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Generic guidelines for seaward extensions to existing breeding northern fulmar *Fulmarus glacialis* colony Special Protection Areas

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1 Summary

- Article 4 of the EU Birds Directive (79/409/EEC) requires Member States to identify and classify the most suitable territories in number and size as special protection areas for the conservation of specified bird species. These sites, called Special Protection Areas (SPAs), together with Special Areas of Conservation classified under the Habitats Directive (92/43/EEC), make up a European network of protected sites, known as Natura 2000.

- Although the Birds Directive takes into account the protection or conservation requirements of these species in the geographical sea and land area, most progress has been made in the terrestrial environment. Recently, the Joint Nature Conservation Committee (JNCC) has been undertaking work to further develop Natura 2000 in the UK marine environment.

- One strand of this work is determining generic guidelines for extending existing seabird breeding colony SPAs into adjacent marine areas. Previous work has recommended generic seaward boundary extensions of 1km for SPAs where common guillemots, razorbills or Atlantic puffins are listed as qualifying interest features, and 2km for SPAs where northern gannet is listed as a qualifying interest feature (McSorley *et al*, 2003). This report presents generic guidelines in support of setting seaward boundary extensions to all existing breeding colony SPAs for which breeding northern fulmars *Fulmarus glacialis* are an interest feature.

- In this report, we present geostatistical modelling and spatial analysis of high resolution northern fulmar data collected up to approximately six kilometres offshore around Rathlin Island and Fetlar. Data collection and analyses are similar to those presented in McSorley *et al* (2003).

- We found that spatial patterns of northern fulmars engaged in non site-specific maintenance behaviour (preening, bathing and display) in waters adjacent to Rathlin Island and Fetlar were remarkably similar, with such aggregations found consistently within two kilometres of the shore.

- We conclude that the marine component of all SPAs where northern fulmar is listed as an interest feature, be defined to include water out to two kilometres from the colony shore. The revised SPA boundary should encompass this area.

- The work presented in this report is the result of surveys and analyses undertaken by the JNCC on behalf of UK government and the country nature conservation agencies, English Nature (EN), Scottish Natural Heritage (SNH), Countryside Council for Wales (CCW), and also the Environment and Heritage Service of Northern Ireland (EHS).

2 Introduction

2.1 The Birds Directive

In 1979, the European Community (EC) adopted the Council Directive on the Conservation of Wild Birds (termed the Birds Directive; 79/409/EEC). The Birds Directive provides for the protection, management and control of all species of naturally occurring wild birds in the European territory of European Union (EU) Member States.

Article 4 of the Birds Directive requires Member States to identify and classify the most suitable territories in number and size as special protection areas for the conservation of species listed in Annex I of the Directive, and regularly occurring migratory species not listed in Annex I. These sites are called Special Protection Areas (SPAs). SPAs, together with Special Areas of Conservation classified under the Habitats Directive (92/43/EEC), make up a European network of protected sites is known as Natura 2000.

Although the Birds Directive takes into account the protection or conservation requirements of these species in the geographical sea and land area, most progress has been made in the terrestrial environment (Stroud *et al*, 2001). Johnston *et al* (2002) introduce the further development of Natura 2000 in the marine environment and lists three strands of work for implementation of the Birds Directive, namely:

i. seaward extensions of existing seabird breeding colony SPA boundaries beyond the low water mark;
ii. inshore feeding areas used by concentrations of birds (e.g. seaducks, divers and grebes) in the non-breeding season; and
iii. offshore areas used by marine birds, probably for feeding but also for other purposes.

Other aggregations not captured in the former three strands may also be identified.

JNCC are currently addressing these strands of work. Under the first strand, JNCC has recommended a generic seaward boundary extension of one kilometre for all auk (defined here as common guillemot *Uria aalge*, razorbill *Alca torda* and Atlantic puffin *Fratercula arctica*) SPAs and two kilometres for all northern gannet *Morus bassanus* SPAs (McSorley *et al*, 2003). This report builds on information already presented in McSorley *et al* (2003). It aims to identify generic guidelines for definition of important aggregations of northern fulmars *Fulmarus glacialis* in the marine area adjacent to their existing colony SPAs during the breeding season, and thus, the marine component of the SPA interest feature. Herein, we discuss implications for seaward boundary extensions to existing SPAs.

2.2 Rationale

SPAs must "provide for the conservation requirements of the species in the season(s) and for the particular purposes for which they are classified" (Stroud *et al*, 2001). Existing (terrestrial) SPAs for breeding fulmars were selected and site boundaries determined with respect to the breeding numbers and spatial extent of the colonies. To date, the conservation requirements of these birds at sea have not been considered relating to the identification of SPAs.

Many species of seabird have a clear functional link with the marine areas immediately adjacent to the breeding colony. Auks and northern gannets form important aggregations of birds engaged in preening, bathing and display in waters immediately adjacent to the colony (McSorley *et al*, 2003); Manx shearwaters *Puffinus puffinus* form evening aggregations (rafts) within 10km from the colony (Brooke 1990); and shags *Phalacrocorax aristotelis* feed inshore close to their breeding colonies (mostly within two kilometres of the breeding site; Wanless *et al*, 1991). The first strand of SPA work (as listed above) aims to provide guidelines in support of extending existing SPA boundaries into the marine environment.

Breeding seabirds spend much of their time attending the nest or foraging for food for themselves, their partner and/or their chicks. However, some breeding seabird species also require time and space in waters close to the colony to carry out essential maintenance behaviours such as displaying, bathing and preening (McSorley *et al*, 2003). McSorley *et al* (2003) show that there is compelling quantitative evidence that maintenance behaviours are carried out by significant numbers of auks and gannets up to one kilometre and two kilometres, respectively, from the colony.

Selection of these inshore areas by seabirds is dependent on the distance from the colony; density of auks and gannets engaged in maintenance behaviours decreases with distance from the colony shore (McSorley *et al*, 2003). It is unlikely that site-specific characteristics play a significant role in selection of these areas by the birds; presumably these birds will carry out these activities in any waters closest to their breeding site. Thus, we have assumed that the distribution of birds engaged in maintenance behaviour on waters around the colony is not based on site-specific attributes of the colony waters. Therefore, should we identify any consistent dispersion patterns around colonies, a generic seaward boundary extension may be applied to all existing SPAs to include the seaward extent of the appropriate qualifying interest feature (an interest feature is any “population” of a bird species for which an SPA has been designated under the Birds Directive).

McSorley *et al* (2003) presented data collected using a boat-based survey method, from six seabird breeding colony SPAs. Northern fulmars are listed as an interest feature (a member of a qualifying seabird assemblage) at two of these sites, the Firth of Forth Islands SPA, and the Fowlsheugh SPA. Northern fulmars engaged in maintenance behaviour formed some aggregations in waters adjacent to these sites and, thus, appeared to use these areas to a certain extent. However, the data were limited, with further work required to provide more comprehensive evidence of a functional link.

The data presented in McSorley *et al* (2003) were relatively low resolution counts (collected at 1-minute samples), and were collected at colonies with low numbers of northern fulmar; Fowlsheugh holds 652 breeding individuals and the Isle of May (part of the Firth of Forth Islands SPA) holds 738 breeding individuals (breeding population size estimates taken from unpublished Seabird 2000 data, collected in 1999 and 2001 respectively), perhaps explaining the limited evidence of fulmars using these inshore waters for maintenance behaviours.

In this report, we present the results from interpolation of high resolution fulmar distribution data collected in 2002 and 2003. The interpolation procedure (ordinary kriging) presented in the 2003 report (McSorley *et al*, 2003) was different from the procedure presented in this current report (ordinary indicator kriging); the latter procedure allows a more robust analysis of sample count data with many zero counts (termed ‘zero inflation’). We collected data from the waters around two large fulmar colonies Rathlin Island, Northern Ireland (4,064 breeding individuals, Mitchell *et al* (2004)) in 2002, and Fetlar, Shetland (20,886 breeding individuals, unpublished Seabird 2000 data) in 2003.

We use these results to identify any consistent and significant patterns in northern fulmar density with the aim of defining their seaward extent. The existing Rathlin Island and Fetlar SPAs are quite different in composition, with the Fetlar SPA being largely terrestrial (extending on the seaward side to mean low water spring, as with all other Scottish SPAs), and the Rathlin Island SPA having a significant marine component, extending further offshore than mean low water. However, if generic patterns in northern fulmars' modelled densities at sea are identified, the application of generic guidelines for defining the seaward extent of the interest feature may be recommended. This may have implications for seaward boundary extensions to all existing UK SPAs for northern fulmar.

3 Methods

3.1 Data collection

3.1.1 Surveys

Boat-based surveys of the waters around Rathlin Island (Co. Antrim, Northern Ireland) and Fetlar (Shetland Islands, Scotland) were carried out in June 2002 and 2003 respectively by JNCC. The Rathlin Island surveys were carried out in the M.V. *Poplar Voyager* and the Fetlar surveys were carried out in the M.V. *Dunter II*. Figure 3.1 and Figure 3.2 show the timings and spatial extent of survey transects around both islands; the marine area containing these transects is termed the survey area.

A randomly placed grid of evenly spaced, parallel transect lines was imposed upon each survey area. In contrast to McSorley *et al* (2003), survey transects were orientated parallel to the direction of the expected bird density gradient, as recommended by Buckland *et al* (2001). From previous surveys, it was expected that the density of birds would decrease with distance from the colony (McSorley *et al*, 2003) so transects were orientated perpendicular to the shore. The ships steamed along survey transects at speeds of 5-10 knots (10-20km.h^{-1}) out to approximately 6km from each island (Figure 3.1 and Figure 3.2).

Transects were oriented along lines of constant latitude (east-west) or longitude (north-south), according to the expected bird density gradient. Navigation data (latitude and longitude, in reference datum WGS 84) were measured at 1-second intervals using a Global Positioning System (Garmin GPS III Plus); these were simultaneously downloaded onto a laptop computer, and automatically saved onto a Corel Paradox database table using WinWedge 1.2 interface software.

Transects were spaced at approximately 0.3km intervals for Rathlin Island and at approximately one kilometre intervals for Fetlar. Transect spacing for each island was designed to match the amount of available survey time and the size of the area to be surveyed, without allowing any overlap in survey coverage.

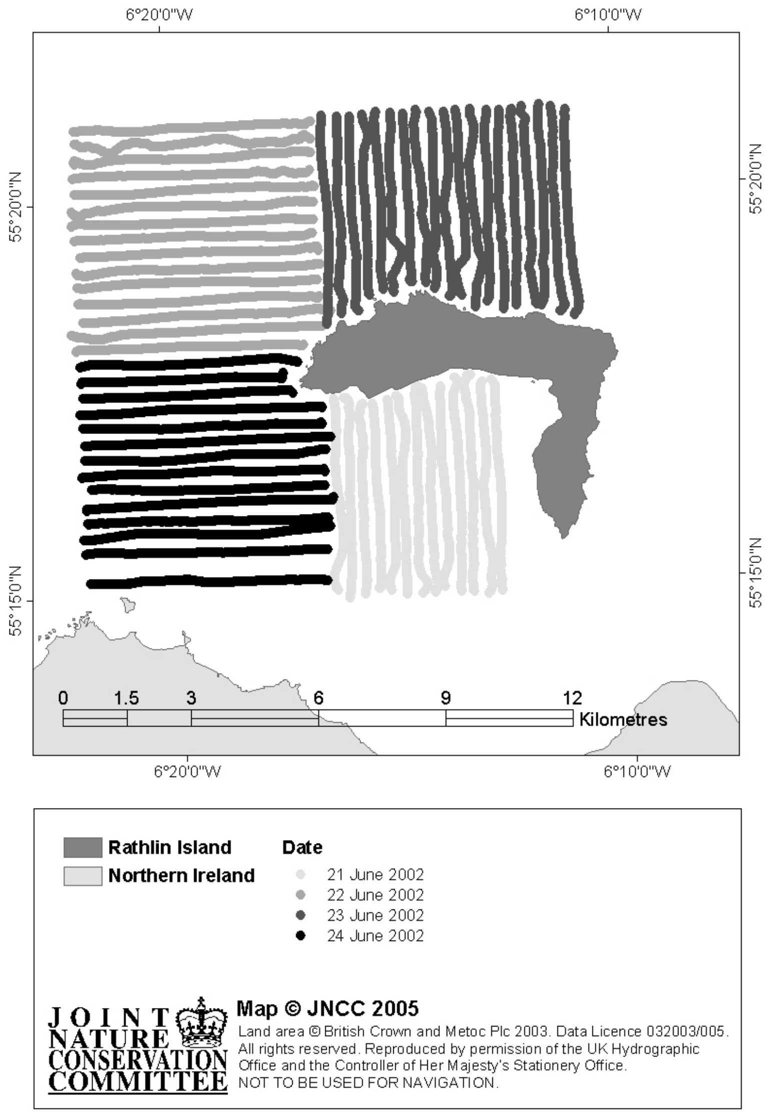

Figure 3.1 Boat-based survey transects around Rathlin Island, Northern Ireland in June 2002.

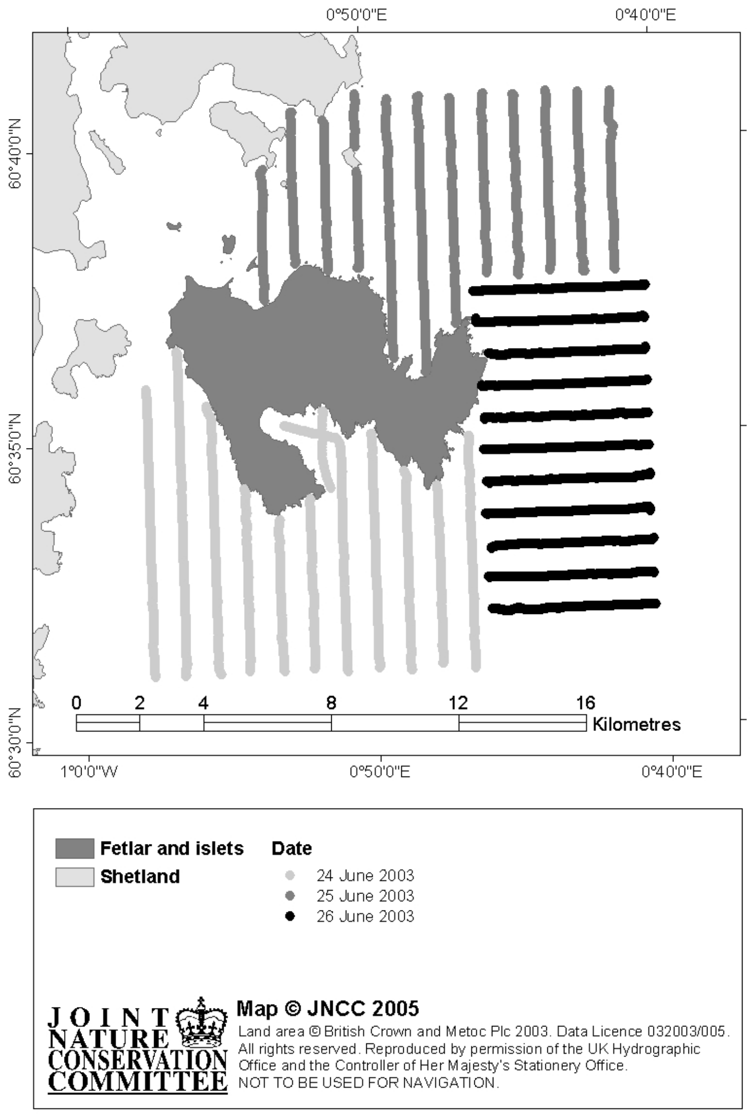

Figure 3.2 Boat-based survey transects around Fetlar, Shetland in June 2003.

Seabird and cetacean observations were recorded using a modified seabirds at sea boat-based survey method (Webb and Durinck 1992), similar to McSorley *et al* (2003). Observations were made concurrently by one port and one starboard observer using a strip transect method, i.e. simple transects with no estimation of distance to observation (Buckland *et al,* 2001). Transect width was 200m (observations were made out to 100m on both sides of the ship); however, sometimes only one side of the ship was surveyed, making the transect width 100m. Observers estimated the transect width using a fixed angle of declination from the visual horizon (Heinemann 1981), which can be measured using a clinometer and the known height above sea level.

Each observer recorded the start and end times of each transect using watches synchronised with the GPS. For each transect, observers recorded survey conditions including glare, visibility, cloud cover, sea state, and wind speed (Beaufort Scale) and direction. Surveys were conducted between 08:00 hrs and 16:00 hrs GMT and in winds of Beaufort force four or less.

Only those birds observed sitting on the water were recorded; flying birds were not recorded. All observed seabird and cetacean species were recorded. Observers recorded the species, number, behaviour and time observed (counts were made at 10-second intervals) for each observation. Seabird behaviour was classified according to Table 3.1.

Table 3.1 Seabird behaviour classes for boat-based seabirds at sea surveys (from McSorley *et al*, 2003). [1]

Behaviour category	Description of behaviour		Site-specific?	Colony-based?
Maintenance	Bathing, preening, display		×	✓
Sleeping	Head tucked under wing		-	-
Feeding	Northern fulmar	surface picking or surface plunging	✓	-
	Manx shearwater	pursuit plunging		
	European shag	pursuit diving with no obvious sign of disturbance by ship		
	Large gulls	surface picking, surface plunging, kleptoparasitism and scavenging		
	Black-legged kittiwake	surface picking, surface plunging and scavenging		
	Auks	pursuit diving with no obvious sign of disturbance by ship		
Inactive	No discernible behaviour observed, includes observations of individual birds where the observers had insufficient time to determine what the birds were doing		-	-

3.2 Method for defining the spatial extent of the interest feature

We defined the spatial extent of the at-sea distribution of northern fulmars engaged in maintenance behaviour using geostatistical and distance band analyses.

3.2.1 Mapping of observed density

Navigation and observation data were linked by a common time field within a Microsoft Access database, and each observation was assigned a position corresponding to the location of the ship at the midpoint of each 10-second sample. Fulmar numbers were converted to densities in each 10-second interval by dividing the number of birds by the area surveyed (distance travelled in a particular 10-second interval multiplied by the width of the transect). Each 10-second sample represented a mean distance travelled of 41.5m (Rathlin) and 43.4m (Fetlar).

An Open Database Connectivity (ODBC) connection was set up between the Microsoft Access database and ArcMap v8.2 (Geographical Information System [GIS] allowing the display, manipulation and analysis of spatial data) allowing fulmar densities to be displayed as a dot distribution map.

[1] Where an entry has been classed as '-', the behaviour category is not necessarily associated with either site specific characteristics or specifically based at the colony e.g. birds may be observed to be inactive in all sea areas, possibly as a result of many things, such as; digesting food they have just eaten; having just completed maintenance behaviour etc.

3.2.2 Modelling of observed density - Geostatistics

Dot distribution maps provide the means to display the density values but they do not allow a quantifiable and repeatable method for determining the most important areas. In order to do this we needed to fill in the gaps in coverage. For this we used an interpolation technique to generate a high-resolution grid that provided an estimate of fulmar density at any point within the survey area.

Kriging is a geostatistical interpolation technique that uses the inherent spatial structure (autocorrelation) of data to generate a regular grid of estimated values. Spatial autocorrelation may be modelled using a semivariogram, which describes the degree of dissimilarity between the values of pairs of points (in this case density values) separated by different distances. Essentially, pairs of points that are close together (i.e. separated by relatively small distances) will have more similar values than those far apart (i.e. separated by larger distances). Kriging has been used successfully for seabird data collected from boats and planes in a range of different studies (Begg and Reid 1997; McSorley *et al,* 2003; McSorley *et al,* 2004).

Often count data include many zero counts, termed zero-elevated data. McSorley *et al* (2004) outline the use of ordinary indicator kriging (OIK) that deals with this problem and that may incorporate an appropriate transformation if data are skewed (a natural log [ln] transformation is commonly used for skewed data; McSorley *et al,* 2004; Tabachnik and Fidell 1996).

In this report we use OIK to interpolate northern fulmar at sea density data. The OIK method, which includes a non-parametric component, used herein is a more robust technique for analysis of zero-elevated data than the ordinary kriging presented by McSorley *et al* (2003), as it allows an accurate estimation of the number of birds present on the water, in contrast to purely parametric kriging methods used on zero-elevated data (as discussed in McSorley *et al,* 2004).

Kriging requires spatial data that are projected (coordinate systems that are designed for a flat surface such as grid references on a map); therefore, the latitude and longitude values were converted to UTM eastings and northings, in the appropriate zone. The Microsoft Access table containing the observed bird density, UTM eastings and UTM northings was exported as a comma separated value (.csv) file into the geostatistical package *EcoSSe 2001* (Clark and Harper 2001). For each survey area (Rathlin Island or Fetlar), data were pooled across all days. OIK was performed for each survey area, generating grids of estimated densities in the waters around Rathlin Island and Fetlar. The grids were based on 100m × 100m grid cells and covered an area beyond the extent of the survey. These grid cells were imported into a Microsoft Access database and displayed in ArcMap v8.2 via the ODBC connection.

3.2.3 Investigation of generic patterns in density - Distance band analysis

The kriging procedure generates density values outside of the survey extent. To exclude land areas and sea areas beyond the extent of the surveys, the grids were trimmed using ArcMap polygons (using the ‘clip’ command in ArcMap v8.2).

The distance from each grid cell to the nearest land was calculated within ArcMap and added as a new field to the attribute table of each grid. This was imported back into MS Access and the mean density of all cells within 200m intervals from the shore (distance bands) was calculated. Mean densities were plotted against distance bands to aid in identification of generic fulmar density patterns, as with auk and gannet density in McSorley *et al* (2003). Such generic patterns may help to define the spatial extent of the marine component of the interest feature, namely the significant aggregations of fulmars engaged in maintenance behaviour.

3.2.4 How important are the waters adjacent to breeding colonies to breeding northern fulmars?

To address this question we calculated the number of birds engaged in maintenance behaviour on the water using the following techniques.

a Estimation of the number of individuals engaged in maintenance behaviour

The total number of fulmars engaged in maintenance behaviour counted during strip transects may be estimated using different analytical methods, including the sum of the observed raw counts, extrapolation of overall density, and the total sum of kriged (OIK) estimated abundances.

The first method of summing the raw counts gives an assessment of the number of birds recorded only within the transects. Since the transects did not cover the total survey area this is an estimate of only a sample of the total number of birds using waters adjacent to the colony.

Overall density (sum of the observed raw counts divided by the transect area; n/km^2) can be used to generate an extrapolated total number of birds by multiplying by the total survey area (km^2). However, this extrapolation does not take into account the spatial autocorrelation or distribution of the counts, and therefore is likely to give a biased, thus possibly inaccurate, estimate (McSorley *et al*, 2003).

The last method for estimation of the number of birds on the water is the preferred option. OIK uses the observed data to generate a grid of estimated densities, using models that take into account the spatial autocorrelation and distribution of the observed data. A regular grid of estimated densities may be generated, giving complete coverage of the whole survey area. Conversion of densities (n/km^2) to abundances (number of birds in each grid cell) enables the calculation of the total sum of kriged estimated abundances in the survey area. This process generates a total number of birds that is comparable to the total number of birds calculated using distance sampling (line transect data collected with distance to the observation). This type of comparison is outlined in McSorley *et al* (2004).

b Estimation of the number of individuals within a certain distance from the colony shore.

Sub-sampling is one of the key advantages to using kriged estimates since it is possible to generate unbiased estimates of the number of birds on the water within possible SPA boundaries or within certain distances from the shore. These are directly comparable to the total sum of the kriged abundances over the entire survey area. Sub-sampling may also be used during the calculation of estimates based on an extrapolation of overall density. However, sub-sampling is likely to exacerbate any bias caused by the spatial autocorrelation and spatial distribution of the bird counts in extrapolation of the overall density.

4 Results

4.1 Observed density

Figure 4.1 and Figure 4.2 demonstrate that the highest observed densities of fulmars engaged in maintenance behaviour are found close inshore to Rathlin Island and Fetlar.

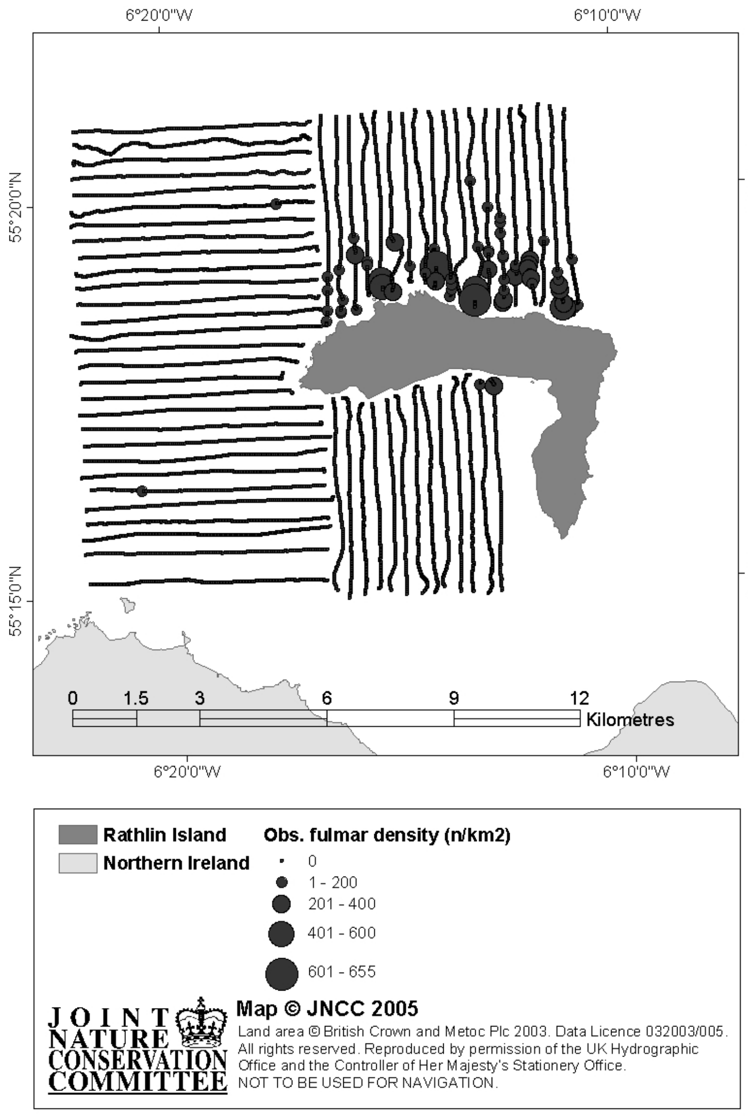

Figure 4.1 Dot distribution map of observed (obs.) fulmar density (number of birds per square kilometre; n/km2) in 10-second samples in waters adjacent to Rathlin Island.

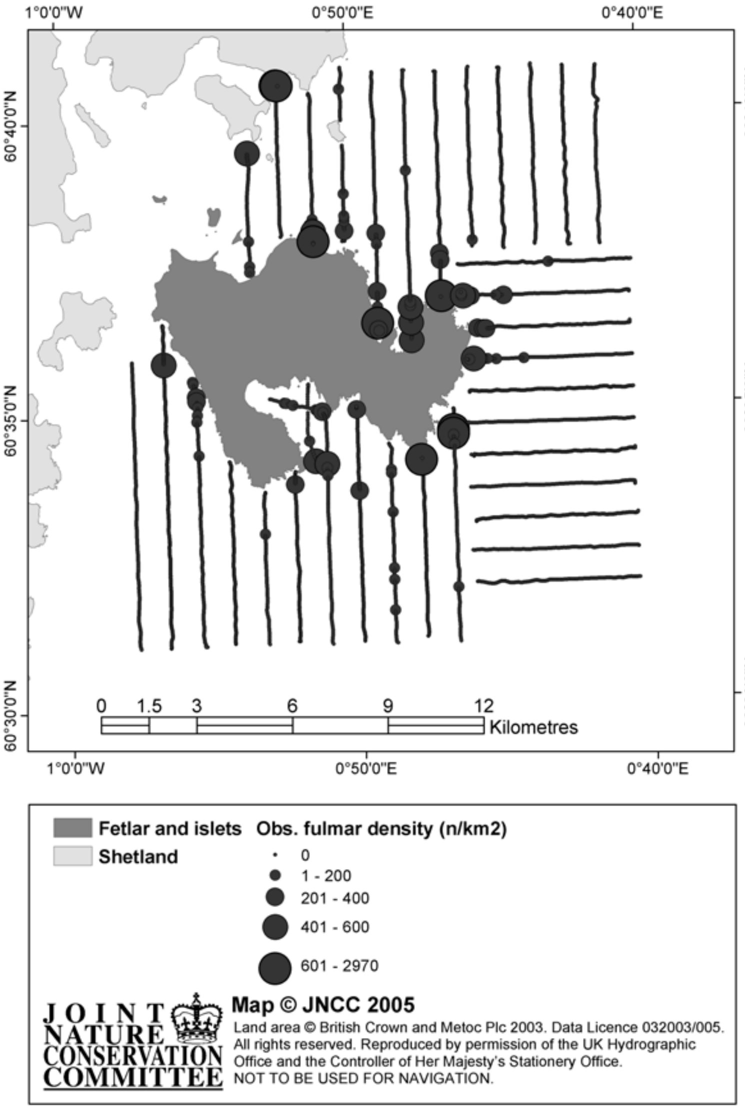

Figure 4.2 Dot distribution map of observed (obs.) fulmar density (number of birds per square kilometre; n/km2) in 10-second samples in waters adjacent to Fetlar.

4.2 Modelled density

Ordinary indicator kriging of the observed fulmar density data around both Rathlin Island and Fetlar (Figure 4.3 and Figure 4.4) show agreement with the observed densities presented in Figure 4.1 and Figure 4.2). However, as with many modelling procedures, kriging smoothes the density values such that estimated values show less extreme variations than the observed values (McSorley *et al*, 2004).

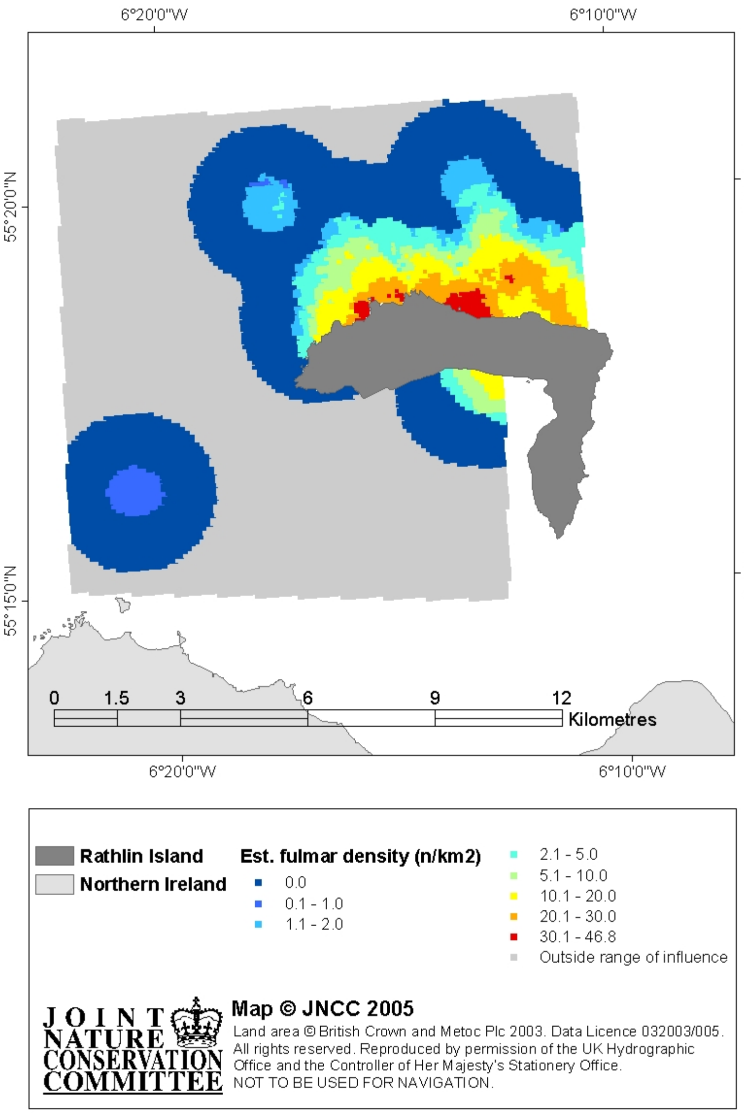

Figure 4.3 Estimated fulmar density (number of birds per square kilometre; n/km2) around Rathlin Island, generated using geostatistics (Ordinary Indicator Kriging). 'outside range of influence' = beyond the limit of the spatial autocorrelation found in the density data.

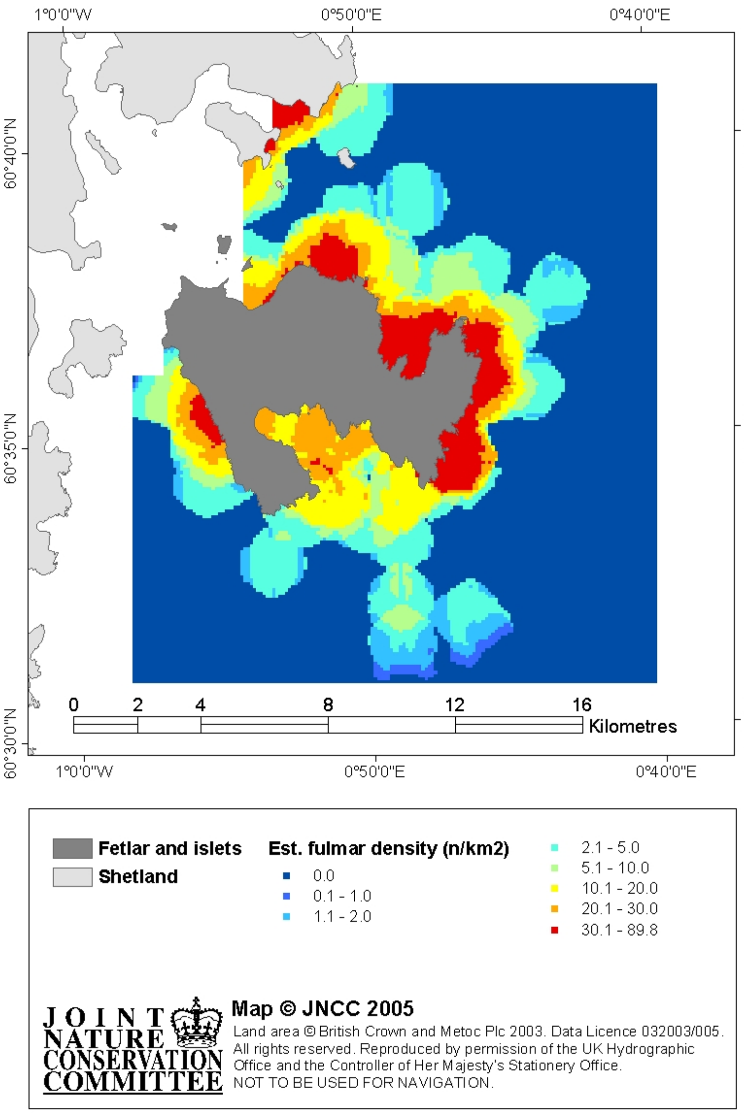

Figure 4.4 Estimated fulmar density (number of birds per square kilometre; n/km2) around Fetlar, generated using geostatistics (Ordinary Indicator Kriging).

4.3 Distance band analysis

Although there were differences in actual density values between sites, as with McSorley *et al* (2003), the relationship between mean density and distance from the shore were consistent. Mean density decreased sharply with distance from the shore, up to approximately two kilometres offshore, after which, it decreased to almost zero (Figure 4.5).

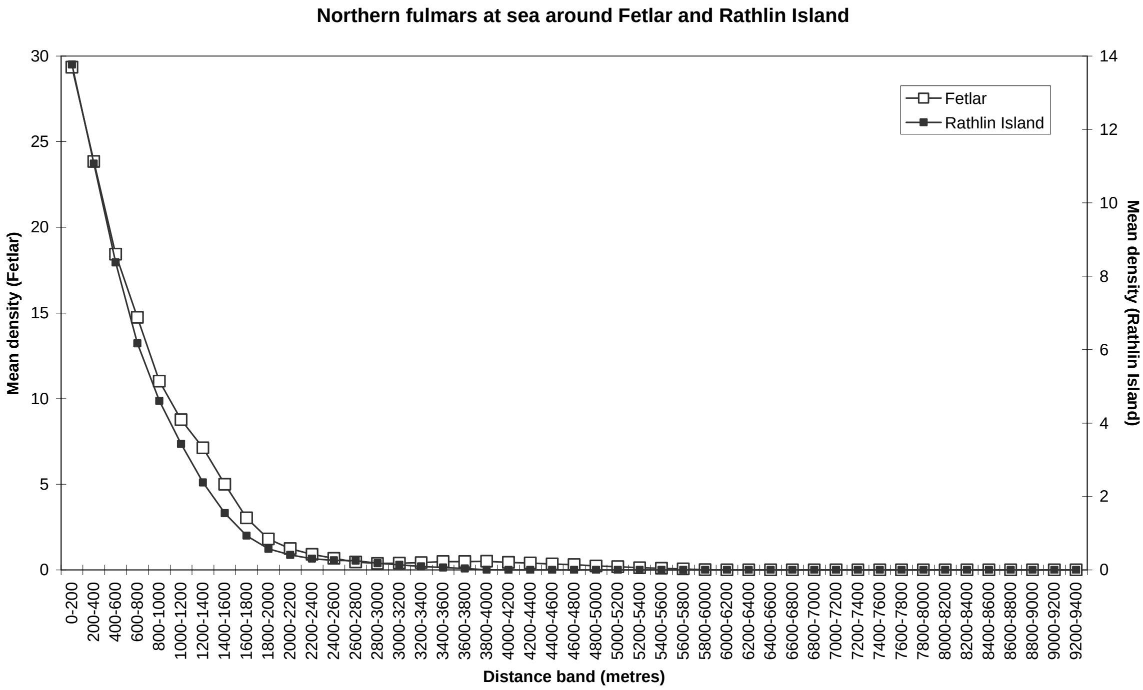

Figure 4.5 Distance band analysis showing the decrease in mean density of northern fulmars engaged in maintenance behaviour in waters around Rathlin Island and Fetlar with increasing distance from the shore.

4.4 Definition of the seaward extent of the interest feature using a generic distance from the colony

Following the distance band analysis (Figure 4.5), the seaward extent of the interest feature is defined as two kilometres from the shoreline around the islands (Figure 4.6 and Figure 4.7). The existing seaward limit of the Rathlin Island boundary falls almost entirely within this distance.

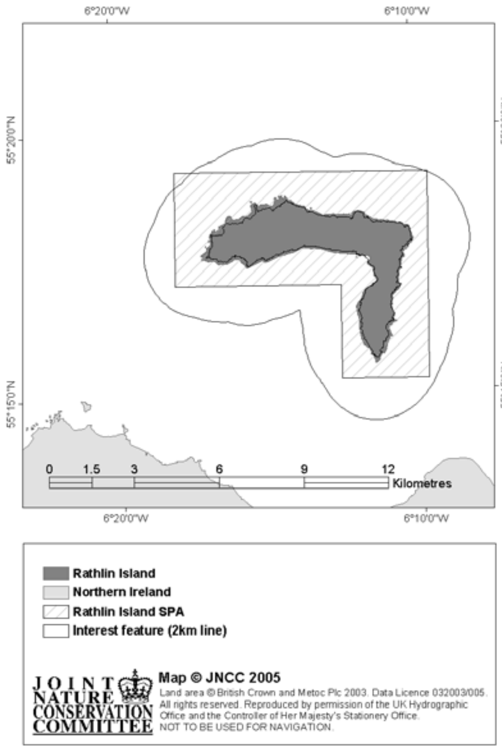

Figure 4.6 Rathlin Island SPA and the seaward extent of the interest feature, defined as 2km from the shore.

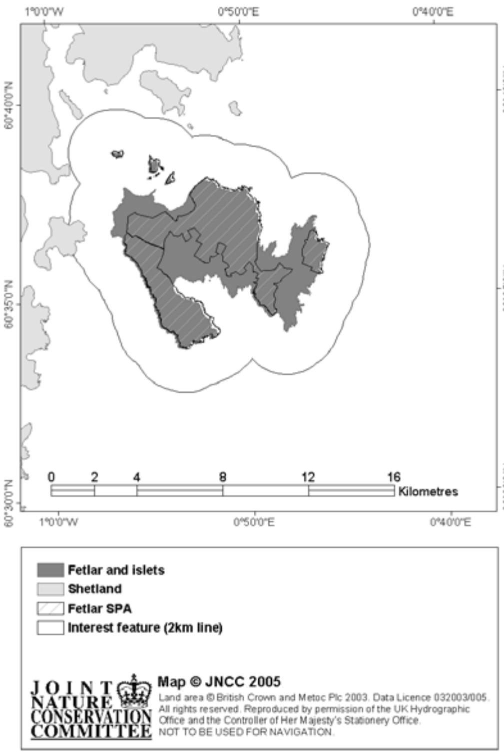

Figure 4.7 Fetlar SPA and the seaward extent of the interest feature, defined as 2km from the shore.

4.5 Importance of waters adjacent to colonies for breeding northern fulmars

To accurately assess the number of fulmars engaged in maintenance behaviour within the marine component of the interest feature, we summed the grid cell abundances within the 2km offshore boundary spatially defined above. Table 4.1 presents these abundance estimates.

Table 4.1 Estimates of the total number of northern fulmar individuals based on various population estimation methods.

	Breeding population size (N individuals; Seabird 2000, unpublished data)	Total number of individual fulmars engaged in maintenance behaviour				Proportion of total no. of fulmars engaged in maintenance behaviour that are within the marine component of the interest feature (d/c*100%)
		a) Observed raw counts	b) Extrapolated overall density	c) Summed kriged abundances in total survey area	d) Summed kriged abundances within the marine component of the interest feature	
Rathlin Island	4,064	101	199	206	196	95.14%
Fetlar	20,886	265	1,647	1,283	1,140	88.85%

The marine component of the interest feature includes a very high proportion of the total number of birds engaged in maintenance behaviour on the water, with 95.14 % of the total estimated number of birds on the water around Rathlin Island being included within the boundary extension, and similarly 88.85 % of the total estimated number of birds on the water around Fetlar. The difference between these two percentages is presumably a reflection of the additional fulmar colonies breeding on the island of Yell and surrounding islets adjacent to Fetlar, compared to the lack of other fulmar colonies adjacent to Rathlin Island (see the aggregation of birds outside the interest feature to the north of Fetlar; Figure 4.2).

Fulmars at these colonies make significant use of the waters around the breeding colonies for maintenance behaviour, thus displaying a functional link and meriting inclusion of these areas within the extent of the SPA. The marine component of the interest feature, which contains significant aggregations of northern fulmars engaged in maintenance behaviour, can be defined as the waters within two kilometres from the breeding colony shore.

5 Conclusions

As with auks and gannets (McSorley *et al*, 2003), there is excellent agreement in the relationships between mean density of northern fulmars engaged in maintenance behaviours and distance from the colony for both islands. On the basis of these data, we conclude that northern fulmars form consistent aggregations within two kilometres from the colony shore (Figure 4.5). Maintenance behaviours are presumably activities that are regularly carried out by all breeding fulmars since they need to keep their feathers clean and waterproofed, and also require time and space to perform courtship displays. It would be energetically inefficient for an attending adult (incubating the egg or attending the chick) to fly any great distance from the colony to carry out these activities; therefore there is a decrease in the density of fulmars engaged in maintenance behaviour with distance from the colony.

We conclude that northern fulmars make significant use of waters adjacent to colonies for maintenance behaviours, implying a functional link. It is likely that all northern fulmars at the colonies use these waters at some stage for maintenance behaviour, possibly on a daily basis.

Since SPAs must provide for "the conservation requirements of the species in the season(s) and for the particular purposes for which they are classified" (JNCC 1999); areas that are used by the qualifying species, and thus deemed important, should be included within the SPA boundary. Existing sites for breeding fulmars have been chosen and site boundaries determined in light of breeding numbers and the spatial extent of the colony; however, as stated previously, determination of these sites' boundaries has, up till now, not included the protection or conservation requirements of these birds at sea. This report has shown that existing SPAs do not fulfil these requirements because breeding fulmars also make use of the waters immediately adjacent to the colony for maintenance behaviours, so meriting an extension of existing SPA boundaries into these waters. By extending the SPA boundaries into the marine environment, the most 'suitable areas' will be protected. Consideration of other marine waters further from the colonies, for feeding and possibly other purposes, is under way.

We have defined the seaward extent of the interest feature as marine waters within 2km of the colony shore, based on densities of northern fulmars engaged in maintenance behaviour. We conclude that a generic seaward boundary extension of 2km from mean low water (mean low water springs in Scotland) would protect the interest feature, i.e. all birds breeding at the colony.

The existing SPAs for Rathlin Island and Fetlar differ quite markedly; Rathlin Island has the only existing UK breeding colony SPA for seabirds with a substantial marine component (Figure 4.6), whereas, as with the rest of the UK's breeding colony SPAs for seabirds, Fetlar is almost entirely terrestrial (Figure 4.7). The Rathlin Island and Fetlar SPAs also differ in their seabird species' composition (see Stroud *et al*, 2001):

- Rathlin Island SPA supports internationally important numbers of common guillemot (28,064 pairs), razorbill (5,978 pairs), and a seabird assemblage of 66,000 individuals, including northern fulmar, mew gull *Larus canus*, lesser black-backed gull *Larus fuscus*, herring gull *Larus argentatus*, black-legged kittiwake *Rissa tridactyla*, common guillemot, razorbill and Atlantic puffin.

- Fetlar SPA supports nationally important numbers of red-necked phalarope *Phalaropus lobatus* (30 pairs), internationally important numbers of great skua *Stercorarius skua* (512 pairs), and a seabird assemblage of 22,000 individuals, including northern fulmar, red-necked phalarope, Arctic skua *Stercorarius parasiticus*, great skua, and Arctic tern *Sterna paradisaea*.

Rathlin Island SPA already qualifies for a marine boundary extension of 1km because of its internationally important numbers of breeding common guillemots, razorbills and Atlantic puffins (McSorley *et al*, 2003). It also qualifies for a marine boundary extension of 2km due to its internationally important numbers of breeding northern fulmar.

Fetlar SPA does not hold qualifying numbers of northern gannet, common guillemot, razorbill or Atlantic puffin. However, the site qualifies for a 2km marine boundary extension, due to its internationally important numbers of breeding northern fulmar.

A generic 2 km distance from the shore should be used to define the seaward extent of all 25 UK SPAs where northern fulmar is listed as a qualifying species (Stroud *et al,* 2001), including[1]:

1. Buchan Ness to Collieston Coast 2. Calf of Eday 3. Cape Wrath 4. Copinsay 5. East Caithness Cliffs 6. Fair Isle 7. Fetlar 8. Firth of Forth Islands 9. Flannan Isles	10. Foula 11. Fowlsheugh 12. Handa 13. Hermaness, Saxa Vord and Valla Field 14. Hoy 15. Mingulay and Berneray 16. North Caithness Cliffs 17. North Rona and Sula Sgeir	18. Noss 19. Rathlin Island 20. Rousay 21. Shiant Isles 22. St Kilda 23. Sumburgh Head 24. Troup, Pennan and Lion's Head 25. West Westray

After the interest feature has been defined using this generic 2km distance, the existing boundary should be extended into the marine environment using boundary placement guidelines i.e. that they should be as simple as possible, and placed along parallels of latitude or meridians of longitude or as diagonal lines between two points where this provides a more easily identified or more practical boundary (Johnston *et al,* 2004). Final determination of the boundary rests with the relevant country nature conservation agencies and competent authorities.

[1] This list is up to date but may be subject to change as the SPA network develops.

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