Seabirds in the North-East Atlantic

Climate Change Vulnerability and Potential Conservation Actions

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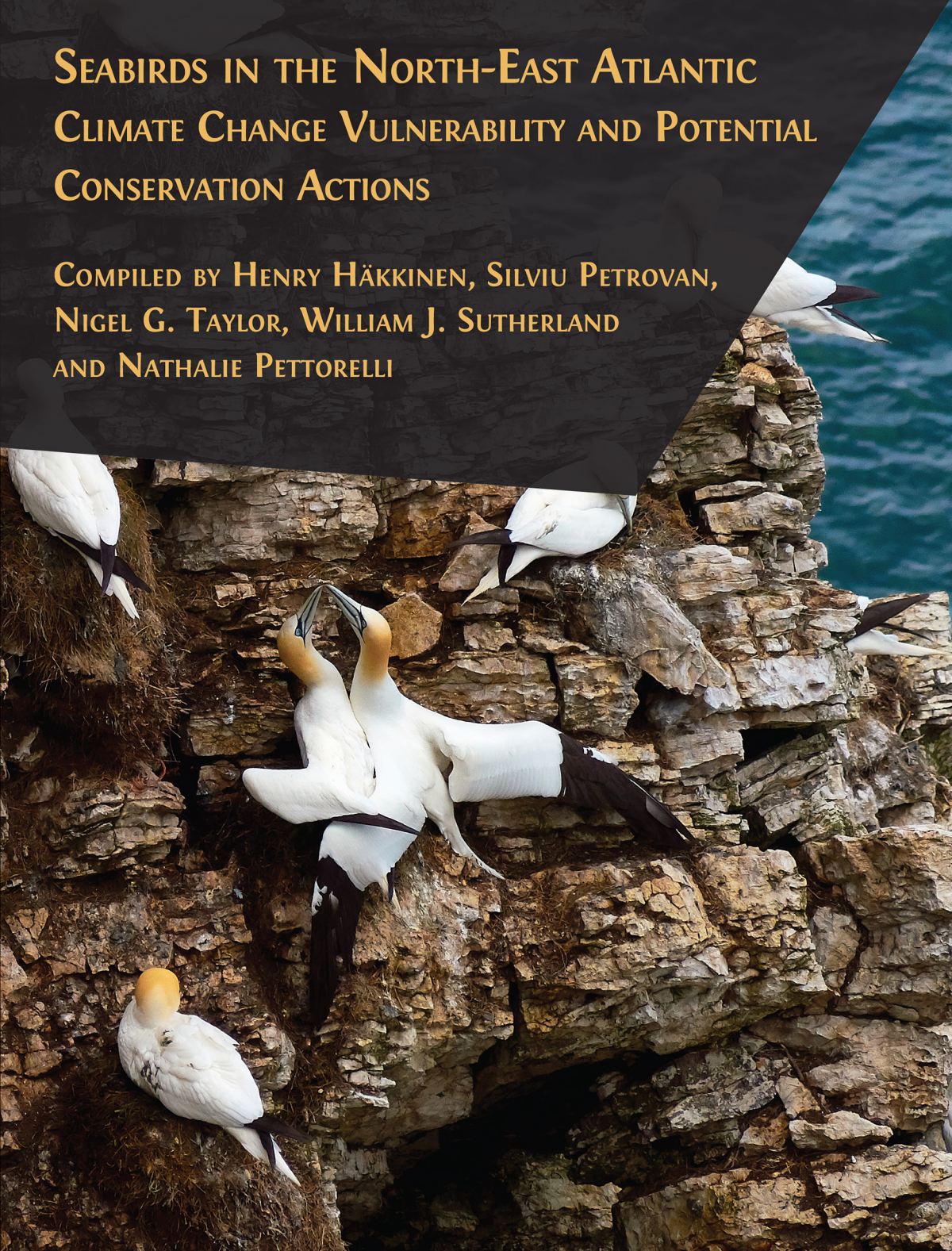

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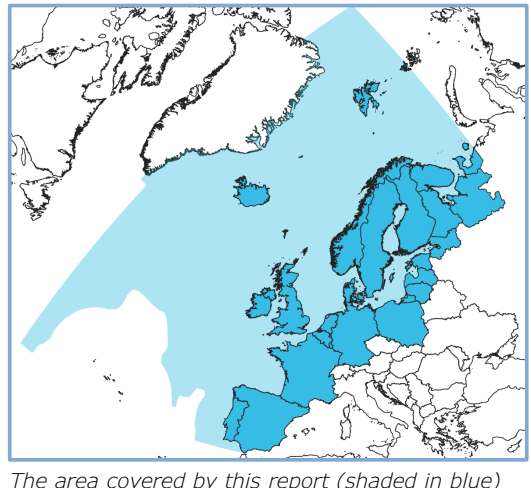
Introduction

0.1 What is this book?

This resource is part of a series produced by the Zoological Society of London and the University of Cambridge, which aims to (1) assess seabirds' vulnerability to climate change in the North-East Atlantic, and (2) identify potential conservation actions that could reduce this vulnerability. This guidance collates information from the scientific literature, non-governmental organisations' reports, conservation practitioner input and online databases into a single resource, and provides a reference manual to assist conservation planning. It is intended to be used by anyone who wishes to identify climate change threats to seabirds; to compare threats between different areas of the North-East Atlantic; to start a quantitative climate change vulnerability assessment for a local population; or to review options for conservation action in response to climate change.

This book synthesises available information for seabirds in the North-East Atlantic. The North-East Atlantic covers the OSPAR region of Europe, from the Barents Sea and Svalbard in the North, to the coast of Portugal in the South. We also included species and populations breeding in and around the Baltic Sea; this adjustment was made in response to known distributions of significant fish stocks, as well as information on areas known to be important breeding and/or wintering grounds for species otherwise common in Western Europe. We did not assess species or populations in the Mediterranean, around Greenland, around the Azores or around the Canaries.



The area covered by this report (shaded in blue) based on the OSPAR region of the North Atlantic.

As part of planning and developing this series of resources, we consulted and collaborated with a variety of conservation stakeholders and practitioners from across Europe, and have added their

knowledge and experience to complement the available published information. This includes currently unpublished impacts and first-hand experience on the practicality and effectiveness of conservation actions. We would like to thank everyone who contributed to the development of this work. This document is part of version 1.2, published in June 2023, but assessments may be updated based on feedback and newly available information. To check for updates to our assessments, please visit our website at: www.ZSL.org/seabird-guidelines and at https://doi.org/10.11647/OBP.0343.

0.2 What this book contains

This book contains two major sections. The first assesses how vulnerable seabirds in the North-East Atlantic are to climate change, and the second assesses the conservation actions available for each identified climate change related threat. We carried out an assessment for all seabird species that have a permanent breeding population in the North-East Atlantic.

A "seabird" is not a distinct taxonomic group, but is defined by any species of bird that predominantly relies on marine habitat for at least part of its annual cycle. We identified 48 species, loosely grouped as auks, cormorants, gannets, grebes, gulls, loons/divers, sea ducks, skuas and terns. There are several additional species that are marginally marine, or have at least a few populations that are marine, but in most cases we excluded such species as they are predominantly associated with terrestrial, freshwater or estuarine habitats. We use the English common names used as standard by Birdlife, though other synonyms may be more familiar to some readers. In particular, we use "loons" rather than "divers" and refer to "murres" rather than "guillemots". For further details please see the Birdlife Taxonomic Checklist (http://datazone.birdlife.org/species/taxonomy).

The following is a summary of each section of the guidance. For further information on how we compiled each section, please see our corresponding appendices that contain full references and information on sources used. For a full methodology, see the accompanying 'Methodology' folder in Appendix 2.

Section 1: Vulnerability to climate change. Section one reviews the vulnerability of each auk species to climate change, using the framework laid out by Foden et al., 2017. It subdivides vulnerability into three main categories:

- **Section 1.1: Exposure.** Exposure is a description of the nature, magnitude and rate of changes induced by climate change. We assessed exposure in four ways:
    - **Section 1.1.1: Current impacts on seabirds attributed to climate change.**

This is a numbered list of the impacts of climate change on each species that has so far been observed in the North-East Atlantic. An impact is defined as a change in breeding success, abundance, survival, condition, behaviour or genetics that can be at least partially attributed to climate change. This includes: a) long-term trends in populations where climate change is believed to be a contributing driver, b) impacts of extreme climate events where the frequency/severity/duration of such events is known to be linked to climate change, c) an observed significant increase in exposure to a known threat (e.g. predators, parasites) where climate change is believed to be a contributing factor. Impacts may be: positive, where climate change has resulted in a positive change to a demographic parameter (e.g. breeding success or abundance), negative, where climate change has resulted in a negative change to a demographic parameter (e.g. breeding success or abundance), or neutral, where climate change has clearly had an effect on a population but it is unclear whether the effect is positive or negative (e.g. change in phenology with no recorded change in breeding success or abundance etc.). The location of these impacts is marked on the accompanying map by numbered icons. For a full list of sources see Appendix 1.1.1.

◦ **Section 1.1.2 Potential changes in breeding habitat suitability.** We here aim to predict how much of the species' current breeding range will be significantly less suitable in 2070-2100, based upon changes to the marine and terrestrial environment. We also estimate what proportion is likely to remain suitable, and whether parts of species' current ranges will become more suitable. The underlying species distribution model (SDM) considers predicted changes in temperature, precipitation, salinity, distance from the sea and marine chlorophyll concentration, as well as several species-specific variables which are detailed in the appendices. After comparing estimated habitat suitability between 2020 and 2070-2100, we split the coastal region of North-West Europe into one of the four following categories: 1) Habitat is currently suitable for a given species but will likely become significantly less so in the future (marked in red on the map), 2) Habitat is currently suitable and will likely remain stable in the future (marked orange on the map), 3) Habitat is currently suitable but will become significantly more so in the future (marked green on the map) and 4) Habitat is not currently suitable and will not be in the future (not marked on the map). There is considerable uncertainty around these estimates, and as such they should be understood as an indicator of risk rather than a firm prediction. Note that maps are aggregated and enlarged to make small islands more visible and are not exact representations of species ranges.

◦ **Section 1.1.3: Predicted changes in key prey species.** For each species we compiled a list of key marine prey species, as well as existing estimates of

how their range and abundance may change between now and 2100. We identified areas where one or more key prey species are likely to become significantly less common in the future and highlight these as areas of high risk.

- **Section 1.1.4: Climate change impacts outside of Europe.** In some cases climate change is known to impact populations outside of our study area. These data provide supporting evidence for impacts in Europe, highlighting impacts that may be of concern to populations in the future, even if those impacts have not so far been observed in the North-East Atlantic. In selected cases, we summarise the nature of the impacts and the general area in which they occur. Further details and references are provided in Appendix 1.

- **Section 1.2: Sensitivity.** Sensitivity is the degree to which a species is likely to be affected, either adversely or beneficially by climate change. Sensitivity is expected to be shaped by species traits (e.g. body size, home range area or sociality) and is determined largely by intrinsic, biological features that have evolved over time. We used a list of candidate traits based on Foden & Young (2016) and identified which, if any, each species possesses.

- **Section 1.3: Adaptive capacity.** Adaptive capacity is the potential, capability, or ability of a species to adjust to climate change, to moderate potential damage, or to respond to the consequences. This may be either through changes in behaviour or changes in physiology. We used a list of candidate traits based on Foden & Young (2016) and identified which, if any, each species possesses.

Section 2: Potential conservation actions.

In this section we list potential conservation actions in response to climate change impacts and the evidence behind their effectiveness. For each impact we have compiled a list of local actions that may prevent or limit the direct or indirect impacts of climate change. Potential conservation actions were compiled from Conservation Evidence (Williams et al. 2013) as well as supplementary literature searches of published seabird conservation studies up to July 2021, and from direct consultation with practitioners.

By "local action" we mean conservation actions that directly prevent or limit an impact, and act on a local population scale. While broader scale action tackling climate change and ecosystem scale conservation are incredibly valuable, we intend this resource to be used as a guide to help conservation of populations at a local level. See the "making evidence-based decisions and how to use this guidance" section for further information.

We do not include actions that aim to increase the resilience of seabird populations to climate change by reducing other impacts (e.g. legal protection of species, hunting bans, reducing pollution). In some cases where very few viable direct actions are available, or likely to be effective, we include some discussion of indirect actions to support populations. However, indirect actions are often part of complex cause-and-effect pathways, and it is very difficult to assess their overall effectiveness on conserving seabird populations.

By "direct impact" we mean the direct physical impacts of climate change, or related changes in the physical environment, on seabirds. Examples would be heat stress caused by rising temperatures or increased physiological costs of foraging due to stronger winds. By "indirect impact" we mean changes in ecological processes that then impact seabirds. Examples would be changes in prey range, abundance or composition, increase in predation due to range-shifts, or changes in disease prevalence.

We do not include actions in response to human activities, even if the distribution or intensity of these might be influenced by climate change. For example, renewable energy infrastructure is likely to change in response to climate change, and is likely to increase exponentially in future decades to tackle the climate crisis. However, as this is a human-mediated impact, it is not included in this guidance.

For this section we group by climate change impact rather than species. For example, if multiple species are likely to suffer prey shortages in the breeding season, we summarise the possible actions in response for all species in the group at once. If actions and evidence are specific to one or a few species, this is discussed in the action summary and footnotes.

For each action we assessed the available evidence about its effectiveness and the relative strength, relevance and transparency of the supporting evidence (on a scale from 1 to 5). The following points give an outline of the criteria used to assess each score; for a full methodology see Appendix 2. For each action, we also provide a list of references and sources we used in Appendix 2.

- **Effectiveness:** For each action we assessed how effective it was when carried out on seabirds. Each conservation action is rated based on the evidence for its effectiveness, ranging from "likely to be beneficial" to "likely to be harmful". Effectiveness categories are taken from Conservation Evidence (Williams et al. 2021), and thus pertain to all birds unless noted otherwise. For a full methodology see Appendix 2. Studies documenting actions' effectiveness, specifically on seabirds, were used as the primary evidence base, but if a suggested action has not been trialled on seabirds we also consulted available evidence based on conservation studies targeting other bird species. We also included information

from practitioners (if available) regarding an action's effectiveness or practicality for key populations in Europe.

- **Strength:** This refers to several characteristics of the underlying evidence base regarding the relative robustness and coverage of the evidence. In particular, it is based on how many studies have explored a given conservation action, did they test it on a large number of individuals or have a large number of replicates, has it been tested in various parts of a species' range, and did the authors have a clear and sensible metric for success and was it measured robustly.

- **Relevance:** This refers to how much of the underlying evidence base is composed of evidence specifically regarding the species group in question (e.g. auks). If an action is rated as beneficial, then the relevance score refers to how confident practitioners can be that a given conservation action is beneficial specifically for the focal species group.

- **Transparency**: This refers to how much of the underlying evidence base is composed of evidence that has clear methodology, readily available and detailed data, and a clear, evidence-based rationale, all of which has preferably been peer-reviewed.

Appendices

As an evidence-based guidance resource, being clear about where the information underlying our assessment has come from is key. Therefore, for each of the sections in the main text there is a corresponding appendix section containing references, additional detail or notes on methodology for those who wish to examine the primary sources or find additional reading. Appendix 1 contains additional information for Section 1 of the guidance, and Appendix 2 contains additional information for Section 2. Subheadings in the appendix match those in the main text. For example, if you would like to find the sources we used to create Section 1.1.1 (Current impacts attributed to climate change), then please consult Appendix 1.1.1.

0.3 What this book does not contain

A relative assessment of risk or effectiveness. Different populations face different combinations of risks and to different degrees of severity. For this assessment it was not possible to assess or rank the greatest threats to each population. Instead, we list all identified factors that contribute to vulnerability and the evidence behind them. Practitioners can however use this guide as a starting point to assess threats posed by climate change to their local population.

Recommendations for specific courses of action. This guidance is intended for use by practitioners as a reference guide to highlight threats and potential conservation actions for a given species. What action is most appropriate in a given scenario is dependent on many different factors, including ecological, financial, political and social concerns. This guidance should be considered in addition to the experience and judgement of those who work in the field.

0.4 Making evidence-based decisions and how to use this guidance

This guidance is a resource for a much wider framework, namely assessing threats to biodiversity and carrying out evidence-based conservation action. There are several published decision-making frameworks for conservation, and we will provide an example here based on the evidence-to-decision tool (https://evidence2decisiontool.com/), which identifies three major steps to making decisions. Here, we provide a brief summary of these steps and then detail where and how this guidance is intended to facilitate this process.

1) Define the decision context. What is being targeted, a specific site, a species, a population, or other? Is there a threat that needs to be addressed? If there are multiple threats, which should be addressed first? Which threat is the most urgent, should it be addressed first as a priority? How much impact could this threat have? What are the relevant ecological, physical, socio-economic and cultural factors that may be beneficial or a barrier for conservation? What are the goals of the conservation effort (this may include short-term and long-term goals such as: successfully moving nests, decreasing number of nests destroyed, increasing fledgling success rate, increasing population size over a decade)?

2) Gather evidence. If action is needed in response to identified threats, what are the potential actions? What is the evidence behind these actions; which are known to be effective? Is this action likely to be effective when applied to the specific situation at hand? Is an action feasible to carry out at the scale required? What are the financial and physical resources needed? What are the risks, costs and benefits of each action? Is it possible there will be unintended consequences? Is the action acceptable to stakeholders (e.g. will the action negatively impact another conservation target)?

3) Make an evidence-based decision Which threats need to be addressed? Which actions should be carried out? What is the justification for these decisions? After carrying out stages 2 and 3, it might be that the primary threat is extremely difficult to address, so is there another way to support a population by addressing another, secondary threat? Should the action instead focus on supporting and protecting the population in another way? How will you document and report the

conservation project? How will you monitor and evaluate the success of the action?

This guidance book provides key information for steps 1 and 2 of the above framework. 1) It aims to help practitioners identify current and future threats to seabird species from climate change, and where these are likely to be most pressing. This guidance focuses on species-level context and identifies ecological and physical factors (through sensitivity and adaptive capacity), that are major barriers and opportunities for species to adapt. 2) This guidance lists potential actions in response to identified climate change impacts. Practitioners can review these potential actions, and assessments of their effectiveness. While it's not possible to provide site-specific context, we have also included some information on acceptability and feasibility based on practitioner experience and feedback.

When combined with practitioner experience and judgement, this guidance should assist decisions regarding how to (a) prioritise species and areas for conservation, and (b) make an evidence-based decision on if and how active intervention should be carried out.

0.5 References

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0.6 License

0.7 Preferred citation

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0.8 Contributors

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