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ICES SPECIAL REQUEST ADVICE:
EU REQUEST ON SUPPORT FOR THE IMPLEMENTATION OF THE ACTION PLAN FOR HARBOUR PORPOISE IN THE BALTIC SEA (BALTIC PROPER)

(Prepared by ICES)

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EU request on support for the implementation of the Action Plan for harbour porpoise in the Baltic Sea (Baltic Proper)

Advice summary

Due to lack of information from the Baltic Proper, ICES drew on evidence on fishing métiers most likely to cause bycatch of the Baltic Proper harbour porpoise from other areas in the Northeast Atlantic (including the Belt Sea). Métiers with a substantial risk of bycatch identified were set gillnets and trammel nets.

By using data from all sizes of vessels, ICES mapped the fishing effort by quarter of set gillnets and trammel nets for 2021 and 2022. Fishing effort is mapped at the available spatial resolution of an ICES rectangle (0.5 × 1 degrees), equalling an area of approximatively 60 × 60 km.

An existing method for bycatch risk assessment (ByRA; Verutes *et al*., 2020) was used as a proxy to estimate the relative bycatch risk for Baltic Proper harbour porpoise. The relative bycatch risk was determined from the temporal and spatial overlap between the harbour porpoise detection probability data, which served as a proxy for habitat suitability, and the fishing effort data.

The relative bycatch risk of harbour porpoise, based on relative ranks, is mapped for each quarter of the year for ICES rectangles in the Baltic Sea. High bycatch risk is driven by high harbour porpoise habitat suitability and consistently high fishing effort, specifically set gillnets with medium and large mesh sizes.

ICES recommends improvements in the monitoring of the population and fishing effort data, in the case of the Baltic Proper harbour porpoise. However, a sustainable population could not be achieved without the implementation of the management measures previously advised (ICES, 2020a).

Request

DGMARE Special request to ICES:

ICES is requested to:

Concerning the Harbour Porpoise in the Baltic Sea,

- *a)* *assess the fishing gears most likely to cause by-catches of harbour porpoise, based on experience and data from areas where the porpoises are abundant;*
- *b)* *map the fishing effort deployed using those gears in 2021 (and if possible 2022) at c-square resolution;*
- *c)* *develop a proxy for risk of incidental catches of Baltic Sea harbour porpoise based on the distribution of high-risk fishing effort and its overlap with the distribution of harbour porpoise as assessed in SAMBAH surveys or other means;*
- d) *rank the c-squares corresponding to the top 10, 20, 30, 40 and 50% of the Baltic Sea area in terms of risk caused to the porpoise population and present the resulting spatial patterns.*

Elaboration on the advice

Harbour porpoise is the only resident cetacean species in the Baltic Sea, with two distinct populations: the Baltic Proper population and the Belt Sea population (Amundin *et al*., 2022; Celemín *et al*., 2023). The Baltic Proper population remains categorized as Critically Endangered on the IUCN red list and is estimated to consist of fewer than 500 individuals (Amundin *et al*., 2022). The Belt Sea population has a much higher abundance, estimated at over 14 000 individuals (Gilles *et al*., 2023).

The two populations overlap in the western Baltic Sea primarily during the wintertime, while there is a clear spatial separation between the two populations during the reproduction period in summer (Benke *et al*., 2014; Carlén *et al*., 2018; Celemín *et al*., 2023).

To immediately reduce bycatch of Baltic Proper harbour porpoise, ICES has previously advised a combination of spatial-temporal closures and application of pingers in static nets (i.e. trammel net, gillnet, and semi-driftnet) fisheries (ICES, 2020).

In the same advice, ICES has further stated that to meet the management objective of achieving bycatches of Baltic Proper harbour porpoise below the potential biological removal limit (0.7 individuals per year; NAMMCO–IMR, 2019), all fisheries of concern as listed above should be closed.

Fishing gears most likely causing bycatches of harbour porpoise

Due to the extremely low abundance of Baltic Proper harbour porpoise and low monitoring effort, recordings of bycatch events of harbour porpoise in the Baltic Proper are very rare (ICES, 2020b). Therefore, ICES drew on evidence on fishing métiers most likely to cause bycatch of the Baltic Proper harbour porpoise from other areas in the Northeast Atlantic (including the Belt Sea).

The métiers identified with the highest risk of bycatch were set gillnets (GNS), trammel nets (GTR), and driftnets, followed by bottom and midwater otter trawls and midwater pair trawls. No bycatch of harbour porpoises was reported in longlines or pots.

Based on this evidence, this advice focuses on GNS and GTR.

Spatial mapping of fishing effort

The spatial resolution of fishing effort is 0.5 × 1 degrees, which follows the spatial resolution of ICES rectangles.

ICES has analysed spatial fishing effort, expressed as days at sea, by the following six gear groups according to métier and mesh size: GNS < 90 mm, GNS 90–156 mm, GNS ≥ 157 mm, GTR < 90 mm, GTR 90–156 mm, and GTR ≥ 157 mm. For each gear group and year (2021 and 2022), fishing effort maps were plotted (figures 1 and 2).

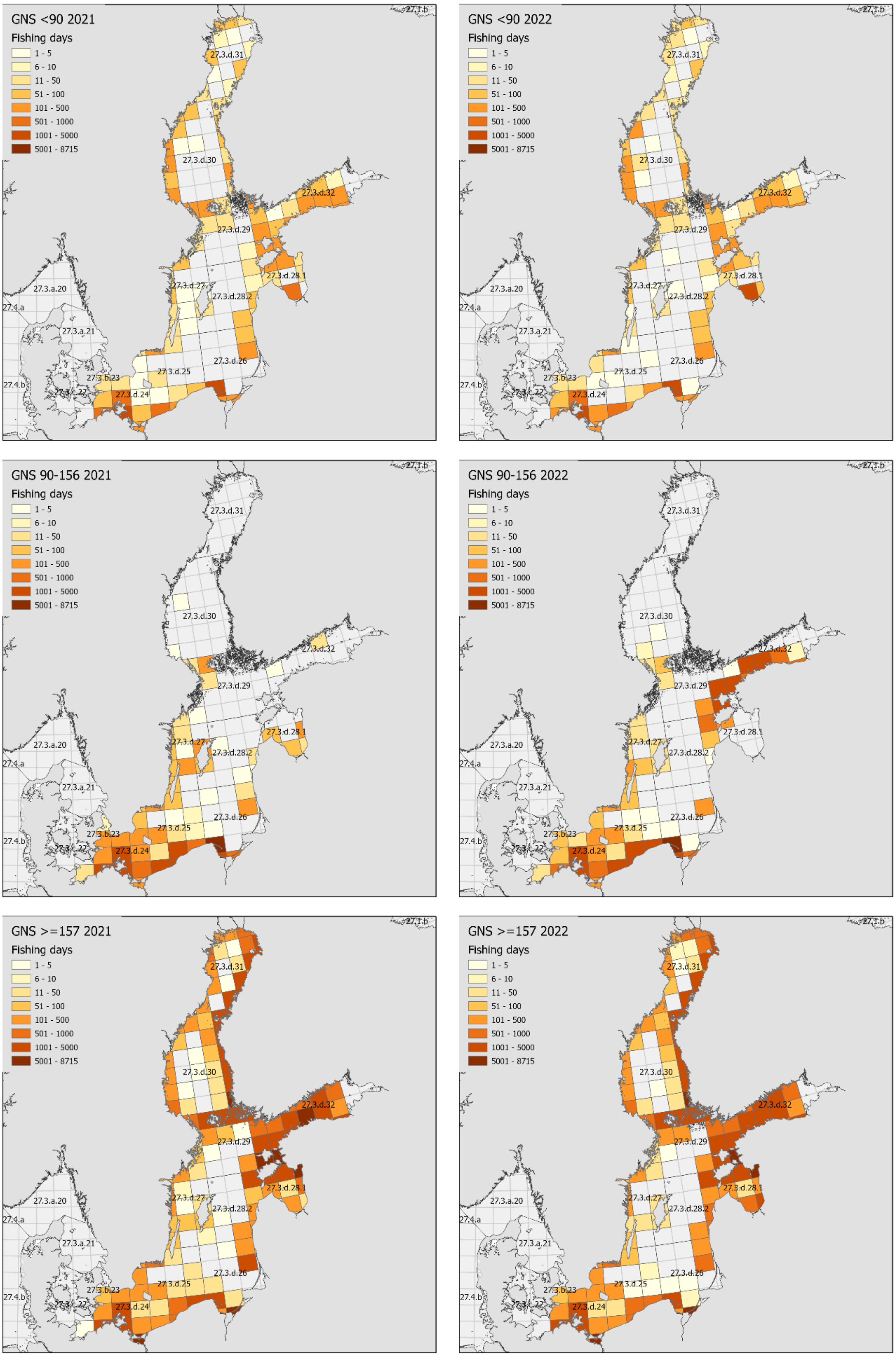

Figure 1 Fishing effort of set gillnets (GNS) with mesh sizes < 90 mm (upper panels), 90–156 mm (middle panels), and ≥ 157 mm (lower panels) by ICES rectangle (0.5 × 1 degrees) in the Baltic Sea in 2021 and 2022.

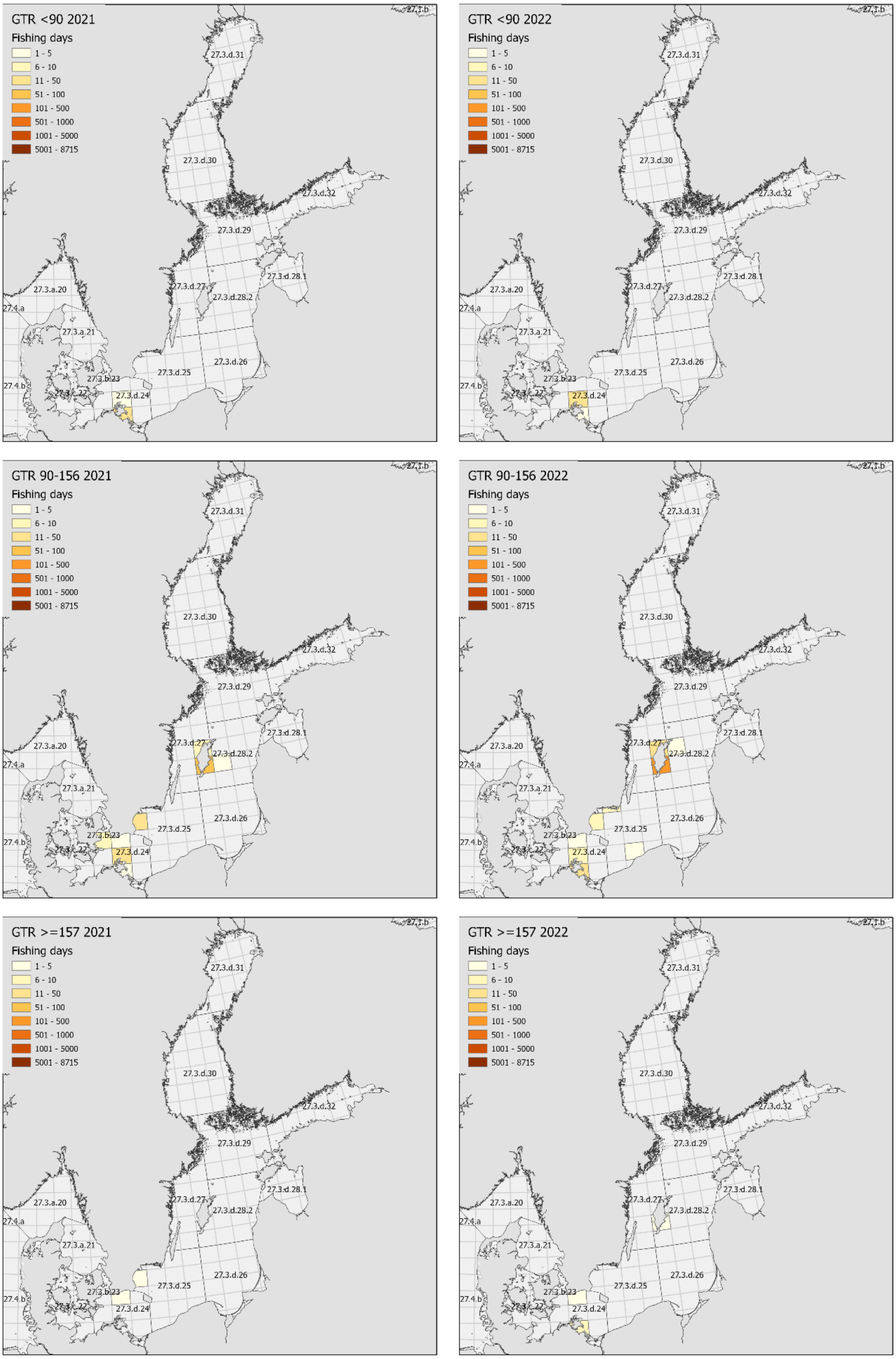

Figure 2 Fishing effort of trammel nets (GTR) with mesh sizes < 90 mm (upper panels), 90-156 mm (middle panels), and ≥ 157 mm (lower panels) by ICES rectangle (0.5 × 1 degrees) in the Baltic Sea in 2021 and 2022. The mesh size corresponds to the middle section of the trammel net.

Assessment of spatial bycatch risk of harbour porpoise

In lieu of bycatch data, a method for bycatch risk assessment initially developed for marine mammal bycatch (known as "ByRA"; Verutes *et al*., 2020) was adapted as a proxy to estimate bycatch risk for Baltic Proper harbour porpoise. ICES has previously used ByRA for seabird bycatch advice (ICES, 2023).

ByRA uses a framework based on a productivity-susceptibility analysis, which assesses and visualizes bycatch risks spatially and seasonally. This method evaluates bycatch risk for each grid cell of predefined dimensions within the study area, providing a way to compare and identify areas and seasons of concern.

The fishing effort data was available by ICES rectangle (ca. 60 × 60 km). Within each rectangle and for each métier, only the highest value of fishing effort in 2021 or 2022 was used. Area adjustments were applied to account for varying fishable areas within the rectangles, to adjust the fishable area within each rectangle by subtracting any land mass area from the total area of each ICES rectangle. Existing bycatch mitigation measures, such as spatial and temporal area closures, were not included in the ByRA calculations because they are assumed to be reflected in the fishing effort data.

The analysis was conducted for each quarter of the calendar year, aligning with the minimum temporal resolution available from the fishing effort data. Survey data from the Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise (SAMBAH) project (from April 2011 to July 2013, comprising 5 404 month/time/station records) were used to model the probability of detection of harbour porpoise (Carlén *et al*., 2018). Presence/absence modelling was carried out with a monthly temporal resolution, where any station that had at least one detection of a harbour porpoise in each month was considered a presence, and any station that did not have a detection in that month was considered an absence. The monitoring stations were placed approximately 23.5 km apart, and the average effective detection radius of the harbour porpoise click detectors (C-PODs) were calculated to be around 20 m (Amundin *et al*., 2022). The available harbour porpoise detection probability data were matched to each quarter by calculating mean detection densities across the three months. The resulting data, a proxy for harbour porpoise habitat suitability over the SAMBAH survey area, were grouped by summer (May–October) and winter (November–April) periods (Figure 3). This approach does not assess possible overlaps between the harbour porpoise populations of the Baltic Proper and the Belt Sea.

The two datasets used in the advice have different spatial resolutions: the fishing effort data have a coarse spatial resolution at ICES rectangle scale, while the harbour porpoise habitat suitability data are available at much finer spatial scale (see above). To align these two datasets, the criterion "spatial overlap" was evaluated at spatial resolution of 5 × 5 km grid cell. It was assumed that the fishing effort is evenly distributed within each ICES rectangle. The percentage of overlap in each grid cell was categorized as low (1), medium (2), and high (3). Low (1) equals < 10% of species overlap with gear and (high) 3 equals > 30% of species overlap with gear.

The criterion "likelihood of interaction with gear" was evaluated at the scale 2–6 based on fishing effort (intensity in days at sea) and harbour porpoise habitat suitability. The criterion "likelihood of interaction with gear" was evaluated at spatial resolution of 5 × 5 km grid cell. The likelihood of interaction with gear was calculated as the sum of habitat suitability ranking (1−3; Figure 3) and a combined fishing occurrence and gear-type intensity rating, classified from lowest to highest (1−3). The rationale is that if both harbour porpoise and fishing gear have a high probability of co-occurrence in a given area, the likelihood of interaction is also high. Summed scores of 2 and 3 indicated low likelihood of interaction between harbour porpoise and fishing gear, a score of 4 indicated medium likelihood, and scores of 5 and 6 indicated a high likelihood of interaction

The cumulative relative bycatch risk was assessed at spatial resolution of 5 × 5 km grid cell by using spatial analysis techniques in GIS. The assessment was based on three exposure criteria: spatial overlap, likelihood of interaction with gear, and likelihood of capture by gear (based on expert opinion three level ranking: unlikely, possible, probable) and one consequential criterion – mortality (based on expert opinion three level ranking: negligible, sub-lethal, lethal; ICES, 2024).

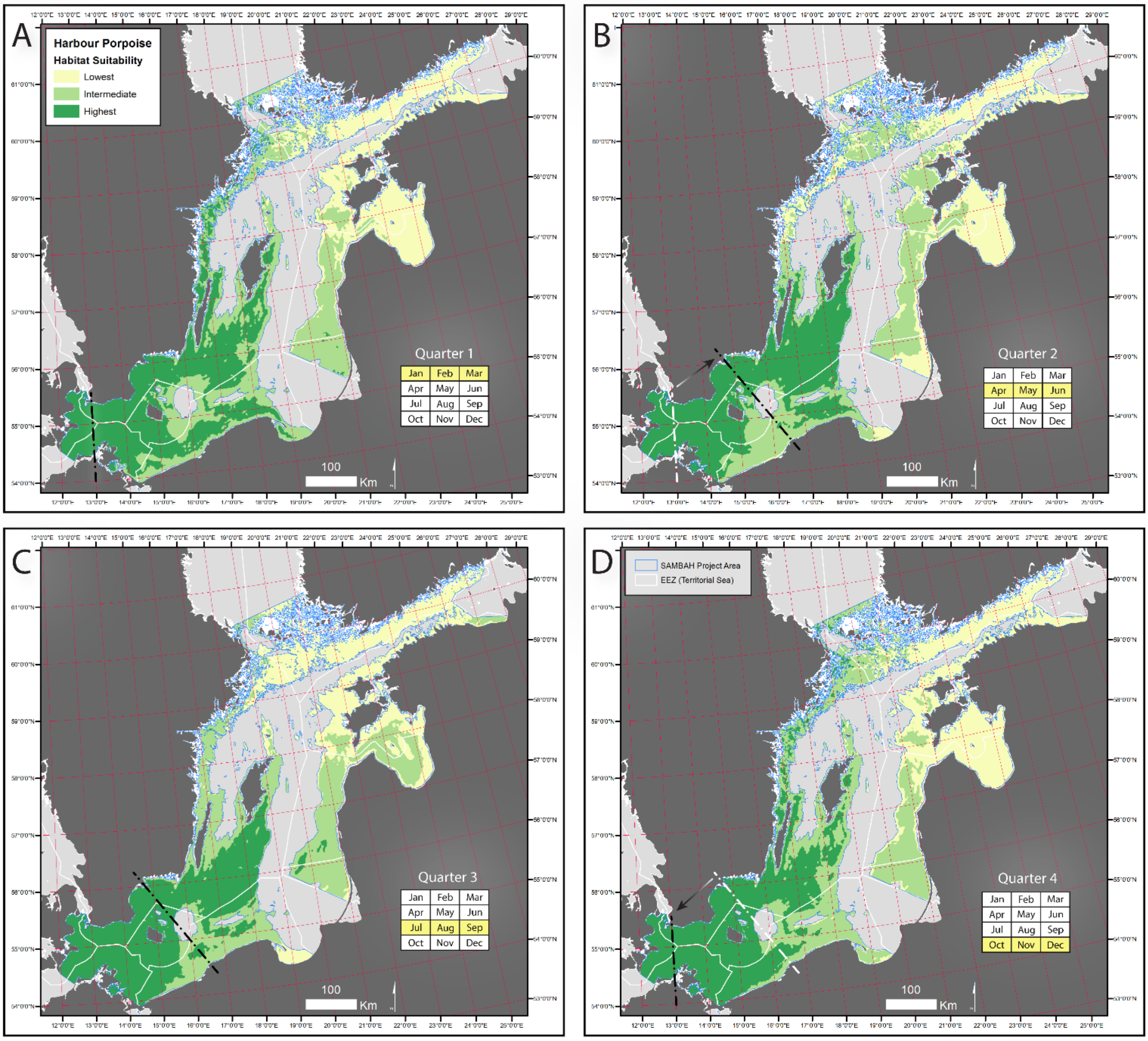

Figure 3 Harbour porpoise habitat suitability estimates for the four quarters of the year (panels A–D). Black dotted lines in the southwestern Baltic reflect the approximate position of a management border of Baltic Proper harbour porpoise distribution in summer (panels B and C) and winter (panels A and D), as proposed by Carlén *et al*. (2018). White dotted lines together with arrows indicate seasonal shifts in this border in the middle of quarter 2 (panel B) and the beginning of quarter 4 (panel D).

Mapping spatial relative bycatch risk patterns

The relative bycatch risk of harbour porpoise, based on relative ranks and classified using quantiles (20/40/60/80%), is shown for each quarter of the pooled years 2021 and 2022 for each 5 × 5 km grid cell in the Baltic Sea (Figure 4). Separate maps for each quarter and year can be found in ICES (2024).

Highest bycatch risk is driven by high harbour porpoise habitat suitability and consistently high fishing effort, specifically set gillnets with medium and large mesh sizes. The Baltic Proper and Belt Sea harbour porpoise populations are separated by a management border, proposed by Carlén *et al*. (2018) that varies seasonally (Figure 4); however, this is a theoretical division, as there is known overlap and movement. Therefore, since the data collection process cannot identify the population origin of detected animals, it is relevant to note that habitat suitability estimates for Baltic Proper harbour porpoise are influenced by individuals from both populations, and that the probability of data inaccuracies in the overlap region is likely to be high. Considering this, highest bycatch risk identified in the southwestern Baltic Sea during the summer are likely attributable to the abundant Belt Sea population.

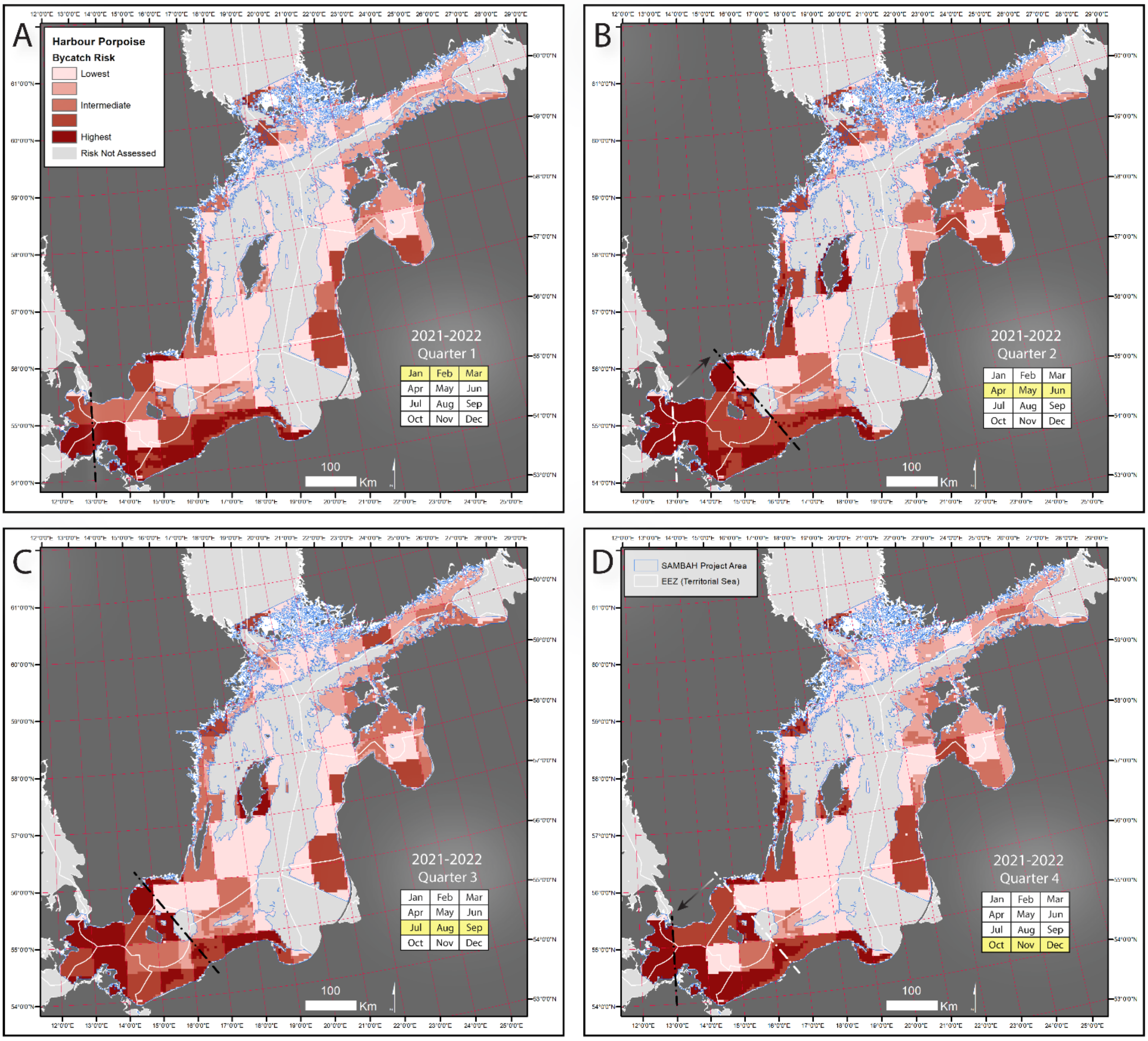

Figure 4 Estimated relative bycatch risk for harbour porpoise in the Baltic Sea at the scale of 5 × 5 km grid cell in set gillnets (GNS) and trammel nets (GTR) for each quarter of pooled years 2021 and 2022. The relative bycatch risk is based on relative ranks and classified using quantiles (20/40/60/80%) of the distribution of values for all four quarters (A-D). Black dotted lines in the southwestern Baltic reflect the approximate position of a management border for Baltic Proper harbour porpoise distribution in summer (panels B and C) and winter (panels A and D), as proposed by Carlén et al. (2018). White dotted lines together with arrows indicate seasonal shifts in this border in the middle of quarter 2 (panel B) and the beginning of quarter 4 (panel D).

Recommendations

Until estimates of Baltic Proper harbour porpoise population abundance and distribution, as well as fishing effort data from vessels of all sizes, are substantially improved, bycatch risk can only be estimated at very coarse spatial and temporal resolutions. To improve bycatch risk assessment of Baltic Proper harbour porpoise, ICES recommends to

- ensure regular coordinated monitoring at a scale that enables the estimate of the abundance and distribution of harbour porpoise in the Baltic Sea at a population level,
- report standardized fishing effort data for vessels of all sizes for consideration during the implementation of the latest relevant regulations. This should include:
  - fishing positions reported at fine-scale spatial and temporal resolutions,
  - duration of fishing operations, such as soaking time,
  - gear dimensions, such as mesh size, length, and height.

Basis of the advice

In the EU request, the specified spatial scale is "at c-square resolution", which was interpreted by ICES as referring to the 0.05 × 0.05 degrees square resolution commonly used by ICES. However, achieving this fine spatial resolution would require data on fishing effort from the satellite-based vessel monitoring system (VMS), which is usually not available for fisheries using passive gear in the Baltic Sea. In most cases, fishing vessels using nets only have to provide spatial information on fishing position using ICES rectangles. The spatial resolution of the current relative bycatch risk advice is 5 × 5 km.

Data sources

Harbour porpoise habitat suitability estimates

Harbour porpoise data originate from the SAMBAH project which was conducted from May 2011 to May 2013 at 5−80 m depths (Carlén *et al*., 2018). The analysis presented in this advice only included areas covered by the SAMBAH project.

Fishing effort data

Different fishing effort data sources have been used to identify the best available data in ICES or public databases. To provide the most complete fishing effort data for vessels of all sizes, data by ICES rectangle from the EU STECF Fisheries Dependent Information (FDI) and the Regional Database and Estimation System (RDBES) were used for the analysis. Differences between these two data sources were recognized.

Spatial fishing effort data have been prepared for set gillnet and trammel net fisheries for ICES subdivisions 27.3.24−27.3.32. The gears were grouped into set gillnets and trammel nets with small, medium, and large mesh sizes at < 90, 90−156, and ≥ 157 mm, respectively (the mesh size of trammel net corresponds to the middle section of the net). To follow a precautionary approach, the highest value from the two data source options (FDI and RDBES) for fishing days per ICES rectangle in total and by quarter was used as the fishing effort metric in the relative bycatch risk assessment.

The availability, strengths, and limitations of all these data sources are described in ICES (2024).

Issues relevant to the advice

There are data limitations that should be taken into account when interpreting the relative bycatch risk maps. For example, there is a time gap of around ten years between the only available data for the distribution of harbour porpoises (2011−2013), and the requested fishing effort data for 2021 and 2022. Further inaccuracies result from the fact that, although the harbour porpoise data were available for individual months, the data on fishing effort was only available for each quarter of the year.

The relative bycatch risk of harbour porpoise was estimated based on relative ranks and classified using quantiles (20/40/60/80%) to split the probability distribution of risk into equal parts and presented in the spatial maps to ensure distinguishability of different classes of risk.

The only available measure of fishing effort (days at sea) provides a very limited reflection of the actual fishing effort expended. It does not, for instance, include the soak time of the net or the length of nets deployed. Such characteristics of the fishing effort will affect the bycatch risk of harbour porpoise, as well as the use of technical mitigation measures. Additionally, without the availability of actual bycatch data in relation to these fishing effort parameters, it is not possible to make more detailed estimations.

ByRa didn't take into account the possible spatial overlap between the harbour porpoise populations of the Belt Sea and Baltic Proper. This source of bias is further exaggerated by the fact that the abundance of the Belt Sea population is substantially larger than the Baltic Proper population (Amundin *et al*., 2022; Gilles *et al*., 2023). The situation is further complicated as the spatial overlap between these two populations varies seasonally (Benke *et al*., 2014), resulting in higher uncertainty of the bycatch risk assessment.

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