**The Seabird Prey Data Base**

This data base was created as part of the Marine Ecosystem Research Programme, funded by the Natural Environment Research Council (NERC) and the Department for Environment, Food and Rural Affairs (Defra), that aimed to integrate existing and new marine data sets with current models of marine ecosystem services to further our knowledge and understanding of the UK marine ecosystems. The aim of the Seabird Prey Date Base was to collate a new data set with all known information on prey consumed by seabirds breeding in the British Isles.

For the predators we have focused on the 10 most common seabird species by total biomass during the breeding season (Table 1). As the focus of the programme was an assessment of the marine ecosystem, for this database we only selected seabird species where the majority of their consumed prey was marine to reflect the focus of the programme. Among the top-ten British seabird species by biomass are two gull species (Herring Gull (*Larus argentatus*) and Lesser Black-backed Gulls (*L. fuscus*), but they show a very different diet from the other seabirds, forage to a substantial amount on terrestrial habitat (Garthe et al., 2016; Götmark, 1984) and if they consume marine prey its taxonomy is usually poorly resolved. Therefore we concentrated on Northern Gannet (*Morus bassanus*), Common Guillemot (*Uria aalge*), Northern Fulmar (*Fulmarus glacialis*), Atlantic Puffin (*Fratercula arctica*), Black-legged Kittiwake (*Rissa tridactyla*), Razorbill (*Alca torda*), Manx Shearwater (*Puffinus puffinus*), and European Shag (*Phalacrocorax aristotelis*). Together, these birds accounted for 95% of biomass of seabirds consuming a marine diet in 2000 (Grandgeorge et al., 2008; Mitchell, Newton, Ratcliffe, & Dunn, 2004) and thus their prey will reflect the major of marine prey consumed by seabirds in British waters.

Information was gathered from the primary literature by searching the Web of Science for titles, abstract or keywords containing ‘diet’, ‘food’, and species name. Publications found in the Web of Science search was then inspected for relevant diet information in that publication and references to earlier studies that may provide further diet information. Those publications were then also inspected in the same way until no new references would occur. We have also contacted researchers known to collect or have been collecting seabird diet information for further information that sometimes lead to the inclusion of unpublished information if the source agreed to the inclusion of that information into the data base (coumn Reference).

For a study to be included in the data base it required to provide at least quantitative information on the diet (see below), a sampling location (site name, latitude and longitude) and sampling date (year of data collection or at least a range of years over which the diet information was collected). We also included a range of other information (Table 2). We distinguished between sampling during the species breeding season (Breeding status, although often not necessarily known whether a particular sample come from a breeding adult) and the non-breeding season; there is much less information for the latter. We distinguished between breeding and non-breeding as diets may change due to seasonal variation in prey availability and between breeding and non-breeding requirements. Diets may also vary between different breeding stages but often the exact breeding stage was not known. Moreover, even in the breeding season typically chicks or birds with chicks are sampled, but there are also non-breeding birds; individuals with chicks can bring in food that is higher in energetic density than the food taken by birds without chicks (Noordhuis & Spaans 1992, Brown & Ewins 1996, Ojowski et al. 2001). We also recorded whether the diet sample was obtained from the parent bird or the nestling (Age Group), as chick food can differ from the food eaten by adults (e.g. Ydenberg 1994, Mehlum, 2001, Dierschke & Hüppop 2003). In same cases a sample could have come from either of them as this was recorded as ‘Adult & Chick’.

For the prey taxa we first recorded the prey type as given in the original study. However, same taxa names have changed over time and in order to use a consistent terminology we matched each prey type to the corresponding lowest possible taxonomic level in WoRMS (http://www.marinespecies.org/) and this is recorded under Prey Species. The quantitative information on how common a prey was in a particular location and year (location-year) can be expressed in one of three currencies commonly used in seabird dietary studies (Duffy & Jackson 1986, Barrett et al. 2007): frequency of occurrence, numerical frequency and biomass frequency (see Table 2). We recorded the metrics that were provided by the original study per year and location (location-year); each prey taxa is entered as a separate record. So if for a seabird predator n prey taxa were identified in the samples for a particular year and location, then there are n rows in the data base representing that information. If there was diet information for separate year, we recorded the information separately, otherwise we give the start and end year over which years information was collected. If the study provided information of the size of a prey taxa (typically prey length) we recorded this under Prey Size; if a range of length were given we recorded the median value. For each location and year the number of samples recorded are provided in the column Sample Size. This is the number of different samples collected at a particular location and year and it is not possible to exclude the possibility that occasionally multiple samples from the same individual could have been included. We have included all available information irrespective of sample sizes, but this may be filtered by a minimal sample size required to provide a representative picture of the birds’ diet which may vary between different sample types and diet diversity.

Diets from different seabird species are typically collected with different methods (recorded as Sample Type) but often the majority of studies within a species use the same method. Each method has its limitation (see Barrett et al. 2007, Karnovsky et al. 2012). The most representative diet assessment is likely from stomach content and there is information from stomachs for most species and the predominant method for each species can be compared against stomach content to gain some insight into the limitations specific to the methods and locations collated here.

 Finally we recorded whether the information was gathered from a peer reviewed publication (primary literature) or an unpublished record in the column Source.

 Table 3 gives a summary of the number of locations and number of location-years that the data base covers for each of the species included in the data base. The number of locations varies between species depending on number of colonies in Britain and how readily diet information for this species can be collected. For Common Guillemots a total of 42 locations and 152 location-years all around the British coast were included. There was also a good number of locations (range 8-17 locations) and location-years (39-106 locations-years) for Atlantic Puffin, Black-legged Kittiwake, European Shag and Razorbill. There was information for five colonies for Northern Fulmar and Northern Gannet, the latter reflecting the samller number of breeding locations in Britain than for the other species. Finally, diet information for Manx Shearwater was only available for one location from one year, although the species would breed at more locations in Britain. The geographical spread of the locations is skewed towards the northern and western parts of the British Isles as this is where the majority of breeding seabirds occur.

 It is hoped that this information will be useful to provide an overview of on what prey species our most common seabirds in British waters rely and insights both in the function and structure of marine ecosystems and a bases for conservation management decisions as many of our seabird populations are declining. As new information will keep adding to our knowledge of the diets of British seabirds this data base will be able to include these new information and act as a reposotory for diet information of British Seabirds.

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Table 1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Species |  | Clutch | Body | Breeding Pairs | Individual breeders | Breeders & | Juveniles | Total  | Biomass | Cummulative |
|  |  |  | mass (g) |  |  | non-breeders |  | population |  (tonnes) | % biomass |
| Northern gannet | *Morus bassanus* | S | 3015 | 259311 | 518622 | 797879 | 181518 | 979397 | 2952.88 | 0.27 |
| Common guillemot | *Uria aalge* | S | 836 | 779742 | 1559484 | 2399204 | 545819 | 2945023 | 2462.04 | 0.49 |
| Northern fulmar | *Fulmarus glacialis* | S | 758 | 537991 | 1075982 | 1655355 | 376594 | 2031949 | 1540.22 | 0.63 |
| Atlantic puffin | *Fratercula arctica* | S | 415 | 600751 | 1201502 | 1848463 | 420526 | 2268989 | 941.63 | 0.71 |
| Herring gull | *Larus argentatus* | M | 988 | 147114 | 294228 | 420325 | 467845 | 888170 | 877.51 | 0.79 |
| Manx shearwater | *Puffinus puffinus* | S | 419 | 374067 | 748134 | 1150974 | 261847 | 1412821 | 591.97 | 0.85 |
| Black-legged kittiwake | *Rissa tridactyla* | M | 393 | 415995 | 831990 | 1188556 | 155587 | 1344143 | 528.25 | 0.9 |
| Razorbill | *Alca torda* | S | 677 | 108044 | 216088 | 332443 | 75631 | 408074 | 276.27 | 0.92 |
| Lesser black-backed gull | *Larus fuscus* | M | 814 | 91323 | 182646 | 260923 | 54794 | 315717 | 256.99 | 0.94 |
| European shag | *Phalacrocorax aristotelis* | M | 1763 | 32306 | 64612 | 92303 | 19384 | 111687 | 196.9 | 0.96 |
| Great black-backed gull | *Larus marinus* | M | 1622 | 19691 | 39382 | 56260 | 11815 | 68075 | 110.42 | 0.97 |
| Great cormorant | *Phalacrocorax carbo* | M | 2300 | 11560 | 23120 | 33029 | 6936 | 39965 | 91.92 | 0.98 |
| Black-headed gull | *Chroicocephalus ridibundus* | M | 265 | 62498 | 124996 | 178566 | 37499 | 216065 | 57.26 | 0.98 |
| Great skua | *Stercorarius skua* | M | 1431 | 9635 | 19270 | 27529 | 5781 | 33310 | 47.67 | 0.99 |
| Common gull | *Larus canus* | M | 410 | 21475 | 42950 | 61357 | 12885 | 74242 | 30.44 | 0.99 |
| Black guillemot | *Cepphus grylle* | M | 385 | 21342 | 42684 | 60977 | 12805 | 73782 | 28.41 | 0.99 |
| Arctic tern | *Sterna paradisaea* | M | 102 | 56123 | 112246 | 160351 | 33674 | 194025 | 19.79 | 1 |
| Sandwich tern | *Sterna sandvicensis* | M | 249 | 14252 | 28504 | 40720 | 8551 | 49271 | 12.27 | 1 |
| Leach's storm-petrel | *Oceanodroma leucorhoa* | S | 44 | 48357 | 96714 | 148791 | 33850 | 182641 | 8.04 | 1 |
| European storm-petrel | *Hydrobates pelagicus* | S | 25 | 82820 | 165640 | 254831 | 57974 | 312805 | 7.82 | 1 |
| Common tern | *Sterna hirundo* | M | 125 | 14497 | 28994 | 41420 | 14497 | 55917 | 6.99 | 1 |
| Arctic skua | *Stercorarius parasiticus* | M | 465 | 2136 | 4272 | 6103 | 2136 | 8239 | 3.83 | 1 |
| Little tern | *Sterna albifrons* | M | 49 | 2153 | 4306 | 6151 | 2153 | 8304 | 0.41 | 1 |
| Roseate tern | *Sterna dougallii* | M | 115 | 790 | 1580 | 2257 | 790 | 3047 | 0.35 | 1 |
| Mediterranean gull | *Ichthyaetus melanocephalus* | M | 796 | 113 | 226 | 323 | 113 | 436 | 0.35 | 1 |

Table 2: Description of the variables represented in the data base.

|  |  |  |
| --- | --- | --- |
| Column | Name | Description |
| 1 | Common name | Common name of the seabird predator (see Table 1). |
| 2 | Species | Scientific species name of the seabird predator  |
| 3 | Year | The year or the range of years the diet samples were taken. Typically we report separate diets per year where this is possible, but if the study pooled the information over a number of years, and the data are not given per year, we used the pooled information and give the range of years (startyear and endyear). |
| 4 | Location | That is the location where diet samples were taken, typically at a breeding colony. Sometimes samples were taken over a wider region and where it was not distinguished between two or more specific locations where diet samples were collected we took approximately the midpoint between multiple locations where relevant. The location is the place name as given in the reporting study. |
| 5 | Latitude | For each location we established the latitude; they are all North |
| 6 | Longitude | For each location we established the longitude; negative values are for West and positive values for East. |
| 7 | Breeding status | Distinguishes whether diets were sampled during the Breeding season (not necessarily from known breeding birds though) or during the non-breeding season.  |
| 8 | Age Group | Distinguishes whether the diet samples were collected from Adult or Chick. In some cases it is not possible to distinguish between the two age classes (for example when pellets were sampled during the chick rearing stage when the pellets could come from either of them) which is recorded as Adult & Chick. |
| 9 | Prey.type | The prey taxa as used by the original study |
| 10 | Prey.species | Taxonomic name that conforms to WoRMS (http://www.marinespecies.org/)  |
| 11 | FoO | Frequency of occurrence (0.00-1.00): the proportion of diet samples that contained a given prey.species. As a sample can contain several different prey.species, frequency of occurrence of all prey.species recorded in a particular study won’t necessarily add up to 1.00. For stomach content analyses, whenever possible this was expressed as a proportion of stomachs that had some content (i.e. exclude empty stomachs). |
| 12 | Num Freq | Numerical frequency (0.00-1.00) of a given prey.species among the total number of all recorded prey items. Within a given study these frequency must add up to 1.00 |
| 13 | Freq Biomass | Where the biomass of all prey.species was determined it is also possible to express each prey.species as a proportion (0.00-1.00) of the total biomass/volume/energy intake delivered |
| 14 | Prey size | Wherever it was reported we recorded the average prey size (length in mm) as given by the study |
| 15 | Sample.size | This gives the number of samples that a study has examined, taken is the number of samples acknowledging that there could be multiple samples per nest, as too few studies reliably reported the actual number of nests sampled. |
| 16 | Sample.type | Different studies used different methods to assess diet, and typically different techniques are used on different species; each having their own limitations (to be summarised). For a discussion of the different methods to asses seabirds and their limitations see Barrett et al. 2007 and Karnovsky et al. 2012. |
| 17 | Source | Here we distinguish between studies reported in peer-reviewed literature (Primary Literature) or unpublished reports or people that have passed on to us their data (Report) |
| 18 | Reference | For each entry we give the reference (for Primary Literature: author(s) year journal volume startpage endpage) or names and contact details for who provided the data. |

Table 3: Number of unique locations and the sum of all years for all colonies (location-years) for each species included in the data base

|  |  |  |  |
| --- | --- | --- | --- |
| Species |  | Number of unique locations | Number of location-years |
| Northern gannet | *Morus bassanus* | 5 | 20 |
| Common guillemot | *Uria aalge* | 42 | 152 |
| Northern fulmar | *Fulmarus glacialis* | 5 | 12 |
| Atlantic puffin | *Fratercula arctica* | 12 | 106 |
| Manx shearwater | *Puffinus puffinus* | 1 | 1 |
| Black-legged kittiwake | *Rissa tridactyla* | 17 | 101 |
| Razorbill | *Alca torda* | 8 | 44 |
| European shag | *Phalacrocorax aristotelis* | 9 | 39 |