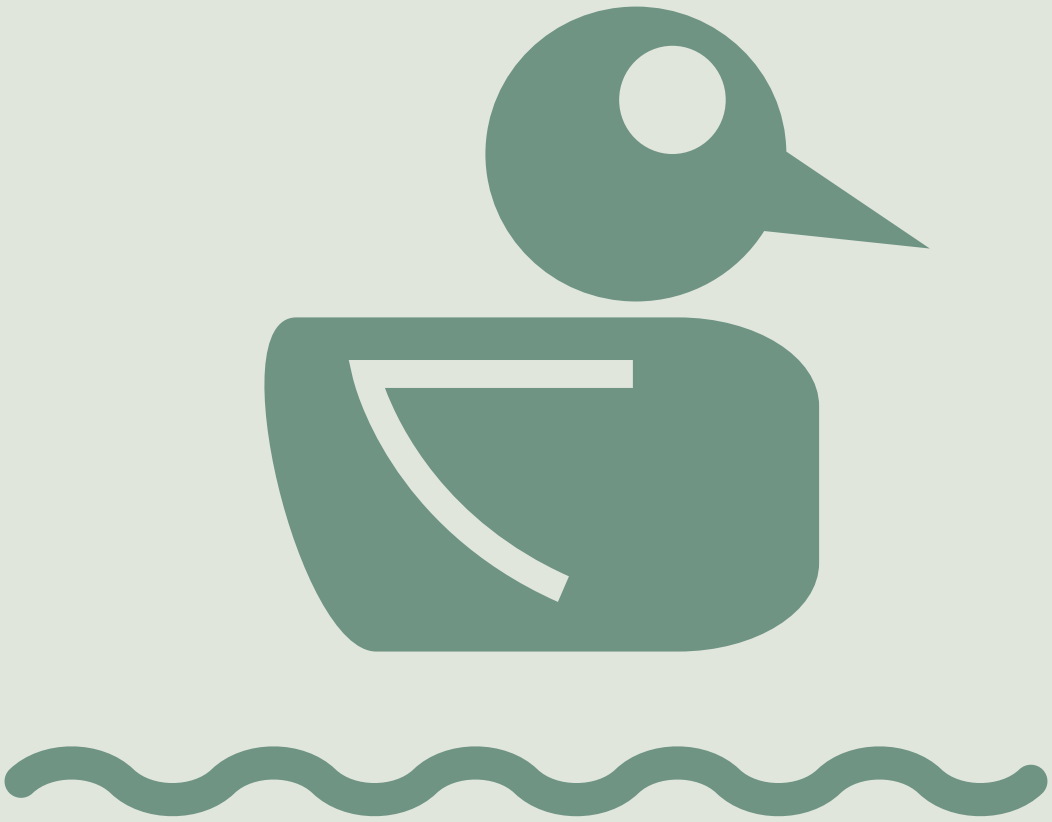
Sufficiency of existing measures for waterbirds in the Baltic Sea

Co-funded by the European Union

Species and biotopes

2021



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Co-funded by the European Union

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Sufficiency of existing measures for waterbirds in the Baltic Sea

Table of Contents

Summary of main results 2
Introduction 3
Report background 3
Topic background 4
Description of waterbirds in the SOM assessment 4
Methods and data 6
Activity-pressure contributions 6
Effectiveness of measures and pressure-state linkages 6
Pressure reductions and state improvements 7
Topic specific model structure, assumptions and challenges 7
Overview of data 7
Development of human activities 10
Results and interpretation 11
Background 11
Format of presentation 11
Coverage of pressures in the SOM analysis 13
Are existing measures sufficient for maintaining GES and achieving state improvements? 13
What are the time lags between pressure and state? 16
What are the pressures contributing to the state components? 17
What are the pressure reductions from existing measures? 19
How effective are measure types in reducing pressures? 20
Which activities contribute to pressures? 25
What are the impacts of measures types? 25
What are the impacts of existing measures? 25
Background of respondents 34
Discussion 35
Impact of alternative scenarios for development of human activities 35
Impact of using literature data on effectiveness of measures 35
Evaluation of quality and confidence 36

Reflection on measure types 37
Lessons learned 37
Use of results, implications and future perspectives 38
References 39
Annexes 40
Annex 1 Activity-pressure data 40
Annex 2 Modified activity list (if modified) 40
Annex 3 Measure types list 40
Annex 4 Linking existing measures to measure types 40
Annex 5 Literature review search terms 40
Annex 6 Literature review summary 40
Annex 7 Topic structure 40
Annex 8 Effectiveness of measures survey 40
Annex 9 Pressure-state survey 40
Annex 10 Supplementary results for effectiveness of measures 41

Summary of main results

The SOM analysis for waterbirds has attempted to evaluate the sufficiency of measures to maintain GES for common eider, great cormorant, sandwich tern and great black-backed gull, and sufficiency of measures to achieve state improvements for long-tailed duck and red-throated diver.

Due to lack of data, estimates of the sufficiency of measures and total pressure reductions are not presented. Most importantly, the contribution of activities to waterbird disturbance and displacement by human presence is missing. Additionally, across all SOM topics experts had difficulty assessing populations that were above GES, causing greater uncertainty. In the case of waterbirds, this applies to common eider, sandwich tern, great black-backed gull, and great cormorant.

The required pressure reduction to maintain GES ranges between 10% and 50% for the common eider and between 0 and 45% for the great cormorant. For both the long-tailed duck and red-throated diver, pressure reductions of 20-50% are required to achieve a 10% state improvement. There are insufficient data on required pressure reductions for sandwich tern and great black-backed gull.

The main pressures affecting waterbirds are in general bycatch in fishing gears and species disturbance or displacement by human presence. The number of significant pressures and the importance of the pressures varies across species. Intentional killing is a major pressure to great cormorant, common eider and great black-backed gull. Sandwich tern is affected by non-indigenous species and pressures occurring outside the Baltic Sea region.

Reducing fishing effort with gillnets or other gears appears among the most effective measure types to reduce waterbird bycatch from fish and shellfish harvesting. Increased hunting restrictions seem to be effective in reducing the intentional killing of waterbirds from hunting and population control. The estimates on the effectiveness of measure types are rather uncertain. All measure types affecting collisions from renewable energy generation, and waterbird disturbance and displacement by human presence appear to be moderately effective.

Several of the pressures to waterbirds originate from a single activity, i.e. fish and shellfish harvesting, renewable energy generation or hunting and population control. Results on the contribution of activities to waterbird disturbance and displacement by human presence are excluded due to lack of data.

Introduction

Report background

The sufficiency of measures (SOM) analysis assesses improvements in environmental state and reduction of pressures that can be achieved with existing measures in the Baltic Sea region, and whether these are sufficient to achieve good environmental status (GES). The analysis involves estimating the state of the marine environment in 2030, based on a starting point of 2016 (i.e. the latest HELCOM status assessment), and given measures in existing policies, their implementation status, and the projected development of human activities over time. The evaluation can be carried out compared to relevant and agreed HELCOM threshold values for GES, where available.

The main aim of the SOM analysis is to support the update of the HELCOM Baltic Sea Action Plan (BSAP) by identifying potential gaps in achieving environmental objectives with existing measures for the Baltic Sea. In addition, the analysis can indicate both thematically and spatially where new measures are likely needed.

The same overall approach has been applied across all topics included in the SOM analysis to ensure comparability and coherence of the results, while considering topic-specific aspects and making necessary adjustments. The main components of the analysis include assessing the contribution of activities to pressures, the effect of existing measures on pressures, the effect of development of human activities on pressures, and the effect of changes in pressure on environmental state. The SOM approach, model and data collection are described in detail in methodology report.

The methodology for the SOM analysis is designed to accommodate the broad array of topics relevant in the HELCOM region and to enable a region-level analysis. It balances between state-of-the-art knowledge, availability of data, and advice taken onboard from various HELCOM meetings and bodies.

The data used in the SOM analysis have been collected using expert elicitation and by reviewing existing literature, model outputs and other data sources. Data availability varies substantially across topics and data components, which is reflected in the presentation of the methods and results in this report.

The SOM analysis presents the first attempt to quantify the effects of existing measures and policies on the environment and achieving policy objectives for various environmental topics in HELCOM and the Baltic Sea area. It is aimed at assessing the overall sufficiency of existing measures at the Baltic Sea level. The results are based mainly on expert elicitation, and thus they should be utilized appropriately. Due to the pioneering nature of the approach and variable data quality and availability in the SOM analysis, the findings do not provide conclusive answers on the need for new measures, but indicate likely gaps, and should thus also be reviewed in relation to the results of other assessments.

This topic report describes the analyses carried out and the results for the SOM analysis on waterbirds, providing detailed topic-specific information. First, it presents background information and describes the data and methods for addressing the topic in the SOM assessment, including relevant assumptions and challenges. Second, it presents and

discusses the findings for each result component. Third, it provides discussion on the impacts of alternative assumptions and data, evaluates the quality and confidence of the analysis, and provides implications and future perspectives. The annexes contain detailed information on the data components, topic structure and expert surveys for the analysis, as well as supplementary results.

Similar topic reports have been prepared for all nine topics covered in the SOM analysis. In addition, the results are summarized in the main report and the full methodology is described in the methodology report.

Topic background[1]

The Baltic Sea is an important resting, feeding, moulting, breeding and wintering area for around 80 bird species. The waterbirds connect food webs in water with those on land, and by migration they also link the Baltic Sea with other marine regions. The Baltic Sea bird community is highly variable depending on the season. Although some of the bird species are present in the Baltic Sea area around the year, for example the great black-backed gull (*Larus marinus*), many species use the Baltic Sea only during specific seasons. Some species use the Baltic Sea as a wintering ground, for example the long-tailed duck (*Clangula hyemalis*), whereas others migrate to the area for breeding.

Waterbirds are widely dispersed and influenced by various human activities and pressures. Coastal developments, fishing, shipping, wind farms, recreation and hunting, are examples of human activities that may lead to disturbance, loss of habitat, alterations to the breeding and feeding environment, as well as mortality. Many waterbird species are vulnerable to incidental by-catches in fishing gear. However, species react in different ways to the pressures, and changes in the environment, resulting also in effects on species composition and food web structure.

Description of waterbirds in the SOM assessment

Birds are included in the SOM analysis as six state components: *Abundance of common eider, Abundance of great cormorant, Abundance of sandwich tern, Abundance of long-tailed duck, Abundance of red-throated diver,* and *Abundance of great black-backed gull* (Figure 1). One or both of the HELCOM indicators "Abundance of waterbirds in the wintering season" and "Abundance of waterbirds in the breeding season" include coverage of four of the six species (Table 1). The analysis structure for all species reflects both these indicators and MSFD criteria D1C2[2]. The selected species represent only a portion of the waterbird species in the Baltic. They were selected as they have relatively large geographical ranges with the majority covering all or most of the Baltic Sea and show variety across several other characteristics (i.e. feeding group, established GES threshold).

[1] Paraphrased or quoted from HELCOM, 2018. State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016. Baltic Sea Environment Proceedings 155.

[2] Marine Strategy Framework Directive criteria D1C2 – The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

The GES threshold for waterbird abundance is set at abundance deviations less than 30% (20% in species laying only one egg per year) downwards from the abundance in the reference period (generally 1991-2000). This is expressed as an index value with good state being above 0.7. In the latest HOLAS assessment period (2011-2016), at the whole Baltic Sea scale, all evaluated species were found to be in a good state: common eider (0.973), great cormorant (0.977), sandwich tern (1.445), and great black-backed gull (0.891). Long-tailed duck and red throated diver are not currently part of the HELCOM indicator assessments due to the lack of off-shore abundance data. In the SOM analysis they are evaluated in terms of pressure reductions required to reach specific state improvements.

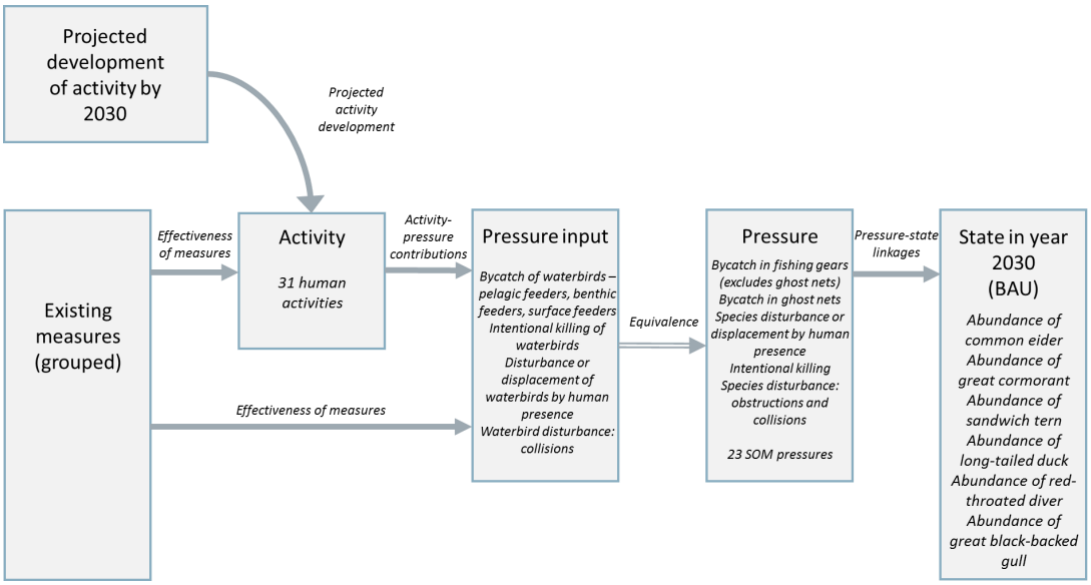


Figure 1. Schematic of the SOM analysis for waterbirds. For waterbirds the terms pressure input and pressure are nearly identical and only the term pressure is used further in this report.

Table 1. Waterbird species in the SOM analysis. Season indicates the HELCOM indicator data set used when evaluating abundance. For consistency, the two species not part of HELCOM indicators (long-tailed duck, red-throated diver) were also assigned a season for evaluation. For GES-based assessments, the base state and GES threshold value are presented. Improvement-based assessments do not have a base state and show not applicable (NA) in the relevant columns.

Common name	Scientific name	Feeding group	Season	Base state	GES threshold value
Common eider	*Somateria mollissima*	benthic feeder	Breeding	0.973	0.7
Great cormorant	*Phalacrocorax carbo*	pelagic feeder	Breeding	0.977	0.7
Sandwich tern	*Thalasseus sandvicensis*	surface feeder	Breeding	1.445	0.7
Long-tailed duck	*Clangula hyemalis*	benthic feeder	Wintering	NA	NA
Red-throated diver	*Gavia stellate*	pelagic feeder	Wintering	NA	NA
Great black-backed gull	*Larus marinus*	surface feeder	Wintering	0.891	0.7

Methods and data

The section below includes an overview of any topic-specific methodologies. A full description of the general approach, methods and data collection for the SOM analysis is available in the methodology report. Note that the detailed results are presented for the most likely development of human activities and using the expert data on effectiveness of measures.

Activity-pressure contributions

The contributions of activities to the disturbance or displacement by human presence for each of the 6 waterbird species were determined using surveys that were distributed to national topic experts via the HELCOM-OSPAR-ICES Joint Working Group on seabirds (JWG Bird). However, due to the lack of responses to this request, surveys were also distributed alongside the expert surveys on effectiveness of measures and pressure-state linkages. Responses from individual experts were accepted, but because national responses were preferred, all responses were weighted nationally to standardize the data set. Respondents were asked to assess the maximum, minimum, and most likely contribution of any activity contributing more than 5% to the pressures on waterbirds. Responses to activities contributing below that threshold were invited but not required. Respondents were also asked to assess the extent to which existing data informed their answer using a five-point scale (1 being very low and 5 very high).

Effectiveness of measures and pressure-state linkages

Measure types (Annex 3) and structural relationships between the measure types and activities and pressures (Annex 7) were designed by HELCOM ACTION WP6. The measure types were informed by the existing measures list (Annex 4) but were also designed to acknowledge the full breadth of potential measures.

For waterbirds, the effectiveness of measures survey structure comprised 13 unique measure types covering 6 activities. The same measure type may be listed under multiple activities, pressures, and feeding groups. Altogether this resulted in 37 assessments of measure type effectiveness across the six pressures, *Intentional killing of waterbirds*, *Waterbird bycatch - pelagic feeders*, *Waterbird bycatch - benthic feeders*, *Waterbird bycatch - surface feeders*, *Waterbird disturbance and displacement by human presence*, and *Waterbird disturbance: collisions*. The exact list of measure types, and their grouping by activities and pressures is shown in Annex 7. The effectiveness of measures survey itself is included as Annex 8.

Effectiveness of the measure types and links between the pressures and state components were determined using online expert surveys implemented in December 2019 - February 2020 with follow-up surveys conducted in the spring 2020. The expert pool consisted of the HELCOM-OSPAR-ICES Joint Working Group on seabirds and nationally nominated experts. Additionally, the project received survey responses from experts not on the original invitation list; these responses were also included in the analysis. The full description of the methodology and data collection is available as part of the SOM methodology report.

Pressure reductions and state improvements

Pressure reductions are calculated using the data on activity-pressure contributions, effectiveness of measure types, links between existing measures and measure types, and projected development of human activities. The projected reductions in pressures account for the joint impacts across the measure types, as well as the spatial area where the pressures can be reduced to avoid overestimating the pressure reductions. Pressure reductions can be positive (pressure is reduced), negative (pressure is increased) or zero (no change in pressure), depending on the combined effect of existing measures and changes in the extent of human activities. When the reduction in pressures from existing measures is larger than the increase from changes in human activities, pressures are reduced.

The calculation of sufficiency of measures takes all the components of the SOM analysis into account: the activity-pressure contributions, effectiveness of measure types in reducing pressures, links between existing measures and measure types, projected pressure reductions from existing measures, development of human activities, significance of pressures to state components and pressure reductions required to achieve GES (see methodology document).

Topic specific model structure, assumptions and challenges

The lack of a dedicated Topic Team consisting of topic experts during the design of the SOM analysis on waterbirds was a significant obstacle to achieving an effective analysis. Future work on the topic requires greater expert input to be productively advanced.

Overview of data

The SOM analysis for waterbirds evaluates the sufficiency of measures in achieving GES or specific state improvements (depending on the species), considering the effects of existing measures and future development of human activities.

Table 2 shows the origin and spatial resolution for the data components in the SOM analysis for waterbirds. Activity-pressure contributions and pressure-state links are based on expert data. Information on existing measures comes from literature reviews and Contracting Parties, and development of human activities is based on existing literature, data and projections.

Estimates of the effectiveness of measures were collected both via expert surveys and a literature review for all topics included in the SOM analysis. The aim of the literature review was to compile information from scientific articles and reports providing estimates on the effects of measures in reducing pressures that could be used in the SOM analysis, either by including the estimates in the SOM model or by providing comparison points. The literature review was conducted by topic, with the information collected into structured excel files (see the methodology document, Annex 5 and Annex 6 for more information). For waterbirds, 74 effectiveness estimates from 9 studies were compiled. Out of these, 10 estimates from 3 studies could be included in the model. Comparison between the expert-

based estimates and those from literature is possible using the figures presented in Annex 10.

The spatial resolution (level of detail) differs across the data components of the SOM analysis. All assessment areas are based on the 17 HELCOM scale 2 sub-basins and the assessment area ranges from the entire Baltic Sea to individual sub-basins. The activity-pressure contributions for waterbirds are assessed for each species separately and therefore correspond to the area used for the state assessment for each species (Figures 2-7), while the effectiveness of measure types in reducing pressures and the effect of development of human activities are assessed at the scale of the entire Baltic Sea. The spatial resolution for the pressure-state linkages includes a single assessment area for each species which varies in size from 12 sub-basins to the whole Baltic Sea (Figures 2-7). Table 2 shows the origin and spatial resolution for the data components in the SOM analysis for waterbirds.

Table 2. Data for waterbirds (more information on data collection is available in the methodology document).

Data component	Source of data	Spatial resolution
Activity-pressure contributions	Expert evaluation	Varies by assessed population (Figures 2-7)
Existing measures	Literature review, Contracting Parties	17 sub-basins
Effectiveness of measures	Expert evaluation	Whole Baltic Sea
Development of human activities	Literature review, existing data and projections	Whole Baltic Sea
Pressure-state links	Expert evaluation	Varies by assessed population (Figures 2-7)

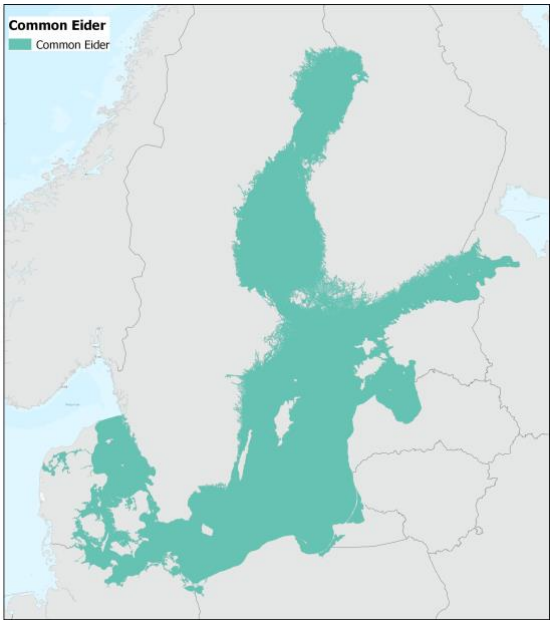


Figure 2. Spatial division of the Baltic Sea used for state assessment for common eider. Common eider is assessed as a single Baltic wide population.

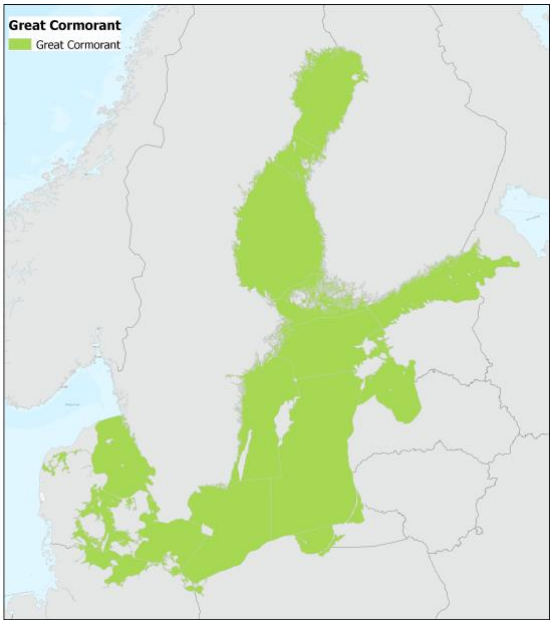


Figure 3. Spatial division of the Baltic Sea used for state assessment for great cormorant. Great cormorant is assessed as a single Baltic wide population.

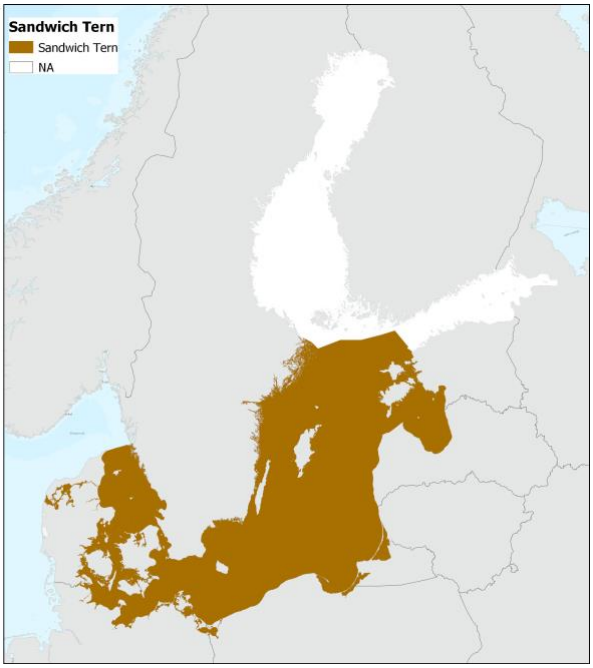


Figure 4. Spatial division of the Baltic Sea used for state assessment for sandwich tern. Sandwich tern is assessed as a single population covering 12 sub-basins (Kattegat, The Sound, Great Belt, Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Gdansk Basin, Western Gotland Basin, Eastern Gotland Basin, Gulf of Riga, Northern Baltic Proper).

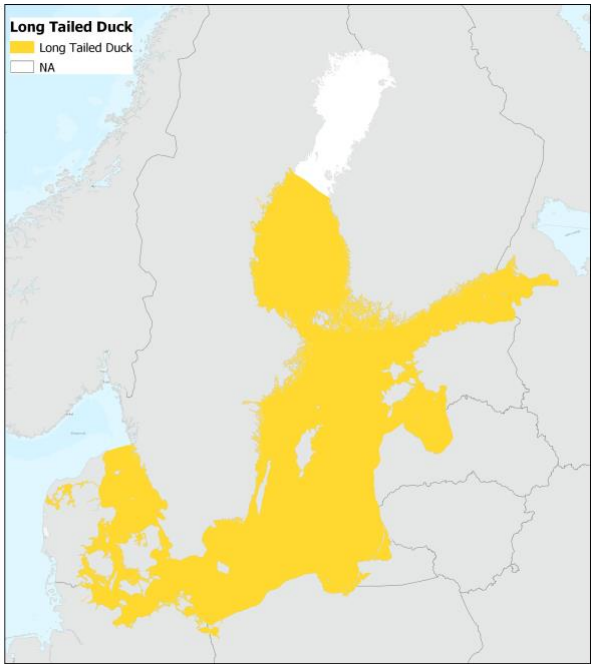


Figure 5. Spatial division of the Baltic Sea used for state assessment for long-tailed duck. Long-tailed duck is assessed as a single population covering 15 sub-basins (Kattegat, Sound, Great Belt, Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Gdansk Basin, Western Gotland Basin, Eastern Gotland Basin, Gulf of Riga, Northern Baltic Proper, Gulf of Finland, Åland Sea, Bothnian Sea).

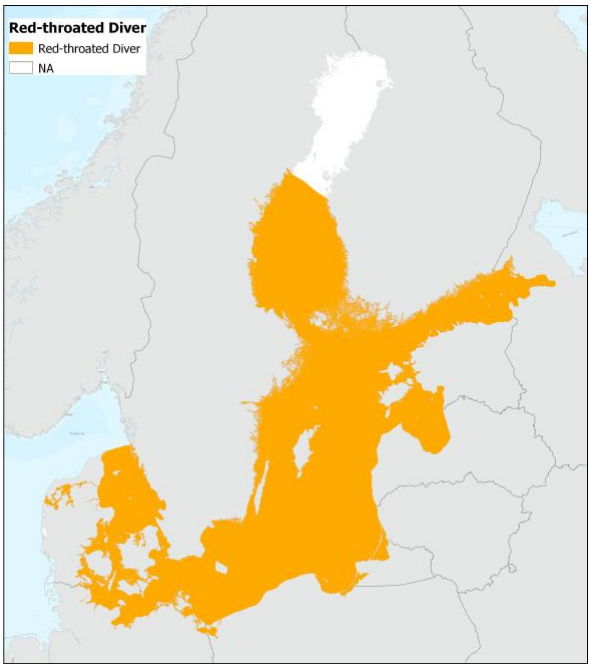


Figure 6. Spatial division of the Baltic Sea used for state assessment for red-throated diver. Assessed as a single population covering 15 sub-basins (Kattegat, The Sound, Great Belt, Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Gdansk Basin, Western Gotland Basin, Eastern Gotland Basin, Gulf of Riga, Northern Baltic Proper, Gulf of Finland, Åland Sea, Bothnian Sea).

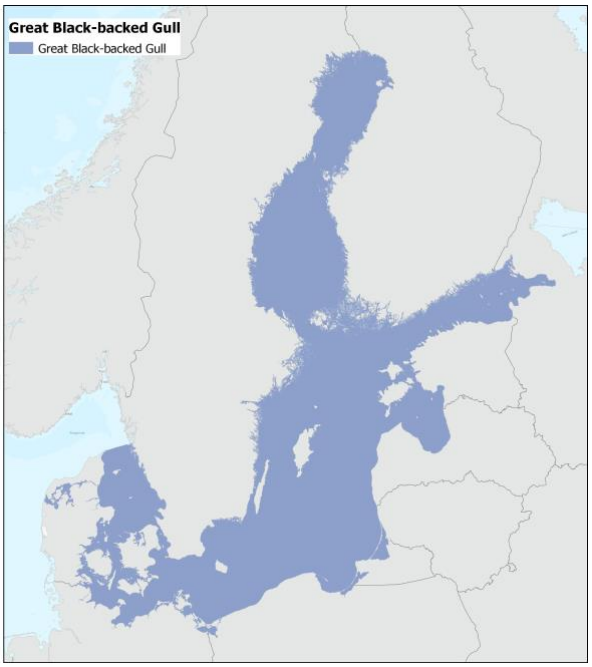


Figure 7. Spatial division of the Baltic Sea used for state assessment for great black-backed gull. Great black-backed gull is assessed as a single Baltic wide population.

Development of human activities

In addition to existing measures, changes in the extent of human activities may affect pressures over time. Four scenarios for future changes in human activities were developed: 1) no change, 2) low change, 3) moderate (most likely) change, and 4) high change. These alternative scenarios aim to capture uncertainties and variation in the future development of human activities. The results of the SOM analysis were estimated for each of the four scenarios to assess how the alternative assumptions on the development of human activities affect the findings. Detailed results are presented for the most likely development scenario, and implications of using the other scenarios on the results are reviewed in the discussion section.

The scenarios specify a percent change in each activity in 2016-2030 based on existing information and projections from the Baltic Sea region (see methodology report for details and references). Change scenarios were made only for predominant activities in the Baltic Sea region, covering agriculture, forestry, waste waters, (commercial) fish and shellfish harvesting, aquaculture, renewable energy production, tourism and leisure activities, transport shipping and transport infrastructure. Other activities are assumed to stay unchanged. This means that only 9 of the 31 standard SOM activities have change scenarios in the SOM analysis. This results in varying influence of these scenarios on the results across topics, pressures and state components, depending on the significance of the activities to the pressures relevant to the topic.

For waterbirds, most pressures are caused by a single activity. There is no development scenario for hunting (intentional killing of waterbirds), and thus it is assumed to stay constant until 2030. Change scenarios were made for fish and shellfish harvesting (bycatch of waterbirds) and offshore wind energy generation (collisions). For fish and shellfish harvesting, no changes are projected until 2030 in the most likely scenario. The alternative low and high scenarios project a decrease and increase of 10% by 2030, respectively. Offshore wind energy production is expected to increase significantly by 2030 based on the scenarios. In the most likely scenario, this increase is as high as 290%. In the low scenario, increase of 150% and in the high scenario an increase of 350% are projected. The assumption on the future development in the extent of wind energy production has a significant effect on the waterbird disturbance from collisions. More information on the development scenarios and source materials is given in section 9 of the methodology report.

The current situation with COVID-19 and its possible implications to the development of human activities is not reflected in the scenarios, as there is no information on the long-term effects it may have on the economy or activities. The current situation poses a challenge for choosing the most likely scenarios for the development of human activities, which has been done based on currently available information.

Results and interpretation

Background

The SOM results are presented in the format of percent shares or probabilities. The main finding of the analysis is the probability to achieve GES/environmental target or specific state improvements/pressure reductions, taking into consideration the effects of existing measures and changes in the activities and their influence on pressures. The contribution of activities to pressures, the effect of measures on pressures, and the significance of pressures to state components are presented as percent values (e.g. how many percent would the measure reduce the pressure). Results are presented mainly in tables, which show the most likely (expected) values and standard deviations. Standard deviation is a way of showing the variation in the values. When it is high, values are spread over a wider range, and when it is low, values are closer to the most likely value. Figures and graphs presenting distributions are included in the annexes. They show the same results as the tables but allow either more detailed information or alternative visualization of the results.

For the data that are based on expert surveys, the confidence rating gives the most common answer to experts' assessment of the confidence in their own survey responses on a low-moderate-high scale. More detailed information on how each result has been calculated is presented in a separate document.

This document presents the detailed results based on the expert-based data (survey responses). Literature data on the effectiveness of measures has been collected and included in an alternative model estimation. The impacts of using the literature data are evaluated in the discussion section. In the detailed results, the projected development of human activities is based on the most likely future development until 2030 (for details, see the methodology document), and the impacts of alternative scenarios on human activities are examined in the discussion section.

Format of presentation

The format the results are reported in different ways (not presented, qualitative/semi-quantitative, quantitative) depending on the type of result and the number of participating experts. Further, for all results utilizing other SOM results as input data, reporting is done at the most conservative standard used in the input data. In practice this means that if one input data point is reported as 'insufficient data', all results using that data point will also be reported as 'insufficient data'; similarly for qualitative/semi-quantitative data points. However, note that this standard is only applied in the case of data points actively used to calculate another result. For example, many measure types are hypothetical or otherwise not implemented in the Baltic Sea and therefore do not factor into results on projected pressure reductions from existing measures. Insufficient data for such measure types does not affect reporting other results that rely on data for effectiveness of measure types. Results that do not meet the data standards described here and in greater detail below are marked with 'insufficient data' in the report.

For results concerning required pressure reductions and significance of pressures to state components, results with 2 or fewer respondents are not reported; results with 3 to 4 respondents will be either not reported, or qualitatively/semi-quantitatively reported based on feedback from the SOM topic teams or other HELCOM expert body; results with 5 or more respondents are reported quantitatively. This standard allows flexibility for reporting on assessments that are of spatially limited areas and therefore have fewer experts available to survey, while also being somewhat conservative in reporting fully quantitative results.

For expert-based effectiveness of measures results, measure types with 5 or more respondents are reported quantitatively and those with 4 or fewer respondents are listed as having insufficient data.

For expert-based activity-pressure results, expert responses where primarily sought through the HELCOM expert networks in the form of national responses. Individual expert responses were accepted but were consolidated into average responses by country to conform to the format of other responses. Thus, the maximum number of responses is 9. This maximum is rarely reached due to responses typically only applying to areas adjacent to the specific country. Acknowledging this, activity-pressure relationships are reported if there are expert responses from 3 or more countries or if the number of countries providing expert responses is greater than 1/2 the number of countries bordering any given sub-area (see Table 3 below; responses from experts based in any HELCOM country will be counted toward the reporting threshold, i.e. the reporting assessment is not limited to responses from bordering countries).

For waterbirds, results on the sufficiency of measures in maintaining GES or achieving state improvements and total pressure reductions have been excluded for all species, due to the lack of data on activity-pressure contributions for waterbird disturbance and displacement by human presence. Only three experts from two countries replied the activity-pressure survey, and thus the requirements for the number of countries were not met for any of the species. Thus, projected pressure reductions in waterbird disturbance and displacement could not be estimated. In addition, there is insufficient data to present the results on the required pressure reductions and time lags for some species, as less than three experts have contributed to the estimates. All results on the effectiveness of measure types are presented, as they are based on the evaluations of more than five experts.

Table 3. Required number of countries providing expert responses to the activity-pressure survey to meet the minimum data threshold for reporting.

Bordering countries	Required number of countries providing expert responses to meet minimum data threshold	Example areas
1	1	Western Gotland Basin
2	2	Bothnian Sea, Gulf of Riga
3	2	Gulf of Finland
4+	3	Eastern Gotland Basin, Baltic Sea

Coverage of pressures in the SOM analysis

The SOM analysis has only been able to account for a portion of all pressures that affect the state components, and the effect of several significant pressures have not been included due to not being able to quantify the link between the pressure inputs, pressures and state components in the analysis. This means that the effect of reductions in these excluded pressures on the state components is not included in the total pressure reductions, and the projected total pressure reductions and probability to achieve GES or environmental target are underestimated. The share of pressures covered in the analysis has been calculated based on the significance of pressures to the state component in question. The share varies across topics and state components from low (around 20%) to high (more than 80%).

Are existing measures sufficient for maintaining GES and achieving state improvements?

Four of the six species included in the SOM analysis have established GES threshold values. They (common eider, great cormorant, sandwich tern and great black-backed gull) are all already in GES based on their abundance. Thus, in principle, it would be possible to evaluate whether existing measures are sufficient in maintaining GES by comparing the state improvement from existing measures to the potential state improvement required to maintain GES. For species with no GES threshold values (long-tailed duck and red-throated diver), the SOM analysis could in principle compare the pressure reduction from existing measures to the pressure reduction required to achieve a specific state improvement. However, low number of contributing experts to the activity-pressure part of the analysis have resulted in an incomplete SOM assessment, and the data do not allow for assessing the sufficiency of measures to maintain GES or achieve state improvements for waterbirds (see Table 4).

Data on the activity-pressure contributions for waterbird disturbance and displacement by human presence are missing, which has led to the exclusion of results dependent on that information. Further, estimates on the required pressure reductions to maintain GES is missing for some species. Thus, there is not enough data to present the results on sufficiency of measures (Table 4).

Table 4. Sufficiency of measures in maintaining GES (common eider, great cormorant, sandwich tern and great black-backed gull) or achieving specific state improvements (long-tailed duck and red-throated diver) for waterbirds. Results are not presented due to insufficient data.

State	Assessment area	Total pressure reduction (%)	Probability to maintain GES (%) with expected pressure reduction	Probability (%) to achieve state improvements with expected pressure reduction	Maximum possible pressure reduction due to model coverage (%)
Common eider	Baltic Sea	Insufficient data			
Great cormorant	Baltic Sea	Insufficient data			
Sandwich tern	Sandwich tern range (12 of 17 sub-basins)	Insufficient data			
Long-tailed duck	Long-tailed duck range (15 of 17 sub-basins)	Insufficient data			
Red-throated diver	Red-throated diver range (15 of 17 sub-basins)	Insufficient data			
Great black-backed gull	Baltic Sea	Insufficient data			

Table 5 presents the estimates of the total pressure reduction required to maintain GES or achieve a specific state improvement for each bird species, based on the expert responses. The required pressure reduction to maintain GES ranges between 10% and 50% for the common eider and between 0 and 45% for the great cormorant. There is insufficient data on required pressure reductions for sandwich tern and great black-backed gull. For both the long-tailed duck and red-throated diver, pressure reductions of 20-50% are required to achieve a 10% state improvement. There is some uncertainty about the required pressure reductions, but the certainty of the estimates is moderate or high. Expert's confidence in their own responses to the question on total pressure reduction required is low for common eider, moderate for great cormorant and high for long-tailed duck and red-throated diver.

Table 5. Total pressure reduction required to maintain GES or achieve a specific state improvement for waterbirds. Standard deviation is given in parentheses. Please note, values are calculated directly from expert survey data and will differ somewhat from model results. Confidence depicts the most common rating of expert's confidence in their own responses to the question on total pressure reduction required to maintain GES/achieve state improvements.

State	**Common eider - Breeding season**	**Great cormorant - Breeding season**	**Sandwich tern - Breeding season**	**Great black-backed gull - Wintering season**
Most likely pressure reduction required (%)	35 (23) ○○●	23 (21) ○○●	Insufficient data	Insufficient data
Confidence	Low	Moderate	NA	NA
Number of experts	8	4	Less than 3	Less than 3
State	**Long-tailed duck - Wintering season, 10% state improvement**	**Long-tailed duck - Wintering season, 25% state improvement**	**Long-tailed duck - Wintering season, 50% state improvement**	
Most likely pressure reduction required (%)	36 (16) ○●●	59 (18) ●●●	87 (7) ●●●	
Confidence	High	High	High	
Number of experts	4	4	4	
State	**Red-throated diver - Wintering season, 10% state improvement**	**Red-throated diver - Wintering season, 25% state improvement**	**Red-throated diver - Wintering season, 50% state improvement**	
Most likely pressure reduction required (%)	36 (15) ○●●	54 (18) ○●●	87 (7) ●●●	
Confidence	High	High	High	
Number of experts	4	4	4	

Colour scale for the percent reduction in pressures required to maintain GES or achieve a specific state improvement in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the reduction required estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
NA = not applicable
Data used: expert estimates of required pressure reductions to achieve GES

What are the time lags between pressure and state?

Information on time lags between pressures and state of waterbirds was collected from experts, who evaluated how long it would take to fully realize state improvements in the abundance of the species after measures have been implemented. Table 6 shows the distribution and average of the answers for waterbirds.

The average time lags are around 10 years for common eider, long-tailed duck and red-throated diver, and around 3 years for great cormorant. There is insufficient data on time lags for sandwich tern and great black-backed gull.

For all species, the low reproduction rate and generally long lifecycle were stated as the main factors contributing to time lags. For the red-throated diver, impacts from climate change were mentioned to contribute to the time lags. In the case of pressures that cause disturbance and habitat loss, a longer time to visible effects is to be expected than for pressures that directly affect survival (bycatch in fisheries) and reproduction (predation of nests and offspring).

Table 6. Time lags in realizing state improvements after measures have been implemented. Responses with clear reference to time lags due to lags in the implementation of measures have been excluded.

Time lag	Common eider	Great cormorant	Sandwich tern	Long-tailed duck	Red-throated diver	Great black-backed gull
0 years (no time lag)	0	1	Insufficient data (less than 3 experts)	0	0	Insufficient data (less than 3 experts)
0-5 years	1	2		0	0	
6-10 years	3	1		4	4	
11-25 years	3	0		2	1	
26-50 years	0	0		0	0	
51-100 years	0	0		0	0	
More than 100 years	0	0		0	0	
Excluded	1	1		1	1	
Average	11.1	3.1		10.8	9.5	
SD	5.8	2.7		4.7	4.0	
Confidence	Moderate	Moderate		Moderate	Moderate	
Number of experts	7	4		6	5	

Data used: expert estimates of time lags

What are the pressures contributing to the state components?

Table 7 shows the significance of pressures affecting the state of waterbirds, enabling comparisons across species. Experts identified 3-6 most significant pressures affecting the state component in question and rated their significance on a scale from 0 to 5 (0 = not very significant, 5 = extremely significant). These significance scores were summed across experts, and after that, the score for each individual pressure was divided with the total score for all pressures to calculate the percent shares of pressures to the state component.

Experts identified in total 17 distinct pressures significant to waterbirds, and there are differences in the number and ranking of the pressures across the six species. The most significant pressures across the species were *bycatch in fishing gears (excludes ghost nets)* and *species disturbance or displacement by human presence*. *Intentional killing* is a significant pressure to great cormorant, common eider and great black-backed gull, and sandwich tern is significantly affected by *non-indigenous species* and *pressures occurring outside the Baltic Sea region*.

Experts' confidence in their own responses to the significance of pressures question was moderate or high.

It is important to be aware that only anthropogenic pressures are considered here and in the larger context of judging achievement of environmental targets other issue could be important. For example, because of a great conservation success, the number of white-tailed eagles has increased substantially. The eagle is a very important predator on breeding eiders and is regarded as one of the main factors behind the last decades' declining eider population in Finland and Sweden. Thus, table 7 does not include all pressures potentially influencing the species in focus but is likely to give a good overview of the relative importance of anthropogenic pressures.

Table 7. Significance of pressures (%) affecting the state of waterbirds by species.

State Pressure	Common eider	Great cormorant	Sandwich tern	Long-tailed duck	Red-throated diver	Great black-backed gull
Bycatch in fishing gears (excludes ghost nets)	16	20		27	27	6
Bycatch in ghost nets	2	3		4	3	
Impulsive underwater noise					1	
Extraction of fish (includes prey depletion)	2	10			6	18
Species disturbance or displacement by human presence	22	17	35	13	18	6
Species disturbance: obstructions and collisions	1				11	18
Intentional killing (hunting, illegal killing)	14	26		7		18
Effects of non-indigenous species	12	3	35	3		
Physical disturbance of marine habitats	4	1		3	6	
Physical loss of marine habitats	2			5	3	
Effects of marine litter (excluding bycatch in ghost nets)				2		
Effects of eutrophication	8	3		4		
Hydrocarbon pollution	2	1		10	8	6
Organohalogen pollution (e.g. PFOS, PCBs, PBDEs, dioxins)						6
Effects of pressures occurring outside the Baltic Sea region (migratory species only)	4	10	22	14	11	12
Change in hydrologic conditions	6			2		
Human-induced food web imbalance	4	6	9	8	5	12
Confidence	High - Moderate	High	Moderate	High	High	Moderate
Number of experts	10	9	4	7	6	5

Colour scale for the significance of the pressure to the state variable (based on the expected value):
0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Pressures for which the link between the pressure input, pressure and state cannot be quantified in the SOM analysis are highlighted in grey, e.g. there is no quantified link between reductions in anthropogenic introductions of non-indigenous species to the effects of non-indigenous species, and further to the state of waterbirds.
Data used: expert estimates of significance of pressures to state components

What are the pressure reductions from existing measures?

Tables 8.1 and 8.2 show the effects of existing measures in reducing pressures to waterbirds at the scale of the Baltic Sea in 2016-2030, considering the changes in the extent of human activities. They are calculated using the data on activity-pressure contributions, effectiveness of measure types, links between existing measures and measure types, and projected development of human activities.

Most of the pressures are caused by a single activity, and the effectiveness of measures data are at the Baltic Sea level, and thus the pressure reductions are presented at the Baltic Sea scale.

The projected pressure reductions for *waterbird bycatch* and *waterbird disturbance: collisions* are presented in Table 8.1 as a weighted average for the Baltic Sea. *Waterbird bycatch* is expected to remain unchanged for all feeder groups, due to the inclusion of only a single spatially limited existing measure in the analysis. The negative value for *waterbird disturbance: collisions* indicates that the pressure is expected to increase, as the pressure reductions from existing measures are unable to compensate for the pressure increases caused by the significant growth in offshore wind energy production, which is expected to increase by 290% by 2030 in the most likely scenario. Thus, the large increase in the extent of the activity contributing to collisions is driving the projected changes in pressures.

Table 8.2 shows that the projected pressure reductions for *waterbird disturbance and displacement by human presence* and *intentional killing of waterbirds* by species as a weighted average for the Baltic Sea. There is insufficient data to present the results for *waterbird disturbance and displacement*, as information on the contribution of activities to the pressure is lacking. Change in *intentional killing of waterbirds* is only expected for the long-tailed duck and is projected to be reduced to a rather high extent. This result is based only on the effectiveness of measures, as no change in the extent of hunting is expected by 2030. No changes are expected in intentional killing for the other species, as no existing measures were reported.

Table 8.1. Projected pressure reductions (%) from existing measures in *waterbird bycatch* and *waterbird disturbance: collisions* in 2016-2030. The table depicts the most likely/expected pressure reduction, and standard deviation is given in parenthesis. Projected reductions are presented as the weighted average of each assessment unit for each listed taxonomic grouping. Note that very small projected changes in pressure will appear as zero change due to rounding.

Pressure Area	Waterbird bycatch			Waterbird disturbance: collisions
	Pelagic feeders	Benthic feeders	Surface feeders	
Baltic Sea	0 (0) ●●●	0 (0) ○●●	0 (0) ○●●	-159 (45) ●●●

Colour scale for the pressure reductions in percent (based on the expected value):
<0%, 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the pressure reductions (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types, information on existing measures

Table 8.2 Projected reductions (%) from existing measures in *waterbird disturbance and displacement by human presence* in 2016-2030. The table depicts the most likely/expected pressure reduction, and standard deviation is given in parenthesis. Projected reductions are presented as the weighted average of each assessment unit for each listed taxonomic grouping.

Pressure Species	Waterbird disturbance and displacement by human presence	Intentional killing of waterbirds on the targeted species
Common eider	Insufficient data	0 (0)
Great cormorant	Insufficient data	0 (0)
Sandwich tern	Insufficient data	0 (0)
Long-tailed duck	Insufficient data	51 (18) ○●●
Red-throated diver	Insufficient data	0 (0)
Great black-backed gull	Insufficient data	0 (0)

Colour scale for the pressure reductions in percent (based on the expected value):
<0%, 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the pressure reductions (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types, information on existing measures

How effective are measure types in reducing pressures?

This section presents the percent effectiveness of measure types in reducing *waterbird bycatch, waterbird disturbance: collisions, waterbird disturbance and displacement from human presence,* and *intentional killing of waterbirds*. The estimates are presented per activity when relevant, i.e. they portray the percent reduction in the pressure from the activity in question, and not in the total pressure across all activities. Information on the reductions over all activities contributing to the pressure is given in the section on the impacts of measure types. Data on the effectiveness of measure types originate from expert surveys and are at the Baltic Sea scale.

The effectiveness estimates can be compared across measure types to assess, on average, how effective they are in relation to each other in reducing the pressure from the specific activities, or across activities to assess which measure type could be the most effective for each activity.

Several of the pressures to waterbirds originate from a single activity. The most effective measure type in reducing *waterbird bycatch* from fish and shellfish harvesting appears to be *reducing fishing effort with gillnets or other gears causing bycatch of waterbirds* (Table 9.1). For *waterbird disturbance: collisions* from renewable energy generation (wind, wave and tidal power), all measure types included in the analyses seem moderately effective (Table 9.2). For the *intentional killing of waterbirds* from hunting and population control, both measure types appear effective, in particular *increased hunting restrictions* (Table 9.3).

Table 9.4 shows the effectiveness of measure types in reducing the pressure of *waterbird disturbance and displacement by human presence* from five different activities. The effectiveness of all measure types is moderate, and there are no large differences across measure types or activities.

Overall, there is considerable uncertainty about the effectiveness of the measure types based on the standard deviations. The certainty of the estimates varies from low to high, and experts' confidence on their own estimates is moderate or high.

Estimates of the effectiveness of measure types are used to assess the effects of existing measures in reducing the pressures to waterbirds and to calculate pressure reductions from existing measures by 2030.

Table 9.1 Effectiveness of measure types (%) in reducing *waterbird bycatch.* Values are presented for three feeding groups (pelagic feeders, benthic feeders, and surface feeders). The effectiveness of a measure type is the percent reduction in the pressure resulting from a specific activity. The table depicts the most likely/expected values of effectiveness, and standard deviation is given in parenthesis.

Measure type ID	Activity Measure type	Fish and shellfish harvesting (all gears; professional, recreational)			Has corresponding existing measures in the SOM analysis (Yes/No)
		Pelagic feeders	Benthic feeders	Surface feeders	
55	Reduce fishing effort with gillnets or other gears causing bycatch of waterbirds	76 (10) ●●●	70 (25) ○●●	57 (26) ○●●	No
56	Reduce bycatch of waterbirds by modifications of fishing gears	45 (20) ○●●	42 (23) ○●●	46 (28) ○○●	No
57	Implement fisheries management measures in MPAs	35 (14) ○●●	39 (21) ○●●	33 (17) ○●●	Yes
	Confidence	High - Moderate	High - Moderate	High	
	Number of experts	10-11	10-11	10-11	

Colour scale for the effectiveness of a measure type in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the effectiveness estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types

Table 9.2 Effectiveness of measure types (%) in reducing the potential *waterbird disturbance: collisions.* The effectiveness of a measure type is the percent reduction in the pressure resulting from a specific activity. The table depicts the most likely/expected values of effectiveness, and standard deviation is given in parenthesis.

Measure type ID	Activity Measure type	Renewable energy generation (wind, wave and tidal power), including infrastructure	Has corresponding existing measures in the SOM analysis (Yes/No)
62	Environmentally sound lighting of offshore installations	38 (23) ○○●	Yes
63	MSP considers migratory patterns and other sensitive areas	49 (24) ○●●	Yes
64	Seasonal or real time (e.g. radar based) closures of wind farms	48 (24) ○●●	No
	Confidence	Moderate	
	Number of experts	11	

Colour scale for the effectiveness of a measure type in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the effectiveness estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types

Table 9.3. Effectiveness of measure types (%) in reducing the potential *intentional killing of waterbirds.* The effectiveness of a measure type is the percent reduction in the pressure resulting from a specific activity. The table depicts the most likely/expected values of effectiveness, and standard deviation is given in parenthesis.

Measure type ID	Measure type	Waterbirds	Has corresponding existing measures in the SOM analysis (Yes/No)
53	International single species action plan	57 (20) ○●●	Yes
54	Increased hunting restrictions	78 (10) ●●●	No
	Average confidence	Moderate	
	Number of experts	9-11	

Colour scale for the effectiveness of a measure type in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the effectiveness estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types

Table 9.4. Effectiveness of measure types (%) in reducing the potential *waterbird disturbance and displacement by human presence*. The effectiveness of a measure type is the percent reduction in the pressure resulting from a specific activity. The table depicts the most likely/expected values of effectiveness, and standard deviation is given in parenthesis.

Measure type ID	Activity Measure type	Urban uses	Renewable energy generation	Fish and shellfish harvesting	Tourism and leisure activities	Transport – shipping	Has corresponding existing measures in the SOM analysis (Yes/No)
39	Full implementation of the EU Maritime Spatial Planning Framework Directive	28 (21) ○○●	35 (19) ○●●	29 (19) ○○●	29 (20) ○○●	35 (22) ○○●	Yes
58	New or expanded marine protected areas	33 (21) ○○●	39 (20) ○●●	31 (15) ○●●	38 (22) ○●●	30 (18) ○○●	Yes
59	Strengthen protection in existing marine protected areas	35 (24) ○○●	42 (21) ○●●	38 (17) ○●●	46 (25) ○●●	39 (25) ○○●	No
60	Measures targeting protection of threatened habitats and biotopes	35 (24) ○○●	Not assessed	35 (21) ○○●	40 (24) ○●●	32 (21) ○○●	No
61	Strengthened coastal strip management	28 (18) ○○●	29 (21) ○○●	Not assessed	34 (27) ○○●	29 (24) ○○●	Yes
	Confidence	Moderate	Moderate	Moderate	Moderate	Moderate	
	Number of experts	10	10-11	11	11	10-11	

Colour scale for the effectiveness of a measure type in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the effectiveness estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of effectiveness of measure types
Full activity names:

- Urban uses (land use), including storm water runoff
- Renewable energy generation (wind, wave and tidal power), including infrastructure
- Fish and shellfish harvesting (all gears; professional, recreational)
- Tourism and leisure activities (boating, beach use, water sports, etc.)
- Transport – shipping (incl. anchoring, mooring)

Which activities contribute to pressures?

Most of the pressures to waterbirds originate from a single activity. This applies to *waterbird bycatch* from fish and shellfish harvesting, *waterbird disturbance: collisions* from renewable energy generation (wind, wave and tidal power), and *intentional killing of waterbirds* from hunting and population control. The only pressure affected by several activities is *waterbird disturbance and displacement by human presence*. Information on the contribution of activities to this pressure was collected from experts, but due to insufficient number of responses, the results are not presented in this report. This affects all results dependent on the activity-pressure contributions.

What are the impacts of measures types?

The impacts of measure types show the impact of measure types on reducing the pressures to waterbirds. They include the effectiveness of measure types and the contribution of activities to pressures. Thus, the impact shows how much the measure type reduces a pressure across all activities contributing to the pressure and give indications on which measures could be the most relevant in addressing specific pressures.

For the single-activity pressures on waterbirds, the impacts of the measure types are the same as the effectiveness estimates. As the activity-pressure data are missing for waterbird disturbance and displacement, the impacts of measure types on this pressure cannot be presented either.

What are the impacts of existing measures?

This section presents information about existing measures affecting bycatch, disturbance and displacement and disturbance: collisions of waterbirds and intentional killing of long-tailed-duck. In the SOM analysis, existing measures are those measures in current policy frameworks (e.g. BSAP, EU MSFD, EU WFD, EU Biodiversity Strategy 2020) that affect pressures and environmental state within the time frame of the analysis (2016–2030). This includes measures that have been implemented, are partially implemented or are planned to be implemented by 2030. Measures which have already been fully implemented and have fully affected pressures and environmental state by 2016 have been excluded, as no further improvement of status is expected during in 2016–2030. Information about existing measures was compiled through a literature review and from Contracting Parties.

The impact is the percent reduction in a specific pressure from implementing the measure in the relevant spatial area. It has been calculated based on the effectiveness of the measure, proxied by the effectiveness of the measure type it corresponds to, and the contribution of activities to the pressure in question. Similar to the impact of a measure type, the impact of an existing measure indicates how much the measure reduces the pressure across all activities contributing to the pressure.

Tables 10.1, 10.2, 10.3 and 10.4 present the impacts of existing measures in reducing waterbird bycatch, disturbance and displacement, disturbance: collisions and intentional killing. The impacts are presented both for the Baltic Sea scale and for the area affected by

the existing measure. In addition, information on the share of the Baltic Sea area affected by the existing measure is included. Both the effectiveness of the measure and the spatial area affected are relevant for the impact at the Baltic Sea scale. Some existing measures may have high impact in the affected area, but their impact at the Baltic Sea scale is low because they only affect a small area, while some measures may have a relatively low impact in the affected area but affect a large share of the Baltic Sea.

There are two existing measures affecting the bycatch of benthic, pelagic and surface feeders in the SOM analysis (Table 10.1). As these have only very local impacts, they are not impactful at the Baltic Sea scale.

For waterbird disturbance and displacement, insufficient data on activities contributing to pressures is available to make an impact estimation. However, the SOM analysis includes six measures affecting common eider, great black-backed gull and great cormorant, long-tailed duck and red-throated diver, and five affecting sandwich tern (Table 10.2).

Three measures impact waterbird disturbance: collisions in the SOM analysis (Table 10.3). The most impactful at the Baltic Sea scale is *MSP considers migratory patterns and other sensitive areas*, as it applies to a large share of the Baltic Sea.

The only existing measures reducing intentional killing in the SOM analysis is the *international single species action plan for long-tailed duck organized under AEWA*, which has a high impact in the area affected and applies to almost the entire Baltic Sea (Table 10.4).

Table 10.1. Impacts of existing measures in reducing waterbird bycatch. Impact is the percent reduction in a specific pressure from implementing the measure. Standard deviations are given in parenthesis. Please note that values less than 0.5 have been rounded to zero. Measure name and description correspond to those used in Annex 4 for referencing purposes. In rare cases, the name and description may not be representative of the existing measure due to the free text reporting format used during existing measures data collection.

Species group	Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
benthic feeders	BALDE-M919-other	Fisheries management measures in Natura 2000 sites in the EEZ	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	38 (22)	0
benthic feeders	Fisheries measures (M412-UZ4-02)	o Fisheries management measures in Natura 2000 sites. Germany will develop 'common advices' for necessary fisheries restrictions in these areas, which will be developed with the federal states, stakeholders from the fisheries industry and NGOs involved in fisheries management o MSFD targets considered when developing the federal fisheries policies	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	39 (21)	0
pelagic feeders	BALDE-M919-other	Fisheries management measures in Natura 2000 sites in the EEZ	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	36 (14)	0
pelagic feeders	Fisheries measures (M412-UZ4-02)	o Fisheries management measures in Natura 2000 sites. Germany will develop 'common advices' for necessary fisheries restrictions in these areas, which will be developed with the federal states, stakeholders from the fisheries industry and NGOs involved in fisheries management o MSFD targets considered when developing the federal fisheries policies	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	36 (14)	0

Species group	Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
surface feeders	BALDE-M919-other	Fisheries management measures in Natura 2000 sites in the EEZ	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	33 (17)	0
surface feeders	Fisheries measures (M412-UZ4-02)	o Fisheries management measures in Natura 2000 sites. Germany will develop 'common advices' for necessary fisheries restrictions in these areas, which will be developed with the federal states, stakeholders from the fisheries industry and NGOs involved in fisheries management o MSFD targets considered when developing the federal fisheries policies	Fishing	DE	Implement fisheries management measures in MPAs	0 (0)	33 (17)	0

Data used: information about existing measures and their spatial scale, expert estimates of effectiveness of measures types
Full activity names:

- Fish and shellfish harvesting (all gears; professional, recreational)

Table 10.2. Impacts of existing measures in reducing waterbird disturbance and displacement. Impact is the percent reduction in a specific pressure from implementing the measure. Standard deviations are given in parenthesis. Note that values less than 0.5 have been rounded to zero. Measure name and description correspond to those used in Annex 4 for referencing purposes. In rare cases, the name and description may not be representative of the existing measure due to the free text reporting format used during existing measures data collection.

Species	Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
Common eider, Great black-backed gull, Great cormorant	No name	Full implementation of the EU Maritime Spatial Planning Framework Directive	Tourism and leisure activities, Urban uses, Transport – shipping, Fishing, Renewable energy generation	EU countries	Full implementation of the EU Maritime Spatial Planning Framework Directive	Insufficient data	Insufficient data	94
Long-tailed duck, Red-throated diver	No name	Full implementation of the EU Maritime Spatial Planning Framework Directive	Tourism and leisure activities, Urban uses, Transport – shipping, Fishing, Renewable energy generation	EU countries	Full implementation of the EU Maritime Spatial Planning Framework Directive	Insufficient data	Insufficient data	85
Sandwich tern	No name	Full implementation of the EU Maritime Spatial Planning Framework Directive	Tourism and leisure activities, Urban uses, Transport – shipping, Fishing, Renewable energy generation	EU countries	Full implementation of the EU Maritime Spatial Planning Framework Directive	Insufficient data	Insufficient data	62
Common eider, Great black-backed gull, Great cormorant	Generally protected coastal strip	b) that a generally protected coastal strip therefore be established outside urban areas and existing settlements, the width of which shall be determined by the nature and landscape values of the coast, extending at least 100 to 300 meters from the mean water line landwards and seawards;	Tourism and leisure activities, Urban uses, Renewable energy generation	FI	Strengthened coastal strip management	Insufficient data	Insufficient data	20

Species	Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
Long-tailed duck, Red-throated diver	Generally protected coastal strip	b) that a generally protected coastal strip therefore be established outside urban areas and existing settlements, the width of which shall be determined by the nature and landscape values of the coast, extending at least 100 to 300 meters from the mean water line landwards and seawards;	Tourism and leisure activities, Urban uses, Renewable energy generation	FI	Strengthened coastal strip management	Insufficient data	Insufficient data	15
Common eider, Great black-backed gull, Great cormorant, Long-tailed duck, Red-throated diver, Sandwich tern	IMPLEMENTATION OF INTEGRATED COASTAL MANAGEMENT AND MARITIME SPATIAL PLANNING IN THE BALTIC SEA AREA	to develop maritime spatial plans and integrated coastal management measures which ensures the implementation of the principles for integrated management of human activities, and are coordinated with regional marine management strategies.	Tourism and leisure activities, Urban uses, Renewable energy generation	DK	Strengthened coastal strip management	Insufficient data	Insufficient data	20
Common eider, Great black-backed gull, Great cormorant, Long-tailed duck, Red-throated diver	M001	Developing a network of marine protected areas in Estonian EEZ	Tourism and leisure activities, Urban uses, Transport – shipping, Fishing, Renewable energy generation	EE	New or expanded marine protected areas	Insufficient data	Insufficient data	1
Common eider, Great black-backed gull, Great cormorant, Long-tailed duck, Red-throated diver, Sandwich tern	Integrated coastal zone management (BALDE-M929-other)	Integrated coastal zone management	Tourism and leisure activities, Urban uses, Renewable energy generation	DE	Strengthened coastal strip management	Insufficient data	Insufficient data	4

Species	Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
Common eider, Great black-backed gull, Great cormorant, Long-tailed duck, Red-throated diver, Sandwich tern	Marine protected areas in the EEZ of the German North and Baltic Seas (M914)	No description	Transport – shipping, Renewable energy generation	DE	New or expanded marine protected areas	Insufficient data	Insufficient data	0

Data used: information about existing measures and their spatial scale, expert estimates of effectiveness of measures types, activity-pressure contributions
Full activity names:

- Fish and shellfish harvesting (all gears, professional, recreational)
- Urban uses (land use), including storm water runoff
- Tourism and leisure activities (boating, beach use, water sports, etc.)
- Renewable energy generation (wind, wave and tidal power), including infrastructure
- Transport – shipping (incl. anchoring, mooring)

Table 10.3. Impacts of existing measures in reducing waterbird disturbance: collisions. Impact is the percent reduction in a specific pressure from implementing the measure. Standard deviations are given in parenthesis. Note that values less than 0.5 have been rounded to zero. Measure name and description correspond to those used in Annex 4 for referencing purposes. In rare cases, the name and description may not be representative of the existing measure due to the free text reporting format used during existing measures data collection.

Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
Bird spatial planning	E. Enable appropriate planning of the use of marine space that incorporates conservation need of seabirds in the Baltic-wide context thus contributing to reaching their favourable conservation status G. Avoid that wind energy facilities and wave energy installations are sited in areas important for birds, and that the loss of off-shore staging habitats will be halted H. Avoid that wind energy facilities are situated within major migrating routes of birds	Renewable energy generation	FI, LV, PL, SE	MSP considers migratory patterns and other sensitive areas	34 (13)	49 (18)	69
Measures to protect migratory species in marine areas (UZ3-02, M410)	No description	Renewable energy generation	DE	MSP considers migratory patterns and other sensitive areas	2 (1)	49 (23)	4
Development and application of environmentally sound lighting of offshore installations and accompanying measures (UZ6-06)	No description	Renewable energy generation	DE	Environmentally sound lighting of offshore installations	1 (1)	38 (23)	4

Data used: information about existing measures and their spatial scale, expert estimates of effectiveness of measures types
Full activity names:

- Renewable energy generation (wind, wave and tidal power), including infrastructure

Table 10.4. Impacts of existing measures in reducing intentional killing of long-tailed-duck. Impact is the percent reduction in a specific pressure from implementing the measure. Standard deviations are given in parenthesis. Note that values less than 0.5 have been rounded to zero. Measure name and description correspond to those used in Annex 4 for referencing purposes. In rare cases, the name and description may not be representative of the existing measure due to the free text reporting format used during existing measures data collection.

Measure name	Description	Activities	Countries	Measure type	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
Long-tailed duck ISSAP	International single species action plan for Long-tailed duck organized under AEWA	Hunting and population control	All countries	International single species action plan	51 (18)	57 (20)	90

Data used: information about existing measures and their spatial scale, effectiveness of measures types

Background of respondents

There were two expert surveys for waterbirds: effectiveness of measures and pressure-state linkages. Altogether 11 survey responses with 12 experts were received for the effectiveness of measures survey. One of the answers was a group response with two contributing experts. For the pressure-state survey, there were 13 responses with 14 contributing experts. Two group responses were received, with each two contributing experts. For the activity-pressure survey, two responses were received, one from Poland (one expert) and one from Sweden (two experts). The number of experts contributing to the three types of waterbird surveys by contracting parties is shown in Table 11, with information on the response count by sub-topic and geographic area presented in Table 12.

Table 11. Number of experts contributing to the waterbird surveys

Survey	DE	DK	EE	FI	LT	LV	PL	RU	SE	Total
Effectiveness of measures	2	5	-	-	1	-	1	2	1	12
Pressure-state	2	6	-	1	1	-	1	2	1	14
Activity-pressure contributions	-	-	-	-	-	-	1	-	2	3

Table 12. Number of responses to the waterbird surveys. Please note that geographic area applies only to sub-basins for which the bird species generally occurs in.

Survey	Sub-topic	Geographic area	Response count
Effectiveness of measures		Whole Baltic	12
Pressure-state	Common eider - Breeding Season	Whole Baltic	9
	Great cormorant - Breeding Season	Whole Baltic	8
	Sandwich tern - Breeding Season	Whole Baltic	3
	Long-tailed duck - Wintering Season	Whole Baltic	7
	Red-throated diver - Wintering Season	Whole Baltic	6
	Great black-backed gull - Wintering Season	Whole Baltic	4

More detailed background information is available for the experts participating in the effectiveness of measures and pressure-state surveys. Almost all experts stated ornithology or biology as their field. About half of the experts had over 20 years of experience in their field (Table 13). Experts represented research institutions, ornithological societies, government institutes, state agencies or ministries.

Table 13. Years of experience in the field for waterbird surveys

	Effectiveness of measures survey		Pressure-state survey	
Years	Number of experts	Share of experts	Number of experts	Share of experts
0-2 years	0	0 %	0	0 %
3-5 years	2	17 %	2	14 %
5-10 years	3	25 %	3	21 %
10-20 years	2	17 %	1	7 %
over 20 years	5	42 %	8	57 %

Discussion

Impact of alternative scenarios for development of human activities

The detailed results are presented for the most likely development scenario for the extent of human activities in 2016–2030. In addition, three other development scenarios were estimated: no change, low change and high change scenarios. These scenarios cover 9 out of the 31 activities in the SOM analysis. The extent of other activities is assumed to remain constant in all scenarios.

As activities contribute to pressures, their assumed change over time affects the pressure reductions and probability to achieve state improvements. The impact depends on to what extent the activities, contributing to the specific pressure, are covered in the change scenarios. For waterbirds, most pressures are caused by a single activity. There is no change scenario for hunting, and thus it is assumed to stay constant until 2030. Change scenarios have been made for fish and shellfish harvesting and offshore wind energy generation.

In the most likely scenario, no changes in the extent of fishing are projected until 2030. The alternative low and high scenarios project a decrease and increase of 10% by 2030, respectively. The scenario affects the bycatch of waterbirds directly, as 10% higher pressure reductions are projected in the decrease scenario and 10% lower pressure reductions in the increase scenario.

Offshore wind energy production is expected to increase significantly by 2030 based on the scenarios. This increase is 150% in the low, 290% in the most likely, and 350% in the high increase scenario. The assumption on the future development in the extent of wind energy production has a significant effect on the pressure changes for waterbird disturbance from collisions. When no changes in the extent of wind energy production are expected, collisions are expected to decrease by around 25-35%. In the low change scenario, a pressure increase is already expected, but it is considerably lower than in the most likely scenario. Using the high scenario leads to an even higher increase in collisions.

Impact of using literature data on effectiveness of measures

In addition to survey data from experts, literature data on the effectiveness of measures has been compiled. The literature data points have been used in a similar way as the expert survey responses, and when it has been available, it has been used to replace the expert estimates of the effectiveness of the measure type. However, literature estimates are not available for all measure types. Thus, it is not possible to implement the model estimation and provide the results relying entirely on the literature data on effectiveness of measure types. Thus, the model including the literature estimates is a combination of literature and expert data on effectiveness of measure types. The origin of other data components is not affected.

For waterbirds, only 10 estimates from 3 studies could be included in the SOM model. The projected pressure reductions from existing measures are not affected by the inclusion of literature data, as none of the implemented measure types have literature data.

Evaluation of quality and confidence

The SOM analysis for waterbirds has been unable to assess the sufficiency of existing measures to maintain GES or achieve state improvements, due to lack of data mainly on the activity-pressure contributions for waterbird disturbance and displacement. Additionally, results on required pressure reductions and time lags for some species have been left out due to too few data points.

The overall certainty of the assessment for waterbirds could be characterized as moderate. Experts from seven coastal countries contributed to at least some parts of the assessment. The total number of experts contributing to the surveys is relatively high for both the effectiveness of measures and pressure-state part, but the activity-pressure survey suffers from a lack of data, as only three responses from two countries were received. Thus, the results on the sufficiency of measures to maintain GES/achieve state improvements have been excluded due to lack of data on the contribution of activities to pressures. Further, the results on the effectiveness of measure types are rather uncertain.

Quality and precision could potentially be improved with the collection of additional expert responses, particularly for the activity-pressure contributions for waterbird disturbance and displacement by human presence, but, due to the lack of a topic team for waterbirds, a critical review of the topic in collaboration with topic experts is recommended before further work is conducted.

For the individual results, certainty ranges from low to high for the effectiveness of measures types, and from moderate to high for the projected reductions in pressures. Certainty of the estimates of the pressure reduction required to maintain GES or achieve a specific state improvement ranges from low to high. These uncertainties should be kept in mind, in particular when examining the numeric estimates.

The most common confidence level experts reported for their own evaluations is moderate or high for the effectiveness of measures and significance of pressures to state components. For the estimates of required pressure reductions, it is low for common eider, moderate for great cormorant and high for long-tailed duck and red-throated diver.

There were some technical challenges that affected the survey implementation. Firstly, there was a problem in the survey software for the effectiveness of measure types survey that resulted in losing some responses. The original responses became often unusable, as it was not possible to identify which items had been skipped on purpose and which were lost data. This issue was addressed by sending follow-up invitations for experts to review and, when needed, complement their original saved response. Not all experts participated in the review and those responses had to be deleted from the final sample, thus the final numbers presented above represent only those with completed and reviewed responses. Secondly, the simultaneous assessment of effectiveness of a measure type and certainty of that effectiveness proved in some cases difficult, as it required placing non-quantitative dots in a coordinate system to generate quantitative estimates. The dots were translated into

effectiveness and certainty values between 0 and 100. Some experts would have preferred that the quantitative estimates would have been visible and could have been transparently influenced.

When interpreting the results, the assumptions and generalizations that were made when collecting the input data and defining and using the data on measure type effectiveness and pressure-state linkages need to be taken into account. The input data are based mainly on expert elicitations rather than existing models and data and reflect substantial uncertainty. For more information on the SOM methodology, data collection and assumptions, see this document.

It should be stressed that changes in the population of waterbirds are complex. On the one hand, different pressures have an impact on the individual species. On the other hand, these birds are migratory and live in different areas throughout the annual cycle, some of which are many thousands of kilometres apart. It is therefore even for experts generally difficult to predict the effect of individual measures and to weigh the effects against each other.

Reflection on measure types

Measure type design was particularly impacted by lack of a dedicated topic team. While there do not appear to be any systematic flaws, critical review of these measure types in collaboration with topic experts is recommended.

Measure type 54, 'Increased hunting restrictions', is highly sensitive to the magnitude of restrictions implemented. Given that this measure type is structured to reduce the activity of *hunting and population control* from a potentially broad group of measures, the low standard deviation is unexpected and likely points toward an issue with the measure type design or experts' understanding. More development of this and similar measure types sensitive to the magnitude of implementation is recommended.

Effectiveness of measures estimates for *waterbird disturbance and displacement by human presence* were very similar across the measure types. The measure types are quite general; often inheriting the imprecise descriptions from existing measures (Annex 4). This may have resulted in the pattern observed in the effectiveness of measures values. A more targeted approach would be possible in the future, but only if sufficient expertise is available for such an assessment.

Lessons learned

Overall, the SOM analysis for waterbirds suffers from scarcity of data due to low participation of experts to the activity-pressure survey. Thus, not all element of results could be presented. A major drawback was the lack of a topic team to support the development of the topic-specific methodology and the expert survey structures. With this, it is good to acknowledge the feedback from the HELCOM-OSPAR-ICES Joint Working Group on Marine Birds and topic experts from Germany and Sweden that contributed to the format of the data collection for waterbirds and all topics. Further similar work would benefit from close cooperation and active engagement of topic experts.

Issues related to personal expertise of the respondents are present in all of the SOM surveys but were highlighted by topic experts in the case of waterbirds. Due to the personal focus of the experts the results may have been biased towards issues concerning disturbance and mortality from e.g. bycatch and collision, whereas expertise regarding the impact of chemical compounds (hazardous substances) was probably underrepresented. Expertise across species also varied greatly. This might best be resolved through increased emphasis on the ability to skip questions based on personal expertise and broader recruitment of respondents.

Use of results, implications and future perspectives

The results may support further activities regarding the protection of the Baltic Sea, including the breeding, migrating and wintering waterbirds. The study can give important clues about where negative impact is occurring (including cumulative effects) and where action is needed. However, any further planning of details needs accurate analyses about the interplay of activities, pressures and their impact based on scientific studies and population modelling.

References

HELCOM, 2018. State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016. Baltic Sea Environment Proceedings 155.

Annexes

Annexes 1-9 contain the expert surveys as well as information on the measure types and the literature review. They are available on the SOM Platform workspace.

Annex 10 contains graphs that provide additional information and perspectives on the results.

Annex 1 Activity-pressure data

Excel used as a template for receiving data for the activity-pressure survey.

Annex 2 Modified activity list (if modified)

The topic uses the standard activity list; thus, no modified activity list is available.

Annex 3 Measure types list

PDF containing the measure types used in the assessment of the effectiveness of measures for *Waterbirds*. Document includes examples of existing measures that if implemented would be included in the corresponding measure type.

Annex 4 Linking existing measures to measure types

Excel containing the identified existing measures and their relationship to the measure types used in the SOM analysis.

Annex 5 Literature review search terms

Excel containing the search terms used during the literature review on effectiveness of measures for *Waterbirds*.

Annex 6 Literature review summary

Excel document containing the effectiveness of measures data retrieved from the literature review.

Annex 7 Topic structure

Excel containing the relationships between measure types, activities, pressures, state components, and sub-basins. Also contains information on GES thresholds.

Annex 8 Effectiveness of measures survey

PDF of the Effectiveness of measures survey for *Waterbirds*.

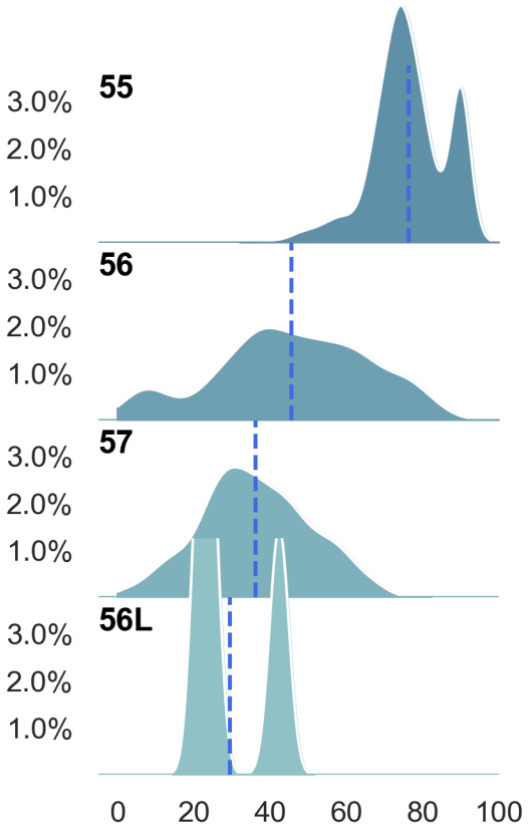
Annex 9 Pressure-state survey

PDF of the Pressure-state survey for *Waterbirds*.

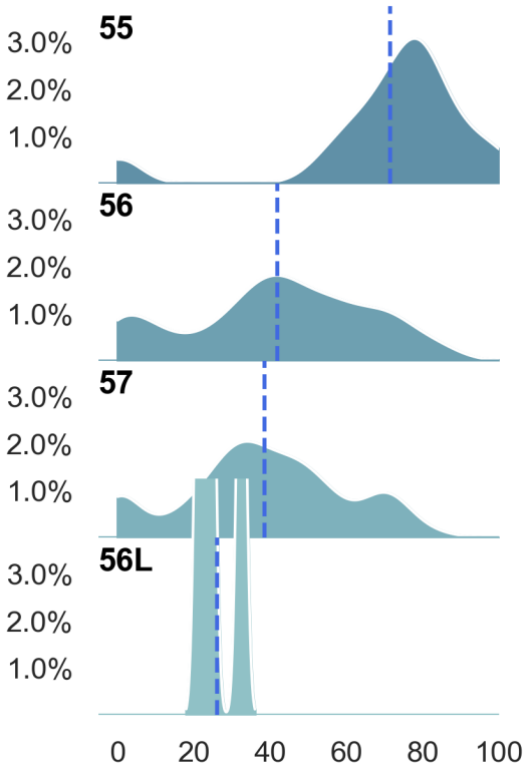
Annex 10 Supplementary results for effectiveness of measures

Table A1. Distribution of the effectiveness of measure types in controlling the pressure *of waterbird bycatch.* The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird bycatch - pelagic feeders
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type: bycatch of waterbirds	55: Reduce fishing effort with gillnets or other gears causing
	56: Reduce bycatch of waterbirds by modifications of fishing gears
	57: Implement fisheries management measures in MPAs
	56L: Reduce bycatch of waterbirds by modifications of fishing gears (literature based)
Expert assessment:	10-11 experts, confidence = high-moderate



Pressure:	Waterbird bycatch - benthic feeders
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type: bycatch of waterbirds	55: Reduce fishing effort with gillnets or other gears causing
	56: Reduce bycatch of waterbirds by modifications of fishing gears
	57: Implement fisheries management measures in MPAs
	56L: Reduce bycatch of waterbirds by modifications of fishing gears (literature based)
Expert assessment:	10-11 experts, confidence = high-moderate



Pressure:	Waterbird bycatch - surface feeders
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type: bycatch of waterbirds	55: Reduce fishing effort with gillnets or other gears causing
	56: Reduce bycatch of waterbirds by modifications of fishing gears
	57: Implement fisheries management measures in MPAs
	56L: Reduce bycatch of waterbirds by modifications of fishing gears (literature based)
Expert assessment:	10-11 experts, confidence = high

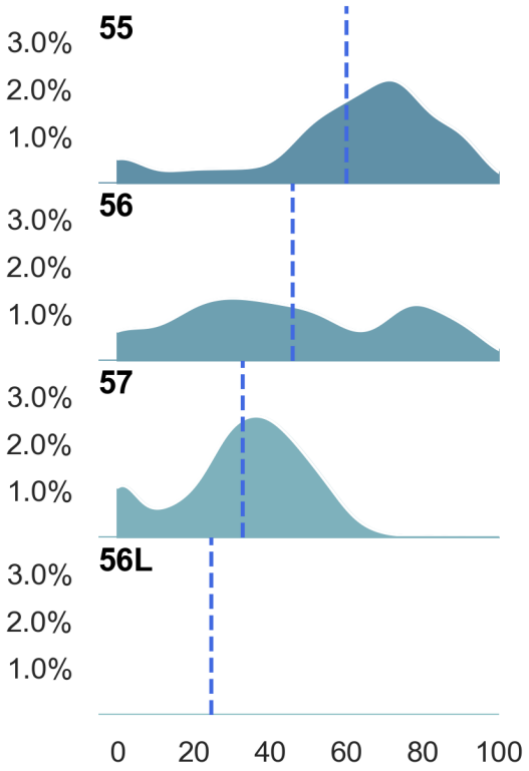


Table A2. Distribution of the effectiveness of measure types in controlling the pressure *of waterbird disturbance: collisions.* The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird disturbance: collisions
Activity:	Renewable energy generation (wind, wave and tidal power), including infrastructure
Measure type:	64: Seasonal or real time (e.g. radar based) closures of wind farms
	63: MSP considers migratory patterns and other sensitive areas
	62: Environmentally sound lighting of offshore installations
Expert assessment:	11 experts, confidence = moderate

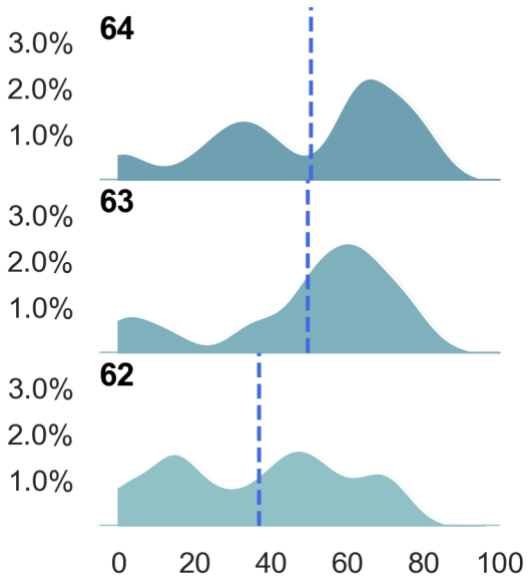


Table A3. Distribution of the effectiveness of measure types in controlling the pressure of *intentional killing of waterbirds.* The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Intentional killing of waterbirds
Activity:	Hunting and population control
Measure type:	54: Increased hunting restrictions
	53: International single species action plan
Expert assessment:	9-11 experts, confidence = moderate

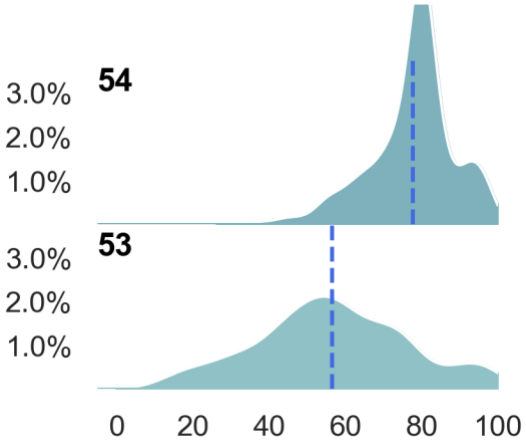
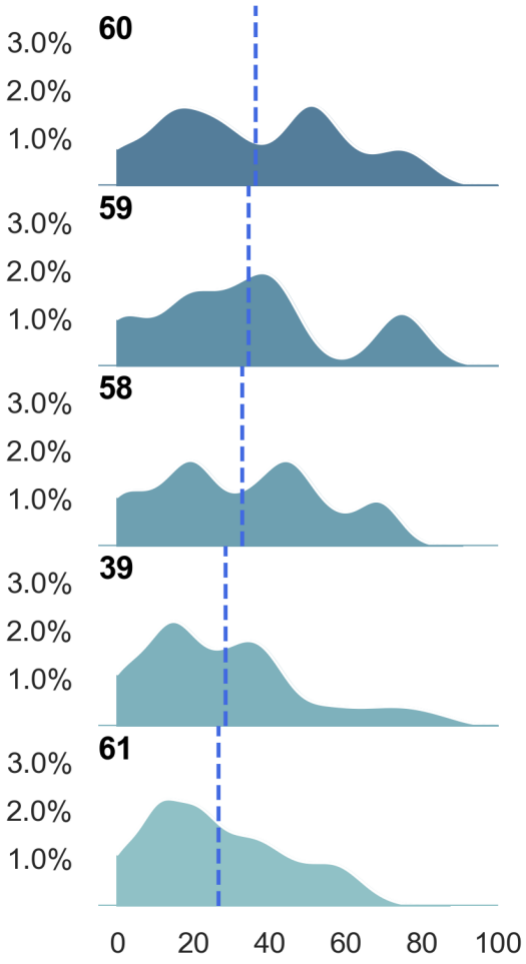


Table A4. Distribution of the effectiveness of measure types in controlling the pressure *of Common eider disturbance and displacement*. The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird disturbance and displacement - Common eider
Activity:	Urban uses (land use), including storm water runoff
Measure type:	60: Measures targeting protection of threatened habitats and biotopes
	59: Strengthen protection in existing marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10 experts, confidence = moderate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Pressure: Waterbird disturbance and displacement - Common eider

Activity: Renewable energy generation (wind, wave and tidal power), including infrastructure

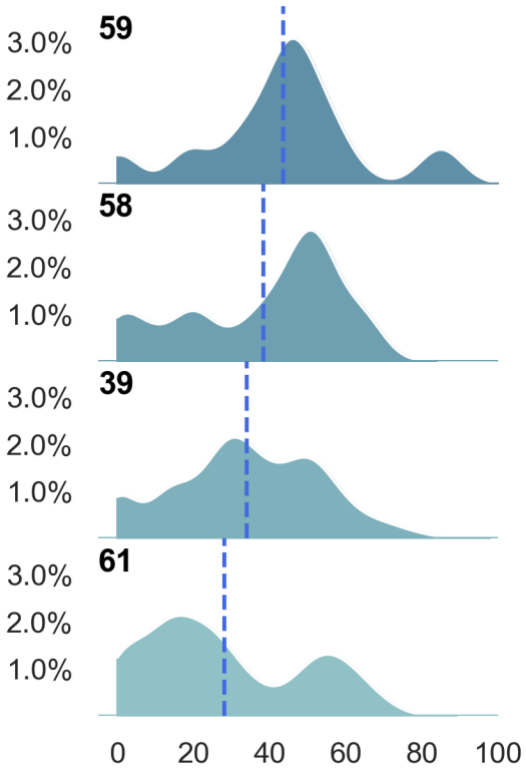
Measure type: 59: Strengthen protection in existing marine protected areas

58: New or expanded marine protected areas

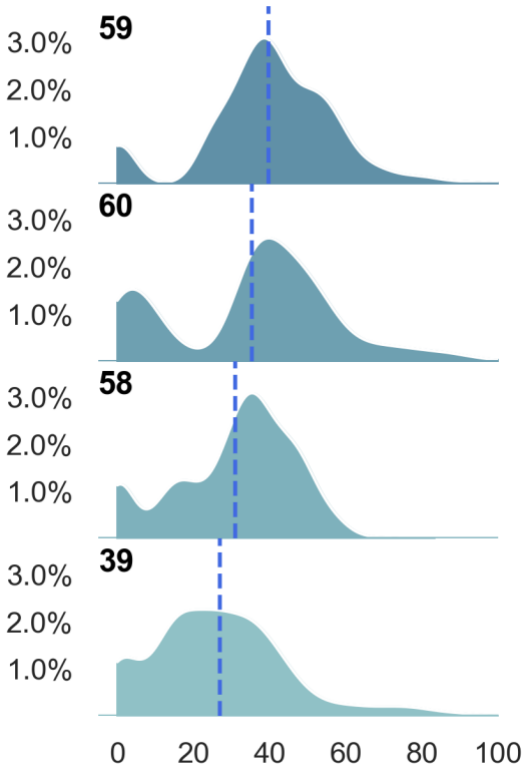
39: Full implementation of the EU Maritime Spatial Planning Framework Directive

61: Strengthened coastal strip management

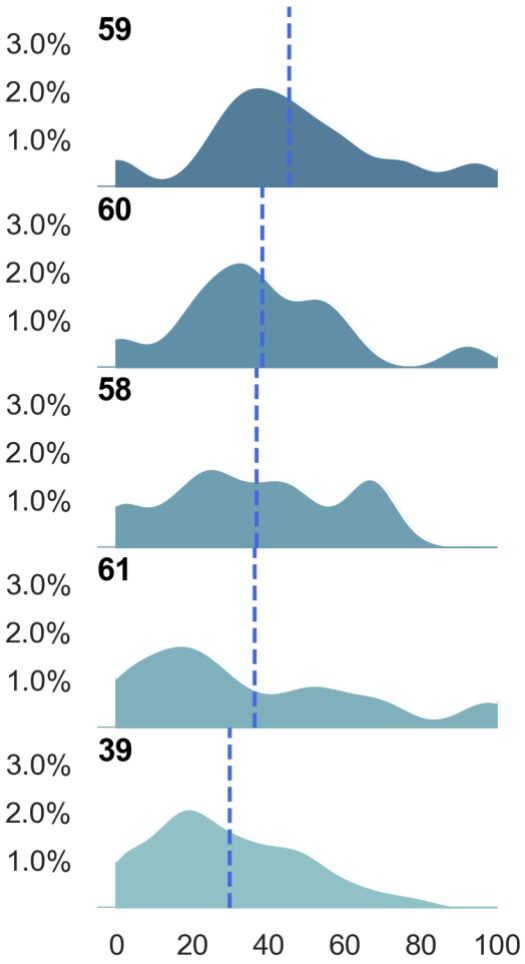
Expert assessment: 10-11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Common eider
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Common eider
Activity:	Tourism and leisure activities (boating, beach use, water sports, etc.)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Common eider
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate

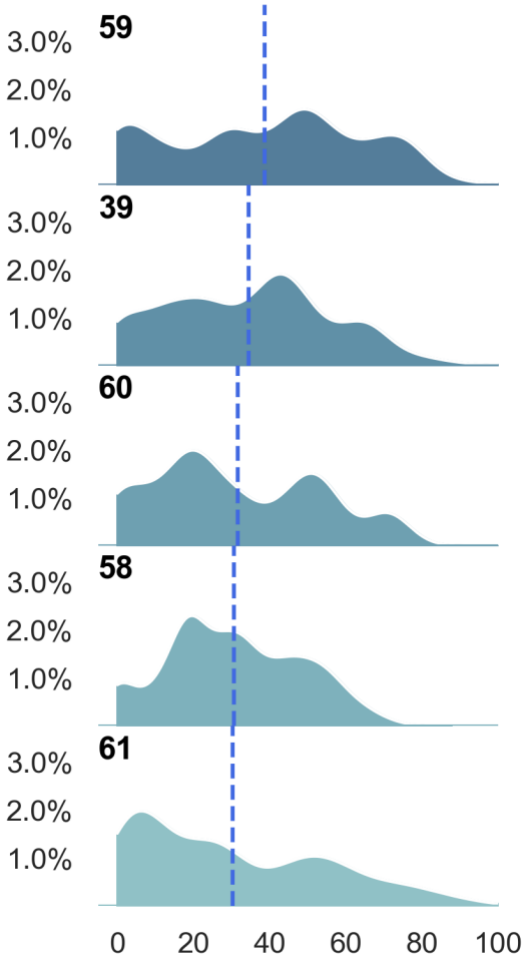
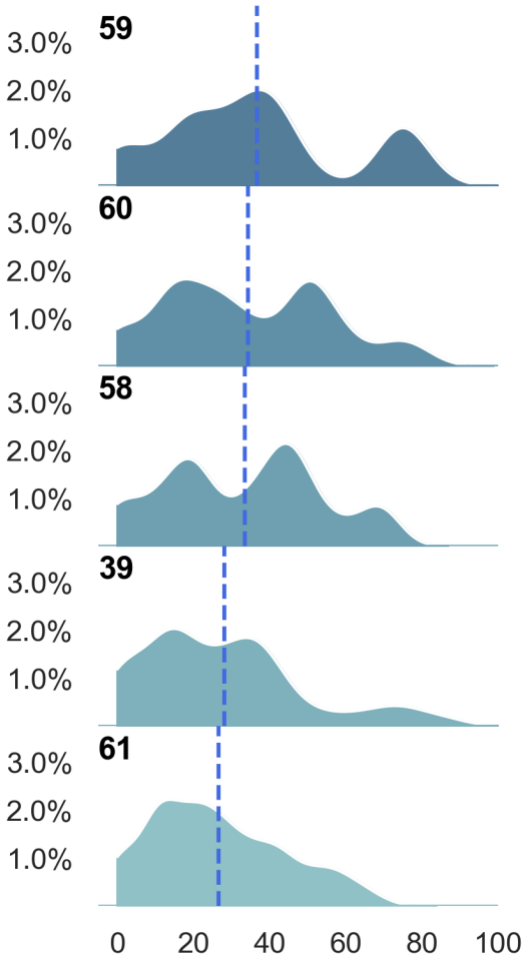
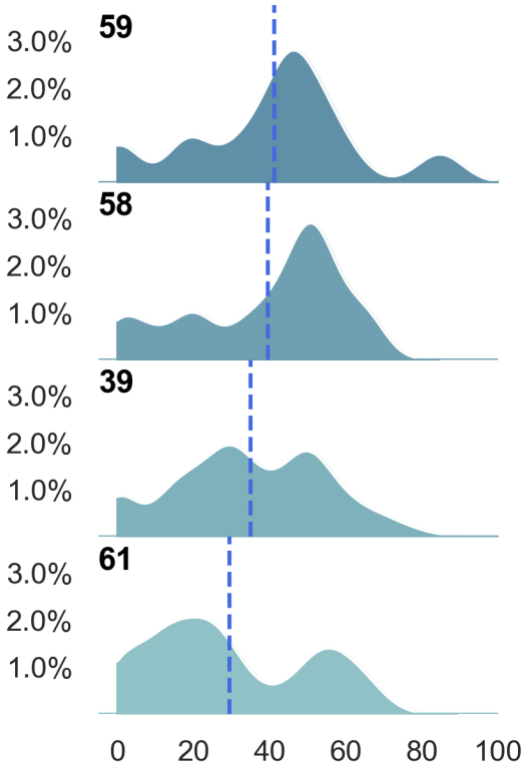


Table A5. Distribution of the effectiveness of measure types in controlling the pressure *of Great cormorant disturbance and displacement.* The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird disturbance and displacement - Great cormorant
Activity:	Urban uses (land use), including storm water runoff
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great cormorant
Activity:	Renewable energy generation (wind, wave and tidal power), including infrastructure
Measure type:	59: Strengthen protection in existing marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate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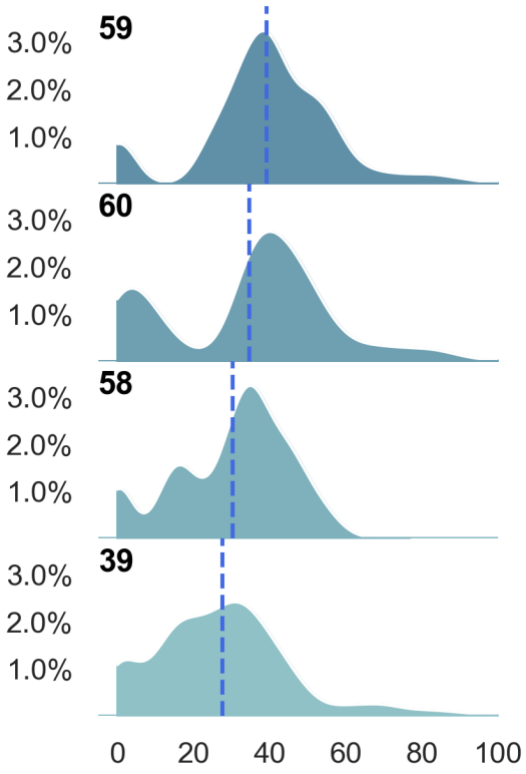
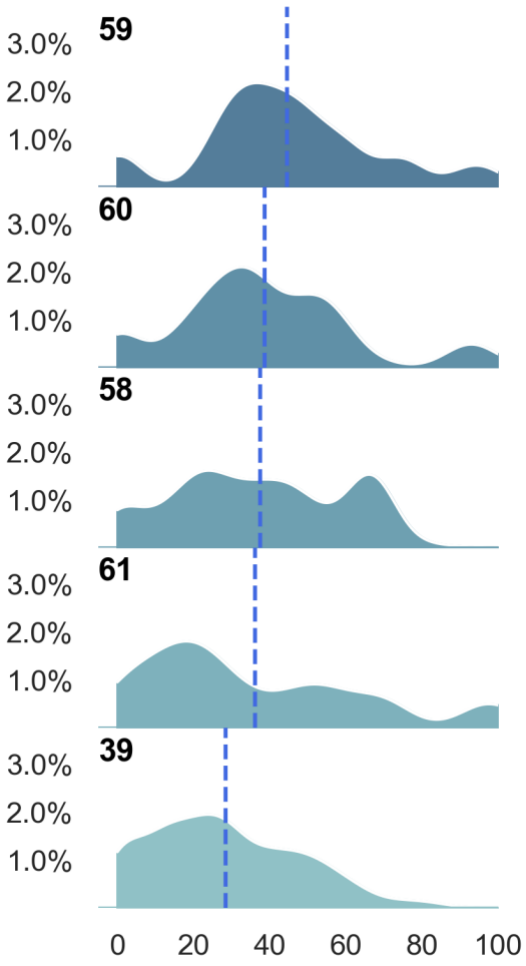
Pressure:	Waterbird disturbance and displacement - Great cormorant
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great cormorant
Activity: etc.)	Tourism and leisure activities (boating, beach use, water sports,
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great cormorant
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate

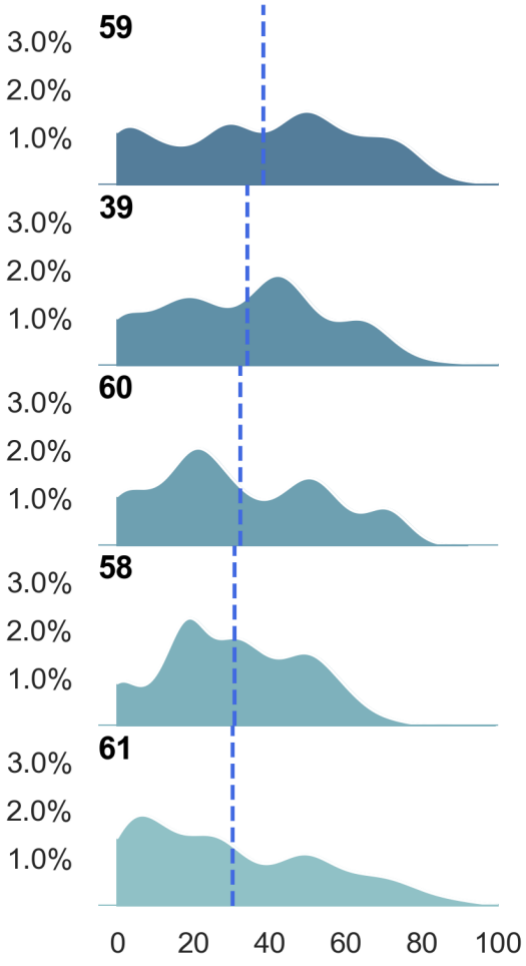
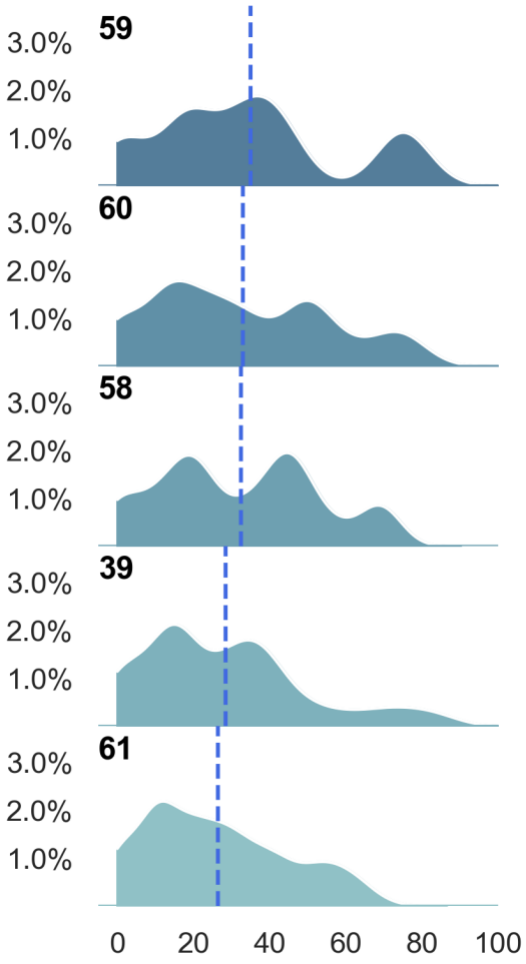


Table A6. Distribution of the effectiveness of measure types in controlling the pressure *of Sandwich tern disturbance and displacement*. The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird disturbance and displacement - Sandwich tern
Activity:	Urban uses (land use), including storm water runoff
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10 experts, confidence = moderate



Pressure: Waterbird disturbance and displacement - Sandwich tern

Activity: Renewable energy generation (wind, wave and tidal power), including infrastructure

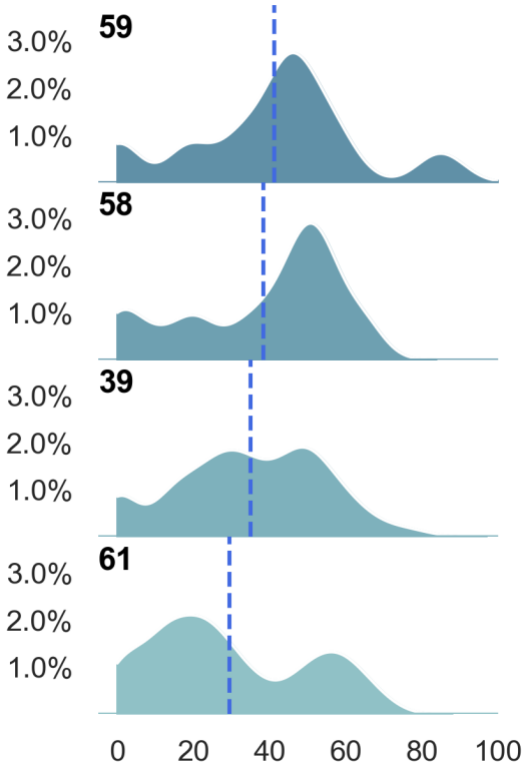
Measure type: 59: Strengthen protection in existing marine protected areas

58: New or expanded marine protected areas

39: Full implementation of the EU Maritime Spatial Planning Framework Directive

61: Strengthened coastal strip management

Expert assessment: 10-11 experts, confidence = moderate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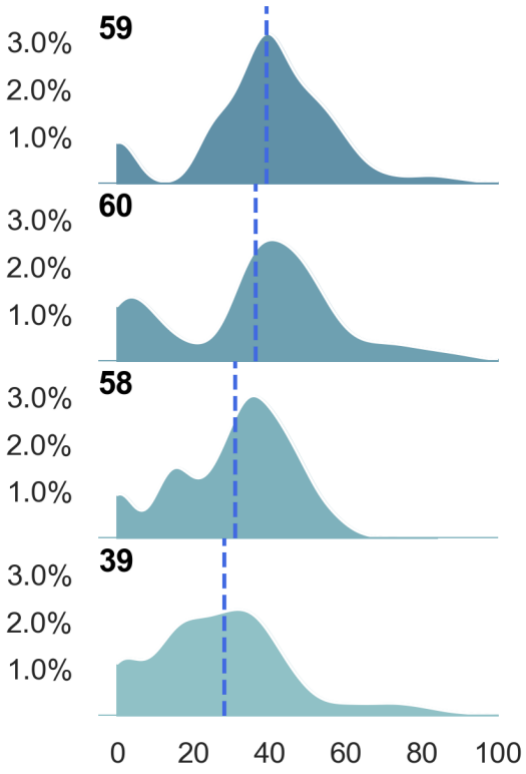
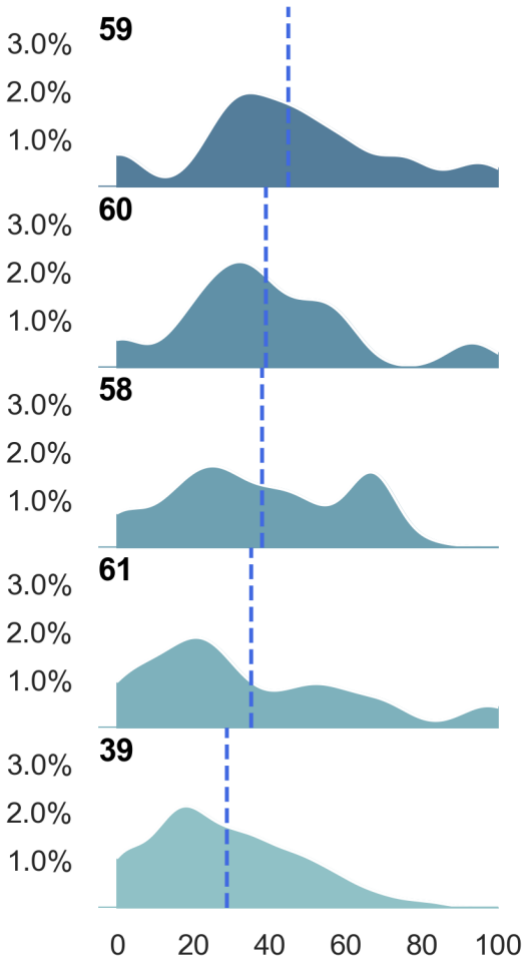
Pressure:	Waterbird disturbance and displacement - Sandwich tern
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Sandwich tern
Activity: etc.)	Tourism and leisure activities (boating, beach use, water sports,
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Sandwich tern
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	58: New or expanded marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate

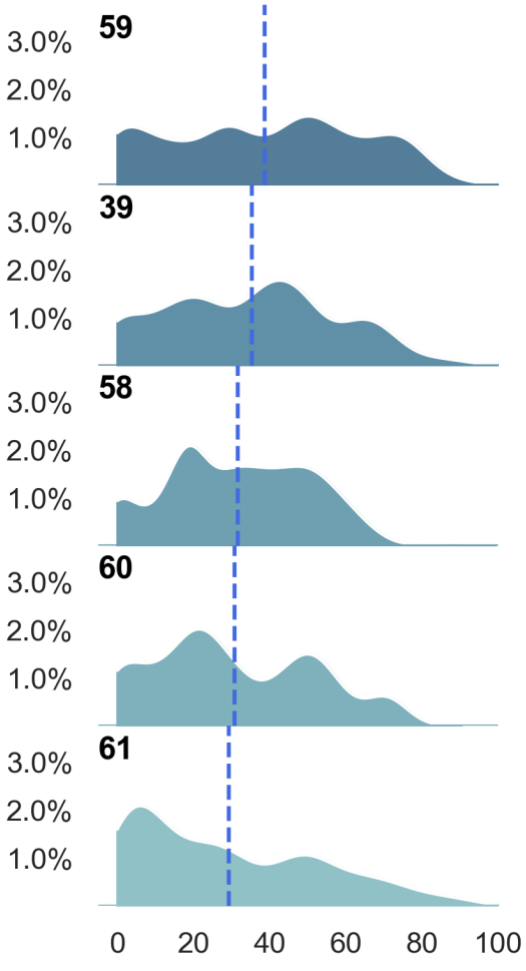


Table A7. Distribution of the effectiveness of measure types in controlling *the pressure of Long-tailed duck disturbance and displacement*. The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure: Waterbird disturbance and displacement - Long-tailed duck

Activity: Urban uses (land use), including storm water runoff

Measure type: 59: Strengthen protection in existing marine protected areas

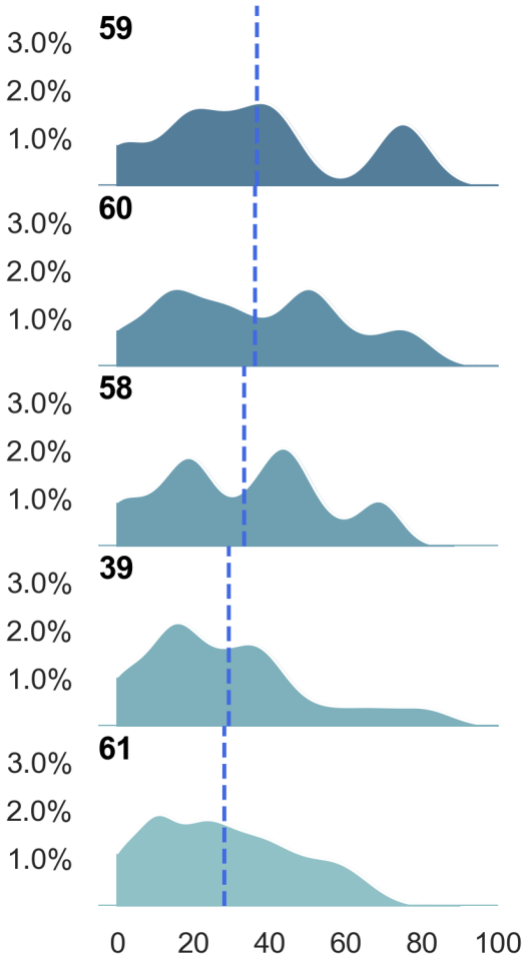
60: Measures targeting protection of threatened habitats and biotopes

58: New or expanded marine protected areas

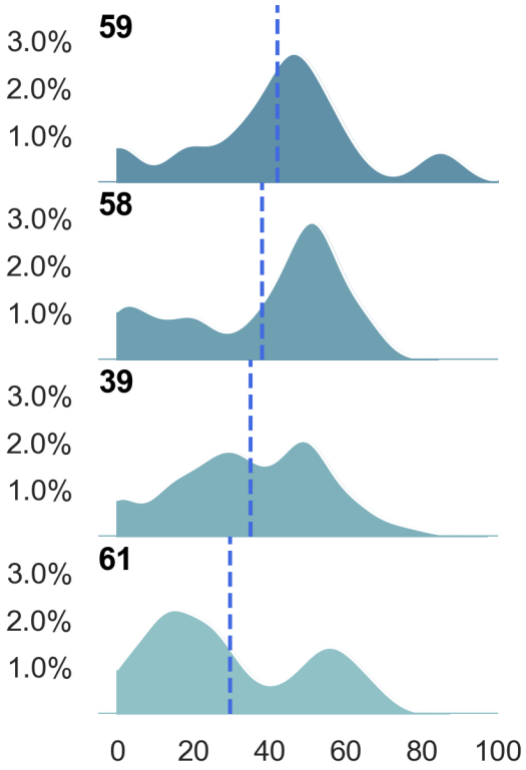
39: Full implementation of the EU Maritime Spatial Planning Framework Directive

61: Strengthened coastal strip management

Expert assessment: 10 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Long-tailed duck
Activity:	Renewable energy generation (wind, wave and tidal power), including infrastructure
Measure type:	59: Strengthen protection in existing marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate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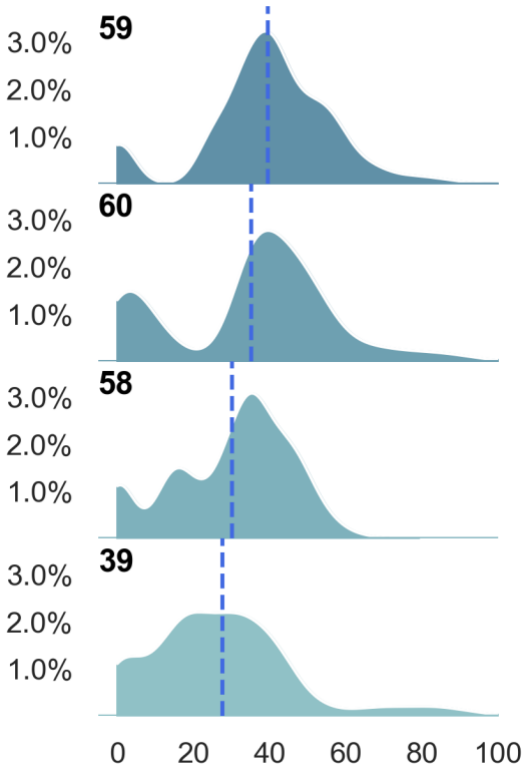
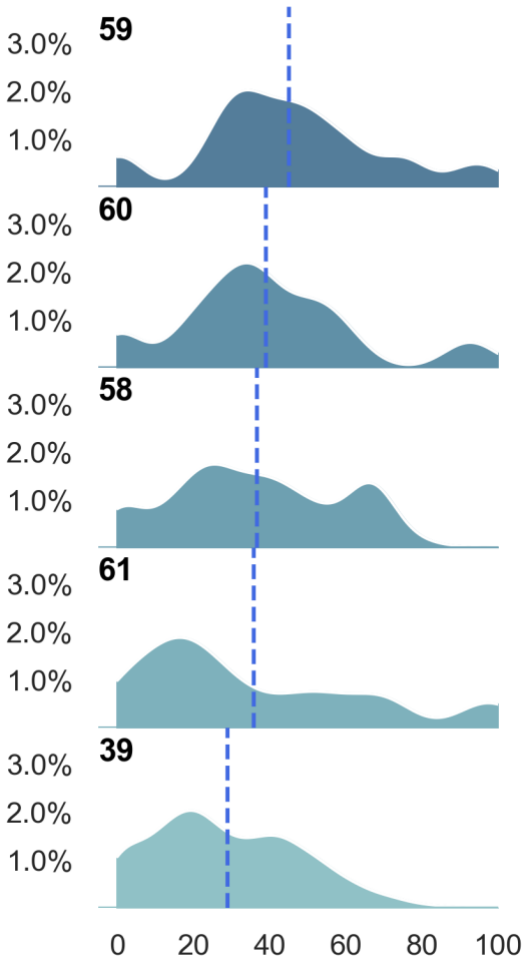
Pressure:	Waterbird disturbance and displacement - Long-tailed duck
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Long-tailed duck
Activity: etc.)	Tourism and leisure activities (boating, beach use, water sports,
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Long-tailed duck
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate

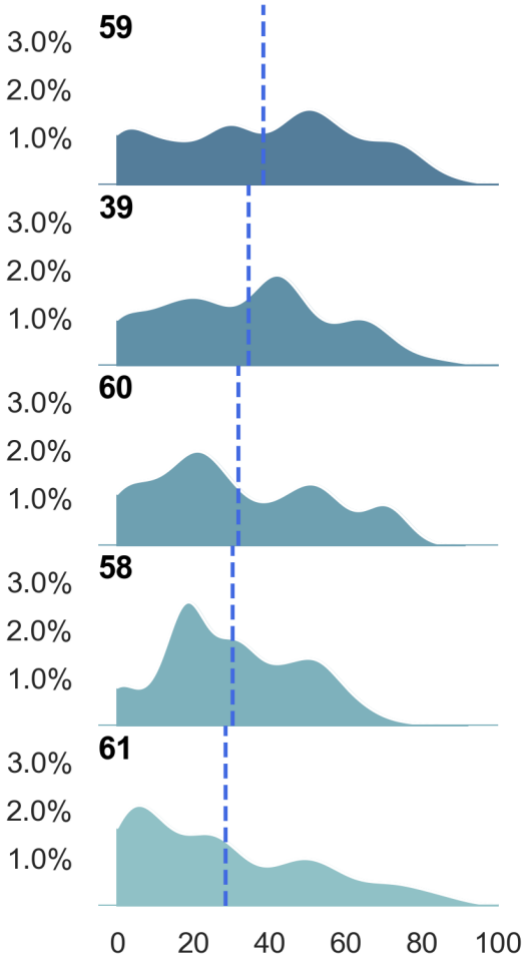


Table A8. ***Distribution of the effectiveness of measure types in controlling the pressure of Red-throated diver disturbance and displacement.*** The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure: Waterbird disturbance and displacement - Red-throated diver

Activity: Urban uses (land use), including storm water runoff

Measure type: 59: Strengthen protection in existing marine protected areas

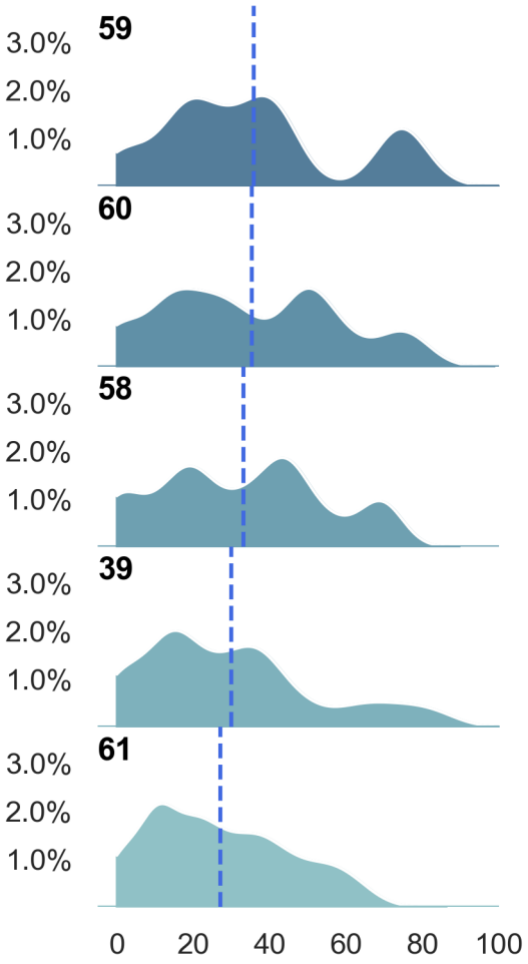
60: Measures targeting protection of threatened habitats and biotopes

58: New or expanded marine protected areas

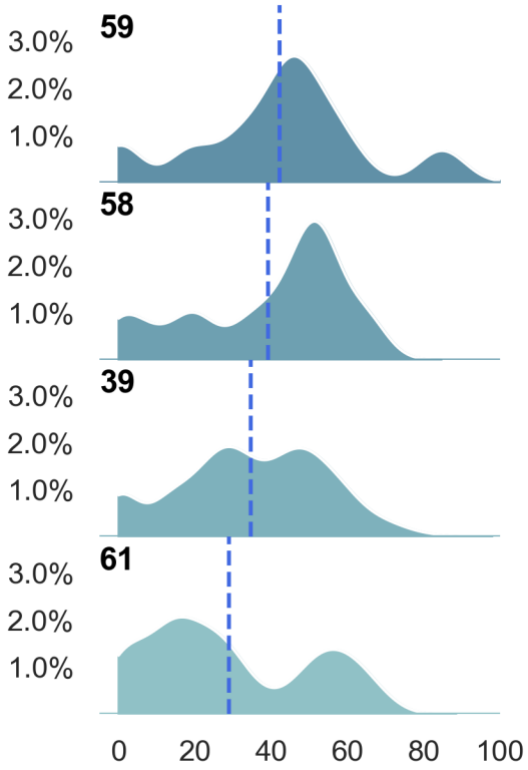
39: Full implementation of the EU Maritime Spatial Planning Framework Directive

61: Strengthened coastal strip management

Expert assessment: 10 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Red-throated diver
Activity:	Renewable energy generation (wind, wave and tidal power), including infrastructure
Measure type:	59: Strengthen protection in existing marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate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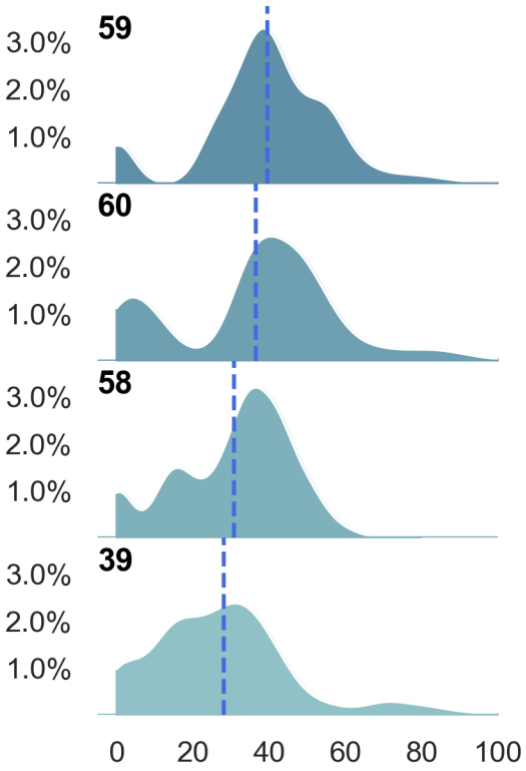
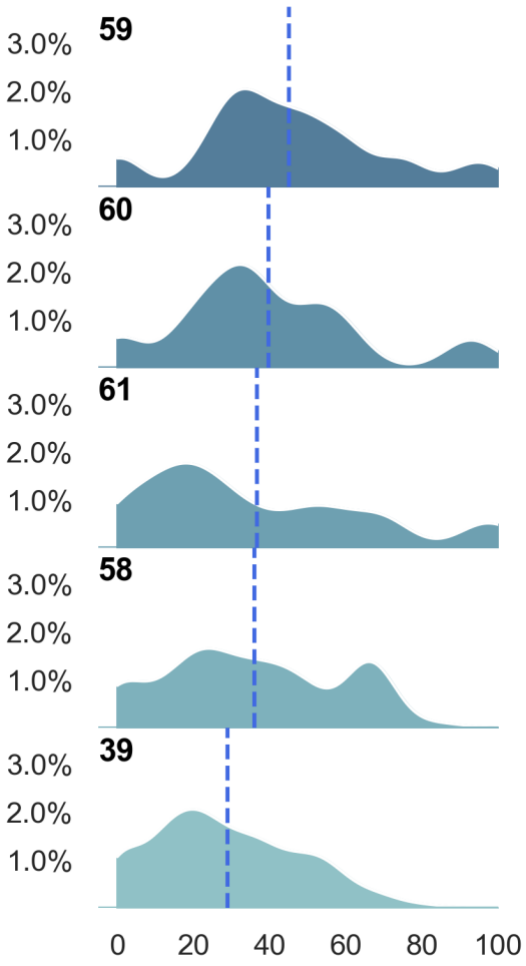
Pressure:	Waterbird disturbance and displacement - Red-throated diver
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Red-throated diver
Activity: etc.)	Tourism and leisure activities (boating, beach use, water sports,
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	61: Strengthened coastal strip management
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Red-throated diver
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate

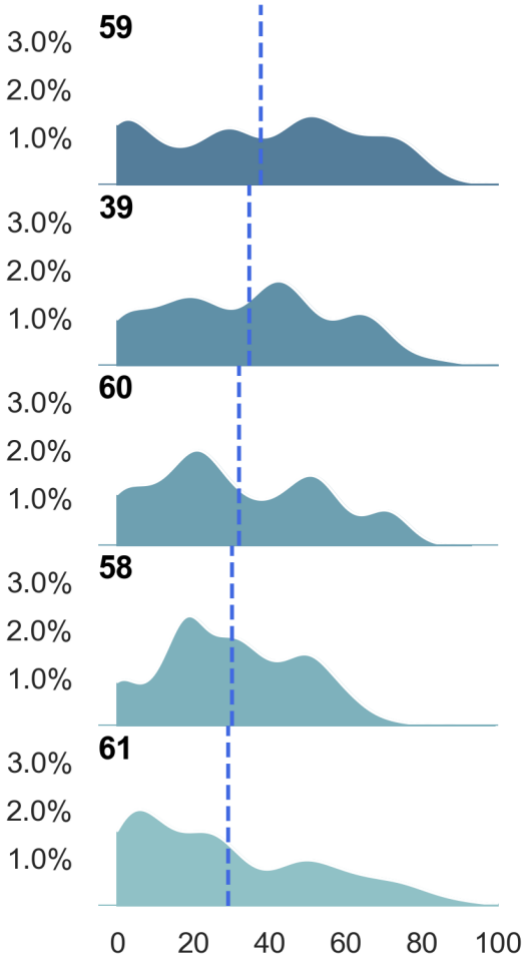
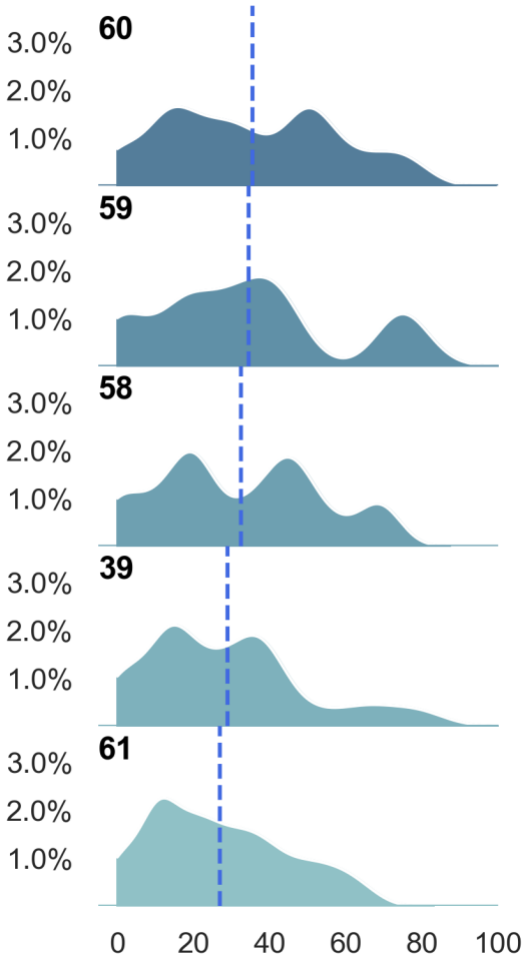
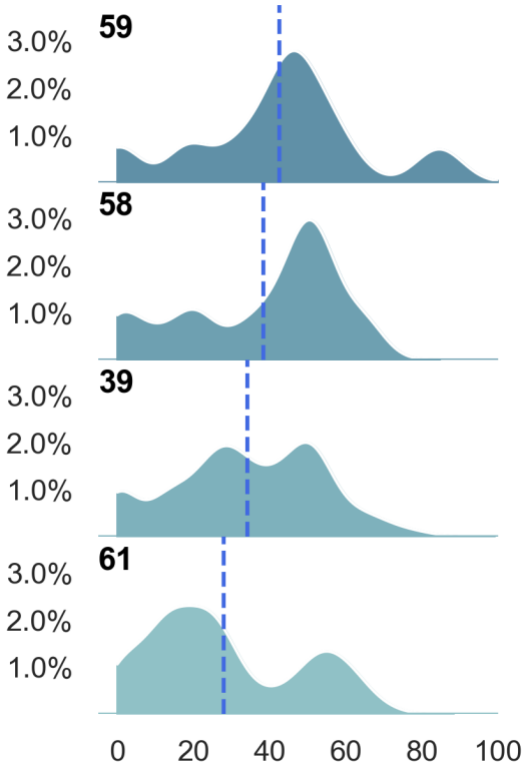


Table A9. ***Distribution of the effectiveness*** **of measure types in controlling the pressure** ***of Great black-backed gull disturbance and displacement.*** The effectiveness of a measure type is the percent reduction in a pressure resulting from a specific activity. The graphs present the probability distribution of effectiveness, based on expert responses or literature estimates. The dashed line represents the expected value. Figures showing only a dashed line and no apparent probability distribution are point estimates without variation.

Pressure:	Waterbird disturbance and displacement - Great black-backed gull
Activity:	Urban uses (land use), including storm water runoff
Measure type:	60: Measures targeting protection of threatened habitats and biotopes
New or expanded	59: Strengthen protection in existing marine protected areas 58: marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great black-backed gull
Activity:	Renewable energy generation (wind, wave and tidal power), including infrastructure
Measure type:	59: Strengthen protection in existing marine protected areas
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	61: Strengthened coastal strip management
Expert assessment:	10-11 experts, confidence = moderate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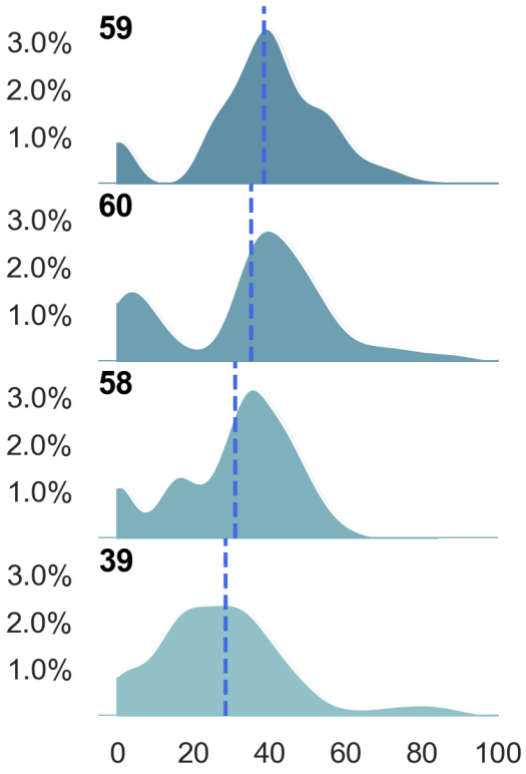
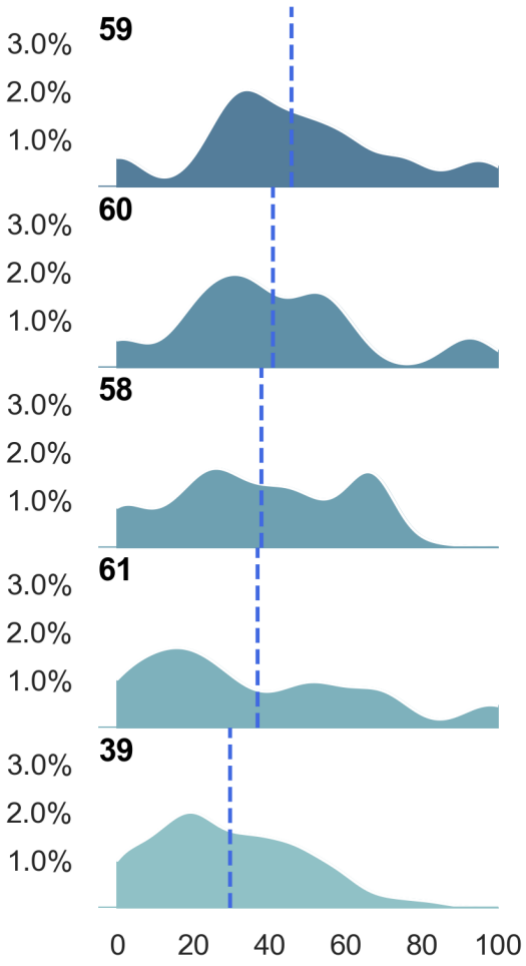
Pressure:	Waterbird disturbance and displacement - Great black-backed gull
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great black-backed gull
Activity: etc.)	Tourism and leisure activities (boating, beach use, water sports,
Measure type:	59: Strengthen protection in existing marine protected areas
	60: Measures targeting protection of threatened habitats and biotopes
	58: New or expanded marine protected areas
	61: Strengthened coastal strip management
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
Expert assessment:	11 experts, confidence = moderate



Pressure:	Waterbird disturbance and displacement - Great black-backed gull
Activity:	Transport – shipping (incl. anchoring, mooring)
Measure type:	59: Strengthen protection in existing marine protected areas
	39: Full implementation of the EU Maritime Spatial Planning Framework Directive
	60: Measures targeting protection of threatened habitats and biotopes
	61: Strengthened coastal strip management
	58: New or expanded marine protected areas
Expert assessment:	10-11 experts, confidence = moderate