# HOLAS-III HARBOUR PORPOISE IMPORTANCE MAP

## Methodology

Technical Report from DCE – Danish Centre for Environment and Energy No. 240 2022

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# Data sheet


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Abstract: This report describes the methodology used for creating a new map of porpoise presence within the HELCOM area for HOLAS-III. The map were based on data from telemetry and visual surveys for the Belt Sea population and passive acoustic monitoring (SAMBAH and national surveys) and national expert judgement for the Baltic Proper population.



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# Contents

# Preface

During the EG MAMA 15-2021 meeting, it was decided that the harbour porpoise distribution maps, originally created for HOLAS-II, needed to be improved and updated for HOLAS-III. An international group of experts (all members of EG MAMA) were assigned to achieve this goal. The group contained the co-authors of this report and thereby represented the following Baltic countries: Denmark, Finland, Germany, Poland and Sweden. Deborah Shinoda from the HELCOM secretariat participated as an observer.

The methodologies for the maps were agreed upon during online group meetings and all co-authors have agreed to the final outcome and reviewed this report.

# Background

The waters included in HOLAS-III (identical to the HELCOM area) are inhabited by two separate populations of harbour porpoises, namely the Belt Sea population primarily inhabiting the Kattegat, the Belt Seas and the Western Baltic, as well as the Baltic Proper population primarily inhabiting the Baltic Proper. The distributions of the two populations are believed to overlap in the western Baltic between the Kadet and Drogden Trenches in the west and Bornholm in the east (the Arkona Basin). The degree of overlap varies over the year.

The conservation status of the two populations is different. The abundance of the Belt Sea population has been assumed to be stable based on the MiniSCANS survey in 2012 and SCANS-III survey in 2016 which estimated 42,324 individuals (CV=0.30) (Hammond et al. 2021). In contrast, during the most recent survey in 2020 (MiniSCANS-II), the abundance was estimated to be approximately 17,300 individuals (CV=0.20; Unger et al. 2021), which is concerning. However, the difference between the 2021 estimate and previous ones is not statistically significant (due to large confidence intervals, primarily of the earlier surveys), and the abundance will be evaluated again when the results of the SCANS-IV survey (planned for July 2022) become available. The Baltic Proper population is categorised as critically endangered by the IUCN and the HELCOM Red List and its abundance was estimated during the SAMBAH project in 2011-2013 to be approximately 500 individuals (Amundin et al. 2022).

## Change in methodology since HOLAS-II

As a result of the differences in conservation status, and the different amount of data available on distribution for each of the two populations, they were handled separately when preparing the HOLAS-III maps. Furthermore, due to the huge difference in the abundance of the two populations, it was decided to change the HOLAS-II distributions maps that showed relative density of porpoises, to maps of areas of importance for harbour porpoises. This way, the critically endangered Baltic Proper population would not weigh less in the HOLAS-III assessment, simply due to its low abundance. This change meant that new categories needed to be defined, and these are now defined as "higher" importance, "medium" importance, "lower" importance and "no/limited data". These categories were chosen due to concern about the lowest category for the Baltic Proper population, and to underline that the categories are relative and not absolute. The low abundance of this population is of such high concern, that each individual must be considered of high importance and since individual porpoise detections/incidental sightings do occur in basically all of the Baltic Sea (east of the Belt Sea population management unit), it could be argued that all of the Baltic Sea (the Baltic Proper, the Gulf of Finland and the Gulf of Bothnia) is of high importance and certainly not of low importance. Furthermore, the most comprehensive study in the Baltic Proper, the SAMBAH project, is by now rather old since data collection took place in 2011-2013 (Carlén et al. 2018, Amundin et al. 2022), therefore our knowledge on the distribution may be outdated and areas of importance may have changed. Consequently, the old HOLAS-II categories "high" and "low" were renamed as "higher" and "lower" importance.

# 1 Belt Sea area

The distribution and distributional pattern of the Belt Sea harbour porpoise population have been studied by multiple methods such as visual surveys (ship-based and aerial), passive acoustic monitoring (PAM) and telemetry. In 2008, Teilmann et al. (2008) identified hotspots by analysing tracking data from 60 porpoises tagged between 1997 and 2006. This analysis was used by the Danish Ministry of the Environment to identify Natura 2000 sites for harbour porpoises in Denmark. In 2018, these analyses were repeated with new data from more recent years by Sveegaard et al. (2018), and it became clear that the distribution had shifted towards the east especially in the south-eastern part of the Belt Sea area. Thus, for the HOLAS-III maps only the new data from 2007-2021 were used. These data were further divided into summer (May-October) and winter (November-April) seasons to match the method used for the Baltic Proper harbour population (see below).

The majority of porpoises that have been tagged within the Belt Sea area do not, or only temporarily, move out of the summer management area for the population (Sveegaard et al., 2015). However, there seems to be a transition zone towards the Baltic where porpoise tagged in the Belt Sea area move temporally into the western part of the Baltic Proper. Thus, for the analysis of distribution for the Belt Sea population, locations from all of the HELCOM area from the northern Kattegat and south-east towards the summer population management border for the Baltic Proper were included (see Figure 1). This area covers the entire Belt Sea population management unit as identified by Sveegaard et al. (2015).

The process for the distribution analysis was as follows (illustrated here with the summer analysis):

The locations of the porpoises were filtered to one location per porpoise per day and divided into summer and winter seasons (see Figure 1.1). For more details on location filtering see Sveegaard et al. (2011). This filtering created a data set with 1858 positions from 50 individuals in the summer and 1402 positions from 44 individuals in the winter.

The Kernel Density tool in ArcGIS was used to calculate a magnitude per unit area from the locations using a kernel function to fit a smoothly tapered surface to each point (see Figure 1.1). The smoothing factor was set to 50 km.

The kernel density raster layer was then uploaded in Geospatial Modelling Environment (GME, https://www.spatialecology.com/) and isopleths were calculated. The isopleths are contour lines encompassing a certain percentage of the locations in the smallest possible area. For instance, the 10% isopleth will contain 10% of all the locations and thus be the highest density, while the 100% isopleth will contain all of the locations and have the lowest density. The 75 % isopleth was used as the medium importance area and 50% as the higher importance area. The areas outside of these isopleths were categorized as lower importance.

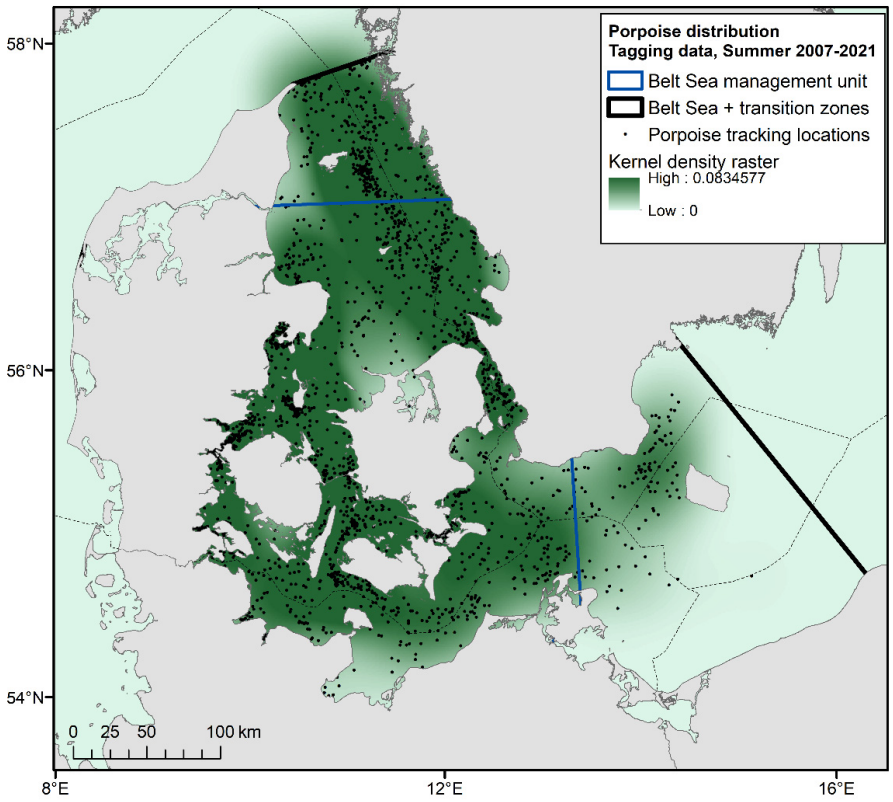



**Figure 1.1.** Number of locations (1 per porpoise per day) from tracked harbour porpoises within the study area in the summer period (May-Oct, 2007-2021). The Kernel density raster layer based on the locations calculated in ArcGIS is also shown. The management unit of the Belt Sea population as well as the study area (Belt Sea + transition zones) is indicated.

The maps of Kernel Density distribution for the summer (Figure 1.2) and winter season (Figure 1.3) were merged into one map (Figure 1.4), which is identical to the method used in the Baltic Proper area (see below).

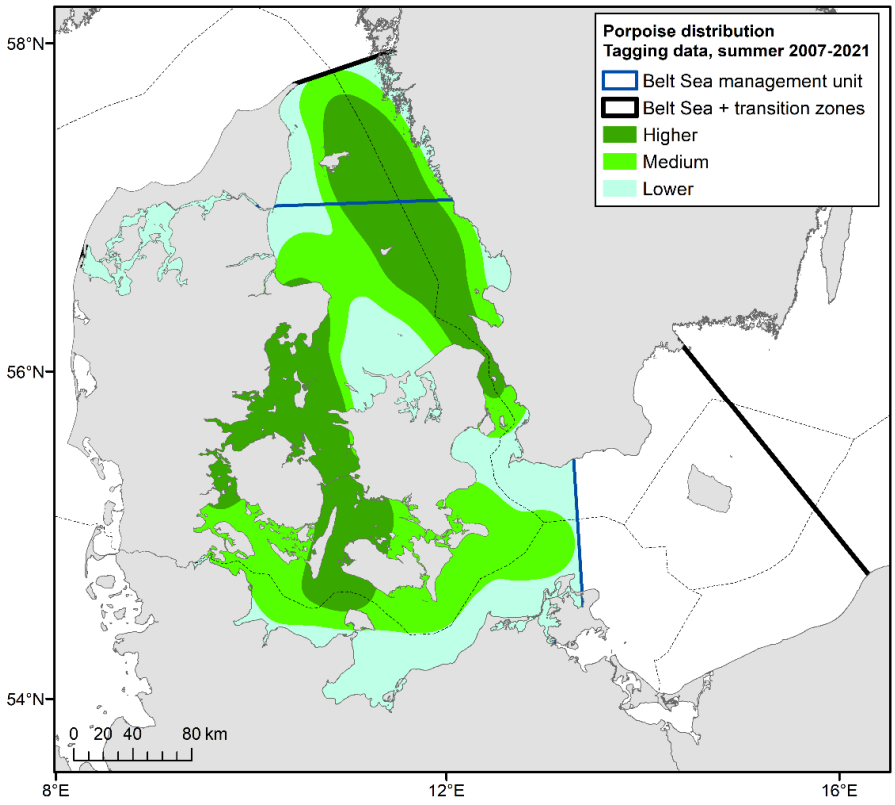



**Figure 1.2.** Kernel density maps illustrated as isopleths (75% = medium importance, 50% = higher importance) based on locations from tracked harbour porpoises within the study area in the summer (May-Oct, 2007-2021). The management unit of the Belt Sea population as well as the study area (Belt Sea + transition zones) are indicated.

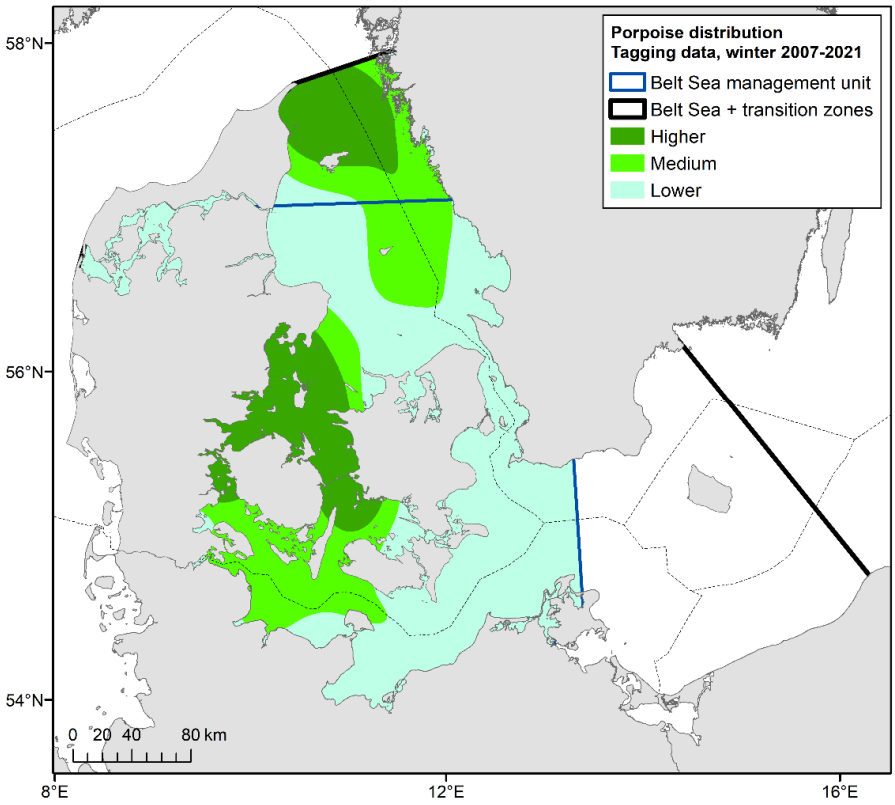



**Figure 1.3**. Kernel density maps illustrated as isopleths (75% = medium importance, 50% = higher importance) based on locations from tracked harbour porpoises within the study area in the winter (Nov-Apr, 2007-2021). The management unit of the Belt Sea population as well as the study area (Belt Sea + transition zones) are indicated.

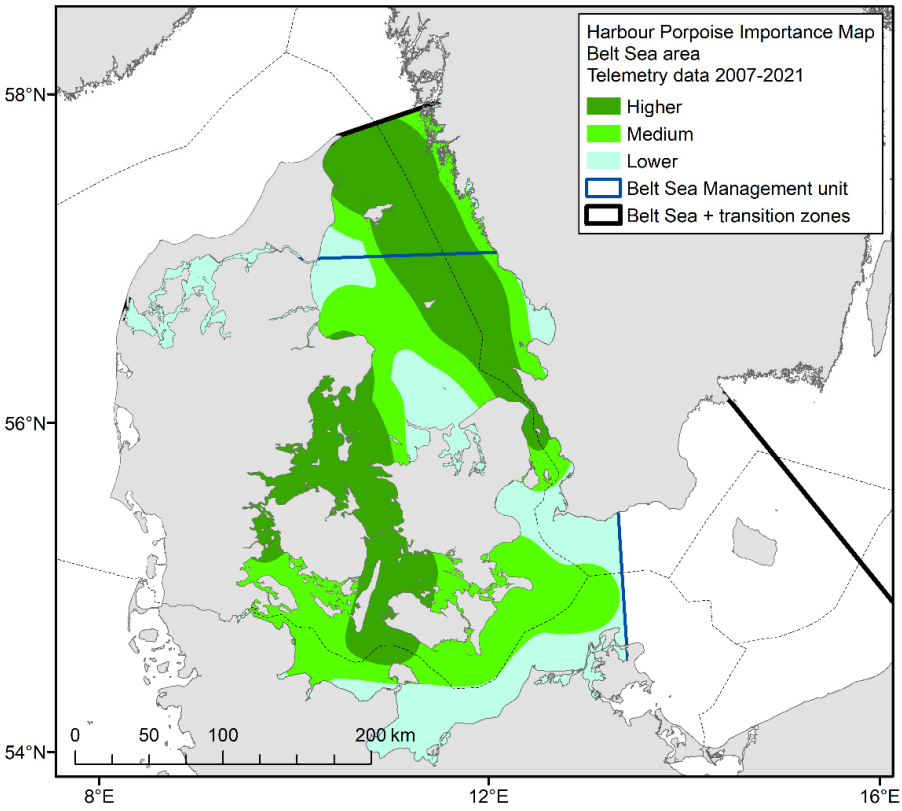



**Figure 1.4**. The merged summer-winter Kernel density map illustrated as isopleths (75% = medium importance, 50% = higher importance) based on locations (2007-2021) from tracked harbour porpoises within the study area. The management unit of the Belt Sea population as well as the study area (Belt Sea + transition zones) are indicated.

The merged Kernel density map was then compared visually with data from SCANS-III (Lacey et al. 2022), the Belt Sea density surface model (period 2002-2016; ITAW / unpublished) and the MiniSCANS-II sightings (Unger et al. 2021) by the expert group. This step was completed to ensure that no potentially important areas were missed in the telemetry analysis, which are based

on the locations of merely 60 individual porpoises. This led to the identification of two additional important areas in the southern Kattegat and the Southern Little Belt / Kiel Bay marked in blue and turquoise respectively in Figure 1.5 and to the final map in Figure 1.6.

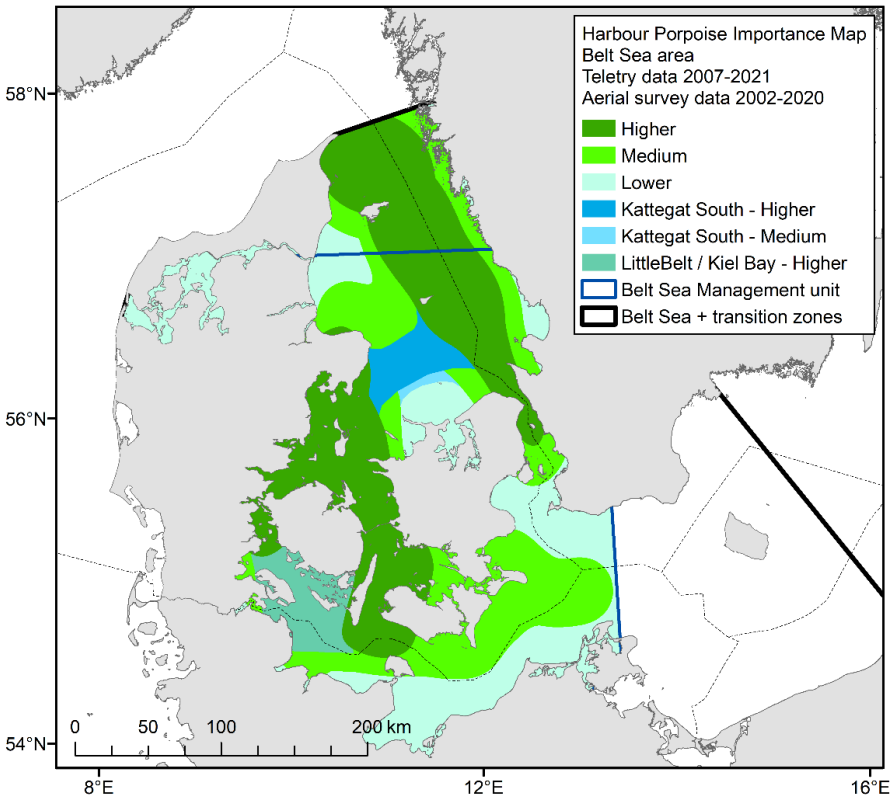



**Figure 1.5.** The merged summer-winter Kernel density map with the two additional important areas in the southern Kattegat (blue) and the southern Little Belt/Kiel Bay (turquoise) indicated. The blue and turquoise areas were identified based on aerial survey data from SCANS-III (Lacey et al. 2022), the Belt Sea density surface model (period 2002-2016; ITAW/unpublished) and the MiniSCANS-II (2020) observations (Unger et al. 2021). The management unit of the Belt Sea population as well as the study area (Belt Sea + transition zones) are indicated.

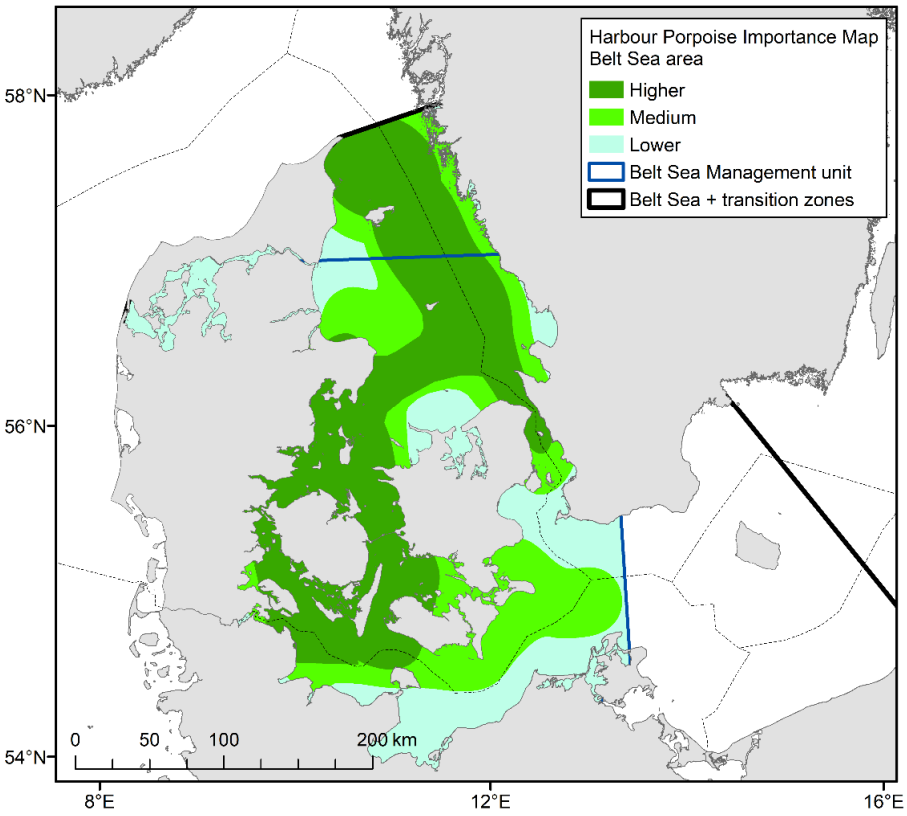



**Figure 1.6**. Final map of the importance of different areas for the Belt Sea population of harbour porpoises based on locations from 60 tracked harbour porpoises 2007-2021, as well as aerial survey data from SCANS-III (Lacey et al. 2022), the Belt Sea density surface model (period 2002-2016; ITAW/unpublished) and the MiniSCANS-II observations (Unger et al. 2021).

# 2 Baltic Proper

Very few surveys have been carried out in the distribution range of the Baltic Proper harbour porpoise population. Early visual surveys covered only a small part of the range of the population and did not yield reliable results on density and abundance due to low sighting rates and unreliable statistical analyses. SAMBAH used passive acoustic monitoring (PAM) in 2011-2013 to estimate abundance (Amundin et al. 2022) and distribution (Carlén et al. 2018) in the Baltic Proper from the Darss and Drogden underwater sills to approximately 60˚ N. Based on detection rates and patterns in the data, SAMBAH identified two seasons, one summer/breeding season by May – October and one winter season from November – April. In the summer breeding period, animals seem to aggregate around the off-shore banks in the central Baltic Proper, and during the winter period they seem to disperse over larger and more coastal areas.

The HOLAS-III maps for the Baltic Proper harbour porpoise are based on probability of detection data from SAMBAH for the two identified seasons, in combination with national expert judgement based on information obtained from the Finnish national passive acoustic monitoring program and passive acoustic research projects in Polish coastal waters. The process to create the HOLAS-III distribution maps for the Baltic Proper population was as follows:

Areas of ≥20% probability of acoustic detection were chosen to represent areas of higher importance. This was based on the same reasoning as in the ASCOBANS Jastarnia Plan (2016), where during May and October approximately 30% of the population was calculated to be within the areas of ≥20% probability of detection. The areas of ≥20% probability of detection in both summer and winter were extracted from the predicted SAMBAH maps and these seasonal areas were combined into one. A convex hull (the smallest polygon containing all the 20% probability of detection areas) was hand-drawn around it to denote areas of high importance for the Baltic Proper harbour porpoise. An area in Polish waters was also added based on an assessment of local PAM data from the national experts (see Figure 2.1).

Using the same method, areas with a detection probability of 10-20% were extracted from the SAMBAH summer and winter distribution maps and combined using a hand-drawn convex hull to show areas of medium importance for the Baltic Proper harbour porpoise population. A hand-drawn polygon was added to this layer around an area in Finnish waters where the national monitoring programme shows regular presence of porpoises (Figure 2-2).

**Figure 2.1.** Areas of high importance for the Baltic Proper harbour porpoise population, based on SAMBAH data and expert assessment of PAM data in Polish waters

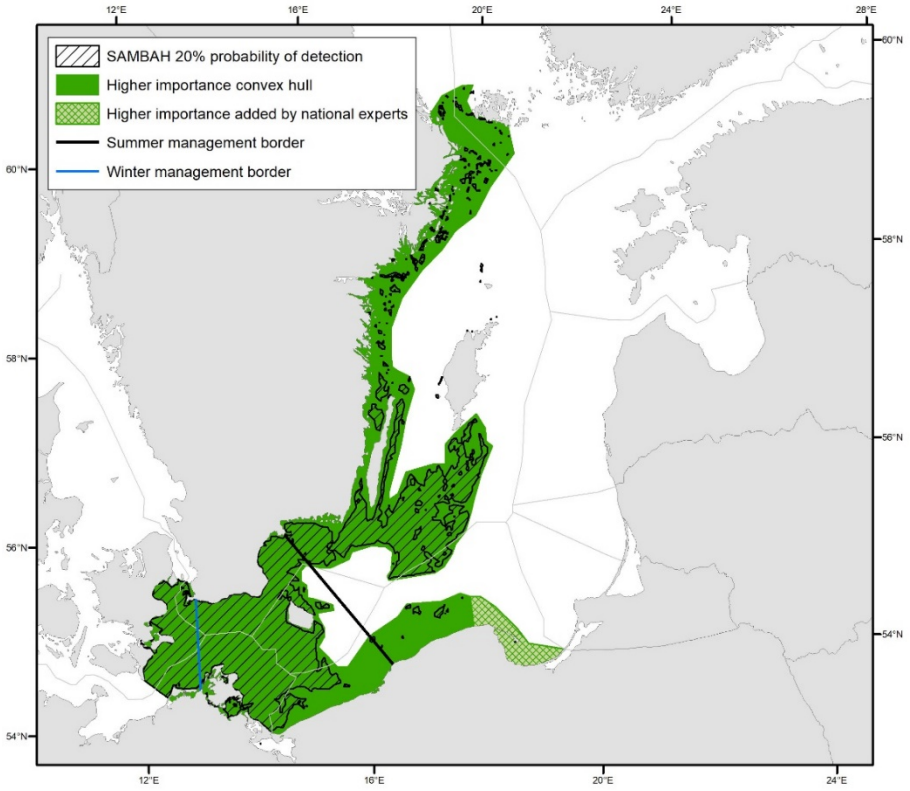
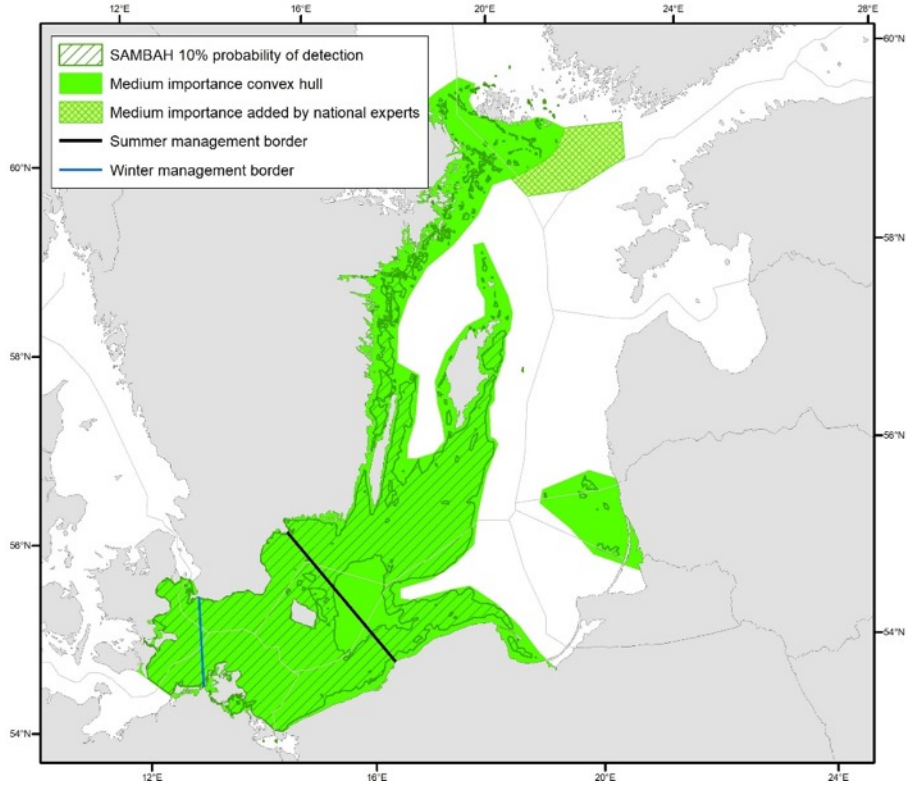



**Figure 2.2.** Areas of medium importance for the Baltic Proper harbour porpoise population, based on SAMBAH data and expert assessment of PAM data in Finnish waters.



The rest of the Baltic Sea is shown as areas of lower importance for the Baltic Proper harbour porpoise, since rare observations of harbour porpoise in the entire Baltic Sea does occur.

The SAMBAH project did not survey areas in the Baltic Proper over 80 m depth, nor the Gulf of Bothnia or Russian waters. Therefore, the HOLAS III map also needs to indicate areas with no or limited data. This was done by drawing a polygon around areas where there is no data from SAMBAH or other monitoring studies (Figure 2.3). Reports of opportunistic sightings show that porpoises occur outside the areas of the monitoring studies. This was added to the HOLAS III distribution map as a striated / shadowed area on top of the other layers (Figure 2.4).

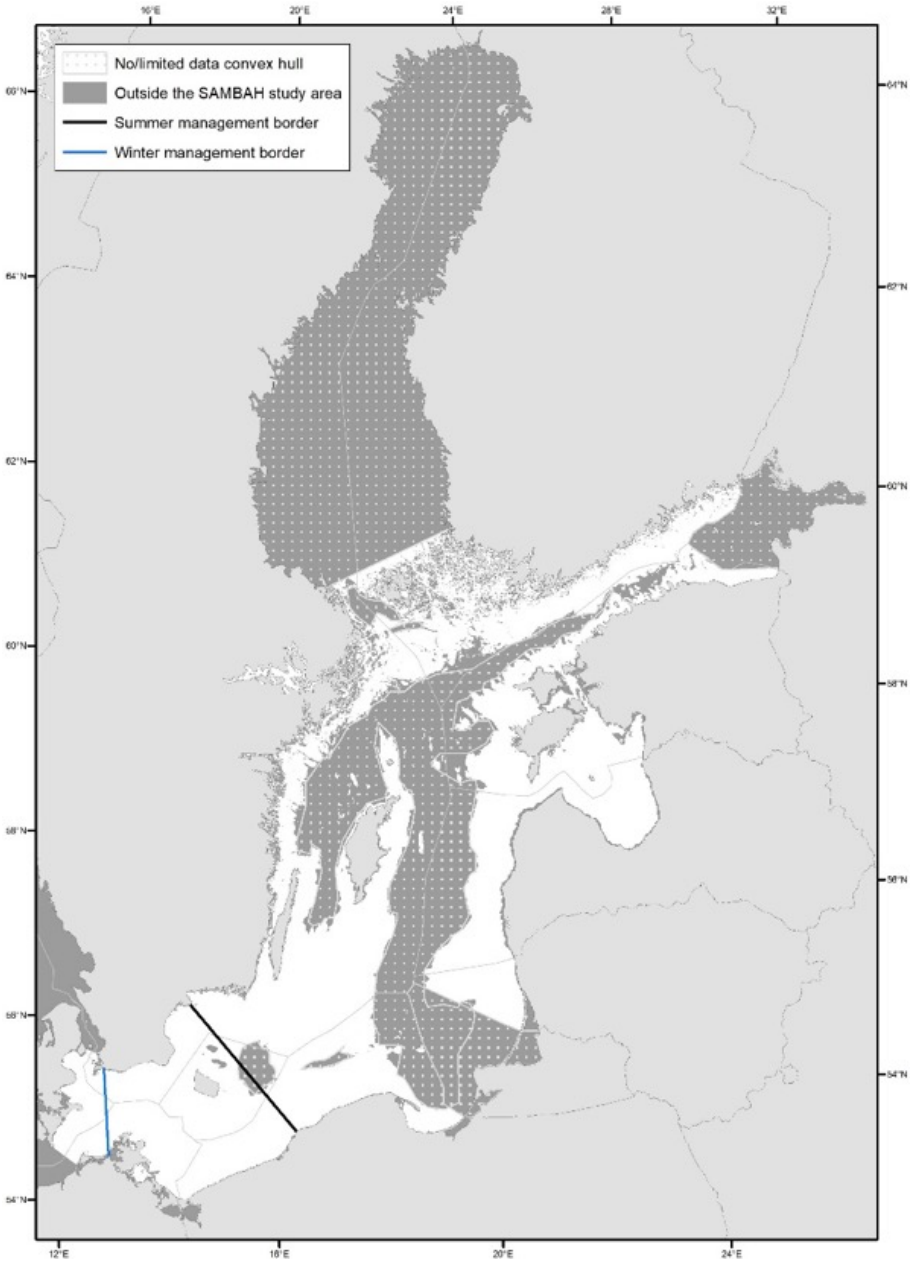
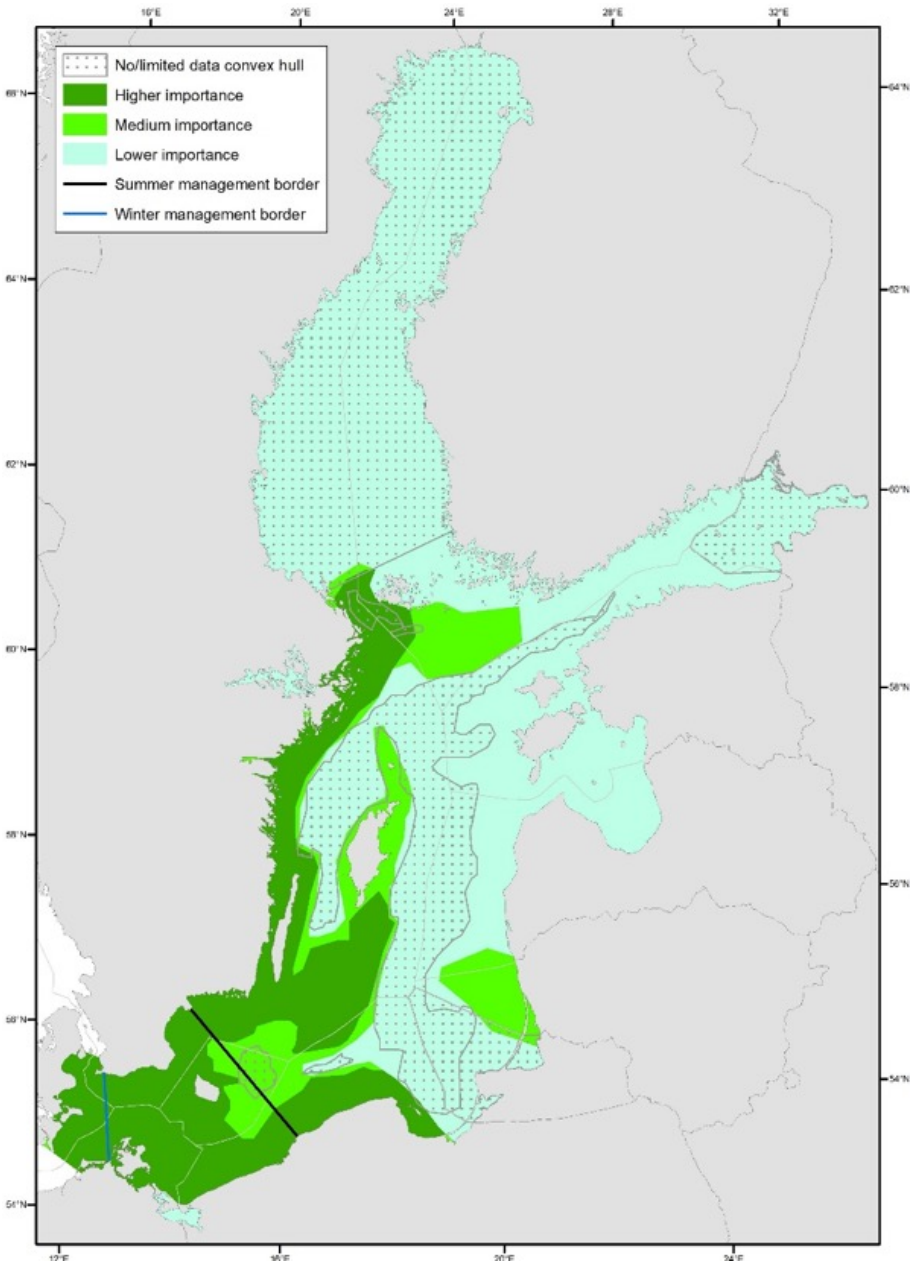



**Figure 2.3.** Areas with no or limited data (indicated by shaded areas) on distribution of the Baltic Proper harbour porpoise population.

**Figure 2.4.** Final map of importance for the Baltic Proper area based on SAMBAH data and national expert judgement. Note the Summer management borders for the Baltic Proper population. West of the boarders, the majority of porpoises will belong to the Belt Sea population.



# 3 Final HOLAS-III porpoise map

The map for both harbour porpoise populations were merged into one importance map for the species (Figure 3.1). The delimitation between the two populations was placed at 13.0˚E based on the same reasoning as in the ICES advice (2020). The border between population areas is sharply visible in the final map. This does not reflect a true sharp border of the importance for harbour porpoises, however with the current knowledge of population distribution, this is the best possible option.

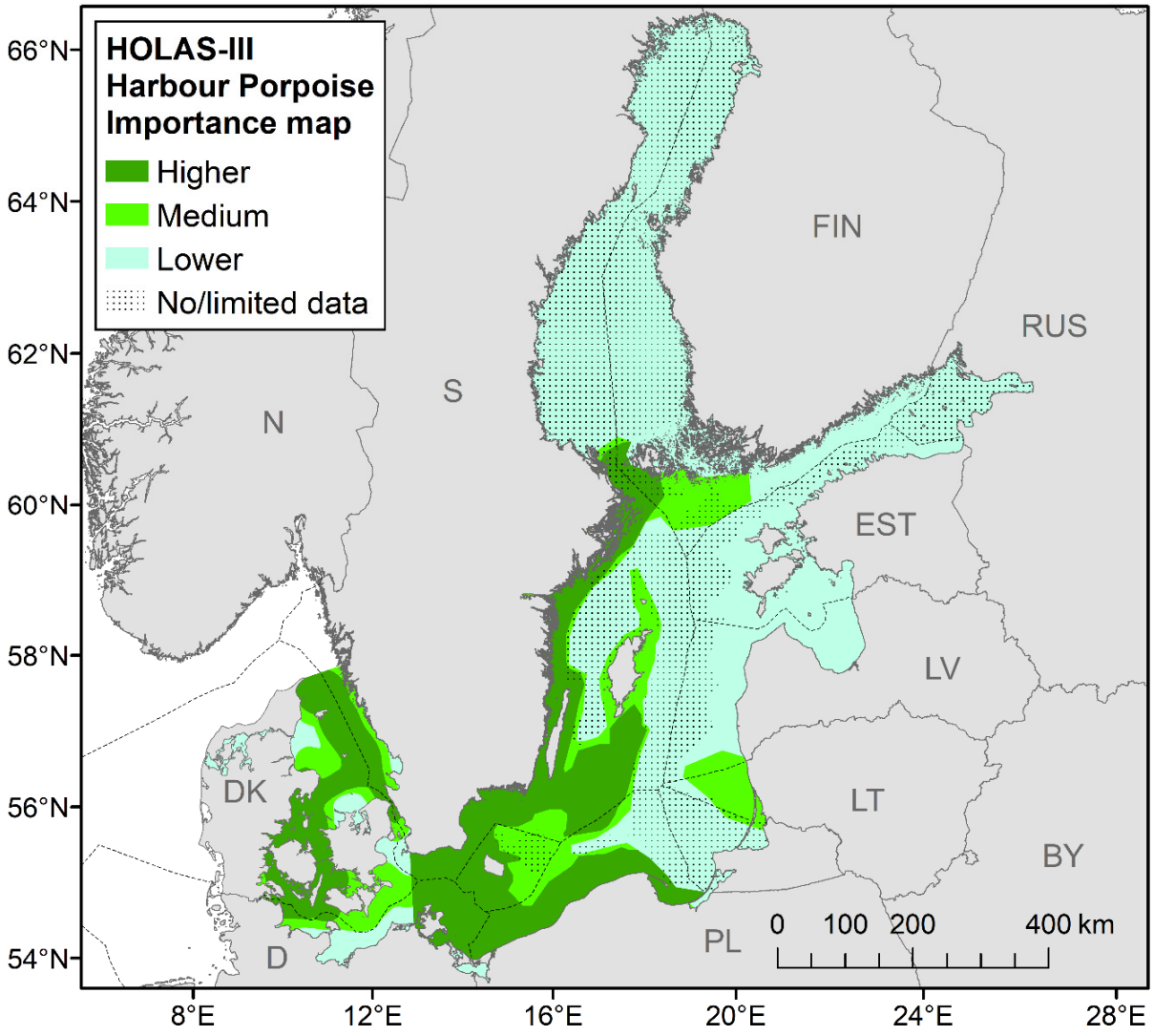



**Figure 3.1.** Final HOLAS-III map of importance for harbour porpoises within the HELCOM area. Levels of importance are based on data from telemetry and visual surveys (Belt Sea) and passive acoustic monitoring (SAMBAH and national surveys) and national expert judgement (Baltic Proper).

# 4 Acknowledgement

We thank everyone involved in the huge team effort that the SAMBAH project represented; national field teams, numerous skilled ship crews, everyone involved in data management and analyses as well as the funding agencies.

We also thank everyone involved in the tagging of harbour porpoises in the Belt Sea region; scientists, pound net fishermen and funding agencies. And a special thanks to Rune Dietz and Jonas Teilmann, responsible for the tagging program since 1997.

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