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PERSPECTIVE

Co-developing guidance for conservation: An example for seabirds in the North-East Atlantic in the face of climate change impacts

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Abstract

Conservation guidance—an authoritative source of information and recommendations explicitly supporting decision-making and action regarding nature conservation—represents an important tool to communicate evidence-based advice to conservation actors. Given the rapidly increasing pressure that climate change poses to biodiversity, producing accessible, well-informed guidance on how to best manage the impacts and risks of changing climatic conditions is particularly urgent. Guidance documents should ideally be produced with multistage input from stakeholders who are likely to use and implement such advice; however, this step can be complicated and costly, and remains largely unformalized. Moreover, there is currently little direct evidence synthesized for actions that specifically target climate change and guidance remains largely absent. Here, we introduce a process for co-developing guidance for species conservation in the face of climate change, using seabirds in the North-East Atlantic as a case study. Specifically, we collated evidence on

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climate change vulnerability and possible conservation actions using literature synthesis, stakeholder surveys, and ecological modeling. This evidence base was then discussed, refined, and expanded using structured stakeholder workshops. We summarize the knowledge gained through stakeholder engagement and provide recommendations for future international efforts to co-produce conservation guidance for managing wildlife, in the context of a rapidly changing climate.

KEYWORDS

climate change vulnerability assessment, evidence-based conservation, knowledge co-creation, knowledge translation

1 | INTRODUCTION

Conservationists continually make decisions: prioritizing which species and populations to conserve; deciding whether and how to intervene to mitigate specific threats; planning and monitoring outcomes of conservation projects; or deciding on the scope and content of conservation policy. Conservation decisions can have long-lasting effects on ecosystems, and while many are relatively straightforward, others are extremely complex and require careful weighing of options and evidence. Such decisions should be based on robust evidence, composed of established theory, published data and studies, and sources of Indigenous and local knowledge (Kadykalo et al., 2021; Salafsky et al., 2019; Sutherland et al., 2004). Barriers to the use of evidence in conservation decision-making include the large and ever-increasing volume of scientific information, the inaccessibility of unpublished basic data and published primary studies (e.g., due to paywalls and other institutional barriers; Gossa et al., 2015; Sutherland et al., 2019), difficulties in interpreting primary studies and syntheses, limited time or funding to synthesize evidence, and the failure of available evidence to address questions of importance for end users and decision-makers (Walsh et al., 2019). Guidance documents can help address several of these barriers by summarizing relevant information and evidence from a variety of sources and in a structured, transparent way.

Guidance documents vary in terms of scope and structure but can be defined as "an authoritative source of information and recommendations with the objective of informing... decisions and actions" (Downey et al., 2022). Concise, accessible and robust guidance can increase the use of empirical evidence in decision-making, and guidance documents can, and should, be a key part of the conservation decision-making landscape (Turner et al., 2019; Walsh et al., 2019). Guidance can also provide a critical overview of the available evidence and knowledge gaps, sometimes highlighting context-specific implementation issues and uncertainties (Downey et al., 2022). The level of detail, context, and scale of guidance can be very flexible and depends greatly on its intended use. For example, guidance can be a short list of things to consider when carrying out a specific conservation action (e.g., installing bat boxes; Bat Conservation Trust, 2022) or can provide detailed background information to support emerging recommendations at a landscape level (e.g., for peatland restoration; Quinty & Rochefort, 2003).

There is growing recognition of the importance of including a range of stakeholders (e.g., conservation practitioners, researchers, and policymakers) in biodiversity conservation and other environmental management projects, although evidence of the efficacy of this remains relatively rare (Sterling et al., 2017). Guidance can provide an important platform for engaging stakeholders, facilitating information sharing and consolidation of evidence from different perspectives, all within an agreed area of interest. Different stakeholders value guidance documents for different reasons: practitioners may value guidance as a recognized resource for addressing key threats, and evaluating potential conservation actions or monitoring techniques; researchers may use guidance to identify knowledge gaps that are backed by practitioners and policymakers as priorities for study; policymakers may refer to guidance to identify which species need more protection, where new protected areas should be set, or harmful practices that could be changed.

In turn, stakeholder engagement can be very beneficial to guidance production. For example, it can broaden the considered evidence base, ensure guidance is up-to-date and relevant to the local socio-ecological context, broaden communication of findings, and increase trust in and likelihood of uptake of recommendations (Sterling et al., 2017; Young et al., 2013). The transparent incorporation of various sources of evidence outside of published,

peer-reviewed information (e.g., reports, expert opinion, or unpublished data) is particularly relevant for topics where the published evidence is weak or inconclusive, or for discussing the context and challenges of practical implementation that are not typically included in peer-reviewed literature. In addition, broad stakeholder participation that covers the spatial scope of the guidance can substantially improve the quality of the evidence by better reflecting local differences in species ecology and implementation context, as well as facilitating access to non-English literature sources. In practice, however, co-production of guidance with stakeholders is rare due to time or financial constraints, or uncertainty about who should fund and lead such efforts (Karcher et al., 2022; Tseng et al., 2022), despite a number of published studies providing recommended practice and methodology (e.g., see Beier et al., 2017; Cook et al., 2013; Djenontin & Meadow, 2018). As a result, there is little information about the specific challenges of co-producing conservation guidance with stakeholders and how to best deliver this process.

There is substantial work on participation, knowledge exchange, and co-developing guidance in fields such as environmental and sustainability research (Bremer et al., 2019; Vincent et al., 2018; Visman et al., 2022; Wyborn et al., 2019) and health services (Hawkins et al., 2017; Hickey et al., 2018), and this provides an important basis and potential frameworks for co-production of guidance in other contexts such as conservation. Prior to engaging stakeholders, there is a need to plan the type, frequency, and intensity of engagement, which is likely to vary between projects. "Co-production," defined here as "the process of producing usable, or actionable, science through collaboration between scientists and those who use science to make policy and management decisions" (Meadow et al., 2015), emphasizes multiple modes of engagement and types of knowledge exchange—especially meaningful knowledge exchange between stakeholders and researchers (Reed et al., 2014; Rowe & Frewer, 2016; Vincent et al., 2018). In addition, input and engagement should be integral at multiple stages of a project, including when defining objectives, designing the structure and outputs, and generating evidence and content.

In this paper, we describe the approach we used to co-produce guidance for seabird conservation in the North-East Atlantic in the face of climate change, which follows the principles of a Participatory Integrated Assessment (Meadow et al., 2015). Climate change is an interesting focus when it comes to conservation guidance production for several reasons. First, it is a pressure that acts at the global scale but is associated with wide variation in the type and intensity of outcomes at the local level (Arnell et al., 2019). Second, most anthropogenic climate change impacts have not yet happened (IPCC, 2022), leading to difficulties in accurately quantifying possible local impacts on species and the associated timescales, especially considering the potential role of inter-annual variability and extreme climatic events. Similarly, there is little existing published work on the use of conservation actions to reduce direct impacts of climate change or severe weather: for example, 173 studies specifically address this in the Conservation Evidence database, compared to 1972 relating to agriculture (Sutherland et al., 2021). Stakeholder engagement is particularly important to capture the latest impacts of, and responses to, a developing threat like climate change. Third, climate change interacts with other drivers and pressures in complex ways (Schulte to Bühne et al., 2021), and many climate change impacts are indirect (Gissi et al., 2021; Mitchell et al., 2020). Seabirds were chosen as they are a highly threatened and relatively well-studied group of organisms suffering substantial impacts from climate change (Dias et al., 2019), but for which there is limited existing conservation guidance linked to climate change. In addition, as seabirds are wide-ranging and, in many cases, migratory, conservation planning should ideally be international in nature, allowing us to explore the challenges and opportunities of engaging international stakeholders. By detailing the approach we undertook, this work aims to (i) provide a rare example of the methods and processes that can be used to develop evidence-based, regional-scale guidance for conservation in the specific context of climate change and (ii) articulate how such guidance ultimately benefitted from stakeholder involvement. Using the experience gained in this work we provide suggestions that can be applied to other taxa, regions, and conservation challenges.

2 | METHODS

2.1 | Scope of guidance and overview of structure

The guidance described herein aimed to (a) assess the vulnerability of seabirds in the North-East Atlantic to climate change, and (b) use this vulnerability assessment to identify and prioritize conservation management actions (Glick et al., 2011; Figure 1). The study area was based on the OSPAR North-East Atlantic region (OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, www.ospar.org), with the omission of the Azores and Greenland and addition of the Baltic States and western

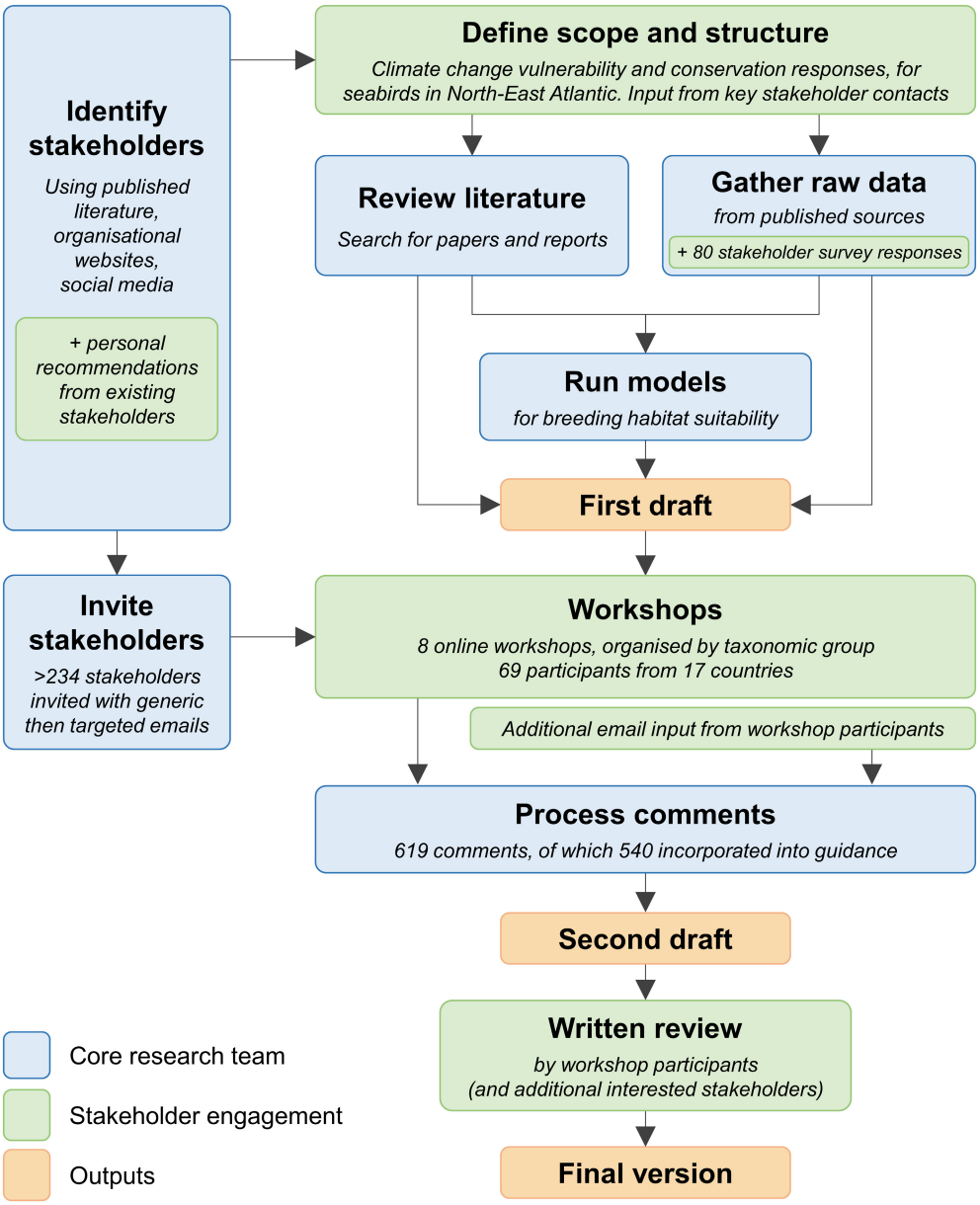

FIGURE 1 Overview of process used to create guidance.

Russia (Häkkinen et al., 2022; Figure 2). Seabird species were defined as those in which the majority of the population in the study area depends on marine habitats (e.g., for foraging) for at least part of the year. We produced guidance documents for 48 seabird species breeding within the North-East Atlantic. To keep the guidance focused, we considered only impacts resulting from abiotic pressures (e.g., increased temperature and sea level rise) and biotic pressures (e.g., changes in prey availability or predator behavior) linked to climate change (Foden et al., 2019). We excluded impacts linked to human responses to climate change (e.g., redistribution of fishing effort and construction of wind farms). We considered primarily local-scale, practical actions that may be used specifically to alleviate climate change impacts at the individual or population level. We acknowledge the important role of ecosystem-level conservation (e.g., creating marine conservation areas), and of global-scale mitigation of climate change impacts (e.g., carbon capture and storage, reducing fossil fuel use), but did not typically include these actions in our guidance because they are largely unavailable to our target audience of local practitioners.

Species formed the basic unit of our guidance, since a great deal of conservation works at the species level and the fact that the ecology and threats to species can vary widely within Orders or Families. Guidance for each species followed a standard structure. For further details on the methodology and content of each section see Section 2.2.1 and Supplementary File 1.

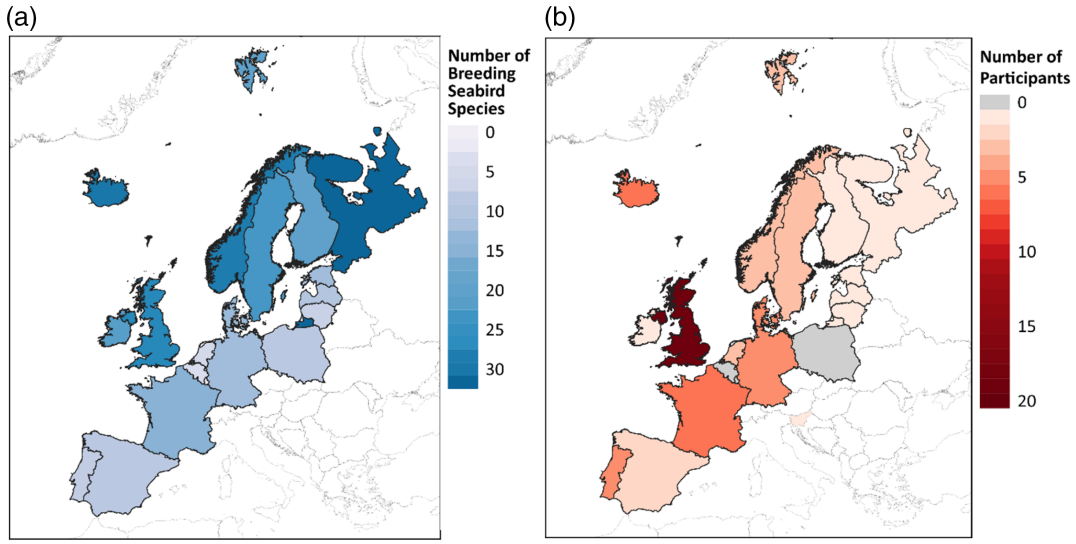

FIGURE 2 (a) Number of seabird species included in our guidance that breed in each country within the study area. (b) Number of participants across all workshops based in each country.

2.2 | Guidance workflow

2.2.1 | Initial steps and first draft

Initially (November 2020 to April 2021), a core team (HH, NP, SP, WJS, NGT) explored existing guidance on seabirds and climate change to identify gaps in the guidance landscape. Through searches of academic literature and websites of key conservation organizations, and talking to practitioner contacts, we discovered that there were very few seabird conservation guidance documents that mentioned climate change in any way, and where they did, the emphasis was minimal. We then broadened our scope to find seabird guidance on any subject to review the structure, format, and underlying framework and used this information to guide our own work. We reached out to several stakeholders to discuss guidance creation, specifically targeting practitioners who had reviewed threats to seabirds previously and had experience with conservation planning.

Meanwhile, the core team decided upon the taxonomic and spatial scope of work. We consulted with key stakeholder contacts to carefully define "seabirds" and "North-East Atlantic," in a manner that would be (a) relevant and comprehensible to practitioners and (b) ecologically meaningful.

At this stage, the core team also trialed several possible structures and methodologies for each section of the guidance. After deciding on an initial structure, we made a draft guidance document for one species, the Atlantic puffin *Fratercula arctica*, and shared the structure and underlying methods with close stakeholder contacts as well as specialists in puffin conservation (10 stakeholders in total). Feedback resulted in several major changes to the structure and content of the guidance, in particular the addition of the key prey species loss assessment. The broad methods and structure were decided at this point, though further refinements were made throughout (see Table S1 for more detail).

At the same time, the core team built a list of stakeholder contacts by eliciting suggestions from known contacts, searching through published studies and reports, searching the websites of international, national, and local organizations (with the help of online translation tools where necessary), and exploring social networks (e.g., followers on Twitter and ResearchGate). This resulted in an initial list of 195 stakeholders involved in seabird research, practice, and policy from across Europe. This list was updated throughout the project as new contacts were identified or suggested, and by the end of the workshops (see below) was expanded to 240 individuals.

The core team subsequently (April 2021 to January 2022) produced a first draft of the guidance for each seabird species based on published data, primary studies, and synopses of evidence (Williams et al., 2013, 2021), with an update focused on seabirds specifically for this project, and species distribution modeling (Häkkinen et al., 2021). Additional impacts and actions were incorporated using suggestions from a multi-lingual survey sent out to 195 stakeholders across 16 of the 18 countries within the study area (Häkkinen et al., 2022). This survey also served to open communication with our identified contacts, and invited participants to become involved with our future work. These first drafts provided the basis for discussion and feedback in stakeholder workshops. Figure 3 summarizes the guidance for one species. For

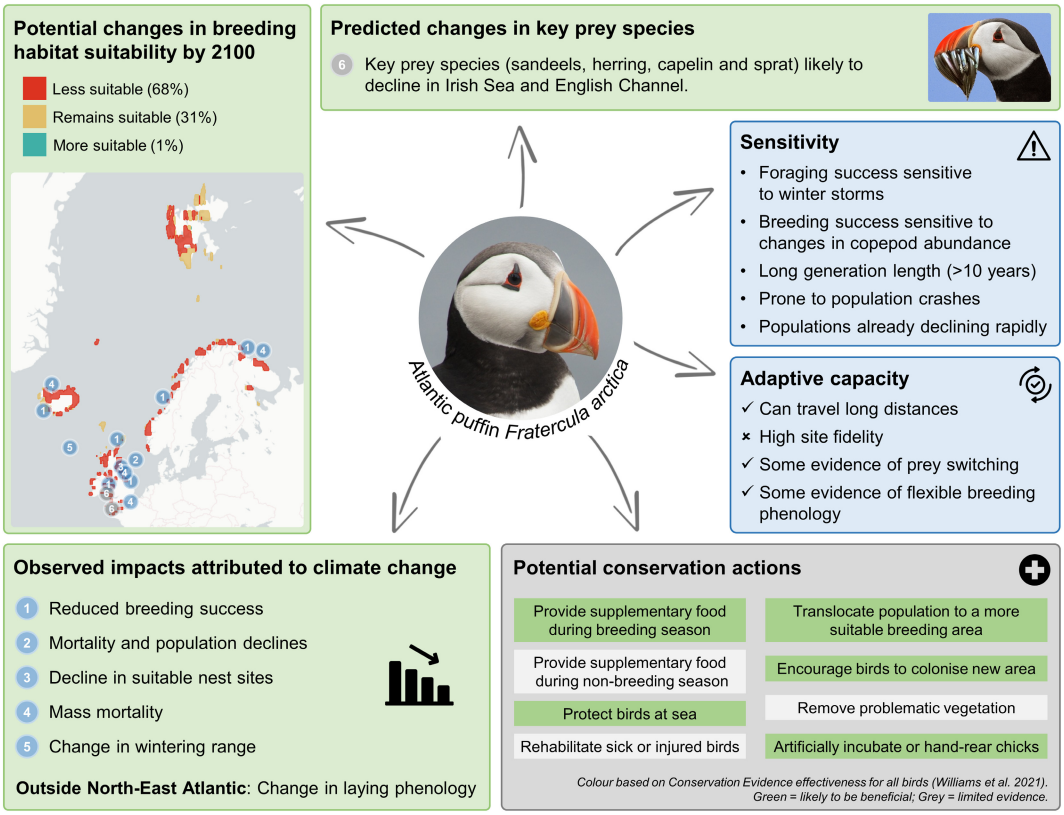

FIGURE 3 Visual overview of guidance for one species, the Atlantic puffin *Fratercula arctica*. For further detail, including methods and references, see the full guidance (Häkkinen et al., 2023). Photo credits: Steve Garvie, Nadine Koller. Icon credits: Cuputo, Adrien Coquet, Andrejs Kirma (Noun Project).

further information on methods and structure of the overall guidance, see Supplementary File 1.

2.2.2 | Stakeholder engagement workshops

Workshops were a key feature in our guidance production process. They had several aims: to verify the accuracy of the information collated, especially when it may not have been up-to-date, by drawing on the collective decades of experience of workshop participants; to obtain additional, unpublished information, including local knowledge, to fill gaps in the published literature; to engage end-users in the creation of the guidance, to ensure the end product is useful to them and to give some sense of ownership, which should increase uptake of the final guidance; and to encourage interactions and collaborations between seabird conservationists across Europe.

Participation in the workshops was intended to be broad, balanced, and inclusive. Conscious attempts were made to include participants working in a range of countries, sectors, and organizations, at different career stages. The importance of gender balance was also recognized. Although invitations focused on conservation practitioners and researchers, representation was sought across the workshops from all groups who contribute to seabird conservation, including monitoring groups and policy-makers. Attempts were also made to include participants from across the distribution range of all species in each workshop. We acknowledge that local or Indigenous groups with 'lived experience' of seabird conservation were not fully represented in the workshops. Indigenous communities are under-represented in many branches of co-production research, and we encourage others to explore these valuable potential networks further and draw on the available advice on engaging these communities, which is increasingly available for specific contexts (such as for Arctic Indigenous groups; Stith et al., 2022; Yua et al., 2022).

The core team sent an initial email invitation to 234 stakeholders based in 17 of the 18 countries within the study area (see Table 1 for a full list of target countries; it was particularly difficult to find contacts for some countries such as the Baltic States and Russia). Workshops were split into eight species groups, namely: auks; ducks and phalaropes; gannets and cormorants; grebes and divers/loons; gulls; petrels, storm-petrels, and

TABLE 1 Summary of representation across workshops. For each workshop we recorded which countries within the study area have breeding extant populations of at least one species in the relevant species groups. The number in brackets following the name of the species group indicates how many species were in that group. Country representation was defined by the presence of a workshop participant based in that country; note that this is conservative as many participants have knowledge of or experience in other countries. Participants from countries without any breeding populations for a given species group are highlighted in bold. Please note that "Denmark" includes both the mainland, surrounding islands and the Faroes; "Norway" includes the mainland, surrounding islands and Svalbard.

Species group	Percent of countries represented	Countries represented	Countries not represented
Total (48)	**89%**	**16** (*Denmark*, *Estonia*, *Finland*, *France*, *Germany*, *Iceland*, *Ireland*, *Latvia*, *Lithuania*, *Netherlands*, *Norway*, *Portugal*, *Russia*, *Spain*, *Sweden*, *United Kingdom*). **+1 country outside of study area** (*Slovenia*)	**2** (*Belgium*, *Poland*)
Auks (6)	**50%**	**7** (*Finland*, *Germany*, *Iceland*, *Norway*, *Spain*, *Sweden*, *United Kingdom*) **+1 country with no extant breeding population (Netherlands)**	**7** (*Denmark*, *Estonia*, *France*, *Ireland*, *Latvia*, *Poland*, *Russia*)
Ducks and phalaropes (10)	**73%**	**11** (*Denmark*, *Finland*, *France*, *Iceland*, *Latvia*, *Lithuania*, *Netherlands*, *Norway*, *Russia*, *Sweden*, *United Kingdom*)	**4** (*Estonia*, *Germany*, *Ireland*, *Poland*)
Gannets and cormorants (3)	**64%**	**7** (*Germany*, *Iceland*, *Ireland*, *Latvia*, *Norway*, *Portugal*, *United Kingdom*) + **1 country outside of study area** (*Slovenia*)	**4** (*Denmark*, *France*, *Russia*, *Spain*)
Grebes and divers/loons (5)	**46%**	**6** (*France*, *Germany*, *Iceland*, *Latvia*, *Sweden*, *United Kingdom*)	**7** (*Denmark*, *Estonia*, *Finland*, *Lithuania*, *Norway*, *Poland*, *Russia*)
Gulls (10)	**39%**	**7** (*Finland*, *France*, *Germany*, *Iceland*, *Netherlands*, *Portugal*, *United Kingdom*)	**11** (*Belgium*, *Denmark*, *Estonia*, *Ireland*, *Latvia*, *Lithuania*, *Norway*, *Poland*, *Russia*, *Spain*, *Sweden*)
Petrels, storm-petrels, and shearwaters (6)	**70%**	**7** (*France*, *Germany*, *Iceland*, *Norway*, *Portugal*, *Spain*, *United Kingdom*)	**3** (*Denmark*, *Ireland*, *Russia*)
Skuas (3)	**43%**	**3** (*Denmark*, *Norway*, *United Kingdom*) + **2 countries with no extant breeding population (Netherlands, Germany)**	***4*** (*Finland*, *Iceland*, *Russia*, *Sweden*)
Terns (5)	**33%**	**6** (*Denmark*, *Estonia*, *Germany*, *Netherlands*, *Portugal*, *United Kingdom*)	**12** (*Belgium*, *Finland*, *France*, *Iceland*, *Ireland*, *Latvia*, *Lithuania*, *Norway*, *Poland*, *Russia*, *Spain*, *Sweden*)

shearwaters; skuas; and terns. Many researchers and practitioners work with only one or few species, so individuals were asked to sign up for whichever workshop(s) most closely matched their expertise and interests. Workshops were limited to 10–15 participants; our previous experience suggests a larger number limits participation and makes time management very difficult. In the weeks before each workshop, targeted invitations were sent to (a) key stakeholders who had not received or responded to the original invitation and/or (b) individuals from underrepresented regions or those working on underrepresented species for specific workshops. Participants from past workshops helped to identify these contacts.

Workshops were delivered online, via Zoom (Zoom Video Communications Inc.) between October 2021 and January 2022. Each lasted approximately 3 h and began with a short description of the project and its objectives; it ended with time for general discussion and description of the next steps. For each topic, the chairs presented tables or short texts listing ideas and options for all species within the focal group. They would then ask participants to point out errors and omissions; typically participants were given several minutes to read, discuss and reach a consensus on suggestions. Responses were often followed up with specific questions, typically for clarification. We provide an

example workshop presentation in Supplementary File 2.

Participants could contribute verbally and/or through the chat function in Zoom. The workshop chairs encouraged contributions of the strongest evidence possible, for example preferring peer-reviewed papers over organizational reports, and observations with supporting data over observations without. They also encouraged personal observations and local knowledge, which can provide up-to-date and otherwise unavailable information (Ulicsni et al., 2019), though for such points they asked for at least one other participant to provide support. The final guidance specifies the source of all points of information.

To cover all topics in a timely manner, there was an approximate schedule of how long each section should last. Having three organizers helped a workshop to run smoothly. One facilitator had control over the overall workshop, including introducing topics, asking questions of participants, and time-keeping. The second facilitator monitored the chat and supervised input (selecting participants to speak, encouraging wider discussion about a controversial point, and eliciting responses from participants who had not contributed). A third person kept minutes. All three organizers contributed to discussions, but kept input to a minimum to maximize the time participants had to speak. Questions from participants were handled as quickly as possible. On occasion, discussions were paused until the end of the workshop to ensure the workshop ran to schedule.

2.3 | Second draft and further feedback

The core team collated a list of every comment made (a) during the workshops, based on a recording and transcript of each workshop, and (b) in email exchanges immediately following each workshop. A "comment" was defined as a distinct actionable suggestion or criticism. Where participants spoke at length about several topics, statements were split into several component comments. Where multiple participants made the same contribution (e.g., suggested the same paper, or agreed with each other), these were counted as separate comments. The final compiled list of comments covered every aspect of the draft guidance content, including: additional impacts not found in the initial literature search; criticisms of the inclusion of some impacts, traits, and actions; comments asking for clarification of definitions; and amendments to the species list and range maps.

Each comment was investigated and categorized as either: (a) "incorporate": a comment that clearly should be incorporated such as when a relevant study was suggested, important local context was described, or a mistake was pointed out; (b) "possibly incorporate": a comment that was either opinion-based or for which supporting information was not readily available. In this case, the core team would follow up with the workshop participant or discuss whether to action the point with our group of close stakeholder contacts. Following this round of clarification and discussion the comment would then be categorized as "incorporate" or "exclude"; or (c) "exclude": a comment that was later retracted after discussion, made in error, or fell out of the scope of our guidance. Border-line comments—such as where a point was well supported but potentially out of scope or if a piece of local knowledge was difficult to find consensus opinion on from other local sources—were clarified with additional input from the original contributor (as per option b above), or failing that, were discussed amongst the core team and categorized as "incorporate" or "exclude."

After several rounds of "incorporating," "excluding," and following up comments, the final guidance documents were synthesized with the new information gained from stakeholders, including new impacts, species traits, ecological information, conservation actions, conservation effectiveness assessments, references and supporting evidence (for examples of knowledge added see Table S1). The revised guidance documents were sent to contributing stakeholders ($N = 57$) for further review (April–May 2022). The guidance was then updated based on this second round of comments and sent back to stakeholders for final validation before publication.

2.4 | Data analysis

To summarize the target and actual coverage for each species group, we identified which sovereign states supported an established breeding or non-breeding population of the species group (BirdLife, 2022) and the location of participants in the relevant workshop. We identified which countries were not represented for specific groups and summarized this across all species groups. Using current home institutions is likely an over-simplification as many conservation practitioners and researchers work internationally, supporting conservation in countries other than where they are based. However, our process provides a broad overview of the number and proportional representation of each country.

We wished to identify how different groups of stakeholders participated, and the types of information they provided. Each participant was categorized as focused on research, practice, or policy based on their primary organizational affiliation. Any participants who did not fall

TABLE 2 Summary of outcomes from the workshops. Each contribution—a discrete suggestion, criticism, or opinion—was categorized into one or several non-exclusive categories. Here, we provide a summary of types of comments received, types of new studies brought to our attention, and types of contributions and how they impacted the overall guidance documents.

Category	Type of new information	Number
Comment summary	Total number of actionable comments	540
	Of which provided new points to be included	265
	Of which provided new evidence on existing points	257
	Of which were based on personal or unpublished data	78
	Of which were site-specific and based on first-hand experience	87
New studies	Number of new studies contributed	103
	Of which were in a language other than English	18
Types of contributions	Total number of comments that corrected or amended species range and abundance information	81
	Number of new climate change impacts contributed by workshop participants	45 (45% of all impacts)
	Number of previously identified impacts where supporting evidence was strengthened due to contributions from workshops	19 (19% of all impacts)
	Number of new conservation actions contributed by workshop participants	10 (32% of all actions)
	Number of previously identified conservation actions where supporting evidence was strengthened due to contributions from workshops	12 (39% of all actions)

into these three categories were classed as "other." We also wished to partially quantify how much and in what ways the comments from the workshops contributed to the overall guidance. One researcher (HH) manually recorded meta-data related to each comment in a separate database. Each comment was assessed against one (or several) of the following categories: (a) new information that could form a major new point in the guidance; (b) new evidence to support a point already present in the guidance; (c) information based on personal or unpublished data; (d) information specific to the participant's study area; (e) a new study not previously included in the guidance; (f) a new study in a language other than English; (g) information that changed species' range maps; (h) a new climate change impact; (i) new evidence that supported an existing impact; (j) a new conservation action not already in the guidance; (k) new evidence to support an existing conservation action. If several participants made the same point, or provided supporting studies to a previous point, the first mention was categorized as "new information" and subsequent mentions were categorized as "new evidence to support a point" (see Table S2 for the classification system used with some example data). We identified any climate change impacts or conservation actions that were added to the guidance as a direct result of comments from the workshops. This total was compared to the total number of impacts and actions as a simple metric of how much information was added to the guidance from the workshops.

3 | RESULTS

3.1 | Initial drafts and feedback

Considerable changes to the guidance structure were incorporated following initial discussions with stakeholders (Section 2.2.1), based on what stakeholders expressed was relevant, comprehensible, and achievable (see Table S1 for a list of structure changes). Eighty responses were received from the stakeholder survey in seven different languages. These identified additional climate change impacts and conservation actions. Respondents formed the basis of our communication network (see Häkkinen et al., 2022 for further details). The final overall structure and design can be seen in the current version of the guidance (Häkkinen et al., 2023).

3.2 | Workshop participation

The draft guidance for 48 species of seabirds was presented across eight workshops to 69 participants (some of whom attended more than one workshop), representing 45 different organizations from 17 countries (16 from within the study area and one additional participant from Slovenia). This included representation from several islands that host major seabird populations, in particular the Faroe Islands (classified under Denmark in Table 1) and Svalbard (classified under Norway in Table 1).

Representation was not even across countries (Figure 2). The United Kingdom had the most participants (19) across all workshops. The least represented were Belgium and Poland (0 participants); and Estonia, Ireland, Finland, Latvia, Lithuania, and Russia (1 participant each). However, it should be noted input was received even for countries that had no participants, in large part due to the international experience of many of the participants. For example, there were two participants of Polish nationality with experience of conservation in Poland, but who were based at organizations outside of Poland. Representation varied between workshops, with the "Ducks and Phalaropes" workshop achieving the highest coverage of relevant countries, and the 'Tern' workshop the lowest (Table 1).

Of the organizations represented, 24 were primarily research-orientated, 13 were practice or local management-orientated, 5 were policy/decision-making orientated, and 3 were classed as other types of organizations (hunting and consultancies).

3.3 | Feedback

A total of 619 comments were made across all workshops. Of these 540 (87%) were incorporated into the guidance (Table 2). The remainder were requests for clarifications, errors that were later rescinded, ideas and comments that were out of scope of the guidance, and general discussion around the scope of the guidance. These comments included numerous new pieces of information, some totally new and some supporting existing points of the guidance (Table 2; Table S1). Of the 103 studies that the core team had not previously identified, 18 were in languages other than English, including studies in Danish, Dutch, German, Finnish, Icelandic, Norwegian, Russian, Spanish, and Swedish. These non-English studies also cited several additional relevant studies in other languages, which were later incorporated into the guidance.

4 | DISCUSSION

Guidance can, and should, be a key part of conservation, and guidance is made more robust with the input and collaboration of stakeholders. Engaging stakeholders at critical phases of guidance development, including the design phase, the initial drafts, and several rounds of feedback, enabled open communication throughout and strongly guided the format and content of the final guidance. The inclusion of stakeholders in the development of our guidance greatly improved its depth and coverage. Numerous key climate change impacts were identified, as well as several novel conservation actions (Table 2; Table S1). The resources developed in this project are aimed at informing the work of various interested parties on a voluntary basis and without placing any restrictions or expectations on their use. However, in some sectors, demonstrating the clear use of standards and best practice protocols, including from recognized sector guidance, is an important expectation during the planning process. By sharing our methodology and experiences of co-developing guidance with stakeholders, we provide a basis for future endeavors to start, develop, critique and ultimately improve their process for generating guidance. To our knowledge, this study represents the first time such a record of conservation guidance co-development has been published. We here summarize the major lessons learned, including practices that worked particularly well and the main challenges we faced.

4.1 | What went well?

Running stakeholder workshops required substantial effort and preparation time to identify, contact and ensure the participation of relevant stakeholders that covers a broad international context. While there were potential benefits from hosting the seabird project at well-known conservation institutions (Zoological Society of London and the University of Cambridge), this engagement process might be more difficult in other contexts, especially as practitioners were asked to donate their time to the workshops and reviewing the guidance products. However, the workshops produced several important and immediate benefits. First, they allowed us to glean up-to-date information, including unpublished observations or information published in internal reports from participants' host institutions or countries (Table 2). The workshops tapped into local knowledge, both from participants directly and via their professional networks, and identified resources in multiple languages that would have been very difficult and time-consuming to identify otherwise, if at all (Table 2). Second, the workshop organizers could adjust the framing of questions to extract the desired information, and could clarify responses immediately. Third, the workshops allowed real-time interactions between participants whereby they could build on or disagree with each other's contributions. These last two points would have been more difficult, or impossible, using other methods of stakeholder involvement such as written surveys. We believe the time taken to hold these workshops justified the substantial improvements they generated in the guidance.

A multi-lingual core team facilitated communication in multiple languages. Additional informal networks

with other multi-lingual colleagues were also invaluable, especially for checking and confirming specialist ecological terms. Projects without access to these linguistic resources could face significant translation costs to ensure transferability across organizations and countries, which could create a barrier to broad stakeholder involvement. However, we believe providing avenues to communicate effectively with non-English speakers, such as emails and surveys with information available in multiple languages, has significant benefits. Communities that would otherwise be missed can become actively involved in guidance creation, and help to identify the substantial body of evidence relevant to biodiversity conservation that exists in languages other than English (Amano et al., 2021).

Holding the workshops remotely and online, in our case via Zoom, was largely driven by the movement restrictions and uncertainty surrounding the COVID-19 pandemic. However, this format also removed financial and logistical barriers to participation from different countries and organizations. Moreover, data verification was substantially simplified via the use of individual recordings in conjunction with the live transcript function. However, we recognize that online workshops may have also reduced the opportunity for critical back-and-forth discussions, both in the formal and structured nature of the workshop (e.g., participants always had to signal their intention to speak) and due to the absence of breaks where participants could discuss informally.

Attempts were made to maximize engagement and remove barriers to contribution, especially given that participants came from a wide variety of backgrounds and countries. Participants were encouraged to contribute in whatever way they felt most comfortable. Participants raised a hand when they wished to speak, preventing confusion with too many overlapping voices and reducing the chance of someone speaking over other, quieter participants. Participants could also choose to communicate in writing via the chat function: in English, making use of autocorrect or translation software, or in their preferred language. The chat function was also a useful channel to capture direct links to evidence sources. Participants were also told they could submit comments after each workshop, if they wished to consider the evidence further before offering input. The organizers did not typically call on participants specifically, except if a participant had known expertise in a topic and had not offered any input.

Throughout the process, the core team aimed to communicate the goals of both the overall project and specific activities as clearly as possible. They explained that the discussions and workshops were part of a process of multistage stakeholder engagement, and that active participants could contribute as authors of the guidance and associated publications. This established a transparent basis of collaboration and personal investment early on, which may have increased engagement. The positive and active feedback received was extremely encouraging, and resulted in greater communication with stakeholders than was initially anticipated (Figures 1 and 2).

Summarizing complex data in tables or figures stimulated more engagement than presenting text, even when summarized in bullet points. For example, cross-tabulations of traits and species for sensitivity and adaptive capacity were presented; traits were listed in the left-hand column and species were listed along the upper-most row. Symbols, or minimal notes, were added to each cell in the table (see Supplementary File 2 for examples). This was more easily digestible than text and stimulated comparisons across species in novel ways. For example, the initial literature review identified three ground-nesting sea duck species that were sensitive to flash flooding (harlequin duck *Histrionicus histrionicus*, red-breasted merganser *Mergus serrator*, and common eider *Somateria mollissima*). Participants could work across the row for this trait and suggested three other ground-nesting, flooding-sensitive species (long-tailed duck *Clangula hyemalis*, common scoter *Melanitta nigra* and velvet scoter *Melanitta fusca*). Additionally, the table allowed participants with expertise in a particular species to consider only the column for that species. While our specific format may not be appropriate for all guidance production, some general principles will still certainly apply. In particular, the order and manner in which information is presented is critical to maximizing useful feedback. With not enough information, or with unclear goals, time is wasted and side-tracking is more likely. However, too much information can be overwhelming and can reduce a workshop to a reading exercise. Several major adjustments were made to the structure after the first workshop, nearly all of which were to reduce irrelevant information presented, and to make it much clearer what exact information was sought from participants.

4.2 | What could be improved?

While we had broad international representation of stakeholders, it was challenging to achieve balanced representation across stakeholder groups and countries, despite conscious attempts to achieve this (Figure 2). Bias towards researchers in the United Kingdom probably reflects a combination of our personal networks (the core team were all based in the United Kingdom), the workshop invitations and workshops themselves being in English (which may have discouraged participants from

countries where English is not widely spoken), and the strength of seabird research (EMODnet, 2019; Mott & Clarke, 2018) and conservation practice in the United Kingdom. High participation from the United Kingdom also reflects a genuine local concentration of seabirds: 29 of our 48 focal seabird species either breed or winter in the United Kingdom, often with large populations, behind only Iceland and Norway which host 31 and 30 species respectively. It should also be noted that many participants based in the United Kingdom carry out work internationally in Europe and beyond, something that is not captured in our data. While pre-workshop surveys were multilingual (Häkkinen et al., 2022), more personalized workshop invitations in other languages might have attracted more non-UK participants and are something that should be considered in future projects. While participants were informally asked for additional suggestions to contact, a more formalized process may have increased representation and made more effective use of others' networks and experience. In addition, despite the advantages discussed above, purely online workshops may have hindered our capacity to engage stakeholders. In-person conferences, such as in our case the European Seabird Conference, are an excellent method of finding collaborators, and in the future building networks using both digital and in-person methods should be considered.

There was also some participation bias in terms of the organizations involved. Over half of the organizations that participated were primarily research-based, though many did relevant work in practice and policy. There are likely several causes behind this, firstly that the core team work as researchers at research-based institutes, meaning the initial search and selection of participants was partly biased towards research organizations. Although a research-focussed core group was acceptable in our case, this is not necessarily universally true and future co-production projects should consider how a more diverse core team could enhance project planning and outputs. A conscious effort was therefore made to target practice- and policy-focused organizations, our pre-existing network of research contacts heavily contributed to the final participant list. In addition, there are costs associated with attending workshops, in terms of time and energy. The workshops lasted 2–3 h, and for small organizations or busy project teams this is a significant investment of resources to help with a project that may not be directly related to their own work. Several workshop participants stated that they would like to contribute further but simply lacked the time or resources to attend more than one workshop. In the future, it may not be possible to eliminate all or even most associated costs, but the cost to organizations and individuals to attend and contribute to collaborative projects should be considered and mitigated where possible. Cognizant of the limited time and resources that many participants could contribute to this project, the decision was made to limit multi-way interactions to the initial eight workshops. After these, rounds of feedback were carried out using email correspondence between the core team and stakeholders. This has the significant drawback of limiting interactions between groups of stakeholders, and potentially engagement overall. It should be noted that in many cases this may not be appropriate, or best-practice, as co-production should ideally maximize opportunities for stakeholders to engage and communicate in multiple formats. Additional follow-on workshops or events to engage stakeholders could be considered for similar projects going forward and weighed against the time and resources available to stakeholders.

The costs to organizers should be considered as well. The core team dedicated time to planning, organizing, and running workshops, with effort broadly conforming to initial forecasts. However, the time involved afterward in evaluating over 500 comments and suggestions, accessing and reading over 20 papers in various languages, and revising the guidance documents was a significant undertaking, and exceeded our initial estimates. The post-processing time should be planned carefully in advance, to ensure information from workshops and collaborators is meaningfully incorporated. In total, we estimate that the process of stakeholder engagement added around 5–6 working person-months to guidance production, including preparation of workshops beforehand, running the workshops themselves, and processing of input afterward. Time-saving tools that we found useful included: using a single online form (e.g., Google Forms) to manage workshop sign-ups; using automatic transcription software (e.g., within a paid-for Zoom account) to process workshop recordings; and, as mentioned above, using video-conferencing software to run workshops rather than having to organize in-person meetings.

Climate change is a difficult, complex, and developing threat to many species given the variability of potential outcomes based on reductions (or not) of greenhouse gas emissions, the fact that most impacts have not yet happened (IPCC, 2022), and the spatial variability of such impacts (Arnell et al., 2019). This spatial variability makes the limited information on climate change impacts for most species concerning and perhaps limits the utility of this aspect of the guidance for people working in geographic knowledge gaps. We found it challenging to define the scope of several areas of the guidance in relation to climate change. For example, it was challenging to identify actions that can be used to address climate change impacts (Table S2): most conservation actions can

be used to aid populations and increase their ability to cope with climate change by increasing adaptive capacity or reducing sensitivity, but we wanted to focus on actions that can be used specifically to address impacts related to abiotic or biotic climate change pressures. However, many additional impacts can be more indirectly related to climate change, for example via human responses to climate change. As a result, participants often discussed major threats and interventions that are important to seabird populations, but were only peripherally connected to climate change and so were typically not included in the final guidance (Table 2). More specific and comprehensive definitions may have helped participants stay within the scope of the project and ultimately saved valuable discussion time for more relevant topics. Further, many actions that address climate change impacts are broad in spatial and temporal scales. We focussed specifically on local population impacts and actions that can be carried out by conservation stakeholders at a reasonably local scale, which was occasionally at odds with the scale of the issues faced. This choice was intentional, as our conservation guidance was intended to assist decision-makers at a local level, but leaves a prominent gap for threats that require broad national or regional action to combat effectively. Existing methods of building species or biodiversity action plans could therefore be combined with conservation guidance to build a more cohesive overview.

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DATA AVAILABILITY STATEMENT

The final outputs of the co-production process, including all seabird species climate change vulnerability assessments and conservation assessments, are available at https://doi.org/10.11647/OBP.0343 or from the corresponding author. These resources also contain additional methodology and data of the guidance production process.

Data regarding organisation and structure of the co-production process are provided in the supplementary material, including additional guidance production methods, an example workshop presentation, and a summary of contributions by stakeholders.

Data regarding participants and specific contributions are withheld for privacy reasons, but additional data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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