Generic maintenance extensions around seabird breeding colonies: data collection and analysis

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1. Background and overview

In 1979 the European Commission adopted the Birds Directive which, amongst other conservation measures, requires Member States to classify Special Protection Areas (SPAs) for birds listed on Annex I to the Directive and for regularly occurring migratory species.

Almost all species of seabird that breed in the UK have some of their breeding sites protected within breeding colony SPAs. Breeding seabirds, when not attending the nest or foraging, may spend time in waters adjacent to the colony engaging in maintenance activities such as preening, bathing and displaying.

Birds engaged in such behaviours usually use the waters close to the colony. To identify the distance out to sea at which most birds engage in these behaviours, JNCC systematically surveyed waters around ten seabird breeding colonies, and carried out spatial analyses of the distribution of birds engaged in maintenance behaviours (more detail in JNCC reports 329, 358, 406).

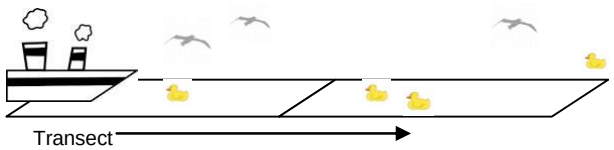
2. Data collection and analysis

For all species except for Manx shearwater *Puffinus puffinus* (which engage in maintenance activities during evening, when visual observations are difficult), visual observation surveys were undertaken from boats following straight line parallel transects that were spaced mostly between 250 and 500m apart and went5 or 6 km out at sea. Observers recorded numbers and locations of birds engaged in maintenance activities (more details on boat surveys in box 1).

All species except Manx shearwater

Five seabird species were found to engage in such behaviours at sufficient densities to allow analysis; common guillemot (*Uria aalge*), Atlantic puffin (*Fratercula arctica*), razorbill (*Alca torda)* and northern gannet (*Morus bassanus*) (McSorley *et al.* 2003) and northern fulmar (*Fulmarus glacialis*).

Box 1: Data collection from boats
Observers counted all birds in a line transect running parallel to the track line of the boat. Transects were divided into smaller sections and the position of the boat was recorded at each section start. Birds sitting on the water were recorded when they were level with the observer as the boat passed by. For each transect section, seabird numbers were summarised, together with the area surveyed in that section and assigned to the location of the section starting point.



The observations were mapped and analysed in a 4 step process:

Step 1: Maps of observed bird density (birds km^{-2}) were calculated for each species in the waters around each study colony.

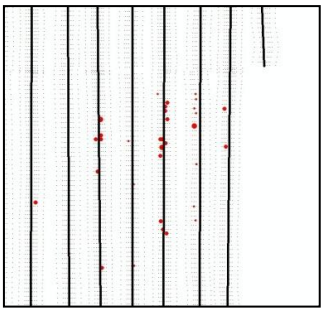
Step 2: The observations were smoothed using Kriging (see box 2) which generates a smoothed grid of density across the waters around the study colonies: this technique essentially fills in the gaps in coverage between survey transects.

Step 3: Mean densities were calculated for concentric distance bands from the colony (200m intervals) to investigate how density declined with distance from colony.

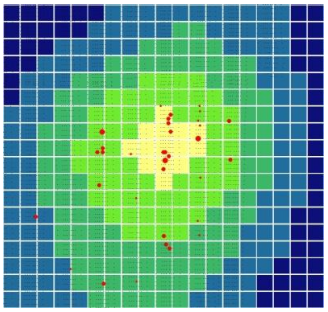
Step 4: An assessment was made of the distance from colony at which densities became consistently low; this distance is the basis for generic maintenance extensions (species specific); the majority of maintenance activities occur within this distance.

Box 2: Creating density maps: kriging

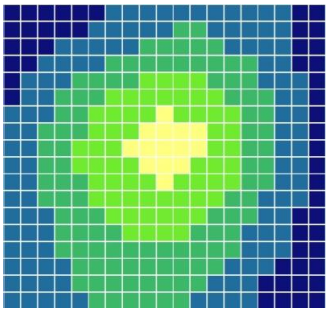
There is a wide variety of spatial interpolation techniques available which can be used to fill gaps between existing data to produce density maps. JNCC used kriging for the maintenance extension analysis. Kriging is an analysis technique which makes use of the property that things closer together in space are more similar than things that are further away (autocorrelation). Kriging looks at this relationship in a given dataset, describes it as a mathematical function specific for these particular data, and uses it to predict values at locations with no data. This means that an estimate of seabird density can be obtained for areas that do not have much (or any) data, based on densities observed from surveys nearby.



Transect survey and observed seabrids



Kriging uses the observations to estimate the densities



Smoothed density map

Manx shearwater

Manx shearwater undertake most of their maintenance activities during evenings, when visual observation is not suitable. Radio-telemetry was therefore used to identify locations of birds sitting on the sea, as a proxy for locations of maintenance behaviours (behaviour could not be directly observed using this method).

Sample birds from each study colony (three colonies) were fitted with a VHF radio transmitter. Receivers followed the direction and strength of radio signals from at least three locations on each colony, allowing triangulation to determine the locations of the birds. Locations were estimated only for birds that were not moving and that had a stable signal.

Analysis followed a similar series of steps as for the other species described above:

Step 1: Individual bird locations were mapped around each study colony.

Step 2: The observations were smoothed using Kernel Contours. This is similar to the kriging method described in box 2 in that it fills the gaps between observations, but it is suitable for radio tracking location data.

Step 3: Kernel cores were mapped, which describe the main areas used by the birds, in percentile intervals. In this context, a kernel core is the area covered by the cumulative 5 percentiles of the total number of locations e.g. the area covered by 5%, then 10%, 15%, 20%, 25%, etc of the locations.

Step 4: The area contained within the 95% kernel core was used to determine the distance from colony for generic maintenance extensions.

3. Outcomes

Based on this analysis, the recommended generic maintenance extension for common guillemot, Atlantic puffin and razorbill is 1km, and for northern gannet and northern fulmar it is 2km.

Manx shearwaters showed greater variation in core rafting areas between colonies, and so the generic recommendation is a minimum of 4km, but with extensions of up to 9km where data suggests it.

As a result of this work, some seabird colony SPAs around the UK have now been extended to account for areas at sea used for maintenance behaviours, including 31 seabird colony SPAs in Scotland. Further colonies are being considered for extension around the UK.