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Fish and more: A global seabird-base is underway

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Data on marine biodiversity are scattered in databases or exist on paper or other published forms, but are not available for interactive searching. However, for sustainable use and management of marine ecosystems, it is essential to make information readily accessible to decision-makers and scientists (Bisby 2000; Edwards *et al.* 2000). Efforts to make information available in a digital form include, among others, the creation of FishBase (www.fishbase.org; Froese & Pauly 2000), which is a comprehensive biological database on all known marine and freshwater fishes. Similarly, Cephbase (www.cephbase.org) provides thorough biological information on all living cephalopod species. Lastly, investigators at the *Sea Around Us* Project (SAUP; www.seaaroundus.org) have constructed a global database of fisheries catches to investigate what impacts fishing has on the marine environment. Towards a more comprehensive understanding of marine ecosystems, the SAUP has also started gathering information on groups such as marine reptiles, echinoderms, marine mammals, and seabirds.

Under the scientific framework of the SAUP, a Microsoft Access database with global coverage was created to include information on the taxonomy, global distribution, biology, ecology, and population dynamics of 351 seabird species. Information was extracted from sources published in peer-reviewed journals as well as in the grey literature. Some existing online seabird databases (e.g., BirdLife International, www.birdlife.net) were also used for data mining (Karpouzi 2005).

All 351 species belong to four orders and 14 families. Their taxonomic classification followed that by Peters (1934, 1979) and was included in the

Taxonomy table. The *Morphology* table included species-specific information on morphological attributes of species (i.e., body mass, culmen, tarsus, and wing length), as well as information on their breeding biology (e.g., clutch size, duration of the species' breeding period). Lastly, data on the species' foraging behaviour was compiled in the *Foraging* table.

The latter included data on foraging attributes, such as: (i) distance flown from colony in search of prey; (ii) diving depths; (iii) traveling speeds; (iv) foraging trip duration; (v) habitat preferences (i.e., nearshore, coastal, pelagic, and foraging over continental shelves); and (vi) affinities with ice.

Each seabird species, within its distributional range, comprises of breeding populations (i.e., number of individuals breeding at a locality, thus forming a breeding colony). From 1950 to 2003, a mean annual population size (usually expressed in the literature in breeding pairs) per colony was recorded in the *Population* table. To account for non- and pre-breeders present in colonies, breeding pairs were transformed into numbers of individuals using equations developed by ICES (2000). Lastly, a *Diet* table was constructed to include diet composition data (% gravimetric abundance) that was available for various breeding populations of 174 seabird species.

Data stored in the *Foraging* table were used for mapping the at-sea distribution of seabird species using a GIS-based modelling approach (Fig. 1). The model parameters considered were: (i) the species' north and south latitudinal range; (ii) their breeding localities; (iii) foraging range; (iv) habitat preferences; and (v) distribution maps of forage prey available in the SAUP database. For the majority of seabirds, probability of occurrence was assumed to decrease linearly with distance from land, to zero at the maximum reported foraging range. For only four out of 351 species, probability of occurrence was described by a trapezoidal probability distribution (i.e., occurrence was assumed to be uniformly highest within a threshold distance from the breeding colony, and then decrease linearly to zero at the maximum reported foraging range). The models predicted that the waters around New Zealand, the eastern coast of Australia, and the sub-Antarctic Islands were characterized by highest species richness (Fig. 1).

The majority of seabird species is distributed in the Southern hemisphere (Fig. 1). The same pattern is particularly evident for albatross and petrel species (Chown *et al.* 1998; Karpouzi 2005). Albatross and petrel populations are declining at an alarming rate because longline fishing poses a great threat (Birdlife International 2004). Indeed, 73 out of 351 species are critically endangered, endangered, or near threatened in the 2003 IUCN Red List of Threatened Species (www.redlist.org), most occurring in the southern he-

misphere. Thus, areas of highest probability of holding important concentrations of seabirds may require immediate attention for conservation actions.

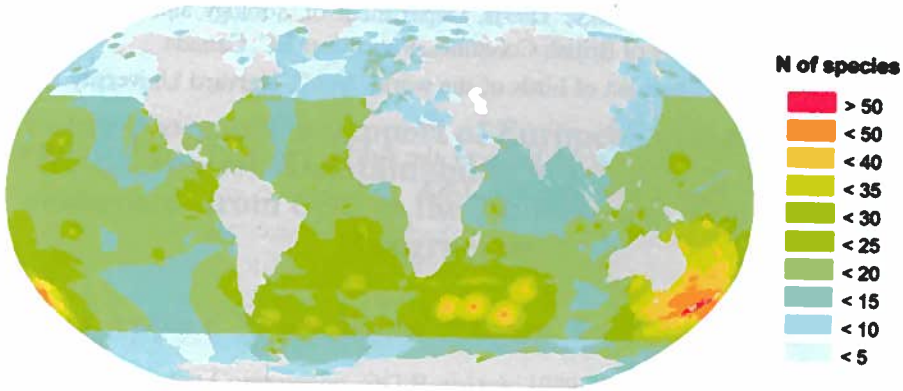

Figure 1 Map of predicted at-sea distribution of seabird species during an average year in the 1990s, expressed in number (N) of seabird species per 30-min (longitude and latitude) spatial cell

Future steps for the improvement of the database include continuous updating of all tables with information that becomes available. Furthermore, the *Population* table will expand to include minimum and maximum population sizes. Breeding populations of seabirds occurring in countries/areas with long coastline (e.g., India, People's Republic of China, Gulf of Alaska) require more adequate representation. Lastly, information on foraging attributes of seabirds is lacking to a great extent; thus the *Foraging* table needs to be further populated and expanded.

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