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Background

State & Conservation 14-2021 invited JWGBIRD to outline how baselines and threshold values are identified and established for the indicators under the umbrella of its work. This document contains the respective description of a possible pre-core indicator assessing the status of breeding waterbird species by the help of breeding success. The indicator serves the MSFD criterion D1C3.

The document below provides a template filled by indicator leads to provide an overview of progress to STATE & CONSERVATION 15-2021. Key aspects such as methodologies, spatial extent changes, assessment scales and threshold values are presented, identifying ongoing work and other relevant issues towards HOLAS III. This process builds on the prior review of indicator development carried out under STATE & CONSERVATION 14-2021 (summarised in document 4J-16 Rev.1, and detailed within numerous documents under agenda item 4J). The focus of these development works is the completion of indicator development and adjustment work for HOLAS III by the end of 2021, as previously agreed under HOD 57-2019 (document 4-20, Outcomes paragraph 4.51).

The aspect of threshold values in particular is a key issue as threshold value approval will be carried out at HOD 61-2021, with these same templates being submitted to HOD at the same stage as submission to State and Conservation 15-2021 (to allow for the longer national processes required that culminate in approval at HOD).

The document below addresses a single indicator and as well as the generic 'action requests' relating to endorsement of the proposed application in HOLAS III (and the threshold values proposals, where relevant), specific additional requests or statements are also indicated within the separate sections of the document to help guide where further input/discussion/guidance may be needed.

This template aims to report the indicator development for HOLAS III, allowing for technical guidance and endorsement by STATE & CONSERVATION 15-2021 and also simultaneously to facilitate the threshold value approval process by HOD 61-2021.

Action requested

The Meeting is invited to:

- provide further technical guidance to the indicator leads and experts, including specific requests defined within the document;
- consider and endorse the proposed developments of the indicator for use in the HOLAS III assessment via the application of case studies in the HOLAS III thematic assessment to provide supporting contextual information to the overall assessment of waterbirds.

Breeding success of waterbirds

Indicator name
Breeding success of waterbirds
Scale of assessment for HOLAS III and rationale
The indicator shall be applied to seven aggregations of HELCOM Assessment Unit Scale 2 sub-basins (subdivisions hereafter). The subdivisions are the same as in the two waterbird abundance indicators and follow the same rational. They are defined as follows: • A: Kattegat (Kattegat), • B: Belt Group (Great Belt, The Sound), • C: Bornholm Group (Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin), • D: Gotland Group (Gdansk Basin, Eastern Gotland Basin, Western Gotland Basin, Gulf of Riga), • E: Åland Group (Northern Baltic Proper, Åland Sea), • F: Gulf of Finland (Gulf of Finland), • G: Bothnian Group (Bothnian Sea, The Quark, Bothnian Bay). The indicator reflects the breeding conditions for waterbirds and predicts population development under these environmental conditions. Thus, this indicator goes hand in hand with the indicator on the abundance of breeding birds. The aggregation of sub-basins to subdivisions is necessary because the sub-basins themselves are relatively small and do not correspond to the exchange of individuals between and thus the connectivity of the different breeding colonies (Evans 2017). Some species also have large foraging ranges that could lead to the use of multiple sub-basins relatively frequently. This is the case, for example, with the targeted assessment of the Razorbills of Stora Karlsö, whose foraging flights lead into two sub-basins (Isaksson et al. 2019).
Spatial coverage of the indicator for HOLAS III
In principle, the indicator is applicable to the entire Baltic Sea. The coverage of the Baltic Sea in HOLAS III depends on the parts of the Baltic Sea from which breeding success data are available and for which species. If the application of the indicator is limited to the razorbills of Stora Karlsö, then only the Gotland Group subdivision would be considered.
Methodology to be applied for HOLAS III and rationale
The indicator predicts how observed levels of breeding success may impact on the long-term population growth rate of a species. Thresholds are set to indicate when breeding success is low enough to lead to population declines, using IUCN red list criteria to provide context to the extent of the predicted declines (see below). The approach uses simple population models for each species that are validated using the trends in breeding abundance from the HELCOM Core Indicator *Abundance of waterbirds in the breeding season*. The data requirements are as follows: a) breeding seabird colonies (incl. gulls and terns) and breeding waterbirds (incl. waders) nesting close to the coast and using marine environment (e.g. for food) – counts of breeding pairs (preferably or failing that - adults) per species per colony per year; and counts of young fledged from a specified number of monitored pairs or nests (preferably or fail that counts of young hatched), per species per colony per year. These data will be used to produce for each species in each subdivision, trends in annual average breeding productivity from estimates of annual breeding success at each colony that is monitored: *Breeding success per colony = number of young fledged / number of nests (or breeding pairs) monitored*

Examples of trends in breeding productivity of black-legged kittiwake and common guillemot in the Greater North Sea are shown in Figure 1. A six-year rolling mean of breeding productivity is used to smooth the trend (see Figure 1). These smoothed values are used to calculate the new indicator metric – population growth rate (see below).

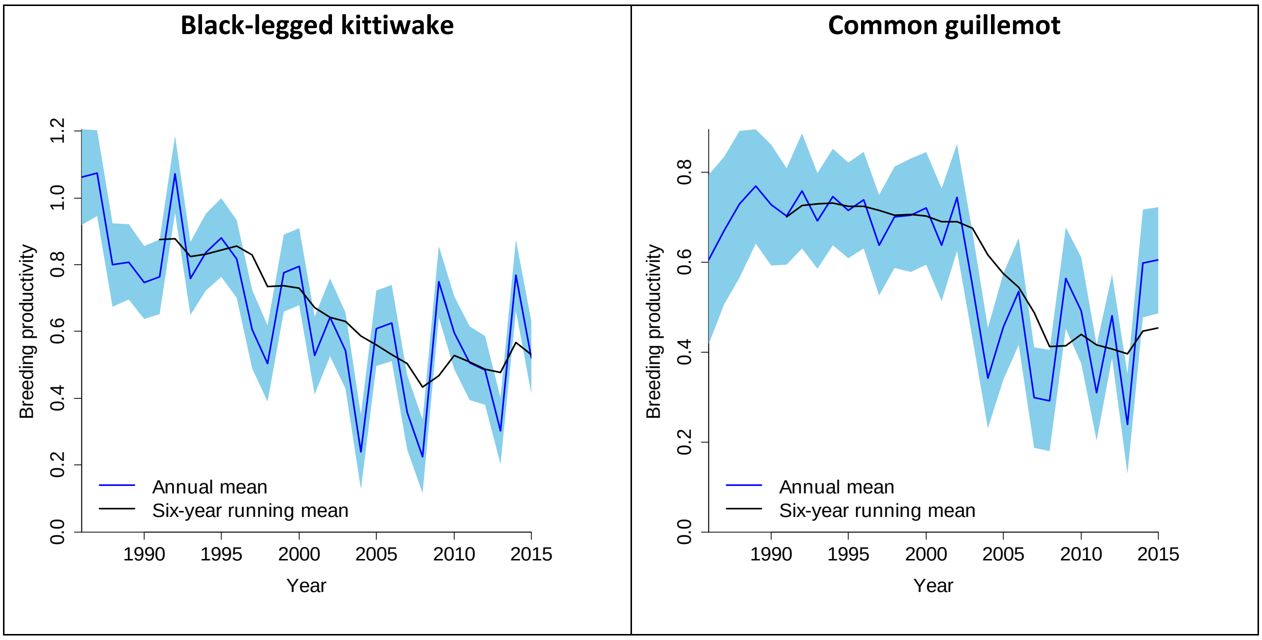

Figure 1: Trends in breeding productivity of black-legged kittiwake (left) and common guillemot (right) in the Greater North Sea. The blue line shows the annual mean breeding productivity, with 95% confidence limits. The black line shows the six-year retrospective running mean. Figures developed by JWGBIRD (ICES 2020).

The metric of the indicator is defined as the factor by which the population grows per year (the ratio of population size in one year compared to population size in the previous year t). This is also known as the finite growth rate and often denoted using the Greek letter λ (lambda). A stable population has a growth rate of 1, a growing or increasing population has a growth rate of greater than 1 and a declining population has a growth rate of less than 1.

Calculation of the metric: The indicator, for each species, consists of estimates of population growth rate calculated from each six-year running mean of annual mean breeding success in each assessment unit. The steps required to calculate the metric and then assess the indicator are detailed in Annex 1. In summary, the population growth rate is calculated using a simple population model, which is constructed for each species. The values of the parameters in the model, other than productivity (i.e. number of age classes and survival rates of each age class), are initially based on expert knowledge and/or values published in the literature (e.g. Horswill & Robinson 2015). The model also makes some basic assumptions that are detailed in Annex 1. The values of the parameters in the model are then adjusted so that the population growth rate predicted by the model mirrors the observed trend in population abundance over the same period, as calculated for the same species in the HELCOM Core Indicator *Abundance of waterbirds in the breeding season* (see Annex 1).
The values of the 6-year running mean breeding success (in Figure 1) are then entered into the population model, in order to calculate for each year the expected (asymptotic) growth rate. These values represent the expected long-term annual growth rate of the population, if breeding productivity was maintained at the mean level observed in the most recent six-year period (see Figure 1).

Threshold value setting logic and rationale
A threshold is set uniquely for each species in each assessment unit to define the growth rate which, if sustained, would lead to a decline in population size of ≥ 30% over three generations, which is consistent with the IUCN red-listing criteria for species that are 'Vulnerable' (IUCN 2012). Generation time is calculated for each species using the population models used to calculate population growth rate (details in Annex 1). Generation time is then used in a simple equation (Annex 1) to calculate the threshold population growth rate equivalent to a 30% decline in population size over three generations (see examples in Figure 2). The threshold for population growth rate will vary between species because of differences in generation time (Figure 2).

Black-legged kittiwake	Common guillemot

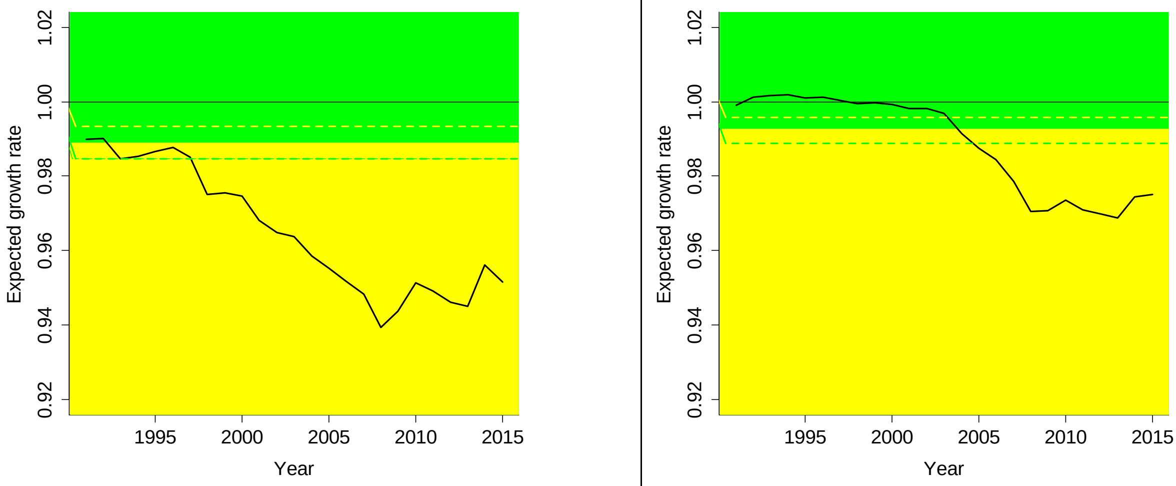

Figure 2: Proposed output: the expected long-term population growth rate (black line), given the six-year retrospective running mean breeding productivity (shown in figure 1), and assuming that survival remains constant. A growth rate of 1.0 (horizontal black line) indicates that the population is stable. Green background indicates when the population is growing, is stable or is declining by less than 30% over three generations. Yellow background indicates when the population is declining by more than 30% over three generations. The dashed lines denote the 95% confidence interval around the threshold growth rate that is equivalent to a decline of 30% over three generations. Examples for black-legged kittiwake and common guillemot in the Greater North Sea developed by JWGBIRD (ICES 2020).

Growth rates lower than the threshold described above can be put into context of the likely future prospects of the population by using coloured bands showing the growth rates equivalent to the other IUCN red-list criteria (IUCN 2012), as shown in Figure 3:

CR (critically endangered):	≥ 80 % decline
EN (endangered):	≥ 50 % decline
VU (vulnerable):	≥ 30 % decline

Black-legged kittiwake	Common guillemot

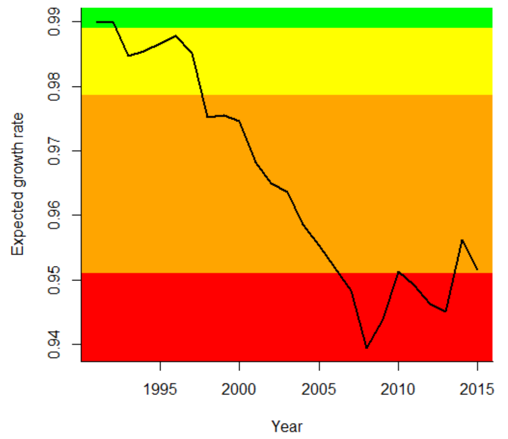

Figure 3: Predicted future prospects: the expected long-term population growth rate (black line), in the context of IUCN Red list categories. The background colours show the IUCN red list category corresponding to the expected growth rate, given the calculated generation time. Green: Least Concern/Near Threatened, yellow: Vulnerable (≥ 30% decline over three generations), orange: Endangered (≥ 50% decline over three generations), red: Critically Endangered (≥ 80% decline over three generations). Examples for black-legged kittiwake and common guillemot in the Greater North Sea developed by JWGBIRD (ICES 2020).

The logic behind this threshold setting is that a species cannot be in good status if the observed rate of productivity threatens the population. Problems in the environment acting on the breeding productivity can be detected immediately, therefore this indicator can serve as an early-warning system. It can be predicted whether a species is threatened or not under the given conditions and the respective breeding productivity.
There is a clear link to the policy relevance of the indicator:
The *Baltic Sea Action Plan* aspires to *viable populations of the species* as well as *thriving and balanced communities of plants and animals*. Both objectives can only be achieved if species are not declining to a degree leading to being threatened. Sufficient breeding productivity is a crucial component for a viable population.
Furthermore, the threshold is strongly linked to the MSFD, because the biodiversity criterion D1C3 states that *the population demographic characteristics of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures* (Commission Decision 2017/848). Breeding productivity is a crucial population demographic characteristic, and as breeding productivity is often linked to anthropogenic pressures such as disturbance, it is well suited to assess the status of a species.

Threshold value(s)

The threshold values are species-specific because of differences in generation time. Threshold values for razorbill (and where appropriate for other species) will be developed after adoption of the indicator for a pilot assessment in HOLAS III. A numeric value cannot be given at this stage.

Other significant issues that need to be addressed or presented to State and Conservation

The indicator concept was developed by the OSPAR/HELCOM/ICES Joint Working Group on Marine Birds (JWGBIRD) as a new assessment approach for the OSPAR Common Indicator *B3 Marine Bird Breeding Success*. From the beginning, the aim of JWGBIRD was to prepare this indicator for application also in waterbird assessment in the Baltic Sea under HELCOM, underlining the explanatory power of the

indicator for status assessments of the marine environment, but also recognising that HELCOM Contracting Parties have few data available to inform this indicator.
For HOLAS III, a pilot assessment is targeted for razorbills *Alca torda* breeding on the island of Stora Karlsö near Gotland/Sweden (located in the Baltic Sea subdivision Gotland Group, see above). Breeding productivity has been monitored there for many years.
If after adoption by State & Conservation 15-2021 Contracting Parties can identify additional time series of waterbird breeding success, the indicator could be extended to more species and other subdivisions.
This template was circulated among all experts of the OSPAR/HELCOM/ICES Joint Working Group on Marine Birds (JWGBIRD) for reviewing and commenting. Comments have been received from experts in HELCOM Contracting Parties (DK, PL) and have been taken into account in the preparation of the final version.

Latest indicator report or (for new indicators) initially completed indicator template

Originally, the breeding productivity of waterbirds was part of the indicator on the abundance of breeding waterbirds. However, an assessment has not yet taken place. Some basic discussion of the topic is included in the last report on the abundance indicator:

HELCOM 2018. Abundance of waterbirds in the breeding season. HELCOM Core Indicator Report. https://helcom.fi/media/core%20indicators/Abundance-of-waterbirds-in-the-breeding-season-HELCOM-core-indicator-2018.pdf

References

Evans TJ 2017. Across landscapes and seascapes. The movement ecology of diving and flying guillemots and gulls during breeding. PhD Thesis, Lund University.
Horswill C & Robinson RA 2015. Review of seabird demographic rates and density dependence. JNCC Report 552.
ICES 2020. Joint OSPAR/HELCOM/ICES Working Group on Seabirds (JWGBIRD; outputs from 2019 meeting). ICES Scientific Reports 2:80. 101 pp.
http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/EPDSG/2020/Joint%20OSPAR%20HELCOM%20ICES%20Working%20Group%20on%20Seabirds%20(JWGBIRD;%20outputs%20from%202019%20meeting).pdf
Isaksson N, Evans TJ & Åkesson S 2019. Foraging behaviour of Razorbills Alca torda during chick-rearing at the largest colony in the Baltic Sea. Bird Study 66: 11-21.