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Annex 3: 2018 options for monitoring UK marine birds

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Foreword

Yessica Griffiths and Dr Karen Webb, JNCC (2024)

This historical paper is part of an archival report series, produced between 2016 and 2018, which collectively presents options for monitoring UK marine biodiversity. These options for monitoring were evaluated at a series of workshops in 2017 and 2018, by scientific experts from the Healthy and Biologically Diverse Evidence Group (HBDSEG) and policy advisors from the four governments of the UK. The initial set of workshops provided a steer on political ambitions for monitoring specific aspects of marine biodiversity, while a final workshop garnered advice from scientific experts on the proposed monitoring across UK marine biodiversity. In 2019, the combined outcomes of these workshops formed advice for UK Governments on monitoring of UK marine biodiversity. The process for developing this advice is outlined in the summary paper ([Webb et al. 2024](#)).

Publication of this historical report series provides a publicly available audit of the information underpinning the 2019 advice to UK Governments on proposed marine biodiversity monitoring in UK waters. This information provides a solid foundation for developing updated future advice. At the time of publication (2024), many of the evidence gaps which have been highlighted remain and, in some instances, have increased.

This paper provides a snapshot in time of the monitoring of UK marine birds in 2017 and the collated viewpoints, on proposed monitoring, of HBDSEG and policy representatives in 2018. These viewpoints are historical and do not necessarily reflect viewpoints at the time of publication in 2024. All monitoring options developed and presented in this paper were dependent on the assumption that core UK monitoring programmes would continue at the same level of funding. However, inflation has significantly increased the costs of marine monitoring, and as a result there has been ongoing, yearly erosion of core monitoring.

Greater understanding of marine bird populations is required to provide evidence for tackling the biodiversity loss and climate crisis. Monitoring marine birds provides valuable data on the overall ecosystem health and biodiversity, fulfilling legal obligations and informing decisions to ensure sustainable management and conservation of marine resources.

This paper is based on work completed by the JNCC-led Marine Biodiversity Monitoring R&D Programme in 2015 to develop monitoring options for marine birds in UK waters (Wilson *et al.* 2015). It should be noted that some of the legislative drivers which have been referenced in this report have been updated or superseded since 2017. In addition, new legislation and obligations have been introduced and advances in technology and the publication of new research have influenced the marine bird monitoring landscape in the UK. For clarity, '[2017]' has been included alongside all occurrences of the term 'current' (and its derivatives) and within all table and figure captions and headings, throughout this paper.

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1 Overview

The UK Marine Biodiversity Monitoring R&D Programme (led by JNCC) has been tasked by UK Governments with developing recommendations for an integrated monitoring scheme for marine biodiversity across all UK waters. We are not currently [2017] fulfilling our nature conservation obligations for monitoring and assessment in a coordinated and cost-effective manner, nor are we able to provide robust evidence for marine management purposes. A decision is now required on the future composition of the UK marine bird monitoring programme.

A workshop was held on 8 February 2017 to discuss a set of options for monitoring UK marine birds (see below and Appendixes 1 and 2 for detail). It was not the purpose of this workshop to choose a final option but to use criteria to discuss and score the risks and benefits of each. The findings from the workshop have allowed the distillation of the current options suite into a single option for UK marine bird monitoring.

The option presented here uses the current [2017] level of UK marine bird monitoring (Option 2) as a starting point, to which monitoring elements from across Options 3–5, which participant countries considered important, have been added. The intention is that this option will be used to facilitate further discussion and, ultimately, allow a decision by governments on a final, practicable, marine bird monitoring programme.

A decision on the structure of the final marine bird monitoring programme can be made prior to the production and selection of the remaining marine biodiversity monitoring options, although further work to integrate with these towards a more efficient marine biodiversity level monitoring approach may be required. Integration of marine bird monitoring with that of marine habitats is unlikely to yield significant improvements in efficiency due to the different survey methodologies employed, however, some integration with cetacean monitoring is envisaged.

This decision will begin to enable UK Governments to cost-effectively meet their national and international obligations for monitoring, assessment and reporting on marine birds, and to robustly inform advice on management of human activities in the marine environment.

2 Context

The process of defining broad options for monitoring marine biodiversity components requires a consideration of what, where and how to monitor the component of interest e.g. benthic habitats, marine birds etc. Considering these aspects of monitoring design allows cost estimates to be provided for different levels of ambition, expressed as monitoring effort and evidence for assessments and management. This level of detail can allow policy makers and science advisors to take an informed decision on a preferred option with its associated evidence benefits, risks and broad costs but with a remaining level of flexibility.

Subsequently, the preferred option will then be explored in more detail during a design and evaluation phase, where the details of implementation can be defined and tested. Variance from the original can then be further explored. It is this approach to presentation, and this assumption on next steps, that bounds the option in this paper. The alternative, of developing a fully designed, evaluated and implementable as-is monitoring programme as part of the options process would reduce flexibility, be prohibitively time consuming and would result in resources being heavily invested in developing options to a high level of detail that are ultimately not selected.

Marine birds refer to the 40 species of seabird and 12 species of marine waterbird (seaducks, divers and grebes) which regularly use UK waters. While seabirds are distributed

both inshore and offshore throughout the year, marine waterbirds mainly occur inshore and are usually non-breeding.

The key instruments identified as requiring monitoring of marine birds are the Birds Directive and the Marine Strategy Framework Directive. These directives include explicit requirements for monitoring marine birds to inform periodic assessment and reporting of species and/or environmental status. These Directives are also likely to bear the largest risk of legal challenge if their implementation is assessed as being insufficient.

In addition to explicit monitoring requirements, other legislation exists that also necessitates monitoring of marine bird populations to ensure their protection (e.g. Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), Agreement on the Conservation of Albatrosses and Petrels (ACAP) and The Convention on Wetlands of International Importance (Ramsar)).

There are also several assessment and reporting requirements that must be met by Competent Authorities and developers for proposed plans or projects in the marine environment. These requirements include those under the EU Strategic Environmental Assessment (SEA) Directive, the EU Environmental Impact Assessment (EIA) Directive and 'the Habitats Regulations'.

To meet these obligations, periodic assessments of marine bird species are required which can detect changes in key population parameters in a timely manner. Monitoring must also have the temporal and spatial sensitivity to indicate where pressures may be impacting on marine bird populations and be coupled with research to identify the pressures driving such change. A list of the marine biodiversity obligations considered in the development of monitoring options for UK marine birds is provided in Table 1.

Table 1: National and international obligations for monitoring marine birds [table created in 2017].

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Birds Directive (EU 2009)	Implicit	-	Explicit	<p>The Birds Directive relates to the conservation of all species of naturally occurring birds in the wild state. It covers protection, management and control of wild birds and lays down rules for their exploitation. Member States are required to take measures to maintain populations of all wild bird species, and to take special conservation measures relating to the species listed in Annex I, including the designation of SPAs. The Birds Directive contains strong implicit requirements for monitoring:</p> <p>Article 2: “Member states shall take the requisite measures to maintain the population of the species referred to in Article 1...” There is an obvious implicit need for monitoring of the population status of all species to ensure this article is met.</p> <p>Article 3 requires the undertaking of wider countryside policies and measures to maintain habitat so as to fulfil requirements of Article 2 (i.e. to maintain status). Monitoring of both numbers and range is required to assess distribution status in this regard.</p> <p>Article 4 contains an explicit requirement for monitoring of species in Annex 1 and migratory species, as background to evaluating sites as potential Special Protection Areas. To fulfil this, it is necessary to carry out surveillance of bird population sizes and distributions. It also requires that sites designated as SPAs be managed in a way to avoid pollution, deterioration of habitats and disturbance. This clearly requires some monitoring of disturbance effects which means direct monitoring of birds on designated sites.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Birds Directive (EU 2009)				<p>Management of SPAs is implemented in the UK through a suite of legislation commonly referred to as the Habitats Regulations (see below).</p> <p>Article 7 covers hunting and includes an implicit need for information on the population status of species that are hunted to ensure the practise is sustainable.</p> <p>Article 9 discusses derogations from Articles 5-8. These require regular reporting to allow the EC to assess whether such derogations are impacting on the conservation of the species concerned. Hence there is an implicit need to monitor the population status of these species.</p> <p>Article 10 requires Member States to encourage research and any work required as a basis for the protection, management, and use of the population of all species of naturally occurring wild bird species.</p> <p>Article 12 reporting requirements focuses on assessment of species status (population sizes, trends and distributions, and changes in these parameters over time). This means there is a need to monitor these parameters for all marine bird species' populations. There is also a requirement to assess threats and pressures affecting species for which SPAs have been classified. In addition, Member States must also report the size of the national population that occurs within their national SPA network.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Marine Strategy Framework Directive (MSFD 2008)	Explicit	Explicit	-	<p>MSFD requires coordinated monitoring programmes to be established and implemented to assess the environmental status of marine waters. In practise the required monitoring will relate to assessing whether specific Targets and Indicators are met. Common Indicators were published as part of the Marine Strategy Part 1 in December 2012, but the definitions of some Targets and Indicators are still under development, most notably those which may require monitoring in the marine environment.</p> <p>In reporting on Article 11 of MSFD (monitoring programmes) in 2014, the UK identified existing monitoring programmes which will provide data for assessing these indicators (Defra 2014). These include: the Seabird Monitoring Programme (SMP); national seabird colony censuses; Wetland Bird Surveys (WeBS); Non-Estuarine Waterbird Surveys (NEWS), Breeding Bird Surveys (BBS) and Bird Atlases. The MSFD targets and indicators which have been developed and are of relevance to marine birds are:</p> <p>MSFD Indicator 1.1.2: Distributional pattern within range</p> <p>TARGET: At the scale of the MSFD sub-regions distribution of marine birds is not significantly affected by human activities: No major shifts or shrinkage in the population distribution of marine birds in 75% of species monitored.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Marine Strategy Framework Directive (MSFD 2008)				<p><i>MSFD Indicator 1.2.1: Population abundance; and 4.3.1: Abundance trends of functionally important selected groups/species</i></p> <p>TARGET: At the scale of the MSFD sub-regions abundance of marine birds is not significantly affected by human activities: Changes in abundance of marine birds should be within individual target levels in 75% of species monitored.</p> <p><i>MSFD Indicator 1.3.1: Population demographic characteristics; and 4.1: Performance of key predator species using their production per unit biomass (productivity)</i></p> <p>TARGETS: At the scale of the MSFD sub-regions marine bird productivity is not significantly affected by human activities: Annual breeding success of black-legged kittiwakes should not be significantly different, statistically, from levels expected under prevailing climatic conditions (i.e. sea surface temperature), and widespread seabird colony breeding failures should occur rarely in other species that are sensitive to changes in food availability; and At the scale of the MSFD sub-regions, the risks to island seabird colonies from non-native mammals are reduced.</p>
Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR 1998)	Explicit	Explicit	-	OSPAR provides a comprehensive and simplified approach to addressing all sources of pollution which might affect the maritime area, and all matters relating to the protection of the marine environment. OSPAR established a list of threatened and/or declining species and habitats in the North-East Atlantic. Background documents provide

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR 1998)				<p>recommendations on actions and measures that should be taken to ensure the conservation of these species.</p> <p>There are three marine bird species on the list of threatened/declining species which occur within the OSPAR regions relevant to UK waters (i.e. the Greater North Sea and Celtic Seas regions). These are roseate tern, Balearic shearwater and black-legged kittiwake (the latter is considered under threat/decline only in the Greater North Sea Region). The background documents for all three species relevant to UK waters include proposed monitoring recommendations.</p> <p>As a signatory to the OSPAR convention, delivery of the work programmes agreed under the convention is mandatory for the UK. Article 6 in conjunction with Annex IV (Article 2a) explicitly requires Contracting Parties to cooperate in carrying out monitoring programmes to support joint assessments of the quality status of the marine environment and to evaluate the effectiveness of the measures taken and planned for the protection of the marine environment.</p> <p>The work carried out under OSPAR on monitoring and assessment has become legally underpinned by the MSFD. Failings in delivering the MSFD will lead to failings in delivering OSPAR commitments.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA 1999) under the Bonn Convention on Migratory Species (CMS 1985)	Implicit	-	-	AEWA covers a total of 235 species of birds that are ecologically dependent on wetlands for at least part of their annual cycle. Of these, 98 regularly occur in the UK. Parties to the Agreement are called upon to engage in a wide range of conservation actions which are described in a comprehensive Action Plan and shall endeavour to monitor the populations listed in Table 1 of the Action Plan. One of the fundamental activities undertaken is a regular review of the status of each migratory waterbird population within the Agreement area.
Agreement on the Conservation of Albatrosses and Petrels (ACAP 2004) under the Bonn Convention on Migratory Species (CMS 1985)	Implicit	Implicit	-	<p>The purpose of this legally binding multi-lateral agreement under the Convention on Migratory Species is to establish a cooperative and comprehensive framework and process to restore albatross and petrel species to a favourable conservation status.</p> <p>In terms of UK waters, the only species of relevance to which the agreement applies is Balearic shearwater. An Action Plan within the Agreement (Annex 2) covers work that Parties are required to progressively implement, and this includes research and monitoring:</p> <p>4.1 Parties shall seek to undertake research and monitoring to fulfil the requirements of Article III [General conservation measures], both at sea and on land. Where appropriate, they shall do so co-operatively and shall seek to facilitate the development of improved research and monitoring techniques.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
Agreement on the Conservation of Albatrosses and Petrels (ACAP 2004) under the Bonn Convention on Migratory Species (CMS 1985)				4.2 Parties shall, using at-sea observers on fishing vessels or through other appropriate methods, collect reliable and, where possible, verifiable data to enable the accurate estimation of the nature and extent of albatross and petrel interactions with fisheries.
EU Seabird Plan of Action	-	TBC	-	<p>The EU Seabird Plan of Action (EU-PoA) aims at minimising and, where possible, eliminating the bycatch of seabirds in EU and external waters. It sets out to achieve this through a range of (mainly voluntary) actions, notably through mitigation measures to prevent seabirds encountering fishing gears. However, one of the biggest challenges in implementing the EU-PoA is to define the existence of an incidental seabird bycatch problem in the first place and to make accurate and realistic assessments of the impact of bycatch on seabird populations (ICES 2013).</p> <p>A research project, which was commissioned by DEFRA and project managed by JNCC, is underway to establish the vulnerability of marine birds to bycatch in UK waters. If a significant risk from bycatch is demonstrated, options for additional monitoring of the numbers of birds killed might be necessary; the European Commission is currently [2017] considering whether additional data collection requirements should be placed on Member States as part of a reformed Common Fisheries Policy to deliver the EU-PoA (Defra 2014).</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
The Convention on Wetlands of International Importance (Ramsar Convention 1975)	Implicit (abundance only)	-	Implicit	<p>The UK is a contracting party to the Ramsar Convention which covers all aspects of wetland conservation and wise use and has three main 'pillars' of activity: the designation of wetlands of international importance as Ramsar sites; the promotion of the wise-use of all wetlands in the territory of each country; and international co-operation with other countries to further the wise-use of wetlands and their resources. The Convention uses a broad definition of the types of wetlands covered in its mission and includes estuaries; deltas and tidal flats; and near-shore marine areas. In the UK, the initial emphasis was on selecting sites of importance to waterbirds and consequently many Ramsar sites are also Special Protection Areas (SPAs) classified under the Birds Directive.</p> <p>A National Ramsar Committee acts in an advisory capacity to assist government in the implementation of the Convention. The Committee operate a rolling three-year work plan linked to the Convention's Strategic Plan. Monitoring of the ecological character of Ramsar sites (through Common Standards Monitoring) is part of the implementation.</p>

National & international obligations	Monitoring Requirement			Explanation
	Population size & species distribution	Population condition	MPAs	
<p>Legislation relating to marine developments including:</p> <p>EU Strategic Environmental Assessment (SEA) Directive, EU Maritime Spatial Planning Directive, EU Environmental Impact Assessment (EIA) and ‘the Habitats Regulations’</p>	<p>There are various assessment and reporting requirements which must be met by Competent Authorities for proposed plans or projects in the marine environment. Of note are the: EU Strategic Environmental Assessment (SEA) Directive, EU Maritime Spatial Planning Directive, and ‘the Habitats Regulations’ (which requires Appropriate Assessments for certain Plans or Projects which are likely to significantly affect SPAs). In addition, there are assessment and reporting requirement which must be met by developers under the EU Environmental Impact Assessment (EIA) Directive.</p> <p>These requirements are focussed on evidence gathering to inform assessments rather than monitoring, so they were not used in to determine the objectives of marine bird monitoring. However, data gathering to inform assessment requirements of plans or projects are considered as a potential resource to help meet monitoring requirements that are identified here under other legislative drivers. Conversely, monitoring activities could help fulfil some of the evidence requirements for assessing plans or projects.</p> <p>In addition, Competent Authorities may stipulate that a developer undertakes monitoring as part of the conditions of granting consent for a development (e.g. to check that assumptions made in their Environmental Statement are correct). Additional post-consent monitoring (not necessarily limited to the developer) might be deemed necessary to improve our understanding of effects and inform future consent decisions. It was not within the scope of the marine bird monitoring options report to include the needs of post-consent monitoring activities, as these will be development specific and largely under the onus of the developer. However, there is potential to make efficiencies by integrating post-consent monitoring with wider monitoring activities, and some of the activities identified could potentially be met, or partially met, through post-consent monitoring.</p>			

^a Population demographic characteristics (e.g. breeding success, adult survival, diet); population health (pollutant contamination); bycatch rate (of seabirds).

To identify what to monitor, all legislation that applies to marine birds and the key pressures that can impact on them was reviewed. This risk-based approach allowed the identification of parameters and monitoring objectives which would best suit national and international monitoring obligations.

Monitoring these parameters provides information on population status, drivers of change and state-pressure relationships, all of which are required to meet legislative requirements and ensure timely and appropriate marine management. The marine bird monitoring options report (JNCC 2015) goes through this process in considerable detail and contains a full list of these parameters and their respective monitoring objectives.

The starting point when developing marine bird monitoring options was to review existing monitoring activities and how well these met the parameter-specific objectives that had been set. This allowed decisions to be made on whether additional monitoring, or a new set of monitoring activities, would be required to meet any shortfall. How cost-effective monitoring activities were in terms of their ability to meet objectives and reduce risk was a key consideration.

Species which the UK has internationally important numbers of and those of greatest conservation concern (using BOCC assessments) were given higher monitoring priority. Geographic areas at higher risk from pressures and sites which were marine SPAs were also given higher priority. Issues which were most feasible to address were also prioritised. Monitoring activities were finally built into options with increasing levels of implementation and cost, balanced by diminishing risk.

The set of marine bird monitoring options generated from this process and the monitoring activities each would comprise are summarised in Appendix 1 (Table 1), along with the cost of implementing each option (Table 2) and an appraisal of the evidence requirements, risks, and limitations of each option (Table 4). A more detailed description of the monitoring activities and their pluses and minuses is provided in Appendix 2 (Tables 1 to 13).

3 Workshop summary

3.1 Objectives

The policy workshop to discuss the full set of options for monitoring UK marine birds had the following broad objectives:

- Discuss the context of the marine bird monitoring options work.
- Consider the monitoring options available.
- Agree criteria to inform choices about which option(s) might be selected.
- Determine how the options performed against the criteria and discuss the results.
- Agree the next steps in the work programme.

3.2 Detailed overview

How each of the five marine bird monitoring options (see Appendixes 1 and 2 for detail) was derived and their intended impact and use were discussed to help develop understanding. There was then discussion to aid awareness and understanding of each of the evaluation criteria. Participants then discussed the individual options in turn, within groups, and scored them against the following evaluation criteria:

- a) *Maintaining and improving marine bird conservation status, ecosystem health, halting and reversing biodiversity loss.*
With this option, how confident are we that we will be able to detect status changes in marine birds? When we do see changes, how confident are we that we can differentiate between natural and anthropogenic changes?
- b) *National legal compliance*
Under this option, is there a risk of non-compliance with national legislation and legal challenge?
- c) *European/international legal compliance*
Under this option, is there a risk of non-compliance with legislation and legal challenge?
- d) *Compliance with policy*
What is the risk of non-compliance with ministerial commitments?
- e) *Public trust*
Will the public trust that this is the best option?
- f) *Stakeholder trust*
Will stakeholders think this is a good option?

The main observations from these discussions were that:

- Option 5 delivered significant benefits, but it would be pragmatic to deliver Option 3, with aspects of Option 4, first to determine whether Option 5 was required.
- Elements from Option 3 and 4 were of interest, but not necessarily the entire set of monitoring activities within them.
- Investment in monitoring could be staged over time to determine whether it was needed, contingent upon results from earlier monitoring stages.
- Attractive monitoring activities from Options 3 and 4 should be incorporated in any final option/monitoring programme.
- Contact with the oil and gas industry should be made to explore options for funding at-sea surveys aimed at refreshing the ageing ESAS dataset which the *Seabird Oil Sensitivity Index* and other products rely on. The Department for Business, Energy and Industrial Strategy and the shipping industry may also provide funding for this work.
- Option 3 is more cost-effective if seabirds at sea distribution pattern surveys can be delivered with trained volunteers. This will have societal benefits and deliver cost savings whilst maintaining data quality.

Each participant country then considered their overview, perspective, and position with regards to each option, or monitoring elements across options.

Areas of agreement between two or more countries were as follows:

- The start point for a future marine bird monitoring programme should be Option 2, to which additional Option 3, 4 and 5 activities can be added.
- A full review of Seabird Monitoring Programme during 2017 and 2018, which includes an appraisal of the 2012 SMP review, should be followed by implementation of priority recommendations that will improve SMP reporting power.
- A pilot study to test feasibility of low cost/cost neutral volunteer-based ESAS monitoring scheme should be completed and, if viable, the scheme should be extended to UK-level.

- Greater effort to incorporate other seabirds at sea data types (e.g. aerial survey data from public and private sector) was required.
- There should be government and external funding of national seabird censuses every 18 years, coupled with an appraisal of risk of not meeting the external funding target beforehand.
- R&D to determine whether tracking data can deliver enough power to identify seabird state-pressure relationships was required. If feasible, a collaborative tracking project, with government and external funding, should be developed to track priority species/colonies during the breeding season.
- Targeted at-sea surveys of high priority species (e.g. Slav grebe, common scoter, greater scaup, long-tailed duck, velvet scoter) were necessary.
- R&D should identify the need for targeted surveys to fill high-priority gaps in seabird distribution pattern monitoring (e.g. areas with old data, high exposure to pressures, etc.).

Country-specific requirements were:

- UK-wide at-sea low-effort surveys in inshore waters within 12 nm but conducted both inside and outside SPAs, every 18 years, in winter and summer (Scotland).
- Highest risk SPA sites/species surveyed every six years, with a sample of sites prioritised for monitoring changing over time, in accordance with changing occurrence of pressures.
- R&D to determine whether targeted Balearic shearwater surveys will deliver sufficient monitoring power (England).
- Regular decadal and 'improved' WinGS; for example, extra monitoring at key sites and improved monitoring of non-breeding cormorants (as per Defra review, England)

3.3 Key workshop decision

The over-arching agreement that emerged from the workshop was that the options presented could be taken forward flexibly, by reformulating them according to the strengths of their different elements. For example, a new option could be progressed that effectively takes Option 2 and adds elements from Options 3, 4 and 5.

4 A revised monitoring option

The revised marine bird monitoring option presented in Table 2 takes Option 2 as its baseline and incorporates the additional monitoring activities (see above), from Options 3 to 5, that workshop participants thought were desirable. This has enabled delivery of a bespoke option for UK marine bird monitoring. Additional activities that were not part of the original options suite, but were considered important by workshop participants, have also been incorporated as have monitoring activities that were requested by individual countries.

Table 2: Revised marine bird monitoring option and cost to implement. Estimated *annual* costs in £1,000s separated into Marine, Terrestrial and External budgets/sources. Does not include staff costs; the value of volunteer effort; or take inflation into account. The cost of several monitoring areas will need further refinement. Notes are provided below the table [table created in 2017].

Parameter/group & Monitoring type ^{a,b,c}	Monitoring activity	Cost Marine Terrestrial External	Notes
Seabird breeding population abundance. Type 1 and/or 2	<ul style="list-style-type: none"> Full review of Seabird Monitoring Programme during 2017 and 2018, which includes an appraisal of the 2012 SMP review, followed by implementation of recommendations that will improve SMP reporting power. 	59 Marine	Final figure available after SMP review. Cost provided is from SMP FY17/18 budget.
Seabird adult survival, breeding success, diet, and phenology. Type 1 and/or 2	<ul style="list-style-type: none"> Government and external funded national seabird censuses every 18 years, with appraisal of risk of not meeting external funding target 	118	Ratio of gov/external funding split TBC
Seabird non-breeding population abundance and distribution on land. Type 1 and/or 2	<ul style="list-style-type: none"> Winter Atlas surveys every 10 years Annual WeBS Regular decadal and 'improved' WinGS (i.e. extra monitoring at key sites and improved monitoring of non-breeding cormorants (as per Defra review)) 	41 Terrestrial 95 External	Total cost split equally between seabirds & marine waterbirds
		Tbc Terrestrial	<i>Defra requirement:</i> Wintering populations of cormorants are based on WeBS counts, and these have been recently reviewed for their application to assess the impacts of licensed control (Defra 2013). This concluded that the potential effect of control measures out with the larger well-monitored wetlands was less well known and that effects on the population would be best understood through more detailed survey work at the national level (Defra 2013).

Parameter/group & Monitoring type ^{a,b,c}	Monitoring activity	Cost Marine Terrestrial External	Notes
Seabird at-sea distribution patterns. Type 1, 2 and/or 3	<ul style="list-style-type: none"> Pilot study to test feasibility of low cost/cost neutral volunteer-based European Seabirds at Sea monitoring scheme. If viable, implement at UK-level. <i>If/when a UK scheme is established, R&D will be required to identify the need for targeted surveys to fill high-priority gaps in distribution pattern monitoring (e.g. areas with old data, high exposure to pressures, etc.). Additional monitoring will be implemented if required.</i> R&D to determine whether targeted Balearic shearwater surveys will deliver sufficient monitoring power. Greater effort to incorporate other data types (e.g. aerial survey data from public and private sector). 	<p>20 Marine</p> <p>~50 Marine</p> <p>Tbc Marine</p>	<p>JNCC are leading a pilot study to assess the utility of CalMac ferries for voluntary at sea seabird monitoring on the west coast of Scotland.</p> <p>Estimate.</p>
		<p>Tbc Marine</p> <p>4 Marine</p>	<p><i>Defra requirement</i></p> <p>Annual cost of Balearic shearwater monitoring (4k per annum, for 2 land and boat based surveys every 12 years) if R&D indicates they have sufficient monitoring power.</p>
		<p>Tbc Marine</p>	<p>Requires staff resource to acquire and incorporate data.</p>
Seabird movement. Type 1	<ul style="list-style-type: none"> R&D to determine whether tracking data can deliver enough power to identify seabird state-pressure relationships. If feasible, develop collaborative tracking project, with government funding, during breeding season of priority species/colonies only. 	<p>Tbc Marine</p>	

Parameter/group & Monitoring type ^{a,b,c}	Monitoring activity	Cost Marine Terrestrial External	Notes
Seabird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB. Type 1 or 2	<ul style="list-style-type: none"> <i>RSPB Beached Bird Survey scheme not reviewed as considered sufficient in current [2017] form and assumes data will be made available for government use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</i> 	12 Marine 18 External Tbc Marine	Defra funded postmortem analysis of fulmar corpses to determine level of ingested plastics for OSPAR EcoQO and MSFD indicators. RSPB funded beached bird survey. The EU Action Plan for reducing seabird bycatch in fishing gears aims at minimising and, where possible, eliminating bycatch of seabirds in EU and external waters, though a range of (mainly voluntary) actions. A Defra commissioned spatial risk assessment of vulnerability of marine birds to bycatch in UK waters was recently conducted to inform the scope and nature of any further work required (Bradbury <i>et al.</i> in prep). The areas, effort and associated cost of any future seabird bycatch monitoring scheme have, however, still to be determined.
Seabird displacement. Type 1, 2 or 3 monitoring	<ul style="list-style-type: none"> Currently [2017] subject to R&D and the responsibility of CNCBs, regulators and developers, so options to monitor this parameter are not considered here. 	-	-

Parameter/group & Monitoring type ^{a,b,c}	Monitoring activity	Cost Marine Terrestrial External	Notes
Marine waterbird breeding population abundance. Type 1 and/or 2	<ul style="list-style-type: none"> Rare Bird Breeding Panel and SCARRABS. 	11 Terrestrial 16 External	Rare Breeding Bird Panel is funded by terrestrial monitoring programme and reviewed separately. SCARRABS monitoring costs range from £0 to >£100k per annum and are not included here. SCARRABS may be subject to review by CNCBs.
Marine waterbird non-breeding population abundance and distribution. Type 1 and/or 2	<ul style="list-style-type: none"> WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data. Targeted at-sea surveys of high priority species e.g. Slav grebe, common scoter, greater scaup, long-tailed duck, velvet scoter. Cost-benefit appraisal of UK-wide low-effort surveys in inshore waters (within 12 nm) conducted both inside and outside SPAs, every 18 years, in winter and summer. 	41 Terrestrial 95 External ~10 – 20 Marine Tbc Marine	Total cost split equally between seabirds & marine waterbirds. Based on BOCC3 red list, long-tailed duck and velvet scoter recently added in BOCC4 and cost to survey still to be determined.
Marine waterbird movement. Type 1	<ul style="list-style-type: none"> No UK-wide monitoring programme - information comes from NGO and academic research projects. 		

Parameter/group & Monitoring type ^{a,b,c}	Monitoring activity	Cost Marine Terrestrial External	Notes
Marine waterbird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB. Type 1 or 2	<ul style="list-style-type: none"> RSPB led and funded national annual and local monthly beached bird surveys. <i>Scheme not reviewed as considered sufficient in current [2017] form and assumes RSPB will make data available for governments use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</i> 	See above	
Marine waterbird displacement. Type 1, 2 or 3	<ul style="list-style-type: none"> Case-specific post-consent monitoring in relation to marine renewable developments <i>Currently [2017] subject to R&D and the responsibility of CNCBs, regulators and developers, so options to monitor this parameter are not considered here.</i> 		
Marine bird abundance and distribution within the current [2017] UK SPA network i.e. breeding seabird colony SPAs and their marine extensions; and marine SPAs for wintering waterbirds. Type 1, 2 or 3	<ul style="list-style-type: none"> Highest risk sites/species surveyed every 6 years, with sample of sites prioritised for monitoring changing over time, in accordance with changing occurrence of pressures. 	Tbc Marine	Cost of surveying highest risk sites/species every 6 years, with sample of sites prioritised for monitoring trends (in accordance with changing occurrence of pressures) will be determined with input from CNCBs if option is selected.

5 Discussion

The marine bird monitoring option presented in Table 2 is not intended to be finite and further discussion will be required before any agreement on the composition of the future monitoring programme will be possible. The programme will also need to evolve with time as conservation, political and legislative drivers for monitoring change. Ongoing research and development work will be necessary to ensure that existing and future monitoring activities will have the necessary power to detect trends in key parameters; that reporting requirements are met; and that monitoring is economically efficient.

In the short term, priority areas of work will include a review of the Seabird Monitoring Programme; a pilot project to assess the viability of a low-cost volunteer-based seabirds at sea survey programme; continued effort to adequately fund and complete the current [2017] breeding seabird census; and ensuring data management systems, which can cope with increasing amounts of marine bird monitoring data (from both public and private sectors), are in place.

There are several monitoring activities where uncertainty over their utility remains, and further research will be required before any decision on whether to implement them can be made. These include: an assessment of whether tracking data will have the power to identify seabird state-pressure relationships; determining whether targeted seabirds at sea surveys will be necessary (only be possible if/when the voluntary seabirds at sea programme has been running for several years); and analysis to determine whether targeted Balearic shearwater surveys can deliver sufficient monitoring power.

Further discussion will be required to determine whether SPA monitoring coordinated at a UK level is worthwhile/possible and whether the high-risk SPA site monitoring approach suggested here is sufficiently robust to ensure changes in sites deemed lower risk are still detected over a reasonable period. Defining site risk-level is also likely to be difficult, as pressures are not routinely monitored or are difficult to monitor.

Finally, agreement will need to be reached on whether UK-level targeted surveys of high priority marine waterbird species should be implemented or whether they should be replaced, or supplemented, with a broader UK-wide at-sea low-effort survey in waters within 12 nm, both inside and outside SPAs.

6 Next steps

Table 3: The timetable for reaching agreement on the final marine bird monitoring option.

Activity	Date
Final revised marine bird option paper circulated to workshop participants	Jul-17
Revised option paper circulated to Programme Board for review	Aug-17
Preliminary option preference signed off by Programme Board	Aug-17
Preference analysed with other biodiversity monitoring options by JNCC	Sep-17
Preferences discussed by HBDSEG at March 2017 workshop	Mar-18
HBDSEG outcomes discussed by Programme Board	Apr-18
Paper to MARG produced	May-18

When agreement on the revised option presented here is reached, the next step in the process will consist of detailed planning of new/adjustment of existing monitoring activities. It is at this stage that practical integration of monitoring activities through collaboration with other agencies (sharing of ship time, gear, and staff), other monitoring activities and with marine industries, NGOs and volunteer schemes can be addressed in more detail.

7 HBDSEG advice

HBDSEG workshop participants reviewed the policy option preference for monitoring marine birds and concluded that the evidence provided was inadequate to fulfil all monitoring objectives for all species groups. The relatively broad range of adequacy scores given by participants were due to a combination of:

- a) the different levels of monitoring adequacy that the policy option preference delivered against the species groups it considered (seabirds and marine waterbirds); their respective populations (breeding and non-breeding); and their distributions (within/beyond sight of land); and
- b) uncertainty regarding the final marine bird monitoring programme structure and cost, both of which are dependent on the outcomes from reviews, pilot studies and R&D that are integral to the policy monitoring option preference.

HBDSEG advised that the final option preference paper should provide clear distinction between the risks and benefits associated with different species groups, populations and distributions, and the selected option should unequivocally include the recommendations from reviews, pilot studies and R&D will be implemented.

HBDSEG also advised that the natural capital value, the potential future use of new technology and the estimated value of volunteer effort, should also be included within the selected option.

HBDSEG emphasised the increased efficiency in overall biodiversity monitoring which could be gained from improved integration between seabird, cetacean and seal bycatch monitoring and aerial surveys.

The specific risks which HBDSEG identified as resulting from the inadequacies in the evidence base provided by the policy option preference:

- The ability to identify state-pressure relationships and separate anthropogenic impacts from natural variability was lacking for breeding and non-breeding seabird populations and marine waterbird populations. The policy option preference only had the potential to identify these relationships in breeding seabird populations.
- There was concern about the ability to coordinate monitoring at a UK level, (e.g. of the SPA network), and how common standards of data compatibility and accessibility, could be met.
- The options preference paper did not explain clearly that the preferred option assumes that the recommendations from reviews, R&D, etc., will be implemented.
- The 18-year cycle of breeding seabird censuses would be unable to detect population changes in some species (i.e. those for which annual trend data cannot be generated) within a timescale that would allow appropriate and timely management of pressures.

7.1 Inclusion of HBDSEG advice in policy option preference

HBDSEG advised that the adjustments outlined in Table 4 are made to the policy option preference to ensure the highlighted risks are reduced and a minimum level of evidence is provided to adequately fulfil our monitoring and assessment commitments.

Table 4. Summary of HBDSEG advised amendments to policy option preference [table created in 2018].

Options preference risk	HBDSEG advised amendment	Additional cost	Benefit
<p>Limited ability to identify state-pressure relationships and separate anthropogenic impacts from natural variability.</p>	<p>Implement flyway level collaborative tracking programme for marine water birds.</p>	<p>Cost will be determined by R&D (part of option preference) to determine whether/at what sampling level tracking data can deliver enough power to identify seabird state-pressure relationships.</p>	<p>Improved ability to identify state-pressure relationships in marine waterbird populations and mitigate anthropogenic pressure effects on their populations.</p>
	<p>Ensure SPA risk assessments are completed at a site-level and monitoring frequency is based on this.</p>	<p>Final cost of SPA monitoring programme depends on risk assessments, monitoring frequency at high risk sites, etc.</p>	<p>Efficient use of SPA monitoring budgets to target sites at greatest risk from pressures and ability to mitigate these in a timely manner.</p>
	<p>Review scope and, if necessary, improve Beached Birds Survey to ensure delivery, where possible, of robust information on marine bird state-pressures relationships.</p>	<p>Dependent on results of review and any augmentation to programme.</p>	<p>Potential to identify/monitor state-pressure relationships e.g. effect of litter on marine bird survival rates.</p>
	<p>Investigate value of zooplankton and fish data in interpreting trends in marine bird populations.</p>	<p>Staff time/TBC.</p>	<p>Analysis of these data could provide greater insight into the effects of ecosystem processes on marine bird populations and allow better understanding of state-pressure relationships.</p>
	<p>Collaborate with CSSEG and PSEG towards better use of activity/pressure and environmental quality data to help identify drivers of marine bird populations trends.</p>	<p>Staff time/TBC.</p>	

Options preference risk	HBDSEG advised amendment	Additional cost	Benefit
Inability to coordinate marine bird monitoring at a UK-level and ensure data standards and accessibility.	Secure agreements between UK governments for: a) a coordinated monitoring approach prior to implementation of final marine bird monitoring programme; b) data to be collected, stored, and shared under common standards.	Staff time.	Secure agreement on scope, coordination, and governance of UK-level marine bird monitoring.
Monitoring approach prescribed by R&D elements of monitoring options preference will not be implemented.	Ensure option paper clearly states additional monitoring prescribed by reviews, R&D, and pilot studies (that are part of the monitoring option preference) will be implemented but that the final cost of implementation is not known.	Staff time.	Unequivocal understanding of potential scope of final monitoring programme and that final cost is uncertain.

Options preference risk	HBDSEG advised amendment	Additional cost	Benefit
<p>18-year cycle of breeding seabird censuses is unable to detect trends and inform management in a timely manner for all species.</p>	<p>Ensure SMP review identifies:</p> <ul style="list-style-type: none"> a) how to increase the number of species for which robust breeding abundance and demographic trend information can be delivered on an annual basis at a site, regional and national level; b) what the optimal census frequency should be to identify trends and drivers (especially for colonies/species that cannot be monitored annually) and to be able to mitigate these in timely manner; and c) how to improve monitoring at high risk sites to better support Environmental Impact Assessments and Habitats Regulation Assessments. 	<p>Staff time for review.</p> <p>Final cost of enhancements to SMP TBC by review.</p>	<p>Ensures timely detection of population trends for all seabird species.</p>

References

Webb, K., Griffiths, Y. & Proudfoot, R. 2024. The U.K. Marine Biodiversity Monitoring Programme: Development of advice on future monitoring (2019). *JNCC Report 765*, JNCC, Peterborough, ISSN 0963-8091.
<https://hub.jncc.gov.uk/assets/5db2e26e-b98d-4a49-9293-76a62a25d6f7>

Wilson, L.J., Dunn, T.E. & Lewis, M. (Unpublished) Options for monitoring marine birds in UK waters (2015). JNCC, Peterborough.

Appendix 1

Table A1.1 outlines the five UK marine birds monitoring options that were under consideration, with the monitoring activities each would comprise also provided. The cost of implementing each of these options is presented in Table A1.2 [table created in 2017]. A detailed description of these and the pluses and minuses of each is provided in Appendix 2 (Tables A2.1 to A2.19), while a summary of each option is provided in Boxes 1 to 7.

Table A1.1: Marine bird monitoring options.

Parameter/group & Monitoring type^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Seabird breeding population abundance. Type 1 and/or 2	<p>Review the Seabird Monitoring Programme to determine whether it can be made.</p> <p>more effective and to identify the risks of a reduction in funding.</p> <p>+ Externally funded censuses, every 18 years.</p> <p><i>SMP review will take place in 2017&18</i></p>	<p>Seabird Monitoring Programme.</p> <p>+ Externally funded breeding seabird censuses, every 18 years.^d</p>	<p>Seabird Monitoring Programme.</p> <p>Review, with recommendations implemented.</p> <p>+ Government funded national seabird censuses every 18 years.</p>		

Parameter/group & Monitoring type^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Seabird adult survival, breeding success, diet, and phenology. Type 1 and/or 2	<p>Review the Seabird Monitoring Programme to determine whether it can be made more effective and to identify the risks of a reduction in funding.</p> <p><i>Review will take place in 2017&18</i></p>	<p>Seabird Monitoring Programme.</p>	<p>Seabird Monitoring Programme.</p> <p>Review, with recommendations implemented.</p>		
Seabird non-breeding population abundance and distribution on land. Type 1 and/or 2	<p>WinGS, Winter Atlas surveys every 10 years, annual WeBS.</p>		<p>Regular decadal and 'improved' WinGS (e.g. extra monitoring at key sites).</p> <p>+ Winter Atlas surveys every 10 years.</p> <p>+ Improved monitoring of non-breeding cormorant^s.</p>		

Parameter/group & Monitoring type^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Seabird at-sea distribution patterns. Type 1, 2 and/or 3	Rely on non-government data collection and/or success of bids to external funding mechanisms.	Op 1 + Investigate feasibility of low cost/cost neutral volunteer-based European Seabirds at Sea monitoring scheme.	Use Vessels of opportunity for seabirds at sea surveys by JNCC or contract surveyors. + Targeted Balearic shearwater surveys. + greater effort to incorporate other data types (e.g. aerial survey data from public and private sector). + greater use/development of new modelling approaches + updates to existing tools (e.g. SeaMaST).	Op 3 + Targeted surveys (boat/aerial) to fill high-priority gaps (e.g. areas with old data, high exposure to pressures, etc.).	Targeted aerial survey sampling UKCS every 6 years during breeding season (priority species distribution drives design). <i>VoO surveys under Op 3 would continue during non-breeding season only.</i>
Seabird movement. Type 1	Build partnerships between academia, NGOs and governments and bid for non-government funding and/or rely on research community and NGO-side for information (e.g. RSPB-led FAME and STAR projects).			Collaborative tracking project, with government funding, during breeding season of priority species/colonies only.	Op 4 + Non-breeding season tracking project⁹.

Parameter/group & Monitoring type ^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Seabird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB. Type 1 or 2	<p><i>Scheme not reviewed as considered sufficient in current [2017] form and assumes RSPB will make data available for governments use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</i></p> <p>NB: The EU Action Plan for reducing seabird bycatch in fishing gears aims at minimising and, where possible, eliminating the bycatch of seabirds in EU and external waters, though a range of (mainly voluntary) actions. One of the biggest challenges in implementing the EU-PoA is to define the existence of an incidental seabird bycatch problem in the first place and to make accurate and realistic assessments of the impact of bycatch on seabird populations. DEFRA commissioned a spatial risk assessment of the vulnerability of marine birds to bycatch in UK waters to inform the scope and nature of further work required (Bradbury et al. in prep). There may, therefore, be a future need to monitor bycatch incidence.</p>				
Seabird displacement. Type 1, 2 or 3 monitoring	Currently [2017] subject to R&D and the responsibility of CNCBs, regulators and developers, so options to monitor this parameter are not considered here.				
Marine waterbird breeding population abundance. Type 1 and/or 2	<p>SCARRABS and Rare Bird Breeding Panel</p> <p><i>SCARRABS may be subject to review by SNCBs and Rare Bird Breeding Panel by JNCC, RSPB and BTO.</i></p>				

Parameter/group & Monitoring type^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Marine waterbird non-breeding population abundance and distribution. Type 1 and/or 2	Wetland Birds Survey and Non-Estuarine Waterbird Survey schemes to be reviewed by terrestrial monitoring programme.	WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data.	As Op 2 + Targeted at-sea surveys of high priority species (i.e. Slav grebe, common scoter, greater scaup, long-tailed duck, velvet scoter^e).	As Op 3 + UK-wide at-sea low-effort surveys in largely inshore waters (outside of marine SPAs) every 12 years.	As Op 3 But every 6 years.
Marine waterbird movement. Type 1	No UK-wide monitoring programme- information comes from NGO and academic research projects.				Flyway level collaborative tracking project, with Priority species TBC.
Marine waterbird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB. Type 1 or 2	RSPB led and funded national annual and local monthly beached bird surveys. <i>Scheme not reviewed as considered sufficient in current [2017] form and assumes RSPB will make data available for governments use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</i>				

Parameter/group & Monitoring type ^{a,b,c}	Option 1: Lower cost alternative to current [2017] monitoring	Option 2: Current [2017] monitoring	Option 3: Enhanced monitoring 1	Option 4: Enhanced monitoring 2	Option 5: Enhanced monitoring 3
Marine waterbird displacement. Type 1, 2 or 3	<p>Case-specific post-consent monitoring in relation to marine renewable developments.</p> <p><i>Currently [2017] subject to R&D and the responsibility of CNCBs, regulators and developers, so options to monitor this parameter are not considered here.</i></p>				
Marine bird abundance and distribution within the current [2017] UK SPA network i.e. breeding seabird colony SPAs and their marine extensions; and marine SPAs for wintering waterbirds Type 1, 2 or 3	<p>Coordinated monitoring of SPAs at UK scale.</p>	<p>Frequency decided at country level.</p>	<p>UK co-ordinated rolling programme with relevant sites counted every 12 years using standard methods, supplemented between surveys, for breeding seabird SPAs, with extrapolated trend information based on SMP annual trends.</p>	<p>As Op 3 + Highest risk sites/species surveyed every 6 years, with sample of sites prioritised for monitoring changing over time, in accordance with changing occurrence of pressures.</p>	<p>All relevant sites counted every 6 years.</p>

- ^a Type 1 monitoring constitutes a design to measure the rate and direction of change in the long-term (at the scale appropriate to the question) whilst at the same time collecting relevant information on environmental variables and human pressures to allow inference to be made about possible causes of such change.
- ^b Type 2 monitoring specifically uses different levels of a pressure to create a balanced design to answer questions about the relationship between cause and effect.
- ^c Type 3 monitoring is about designing an experiment (i.e. changing levels of a pressure experimentally by adding or removing the pressure through management) to find evidence of cause and effect.
- ^d Previously breeding seabird censuses were funded with a combination of government and external money.

- ^e Based on BOCC3 red list, long-tailed duck and velvet scoter recently added in BOCC4 and cost to survey has still to be determined.
- ^f Wintering populations of cormorants are based on WeBS counts, and these have been recently reviewed for their application to assess the impacts of licensed control (Defra 2013). This concluded that the potential effects of control measures. out with the larger well-monitored wetlands was less well known and that effects on the population would be best understood through more detailed survey work at the national level (Defra 2013).
- ^g Recent advances in tag development may allow tracking of some species during entire year/longer which could remove need for Option 5/reduce costs.

Table A1.2: Estimated annual costs in £1,000s required from Marine, Terrestrial and External budgets/sources for implementing each option [as advised in 2017]. Does not include staff costs; the value of volunteer effort; or take inflation into account. The cost of several monitoring areas still need further refinement. Detailed notes are provided below the table [table created in 2017].

Group	Table	Option	1			2			3			4			5		
		Budget Marine Terrestrial External	M	T	E	M	T	E	M	T	E	M	T	E	M	T	E
Seabirds	1	Breeding population abundance	59 ^a	0	118 ^b	59 ^a	0	118 ^b	204 ^c	0	0	204 ^c	0	0	204 ^c	0	0
	2	Adult survival, breeding success, diet, and phenology															
	3	Non-breeding population abundance and distribution on land	0	41 _{d(a)}	95 _{d(b)}	0	41 _{d(a)}	95 _{d(b)}	0	41 _{d(a)}	95 _{d(b)}	0	41 _{d(a)}	95 _{d(b)}	0	41 _{d(a)}	95 _{d(b)}
	4	At-sea distribution patterns	0	0	0	tbc ^f	0	tbc ^f	461 _{e+g}	0	0	905 _{e+g+h}	0	0	2077 ^{e+i}	0	0
	5	Movement	0	0	tbc	0	0	tbc	0	0	tbc	100 ^j	0	tbc	300 ^{j+k}	0	tbc
	6	Mortality from plastic ingestion, oiling, and contamination by PiB	12 ^l	0	18 ^m	12 ^l	0	18 ^m	12 ^l	0	18 ^m	12 ^l	0	18 ^m	12 ^l	0	18 ^m
	7	Displacement	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v
Marine	8	Breeding population abundance	0	11 ⁿ	16 ⁿ	0	11 ⁿ	16 ⁿ	0	11 ⁿ	16 ⁿ	0	11 ⁿ	16 ⁿ	0	11 ⁿ	16 ⁿ
	9	Non-breeding population abundance and distribution	0	41 _{d(a)}	95 _{d(b)}	0	41 _{d(a)}	95 _{d(b)}	10 ^r	41 _{d(a)}	95 _{d(b)}	276 ^{r+s}	41 _{d(a)}	95 _{d(b)}	542 ^{r+t}	41 _{d(a)}	95 _{d(b)}

	10	Movement	0	0	tbc	0	0	tbc	0	0	tbc	0	0	tbc	tbc ^u	0	tbc
	11	Mortality from plastic ingestion, oiling and contamination by PiB	0	0	0 ^m	0	0	0 ^m	0	0	0 ^m	0	0	0 ^m	0	0	0 ^m
	12	Displacement	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v	0	0	tbc ^v
SPAS	13	Marine bird abundance and distribution within SPA network i.e. breeding colony SPA's & their marine extensions; and non-breeding aggregations of marine waterbirds	42 _{o+p+q}	0	0 ^w	42 _{o+p+q}	0	0 ^w	21	0	0 ^w	tbc ^x	0	0 ^w	42 _{o+p+q}	0	0 ^w
<i>Total per budget</i>			113	93	342	113	93	342	708	93	224	1497	93	224	3177	93	224
Total per option			548			548			1025			1814			3473		

a Final figure available after SMP review. Cost provided is from SMP FY 16/17 budget.

b Census cost.

c Includes enhanced SMP (86k) and census cost (118k).

d (a) Annual monitoring cost from terrestrial budget = (2016/17 WeBS, 56k JNCC) + (NEWS 13k CNCBs) + (WinGS 2003 – 2006, 13k from JNCC, CNCBs, BTO and Northumbrian Water; full breakdown unknown, so included in terrestrial budget column for simplicity) = 82k;

(b) Annual monitoring cost from external sources = (2016/17 WeBS, 56k BTO + 48k RSPB + 10k WWT + 38k income from data provision = 152k) + Winter Atlas (2007-11 Breeding and Winter Atlas: BTO fundraising of 1.5m for both, estimate assumes 750k for Winter Atlas, so if Atlas every 20 years = ~38k per annum) = 190k

NB

Terrestrial monitoring programmes are reviewed separately.

Costs in table split equally between seabirds & marine waterbirds; and

Cost of extra monitoring at key WinGS sites in Options 3 - 5 has TBC.

- e Annual cost of Balearic shearwater monitoring (4k per annum, for 2 land and boat based survey every 12 years).
- f Cost to start up volunteer-based at-sea surveys using VoOs need further consideration; aim is to generate external revenue through a volunteer membership scheme and from JNCC commercial at-sea training courses.
- g 457k to replenish UK EEZ seabirds-at-sea data currently [2017] over 15 years old, over 18-year survey period using ~25 vessels of opportunity cruises per year with contracts surveyors. Estimate is crude as amount of effort per cruise is weather dependant and targeting specific areas is more difficult than when using charter vessels.
- h Targeted ship-based surveys to fill high-priority gaps i.e. those with oldest data and where seabirds are at greatest exposure to key pressures. Digital aerial surveys would be cheaper if priority areas are inshore.
- i 1683k for targeted survey sampling UKCS during breeding season only. VoO surveys would continue in non-breeding season, so their cost (394k) is included in this total.
- j Collaborative project tracking breeding birds (priority species/colonies tbc).
- k Collaborative breeding and non-breeding bird tracking project (cost higher as more effort required to catch and tag non-breeding birds).
- l Defra funded postmortem analysis by Wageningen Marine Research of fulmar corpses to determine level of ingested plastics for OSPAR EcoQO and MSFD indicators.
- m RSPB funded beached bird survey.
- n Rare Breeding Bird Panel (11k JNCC, 11k RSPB & 5k BTO) is funded by terrestrial monitoring programme and reviewed separately. CNCB SCARRABS monitoring costs may range from £0 to >£100k per annum and are not included here.
- o Cost of surveying marine waterbird non-breeding aggregation SPA's every 6 years (3 sites, with others covered by WeBS not included in total) at 2012, so does not included pSPAs.
- p Does not include cost of surveying terrestrial SPA network as unclear what would be covered through external census funding and expenditure by CNCBs can fluctuate widely between years.
- q Does not include monitoring costs of recently designate/draft SPAs or those under consultation so figure is likely to increase considerably.
- r Targeted at-sea surveys of high priority species i.e. Slav grebe, common scoter and greater scaup. Based on BOCC3 red list, long-tailed duck and velvet scoter recently added in BOCC4 and cost to survey these still to be determined.
- s 266k for UK-wide at-sea low-effort inshore waterbird survey programme outside of marine SPAs (assumes 2yrs survey every 12 years).
- t 532k for UK-wide at-sea low-effort inshore waterbird survey programme outside of marine SPAs (assumes 2yrs survey every 6 years).
- u Flyway level collaborative tracking project, to delineate flyway boundaries/populations (priority species/colonies tbc). UK may not play substantial role, given relatively small proportions of the biogeographic populations of marine waterbirds it hosts, so no cost estimate provided.
- v Responsibility of CNCBs, regulators and developers so no cost estimate provided.

- ^w Some seabird breeding colony SPAs may be covered using external census funding, but this figure is not currently [2017] available.
- ^x Cost for surveying highest risk sites/species every 6 years, with sample of sites prioritised for monitoring trends (in accordance with changing occurrence of pressures) will be determined with input from CNCBs if option is selected.

For each option, evidence requirements delivered, and their risks & limitations are outlined in Table 4. Additional detail is provided in Appendix 2 (Tables 1–13).

Table A1.3: Evidence requirements, risks, and limitations of each option [table created in 2017].

Option 1

Evidence requirements delivered	Risks and limitations
<p>Option 1 aims to reduce current [2017] spend on marine bird monitoring, however, the only marine bird monitoring currently [2017] funded from the marine budget is the Seabird Monitoring Programme. This will be reviewed during 2017&18 to determine whether it can be made less expensive while maintaining its reporting power and to identify the risks of reduced funding. Any reduction in funding within Option 1 can, therefore, only be realised after consideration of the results of this review.</p> <p>Option 1 increases risk by relying on collaboration between countries; the development of external funding sources; putting greater emphasis on access to data collected through non-government initiatives (e.g. NGO & Private Sector); and building and broadening collaborations with other groups.</p> <p>It also advises better coordination of SPA monitoring between countries and with other UK-scale marine bird monitoring, to improve understanding of population level trends & drivers and allow better informed marine management decisions, while potential reducing costs through economies of scale.</p> <p>Marine bird monitoring is also delivered via programmes funded by the terrestrial budget (see Table 4) but the costs of these and a review of their ability to deliver under reduced funding scenarios is not included within these options.</p>	<ul style="list-style-type: none"> • It is unlikely that the assumptions made in this option can be fully met. • Relies heavily on the success of external funding bids to a limited number of mechanisms, many of which are EU-based and eligibility to these post-Brexit is not guaranteed e.g. bids to fund the current breeding seabird census have, thus far, failed. • Greater reliance on monitoring by research and NGO communities, so ability of governments to direct monitoring to meet their needs or access data/products is not guaranteed, nor is that they will be funded in the long-term by these groups. • Is unable to detect population level trends across all UK marine bird species and habitats, nor determine trend drivers and allow timely mitigation. Legislative reporting requirements are therefore only partial met. • Without regular and targeted monitoring, temporal and geographic gaps in the marine bird evidence base will remain. There is, therefore, risk that marine management decisions will be based on insufficient evidence and be inappropriate ultimately leading to legal challenge. • Reduced government funding/reliance on external funding and volunteer effort to meet government monitoring need may lead to increased opposition from the NGO side and a decrease in public opinion of environmental policy.

Option 2

Evidence requirements delivered	Risks and limitations
<p>Option 2 maintains the status quo by continuing current [2017] monitoring activities. It is largely confined to land-based monitoring, meaning most information on seabirds comes from monitoring parameters such as breeding abundance, breeding success and survival rate, while for marine waterbirds comes from land-based counts to estimate population size and trends for species whose distribution are within sight of land.</p> <p>The main benefit of Option 2 is that several species are covered by cost effective monitoring which utilises extensive volunteer effort. This information provides reasonable insight into mechanisms driving change for some species, partially meeting BD reporting requirements and providing adequate data for assessing current MSFD indicators.</p> <p>The development of a low cost or possibly cost-neutral volunteer-based seabirds at sea programme utilising Vessels of Opportunity is currently [2017] being considered. This could improve the ability to meet e.g. BD requirements for some species; provide more UK data for inshore and offshore MSFD abundance indicators; and ultimately improve the UK's ability and confidence in assessing progress towards GES. Increased at-sea survey effort would also improve the information available to reduce uncertainty around exposure to, and therefore, predicted impacts of, marine development on seabird populations.</p>	<ul style="list-style-type: none"> • Knowledge of wider at-sea abundance and distribution is currently [2017] based on increasingly dated information although this situation could be reversed if the volunteer ESAS scheme proves successful and data from e.g. the private sector is better utilised. • Greater reliance on volunteer effort may, however, affect data quality/monitoring precision and the amount of additional skilled volunteer effort available is unknown. There is also uncertainty regarding the cost of running such a scheme (as volunteer networks involve associated costs of coordination, data collation, etc.) and whether these costs can be met from external sources (e.g. using an NGO subscription-based funding model). Further work/a pilot project is therefore required. • Use of vessels of opportunity for at-sea monitoring provides limited scope for targeted survey and therefore, greater survey effort is required over a longer period, than bespoke large-scale surveys, to achieve the power necessary to identify trends in distribution/abundance and identify their drivers. These data may not, therefore, be sufficiently robust for use within MSFD indicators. • The success of a new volunteer-based low cost/cost neutral at-sea survey programme operational is not guaranteed and, in its absence, there will be limited data available on offshore marine bird distribution/abundance (outside of any monitoring of marine SPA network and by e.g. the private sector) so considerable risk remains that the UK will not be able to contribute to MSFD marine bird abundance indicators; provide population-level context to marine bird SPA site condition; or provide the evidence necessary for appropriate marine management. • Improvements to terrestrial-based monitoring are needed to increase scope, precision and geographic representivity of species trend information, especially for priority species.

Evidence requirements delivered	Risks and limitations
<p>At-sea monitoring of seabirds using volunteers on Vessels of Opportunity would also simultaneously collect cetacean data, thus contributing to the Joint Cetacean Protocol which forms part of the Cetacean Monitoring Option 1. In addition, there would be further opportunities to make cost savings by sharing monitoring priorities with private survey companies.</p> <p>SPA monitoring periods within Option 1 are tailored to suit individual sites and budgets, with features deemed at highest risk being monitored more regularly, thus allowing budgets to be used more effectively to meet conservation needs.</p>	<ul style="list-style-type: none"> • Uncertainty regarding implementation of seabird censuses to a timetable that aligns with BD reporting periods and contributes to SPA Site Condition Monitoring. • Lack of non-breeding population estimates for most seabird species so BD requirements only partially met. • Accurate population estimates and trends not available for majority of marine waterbird species as their distribution extend beyond sight of shore, so BD requirements only partially met. • Lack of a coordinated approach reduces potential power SPA monitoring data must contribute to population level assessments and for identifying trends & their drivers; is probably more expensive than a coordinated approach; and may lead to differences between countries with regards to quality and frequency of Birds Directive reporting.

Option 3

Evidence requirements delivered	Risks and limitations
<p>Option 3 begins to address some of the concerns and gaps identified with the current [2017] monitoring activities. It focuses on improving terrestrial-based monitoring (SMP, WinGS, non-breeding cormorant), making substantial gains in accuracy for multiple parameters and species with relatively low additional investment (particularly given the scope for utilising volunteers). The long term strategy of the SMP would include both a census and a sampling approach as part of an integrated programme, rather than having each census carried out through a bespoke initiative. This would ensure that trend information for all breeding seabird species would be available every third BD reporting period and on an annual basis for several species.</p> <p>Additional at-sea effort is prioritised towards low-level UK coordinated monitoring of marine SPAs; improving the accuracy of non-breeding population estimates for high priority species (Balearic shearwater, slav grebe, common scoter and greater scaup) through targeted at-sea monitoring; using vessels of opportunity to update UK scale knowledge on marine bird distribution patterns; and increasing the amount of non-government data being added to the ESAS database.</p>	<ul style="list-style-type: none"> • Inaccurate and biased population estimates remain for most lower-priority marine waterbird species due to continued heavy reliance on shore-based methods and there remains a lack of non-breeding population estimates for almost all seabird species. This means that BD requirements can only be partially met. • Marine SPA monitoring frequency (every 12 years) may be insufficient to provide timely assessments of site/species condition, particularly for sites/species which are more vulnerable. This would mean a potential gap in data of up to 11 years between surveys of an individual marine SPA, so decisions on whether management measures are required might not be timely. This frequency only periodically meets CSM and BD requirements. • The temporal refresh rate of information of at-sea distribution patterns is low and coverage will be constrained by the reliance on Vessels of Opportunity (supplemented with SPA surveys) so many high risk gaps in coverage will remain unfilled. The confidence these data can provide to marine management decision making will therefore vary considerably with space and time. • Vessels-of-opportunity are a cost-effective way to survey across marine environments and are potentially suitable for the purposes of updating information on marine bird distribution patterns. However, they are sub-optimal for monitoring trends in distribution and abundance, which are ideally supported by data from regular, full scale, synchronous surveys, preferably coupled with higher frequency sampling of a sub-set of areas. VoO data capture, at the levels described within this option may, therefore, be insufficient to support MSFD indicators. In addition, the required level of volunteer effort, data management, analysis, and cost of running this scheme have yet to be determined and a pilot project will be necessary prior to scaling to a UK-level.

Evidence requirements delivered	Risks and limitations
<p>As such, Option 3 improves the ability to meet Birds Directive reporting requirements for marine SPAs and in the accuracy of population estimates for priority seabird & marine waterbird species. It also provides UK-level inshore and offshore marine bird data, that could contribute to MSFD Indicators 1.2.1 and 1.3.1 “Species-specific trends in relative non-breeding abundance of marine birds at sea (inshore and offshore)” that more species could be included in future assessments of GES. The increased capture of inshore and offshore marine bird data would also improve knowledge of at-sea marine bird distribution patterns, ultimately giving more confidence to management advice, especially concerning where to site marine developments.</p>	<ul style="list-style-type: none"> No information on at-sea movements of individuals is collected under this option, so is unable to identify connectivity between colonies and exposure to pressures at-sea. This evidence would strengthen our understanding of state-pressure relationships as well as provide crucial evidence to underpin the HRA process.

Option 4

Evidence requirements delivered	Risks and limitations
<p>Option 4 builds on Option 3 by providing a more complete picture of UK-wide marine bird distribution patterns and abundance, especially for marine waterbird species.</p> <p>It implements a UK-wide inshore low-effort at-sea monitoring programme for all marine waterbirds every other BD reporting period (outside the SPA network), improving population estimates and providing context to changes observed within the inshore marine SPA network. Marine SPA monitoring is further strengthened with higher risk sites being surveyed every reporting period (low risk sites every other reporting period). Increased marine SPA monitoring at high risk sites allows regular condition assessments and timely management measures to be implemented if necessary.</p>	<ul style="list-style-type: none"> Although Option 4 is considered adequate to meet most assessment and reporting requirements, it does not meet CSM requirements for lower risk marine SPAs. It is heavily reliant on opportunistic surveys for offshore areas and, therefore, is likely to have limited ability to detect signification changes in distribution of species that utilise these environments. Monitoring movements of birds/tracking is expensive, and the amount of effort/cost required to identify state-pressure relationships could be prohibitive. High quality environmental/pressure data are also required to enable the identification of such relationships and are not always available.

Evidence requirements delivered	Risks and limitations
<p>Vessels of opportunity surveys, which are more offshore-orientated, are supplemented with targeted effort to fill high priority gaps. This provides a broad-scale update to the existing, largely out-of-date, seabird and marine waterbird 'at-sea' dataset, thus allowing a more consistent and evidence-based approach to management within the marine environment.</p> <p>Option 4 improves Birds Directive reporting standards for all marine bird species. It would also to provide data that can contribute to MSFD indicators for marine bird abundance, which would complement existing land-based indicators, and improve ability to measure GES.</p> <p>Information on at-sea movements of individuals during the breeding season would be collected to improve our knowledge of the connectivity between colonies and exposure to pressures at-sea, strengthening our understanding of state-pressure relationships as well as providing crucial evidence to underpin the HRA process.</p>	

Option 5

Evidence requirements delivered	Risks and limitations
<p>Option 5 involves a much fuller at-sea implementation than the other options. As such, it substantially increases our confidence in resulting population status and trend information, both at a UK-wide and protected site level, for both breeding and non-breeding seasons.</p> <p>Option 5 includes targeted surveys of the entire marine SPA network every reporting period. These are complemented by a UK wide inshore low-effort at-sea monitoring programme during the non-breeding season at the same frequency. It also implements targeted, rather than opportunistic, offshore surveys during the breeding season every other reporting period. Finally, tracking is expanded to the non-breeding season allowing assessments of pressures driving seabird trends to be made all year round and across a broad spatial area.</p> <p>It demonstrates a serious commitment to implementing Article 10 of the Birds Directive in the context of specifically commissioning high quality survey work to improve the evidence base for the protection and management of our marine birds at sea, including our ability to detect changes in at-sea distributions.</p> <p>It would expand potential species coverage, of MSFD Indicators 1.2.1 and 1.3.1 “Species-specific trends in relative non-breeding abundance of marine birds at sea (inshore and offshore)”.</p> <p>Option 5 would provide up-to date information on inshore populations and greatly improve the evidence base for marine management applications.</p>	<ul style="list-style-type: none"> • Without intensive, targeted, offshore surveys of seabirds during the non-breeding season, our ability to detect changes in non-breeding distributions remains weak. • Treats all SPAs as equally important, regardless of the risks they face in relation to pressures which may be an inefficient use of resources. • Monitoring movements of birds/tracking is expensive, and the amount of effort/cost required to identify state-pressure relationships could be prohibitive.

Evidence requirements delivered	Risks and limitations
<p>It would provide a better understanding of non-breeding seabird population status. and improve the ability to detect changes in distribution, rather than simply being able to map distributions.</p> <p>Monitoring the entire marine SPA network every reporting period would be in line with Common Standards Monitoring needs and allow timely assessments of site condition to be made.</p>	

Appendix 2

The options presented in Tables A2.1 to A2.13 present lower cost alternatives to current [2017] marine bird monitoring (Option 1), define current [2017] monitoring levels (Option 2), provide incremental levels of monitoring within the UK (Options 3 to 5) and outline the pluses and minuses of each approach.

Box 1: A summary of what is included within each option for monitoring seabird breeding population abundance.

Option 1:

- Review the Seabird Monitoring Programme to determine whether it can be made more effective and to identify the risks of a reduction in funding (SMP review will take place in 2017 & 18).
- Externally funded censuses, every 18 years.

Option 2:

- Seabird Monitoring Programme.
- Externally funded breeding seabird censuses, every 18 years.

Options 3, 4 & 5:

- Seabird Monitoring Programme.
- SMP Review, with recommendations implemented.
- Government funded national seabird censuses every 18 years.

Table A2.1: Monitoring options 1 and 2 for seabird breeding population abundance [table created in 2017].

Option 1	
Plus	Minus
<ul style="list-style-type: none"> • An increase in the level of volunteer effort, could deliver improvements in the quality, quantity and geographic representivity of the SMP breeding population dataset. These could allow delivery of higher quality population trend information (and for more species) than the existing programme. • Potential to reduce cost of SMP through greater use of volunteers to collect data and reduction of professional survey sampling frequency. • Cost of breeding seabird census is not borne by governments. 	<ul style="list-style-type: none"> • Maintaining existing/enhancing the precision of SMP breeding population trend information and its geographical and species representivity is not guaranteed by this review. • Any decrease in SMP reporting power/precision and uncertainty over census funding/ability to deliver regular censuses would reduce ability to identify trends and drivers and mitigate these in timely manner especially for species which receive less monitoring effort. • Potentially less information for HRA and EIA so increased risk of inappropriate assessment/development and legal challenge. • Birds Directive reporting quality may be reduced. • Any reduction in sampling effort and/or the number of parameters monitored could compromise UKs ability to support MSFD indicators/determine whether GES is being met. • Cases by NGO-side concerning governments lack of coherent monitoring and ability to conserve seabird populations could increase. • Greater use of volunteers could lead to geographically patchy data and there is no guarantee that sufficient volunteer effort is available to cover professional monitoring gaps and/or increase volunteer monitoring levels. • May require greater reliance on research/NGOs to determine seabird population health and less control over direction and products. Long term funding of external monitoring schemes not guaranteed. • Public opinion of governments environmental policy may decrease.

Option 2	
Plus	Minus
<ul style="list-style-type: none"> • Provides accurate Birds Directive status assessments for 25 seabird species every census and annually for 12 species covered by SMP. • Supports MSFD 1.1.2, 1.2.1, 1.3.1, 4.3.1. and 4.1 indicators. • Meets OSPAR monitoring recommendations. • Provides evidence base for HRA and EIA, allowing sustainable marine development. • Access to NGO data will be compromised without adequate government funding contribution. 	<ul style="list-style-type: none"> • Population status/trends of 13 species only available after census, so unable to quickly identify trends and mitigate their drivers or potentially prevent considerable declines in population size. • Accurate BD reporting for 12 species only possible immediately after censuses. • Census funding not guaranteed so high risk of failure to meet BD, MSFD indicators and OSPAR requirements • Ability of data to meet HRA, EIA, etc. decreases with time after each census.

Table A2.2: Monitoring options 3, 4 & 5 for seabird breeding population abundance [table created in 2017].

Options 3, 4 & 5	
Plus	Minus
<ul style="list-style-type: none"> •As Opt 2 + • Improved monitoring accuracy, statistical power and geographic representivity. •Lower risk of failing to detect genuine population trends in a timely manner for key species. •Improved reporting accuracy. • Guaranteed regular provision of population scale trends for all UK breeding seabird species. 	<ul style="list-style-type: none"> •Population status/trends of 12 species available only after census, so unable to quickly identify trends and mitigate their drivers or potentially prevent considerable declines in population size. • Accurate BD reporting for 12 species only possible immediately after censuses. • Ability of data to meet HRA, EIA, etc. decreases with time after each census.

Box 2: A summary of what is included within each option for monitoring seabird adult survival, breeding success, diet and phenology.

Option 1:

- Review the Seabird Monitoring Programme to determine whether it can be made more effective and to identify the risks of a reduction in funding (SMP review will take place in 2017 &18).

Option 2:

- Seabird Monitoring Programme.

Options 3, 4 & 5:

- Seabird Monitoring Programme.
- SMP Review, with recommendations implemented.

Table A2.3: Monitoring options 1 and 2 for seabird adult survival, breeding success, diet, and phenology [table created in 2017].

Option 1	
Plus	Minus
<ul style="list-style-type: none"> • May allow improvements in the quality, quantity and geographic representivity of the SMP demographic datasets. • Potential to reduce cost of SMP through greater use of volunteers to collect data and reduction of professional survey sampling frequency. 	<ul style="list-style-type: none"> • Maintaining existing precision of SMP demographic trend information and its geographical and species representivity is not guaranteed by this review and the ability to meet legislative requirements may be compromised. • Changes to the sampling frequency of sites that collect demographic data may lead to a time series that is asynchronous with breeding population abundance data. Ability to identify and mitigate pressures in a timely manner may therefore be compromised which could make stopping/reversing declines more difficult and potentially costlier at conservation, economic and political levels. • Legal cases concerning government’s lack of coherent monitoring and ability to conserve seabird populations could increase. • Greater use of volunteers (as opposed to paid researchers) could lead to lower quality data, reduced trend precision and ability to identify and mitigate trend drivers in a timely manner. This must be evaluated, and steps taken to ensure that data quality is of an acceptable standard. • Greater use of volunteers could lead to geographically patchy data and there is no guarantee that sufficient volunteer effort is available to cover professional monitoring gaps and/or increase volunteer monitoring levels. • May require greater reliance on research/NGOs to determine seabird population health and less control over direction and products. • Seabirds have a totemic status and reduced monitoring, and protection of their populations is highly likely to lead to increased challenge from the NGO side and a decrease in public opinion of environmental policy.

Option 2	
Plus	Minus
<ul style="list-style-type: none"> • Adult survival and breeding success respond faster to pressures than breeding population abundance and are therefore more rapid indicators of pressure effects. • Diet and phenology (timing of breeding) indicate environment state by responding quickly to foraging conditions, thus providing insight on mechanisms behind change. • Monitoring these parameters can thus increase the speed at which pressures can be identified and mitigated. • Supports MSFD Indicators 1.2.1, 4.3.1, 1.3.1; OSPAR monitoring recommendations (black-legged kittiwake and roseate tern) and HRA. • Provides population state indicators that respond to pressures. • Paid researchers collect high quality data annually from UK 'key sites', which are supplemented with data from highly skilled volunteers. This provides UK level time series trend information that has good precision and is synchronous with breeding population abundance data. This improves the ability to identify and mitigate drivers of population change in a timely manner. 	<ul style="list-style-type: none"> • Current [2017] sampling level currently only able to deliver accurate UK-level trends, not regional. • Survival rate monitoring currently [2017] limited to a low number of species and this, coupled with limited geographic coverage, makes it difficult to accurately determine the impact of pressures on seabird populations. • Diet and phenology not monitored for majority of species.

Table A2.4: Monitoring options 3, 4 and 5 for seabird adult survival, breeding success, diet, and phenology [table created in 2017].

Options 3, 4 & 5	
Plus	Minus
<ul style="list-style-type: none"> • Improved demographic and biological trend accuracy at a regional level allowing better understanding of effects of pressures on seabirds and the ability to mitigate these. 	<ul style="list-style-type: none"> • Will not meet all site-specific breeding success and adult survival estimates required for HRA population models.

Box 3: A summary of what is included within each option for monitoring seabird non-breeding population and distribution on land.

Option 1:

- No change / will be reviewed by terrestrial monitoring programme.

Option 2:

- WinGS Winter Atlas surveys every 10 years, annual WeBS.

Option 3:

- Regular decadal and 'improved' WinGS (e.g. extra monitoring at key sites/development of indicators).
- Winter Atlas surveys every 10 years.
- Improved coverage/monitoring of non-breeding cormorants.

Options 4 & 5:

- Regular decadal and 'improved' WinGS (e.g. extra monitoring at key sites/development of indicators).
- Winter Atlas surveys every 10 years.
- Improved coverage/monitoring of non-breeding cormorants.
- Population estimates for other species estimated using existing at-sea data. [*Subject to R&D, this might be supplemented with trend indices derived from abundance data collected during surveys designed to monitor at-sea distribution patterns and marine SPAs (the quality of which would vary depending on the option chosen).*]

Table A2.5: Monitoring options 1 and 2 for seabird non-breeding population abundance and distribution on land [table created in 2017].

Option 1	
No change / will be reviewed by terrestrial monitoring programme.	
Option 2	
Plus	Minus
<ul style="list-style-type: none"> • Provides non-breeding winter gull abundance estimates and distribution information. • Atlas survey provides presence/absence information for non-breeding cormorant. • Improves quality of BD reporting. 	<ul style="list-style-type: none"> • Non-breeding population estimates and distribution information only available for gull species; for species which spend most of the non-breeding season at sea these are not known. • Unable to fully meet Birds Directive reporting requirements for non-breeding seabird population abundance. • Inability to make fully informed marine management decisions increases consenting risk. • NGO schemes, which are part-funded on an ad-hoc basis by governments, mean continuation of schemes, their periodicity and data access are not guaranteed. • Unable to determine effect of cormorant control measures on population.^a

^a Wintering populations of cormorants are based on WeBS counts and these have been recently reviewed for their application to assess the impacts of licensed control ([Defra 2013](#)). This concluded that the potential effect of control measures out with the larger well-monitored wetlands was less well known and that effects on the population as a whole would be best understood through more detailed survey work at the national level (Defra 2013).

Table A2.6: Monitoring options 3,4 and 5 for seabird non-breeding population abundance and distribution on land [table created in 2017].

Option 3	
Plus	Minus
<ul style="list-style-type: none"> •Accurate wintering gull trends. •Accurate assessment of potential effects of licensed cormorant control measures on population.^a •Improved Birds Directive reporting accuracy. 	<ul style="list-style-type: none"> • Non-breeding population estimates only available for gull species; for species which spend most of the non-breeding season at sea these are not known.
Options 4 & 5	
Plus	Minus
<ul style="list-style-type: none"> •Potential to provide at-sea population estimates which would fill an evidence gap in Birds Directive assessments. • BD reporting requirements for non-breeding gull population met. 	<ul style="list-style-type: none"> • Species often occur in sparse and patchy distributions so effort may not be high enough to detect population trends in all species. • Insufficient understanding of seabird behaviour beyond sight of land may compromise ability to implement appropriate management of at-sea activities. • 10 year WINGS period does not provide up-to-date status assessment for every BD reporting round.

Box 4: A summary of what is included within each option for monitoring seabird at sea distribution patterns.

Option 1:

- Rely on non-government data collection and/or success of bids to external funding mechanisms.

Option 2:

- Rely on non-government data collection and/or success of bids to external funding mechanisms.
- Investigate feasibility of low cost/cost neutral volunteer-based European Seabirds at Sea monitoring scheme.

Option 3:

- Use Vessels of opportunity for seabirds at sea surveys by JNCC or contract surveyors.
- Targeted Balearic shearwater surveys.
- Incorporate other data types (e.g. aerial survey data from public and private sector).

Option 4:

- Use Vessels of opportunity for seabirds at sea surveys by JNCC or contract surveyors.
- Targeted Balearic shearwater surveys.
- Incorporate other data types (e.g. aerial survey data from public and private sector).
- Targeted surveys (boat/aerial) to fill high-priority gaps (e.g. areas with old data, high exposure to pressures, etc.).

Option 5:

- Targeted aerial survey sampling UKCS every 6 years during breeding season (priority species distribution drives design).
- Vessels of Opportunity surveys under Option 3 would continue during non-breeding season only.

Table A2.7: Monitoring options 1 and 2 for seabird at-sea distribution patterns [table created in 2017].

Option 1	
Plus	Minus
<ul style="list-style-type: none"> •Low cost to governments. • At-sea monitoring undertaken by (e.g.) SPA SCM and private sector EIA surveys would also be incorporated. 	<ul style="list-style-type: none"> •Relies heavily on success of external bids to limited number of mechanisms, many are EU-based, and eligibility post-Brexit not guaranteed. •Greater reliance on non-government monitoring, so ability to direct monitoring to meet needs or access data/ products is not guaranteed, nor is that these will be funded in long-term. •Unable to detect population level trends across all species and habitats or determine trend drivers and allow timely mitigation. Legislative reporting requirements are therefore only partially met. •Without regular and targeted monitoring, temporal and geographic gaps in evidence base will remain, therefore, risk that marine management decisions are based on insufficient evidence, are inappropriate and ultimately open to legal challenge. •Reduced government funding/ reliance on external funding and volunteer effort to meet government monitoring need may lead to increased opposition from the NGO side and a decrease in public opinion of environmental policy.
Option 2	
Plus	Minus
<ul style="list-style-type: none"> •Equivalent scheme used by NGOs to survey cetaceans so may be possible to develop self-sufficient monitoring scheme for seabirds. • Updates baseline information on distribution patterns that can be used to reduce uncertainty around exposure to, and therefore, predicted impacts of, marine development on seabird populations. 	<ul style="list-style-type: none"> •Uncertainty regarding costs of running scheme and whether these can be met from external sources (e.g. using an NGO subscription-based funding model). •Requires consider-able effort to ensure all volunteer surveyors are trained and ongoing checks to maintain data quality and ultimately that derived products are accurate/ precise

Option 2	
<ul style="list-style-type: none"> • Increased scope to support MSFD Indicators 1.2.1 and 1.3.1 “Species-specific trends in relative non-breeding abundance of marine birds at sea (inshore and offshore) and would support identification of MPAs. • Improved BD reporting accuracy on status of seabird populations at sea. • Collects cetacean data and other marine megafauna (sharks, turtles, sunfish, etc.) 	<ul style="list-style-type: none"> • Limited scope for targeted survey and therefore, greater survey effort required over a longer period than bespoke large-scale surveys, to achieve power necessary to identify trends in distribution and identify drivers. Data may not, therefore, be sufficiently robust for use within MSFD indicators. • Relatively low sample size, suboptimal survey design and high seabird mobility, means power to detect trends in abundance is likely to be very low. • Species often occur in sparse and patchy distributions so effort may not be high enough to detect changes in distribution, especially in early years of scheme. <p>Uncertainties remain in the ability to detect changes in at sea distribution patterns of seabirds, particularly further offshore although expansion of scheme could, in time, cover some of these areas (e.g. through use of merchant ships).</p> <ul style="list-style-type: none"> • ESAS database and data capture systems need to be updated to accommodate increased data flow from this scheme but restrictions on GDS will not currently [2017] allow for this. JNCC are, therefore pursuing alternatives (without government funding) to update the system but success of work not guaranteed. • Dataset unlikely to be able to provide SNCBs, developers and decision-makers with sufficient information to reduce uncertainty around predicted impacts of marine development on at-sea seabird populations across all geographic areas. • Balearic shearwater, a BD Annex 1 species that is IUCN red listed as critically endangered and occurs as a non-breeding population in UK waters, is not routinely monitored.

Table A2.7: Monitoring options 3, 4 and 5 for seabird at-sea distribution patterns [table created in 2017].

Option 3	
Plus	Minus
<ul style="list-style-type: none"> • Cost effective compared with using charter vessels. • Ensures data and derived products are of high quality. • Updates baseline information on distribution patterns which can be used to reduce uncertainty around exposure to, and therefore, predicted impacts of, marine development on seabird populations. • Targets vessels covering areas where data is oldest and where key pressures exposure is considered highest, thus increasing monitoring efficiency/ data value. • Improved BD reporting accuracy on status of seabird populations at sea. 	<ul style="list-style-type: none"> • Opportunistic surveys not designed to overcome specific issues with monitoring highly mobile species, thus power to detect changes in distribution is lower than when using bespoke/ targeted surveys. • Relatively low sample size, suboptimal survey design and high seabird mobility, means power to detect trends in abundance is likely to be very low. • The refresh of information on at-sea distribution patterns may be constrained by the reliance on VoO so 'high risk' gaps may remain unfilled.
Option 4	
Plus	Minus
<ul style="list-style-type: none"> • Increased scope to support MSFD Indicators 1.2.1 and 1.3.1 "Species-specific trends in relative non-breeding abundance of marine birds at sea (inshore and offshore)". • Improved seabirds at-sea distribution information during breeding and non-breeding seasons reduces uncertainty around predicted impacts of marine development on seabird populations. • Monitoring undertaken for marine SPAs during breeding season incorporate-ed in survey design to reduce overall cost. • Improved BD reporting accuracy on status of seabird populations at sea. 	<ul style="list-style-type: none"> • Sample size, survey design and high seabird mobility, may mean that power to detect trends in abundance remains low.

Option 5	
Plus	Minus
<ul style="list-style-type: none"> •Greatly improved baseline information allows finer scale trends in at-sea distribution and possibly abundance to be detected. This reduces uncertainty around predicted impacts of marine development on seabird populations and allows mitigation of the effects of pressures on seabirds to be more rapidly implement-ed. •Would support MSFD Indicators 1.2.1 and 1.3.1 “Species-specific trends in relative non-breeding abundance of marine birds at sea (inshore and offshore)”. •Improved BD reporting accuracy on status of seabird populations at sea. 	<ul style="list-style-type: none"> • Large uncertainties around non-breeding population estimates and distribution of seabirds remains, particularly further offshore.

Box 5: A summary of what is included within each option for monitoring seabird movement.

Option 1:

- Build partnerships between academia, NGOs and governments and bid for non-government funding.

Options 2 & 3:

- No government funded monitoring, so relies on research community and NGO-side (e.g. RSPB-led FAME and STAR projects).

Option 4:

- Collaborative tracking project, with government funding, during breeding season of priority species/colonies only.

Option 5:

- Collaborative tracking project, with government funding, during breeding season of priority species/colonies only.
- Non-breeding season tracking project.

Table A2.8: Monitoring options 1, 2 and 3 for seabird movement [table created in 2017].

Option 1	
Plus	Minus
<ul style="list-style-type: none"> • Potential to improve knowledge of connectivity between colonies and exposure to pressures at-sea throughout year and develop terrestrial-based, cost effective, monitoring of marine SPAs and meet BD requirements. • Ensures access to data and results. 	<ul style="list-style-type: none"> • Government matched funding required to become partner on most bids. • Large budget needed to achieve sampling rate/power to identify trends/drivers. • Requires up-to-date pressures data which are not always available. • Relies on external funding so maintenance of a long-term programme difficult.
Options 2 & 3	
Plus	Minus
<ul style="list-style-type: none"> • Can provide stronger evidence of effects of at-sea pressure exposure on breeding seabirds. • If strong links between breeding colonies and marine SPAs are identified through tracking studies, breeding colony monitoring could be used as a proxy for marine SPA condition. This would provide a much lower cost alternative to monitoring marine SPAs directly. 	<ul style="list-style-type: none"> • Access/timely access to data not guaranteed. • Recent collaborative, government supported projects have now ended. • Tracking data tends to suffer from small sample sizes.

Table A2.9: Monitoring options 4 and 5 for seabird movement [table created in 2017].

Option 4	
Plus	Minus
<ul style="list-style-type: none"> • Improves knowledge of connectivity between colonies and exposure to pressures at-sea and provides crucial evidence to underpin the HRA process. • If strong links between breeding colonies and marine SPAs are identified through tracking studies, breeding colony monitoring could be used as a proxy for marine SPA condition. This would provide a much lower cost alternative to monitoring marine SPAs directly. 	<ul style="list-style-type: none"> • High cost of tracking has meant that historically sample sizes have had to be relatively small. Achieving enough power to identify trends may, therefore, be difficult if funding is sub-optimal. • Assessment of environmental/pressure effects confined to breeding season, so difficult to determine whether these, or non-breeding season effects, are behind population level trends. • Requires good environmental/pressure data which are not always available.
Option 5	
Plus	Minus
<ul style="list-style-type: none"> • Improved knowledge of connectivity between colonies and exposure to pressures at-sea throughout year. 	<ul style="list-style-type: none"> • High cost of tracking has meant that historically sample sizes have had to be relatively small. Achieving enough power to identify trends may, therefore, be difficult if funding is sub-optimal. • Requires good environmental/pressure data which are not always available.

Table A2.10: Monitoring options for seabird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB^a [table created in 2017].

<p>Options 1, 2, 3, 4 & 5</p> <p>RSPB led and funded national annual and local monthly beached bird surveys.</p>
<p>Scheme not reviewed as considered sufficient in current [2017] form and assumes RSPB will make data available for governments use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</p>

^a The EU Action Plan for reducing seabird bycatch in fishing gears aims at minimising and, where possible, eliminating the bycatch of seabirds in EU and external waters, though a range of (mainly voluntary) actions. One of the biggest challenges in implementing the EU-PoA is to define the existence of an incidental seabird bycatch problem in the first place and to make accurate and realistic assessments of the impact of bycatch on seabird populations. DEFRA commissioned a spatial risk assessment of the vulnerability of marine birds to bycatch in UK waters to inform the scope and nature of further work required (Bradbury et al. in prep). There may, therefore, be a future need to monitor bycatch incidence.

Table A2.11: Monitoring options for seabird displacement [table created in 2017].

<p>Options 1, 2, 3, 4 & 5</p> <p>Case-specific post-consent monitoring in relation to marine renewable developments.</p>
<p>Currently [2017] subject to R&D and the responsibility of SNCBs, regulators and developers, so options to monitor this parameter are not considered here.</p>

Table A2.12: Monitoring options for marine waterbird breeding population abundance [table created in 2017].

<p>Option 1</p> <p>SCARRABS and Rare Bird Breeding Panel.</p> <p><i>SCARRABS may be subject to review by SNCBs and Rare Bird Breeding Panel by JNCC, RSPB and BTO.</i></p>	<p>Options 2, 3, 4 & 5</p> <p>SCARRABS and Rare Bird Breeding Panel - <i>Schemes not reviewed as considered sufficient in current [2017] form.</i></p>	
	<p>Plus</p>	<p>Minus</p>
	<ul style="list-style-type: none"> • Single species decadal censuses of abundance and distribution, supplemented with annual recording of rare breeding birds, contributes to monitoring objectives of breeding marine waterbird species. 	<ul style="list-style-type: none"> • Little information on inter-decadal trends exists, so quality of Birds Directive reporting varies with time and ability to detect declines and mitigate their drivers is suboptimal.

Box 6: A summary of what is included within each option for monitoring marine waterbird non-breeding population abundance & distribution.

Option 1:

- Wetland Birds Survey and Non-Estuarine Waterbird Survey schemes to be reviewed by terrestrial monitoring programme.

Option 2:

- WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data.

Option 3:

- WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data.
- Targeted at-sea surveys of high priority species i.e. Slav grebe, common scoter, greater scaup, long- tailed duck, velvet scoter.

Option 4:

- WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data.
- Targeted at-sea surveys of high priority species i.e. Slav grebe, common scoter, greater scaup, long- tailed duck, velvet scoter.
- UK-wide at-sea low-effort surveys in largely inshore waters (outside of marine SPAs) every 12 years.

Option 5:

- WeBS and NEWS + use existing marine SPA identification and SPA site condition monitoring survey data.
- Targeted at-sea surveys of high priority species i.e. Slav grebe, common scoter, greater scaup, long- tailed duck, velvet scoter.
- UK-wide at-sea low-effort surveys in largely inshore waters (outside of marine SPAs) every 6 years.

Table A2.13: Monitoring options 1 and 2 for marine waterbird non-breeding population abundance and distribution [table created in 2017].

Options 1 & 2		
	Plus	Minus
<ul style="list-style-type: none"> Wetland Birds Survey and Non-Estuarine Waterbird Survey schemes to be reviewed by terrestrial monitoring programme. 	<ul style="list-style-type: none"> WeBS (estuarine) and NEWS (non-estuarine/open coast) combined monitor population abundance & distribution and fulfil BD requirements for species whose populations are entirely within sight of shore. 	<ul style="list-style-type: none"> NEWS is every 10 years and accurate BD reporting quality only possible at this periodicity. No programme in place to monitor offshore waterbird species except for occasional ad hoc Site Condition Monitoring of relevant marine SPAs. Most information on offshore species abundance & distribution comes from increasingly dated 'one-off' dataset collected over extensive period (2001 to 2011) as part of marine SPA ID work. This cannot be used to monitor trends in abundance & distribution is unlikely to represent current [2017] situation.

^a Based on BOCC3 red list, long-tailed duck and velvet scoter recently added in BOCC4 and cost to survey has still to be determined.

Table A2.14: Monitoring options 3,4 and 5 for marine waterbird non-breeding population abundance and distribution [table created in 2017].

Option 3	
Plus	Minus
<ul style="list-style-type: none"> •Improves population size estimates and trend precision for high priority species. •Collects other species data during targeted surveys thus improving trend precision for these. • In recent BD reporting round, confidence in wintering population abundance & distribution estimates and trends was considered good for only two marine waterbird species. This approach would increase this to five. 	<ul style="list-style-type: none"> • Population estimates and trends of lower priority species, whose distributions extend beyond sight of land, are likely to be inaccurate because of continued reliance on WeBS / NEWS data. For these species, BD reporting requirements are unlikely to be met.
Option 4	
Plus	Minus
<ul style="list-style-type: none"> •Provides context for interpreting changes monitored within marine SPA network. • Improves population estimates for all species whose distributions extend beyond sight of land. • Also collects seabird distribution data. • Support of future MSFD 1.2.1 & 4.3.1 indicator requirements would increase, as would the evidence base available for HRA. 	<ul style="list-style-type: none"> •Frequency of surveys to monitor marine waterbird abundance may be insufficient to detect any changes in a timely way to inform management decisions.

Option 5	
Plus	Minus
<ul style="list-style-type: none"> • Improves accuracy UK population estimates and trend information for all species. • Provides data from same period as those collected for marine SPA monitoring, thus providing better population level context. • Efficiency savings could be made if surveys were coordinated with a UK-level SPA SCM programme. • Support of future MSFD 1.2.1 & 4.3.1 indicator requirements would increase, as would the evidence base available for HRA. 	<ul style="list-style-type: none"> • Level of effort required to get sufficient reporting power to meet objectives is still to be determined and potentially high cost.

Table A2.15: Monitoring options for marine waterbird movement [table created in 2017].

Options 1, 2, 3 & 4	
No UK-wide monitoring programme- information comes from NGO and academic research projects.	
Plus	Minus
<ul style="list-style-type: none"> • Information gathered could contribute to establishment of accurate flyway boundaries (geographical limits) for marine waterbird populations, which underpins the use of population estimates by agreements and conventions such as AEWA and Ramsar. 	<ul style="list-style-type: none"> • Data collection is limited to one-off research projects that are often geographically limited and their data potentially difficult to access. • Tracking data is expensive to capture and thus often suffers from small sample sizes/low power and potentially biased sampling of certain individuals. • High cost of tracking means sample sizes are often small, so considerable funding may be required to get good precision.
Option 5	
Flyway level collaborative tracking project, with Priority species TBC.	
Plus	Minus
<ul style="list-style-type: none"> •Contributes to establishment of accurate flyway boundaries (geographical limits) for marine waterbird populations, which underpins the use of population estimates by agreements and conventions such as AEWA and Ramsar. 	<ul style="list-style-type: none"> • High cost of tracking has meant that historically sample sizes have had to be relatively small, so considerable funding may be required to get good precision.

Table A2.16: Monitoring options for marine waterbird mortality attributable to plastic ingestion, characteristics of birds affected by oiling and incidence of contamination by PiB [table created in 2017].

<p>Options 1, 2, 3, 4 & 5</p> <p>RSPB led and funded national annual and local monthly beached bird surveys.</p>
<p>Scheme not reviewed as considered sufficient in current [2017] form and assumes RSPB will make data available for governments use. PIB discharge at sea has been banned, so future incidents are likely to be rare although 'reactive' beached bird surveys may be required in response to mass mortality events should they occur.</p>

Table A2.17: Monitoring options for marine waterbird displacement [table created in 2017].

<p>Options 1, 2, 3, 4 & 5</p> <p>Case-specific post-consent monitoring in relation to marine renewable developments.</p>
<p>Currently [2017] subject to R&D and the responsibility of SNCBs, regulators and developers, so options to monitor this parameter are not considered here.</p>

Box 7: A summary of what is included within each option for monitoring marine bird abundance and distribution within the current [2017] UK SPA network i.e. breeding seabird colony SPAs and their marine extensions; and marine SPAs for wintering waterbirds.

Option 1:

- Coordinated monitoring of SPAs at UK scale.

Option 2:

- Frequency decided at country level. *[Marine SPA suite^d (in April 2015) comprised 32 colony extensions and 4 sites for non-breeding aggregations of marine waterbirds. Monitoring of these continues under Common Standards Monitoring framework but differences between the four countries of the UK in the levels of monitoring implemented during each CSM round exist].*

Option 3:

- UK co-ordinated rolling programme with relevant sites counted every 12 years using standard methods, supplemented between surveys, for breeding seabird SPAs, with extrapolated trend information based on SMP annual trends.

Option 4:

- UK co-ordinated rolling programme with relevant sites counted every 12 years using standard methods, supplemented between surveys, for breeding seabird SPAs, with extrapolated trend information based on SMP annual trends.
- Highest risk sites/species surveyed every 6 years, with sample of sites prioritised for monitoring changing over time, in accordance with changing occurrence of pressures.

Option 5:

- All relevant sites counted every 6 years.

Table A2.18: Monitoring options 1 and 2 for marine bird abundance and distribution within the current [2017] UK SPA network i.e. breeding seabird colony SPAs and their marine extensions; and marine SPAs for wintering waterbirds. ^{a, b, c} [table created in 2017].

Option 1	
Plus	Minus
<ul style="list-style-type: none"> • Ensures individual species/ features in common are monitored during same period, and ideally with other wider-UK marine bird monitoring, thus contributing to and allowing better understanding of population level trends & drivers. • Potential to provide efficiency saving/ economies of scale. • Facilitates timely and better-informed decisions on whether management measures are required. • Provides higher quality baseline data to inform HRA process. 	<ul style="list-style-type: none"> • All sites monitored at same time and frequency, regardless of risks they face in relation to pressures. • Ability to detect trends and ensure pressures are mitigated in a timely manner would depend on monitoring frequency adopted.
Option 2	
Plus	Minus
<ul style="list-style-type: none"> • Monitoring periods can be tailored by SNCBs to suit individual sites and budgets, with SPA features deemed at highest risk being monitored more regularly, thus allowing budgets to be used more effectively to meet conservation needs. 	<ul style="list-style-type: none"> • The lack of a co-ordinated approach reduces the potential power SPA monitoring data must contribute to population level assessments and for identifying trends & their drivers. • Probably more expensive than a coordinated approach. • Current [2017] CSM guidance needs reviewing to ensure it is appropriate for entirely marine SPAs and conservation objectives/ management plans for new SPAs may differ from existing ones. • Discrepancy between countries with regards to quality of Birds Directive reporting.

Table A2.19: Monitoring options 3,4 and 5 for marine bird abundance and distribution within the current [2017] UK SPA network i.e. breeding seabird colony SPAs and their marine extensions; and marine SPAs for wintering waterbirds. ^{a, b, c} [table created in 2017].

Option 3	
Plus	Minus
<ul style="list-style-type: none"> • Ensures all sites are monitored on a regular basis. • Allows efficiency saving through coordinated monitoring approach 	<ul style="list-style-type: none"> • Frequency of marine SPA monitoring may not be sufficient to provide timely assessments of their condition, particularly for those sites/ species which are most vulnerable. • Does not meet the frequency requirements of Common Standards Monitoring. • Treats all sites as equally important, regardless of their risk in relation to pressures.
Option 4	
Plus	Minus
<ul style="list-style-type: none"> • Facilitates timely and better-informed decisions on whether management measures are required/ appropriate. • Provides higher quality baseline data to inform HRA process. 	<ul style="list-style-type: none"> • Frequency of marine SPA monitoring for 'lower priority' species/ sites does not meet survey frequency requirements under Common Standards Monitoring guidance.
Option 5	
Plus	Minus
<ul style="list-style-type: none"> • Population abundance conservation objectives would be met every reporting period. • Co-ordination of surveys at UK level would reduce costs and improve understanding of population level context. • This would mean management decision at sites could be based on sound evidence. 	<ul style="list-style-type: none"> • Treats all sites as equally important, regardless of the risks they face in relation to pressures