Joint Nature Conservation Committee

Identification of important marine areas for inshore wintering waterbirds

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1. Background and overview

UK inshore waters (within 12 nautical miles of the coast) are well known strongholds of non-breeding seaduck, divers and grebes, as well as a few seabirds. Together these are simply termed 'waterbirds' in this document *(for species list please see Box 1).*

During the winter months these species regularly occur (sometimes in large numbers) in certain UK inshore areas such as sounds, bays and estuaries which are important feeding and moulting areas, or staging posts where non-breeding waterbirds gather together to overwinter or while on migration.

When this work started there were only very few data available on the distribution of non-breeding waterbirds around the UK coast, and most of them were collected from the shore and were therefore unsuitable as a basis for the evaluation of the seaward extent, numbers and distribution of species. Therefore a strategic approach was needed to identify the most suitable areas on this large scale and to collect data for Special Protection Area (SPA) identification.

Existing data (including Wetland Bird Surveys, Important Bird Areas under BirdLife International, existing survey data and an atlas of seabird distributions) and information from published scientific literature were used to assess which initial areas might be important for winter aggregations of waterbirds.

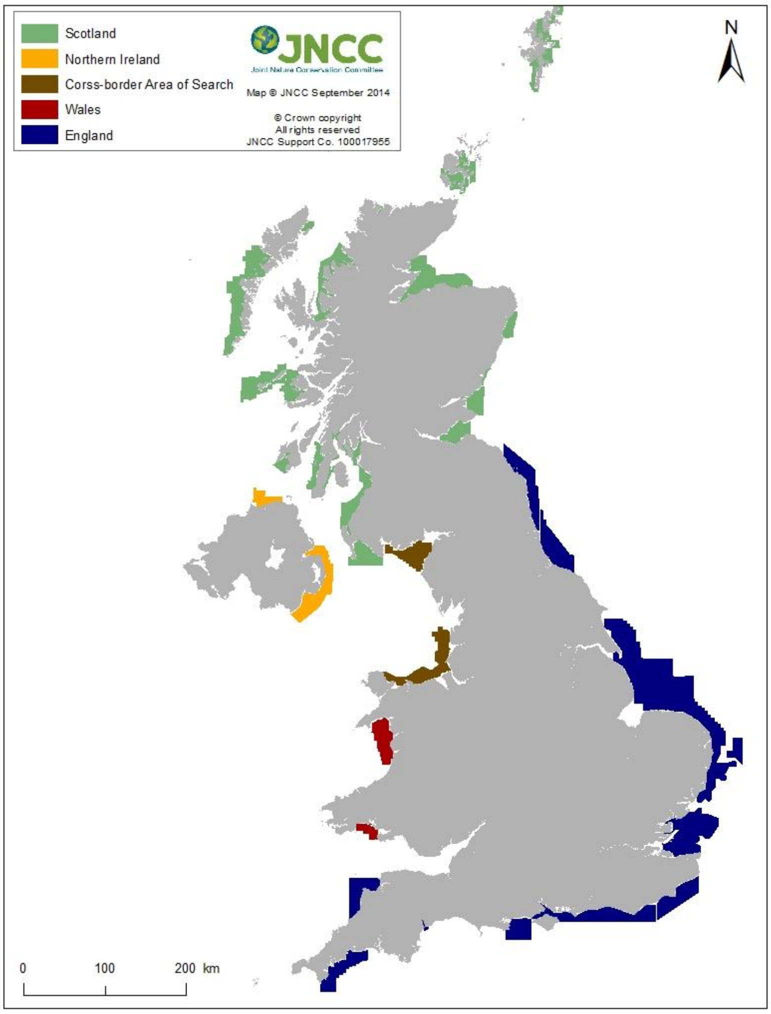

Figure 1: Potentially important Areas of Search for inshore wintering waterbirds throughout the UK.

Based on this initial assessment, 46 Areas of Search (AoS) were identified (Figure 1) across the UK, with 24 of these in Scotland, 13 in England, two in Wales, five in Northern Ireland and two cross-bordering areas between England and Scotland and England and Wales. These areas were furthered assessed and prioritised for data collection, collation and analysis.

Box 1: Target species: The target species for surveys were those inshore waterbirds, i.e. seaduck, divers and grebes that regularly spend the winter period (November to March) within coastal waters of the UK and are listed on Annex I of the EC Birds Directive as rare or vulnerable (in **bold**), or are migratory species.

greater scaup *Aythya marila*
common eider *Somateria mollissima*
long-tailed duck *Clangula hyemalis*
common scoter *Melanitta nigra*
velvet scoter *M. fusca*
common goldeneye *Bucephala clangula*
red-breasted merganser *Mergus serrator*
goosander *M. merganser*
red-throated diver *Gavia stellata*
black-throated diver *G. arctica*

great northern diver *G. immer*
little grebe *Tachybaptus ruficollis*
great crested grebe *Podiceps cristatus*
red-necked grebe *P. grisegena*
Slavonian grebe *P. auritus*
black-necked grebe *P. Nigricollis*
little gull *Hydrocoloeus minutes*
European shag *Phalacrocorax aristotelis*
Great cormorant *P. carbo*

2. Data collection

Since the winter of 1998/99, JNCC's Seabirds At Sea Team carried out a 10 year survey programme to collect up-to-date, detailed data on the numbers and distribution of wintering aggregations of inshore waterbirds, primarily using aerial surveys (*see Box 2 for detailed information*) but supplemented by land-based surveys.

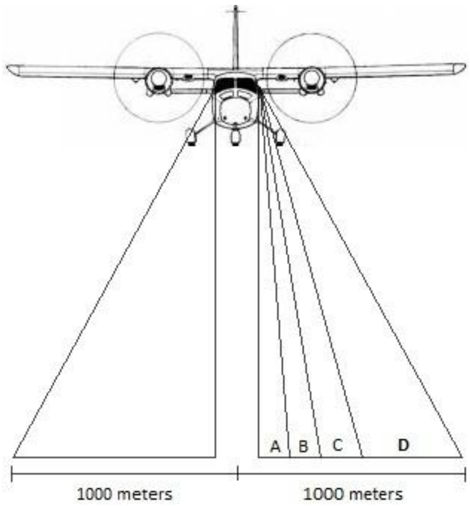

Figure 2: Systematic aerial survey line-transect concept using four distance bands

2.1 Aerial surveys

Using a standardised method two observers counted - from either side of the aircraft (Figure 2) - birds observed as the plane travelled at constant speed and direction, along a pre-determined transect line.

2.1 Land-based surveys

Land-based surveys can detect birds up to approximately 2km from the coast and are the best method for species which are not reliably detected from boats or aircraft such as grebes and black-throated diver. Although they might not be useful for defining a seaward extent of a species distribution, they can be used for assessing their numbers and distribution along the coast.

Box 2: Aerial surveys

All birds observed were recorded. For each bird, or flock of birds, observed, the time at which it occurred (at right angle to the aircraft), the species, and number of birds was recorded, along with the distance from the transect line (into one of three or four distance categories, as shown in Figure 3).

A small aircraft (which can survey large and inaccessible areas in a short space of time) flew in a systematic pattern of parallel transects running perpendicular (at right angle) to the coast and sea depth contours, and therefore along the anticipated gradient of bird density. The plane flew at an altitude of 76m (250ft) and a speed of approximately 185km/h (100 knots).

3. Data analysis

3.1 Aerial surveys

The data analysis involved a three step process.

1) Firstly, aerial survey data were analysed to assess if the estimated population size of individual species - within each AoS - exceeded a numerical threshold for importance. This assessment used the software Distance Sampling (see Box 3 for details) and the UK SPA site selection guidelines which allow assessments of individual species against qualifying levels. For example, the guidelines suggest that areas supporting 1% of the Great Britain population of an Annex I species should be considered as a contender for SPA status. If no species exceeded its threshold, the AoS was relinquished.

2) Secondly, if an AoS did host important numbers of birds regularly, the aerial survey data were used to model the spatial distribution using a technique called kernel density estimation (KDE, see *Box 4*). A KDE spatial distribution map was produced for each year that was surveyed, and these were then overlaid and a mean density estimation map was produced for each AoS and species.

3) Finally, boundaries were drawn around the most important densities of each species in each AoS using a method called Maximum Curvature.

Box 3: Distance Sampling

An effective method to assess whether an area might qualify for SPA status is called Distance Sampling analyses (software developed by RUWPA at the University of St Andrews). Based on the concept of randomly projecting transect lines (line-transects) across the water's surface - along which bird observations are recorded and distance measurements are taken (Figure 3) - it is possible to produce a true estimate of actual bird numbers present at the time of the survey within the surveyed area.

The software Distance models the rate at which the probability of detecting a bird decreases with increasing distance from the aircraft and then compensates for the 'missed' birds (Buckland *et al.* 2001). Distance sampling allows the estimation of 95% confidence intervals associated with total abundance estimates.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. & Thomas, L. (2001) Introduction to Distance Sampling. Oxford University Press, Oxford.

3.2 Land-based surveys

Data for species which can only be reliably counted from the shore, e.g. some grebes and divers, were analysed slightly differently.

1) Firstly, a numerical assessment (against the threshold for importance), as for species analysed using the aerial survey data.

2) Secondly, instead of producing a KDE distribution map, Maximum Curvature was applied to the along-shore count-sections, and identified which sections held important numbers of birds.

3) These count sections were overlaid with the boundary produced for species using aerial survey data as above. Where an important land-based count section was located outside this boundary, the boundary was extended to include this section.

Box 4: Kernel Density Estimation

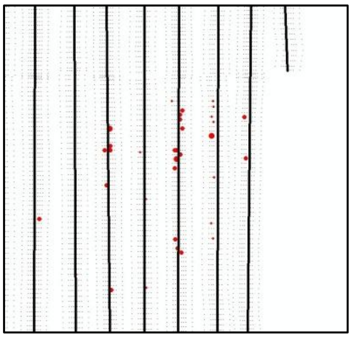

Figure 4a: Bird density point observations (red) calculated every 5 seconds for all four distance bands (small black points). The transect line is shown in black.

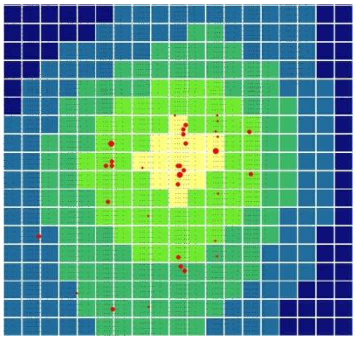

Figure 4b: KDE has been applied to the data in 4a).

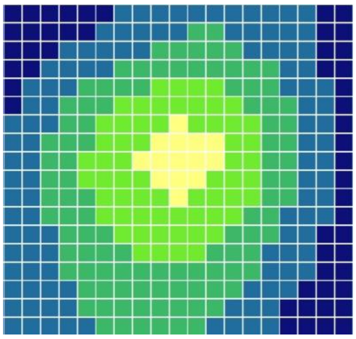

Figure 4c: Highest density grid cells highlighted in yellow and the lowest in dark blue.

4. Boundary Delineation

The mean density estimation maps created from the KDE analysis show a relative gradation of bird densities. There is no clear threshold to distinguish between 'high' and 'low' densities. This kind of problem occurs in most of the marine SPA analysis JNCC has undertaken. In order to solve this problem to identify important areas and draw a boundary around them, a cut-off or threshold value had to be found and only those grid squares with a density value above this cut-off would be included within an SPA boundary.

An objective and repeatable method called Maximum Curvature, identifies such a threshold value. It indicates at what point disproportionately large areas would have to be included within the boundary to accommodate any more increase in the number of birds included within the protected area. As the maximum curvature technique is sensitive to the size of the area it is applied to, a simple shape was drawn around all observations, and any grid cells which were outside of this polygon were excluded from the maximum curvature analysis. Finally, boundaries were then drawn around the cells exceeding the maximum curvature threshold, in as simple a way as possible.

Most of the Scottish draft SPAs are composite sites where more than one bird species will be protected if the SPA becomes classified. Areas identified in this inshore wintering aggregations of waterbirds analysis are combined with overlapping areas identified from other types of analysis, with site boundaries encompassing all of the overlapping important areas at that site.