIs by WeBS

The first task required was to relate WeBS count sites to SSSI boundaries. The latest available (as of October 2010) English SSSI boundaries were downloaded as ESRI shapefiles from the Natural England website to ensure we using the most up to date versions. All known boundaries of WeBS count sections are held on GIS by BTO. Within ArcView GIS v10, we used a spatial join to identify all WeBS Core Count sites that are coincident with SSSIs. Furthermore, the proportional overlap was calculated in order to differentiate between those cases where the water bodies being counted for WeBS clearly relate to the corresponding SSSI as in the example given in Figure 2.1.i, and those instances where there is trivial overlap, for example where a woodland SSSI occurs alongside a water body itself not part of the SSSI and the overlap is due to imprecise digital data capture. All instances where the WeBS site constituted less than 10% of the SSSI area were closely inspected using comparisons against aerial and satellite imagery within the GIS and expert opinion (NAC) to assess whether waterbirds from the WeBS site could be expected to be using the SSSI. Those cases such as flood meadow SSSIs, not counted by WeBS but adjacent to WeBS sites were thus differentiated from cases such as woodland SSSIs unlikely to be utilised by waterbirds from abutting WeBS sites.

Figure 2.1.i: Example of WeBS Core Count site taken to clearly relate to the corresponding SSSI.



Some sites, for example the Cotswold Water Park, have several SSSIs within the boundary of a single WeBS site or only cover a small part of that WeBS site. Where the WeBS site involved was a multi-section site, the spatial data were used to determine which WeBS count sectors were contained within or substantially overlapped these SSSIs.

Having undertaken these spatial comparisons against WeBS Core Count sections, a large number of SSSIs remained for which WeBS Core Count data were not available. While the majority of these may have been notified for other than waterbird features, and indeed may contain no waterbodies capable of supporting waterbirds, it was considered that further investigation was necessary. This involved undertaking a spatial join within the GIS of SSSI boundaries with a GIS layer of waterbodies prepared as part of the ongoing "WeBS stratification" work and based heavily on digital

data from the Ordnance Survey MasterMap® validated against OS 1:25,000 raster data, Google Earth® and Bing Maps®. The likelihood of these SSSIs supporting notable numbers of waterbirds was classified as negligible where there was no corresponding waterbody, and low if there was less than one hectare of water. All cases where a SSSI contained at least one hectare of water within its boundary were compared against aerial and satellite imagery within the GIS (Figure 2.1.ii) and expert opinion (NAC) used to assess the likelihood of waterbirds occurring on these areas judging by the size and surrounding habitat of the water. The likelihood of waterbirds being present on these SSSIs was then classified as medium or high. Furthermore, information on each of these SSSIs was sorted using a web search engine and reference to county bird reports and local county websites (e.g. http://www.manchesterbirding.com/index.htm).

Figure 2.1.ii: Example of use of aerial and satellite imagery to determine whether a SSSI for which there are no corresponding WeBS data can be expected to support waterbirds. Note the discrepancy in the projection of imagery against digitised site boundaries (this was allowed for during interpretation). This illustrates an example where the probability of the SSSI supporting notable numbers of waterbirds would be considered high.

2.2 Assessment of spatial coverage of SSSIs by other surveys

Further attempts were made to obtain data for SSSIs determined to have a high or medium potential to support waterbirds but for which no WeBS data were available.

The BTO also holds spatial data for NEWS count stretches and similar spatial comparisons were undertaken to identify further areas of SSSIs not covered by the more comprehensive WeBS Core Counts.

Attempts were also made to glean data from county bird reports but it rapidly became apparent that this would not provide systematic data and regardless, those data that could be extracted from such sources was sparse. This approach was therefore abandoned.

We also considered data obtained through the BTO/RSPB/BWI/SOC BirdTrack scheme. BirdTrack data are recorded against an observer-defined site name. The sites are initially assigned to a nominal one-kilometre grid reference, although observers are then encouraged to describe whether their site actually fits neatly within this one-kilometre grid square, or within the associated tetrad (two x two kilometre square), or ten x ten kilometre square, or overlaps a 10-km square boundary. Although BirdTrack visits are undertaken using an "as and when" approach and do not follow a formal pattern of planned visits, for popular sites visits often occur with sufficient frequency to approximate WeBS methodology. For each SSSI determined to have a high or medium potential to support waterbirds but for which no WeBS or NEWS data were available, the name of the SSSI was compared against those of BirdTrack sites within the same 10km square. For many cases considered, a BirdTrack site name had an identical match to a SSSI name (e.g. Bentley Priory) and thus could be assigned to that SSSI with a high degree of confidence. In other cases, although names were similar they were only approximate matches (e.g Croft Pasture SSSI and Croft Glebe BirdTrack site). In such cases aerial and satellite imagery and Ordnance Survey 1:25,000 maps were used to assist in the decision of whether to consider them to be the same site or different sites. For example, when both names appear on an Ordnance Survey map then they are unlikely to refer to the same site whereas when there is only one location surrounded by otherwise unsuitable habitat for waterfowl and unlikely to merit SSSI notification, then they are likely to refer to the same site.

2.3. Estimation of English waterbird numbers

2.3.1. Waterbird data used

WeBS provides the most comprehensive monitoring of Britain's waterbirds. Pre-defined wetland sites are visited monthly by volunteer counters, the majority of counts being carried out on a pre-selected date to minimise the risk of double counts of birds moving between sites. WeBS counts take place all year, but coverage is substantially higher in the non-breeding season, between September and March. Over 2,000 sites are counted each year, with many of the larger sites subdivided into smaller count units and covered by coordinated teams.

The methods used here for extrapolating counts from WeBS sites to estimate waterbird populations within England follow closely those currently being used to produce revised population estimates for Great Britain (Musgrove *et al*. in prep). The majority of data used in the analyses relate to counts made in the five-winter period 2004/05 to 2008/09. The "non-breeding season", for the purposes of the estimates presented here, is defined as September to March for all species. It should be noted that this differs slightly to what has been used for previous estimates for waders, e.g. Rehfisch *et al.* 2003 where the non-breeding season was defined as November to March. Wader counts for September and October were previously omitted due to concerns about passage numbers inflating the picture for the non-breeding season. However, amongst the more numerous species, only Ringed Plover *Charadrius hiaticula* and Sanderling *Calidris alba* show very pronounced peaks in numbers on passage compared to the winter, and these typically occur in August and May (and are hence still omitted from the analyses). Furthermore, WeBS coverage is highest from September to March (and hence the dataset is most robust at this time).

Although coverage by WeBS is excellent for estuaries, and is also very good for the larger inland still waterbodies in lowland Britain, coverage of smaller lowland still waters, upland still waters, rivers and the open coast (between estuaries) is much less complete. Although the largest concentrations of most species of waterbirds are covered by WeBS, these other habitats collectively add up to a large resource which is utilised by different species to a greater or lesser extent. Moreover, some species of "waterbirds" use more terrestrial habitats, either for part of the day (such as many geese and gulls, feeding in terrestrial habitats but returning to roost on waterbodies overnight) or more generally (such as Lapwing *Vanellus vanellus*, Golden Plover *Pluvialis apricaria*). Additional data sources thus needed to be consulted for many species (again, see Musgrove *et al.* in prep. for further details).

Although WeBS Core Counts cover some important stretches of the non-estuarine coasts of England, most of the rocky and sandy shores are only surveyed on a roughly decadal basis, by a one-off mid-winter count of a large proportion of the coast. As the coast of Britain is too long to cover in entirety, count stretches are selected randomly to allow reliable estimation of the total numbers of birds using the open coasts (Austin *et al*. 2008). The latest such Non-estuarine Coastal Waterbird Survey (NEWS) was undertaken in December/January 2006/07.

There are a number of species for which none of the present surveys allow defensible population estimates to be made and for which previously published estimates have been relied of supposition rather than objective data (Woodcock, Snipe, Jack Snipe, Water Rail, Moorhen). Numbers of these species are believed to be grossly underestimated on monitored sites and additionally only a small proportion of their populations are believed to occur on such sites. We therefore do not report on these species.

It is important to note that the approach used to generate English estimates follows that in preparation for British estimates (Musgrove et al. in prep.) It is possible that slight changes to estimate generation techniques may be required prior to final publication of the British estimates, which would then ideally imply a change to the British estimates (outwith the scope of this current project). However, it is thought unlikely that any such changes would have a significant effect on the findings of the current report.

2.3.2. Extrapolation to uncounted sites

Kershaw & Cranswick (2003), used extrapolation factors for the more widespread wildfowl species; these factors were used to multiply up the numbers of birds found during WeBS. The factors were based on three intensive studies in several parts of England, and effectively compared the number of each species counted during an attempt at "complete" coverage, with the number counted at the standard WeBS sites. Whilst acknowledging a number of potential issues with this approach, Musgrove *et al*. (in prep) have followed a similar approach for the waterbirds concerned (principally wildfowl) but have derived new extrapolation factors incorporating data from a further two sources aimed at increasing the representativeness of the intensive studies. All these intensive sites were in fact within England. These revised extrapolation factors (Table 2.3.2) have been used for the present estimates for England.

Table 2.3.2: Extrapolation factors from Musgrove *et al*. (in prep) used here to scale total numbers summed across WeBS sites to give population estimates for England.

Species	Factor
Mute Swan *Cygnus olor*	**2.79**
British-breeding Greylag Goose *Anser anser*	**2.13**
Greater Canada Goose *Branta canadensis*	**2.59**
Common Shelduck *Tadorna tadorna*	**1.02**
Eurasian Wigeon *Anas penelope*	**1.05**
Gadwall *Anas strepera*	**1.24**
Eurasian Teal *Anas crecca*	**1.24**
Mallard *Anas platyrhynchos*	**4.32**
Pintail *Anas acuta*	**1.04**
Shoveler *Anas clypeata*	**1.21**
Common Pochard *Aythya ferina*	**1.31**
Tufted Duck *Aythya fuligula*	**1.54**
Common Goldeneye *Bucephala clangula*	**1.31**
Goosander *Mergus merganser*	**3.44**
Little Grebe *Tachybaptus ruficollis*	**2.46**
Great Crested Grebe *Podiceps cristatus*	**1.68**
Great Cormorant *Phalacrocorax carbo*	**1.70**
Moorhen *Gallinula chloropus*	**17.97**
Common Coot *Fulica atra*	**1.38**

2.3.3 Analytical methods

For the majority of waterbird populations, data from all English WeBS sites were extracted from the WeBS database. Whilst coverage of the most important sites is generally excellent, there are inevitably occasions when the regular sites go uncounted. Estimates in place of missing counts are generated routinely by WeBS during the preparation of the WeBS annual indices using the Underhill indexing method (Underhill and Prŷs -Jones 1994). While typically, this method is only applied to sites for which at least 50% of possible counts have been obtained (the 50% rule) this is now considered overly restrictive (Underhill pers. comm.) or even unnecessary (Frost 2010). Accordingly, in order to extend the imputation to allow missing counts to be imputed across all sites, a two stage approach was used. In stage one the 50% rule was imposed as is traditional and thus a complete matrix of counts (comprised of actual and imputed counts) was obtained for all sites for which at least 50% of potential counts were available. Essentially this included the vast majority of major waterbird sites counted by WeBS in England (including all Special Protection Areas for which WeBS holds data). Stage two involved fixing the values for all counts from the sites included in stage one (essentially treating them all as actual counts) and then running the Underhill Indexing analysis across all WeBS sites without evoking the 50% rule. This two stage approach ensured that unusual site trends, perhaps artefacts of poor coverage or due to the small numbers of birds often associated with some of the less well monitored sites, were prevented from unduly influencing trends on well monitored sites. This ultimately resulted in a complete matrix of counts, actual or imputed, across all WeBS sites in England. A final visual check was made of this matrix of counts to ensure that no unreasonable values had been imputed for sites with particularly poor coverage during stage two.

The sites in the WeBS dataset are readily identifiable as inland, estuarine, or non-estuarine coastal. It is thus possible to sum counts across sites to obtain a total (per species/month/year) for each of these three broad habitat classes. As stated earlier, WeBS is known to cover only a relatively small proportion of the non-estuarine coast of Britain, whereas NEWS gives good estimates of the total numbers of birds present in this habitat. However, as NEWS was a single count, in January 2007, an estimated NEWS-equivalent total for each month of the five winters under consideration was generated, by using the ratio of the non-estuarine WeBS total in any given month to the non-estuarine

WeBS total in January 2007. Then, for each month, the non-estuarine component of the WeBS total was replaced with the estimated NEWS-equivalent.

Following this, totals were summed across these three broad habitat classes. For each of the five winters 2004/05 to 2008/09, the peak English total was then selected for each species, and then the mean of the winter peaks over the five winters was calculated. These "five-year peak-means" represent the entire coast (estuarine and non-estuarine), plus counted inland WeBS sites. Thereafter, for appropriate species, estimates were scaled upwards by the extrapolation factors in Table 2.3.2.

Although this approach was followed for all species, for some species (i.e. those for which WeBS methods are not the most suitable for monitoring, such as seaduck, many geese, etc) it was felt that the results were not sufficiently representative of the true population size. In such cases, alternative data sources were consulted and used instead (e.g. Gillings & Fuller 2009; O'brien *et al*. 2008); further details are given in Musgrove *et al.* in prep. and are summarised in the Excel workbook accompanying this report.

English population estimates have been rounded by the following convention: estimates over 100,000 rounded to nearest 10,000; estimates over 10,000 rounded to nearest 1000; estimates less than 10,000 not rounded.

2.4. Estimation of waterbirds supported by English SSSIs

Estimates for the total numbers of waterbirds supported by the English SSSI network were obtained by summing estimates obtained from all WeBS sites coincident with SSSIs (a subset of those data used to derive the English population estimates) with counts from NEWS-II for NEWS count stretches that were coincident with SSSIs but not with areas already encompassed by the WeBS Core Count Sites, and with estimates derived from BirdTrack for SSSIs not covered by either of the other two surveys.

Although the boundaries of WeBS sites and SSSIs are rarely if ever in complete agreement, in most cases it is reasonable to assume that the waterbirds counted within the WeBS site are representative of the numbers using the SSSI. For example, at many coastal sites the SSSI boundary will not extend to agricultural fields or industrial hard-standings and car parks behind the sea wall whereas many waterbirds will be counted on such areas by WeBS having been displaced from within the SSSI by the high tide. Similarly, inland WeBS sites may take in areas of public recreational areas or agricultural habitat adjoining the waterbody that constitutes the SSSI. Thus in most cases counts from the entire WeBS site are used to characterise the numbers on the associated SSSI. Often this is not a one to one match, with some SSSIs encompassing multiple WeBS sites and some WeBS sites encompassing multiple SSSIs. In some cases however, there is only a partial match between WeBS sites and SSSI boundaries to the extant that many more waterbirds may be using the WeBS site than can be argued are using the associated SSSI(s). For example, Cotswold Water Park contains many lakes that lie outwith the four SSSIs that it encompasses. Similar situations were found for a number of other multi-part WeBS sites including Lea Valley Gravel Pits, Somerset Levels, Wraysbury Gravel Pits, Arun Valley and Colne Gravel Pits amongst others. In such cases waterbird counts were derived at the sub-site level by consolidating the counts across WeBS count sectors using the best spatial match obtainable.

Using a similar approach to that used for deriving the English estimates, counts from WeBS sites coincident with SSSIs were summed across all sites by month, and then the peak totals for each winter averaged to obtain five-year peak-means for each species. This was taken to characterise the numbers of waterbirds across SSSIs monitored by WeBS Core Counts.

The numbers of waterbirds to be found on SSSIs or parts thereof monitored by NEWS but not WeBS Core Counts were characterised simply by summing all counts across all appropriate NEWS count stretches.

The numbers of waterbirds to be found on SSSIs not monitored by either of the previous surveys but regularly visited by BirdTrack observers were characterised in a manner similar to that used for sites monitored by WeBS Core Counts. However, because the BirdTrack visits do not target specific dates then counts may not be available for some months whilst multiple counts may be available for other months. Thus in lieu of a single monthly count the maximum count for each species was taken and these summed across all sites. While the use of the maximum count for a given site in a given month would tend to bias the estimate upwards, on balance fewer counts were generally available for a given site across the whole of a winter than is typical for WeBS counts and so this is not considered to be a major issue. Indeed given the gaps in the data matrix across these BirdTrack sites, the characterisation of waterbird numbers across all such sites as the five-year peak-means for each species should still be considered as minimal estimates.

The overall estimates of waterbird numbers across all monitored SSSIs are taken to be the sum of the estimates from each of the three schemes. No attempt has been made to extrapolate waterbird numbers across those SSSIs not monitored by any of the above schemes. Consequently, estimates of numbers on the SSSI network should be considered conservative. This would be expected to be particularly marked for species with a wide inland distribution.

3. RESULTS

3.1 SSSI coverage by the three schemes

The spatial data obtained from the Natural England website included boundaries for 4,117 SSSIs. A full list of these, together with details of which survey scheme data were used to estimate the total numbers of waterbirds held by each are available in the "DataSources" sheet of the Microsoft Excel Workbook that forms part of this report. Of these, 661 corresponded wholly or in part with WeBS Core Count sites. An additional 102 SSSIs corresponded wholly or in part with NEWS count stretches, whilst NEWS count stretches supplemented estimates for a further 44 SSSIs already partially covered by data from WeBS Core Count sites, but where the SSSI boundaries extended along the open coast beyond the full extent of the WeBS Core Count sites. Data obtained from BirdTrack were used to estimate waterbird numbers for a further 101 SSSIs. Thus, overall data were obtained for 864 of the 4,117 SSSIs (Table 3.1.i).

Table 3.1.i: Number of SSSIs corresponding to sites monitored by the three surveys considered.

Data source	Number of corresponding SSSIs
WeBS (whole or partial site)	617
NEWS	102
WeBS + NEWS	44
BirdTrack	101
No data	3,253

Given the relative robustness of the estimates obtained from the various sources it is important to note that the overwhelming majority of individual waterbirds contributing to the estimates will be from the 617 WeBS Core Count sites as these include all the major estuarine SSSIs and larger inland water body SSSIs. In the case of data from the NEWS count stretches these will be particularly important for a small number of waders, principally Turnstone, Ringed Plover, Purple Sandpiper, Sanderling, Curlew, Oystercatcher and Redshank. Data from BirdTrack mainly relates to inland SSSIs supporting small numbers of individuals.

It is also important to note that the 3,253 SSSIs for which no monitoring data were available does not represent a particularly large gap in coverage. These relate almost exclusively to inland SSSIs and of these only 215 were determined, by spatially matching GIS boundary data to Ordnance Survey MasterMap® data, to contain water bodies. The remaining 3,038 were therefore considered as having a negligible likelihood of supporting waterbirds. Of those 215 SSSIs containing standing water, we consider 143 to have a high likelihood of supporting notable numbers of waterbirds (large expanse of water and / or suitable habitat), 14 to have a medium likelihood (small expanse of water surrounded by unsuitable habitat) and the remaining 58 being too small or unsuitable to support more than trivial numbers of a few of the more ubiquitous species (Table 3.1.ii.).

Table 3.1.ii: Proportion of SSSIs determined to contain notable bodies of water for which we have no data on waterbird numbers, relative to those for which waterbird data were available.

Likelihood of supporting notable numbers of waterbirds (based on habitat discernable from Ordnance Survey maps, Bing Maps® & Google Earth®)	Number of SSSIs for which we have no waterbird data	Total number of SSSI	Proportion (%)
Negligible	3,038	4,117	80%
Low	58	85	68%
Medium	14	25	56%
High	143	867	16%

3.2 Estimation of proportions of waterbirds in England supported by the SSSI network

Estimates of the number of wintering waterbirds for England as a whole and across the SSSI network for all species of waterbird that have been recorded by WeBS during the winters 2004/05 to 2008/09 and for which we are reasonably confident in the estimates for England are available in the "Estimates" sheet of the Microsoft Excel Workbook that forms part of this report.

The same information is given below in Table 3.2.i, having first excluded those species that are:

- not considered to be well monitored by WeBS and to a lesser extent the other surveys (such as Snipe, Water Rail and Moorhen);
- only recorded in small numbers (arbitrarily those for which the English estimate is less than 100 individuals such as Slavonian Grebe, Velvet Scoter);
- principally summer visitors but occur in small numbers during the window for winter months used here (such as terns, Little Ringed Plover and Garganey);
- introduced (such as Canada Goose and Ruddy Duck); that occur principally on autumn or spring passage (such as Little Stint and Ruff);
- those for which individuals for coastal SSSI not extending beyond the shoreline are typically out to sea and beyond the limits of those SSSIs (such as divers, sea-duck and Shag);
- those for which individuals for coastal SSSI extending well beyond the shoreline are typically out to sea beyond the limits of the WeBS count sectors (such as divers, sea-duck and Shag);
- which are not well monitored by WeBS daytime counts (such as gulls - large numbers being dispersed over the wider countryside during daylight hours) and;
- vagrants.

Whilst we have retained some species fitting the above criteria in the accompanying Excel Workbook, those that have nonetheless been excluded from Table 3.2.i below should be treated with caution.

Table 3.2.i: Estimated proportion of numbers of waterbirds supported by the SSSI network in England. Any estimates that can be obtained from the accompanying Excel Workbook but that have been excluded from this table should be treated with caution.

	England Estimate	SSSIs Estimate	Percent Supported
Mute Swan *Cygnus olor*	59,000	11,004	18.7
Bewick's Swan *Cygnus columbianus*	5,530	5,379	97.3
Whooper Swan *Cygnus cygnus*	6,280	5,860	93.3
Pink-footed Goose *Anser brachyrhynchus*	140,000	86,743	62.0
European White-fronted Goose *Anser albifrons albifrons*	2,285	1,831	80.1
Icelandic Greylag Goose *Anser anser*	1,359	*2,456	*100.0
British Greylag Goose *Anser anser*	95,000	23,793	25.0
Svalbard Barnacle Goose *Branta leucopsis*	27,000	8,589	31.8
Dark-bellied Brent Goose *Branta bernicla bernicla*	90,000	89,796	99.8
Svalbard Light-bellied Brent Goose *Branta bernicla hrota*	3,344	3,341	99.9
Shelduck *Tadorna tadorna*	50,000	47,440	94.9
Wigeon *Anas Penelope*	360,000	273,634	76.0
Gadwall *Anas strepera*	26,000	10,441	40.2
Teal *Anas crecca*	170,000	104,898	61.7
Mallard *Anas platyrhynchos*	560,000	60,223	10.8
Pintail *Anas acuta*	22,000	19,947	90.7
Shoveler *Anas clypeata*	17,000	9,267	54.5

	England Estimate	SSSIs Estimate	Percent Supported
Pochard *Aythya farina*	36,000	15,258	42.4
Tufted Duck *Aythya fuligula*	90,000	28,332	31.5
Scaup *Aythya marila*	300	271	90.3
Eider *Somateria mollissima*	11,900	5,209	43.8
Goldeneye *Bucephala clangula*	9,900	4,843	48.9
Smew *Mergellus albellus*	170	72	42.4
Red-breasted Merganser *Mergus serrator*	2,970	2,025	68.2
Goosander *Mergus merganser*	8,960	874	9.8
Little Grebe *Tachybaptus ruficollis*	14,000	2,979	21.3
Great Crested Grebe *Podiceps cristatus*	19,000	5,374	28.3
Black-necked Grebe *Podiceps nigricollis*	106	89	84.0
Cormorant *Phalacrocorax carbo*	29,000	12,306	42.4
Little Egret *Egretta garzetta*	3,950	3,515	89.0
Grey Heron *Ardea cinerea*	36,000	2,346	6.5
Coot *Fulica atra*	170,000	59,800	35.2
Oystercatcher *Haematopus ostralegus*	180,000	166,460	92.5
Avocet *Recurvirostra avosetta*	7,508	7,505	100.0
Ringed Plover *Charadrius hiaticula*	12,000	10,412	86.8
Golden Plover *Pluvialis apricaria*	340,000	188,707	55.5
Grey Plover *Pluvialis squatarola*	41,000	40,403	98.5
Lapwing *Vanellus vanellus*	490,000	299,594	61.1
Knot *Calidris canutus*	310,000	305,141	98.4
Sanderling *Calidris alba*	10,000	9,212	92.1
Purple Sandpiper *Calidris maritime*	1,125	996	88.5
Dunlin *Calidris alpina*	300,000	297,704	99.2
Black-tailed Godwit *Limosa limosa*	39,000	36,166	92.7
Bar-tailed Godwit *Limosa lapponica*	32,000	32,081	100.0
Whimbrel *Numenius phaeopus*	164	158	96.3
Curlew *Numenius arquata*	64,000	61,370	95.9
Green Sandpiper *Tringa ochropus*	2,505	212	8.5
Greenshank *Tringa nebularia*	1,440	1,391	96.6
Redshank *Tringa totanus*	71,000	67,665	95.3
Turnstone *Arenaria interpres*	13,000	10,739	82.6

* The apparent discrepancy (SSSI estimate exceeding England estimate) arises from arbitrary allocation of Greylag Goose that have been recorded by WeBS counters to species only (the majority) rather than population resolution, to population based on site location (specifically all north-Cumbrian birds not specifically recorded as belonging to the Icelandic or British population are allocated to the Icelandic population).

4 DISCUSSION

The principal purpose of this report is to present the figures given in Table 4.1.ii. It is, however, worth highlighting a few broad patterns evident from this exercise.

Not surprisingly, most species of wader are served exceptionally well by the SSSI network. This is largely a consequence of their attachment to coastal habitats and, in particular, estuarine habitats, most of the latter being encompassed by the SSSI network. Thus the only species of wader in Table 4.1.ii for which less than 90% of English wintering birds appear to be supported by the SSSI network are the "grassland plovers" (Golden Plover and Lapwing) and those that also favour the non-estuarine open coast (Ringed Plover, Purple Sandpiper and Turnstone). Even so the latter group are still well served by the SSSI network with over 80% of all three being supported by the SSSI network by virtue of the most important stretches of open coast being encompassed by the network. The proportion of the grassland plovers apparently encompassed by the SSSI network also appears quite high, although this may be more a reflection of the suitability of the wider countryside to support these species. All the same, considerable numbers of both species are indeed supported by the SSSI network by virtue of their propensity towards saltmarsh and foreshore in coastal areas.

The winter migrant populations of swans and geese are also well served by the SSSI network. Again, this is partly due to their attachment to coastal habitats but, additionally, most major roosts are also encompassed by the SSSI network. It should be noted, however, that for some species, although nocturnal roosts may be within the SSSI network, the birds feed much more widely in the agricultural landscape during the daytime, with such feeding areas seldom designated as SSSIs.

Following this pattern, of the remaining wildfowl, those best served by the SSSI network are those with a propensity towards estuarine habitats in winter. Thus a particularly high proportion of Shelduck, which winter mainly on estuarine habitats, is supported by the SSSI network as are those species that tend to winter on inshore waters, including Eider and Red-breasted Merganser, that are attracted by the relative sheltered and productive areas in and around estuaries.

Those species that are least well served by the SSSI network are, as would be expected, those species that tend to occur ubiquitously throughout the wider countryside wherever there is water. Thus the SSSI network supports a particularly low proportion of wintering numbers of species such as Mute Swan, Mallard, British Greylag Goose, Tufted Duck, Coot and the two common grebes. The figures suggest that only between 10% and 40% of individuals of these species are supported by the SSSI network. However, these figures may be under-estimates as these species are the ones most likely to have been present on the SSSIs for which no waterbird data were available

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References

Austin, G., Collier, M., Calbrade, N., Hall, C. & Musgrove, A. 2008. *Waterbirds in the UK 2006/07: The Wetland Bird Survey*. BTO/WWT/RSPB/JNCC 2008. BTO Thetford.

Frost, T.M. 2010. *Stochastic Modelling and Analysis of Wildfowl Anatidae Monitoring Data from the Wetland Bird Survey*. PhD Thesis.

Gillings, S. & Fuller, R.J. 2009. How many Eurasian Golden Plovers Pluvialis apricaria and Northern Lapwings Vanellus vanellus winter in Great Britain? Results from a large-scale survey in 2006/07. *Wader Study Group Bulletin*, **116**: 21-28

Kershaw, M & Cranswick, PA. 2003. Numbers of wintering waterbirds in Great Britain, 1994/95-1998/99: I. Wildfowl and selected waterbirds. *Biological Conservation*, 111, 91-104.

Musgrove, A.J., Austin, G.E., Hearn, R.D., Holt C.A., Stroud, D.A. & Wotton, S. (in prep). Population Estimates of British Non-breeding Waterbirds.

O'Brien, S.H. Wilson,L.J Webb,A & Cranswick, P.A.2008. Revised estimate of numbers of wintering Red-throated Divers Gavia stellata in Great Britain. *Bird Study* **55**(2) 152-160.

Rehfisch, M.M., Austin, G.E., Armitage, M.J.S., Atkinson, P.W., Holloway, S.J., Musgrove, A.J. & Pollitt, M.S. (2003) Numbers of wintering waterbirds in Great Britain and the Isle of Man (1994/1995-1998/1999): II. Coastal waders (Charadrii). *Biol. Conserv.*, **112**, 329-341.

Underhill, L.G. & Prŷs-Jones, R. (1994) Index numbers for waterbird populations. I. Review and methodology. *J. Appl. Ecol.*, **31**, 463-480.