Waterbirds around the world

A global overview of the conservation, management and research of the world's waterbird flyways

Edited by G.C. Boere, C.A. Galbraith and D.A. Stroud

Assisted by L.K. Bridge, I. Colquhoun, D.A. Scott, D.B.A. Thompson and L.G. Underhill

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Cover photography: Whooper Swans *Cygnus cygnus* arriving at Martin Mere, England. Photo: Paul Marshall. (www.paulmarshallphotography.com)

Selection of suitable sites for marine protected areas for seabirds: a case study with Special Protection Areas (SPAs) in the German Baltic Sea

Stefan Garthe[1] *& Henrik Skov*[2]

[1] *Research and Technology Centre (FTZ), University of Kiel, Hafentörn, D-25761 Büsum, Germany. (email: garthe@ftz-west.uni-kiel.de)*

[2] *DHI Water & Environment, Agern Allé 11, DK-2970 Hørsholm, Denmark. (email: hsk@dhi.dk)*

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ABSTRACT

This paper is an abbreviated and updated version of two publications: Garthe (2003), Verteilungsmuster und Bestände von Seevögeln in der Ausschließlichen Wirtschaftszone (AWZ) der deutschen Nord- und Ostsee und Fachvorschläge für EU-Vogelschutzgebiete, and Garthe (2006), Identification of areas of seabird concentrations in the German North Sea and Baltic Sea using aerial and ship-based surveys. It gives a brief overview of the field methods used to study the distribution of seabirds at sea in the German Baltic Sea. It also shows how the data were analysed, how seabird concentrations may be delineated, and how suggestions for protected areas were derived from the data.

INTRODUCTION

Marine protected areas (MPAs) for seabirds are currently being established under various international instruments and marine conventions (e.g. OSPAR, HELCOM), and also under the main nature conservation directives of the European Union. When Germany adopted its Federal Nature Conservation Act in April 2002 in order to select Natura 2000 sites including sites within the Economic Exclusion Zone (EEZ), the need arose to obtain an up-to-date overview of the distribution and status of seabirds in German waters of the North and Baltic Seas. This paper briefly describes the field methods used in studying the distribution of seabirds at sea, how the data were analysed, how seabird concentrations may be identified, and how suggestions for protected areas were derived from the data.

FIELD METHODS

Seabird distribution in the south-western Baltic Sea was studied by transect counts from ships and aircraft. This method basically aims at assessing distribution patterns and numbers of seabirds at sea, but ships and aircraft are differently suited for these purposes (see Camphuysen *et al.* 2004 and Garthe *et al.* 2004 for recent reviews). Aerial surveys are able to cover a much larger area in a much shorter time and at a lower cost per kilometre than surveys from ships. However, they are only feasible under conditions of low wind speed, and there are limitations to species identification from the air (e.g. groups such as grebes, gulls, terns and auks cannot usually be identified to species level). Ship-based surveys enable the collection of additional information on the behaviour of the birds and usually allow for sampling environmental data, such as hydrography, which proves very useful for understanding species distribution patterns.

The methodology for counts from ships was first described by Tasker *et al.* (1984) and has been largely standardized internationally. Due to the presence of high densities of birds that quite often fled from approaching ships, it proved necessary to search regularly or continuously for birds using binoculars and to deploy at least two observers, as suggested by Webb & Durinck (1992) and Garthe *et al.* (2002). Birds were counted from either the top deck or the bridge-wing, usually on 300 m wide transects set to one or both sides of the vessel. Flying birds were counted employing the "snapshot" method (Tasker *et al.* 1984, Garthe *et al.* 2002). The position of the survey vessel was recorded automatically by onboard or portable GPS instruments.

Seabirds were counted from aircraft using a transect methodology recently described by Diederichs *et al.* (2002). Flights were conducted from twin-engine aircraft (e.g. Partenavia P-68) flying over German waters from the coast to the outer limit of the EEZ. Transects were usually set perpendicular to the coast to obtain variation over major habitat features such as water depth, distance to coast, and frontal systems. Transects were 10 km apart in the North Sea (20 km in areas far from the coast) and mostly 8 km apart in the Baltic Sea. Flights were conducted at an altitude of 250 ft (78 m) and a speed of 100 knots (185 km/hour). During the counts, all bird observations were recorded on a portable voice recorder; the data recorded included: time (to the nearest second), species, number, general behaviour (five categories) and also, if possible, age and sex. Geographic position was recorded every five seconds onboard the aircraft.

SPECIES SELECTION

Gellermann *et al.* (2003) catalogued those species occurring in German waters which must be considered in the selection of SPAs. They distinguished three different levels of importance for species. In the selection of SPAs, only those species that were categorized in their list as of high or medium importance were used. Three groups of bird species comprised this category. The first group comprises the species that are listed in Annex I of the EU Birds Directive (species that shall be the subject of special conservation measures) and that occur regularly in the offshore waters of the German parts of the Baltic Sea. These are Red-throated Diver *Gavia stellata*, Black-throated Diver *G. arctica*, Slavonian Grebe *Podiceps auritus*, and four species of terns. The second group comprises migratory species that regularly occur in offshore areas. The EU Birds Directive does not define "migratory species", and the definition used in practice is the one provided by the Convention on Migratory Species of Wild Animals (Bonn Convention). This Convention defines migratory species as species in which a significant proportion of the population cyclically and predictably crosses one or more national jurisdictional boundaries. In both study areas, this includes all seabird species. For these species, especially those that occur in major concentrations, the most important areas (or a few of the most important areas) were recommended for selection as SPAs.

The identification of SPAs focused on the German EEZ, and preferably on areas that were important for more than one species. The third group comprises rare offshore species and species occurring only along the coast (e.g. diving ducks, geese and swans).

Analysis of the data was equal for the first two groups, i.e. Annex I species and migratory species. However, concentrations of Annex I species were considered to be much more important and were thus more decisive for the designation of SPAs than areas with only migratory bird species. The third group (i.e. species that were rare offshore or confined to the coast) was not relevant to the SPA selection process in the EEZ because of the virtual absence of these species in this area.

SPECIES DISTRIBUTION

All species distribution maps are based on densities, i.e. the number of individuals per unit area. Some species are distributed over large areas and usually exhibit only short-term aggregations (e.g. gulls), while other species are often densely concentrated and are predictable in their distribution (e.g. seaducks). For all relevant species in the German Baltic Sea, a spatial interpolation procedure based on ordinary kriging (Kitanidis 1997) and used by Skov *et al*. (2000) was adopted and further developed (Garthe 2003, Garthe & Skov in prep.). With this procedure, distributional data were interpolated and smoothed between survey lines on the basis of the species-specific spatial abundance structure (which is measured by the software in use). Fig. 1 gives one example for the Long-tailed Duck *Clangula hyemalis*.

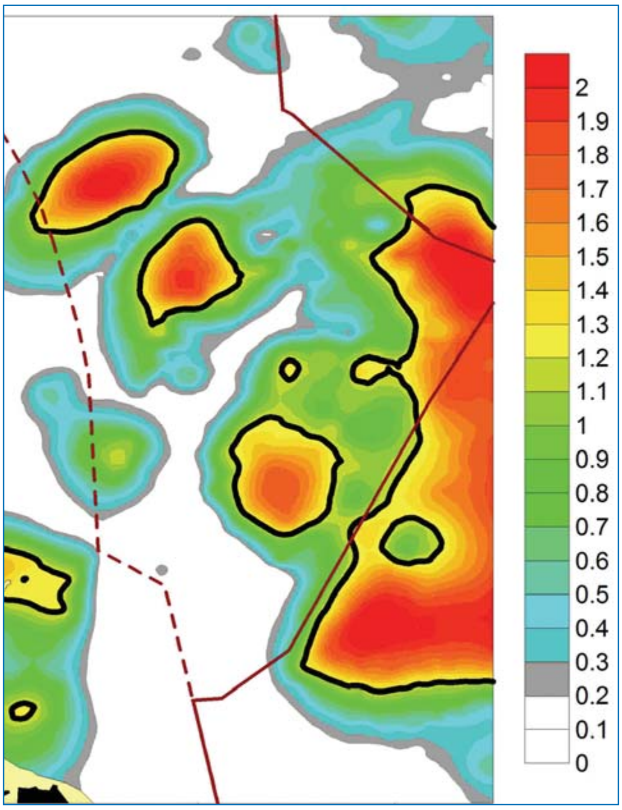

Fig. 1. Distribution of the Long-tailed Duck *Clangula hyemalis* in the German Baltic Sea in winter (December-March); 1986-2002. Colours represent different densities (values as logarithmic density; see legend). Black areas were not studied sufficiently. The dashed red line indicates the seaward limit of German territorial waters; the continuous red line indicates the seaward limit of the German EEZ.

SPA SELECTION

The boundaries of areas of bird concentration were determined by an analysis investigating the gradient of density change over space. In order to do this, the modelled distributional data were projected into a two-dimensional map. In each case, the modelled isoline of bird density (i.e. the line drawn through the same level of bird density) located just outside the strongest gradient in spatial density was chosen as the boundary of a

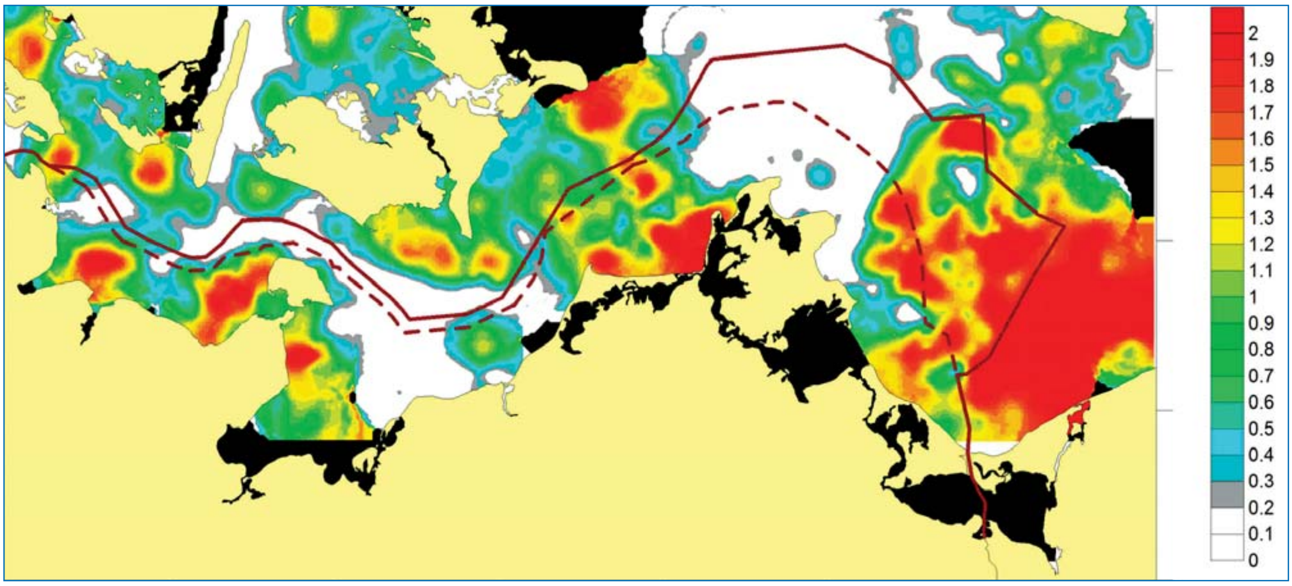

Fig. 2. Distribution of the Velvet Scoter *Melanitta fusca* in the Pommeranian Bay in winter (December-March); 1986-2002. Colours represent different densities (values as logarithmic density [log (density + 1)]; see legend). The dashed red line indicates the seaward limit of German territorial waters; the continuous red line indicates the seaward limit of the German EEZ.

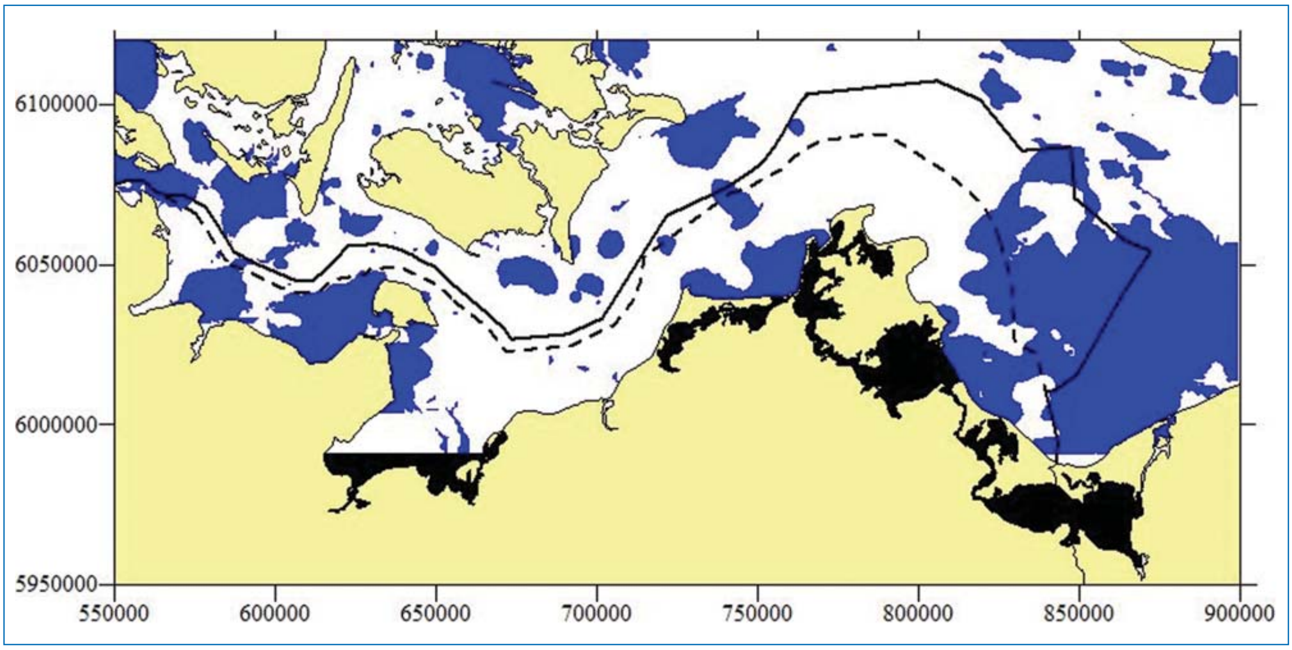

Fig. 3. Overlay of all areas exhibiting concentrations of the species of interest in this study in the south-western Baltic Sea (blue colour). Black areas were not studied sufficiently. The dashed line indicates the seaward limit of German territorial waters, the continuous line indicates the seaward limit of the German EEZ.

concentration (see Fig. 2 for one example). In this way, the major part of the concentration is included in the selected area. The density value of the boundary line was noted and used as the species- and season-specific minimum density defining a seabird concentration. This value was then taken for plotting the contour line showing the spatial extent of the respective concentration.

The areas of concentration and contour lines for each of the species of interest derived from the list of Annex I and migratory bird species were then combined so that a set of areas for potential conservation was identified (Fig. 3). From this map, one potential SPA was suggested.

DISCUSSION

The data collected by ship-based and aerial surveys have been extremely useful for describing the current distribution patterns of all seabird species in the two study areas. Both field methods have their advantages and disadvantages because of their different characteristics. A combination of both methods is ideal for most purposes, including those discussed in this paper. It is important to select these field methods carefully, with respect both to the spatio-temporal scale envisaged for such a study and to the species under consideration.

The robustness of the results has been the focus of considerable attention by various groups in the light of proposals for two large SPAs within the German EEZ in the Baltic and North Seas (Garthe 2003). Most promising was the finding that all surveys carried out after finalization of the SPA proposals (i.e. all surveys in 2003 and 2004) identified the same areas of major concentration as in previous years. This demonstrates that even if the boundaries of the areas of concentration shift slightly, as might be expected in seabirds living in a dynamic environment, the major results are stable and reproducible. However, on a larger time-scale it is possible that the distribution of seabird species could change, especially if environmental conditions change. In the Baltic Sea, this could be the case, for instance, in relation to winter ice distribution, since nearly all of the data collected for this study were from mild and normal winters only. In the North Sea, recent major changes in food availability (which have led to breeding failures in the north-western North Sea) may influence distribution patterns in the German Bight, at least in those species ranging over wide areas of the North Sea.

The analytical methods outlined in this paper are still at an early stage in being adopted as standard procedures for designating SPAs, since most Member States of the European Union have not yet delineated such protected sites in offshore areas. However, these methods have been very useful for selecting areas of seabird concentration and SPAs. More recent work by British colleagues highlights the way forward (e.g. McSorley *et al*. 2004, Webb *et al*. 2004). For species exhibiting a widely dispersed distribution, the procedure for identifying areas of concentration is much more difficult than for aggregated species. To date, no proposals have been made as to how to deal with sea areas in which the only species present are rather evenly or at least widely distributed. In such cases, vast areas would need to be designated to capture a meaningful percentage of bird numbers. This is often politically impossible and might also be less easy to justify scientifically. This problem needs further consideration. For modelling purposes, e.g. in future site selection, covariates (e.g. water depth) should be included. Also, attention might be given to the reliability of data by calculating (statistically) the spatial variation of the boundary lines describing concentrations. If such boundary lines vary substantially over space (e.g. within a standard deviation), then the baseline data and/or aggregation characteristics of the bird species may be less evident than when the boundaries are more stable over space.

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