Recommended Direction for the Seabird Monitoring Programme

Paper by Lawrence Way and Ian Mitchell, JNCC.

1. Introduction

1.1. Since 1989, seabird surveillance in the UK has been undertaken mainly as part of the Seabird Monitoring Programme (SMP). The SMP regularly monitors a selection of the UK populations of 26 species of breeding seabirds. Evidence derived from this sampling has been important in conservation actions, such as helping to implement the Birds Directive. It has also been useful in supporting advice on the wider ecological effects of various human activities including commercial fishing (e.g. for lesser sandeel and whitefish species in the North Sea), and the effects of climate change.

1.2. The SMP has produced a dataset spanning more than 20 years that has provided a valuable contribution to the study of seabird ecology. To date, analyses of SMP data have been published in more than 80 scientific peer-reviewed papers and in 60 books and published reports. The SMP has also developed seabird monitoring techniques and in 1995 published the *Seabird Monitoring Handbook*[1]. Other seabird monitoring schemes around the world have adopted these techniques and have used the SMP as model for their own activities.

1.3. The JNCC is the lead partner of the SMP: it provides co-ordination, maintains common standards for data collection, collates data and ensures dissemination of data and summary interpretation to stakeholders. Data collection is largely undertaken by partner organisations as part of other ongoing work priorities, so that the SMP adds value to these activities, which ensures that the SMP is cost-effective. In addition, the JNCC also funds some of the data collection.

1.4. The purpose of this paper is to identify a medium to long-term direction for seabird surveillance in the UK. It does this by first determining what evidence could be most effectively derived from seabird surveillance. It then assesses what level of surveillance (both temporal and spatial) is needed to provide the evidence, and investigates options for delivering it. These options take into account the surveillance already carried out in the SMP and the collaborative partnerships associated with it. The paper draws on the findings of Mitchell and Parsons (2007).[2]

1.5. The specific goal of this paper is to recommend the future objectives for the collection and dissemination of data by the SMP.

2. Background to seabird surveillance in the UK

2.1. Current knowledge of the status of breeding seabird populations in the UK has largely come from three complete censuses of Britain and Ireland that were conducted during 'Operation Seafarer' in 1969-70 by the Seabird Group, 'The Seabird Colony Register' in

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[1] Walsh, P. M., Halley, D. J., Harris, M. P., del Nevo, A., Sim, I. M. W. & Tasker, M. L. 1995. Seabird monitoring handbook for Britain and Ireland. JNCC / RSPB / ITE / Seabird Group, Peterborough. Available at http://www.jncc.gov.uk/page-2406.

[2] Mitchell, P. I. & Parsons, M. 2007. Strategic Review of UK Seabird Monitoring Programme. JNCC Unpublished Report, October 2007.

1985-88 by the Seabird Group and the Nature Conservancy Council, and 'Seabird 2000' in 1998-2002 by JNCC and the SMP Partnership. There were few comparable data collected prior to Operation Seafarer, apart from surveys of northern gannet colonies that have been regularly undertaken since 1900. The censuses of breeding seabirds in Britain and Ireland have provided detailed information on changes in breeding distribution and comparable estimates of population size. They therefore enable conservation status to be determined over intervals of 15-30 years.

2.2. Complete censuses are logistically demanding given the length of coast and the remoteness of many nesting locations. The last census took 6 years to complete (including planning, data collection and reporting) and cost approximately in the region of £1.3-1.6 million.

2.3. Apart from the surveys of gannet colonies, very little co-ordinated surveillance of seabirds was conducted between Operation Seafarer and the Seabird Colony Register. However, in 1986, the NCC, with partners, started to develop a co-ordinated scheme of seabird surveillance that collected data not just on abundance, but also on breeding success and other parameters such as chick diet. Subsequently, in 1989, the SMP was officially established. The SMP aimed to provide information to enable protection measures to be implemented under the EC Birds Directive, to detect the impact of potential threats to seabird populations including pollution, predators and fisheries, and to provide an indication of the state of the wider marine environment.

2.4. The SMP established detailed monitoring of abundance, breeding success, adult survival and chick diet at four geographically spread 'Key Sites' that included some of the largest seabird colonies in the UK. Since 1989, JNCC has contracted-out the work at the key sites, undertaken on the Isle of May by the Centre for Ecology and Hydrology (CEH), on Fair Isle by the Fair Isle Bird Observatory Trust, on Canna by the Highland Ringing Group and on Skomer by the Wildlife Trust for South and West Wales and the Edward Grey Institute for Ornithology.

2.5. The SMP has also promoted the monitoring of abundance and breeding success at other colonies outwith the key sites throughout Britain and Ireland. The amount of monitoring conducted outwith the key sites has increased steadily through both the activities of individual volunteers and through the monitoring conducted by the SMP's partners[3] and other conservation organisations, such as the Wildlife Trusts, the National Trust, and the National Trust for Scotland.

2.6. The annual cost of the SMP is between £400,000 and £450,000. JNCC contributes 40% of this through funding staff-time in co-ordinating the sampling and collating and reporting the results, and through key site monitoring and other data collection. The remainder of the cost is accounted for by long-term monitoring and research conducted by CEH, RSPB, the Country Agencies, National Trust for Scotland, Shetland Oil Terminal Environmental Advisory Group and others. In addition, volunteer time spent on seabird surveys would be worth around £85,000 annually.

2.7. The data collected from the sample of UK colonies that the SMP has monitored since 1986 is sufficient for estimating accurate UK trends in abundance and breeding success for 17 and 13 species respectively. Not all the colonies are monitored in any one year. However, trends for the whole sample are updated annually using statistical models (e.g. REML, Bayesian), which supplement observed data from colonies that were monitored,

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[3] the statutory country conservation agencies, the Seabird Group, Shetland Oil Terminal Environmental Advisory Group (SOTEAG), Royal Society for the Protection of Birds (RSPB), Centre for Ecology and Hydrology (CEH), British Trust for Ornithology (BTO), and in the Republic of Ireland: BirdWatch Ireland and the Department of Heritage, Wildlife and Local Government.

with predicted values for colonies that were not monitored. This modelling approach has been applied to the UK's Wild Bird Indicator and Biodiversity Strategy suite of indicators in England and Scotland. These trend analyses are currently being used to develop seabird indicators for the OSPAR Maritime Area (i.e. NE Atlantic, and North, Norwegian, Barents and Greenland Seas).

2.8. A very high percentage of some seabird populations breed in protected areas – for example more than 50% of the UK populations of 19 species breed within the SPA network (this includes birds that are not 'qualifying features').

2.9. Common Standards Monitoring (CSM) uses changes in seabird colony size at protected sites to assess the 'condition' of qualifying seabird features against predefined objectives (e.g. 'favourable condition', 'unfavourable condition', or 'destroyed'). The 6 year assessment and reporting cycle of CSM could provide data on abundance for a large proportion of the UK populations of many seabird species. The first round of CSM was able to use data collected during the last complete seabird census – Seabird 2000, to assess the status at protected seabird colonies. The responsible agencies need very cost effective ways of meeting their CSM requirements, and are likely to benefit from collaboration with the SMP over the collection of seabird monitoring data.

2.10. Although most seabird species are colonial, largely cliff-nesters and breed close to other species, the 26 species provide a range of quite different challenges for conducting accurate surveillance. They vary significantly in ease and accuracy of survey techniques. Burrow-nesting, nocturnal species are the most difficult to survey accurately, while it is much more straightforward to obtain accurate estimates of abundance and breeding success of some of the ground-nesting and cliff-nesting species. Some of the largest seabird colonies are on remote uninhabited islands that are logistically difficult and costly to survey. Several species tend not to form mixed colonies with other seabird species. Some species are rare, others restricted to certain regions of the UK. In summary, a variety of very different sampling strategies is required if we need to monitor populations of all or most seabird species.

3. Objectives for the next 15 years

3.1. The SMP has developed considerably in the last two decades. The challenge is to build on the knowledge gained, and to set objectives for the next 15 years so that the evidence gained from seabird surveillance provides maximum value in managing the marine environment, and ensuring that we retain seabird populations in the UK at viable levels. Options for future surveillance need to be compared in terms of the return of evidence against investment in data collection and co-ordination. The SMP's partners and investors should be encouraged to find acceptable and mutually reinforcing ways of complementing each others' input.

3.2. The focus of the review has been influenced by the 'UK Biodiversity Surveillance Strategy[4]. The strategy uses three top level objectives for the surveillance of biodiversity (species, habitats, ecosystems/services, genes):

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[4] See http://www.jncc.gov.uk/page-4409 - The seabirds review was conducted against a developmental version of the strategy, and the objectives in the current version of the strategy have been updated.

- to measure the overall goals set for biodiversity in UK and country strategies;

- to detect the impacts of the pressures affecting biodiversity, through changes in biodiversity status, in order to help set measures and strategies for taking action; and

- to assess the status of the wide range of species and habitats covered by the sum of the policy, legislative, and international conservation commitments.

3.3.   In order to investigate the feasibility of meeting these objectives and the most efficient way of doing so, the review has taken a species-by-species approach. It recognised that the different species vary considerably in terms of their ecology, distribution, conservation status and in how practical it is to monitor their populations accurately. The surveillance of each species was assessed by considering the following (for details, see Appendix 1):

- factors affecting monitoring approach;

- current sampling coverage; and

- factors affecting the need for evidence.

The recommendations on how to co-ordinate seabird surveillance across the UK were based on the sum total of these individual species assessments.

3.4.   The aim was to compare the need for evidence with what will be achievable based on the experience of monitoring so far, in terms of how extensively the UK population of a species is currently sampled (i.e. current sampling coverage) and how practical it would be to expand the sample to obtain more accurate UK-wide trends (i.e. factors affecting sampling approach).

3.5.   The factors affecting the need for evidence were chosen to help apply the UK surveillance strategy objectives (as listed in 3.2 above).

3.5.1.   *Measuring the overall goals set for biodiversity in the UK and country strategies*

The broad goal of the country biodiversity strategies and the UK Marine Monitoring and Assessment Strategy (UKMMAS) is for biodiversity to be sustained as part of healthy functioning ecosystems, and there is the immediate cross-cutting goal of the Convention on Biodiversity to halt biodiversity loss by 2010.

Periodic censuses of all seabird species in the UK (see 2.1 above), provide an assessment of the state of seabird biodiversity in UK waters. However, these censuses, which, if continued every 15-years, would not be frequent enough to provide feedback on progress of the UK's marine strategy, since assessments of the state of the seas are carried out every five years[5]. However, sufficient feedback on the state of seabird populations could be provided by sensitive monitoring that is based on annual sampling of a set of species that occupy different niches of the marine ecosystem i.e. indicators.

The review used evidence of decline, or vulnerability, (e.g. rarity and localised distribution) at UK and European scales, and international responsibility, to identify those species that require more frequent monitoring (see Appendix 1 for details) that is capable of detecting change over a short period. The evidence was also used to identify the type of monitoring required (i.e. of abundance or breeding success or other parameters such as survival or diet) to determine the causes for population change.

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[5] An assessments of the state of the UK's seas called 'Charting Progress' was published by Defra in 2005 as part of UKMMAS and a second report is due in 2010.

3.5.2. *Detecting the impacts of the pressures affecting biodiversity, through changes in biodiversity status, in order to help set measures and strategies for taking action.*

The review identified those species with the greatest potential to act as indicators of the impacts of pressures on the marine environment. The species were selected because they were distributed widely throughout the UK and were straightforward to monitor; trends in their populations were thought (based on the latest literature – see Mitchell and Parsons 2007[6] for a review) to be significantly affected by certain pressures, and that together, they represented a range of feeding niches (as recommended by ICES 2007[7]). If pressures such as over-exploitation (e.g. by commercial fisheries), climate change and invasive species, are having an effect, these populations would be expected to change in a particular way. Correlations between measures of seabird population parameters obtained through surveillance (e.g. breeding success) and measures of pressure variables (e.g. sea-surface temperature) could direct research into the mechanisms involved, which in turn, could support advice on the most effective mitigation.

For each of these potential indicator species, the review assessed the effectiveness of current sampling at providing sufficient data to accurately estimate UK-wide trends in abundance and breeding success and, where necessary, assessed the feasibility of expanding the sample of colonies.

The ability to detect the impact of pressures on seabirds and to do so sufficiently quickly to increase the likelihood of success of any mitigation, is greatly affected by the population parameter being monitored. Since the seabird species that breed in the UK are relatively slow to mature (i.e. at 3-9 years old), trends in the abundance of breeding adults or pairs will provide a poor indication over the short-term, of those pressures that impact mainly on productivity (i.e. by affecting rates of breeding success and survival to maturity). Therefore, trends in breeding success, and trends in behavioural parameters such as diet and phenology provide much better short-term indicators of such impacts.

The current monitoring of breeding success by the SMP was considered sufficient to provide an impact indicator of most pressures, except those that cause increased mortality rather than reduced breeding success e.g. pollution, culling, and fisheries bycatch. Impacts on mortality, if sufficiently large and widespread, will be detected immediately by monitoring abundance, as long as adults are significantly affected. Changes in the rates of survival to maturity are very difficult to measure directly and will only become evident in changes in the size of the breeding population several years later (i.e. 3-9 years).

Simultaneous monitoring of changes in abundance and breeding success with other parameters such as diet, phenology and adult survival, where feasible could enable managers to identify the impacts of certain pressures and to recommend more specific and effective mitigation. However, the labour-intensive methods currently used to monitor changes in these parameters have restricted monitoring to a few intensively studied colonies - mainly the SMP's key sites (see 2.4).

This approach to monitoring pressure impacts i.e. using indicators, is similar to

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[6] Mitchell, P. I. & Parsons, M. 2007. Strategic Review of UK Seabird Monitoring Programme. JNCC Unpublished Report, October 2007.
[7] ICES 2007. Report of the working group on seabird ecology. ICES CM 2007/C:08.

that currently being developed for all components of the marine ecosystem as part of UKMMAS.

3.5.3. *Assessing the status of the wide range of species and habitats covered by the sum of the policy, legislative, and international conservation commitments.*

The strongest legislative commitment relating to seabirds is the UK requirement to implement the EC Birds Directive and all but one of the 26 seabird species breeding in the UK are covered.

The Birds Directive implies the need for periodic monitoring of the status of protected species, but there is no explicit guidance on the frequency of such monitoring; only that Member States should report every three years on their progress on implementing the Directive. Therefore, the information on state produced at 15 year intervals by each previous seabird census, has been sufficient to meet the requirements of the Birds Directive, largely through supporting the identification of SPAs. The EU is currently reviewing Birds Directive reporting, which may result in a requirement for an outcome measure of species populations. However, such a change should not completely dictate the sensitivity and frequency of seabird monitoring, given the variation in value and cost of monitoring each of the Birds Directive species, which vary considerably in their conservation status.

Over 50% of the UK population of 19 species is present in SPAs, so there is considerable scope to estimate population status (i.e. population size and trends in abundance) in these species at least once every six years if Common Standards Monitoring is completed. It is worth considering topping-up CSM with surveys at unprotected seabird colonies, conducted by the SMP to provide a population census of some species. However, it is more likely that CSM will be looking to the SMP to survey protected sites.

The UK priority list of species and habitats for the Biodiversity Action Plan (UK BAP), June 2007, includes four seabirds. Of these, Balearic Shearwater is a non-breeder in the UK, whereas Herring Gull, Arctic Skua, and Roseate Tern all breed in the UK and were listed due to severe declines in population size. Population declines as a component of conservation status has been considered by this review as a factor affecting the need for evidence (see Appendix 1), so there was little to be gained from also taking account of UKBAP–listing.

4. Recommended surveillance

4.1.   The review in Appendix 1 has provisionally recommended patterns of surveillance (i.e. frequency, geographic scale and method of monitoring) for each species, that have been amended to take account of the views of SMP stakeholders expressed at the recent SMP Workshop in Inverness. These species-specific approaches have been synthesised across groups of species in the recommendations listed below in Table 1.

Table 1: Summary of recommended future surveillance of breeding seabirds in the UK.

Group	Species	Monitoring objective	Recommended surveillance
1	Northern Fulmar, Northern Gannet, European Shag, Black-legged Kittiwake, Common Guillemot and Razorbill	To provide indicators of a) state of seabird communities at UK ad regional scales b) pressure impacts	Annual monitoring of abundance & breeding success at a sample of colonies to produce accurate UK & regional trends. Estimates of adult survival, phenology & chick diet for species where appropriate and at colonies where possible.
2	Arctic Skua, Herring Gull, Roseate Tern	To determine why their populations have rapidly declined in size.	Annual monitoring of abundance & breeding success at important colonies, otherwise provide top-up surveys of breeding numbers to CSM every 6 years.
3	Manx Shearwater, European Storm-petrel	To determine whether or not UK populations are declining in size.	Annual monitoring of abundance at the most important UK colonies.
4	Sandwich Tern, Little Tern	To monitor their response to mitigation against disturbance and predation.	Annual monitoring of numbers and breeding success at a sample of colonies to produce accurate UK & regional trends.
5	Great Cormorant	To monitor impacts of licensed culling.	Annual monitoring of abundance at a sample of colonies to produce accurate UK and regional trends. Estimates of annual survival. Records of numbers and age of birds culled.
6	Red-throated Diver[#], Great Skua, Mediterranean Gull*, Common Gull, Black-headed Gull, Lesser Black-backed Gull, Arctic Tern, Black Guillemot, Puffin.	To ensure regular updates on the status of species of conservation concern[8] that are not included in the monitoring described above.	Provide surveys of breeding numbers to fill gaps in Common Standards Monitoring every 6 years. Otherwise: [#] Periodic (12 year) targeted extensive surveys of divers through SCARABBS. *Tracking of population expansion through established Rare Breeding Birds Panel methods applied annually.
7	Great Black-backed Gull[‡], Common Tern[†],	To ensure regular updates on the status of all seabird species regardless of current conservation status.	[†]>50% UK population in SPAs, therefore, provide surveys of breeding numbers to fill gaps in Common Standards Monitoring every 6 years. Otherwise: [‡]<50% UK population in SPAs, therefore, provide surveys of breeding numbers to fill gaps in CSM every 6 years; otherwise census UK population every second or third CSM cycle (i.e. every 12 or 18 years).

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[8] Species of conservation concern are defined here as those on the 'Amber List' of Gregory *et. al.* 2002. The population Status of birds in the UK, Channel Isles and Isle of Man: an analysis of conservation concern 2002-2007. *Brit. Birds* 95: 410-448.

4.2.   It is important to note that some current monitoring activities will be continued regardless of the recommendations of this review, i.e. monitoring that is undertaken by SMP partners to meet their own specific objectives (e.g. for site management). Therefore, existing monitoring will not necessarily be terminated if not included in the list of recommendations below. Our recommendations denote the minimum level of seabird surveillance required to meet the objectives of the UK Surveillance Strategy. All species should receive some level of monitoring and not just those that currently provide cause for conservation concern, to ensure that future detrimental changes are not missed.

4.3.   The species in Group 1 (see Table 1) were chosen for their potential as indicators of a) the state of the UK's breeding seabird community and b) the impacts of pressures. The group was considered to have good indicator potential because it includes representative species from all four feeding niches recommended by ICES (2008)[9], some of the most widespread and abundant of the UK's breeding seabirds, and there is evidence for each species that links population changes to pressures. The existing sample of colonies is sufficient to produce accurate UK trends for all of these species, except for Northern Gannet – more larger colonies will need to be included in the annual sample. All these species have over 50% of the UK populations breeding in SPAs and therefore the annual monitoring of these species contribute significantly to CSM.

4.4.   In order to provide a better insight into the causes of seabird population change and in particular, provide an indicator of the impact of pressures, it is recommended that estimates of adult survival, phenology & chick diet for are collected annually for species in Group 1 where appropriate and possible. Appendix 1 lists for each species those parameters that have been correlated with a pressure and could therefore, provide a good indicator of pressure impacts. Current monitoring of adult survival, phenology and chick diet is confined largely to the SMP's key sites because methods are labour intensive and require frequent visits to a colony. The results from these sites may be limited in their applicability to colonies. However, there is scope to expand to more colonies: for example, by replacing direct measurements of phenology with proximate measures that require only a single visit to a colony (e.g. hatching date can be extrapolated from estimates of chick age obtained from wing-length measurements).

4.5.   SMP partners have expressed a strong desire to maintain long-term monitoring studies at the key sites. The main benefits of key sites to the SMP were identified as:

- The 20 year long series of multi parameter data provides a valuable analytical resource for examining links between seabird population dynamics, pressures and natural process.
- They provide a test-bed for trialling new monitoring techniques that can then be implemented more extensively.
- The intensive monitoring at key sites will enable continuous calibration of more extensive monitoring carried out at other sites.

4.6.   One third of the SMP's annual costs are incurred by key site monitoring. Therefore, it is important that the SMP partnership clarifies the role of key site monitoring and makes the best use of the resultant data.

4.7.   For most other species not included in Group 1 it was recommended that all SMP partners work closely with those in the statutory conservation agencies to ensure that all

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[9] ICES. 2008. Report of the Workshop on Seabird Ecological Quality Indicator, 8-9 March 2008, Lisbon, Portugal. ICES CM 2008/LRC:06. 57 pp.

seabird colonies in protected sites (e.g. SSSI, SPA) are surveyed once every 6 years in line with the recurrent CSM cycle. In addition to meeting CSM requirements, this will enable regional (e.g. country) and UK assessments of state to be made be regularly. CSM presents a considerable challenge to the statutory conservation agencies and therefore, we recommend that the SMP attempts to fills the gaps in CSM using input from other partners and through an increased input from volunteers.

4.8.   SMP partners have expressed a strong desire to continue to regularly census all Britain and Ireland's breeding seabirds because repeat censuses will monitor changes in distribution that may not be detected by sampling and they will provide independent validation of trends estimated from more frequent sampling. The censuses should coincide with the 6 yearly cycle of CSM to make best use of resources. Hence the recommended interval between censuses should be 12 -18 years. The last census, Seabird 2000 was conducted during 1999-2002, so it needs ot be determined if the next census should be conducted during the next CSM cycle (i.e. 2012 – 2017) or during 2018 – 2023.

5. Next steps

5.1.   The SMP Partners need to agree on terms of working together that will be defined in a memorandum of understanding (MoU). The MoU will also contain the terms of reference for the new SMP Steering Committee.

5.2.   The SMP partners need to determine how they can implement the sampling strategy outlined above in Table 1. In particular, can they provide the additional surveys to supplement CSM (see 4.6)? More extensive use of volunteers is recommended in order to achieve the required coverage.

5.3.   Further analyses are required to determine whether the current sample of colonies produces trend data that are sufficiently sensitive and representative regionally for those species that require annual sampling in the future (see Table 1).

5.4.   Development is needed of less labour intensive and cheaper methods for measuring chick diet, adult survival and breeding phenology that would enable these parameters to be monitored in the main group of six 'indicator' species (see Table 1) at more sites than at present.

5.5.   JNCC and its partners needs to determine a clear role for key site monitoring within the SMP and make better use of existing data.

5.6.   SMP partnership needs to decide on the timing and format of the next census of breeding seabirds in Britain and Ireland and seek the necessary resources.

Appendix 1: SMP Surveillance Strategy (version Nov 2009)

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