ENERGINET

ENERGY ISLAND BORNHOLM

TECHNICAL REPORT – MARINE MAMMALS

29-04-2024

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Abbreviation	Explanation
Aerial survey area	The pre-investigation area for EIB and the area where the two fully commissioned German Offshore wind farms Wikinger and Arkona are located
BfN	German Federal Agency for Nature Conservation (Bundesamt für Naturschutz)
BSH	German Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie)
CC	The Cable Corridor
CR	Critical (Red List Status)
C-POD	Cetacean-Porpoise Detector
DEA	Danish Energy Agency
DCE	Danish National Center for Environment and Energy
DPD	Detection positive days
EEA	European Environment Agency (https://www.eea.europa.eu)
EIB	Energy Island Bornholm
IUCN	International Union for the Conservation of Nature
Ind.	Individuals
km	Kilometre
LC	Least Concern (Red List Status)
OWF	Offshore Windfarm
Pre-investigation area	Gross area where there is a permit for pre-investigations for EIB
SEA	Strategic Environmental Impact Assessment
Sig.	Sighting of a marine mammal during an aerial survey
SPL	maximum source pressure level
StUK4	Standard – Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK4)
VU	Vulnerable (Red List Status)
NM	Nautical Mile
YOY	Young of the Year
LC	Least Concern (Red List Status)

1 SUMMARY

INTRODUCTION

With the Climate Agreement for Energy and Industry of the 22nd of June 2020, the majority of the Danish Parliament decided that Denmark will become the first country in the world to develop two energy islands. One of these islands will be the island of Bornholm located in the Baltic Sea ("Energiø Bornholm"), with wind farms south-west of Bornholm with an installed capacity of up to 3.8 GW. The designated wind farm areas consist of Bornholm I South (118 km^2), Bornholm I North (123 km^2) and Bornholm II (410 km^2). The wind farm areas will contain wind turbines with a maximum height of 330 m, maximum 7 transformer platforms, as well as subsea cables. The island of Bornholm will house the transformer station and serve to distribute the produced energy.

As a consequence of these political decisions, a series of biological and scientific investigations will be carried out for a well-defined pre-investigation area as part of the baseline mapping of this part of the Baltic Sea. This also includes a baseline investigation of marine mammals (WP-F) in the pre-investigation area, which is presented in this technical report.

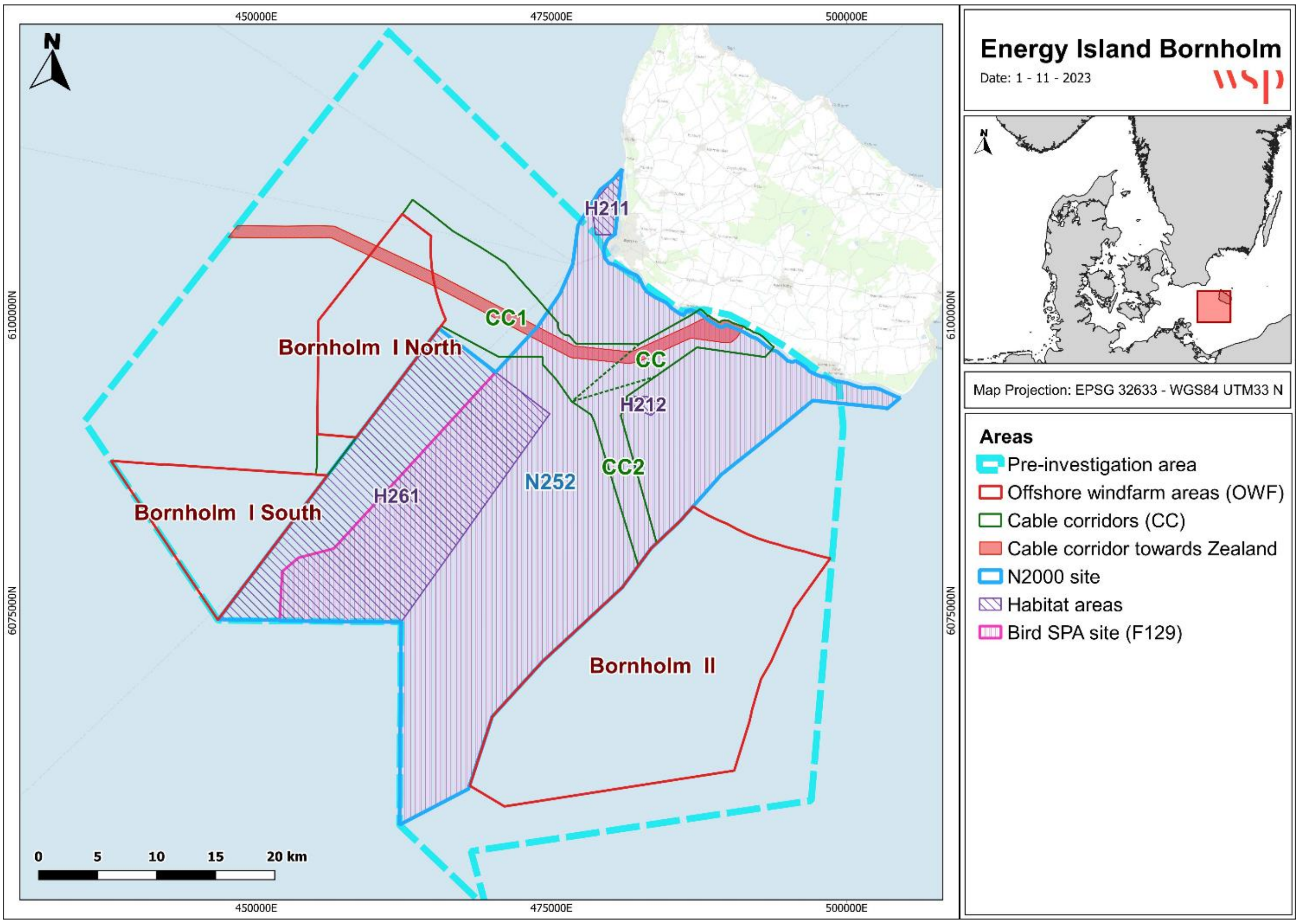

Figure 1-1. Energy Island Bornholm. The cable corridor to Zealand (red corridor) is not included in this technical report, which only concerns the pre-investigation area for Energy Island Bornholm.

Figure 1-1 shows the pre-investigation area for Energy Island Bornholm with wind farm areas Bornholm I North and South (B1N and B1S), Bornholm II, cable corridor area (CC), Natura 2000 site "Adler Grund og Rønne Banke" (N252), habitat areas (H261, H212, H211) and the new bird SPA (Rønne Banke F129) within the Natura 2000 site N252. Conditions are compared between the subareas (Bornholm I and Bornholm II) where relevant.

METHODOLOGY

EXISTING DATA

A brief overview of the existing knowledge (existing data) is given, including the conservation status and biology of the three marine mammal species, regularly occurring in the Energy Islands Bornholm (EIB) pre-investigation area, namely the harbour porpoise (*Phocoena phocoena*), the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*). The presented existing data is based on publicly available literature (peer-reviewed journals as well as non-peer-reviewed reports) relevant to describe the spatial and seasonal presence of these three marine mammal species in and around the EIB pre-investigation area. Furthermore, the potential importance of the EIB pre-investigation area for each of these three species are discussed.

DIGITAL AERIAL SURVEYS

A total of 17 digital aerial surveys has been conducted over the course of the two years pre-investigation period (November 2021 to September 2023) to determine the spatial and seasonal habitat use of harbour porpoises within the pre-investigation area. The aerial survey area covers the pre-investigation area for EIB and the area where the two fully commissioned German Offshore wind farms Wikinger and Arkona are located. A transect design with 13 transects aligned in a north-south direction and a total transect length of 585 km was surveyed. The distance between each transect line was 5 km. On average, 11.1 % of the 2,860 km² aerial survey area was covered per flight using the digital video technology HiDef. This corresponds to the German regulations according to StUK4 (BSH 2013).

PASSIVE ACOUSTIC MONITORING

The Passive Acoustic Monitoring (PAM) was done using 15 C-PODs continuously monitoring the presence of harbour porpoises within the pre-investigation area through recording of porpoise sounds during the two-year survey period (November 2021 to September 2023). The purpose of the passive acoustic monitoring (PAM) investigation was to determine the spatial and seasonal habitat use of harbour porpoises within the pre-investigation area. A total of 10,315 C-POD monitoring days were successfully conducted for this pre-investigation.

EXISTING DATA

HARBOUR SEALS

The harbour seal (*Phoca vitulina*) is the most widely distributed species of all seals within the coastal regions of the temperate to polar parts of the Northern Hemisphere. In the Baltic Sea, harbour seal is found in the Danish, Swedish, German and Polish waters.

The status of the global population (Lowry 2016) and the European population (European Mammal Assessment Team 2007) of the harbour seal are classified by the IUCN as least concern (LC). The HELCOM Red List (2013a) classified the Southern Baltic population as LC, the population in the Kalmarsund as vulnarable (VU). More details are provided in Table 1-1.

Table 1-1. Listing of the harbour seal in international and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= Vulnerable.

Species	IUCN (2017)	HELCOM Red List	National Red Lists	Natura 2000 (BfN 2015)	Bern Convention	Bonn Convention
Harbour Seal ***Phoca vitulina***	Global: LC European: LC	Southern Baltic: LC Kalmarsund: VU	DE: threat of unknown extent DK: LC SE: VU (Baltic population)	Appendix II und V	Appendix III	Appendix II

The harbour seal populations in the Baltic region is divided into four sub-populations (or management units) (Andersen & Olsen 2010, Blanchet et al. 2021): One sub-population in the Kalmarsund, one in the south-western Baltic, one in the Kattegat and one in the Limfjord. The Kalmarsund population was latest estimated to have a population size of about 2,900 harbour seals (HELCOM 2023). Latest estimated population sizes of harbour seals were about 2,000 individuals in the SW Baltic and about 12,500 individuals in the Kattegat (HELCOM 2023a).

The closest resting places (haul-out sites) for harbour seals are located near Falsterbo (Måkläppen) in Sweden, about 100 kilometres away from the pre-investigation area. Tracking studies show that the harbour seal generally stays close to the coast and rarely forage further than 50 km away from haul-out sites (Thompson et al. 1994, Tollit et al. 1998, Cunningham et al. 2009, Dietz et al. 2013). However, juveniles from Danish haul-out sites (McConnell et al. 2012, Dietz et al. 2015) have been observed to travel distances of more than 200 km from their original haul-out sites. However, also none of the animals tracked by McConnell et al. 2012 and Dietz et al. 2015 were observed in the pre-investigation area or close to it, suggesting that the pre-investigation area is not of great importance for harbour seals.

GREY SEALS

The grey seal is a large seal species with a cold temperate to sub-artic distribution along the coasts of the North Atlantic. The status of the global population (Bowen 2016) and the European population (European Mammal Assessment team 2007) of the grey seal are classified by the International Union for the Conservation of Nature (IUCN) as LC, and the status of the Baltic subspecies Halichoerus grypus grypus is assessed by the HELCOM Red List (HELCOM 2013a) also as LC. For more details, see Table 1-2.

Table 1-2. Listing of the grey seal in international and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= vulnerable.

Species	IUCN (2017)	HELCOM Red List	National Red Lists	Natura2000 (BfN 2015)	Bern Convention	Bonn Convention
Grey seal ***Halichoerus grypus***	Global: LC European: LC	LC	DE: highly threatened (Baltic grey seal) DK: VU SE: LC	Appendix II and V	Appendix III	Not listed

The Baltic grey seal (*Halichoerus grypus grypus*) inhabiting the Baltic Sea (Berta & Churchill 2012, Fietz et al. 2016, Olsen et al. 2016) is found throughout the Baltic Sea area with main concentrations in the northern and central parts of the Baltic Proper. HELCOM (2023a) assessed the grey seal population in the Baltic Sea as a single management unit estimated to be about 60,000 animals (HELCOM 2023c). Like harbour seals, grey seals are associated with coastal waters. Grey seals make foraging trips at large distances from their haul-out sites with occasional travelling distances of up to 2,000 km (e.g. Thompson et al. 1991, 1996, McConnell et al. 1999, Dietz et al. 2015). Illustrating this, grey seals tagged in the Rødsand lagoon were found to move up to 850 km east into the Baltic (Dietz et al. 2015).

As the closest haul-out sites for grey seal to the pre-investigation area are no more than 50 km away (Rügen), the area is theoretically still within the foraging range of these haul-out sites. However, McConnell et al. (2012) and Dietz et al. (2015) demonstrated by tagging grey seals, that their migrations were mainly concentrated in local areas around their haul-out sites and that the pre-investigation area was not relevant as a feeding area for grey seals. Based on these two studies the pre-investigation area does not seem to be of particular relevance as a foraging or hunting area for grey seals.

HARBOUR PORPOISE

The harbour porpoise inhabits temperate to cold waters throughout the northern hemisphere and is the only resident whale species in the Baltic Sea (Kinze 1994, Benke et al. 1998).

The pre-investigation area is according to Sveegaard et al. (2018) part of a transition zone, inhabited by two separate populations of harbour porpoise, namely the Belt Sea population and the Baltic Proper population. Whilst the status of the global population (Braulik et al. 2020) and the European population (Sharpe & Berggren

2023) of the harbour porpoise is classified by the IUCN as least concern (LC), the situation in the Baltic Sea is different with both a critical (CR) and vulnerable (VU) population present in the pre-investigation area. The abundance of the Belt Sea population is assumed to be stabile with an estimated abundance of 17,301 individuals (Unger et al. 2021). However, the Baltic Proper population with an estimated abundance of approximately 500 individuals (SAMBAH 2016) and a declining trend is categorized as critically endangered (CR) (Carlström et al. 2023), which is the highest threatened status (IUCN 2007, Hammond et al. 2008). The HELCOM Red List lists the Baltic Proper subpopulation as CR and the Belt Sea subpopulation as VU (HELCOM 2013d). Further details are provided in Table 1-3.

Table 1-3. Listing of the harbour porpoise in international (HELCOM 2013d, IUCN 2021) and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= vulnerable and CR= Critical.

Species	IUCN	HELCOM Red List	National Red Lists	Natura 2000 (BfN 2015)	Bern Convention	Bonn Convention
Harbour Porpoise *Phocoena phocoena*	Global: LC Europe: LC Baltic Sea subpopulation: CR	Baltic Sea: CR Western Baltic: VU	DE: Highly threatened DK: LC SE: CR (Baltic Sea population)	Appendix II und IV	Appendix II	Appendix II

The habitat use by harbour porpoises in the Baltic Sea varies seasonally. In the year 2011 the SAMBAH project was launched to gain reliable assessments of abundance, distribution and habitat preferences of the Baltic Proper population (SAMBAH 2016). Based on passive acoustic data from the SAMBAH project, it was concluded that in winter, the Baltic Proper population of harbour porpoises shows a widespread distribution across the whole SAMBAH study area mixing with the Belt Sea population. During the summer breeding season, however, the two populations seem to be spatially separated: The Belt Sea population remains west from Bornholm while the Baltic Proper population concentrates in Swedish waters around the Hoburg and Midsjö banks south of Gotland and east of Øland. Further national acoustic monitoring projects in Denmark and Germany confirmed the results based on SAMABAH (2016a).

In a recent HOLAS III report (Sveegaard et al. 2022) data from porpoise telemetry in the Belt Sea, SCANS, SAMBAH and other national data were revisited with the aim to create a map (Figure 1-2) showing the importance of areas in the Baltic Sea for harbour porpoises. According to this map, the pre-investigation area is of high importance in terms of habitat use by harbour porpoises. This assessment is primarily due to the regular presence of Baltic Proper animals in winter within the pre-investigation area.

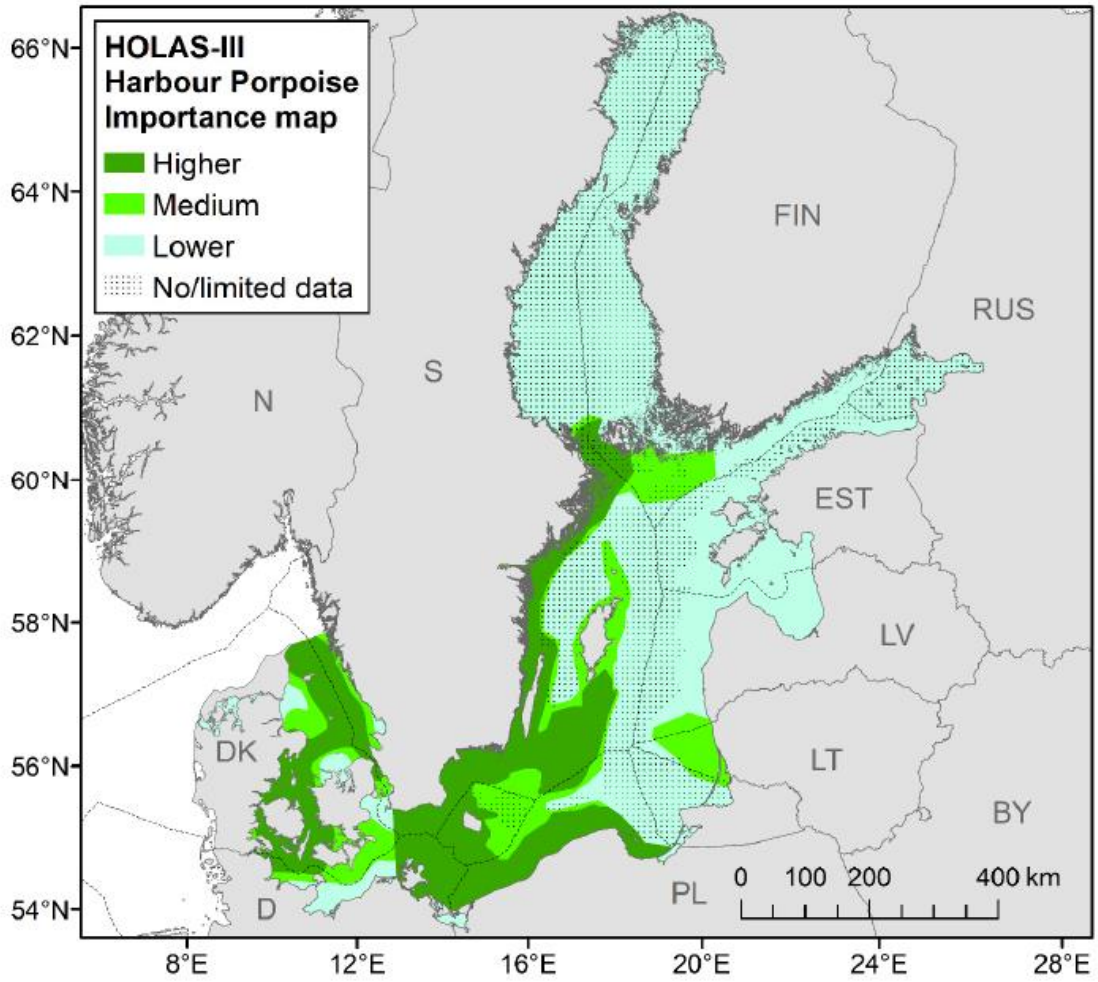

Figure 1-2. HOLAS III map of importance for harbour porpoises within the HELCOM area. From: Sveegaard et al. (2022).

SURVEY DATA

In order to determine the abundance, spatial distribution and habitat usage of marine mammals (seals and whales) in the pre-investigation area, 17 digital aerial surveys were completed in the aerial survey area while 15 C-PODs station were deployed within the pre-investigation area.

A total 37 marine mammals were observed by the aerial surveys within the pre-investigation area (Figure 5-1). Six of these marine mammals were too deeply submerged and could therefore not be determined as seals or porpoises. These sightings were therefore only identified as marine mammals.

SEALS

Thirteen seals were detected by aerial surveys in the pre-investigation area. Since emerged harbour seals and grey seals are difficult to distinguish when viewed from the air, 9 of the seals were not identified to species level. Two of the sightings were identified as harbour seals and two others as grey seals.

The maximum density of seals was recorded on the 11th of April 2022 with 0.0095 individuals per km² and on the 4th of June 2023 with 0.0092 individuals per km² (Table 5-3). In general, seals were recorded with very low densities throughout the year in the entire pre-investigation area. A local concentration of animals and thus a preference for certain areas was not observed.

Compared to observations from the southwestern Baltic Sea, for example compared to the Fehmernbelt, the recorded number of harbour seals is very low in the pre-investigation area. However, for grey seals, numbers observed in the pre-investigation area were comparable to numbers observed in the Fehmernbelt (FEMO 2023).

HARBOUR PORPOISES

AERIAL SURVEYS

According to the presented aerial survey data the harbour porpoise is the most common marine mammal within the pre-investigation area. A total of 18 harbour porpoises were observed during the two-years pre-investigation period. But harbour porpoises were observed on only two flights, both of them carried out in summer. On the 11th of August 2022 5 individuals were observed, corresponding to a density of 0.03 individual per km², and on the 8th of September 2023 another 13 individuals were observed, corresponding to a density of 0.09 individual per km².

Harbour porpoise numbers observed in the pre-investigation area were 10 times lower than observed in the Fehmernbelt (FEMO 2023) and the density must therefore be considered as very low. However, compared to studies conducted close to the pre-investigation area (IBL Umweltplanung GmbH 2020), the results appear to realistically reflect the local abundance and distribution of harbour porpoises. Two other important findings are that no calves were sighted in the entire pre-investigation area and that no harbour porpoises were generally observed in winter.

PASSIVE ACOUSTIC MONITORING

In addition to the aerial surveys, passive acoustic monitoring of harbour porpoise sounds by C-PODs was carried out within the pre-investigation area to determine the local habitat usage of harbour porpoises.

Table 1-4 gives an overview of the results of the passive acoustic monitoring conducted within the pre-investigation area. It shows the respective percentage detection rates of harbour poipose sounds for all C-POD stations averaged over the entire study period. The parameter DPD/month is a suitable parameter to measure the habitat use of harbour porpoises in the pre-investigation area.

Table 1-4. Mean monthly percentage detection rates of harbour porpoise sounds (DPD/month, mean DPH/d and mean DP10M/d) over the whole investigation period at all measuring stations for the passive acoustic monitoring of harbour porpoises. Mean percentage DPH/d and mean DP10M/d were calculated over all available recording days. Parameters are explained in section 3.2.2.

C-POD	EI01	EI02	EI03	EI04	EI05	EI06	EI07	EI08	EI09	EI10	EI11	EI12	EI13	EI14	EI15
DPD/month	17.0	30.5	31.9	31.0	8.5	14.4	3.9	22.0	16.2	4.4	11.8	11.4	25.0	15.7	16.3
DPH/d	1.0	6.2	4.9	4.9	0.4	0.8	0.2	2.3	1.0	0.3	0.9	0.9	3.7	2.0	1.8
DP10M/d	0.2	2.0	1.3	1.2	0.1	0.2	0.0	0.5	0.2	0.0	0.2	0.3	1.1	0.6	0.5

According to Table 1-4 the mean values for DPD/month vary between the station from 3.9 DPD/month at station EI_07 to 31.9 DPD/month at station EI_03. The mean value for all stations within the pre-investigation area and for the entire pre-investigation period is 17.3 DPD/month, which is comparable with results from directly neighboring stations of German monitoring projects (Gallus & Benke 2014, IBL Umweltplanung GmbH 2020).

Nevertheless, there are considerable differences in the detection rates among the various stations of the present study (Table 1-4). Regarding single stations, the mean over the entire study period varies between 3.88 DPD/month and 31.88 DPD/month. The highest rates of more than 30 DPD/month occurred at stations, which were deployed in the north-western part of the pre-investigation area (Figure 5-5).

The results of the passive acoustic monitoring in the pre-investigation area indicate a generally low utilisation of the entire pre-investigation area by harbour porpoises. To consider these data in relation to different seasons, the detection rates were calculated separately for winter and summer (Figure 5-6, top and bottom). The result clearly shows that in summer (May to October) significantly higher detection rates are noted than in winter (November to April). The mean detection rate calculated for winter (November to April) is only slightly above 3 DPD/month for all stations. In the summer months (May to October), however, the average detection rate is over 35 DPD/month and thus significantly higher.

However, the frequency of harbour porpoises at the various stations is very uneven. While the highest seasonal mean values of around 70 DPD/month were recorded for stations in the northwest in summer 2023, the lowest seasonal mean values were noted in summer 2022 at stations EI_07 and EI_10 with less than 2 DPD/month each.

CONCLUSION

This report summarises the results of the two-year baseline study of marine mammals within the EIB pre-investigation area and compares them with data, results and conclusions from literature relevant for the Baltic Sea. Three different marine mammal species regularly occur within this pre-investigation area. These are the harbour seal, the grey seal and the harbour porpoise.

Harbour seals: The closest harbour seal haul-out is located at a distance of about 100 km from the pre-investigation area Dietz et al. (2015). Since telemetry studies have shown that harbour seals rarely make foraging trips further than 50 km away from haul-out sites (Thompson et al. 1994, Tollit et al. 1998, Cunningham et al. 2009, Dietz et al. 2013), it is unlikely that the pre-investigation area is used intensively as a foraging ground.

Ship-based and aerial surveys for the German OWF planning site O-1.3 both resulted in only very few harbour seal sightings. Also, aerial surveys carried out for the EIB aerial survey area demonstrate a low abundance of harbour seals in the pre-investigation area. A total of 13 seals were sighted in the pre-investigation area for all 17 flights, two harbour seals, two grey seals and nine non-identifiable seals. These results confirm findings of McConnell et al. (2012) and Dietz et al. (2015) stating that harbour seals rarely use the pre-investigation area and its surroundings. The low number of sightings indicates that the area is only occasionally visited.

Grey seals: The pre-investigation area is 60 km away from the nearest grey seal haul-out site on Rügen. Data from satellite-tracked grey seals from Rødsand lagoon demonstrated that these animals easily cover distances of more than 850 km (McConnell et al. 2012, Dietz et al. 2015). However, the satellite-tracked grey seals from Rødsand and also grey seals from Måkläppen (Falsterbo) and from Ålandsøerne (in total 18 individuals) showed movements which were largely focused on local areas around their haul-out sites (McConnell et al. 2012, Dietz et al. 2015), and the EIB pre-investigation area only seems to be used for travelling through.

Grey seals from local haul-out sites can therefore use the pre-investigation area for foraging or subadults may cross it on their way to distant haul-out sites (McConnell et al. 2012, Dietz et al. 2015). In this baseline investigation, only 2 grey seals and 9 seals that could not be identified to species-level, were noted for all 17 aerial surveys performed within the pre-investigation area. This result indicates a very low abundance of grey seals in the EIB pre-investigation area. The very low sighting rates that were noted in the nearby German OWF planning area O-1.3 (IBL Umweltplanung GmbH 2020) also suggest that very few grey seals occur in this area and underline that the pre-investigation area is not an important habitat for grey seals. It is therefore concluded that the probability of the pre-investigation area being a regularly used and important foraging area for grey seal is very low.

Harbour porpoise: Two different (sub)populations of harbour porpoise are present in the pre-investigation area: individuals of the Belt Sea population and individuals of the Baltic Proper population. The most recent estimates for the Belt Sea population of harbour porpoises indicate an abundance of 14,403 individuals (Gilles et al. 2023). In contrast to this, the highly endangered Baltic Proper population of harbour porpoises is very small and estimated (based on acoustic detections from 2011 - 2013) to consist of about 500 individuals (SAMBAH 2016).

Existing data indicate presence of harbour porpoise within the pre-investigation area (SAMBAH 2016, Sveegaard 2020, IBL Umweltplanung GmbH 2020), however, with strong seasonal differences, i.e. summer detections likely originate from animals belonging to the Belt Sea population, while winter detections likely stem from both the Belt Sea population and the Baltic Proper population of harbour porpoises (Mikkelsen et al. 2016, SAMBAH 2016, Sveegaard 2020). In general, the harbour porpoise density in the pre-investigation area, even in summer, is very low compared to more western parts of the Baltic Sea.

As few calves earlier has been sighted near the pre-investigation area (IBL Umweltplanung GmbH 2020), it cannot be ruled out that harbour porpoises occasionally also reproduce here. However, as no calves were recorded in the pre-investigation area during this investigation, the presence of females with calves from the Belt Sea population seem to be infrequent.

Since the pre-investigation area lies within the suggested winter mixing zone of both populations, winter detections around the pre-investigation area could partly stem from individuals belonging to the highly endangered Baltic Proper population. Thus, the area might be relevant as a wintering ground for these rare animals of the Baltic Proper population. Nevertheless, the recently created HOLAS III map on the importance of areas in the Baltic Sea for the Baltic Proper population of harbour porpoises categorises the pre-investigation area as being of higher importance. This categorisation must be attributed to the observation that in winter the pre-investigation area is sporadically but regularly visited by animals of the Baltic Proper population, a population classified as critically endangered (CR) (Carlström et al. 2023), corresponding to the highest threat level (IUCN 2007, Hammond et al. 2008).

Earlier smaller-scale aerial surveys exist only from adjacent German waters (IBL Umweltplanung GmbH 2020). These data indicate a harbour porpoise density between 0.002 and 0.009 ind./km² in spring and summer while no sightings were obtained during the autumn and winter seasons. The aerial surveys within the pre-investigation area conducted for this report (17 in total) show quite similar results to what was described for the adjacent area within German EEZ.

Acoustic detections during the present pre-investigation revealed a distinct seasonal pattern of acoustic harbour porpoise detections at all 15 C-POD-stations. Detections were relatively high during the summer months (especially in July and August, when at some stations up to 100 % DPD per months were recorded), but low during the winter months (when DPD were mostly below 10 %). This seasonal pattern seems to be in line with what was found in the Danish National Monitoring from 2019 at least at one station, where detection rates were also over 80 % in July, while winter detections were lower. However, at another station detections were around 50 % in February, a value never reached at any C-POD-position during the present investigation in winter.

The existing data and the results of the present investigations of harbour porpoises within the pre-investigation area allow for the following conclusions to be drawn:

- The pre-investigation area is regularly used by harbour porpoises from the Belt Sea population, especially in summer, for crossing and foraging.
- The abundance of harbour porpoises of the Belt Sea population in the pre-investigation area is low compared to the abundance in the Belt Sea, Mecklenburg Bight or the Kattegat, even in summer.
- Utilisation of the area by females with calves cannot be clearly ruled out for the Belt Sea population. However, its importance as such is definitely lower than that of the more western part of the Baltic Sea.
- The pre-investigation area is of great importance for harbour porpoises, as existing data show that the area is visited in winter by individuals of highly endangered Baltic Proper population.

2 INTRODUCTION

2.1 BACKGROUND

With the Climate Agreement for Energy and Industry of the 22nd of June 2020, the majority of the Danish Parliament decided that Denmark will become the first country in the world to develop two energy islands. One of these islands will be the island of Bornholm located in the Baltic Sea ("Energiø Bornholm"), with wind farms south-west of Bornholm with an installed capacity of up to 3.8 GW. The designated wind farm areas consist of Bornholm I South (118 km2), Bornholm I North (123 km2) and Bornholm II (410 km2). The wind farm areas will contain wind turbines with a maximum height of 330 m, maximum 7 transformer platforms, as well as subsea cables. The island of Bornholm will house the transformer station and serve to distribute the produced energy.

As a consequence of these political decisions, a series of biological and scientific investigations will be carried out for a well-defined pre-investigation area as part of the baseline mapping of this part of the Baltic Sea. This also includes a baseline investigation of marine mammals (WP-F) in the pre-investigation area, which is presented in this technical report.

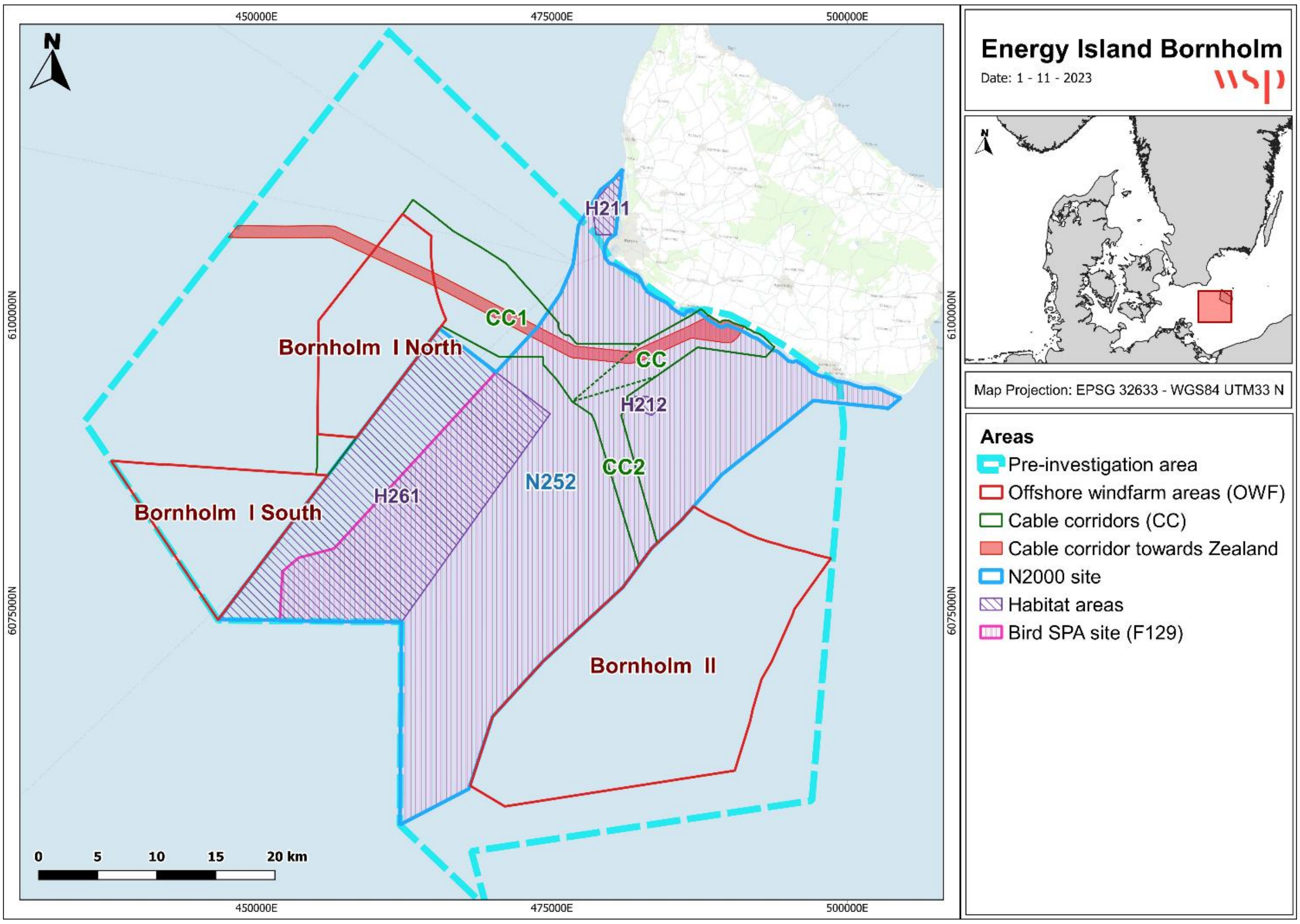

Figure 2-1. Energy Island Bornholm. The cable corridor to Zealand (red corridor) is not included in this technical report, which only concerns the pre-investigation area for Energy Island Bornholm.

Figure 2-1 shows the pre-investigation area for Energy Island Bornholm with wind farm areas Bornholm I North and South (B1N and B1S), Bornholm II, cable corridor area (CC), Natura 2000 site "Adler Grund og Rønne Banke" (N252), habitat areas (H261, H212, H211) and the new bird SPA (Rønne Banke F129) within the Natura 2000 site N252. Conditions are compared between the subareas where relevant.

2.2 AIM

This is the technical report for WP-F Marine Mammals for Energy Island Bornholm. The report presents existing data and survey data for the pre-investigation area for Energy Island Bornholm (EIB) (see Figure 2-1), which will be used as a baseline study for the Environmental Impact Assessment (EIA), that will be created by the contractor of the final offshore wind farm project. The report concerns the pre-investigation area, including the two planned windfarm areas (Bornholm I North and South and Bornholm II, see Figure 2-1).

In addition to the survey data, the report also summarises the existing data on marine mammals for this marine area. Based on existing literature, the report describes the conservation status, abundance and distribution, seasonal utilisation and species-specific characteristics such as the occurrence of different subpopulations for the three species found in this area: harbour porpoise, harbour seal and grey seal.

3 METHODOLGY

This chapter outlines the data collection methods, and analytical approaches employed for WP F to investigate the occurrence of marine mammals within and around the pre-investigation area of Energy Island Bornholm.

3.1 EXISTING DATA

The purpose of section 4 Existing Data is to give a brief overview on the conservation status and biology of the three marine mammal species, regularly occurring in the Energy Islands Bornholm (EIB) pre-investigation area, namely the harbour porpoise (*Phocoena phocoena*), the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*). This section is based on publicly available literature (peer-reviewed journals as well as non-peer-reviewed reports) relevant to describe the spatial and seasonal presence of these three marine mammal species in and around the EIB pre-investigation area. Finally, first inferences about the potential importance of the EIB pre-investigation area for each of these three species will be discussed.

3.2 SURVEY DATA

3.2.1 AERIAL SURVEYS

DATA COLLECTION

To determine abundances, densities, and distribution patterns of resting birds and marine mammals in the pre-investigation area, digital aerial video surveys using the HiDef-technology were conducted. The distribution of surveys followed the pre-agreed design with 7 surveys per year focusing on surveying resting birds especially in autumn, winter and spring with a gap of at least 4 weeks between consecutive flights, and two additional flights in the first year in June and July focused on surveying marine mammals. As the cameras also capture all objects on and above the sea surface during flights aimed at marine mammals, this data can also be used for bird surveys. These marine mammal flights in summer were omitted in the second year, but the program was extended by a further flight in September 2023, so that a total of 17 flights are available between November 2021 and September 2023 (Figure 3-1).

The aerial survey area covered the pre-investigation area for Energy Island Bornholm and the two operating German OWFs “Wikinger” and “Arkona” (Figure 3-1). A total of 13 transects varying between 28 and 66 km in length were covered during the study period, resulting in a total of 585.3 surveyed km (Table 3-1, Table 3-2). The transects ran parallel to each other in a north-south direction and were 5 km apart resulting in a total coverage of appr. 11 % of the total area. Compared to observer-based flights, 11 % coverage reflects excellent resolution, and is many times higher. For assessment studies, some countries require a minimum coverage of 10 % to avoid extrapolating too much into the area not covered. In total, 2,859.9 km² were covered during each of the surveys.

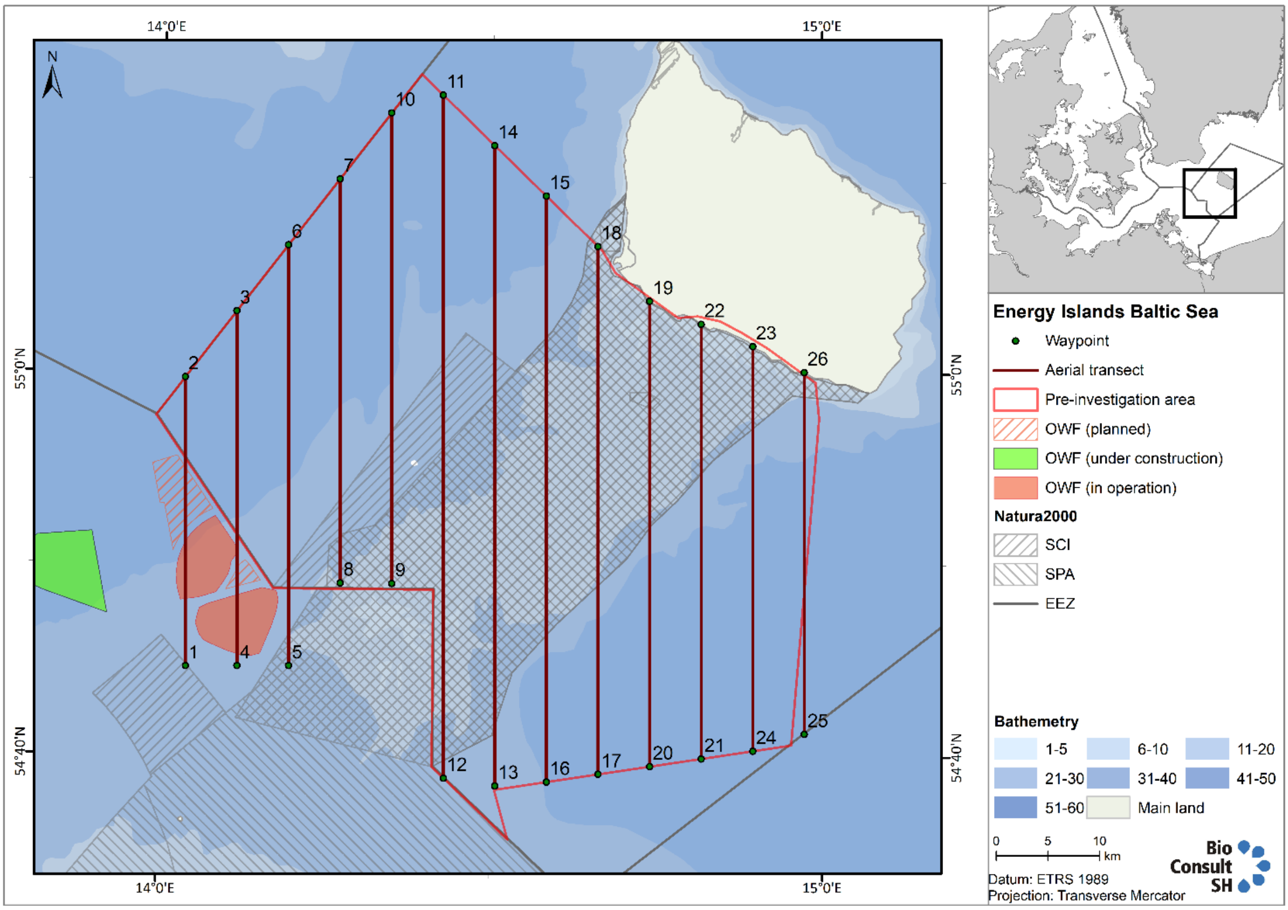

Figure 3-1. Aerial survey transect design for the aerial survey area used during all flights (aerial survey area). The figure includes the Natura 2000-sites (crosshatched) and the pre-investigation area (bordered in red).

Table 3-1. Geographical coordinates and length of aerial survey transects in the aerial survey area for each flight. *WP*: Waypoint, marking starting and ending point of the transect.

Transect	Transect length (km)	Start of transect			End of transect		
		Wp	Latitude	Longitude	Wp	Latitude	Longitude
1	27.980	1	54° 44.61' N	14° 02.48' E	2	54° 59.69' N	14° 02.12' E
2	34.366	3	55° 03.17' N	14° 06.73' E	4	54° 44.64' N	14° 07.14' E
3	40.751	5	54° 44.67' N	14° 11.80' E	6	55° 06.65' N	14° 11.36' E
4	39.127	7	55° 10.12' N	14° 16.00' E	8	54° 49.02' N	14° 16.38' E
5	45.564	9	54° 49.02' N	14° 21.05' E	10	55° 13.59' N	14° 20.65' E
6	66.164	11	55° 14.55' N	14° 25.35' E	12	54° 38.87' N	14° 25.86' E
7	62.033	13	54° 38.48' N	14° 30.52' E	14	55° 11.93' N	14° 30.11' E
8	56.765	15	55° 09.31' N	14° 34.85' E	16	54° 38.71' N	14° 35.16' E
9	51.129	17	54° 39.12' N	14° 39.81' E	18	55° 06.69' N	14° 39.58' E
10	45.061	19	55° 03.83' N	14° 44.30' E	20	54° 39.53' N	14° 44.45' E
11	42.103	21	54° 39.94' N	14° 49.10' E	22	55° 02.65' N	14° 49.00' E
12	39.198	23	55° 01.49' N	14° 53.70' E	24	54° 40.35' N	14° 53.75' E
13	35.040	25	54° 41.24' N	14° 58.40' E	26	55° 00.13' N	14° 58.39' E

Table 3-2. Overview of the 17 digital aerial surveys carried out in the aerial survey area between November 2021 and September 2023. Planned surveys (according to the agreed scope), survey dates, distance and survey effort as well as the covered area are given for every single flight.

Survey no.	Plan according to scope	Date	Distance (km)	Effort (km²)	Coverage (%)
1	1 bird survey between 09 and 11/2021	27.11.2021	587.41	315.7	11.0
2	5 bird surveys between 12/2021 and 05/2022	19.12.2021	586.4	317.14	11.1
3		10.01.2022	587.79	318.57	11.1
4		07.02.2022	588.38	319.17	11.2
5		01.03.2022	587.17	318.86	11.1
6		11.04.2022	586.94	316.73	11.1
7	1 bird survey + 2 marine mammals surveys between 06 and 08/2022	17.06.2022	587.15	318.56	11.1
8		11.07.2022	588.02	311.14	10.9
9		03.08.2022	588.61	318.87	11.1
10	1 bird survey between 09 and 11/2022	09.10.2022	578.67	308.29	10.8
11	5 bird surveys between 12/2022 and 05/2023	14.12.2022	587.52	318.26	11.1
12		28.01.2023	587.2	318.66	11.1
13		22.02.2023	572.08	310.68	10.9
14		12.03.2023	584.97	317.62	11.1
15		09.05.2023	586.79	318.52	11.1
16	1 bird survey between 06 and 08/2023	04.06.2023	600.78	325.18	11.4
17	1 extra bird survey between 09 and 11/2023	08.09.2023	588.31	318.97	11.2
			Total: 9,974.2	**Total: 5,390.9**	**Average: 11.1**

The recording of marine mammals was performed using the digital video technology developed by the company HiDef (HIDEF AERIAL SURVEYING LTD 2024). A twin-engine, high-wing propeller-driven aircraft (Partenavia P 68) was used for the acquisition of digital videos (Figure 3-2). This aircraft is equipped with four high-resolution video camera systems, which take approximately seven images per second and can achieve a resolution of two cm at sea surface. Since the camera system is not directed vertically downwards (depending on the sun position, it can be slightly inclined or even set against the flight direction), interferences arising from solar reflections (glare) can be effectively reduced. The external cameras (indicated by A and D, Figure 3-2) cover a strip of 143 m width while the internal ones cover a width of 129 m each, resulting in 544 m effectively covered. There is however about 20 m distance between each strip to avoid double counting of individuals detected by the cameras. Thus, the total recorded strip of 544 m is distributed over a width of 604 m.

The aircraft flew at an average speed of approx. 220 km/h (120 knots) at an altitude of 549 m. A GPS device (Garmin GPSMap 296) recorded the position every second, which permitted to geographically assign a location to the images and the individuals registered on them. The collected data was stored on mobile hard disks for subsequent review and analysis. For further details regarding the method, see (Weiß et al. 2016).

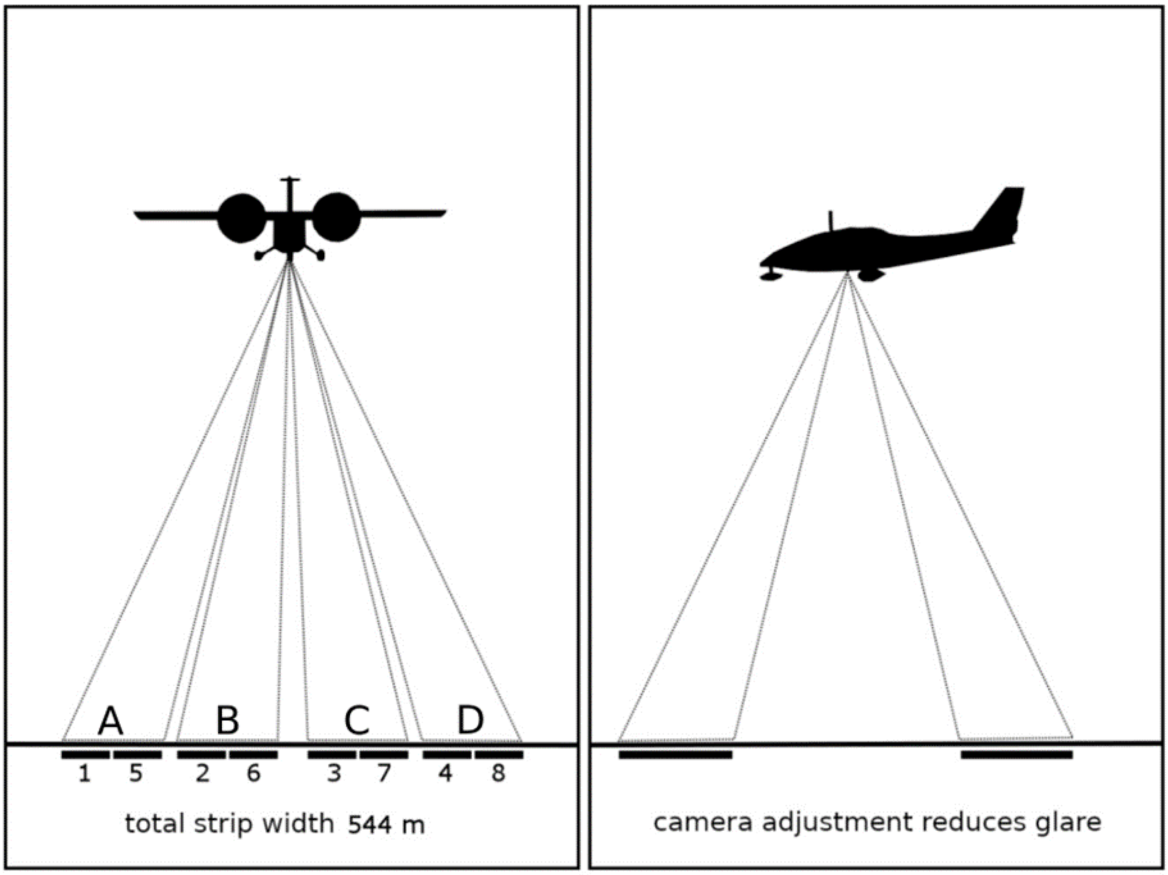

Figure 3-2. The HiDef Camera-System. The four cameras (A to D) cover an effective strip width of 544 m of the sea surface at a flight altitude of 549 m (left: frontal view; right: side view). The numbering indicates the camera images as they are used in the evaluation (the images from each camera are divided into two halves).

DATA ANALYSIS

To facilitate the detection of objects, the video sequences taken from each camera were split into halves, so that each fitted the width of a large monitor. The video files were then processed using an image capture and management software (StreamPix). Images were examined to mark all detected objects (birds, mammals, ships, etc.) and pre-sorted for subsequent identification. To guarantee a consistently high quality, 20 % of each film were randomly selected and processed again by another reviewer. If both reviewers reached a consensus of 90

% regarding object identification, discrepancies were rechecked, and the film afterwards approved for further analysis. If the consensus was below 90 %, the film was reanalysed entirely. Sections of the footage that could not be assessed due to backlight or the presence of clouds were not considered for further analysis.

Once the images were approved, the previously marked objects characterised as birds or marine mammals were identified by experienced observers. Data on birds can be seen in a separate report and will not be handled further in the current report. In addition to species identification, other information such as position, age and behaviour were determined whenever possible. Environmental parameters including air turbidity, sea state, solar reflection, and water turbidity were recorded every 500 images (approx. covering 4 km). To assure quality control, 20 % of the objects identified were re-assessed by a second observer. All discrepancies between the first and second identification process were checked again by a third expert. If there was a consensus of at least 90 %, the data collected was released for further analysis. If the consensus was below 90 %, systematic errors (e.g. problems in determining species groups) were corrected and all objects were re-identified.

Based on the number of detected individuals for each species or species group, monthly or seasonally mean densities given as individuals (ind.)/km² were calculated. As the survey effort differed among transects (see Table 2), densities were corrected by dividing them by the area covered for each transect.

The spatial distribution was determined for all surveys together or seasonally according to the species-specific classification by (Garthe et al. 2007) and displayed using grid density maps. A grid was laid over the aerial survey area with its grid cells aligned with the EEA grid (EEA 2019). For certain species, also point sighting maps from single surveys are displayed to demonstrate distribution patterns at specific days.

Densities of individuals (ind./km²) were calculated for all species or species groups. Regarding harbour porpoises, certain correction factors are included in the calculation and analysis since these marine mammals located more than about 2 m below the water surface may escape detection from the air. Thus, these animals could also be taken into account to determine abundance and densities. To correct for this so-called availability error (Borchers 2003), the number of animals sighted can be multiplied by a factor that takes into account the probability of harbour porpoises being present in the upper level of the water column (0-2 m, Teilmann et al. 2013). This likelihood was determined by means of tagged animals in the North- and Baltic Sea while considering seasonal fluctuations.

The literature does not provide any information about the proportion of seals in the upper 2 m of the water column. Telemetry studies make it clear that the animals mainly remain close to the seafloor and only briefly come to the surface to breathe (Adelung et al. 2004). Consequently, the density of seals presented here can only be taken as a minimum density and not as an average.

3.2.2 PASSIVE ACOUSTIC MONITORING

The purpose of the passive acoustic monitoring (PAM) survey was to determine the seasonal habitat use of harbour porpoise occurring in the pre-investigation area during the two-year survey period from November 2021 to September 2023.

PRE-INVESTIGATION AREA AND TIMING

In November 2021, 15 C-PODs (EI_01 – EI_15) were deployed for Passive Acoustic Monitoring (PAM) of harbour porpoises in the pre-investigation area for EIB. For exact deployment dates please see section "Data recording".

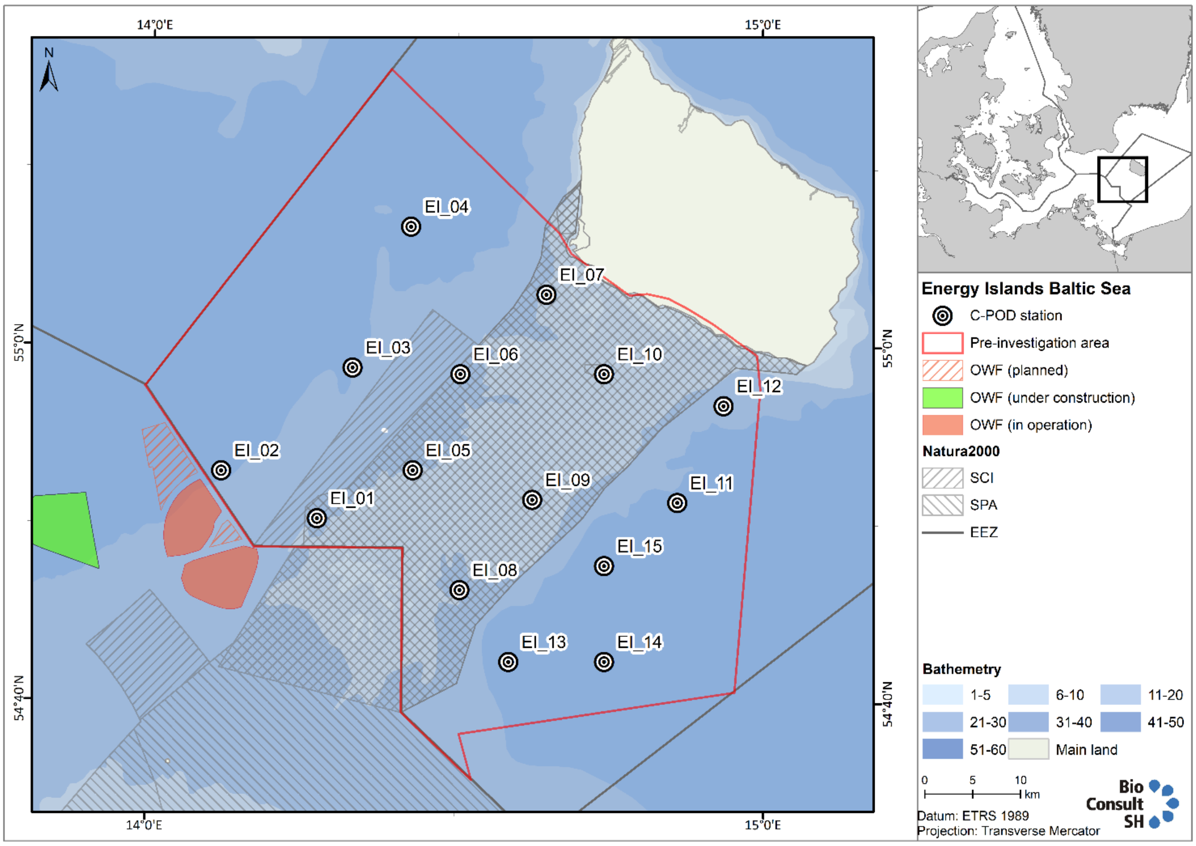

Figure 3-3. Location of C-POD stations used for the passive acoustic monitoring survey in relation to the pre-investigation area of EIB.

Table 3-3. Geographical positions of the deployed C-PODs. C-PODs were deployed at all stations from the 3rd of November 2021 to the 8th of October 2023.

Station	(WGS 84, DD°MM)	(WGS 84, DD°MM)	(WGS 84, DD)	(WGS 84, DD)
1	54° 50.34' N	14° 16.46' E	54,8390118	14,2743266
2	54° 52.97' N	14° 07.06' E	54,8829094	14,1176595
3	54° 58.82' N	14° 19.80' E	54,9804015	14,3300611
4	55° 06.77' N	14° 25.42' E	55,1128945	14,4236763
5	54° 53.09' N	14° 25.76' E	54,8847734	14,4293883
6	54° 58.50' N	14° 30.37' E	54,9749764	14,5062260
7	55° 02.99' N	14° 38.76' E	55,0498894	14,6459452
8	54° 46.37' N	14° 30.42' E	54,7727805	14,5070071
9	54° 51.47' N	14° 37.47' E	54,8577788	14,6244922
10	54° 58.54' N	14° 44.43' E	54,9757019	14,7405676
11	54° 51.32' N	14° 51.62' E	54,8553234	14,8602665
12	54° 56.77' N	14° 56.13' E	54,9461062	14,9355779
13	54° 42.34' N	14° 35.23' E	54,7056757	14,5871000
14	54° 42.37' N	14° 44.54' E	54,7061050	14,7422912
15	54° 47.76' N	14° 44.50' E	54,7959720	14,7417198

DATA COLLECTION

THE CETACEAN PORPOISE DETECTOR (C-POD)

C-PODS were used to conduct passive acoustic monitoring of marine mammals. A C-POD (Cetacean Porpoise Detector) is a hydrophone, detecting the high-frequency echolocation signals of harbour porpoises up to a distance of about 300 m (Figure 3-4). Harbour porpoise clicks are directed in a strongly forward direction. They are emitted within a sound beam with a horizontal beam width of 13° and a vertical beam width of 11° (Koblitz et al. 2012). This means that C-PODs will only be able to detect harbour porpoise presence if these (1) emit click sounds, (2) have their head pointed towards the hydrophone, and (3) are located at a suitable distance from the device. The respective detection radius depends on the C-POD type, C-POD sensitivity, train classification settings and duration of snapshots, as well as sea state, wind, current speed and sediment type which affect the background noise level. The recording of harbour porpoise clicks is therefore highly influenced by the animals' activity as well as distance from and angle of approach towards the C-POD. Applying different pre-set filters, the C-POD converts the sound waves into digital data, which are stored on an SD card. A number of different specific click characteristics is additionally saved. The C-PODs were set to a scan limit of 4,096 clicks/min.

Figure 3-4 C-POD (http://www.chelonia.co.uk/index.html).

C-POD CALIBRATION

All deployed devices were calibrated by the manufacturer (Chelonia Ltd., UK) to the main frequency of porpoise clicks (130 kHz) and set to the same hearing threshold (± 3 dB). Calibration is carried out in a specifically designed test tank in a standardized acoustic environment indicating possible differences in the sensitivity of the devices. The sensitivity of the units had been standardized when built by rotating the complete instrument in a sound field and adjusted to achieve a radially averaged, temperature corrected, maximum source pressure level (SPL) reading within 5 % of the standard at 130 kHz (60.5 dB). The radial values were taken at 5° intervals. The calibration and standardization process are described in detail on the manufacturer's website (www.chelonia.co.uk).

C-POD DEPLOYMENT

According to the international guideline for offshore data acquisition systems (ODAS), all C-PODs were marked by a yellow rubber marker buoy as well as a 6 m spar buoy, equipped with a yellow 3NM flashlight, a radar-reflector and a yellow top-cross (Figure 3-5). Two surface markers are connected via a rope on the sea floor.

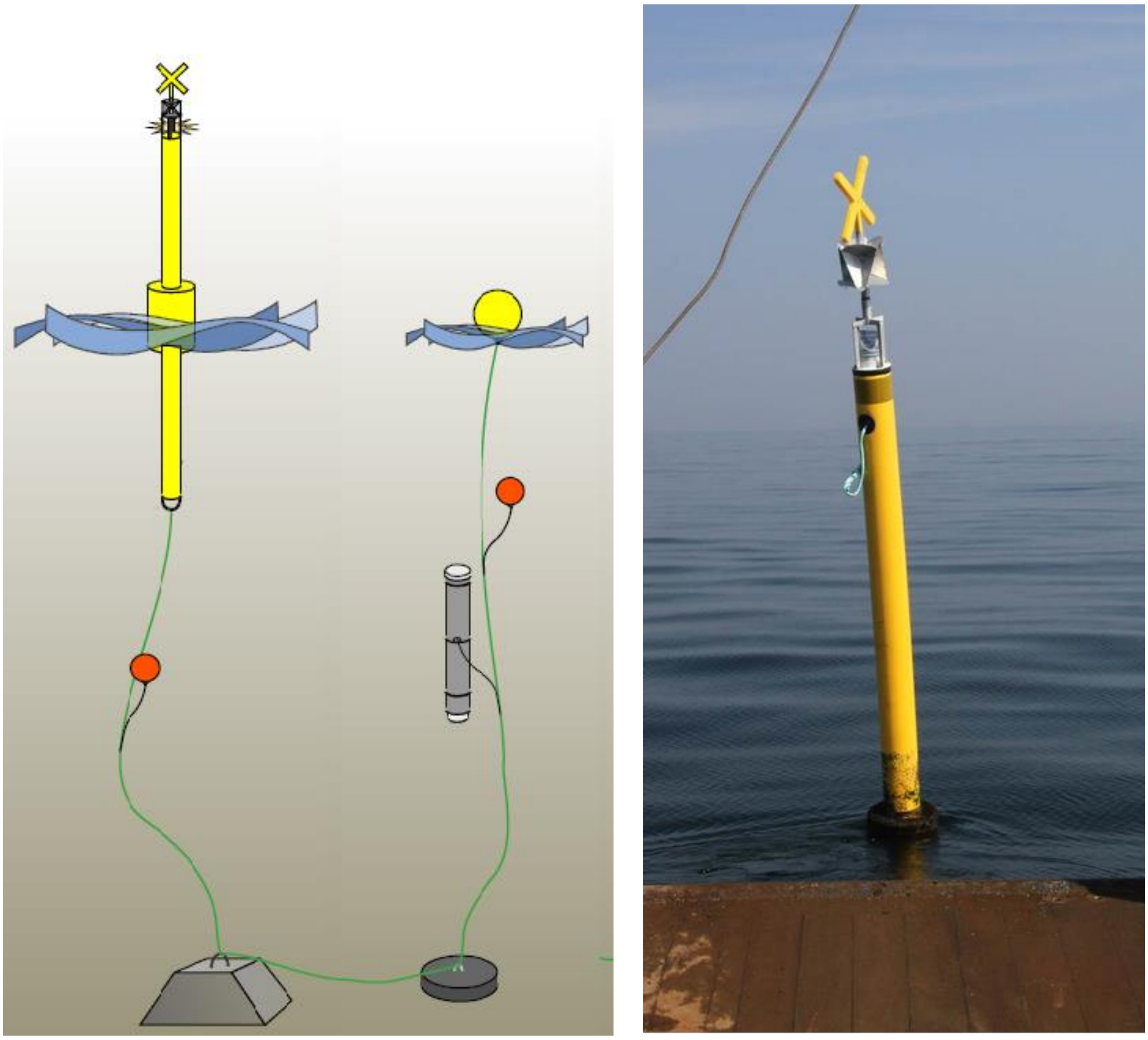

Figure 3-5. C-POD mooring system with spar buoys.

The presence of harbour porpoises was monitored by the C-POD stations for 24 months. Monitoring started in November 2021 after the Danish Maritime Authority approved the deployment. Maintenance of the C-PODs at sea was performed every 6-10 weeks to minimise potential data gaps due to loss or malfunction. The maintenance work was carried out by the MS Skoven.

DATA ANALYSIS

MEASUREMENT UNITS

Harbour porpoise-positive time units are pre-defined periods (e.g., days/hours/10 minutes or minutes), which are checked for the occurrence of harbour porpoise click trains. In case the chosen time unit contains at least one harbour porpoise signal, this time unit is rated to be harbour porpoise positive. As the number of recorded clicks largely depends on the behaviour of the animals and is very sensitive to possible minor differences in sensitivity between the devices, the parameter “positive time unit” is an indication for harbour porpoise presence, which is independent of the context of the animals' sound emission. Different studies were able to show a clear relation between absolute harbour porpoise density (determined in aerial surveys) and the detection rate within the same period and area in form of harbour porpoise positive time units (Siebert & Rye 2008, Kyhn et al. 2012, Williamson et al. 2016, Jacobson et al. 2017, Schubert et al. 2019). It can therefore be assumed that the higher the detection rate, the more harbour porpoises will have been present in the respective range of the C-POD on that particular timeframe, although it cannot be completely excluded that in case of a high detection rate only few animals stayed in the area covered by a C-POD for a longer period of time. This parameter therefore only serves as a rough indicator for harbour porpoise density per time unit. See formula 1, xt = number of clicks for this time unit).

Formula 1:

$$\text{Harbour porpoise positive time per time unit } [\%] = \frac{\text{N time units with clicks } (x_t > 0)}{\text{N total time unit}} * 100$$

The time unit (from minutes up to months or entire study periods) is chosen depending on the specific question and harbour porpoise presence in the pre-investigation area.

The following analyses are based on DPD/month and DP10M/day (see below), focusing on two main questions:

1. What is the monthly presence of porpoises in the preliminary project area?
2. How do animals utilize the area during a 24-hour day?

%DPD/time unit (% detection-positive days per time unit) gives the percentage of survey days per pre-defined time unit (e. g., month/year/study period, etc.) with at least one harbour porpoise signal. Applying this parameter, no difference is made if only one click train was recorded that day or if hundreds of click trains occurred every minute. The coarse resolution parameter is particularly well-suited for datasets characterized by a limited number of harbour porpoise detections, as observed in the current pre-investigation area. The parameter is standardized to values between 0 and 100 as %DPD/month, taking the number of recording days per month as 100%. In areas with low porpoise abundance, i. e., great parts of the eastern Baltic Sea, the daily presence of harbour porpoises has more explanatory power than the (daily) frequency of occurrences (see %DP10M/day). That is because analyses based on an hourly or even minute-by-minute basis have a high susceptibility to randomness due to the very infrequent recording and thus only have a low informative value. To meet highest explanatory goals for areas with low porpoise abundance, the reduced temporal resolution is considered an acceptable limitation in data analysis.

%DP10M/time unit (% detection-positive 10 minutes per time unit): This parameter gives percentages of the number of 10-minute units per pre-defined time unit (e.g., days/month/study period, etc.) with at least one harbour porpoise signal. This parameter is usually used in a resolution per day where it describes within how many of the usually available 144 10-minute units of a 24-hour day at least one harbour porpoise signal was recorded. Thus, it is the most appropriate measure in areas with moderate or high porpoise abundance. This parameter can be used to check for any temporal differences in the presence of porpoises during the course of a 24-hour day. Since the instruments are deployed close to the seabed, regular differences in detections during a day can give valuable information about the habitat use.

CALCULATIONS

Seasonality diagrams for each C-POD station are generated based on harbour porpoise detection rates using the software R (package "stats"; version 3.4.0; R CORE TEAM 2017). The phenology is represented by the parameter %DPD/month. With the former parameter, each day on which at least one click train was recorded, is considered a "detection positive day" (DPD). By this procedure, a day with few click train recordings is treated equal to a day on which almost continuous (i. e. many) porpoise click trains are recorded. The use of this parameter prevents an overestimation of too large stochastic parameters. In contrast, the parameter %DP10M/d offers a finer temporal resolution for each survey day and can be used, for instance, to create daily patterns. However, as the number of detections recorded daily was too low for this project, no reliable daily patterns could be created.

C-POD RAW DATA PROCESSING

Raw data of the C-PODs are processed using the associated software C-POD.exe (Chelonia Ltd., UK). The software is available as a free download under http://www.chelonia.co.uk. C-PODs record signals in real time allowing to identify click trains due to the temporal resolution. Data are processed in two steps. In first step, harbour porpoise click trains are extracted from the raw data by means of an algorithm of the C-POD.exe software. In the second step, signals are classified by the KERNO classifier into different categories according to the probable source: harbour porpoise, dolphin, boat sonar or unknown source. The software assigns each click train to one of these classes and gives an estimate of the quality of this classification. Four quality classes are available:

"**high**": these click trains are highly probable harbour porpoise signals.
"**moderate**": short click trains, which are probably harbour porpoise signals.
"**low**": click trains with sound patterns which may be harbour porpoise signals but deviate from the ideal and may therefore originate from other sources.
"**doubtful**": series of click trains, which are due to the length or the temporal pattern of rather technical origin. These may still contain harbour porpoise click trains, which were only partly recorded by the hydrophone or from a larger distance or at an unfavourable angle.

For the present analysis, standard filtering was applied according to Chelonia Ltd., including only the two highest quality classes ("high" and "moderate") to decrease the number of incorrectly classified harbour porpoise click trains. For Baltic Sea conditions, where low detection rates of harbour porpoise are expected and other cetaceans are unlikely, a second encounter classifier (Hel1) is applied, which analyses the data classified by the KERNO classifier. As the KERNO classifier is characterized by a lower sensitivity, the Hel1 runs the data with a lower positive predictive value. The Hel1 classifier revises the results from the KERNO classifier in order to further eliminate any click trains, which were eventually falsely identified as being of harbour porpoise origin, called "false positives" by the KERNO classifier. Even though the more conservative Hel1 classifier may discard a number of positive porpoise click trains in areas of low porpoise abundance, it often becomes important to only include 100 % secure porpoise signals, as any false positive has a strong influence on the assessment of areas. Since it can be assumed that the "false-positive" rate is constant throughout areas and positions, its influence in areas of higher abundance is quite low.

Since only very few harbour porpoise signals were detected at all by the KERNO classifier during the present study, all harbour porpoise signals in the two highest probability classes were subjected to visual inspection. For this purpose, the raw data with various parameters such as inter-click interval, frequency or loudness were viewed with the help of the C-POD.exe software and experienced harbour porpoise acousticians then classified the click-trains identified by the software as "rather unlikely" (false) or as "rather likely" (true).

DATA RECORDING

15 C-POD stations were deployed in the investigation area in November 2021. The first deployment of 13 of the 15 stations took place on the 3rd of November 2021. The first deployment of station EI_08 and EI_13 followed on the 9th of November 2021. All C-PODs were replaced approximately every two months to extract data and change the batteries. On the 8th of October 2023, all devices were completely recovered, marking the end of monitoring. The deployment and recording periods of the C-PODs for all monitoring stations are shown in Figure 3-6.

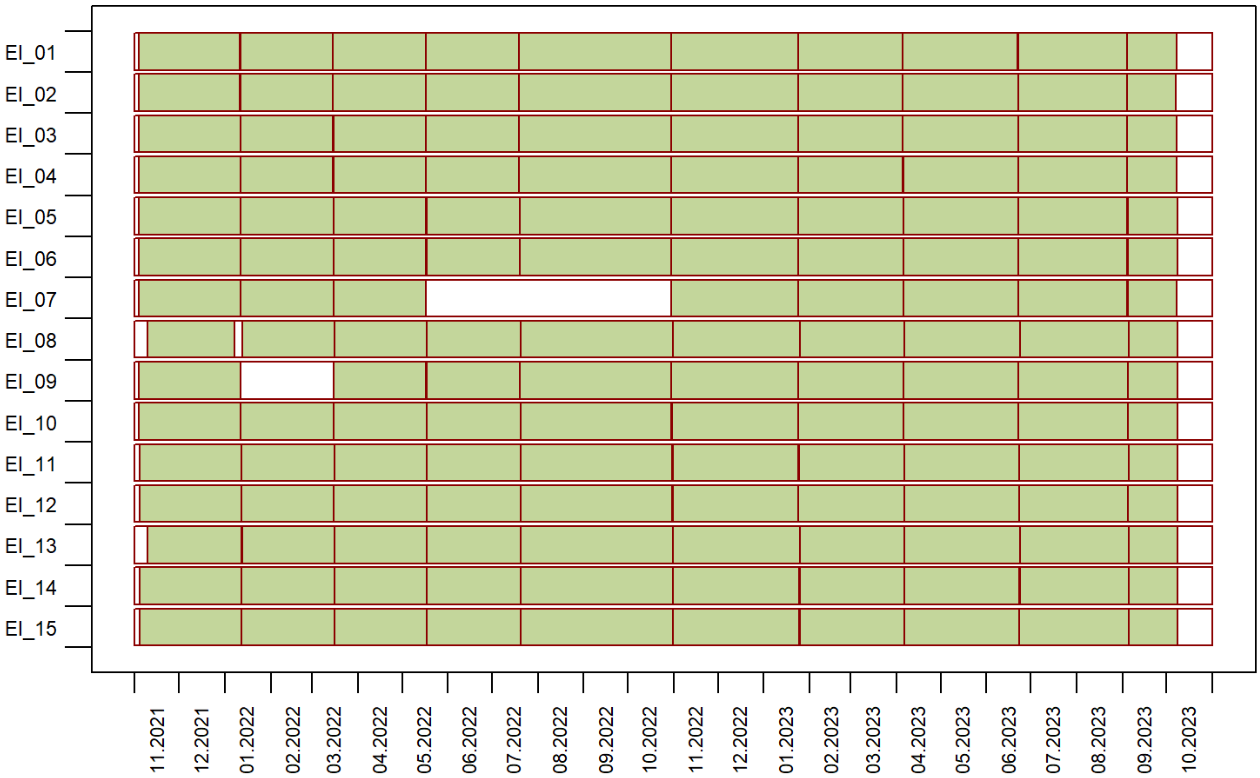

Figure 3-6. Bar chart, indicating the duration of deployment of C-PODs at C-POD stations EI_01 to EI_15 for the survey period (November 2021 to October 2023). Green: C-POD recorded data, white: No data (for further explanation see Table 3-4). The x-axis shows the date, the y-axis the C-POD station. Vertical red lines indicate the time of exchange of the devices.

Table 3-4 provides an overview of stations, where C-PODs either did not record or were lost and therefore longer-term data loss occurred. Such data losses occurred at stations EI_07, EI_08 and EI_09. A total of 233 days of 10,548 possible monitoring days (2.2 %) could not be included in the evaluation due to data loss. 10.315 C-POD monitoring days remained for further consideration.

Table 3-4. C-POD Stations, where C-PODs either did not record or were lost and thus, long-term data loss occurred.

Station	Reason for data loss	Start of data loss (Date)	End of Data loss (Date)	Time of data loss (days)
EI_07	C-POD did not record.	17.05.2022	19.07.2022	63
EI_07	C-POD loss.	19.07.2022	30.10.2022	103
EI_08	Premature termination of data recording on the 7th of October.	07.01.2022	11.01.2022	4
EI_09	C-POD did not record.	11.01.2022	15.03.2022	63

CLICKS OF UNKNOWN ORIGIN

To avoid possible masking effects of too many clicks of unknown sources on the registration of harbour porpoise clicks, the quality of C-POD records was checked. In addition to echolocation sounds of harbour porpoises, C-PODs record all impulse sound events in a frequency band of between 20 kHz and 150 kHz. Among these are the sounds of boat sonars and sediment movement. If a C-POD is deployed in a noisy environment, the pre-set click limit of 4,096 clicks per minute will quickly be exceeded and the C-POD will then record no further data for the rest of this minute. In such a case, harbour porpoise clicks may be missed. However, even if the limit is not reached it cannot be excluded that porpoise clicks may be missed due to masking. A double quality criterion was defined in order to prevent too much data of unknown origin from being included in the further analysis and causing a bias in the outcome: The two criterions were defined based on experience gained in the analysis of different projects in the North Sea and Baltic Sea (Rose et al. 2019). All complete days with C-POD recordings that registered either more than three million clicks (the maximum possible number is > 5.89 million clicks) or had more than 200 minutes reaching the click limit of 4,096 clicks were removed. Furthermore, only whole days with records of 1,440 minutes were included in the evaluation. Duplicate or incomplete records due to e. g. exchanges of C-PODs were excluded. About 4.6 % of all C-POD monitoring days (10,315 days) met these criteria and were therefore discarded. Hence, 9,793 C-POD days remained for further analysis. The dual noise criterion was not applied to sonar analyses, as ship noise was of special interest here.

4 EXISTING DATA

4.1 HARBOUR SEALS

4.1.1 CONSERVATION STATUS

The status of the global population (Lowry 2016) and the European population (European Mammal Assessment Team 2007) of the harbour seal are classified by the IUCN as least concern (LC). The HELCOM Red List (2013a) classified the Southern Baltic population as LC, the population in the Kalmarsund as vulnerable (VU). The national red list of Germany lists the harbour seal as being under threat of unknown extent (Meinig et al. 2020), the red list of Denmark assessed it as LC (Aarhus Universitet 2019) and the red list of Sweden lists the Baltic population as VU (SLU Swedish Species Information Centre 2023). Hunting of harbour seals in Germany is forbidden, in Sweden it is forbidden unless allowed in other parts of the hunting legislation and in Denmark licenses are given to shoot a limited number of individuals each year when seals interfere with fishing gear. Regulation is not allowed between the 1st of June and the 31st of July and never in seal reserves (HELCOM 2013c).

In EU waters, harbour seals are protected by the EU Habitats Directive and listed in its Annexes II and V (European Commission 2021). They are also covered by the EU Marine Strategy Directive, where distribution, number and bycatch must be reported and evaluated according to descriptor 1. The harbour seal is listed in Appendix II of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats) and in Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention (CMS Secretariat 2015). For summary, see Table 4-1.

The Danish Center for Environment and Energy (DCE) assessed the conservation status of the harbour seals in Habitat Directive Article 17 from 2019 (Fredshavn et al. 2019) as favourable in both Danish marine regions. It also states that while stocks in the Wadden Sea and Kattegat are large and long-term viable, stocks in the Limfjord and the Baltic Sea are smaller and more vulnerable. In the DCE Marine areas report from 2021 (Hansen & Høgslund 2021) it is said that the population of harbour seals has shown a substantial increase from 1976 to 2020 as a result of the start of protection measures in 1977 and the establishment of a number of seal reserves with no access. Since 2015, the number of harbour seals in Denmark has fallen by 4 % each year in all four management units, indicating that the population is approaching or has reached ecological capacity or is pressured by unknown factors, such as a lack of food, disturbances or competition by grey seals (Hansen & Høgslund 2021).

Table 4-1. Listing of the harbour seal in international and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= Vulnerable.

Species	IUCN (2017)	HELCOM Red List	National Red Lists	Natura 2000 (BfN 2015)	Bern Convention	Bonn Convention
Harbour Seal ***Phoca vitulina***	Global: LC European: LC	Southern Baltic: LC Kalmarsund: VU	DE: threat of unknown extent DK: LC SE: VU (Baltic population)	Appendix II und V	Appendix III	Appendix II

4.1.2 BIOLOGY, DISTRIBUTION, ABUNDANCE

Harbour seals can reach a maximum age of 36 years (Härkönen & Heide-Jørgensen 1990). Adult East Atlantic harbour seals were found to show an asymptotic length of 146 cm in females and 156 cm in males (Härkönen & Heide-Jørgensen 1990). Asymptotic weight was 67 kg in females and in 75 kg in males, but strong fluctuations depending on reproductive status and season were observed (Härkönen & Heide-Jørgensen 1990). Females reach sexual maturity at an average age of 3.7 years and males about a year later (Härkönen & Heide-Jørgensen 1990). The overall pregnancy rate in 3- to 36-year-old females was 92 % (Härkönen & Heide-Jørgensen 1990). Females give birth on land, usually once a year, between May and June after an average pregnancy period, or gestation, of 11 months. Pups are usually weaned after four weeks and are then left to fend for themselves. Pups shed their embryonic lanugo fur before birth. They can swim and dive immediately after birth but depend on undisturbed sites on land for suckling and resting. Mating occurs in the water after pubs are weaned around July. Males perform an underwater display including specific vocalizations and are sought out by females for mating, a so-called lek-system (van Parijs et al. 1997). Moulting occurs between July and September, with a peak in August, and during this time animals also depend on undisturbed sites on land. This is because a good blood perfusion to the outer skin layers is necessary for moulting, which makes animals more prone to heat loss. Therefore, increased perfusion occurs on land, preferably with dry fur (Dietz et al. 2015). Because of the reproduction and moulting period, harbour seals are most sensitive to disturbance at haul-out sites during summer months between May and August.

Harbour seals show no migration movements and instead they display high site fidelity to their haul-out sites, from where they make foraging trips into deeper waters. These trips are mostly confined to a radius of less than 50 km from the coast but can occasionally be as far as 100 km or further offshore (e.g. Thompson et al. 1994, Tollit et al. 1998, Cunningham et al. 2009, Dietz et al. 2013). Most of these studies found seasonal variation in harbour seal movement, with movements being more confined around haul-out sites during summer when breeding and moulting takes place. Also, juveniles were found to show further ranging movement patterns than adult individuals and sex-specific differences were also found during some of these studies. McConnell et al.

(2012) tagged three adult and two juvenile harbour seals at Rødsand. The adults stayed within 50 km of the haul-out site, but juveniles were found to travel to haul-out sites over 200 km away.

Harbour seals are opportunistic predators but show mainly benthic feeding and prefer small to medium sized benthic fish species. As such, they are mainly found to feed in areas with a water depth below 100 m (Tollit et al. 1998), although they were reported to dive to depths of up to 400 m (Teilmann et al. 2017). Harbour seals feed on a great variety of prey, depending on location, water depth, and individual prey abundance. Thus, these opportunistic feeders share their prey preferences with harbour porpoises and grey seals in the Baltic Sea, including sand eel (*Ammodytes* spec.), black goby (*Gobius niger*), and atlantic cod (*Gadus morhua*) but also other bottom dwelling fish as flounder (*Platichthys flesus*) and plaice (*Pleuronectes platessa*) (Scharff-Olsen et al. 2019).

Based on molecular data and satellite telemetry studies, it was suggested to split harbour seals in the Baltic region into four different subpopulations or management units (Andersen & Olsen 2010, Blanchet et al. 2021): one in the Kalmarsund between Øland and the Swedish mainland, one in the south-western Baltic, one in the Kattegat and one in the Limfjord. As tagging studies have shown, there is no or only limited exchange between colonies separated by more than about 100 km (Dietz et al. 2013, 2015), and thus at least partial reproductive isolation between these four subpopulations. Especially the population in the Kalmarsund is genetically quite distinct and different from the other harbour seal populations in the Baltic. Härkönen and Isakson (2010) conclude that this population was probably founded by animals that later became extinct elsewhere, while other animals re-entered the Skagerrak and Kattegat later. In the 1970s, only about 30 harbour seals were counted, so the population experienced a severe bottleneck (Goodman 1998). Latest counts revealed about 2,000 counted seals in the area in 2021, leading to a current estimated population size of about 2,900 harbour seals (HELCOM 2023).

The population in the Skagerrak, Kattegat and the Danish Straits exceeded 17,000 animals, but declined to only about 2,500 in 1930 due to intense hunting (Heide-Jørgensen & Härkönen 1988). Latest estimated population sizes of harbour seals were about 2,000 individuals in the SW Baltic and about 12,500 individuals in the Kattegat (HELCOM 2023a). There are no breeding sites of harbour seals along the German coast. The ones closest to the EIB pre-investigation area are located about 100 km northwest at Falsterbo (Måkläppen) in Sweden, and in Denmark about 120 km northwest in the Øresund at Saltholm, about 140 km southwest on the Rødsand sand bar and about 150 km west on the eastern coast of Sjælland at Bøgestrømmen. The next closest haul-out sites in easterly direction is located about 150 km to the northeast in the Kalmarsund south of Øland (Figure 4-1).

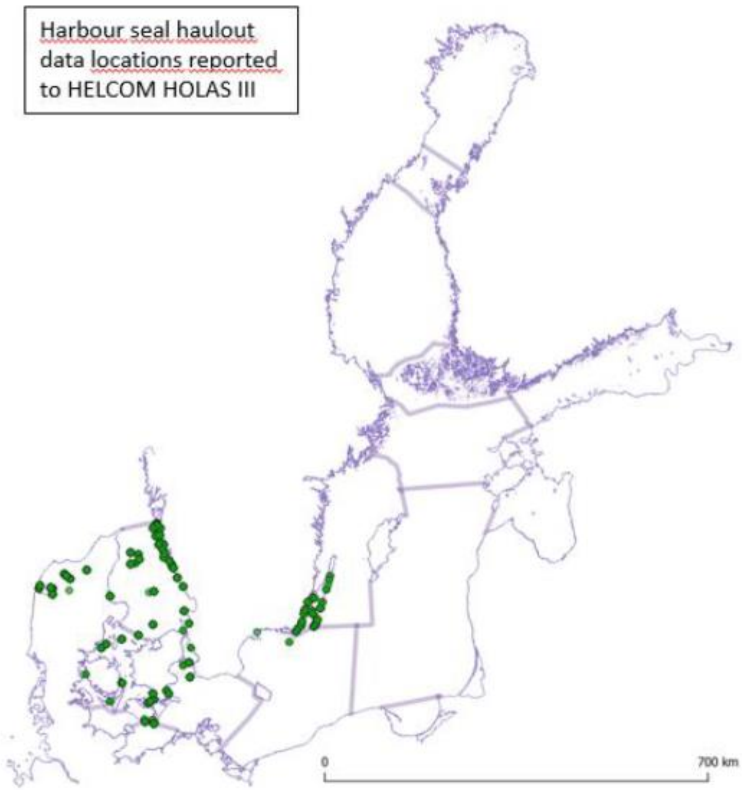

Figure 4-1. Location of harbour seal moulting haul-out sites in the Baltic Sea. From: HELCOM (2023b).

(HELCOM 2023c) states that the harbour seal populations in the Baltic are currently recognized as two official management units consisting of (a) the Kalmarsund and (b) the southwestern (SW) Baltic Sea and the Kattegat. In addition, HELCOM also assessed a third unofficial unit in (c) the Limfjord.

According to the HELCOM core indicator report (2023b), the core indicator evaluates the state of the marine environment based on the distribution of harbour seals in the Baltic Sea. A good status for the harbour seal population is achieved when the distribution of seals is close to pristine conditions (e.g., 100 years ago), or where appropriate when currently available haul-out sites are occupied (modern baseline), and when no decrease in area of occupation occurs. For the distribution indicator, the subpopulations Kalmarsund, and the group consisting of the SW Baltic, Kattegat and Limfjord were assessed independently. Both subpopulations failed to achieve good status (Figure 4-2. Distribution of harbour seals in the Baltic Sea. Left: Occurrence levels for harbour seals of the subpopulations a) Kalmarsund and b) SW Baltic, Kattegat and Limfjord (from HELCOM 2023a). Right: Status evaluation results based on evaluation of the indicator 'distribution of Baltic Seals' – Harbour seal (from HELCOM 2023b).

The population in the Kalmarsund has increased with a rate very close to the threshold for good environmental status, but abundance is still well below the Limit Reference Level, so its status is not good. Concerning abundance, the population's area of occupancy (i.e. the distribution at sea) is at pristine levels, but not all suitable land sites are used. Therefore, the population in the Kalmarsund failed to achieve good status with regards to both key indicators "distribution" as well as "population trends and abundance".

Concerning the status of the population in the SW Baltic and Kattegat, (HELCOM 2023c) states that the SW Baltic population alone is below Limit Reference Level, but when assessed together with Kattegat, the combined abundance exceeds Limit Reference Level. However, the growth rates in the SW Baltic and the Kattegat population are still below the threshold value, indicating no good status. It is also said that it is uncertain if the Kattegat unit is at or below Target Reference Level or undergoing a decline (HELCOM 2023c). The state of distribution of harbour seals achieves the threshold value for good status in the Kattegat, but when assessed together with the SW Baltic population, good status is not achieved. Thus, the population in the SW Baltic and Kattegat also failed to achieve good status with regards to both key indicators "distribution" as well as "population trends and abundance" (HELCOM 2023c).

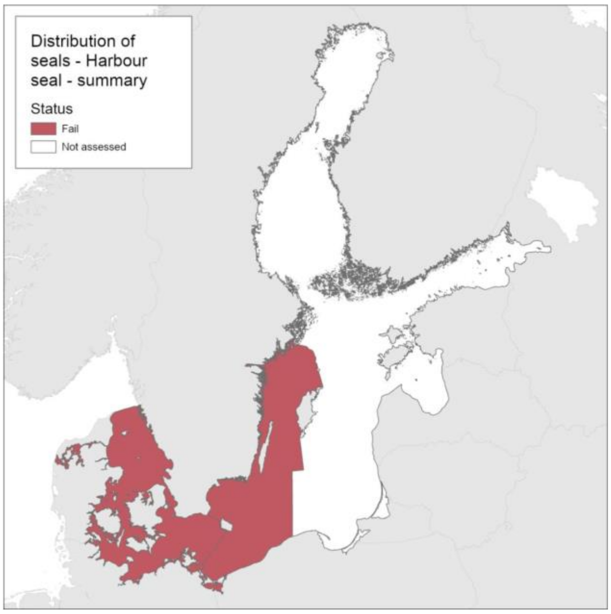

Figure 4-2. Distribution of harbour seals in the Baltic Sea. Left: Occurrence levels for harbour seals of the subpopulations a) Kalmarsund and b) SW Baltic, Kattegat and Limfjord (from HELCOM 2023a). Right: Status evaluation results based on evaluation of the indicator 'distribution of Baltic Seals' – Harbour seal (from HELCOM 2023b).

4.1.3 HABITAT USE AND DENSITY ESTIMATES AROUND THE ENERGY ISLAND BORNHOLM (EIB) PRE-INVESTIGATION AREA

Harbour seals (Phoca vitulina) are the most widely distributed species of all seals ranging from temperate to polar coastal regions all along the Northern Hemisphere. In the Baltic Sea, distribution is limited to Danish, Swedish, German and Polish waters.

As harbour seals show high site fidelity at haul-out sites and aggregate there especially during the lactation and moulting period, estimates of population sizes are based on counts at haul-out sites during the moulting season. Such counts are carried out annually and thus, good knowledge exists on the individual numbers at haul-out sites. However, much less is known about harbour seal density in the surrounding waters and about harbour seal habitat use there. From tracking studies, it is known that harbour seals usually stay close to shore and make foraging trips that are rarely further than 50 km from their haul-out site (Thompson et al. 1994, Tollit et al. 1998, Cunningham et al. 2009, Dietz et al. 2013). Most studies found some seasonal, age- and sex-specific differences in these movement patterns.

McConnell et al. (2012) tagged three adult and two juvenile harbour seals at Rødsand. Adults generally stayed within 50 km of the haul-out site, but juveniles were occasionally found to travel to distant haul-out sites over 200 km away. Examples of tracks and ranges from adult harbour seals from the Rødsand lagoon are shown in Figure 4-3 and Figure 4-4. Dietz et al. (2015) tagged ten harbour seals from Måkläppen. These also mainly stayed within 25 km of their haul-out sites, with juveniles ranging a little further than adults. There were some seasonal differences with animals being more stationary during the summer and showing more extensive movements during winter and spring. Migration routes and home ranges of these ten animals in autumn 2012 are shown in Figure 4-3, and seasonal differences in their Kernel home ranges are shown in Figure 4-4. In conclusion, the home range in these two studies does not reach near the EIB pre-investigation area at any time of the year.

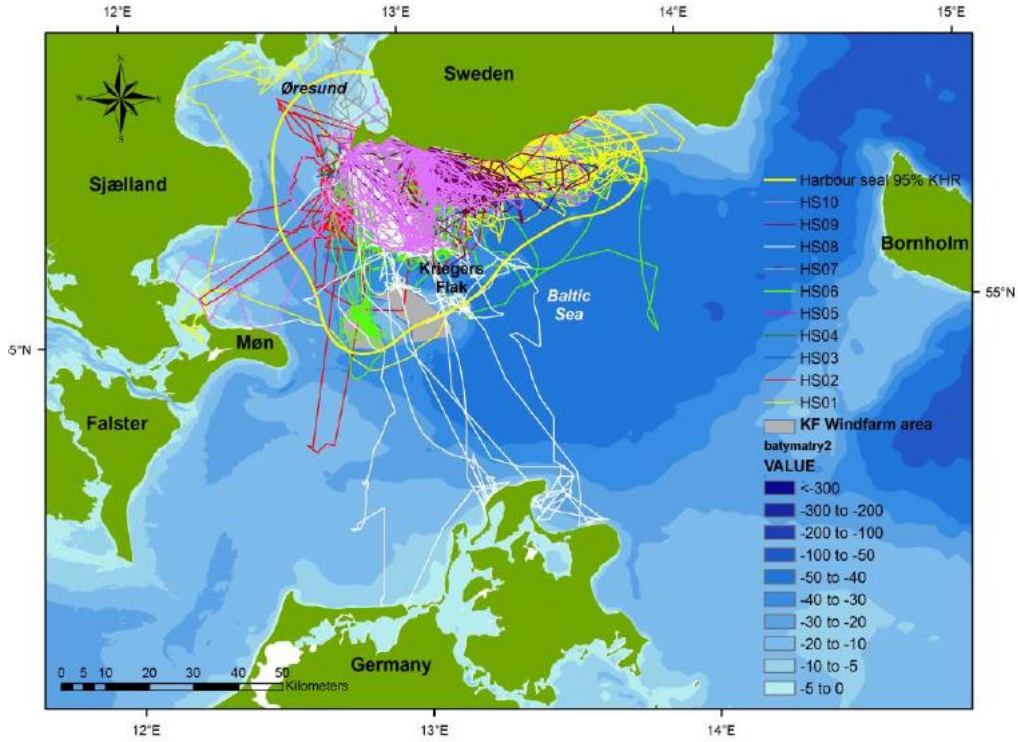

Figure 4-3. Map showing the migration routes and the 95 % Kernel ranges (yellow polygon) for 10 harbour seals tagged during the autumn 2012 at Måkläppen, Falsterbo. From Dietz et al. (2015).

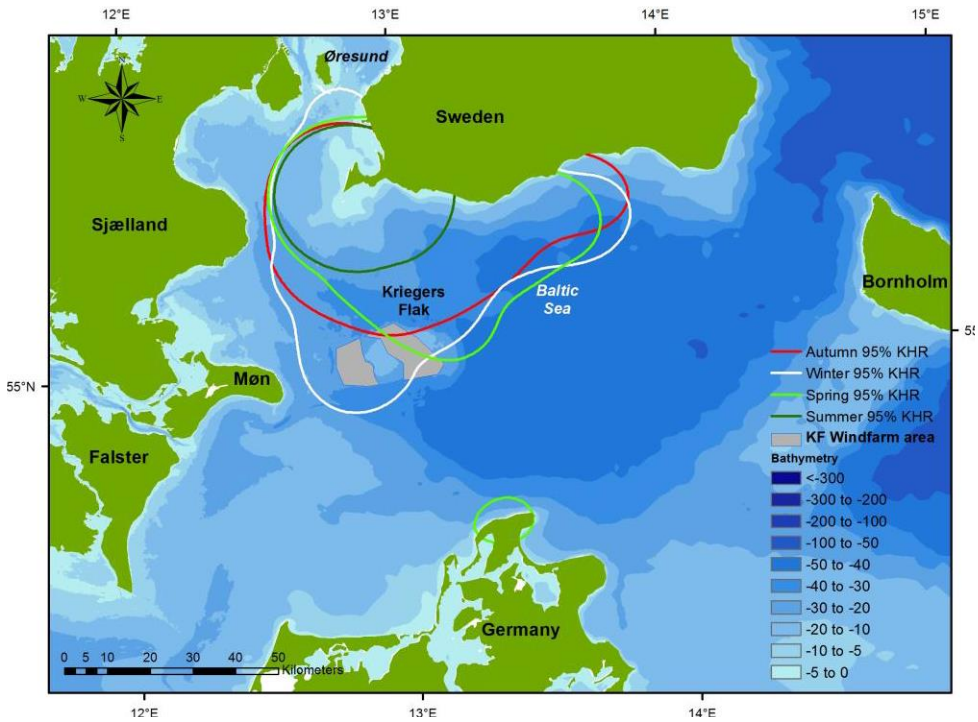

Figure 4-4. Map showing the 95 % Kernel home ranges for the four seasons of the 10 harbour seals tagged in autumn 2012 at Måkläppen, Falsterbo. From Dietz et al. (2015).

Further information on the occurrence of harbour seals in the EIB pre-investigation area can be taken from aerial and ship-based surveys conducted for the OWF "Windanker" within the German planning area O-1.3 in close proximity to the EIB pre-investigation area (IBL Umweltplanung GmbH 2020). Aerial surveys conducted at high altitude (as in this case) rarely allow identifying seals to the species level. However, seal detections in the area were generally very scarce with a total of only 13 seals detected during 20 aerial surveys conducted throughout the year between 2016 and 2018, each covering about 285 km² (Table 4-2). Of these 13 individuals, only one animal could be identified to species level, and this individual was a grey seal. Seal densities calculated from these data ranged between 0 and 0.01 ind./km² and were thus generally very low. Seal density calculated over all data would be 0.002 ind./km². During 24 ship-based surveys in the same period, each with a total transect length of about 125 km, a total of nine seals could be detected (Table 4-3). Of these, seven were grey seals, one was a harbour seal, and one could not be identified to species level. One of the grey seals was a juvenile. Overall, the sighting rate was very low with 0.28 ind./100 km calculated over the total survey effort. Given that the great majority of seals detected during ship-based surveys were grey seals, it is most likely that this also applies to seals detected during aerial surveys, which cover the same study period. The seasonal (Figure 4-5, Figure 4-6) and geographical distribution (Figure 4-7, Figure 4-8) of sightings during both aerial and ship-based surveys show that sightings can occur throughout the year and throughout the pre-investigation area and that there are no specific locations where harbour seals were more frequent. In conclusion, no specific foraging ground could be identified based on marine mammal surveys conducted in relation to the OWF project area O-1.3.

Table 4-2. Number of seal sightings and calculated seal density (for all seal sightings combined) during the 20 digital aerial HiDef surveys conducted during the marine mammal monitoring program in the OWF planning area O1.3. From: IBL Umweltplanung GmbH (2020).

Survey date	Effort [km²]	Harbour seals [n]	Grey seals [n]	Unidentified seal [n]	Seals/km²
20.04.2016	285	0	0	0	0
03.05.2016	285	0	0	2	0.007
26.06.2016	256	0	0	0	0
22.07.2016	285	0	1	0	0
26.08.2016	284	0	0	0	0
10.09.2016	283	0	0	1	0.004
30.10.2016	285	0	0	2	0.007
13.11.2016	285	0	0	0	0
28.01.2017	279	0	0	2	0.007
24.02.2017	285	0	0	0	0
11.03.2017	285	0	0	1	0.004
10.04.2017	285	0	0	0	0
12.05.2017	285	0	0	1	0.004
15.07.2017	284	0	0	0	0
07.08.2017	284	0	0	0	0
27.09.2017	285	0	0	0	0
31.10.2017	285	0	0	0	0
04.12.2017	285	0	0	0	0
27.12.2017	282	0	0	0	0
07.02.2018	284	0	0	3	0.011
Total	**5.657**	**0**	**1**	**12**	**0.002**

Table 4-3. Number of seal sightings and calculated sighting rate (for all seal sightings combined) during the 24 ship-based surveys conducted during the marine mammal monitoring program in the OWF planning area O1.3. From: IBL Umweltplanung GmbH (2020).

Survey date	Distance [km]	Seastate (Petersen)	Harbour seal [n]	Grey seal [n]	Unidentified seal [n]	Sighting rate [n/100 km]
29.03.2016	126.7	1-3	0	1	0	0.79
23.04.2016	126.4	3	0	0	0	0
20.05.2016	128.8	2-3	0	0	0	0
10.06.2016	128.4	4	0	0	0	0
23.07.2016	126.1	0-1	0	2	0	1.59
15.08.2016	127.7	4	0	0	0	0
02.09.2016	128.1	4	0	0	0	0
19.10.2016	121.7	2-4	0	0	0	0
23.11.2016	128.7	0-1	0	2	1	2.33
16/17.12.2016	128.2	2-4	0	0	0	0
08./09.01.2017	127.6	2-4	0	0	0	0
14..02.2017	128.0	3	0	0	0	0
20.03.2017	127.8	0-3	0	0	0	0
01.04.2017	129.4	1-2	0	0	0	0
11.05.2017	129.0	2-3	0	1	0	0.78
10.06.2017	128.0	3-4	0	0	0	0
15.07.2017	127.5	1-3	0	0	0	0
23.08.2017	128.2	1-3	0	0	0	0
16.09.2017	127.6	3	0	0	0	0
10.10.2017	128.1	3-4	0	0	0	0
05.11.2017	127.9	3-4	0	0	0	0
02.12.2017	114.9	3-4	0	0	0	0
07./08.01.2018	128.7	1-3	1	1	0	1.55
17.02.2018	127.8	3	0	0	0	0
Total	**3.051**		**1**	**7**	**1**	**0.29**

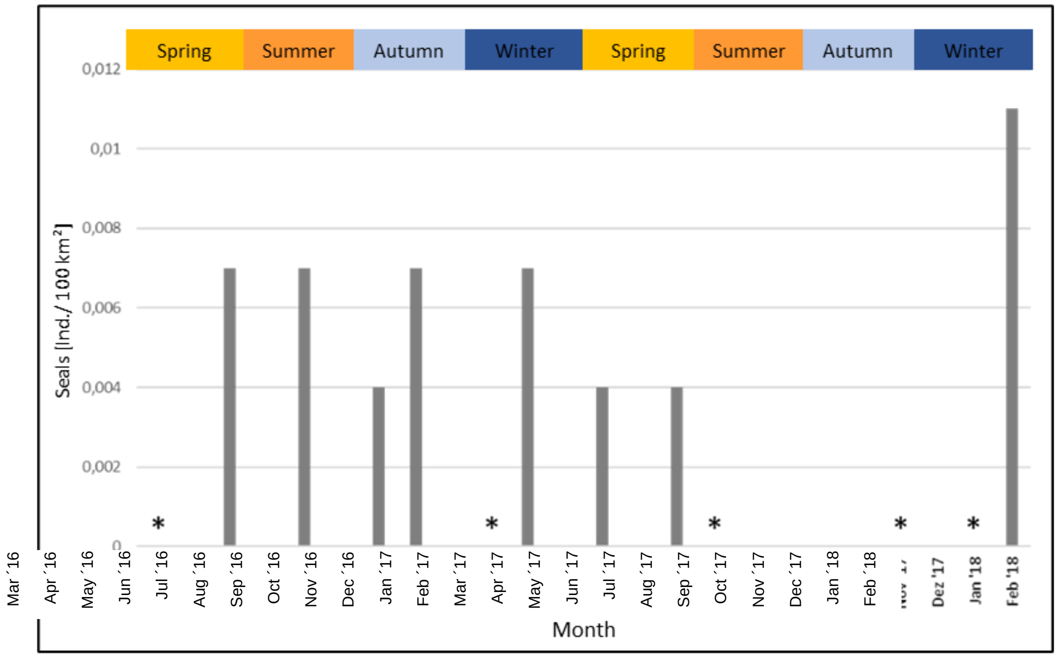

Figure 4-5. Seal densities per months as ind./km² between April 2016 and February 2018 calculated from digital aerial HiDef surveys (grey seals and unidentified seals were combined). * Months without aerial survey. From: IBL Umweltplanung GmbH (2020).

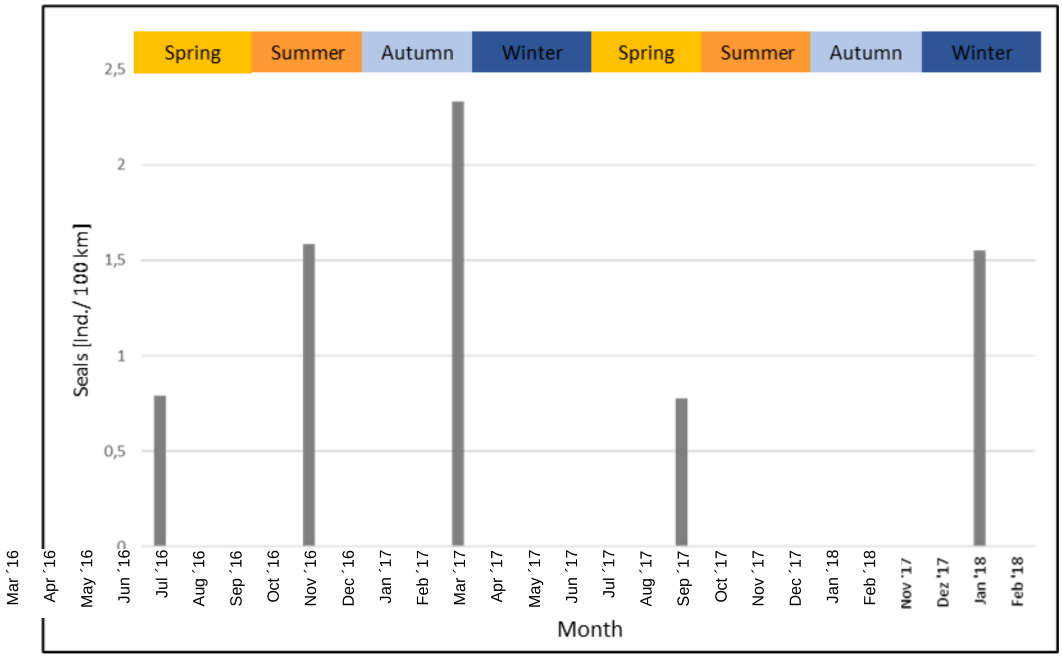

Figure 4-6. Seal sighting rates as ind./100 km during ship-based surveys in the OWF project area O-1.3 in the German EEZ between March 2016 and February 2018 (grey seals and unidentified seals were combined). From: IBL Umweltplanung GmbH (2020).

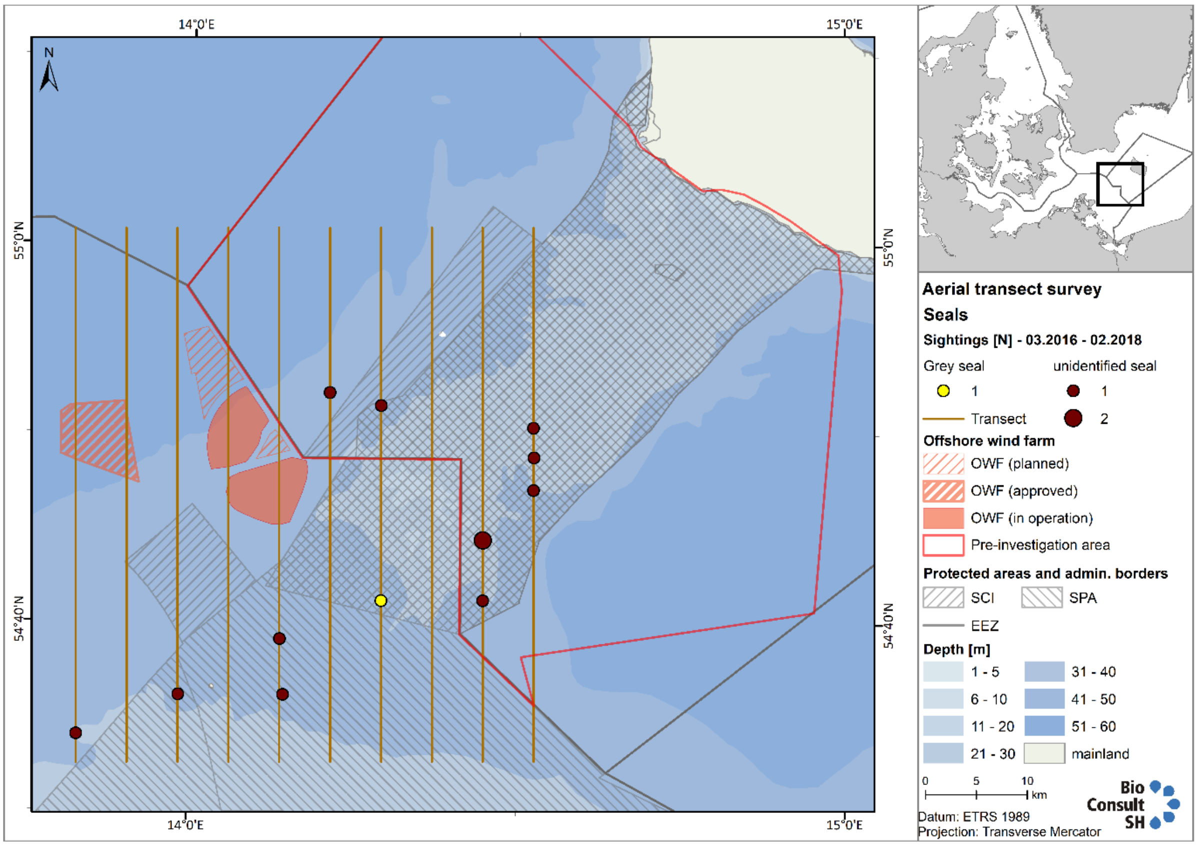

Figure 4-7. Seal sightings during digital aerial HiDef surveys from marine mammal monitoring in the OWF project area O-1.3 in the German EEZ between March 2016 and February 2018. From: IBL Umweltplanung GmbH (2020).

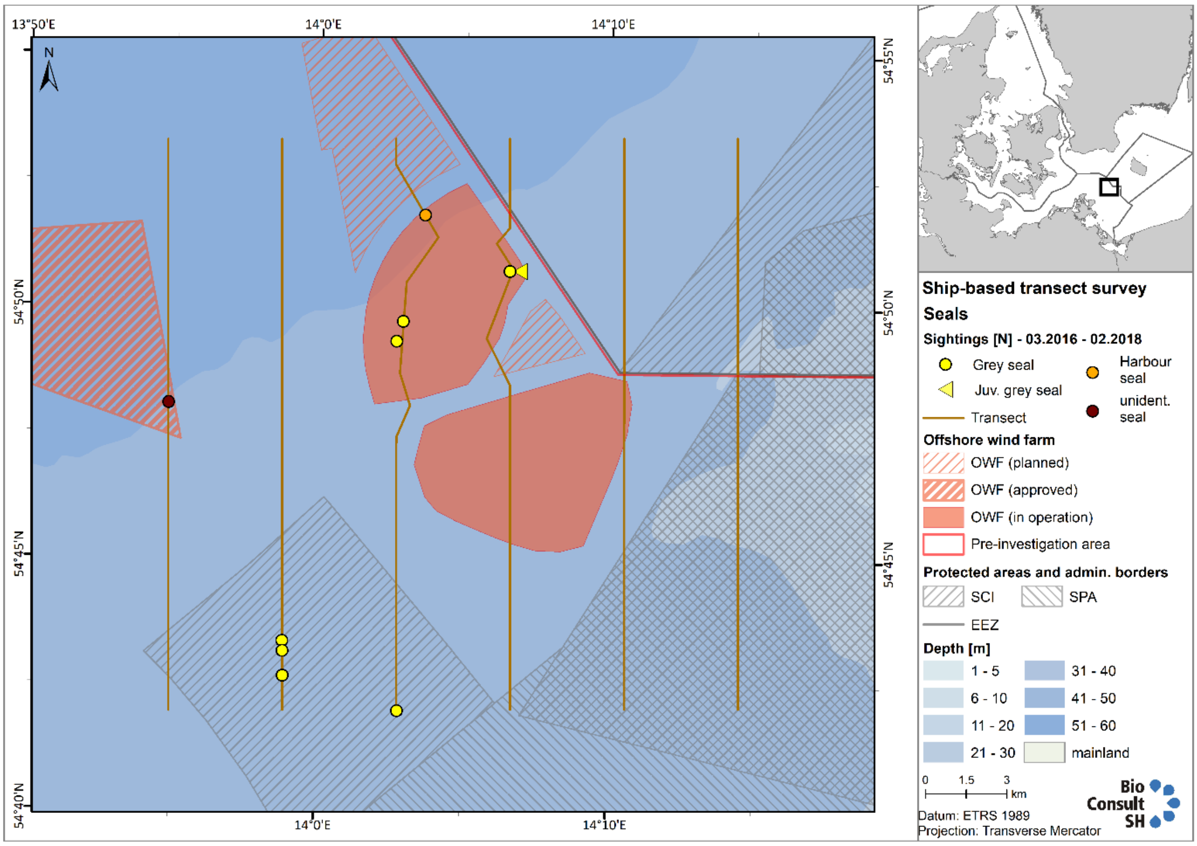

Figure 4-8. Seal sightings during ship-based surveys from marine mammal monitoring in the OWF project area O-1.3 in the German EEZ between March 2016 and February 2018. From: IBL Umweltplanung GmbH (2020).

4.2 GREY SEALS

4.2.1 CONSERVATION STATUS

The status of the global population (Bowen 2016) and the European population (European Mammal Assessment team 2007) of the grey seal are classified by the International Union for the Conservation of Nature (IUCN) as LC, and the status of the Baltic subspecies *Halichoerus grypus grypus* is assessed by the HELCOM Red List (HELCOM 2013a) also as LC. The national Red List of Denmark lists the grey seal as VU (Danske Rødliste 2019; ecos.au.dk). The Red List of Germany lists the grey seal as highly threatened in the case of the Baltic grey seal subspecies and as threatened in the case of the Atlantic subspecies (Meinig et al. 2020).The Swedish Red List lists the grey seal as LC (The Swedish Red List 2020 2020). Hunting in Denmark and Germany is forbidden, in Sweden it is allowed but controlled through various regulations and restrictions (HELCOM Red List Marine Mammal Expert Group 2013).

In EU waters, grey seals are protected by the Habitats Directive and listed in its Annexes II and V (European Commission 2021). They are also covered by the EU Marine Strategy Directive, where distribution, number and bycatch must be reported and evaluated according to descriptor 1. Furthermore, grey seals are listed in Appendix III of the Bern Convention, while they are not listed by the Bonn Convention (CMS Secretariat 2015) (Table 4-4).

DCE assessed the conservation status of the grey seals in Habitat Directive Article 17 from 2019 (Fredshavn et al. 2019) as highly unfavourable in both Danish marine regions, because breeding activity is assessed to be very far from previous levels. It is also stated, however, that conditions are improving in both regions. In the DCE Marine areas report from 2021 (Hansen & Høgslund 2021) it is stated that the numbers of grey seals in Danish waters have increased over the last ten years. In 2020 1,098 grey seals were counted in the Baltic Sea. It is expected that the general increase in numbers will continue in all areas in the coming years. However, in the Baltic Sea, only six pubs were observed at one out of four surveyed sites in 2020, which is a large decline compared to 2017 and worrying for a species of unfavorable conservation status (Hansen & Høgslund 2021).

Table 4-4. Listing of the grey seal in international and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= vulnerable.

Species	IUCN (2017)	HELCOM Red List	National Red Lists	Natura2000 (BfN 2015)	Bern Convention	Bonn Convention
Grey seal ***Halichoerus grypus***	Global: LC European: LC	LC	DE: highly threatened (Baltic grey seal) DK: VU SE: LC	Appendix II and V	Appendix III	Not listed

4.2.2 BIOLOGY, DISTRIBUTION, ABUNDANCE

The grey seal is a large seal species with a cold temperate to sub-artic distribution along the coasts of the North Atlantic. Two subspecies of the grey seal are recognized, which are morphologically and genetically (Boskovic et al. 1996, Graves et al. 2009, Fietz et al. 2013) differentiated: The Atlantic grey seal (*Halichoerus grypus atlantica*) inhabiting the Atlantic and the North Sea, and the Baltic grey seal (*Halichoerus grypus grypus*) inhabiting the Baltic Sea (Berta & Churchill 2012, Fietz et al. 2016, Olsen et al. 2016). The Baltic grey seal is found throughout the Baltic Sea area with main concentrations in the northern and central parts of the Baltic Proper, but the population is expanding in numbers towards the south-western Baltic and Kattegat area (Scharff-Olsen et al. 2019, Galatius et al. 2020). The two sub-species show different breeding periods and differ in their choice of breeding habitat.

Adult male grey seals can reach a body length of up to 2.5 m and a weight of up to 400 kg, female grey seals are smaller with up to 2.1 m body length and a weight up to 250 kg. (Shirihai et al. 2008). Baltic grey seals are a bit smaller and usually reach a body length of 1.65-2.1 m and a body mass of 100-180 kg in females and over 300 kg in males (HELCOM 2013b). Grey seal females reach sexual maturity between three and five years of age and males between four and six years of age. After a pregnancy of about 11.5 months, grey seal pups are born in winter with a pupping period of February-March in the Baltic and October-December in the northeast Atlantic (Galatius et al. 2020).

Grey seals in the Baltic Sea breed mainly on drift ice, but where this is not possible, as in the southern Baltic Sea in most winters, they also breed on land. Grey seal pups are born with their lanugo coat, which is not waterproof, so pubs are not able to enter the water until they have shed it and attained their adult coat after 2-4 weeks. Nursing lasts about 14 days, during which the females do not feed, and pups undergo substantial weight gain, increasing from a birth weight of about 10 kg to almost 50 kg at the time of weaning. Grey seals therefore highly depend on undisturbed haul-out sites above the high-water line in winter for successful reproduction. Baltic grey seals moult between April and June and during this time, they spend a lot of time hauled out.

Like harbour seals, grey seals are associated with coastal waters, but also make foraging trips at larger distances of the coast with occasional travelling distances of up to 2,000 km (e.g. Thompson et al. 1991, 1996, McConnell et al. 1999, Dietz et al. 2015). Grey seals tagged in the Rødsand lagoon were found to move up to 850 km east into the Baltic (Dietz et al. 2015). Generally grey seals visit a larger number of haul-out sites than harbour seals and at greater distances (e.g. Thompson et al. 1996).

Grey seals are generalist and opportunist feeders with a wide range of prey (Scharff-Olsen et al. 2019). The fish species consumed by grey seals include a similar range as that of harbour seals, although grey seals can take larger fish due to their larger size and ability to tear large prey into pieces for consumption. Main contributors to grey seal diet is sand eel (*Ammodytes* spec), flounder (*Platichthys flesus*), herring (*Clupea harengus*) and cod (*Gadus morhua*), depending on location and season (Thompson et al. 1991, 1996). Additionally, seabirds as well as harbour porpoises may also be preyed upon (Jauniaux et al. 2014, Leopold 2015).

The grey seal population in the Baltic Sea suffered from extensive hunting and environmental toxins during the 20th century and was reduced from an original population size of about 80,000 individuals (HELCOM 2023c) to only about 3,000 individuals in the beginning of 1980 (Harding & Härkönen 1999). Until 2021 the numbers increased again until 42,000 grey seals, leading to an estimated population size of about 60,000 animals in 2023 (HELCOM 2023c).

There are no distinct subpopulations recognized of the Baltic grey seal and it ranges widely within the Baltic Sea, although local differences in their distribution is present (Figure 4-9). HELCOM (2023a) assessed the grey seal population in the Baltic Sea as a single management unit based on data from 2003-2021. According to this evaluation, the grey seal population of the Baltic Sea has failed all four key indicators “trends and abundance”, “distribution”, “nutritional status” and “reproductive status” (HELCOM 2023, Figure 4-10).

Even though grey seals in the Baltic Sea show increases in their population size, the population growth rate remained under the threshold values (HELCOM 2023a). Because the population is still growing it was assessed as being below Target Reference Level (TRL) and was evaluated against the threshold of 7 % annual increase during exponential growth. With an estimated annual growth rate of about 5.1 % (80 % support for >=4.7 % according to Bayesian analyses) between 2003 and 2021, the population did not reach the growth target. Therefore, the population achieved good status with regards to “abundance” but did not achieve good status with regards to “population trend”. With regards to “distribution”, the Baltic grey seal population achieved good status in the component “area of occupancy” (at sea distribution), but no good status in the components “haul-out sites” and “breeding sites”, because in some subareas some available sites are not occupied (HELCOM 2023b).

Nutritional status of seals is estimated based on blubber thickness of hunted and bycaught seals, which indicates long-term and short-term changes in food supplies and other stressors. Grey seals in the Baltic Sea failed the threshold for good status in the assessment period 2016-2021. The pregnancy rate in the grey seal population of the Baltic Sea was found to be on average 87 % in the period 2016-2021, which is below the threshold value of 90 % that would indicate a good status (HELCOM 2023b).

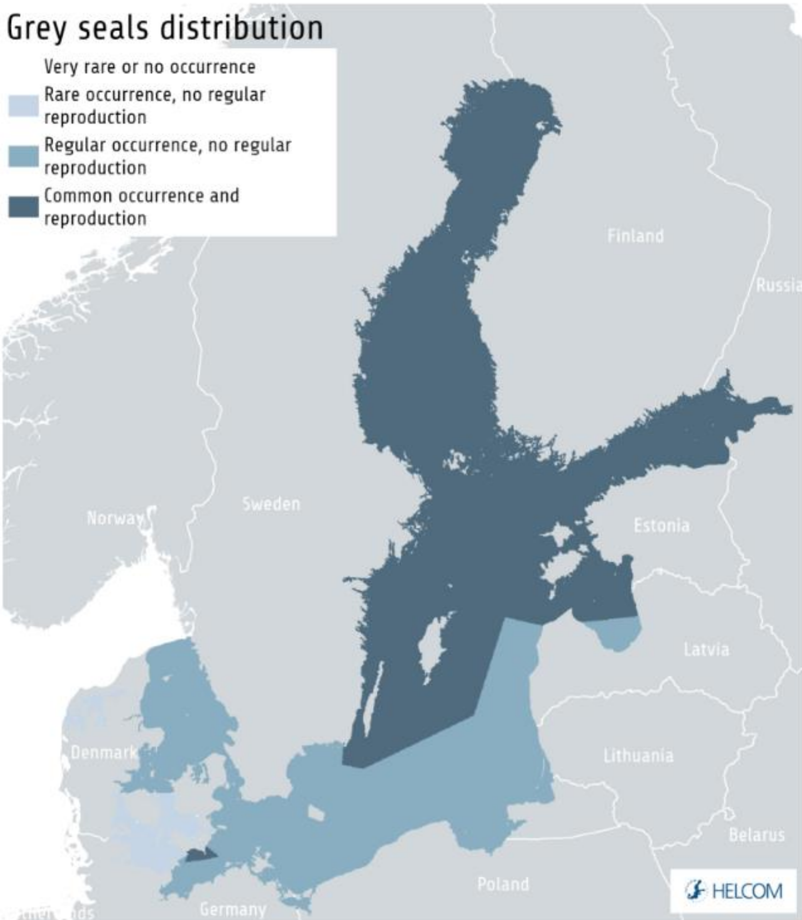

Figure 4-9. Distribution of grey seals in the Baltic Sea, produced for the spatial pressures and impact assessment (HELCOM 2023b), based on expert input.

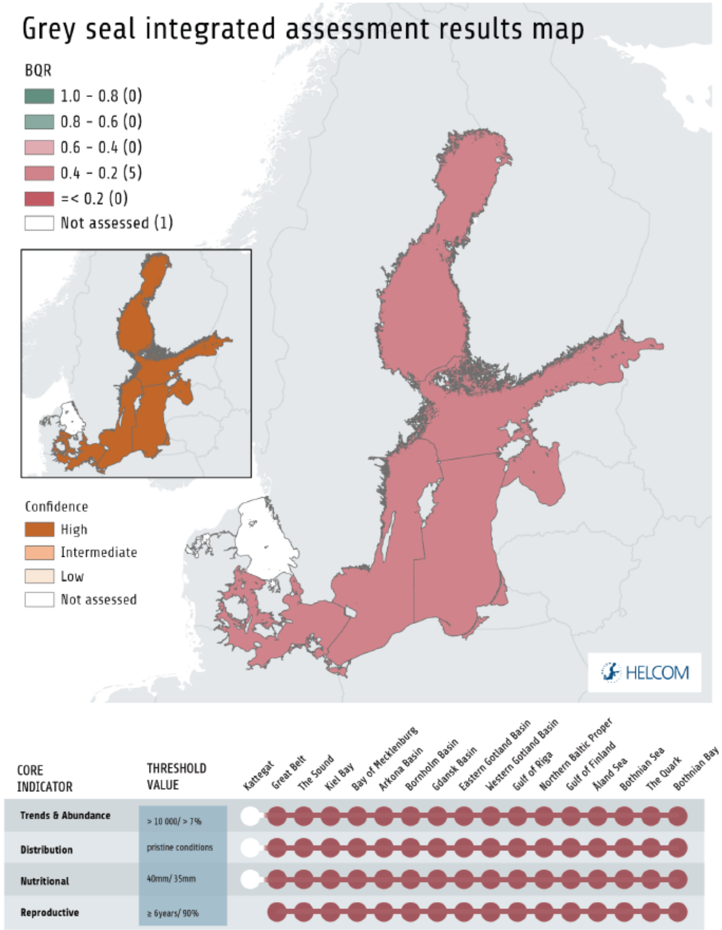

Figure 4-10. Integrated biodiversity status assessment results for grey seals, as generated by the BEAT tool, based on the indicator evaluations for population trends and abundance, distribution, nutritional status and reproductive status. Values >0.6 represent good status. Confidence is presented in the insert map. Corresponding indicator evaluation results are presented in the bottom of the figure. Taken from HELCOM 2023b).

Grey seal haul-out sites in the southern Baltic area and in Kattegat as well as estimated occupancy over the last two decades are shown in Figure 4-11. Haul-outs closest to the EIB pre-investigation area are located 50 km south at Rügen and about 60 km northeast at Ertholmene. There is no breeding at Ertholmene, also not historically, probably because the skerries around these islands are prone to flooding by large waves and in windy conditions (Galatius et al. 2020). At Rügen, there are historic records of regular breeding activity, but since the recolonization of this region by grey seals, only sporadic breeding events there were documented (Galatius et al. 2020). The next haul-out sites with breeding activity are Måkläppen 100 km to the northeast and Rødsand about 140 km to the west.

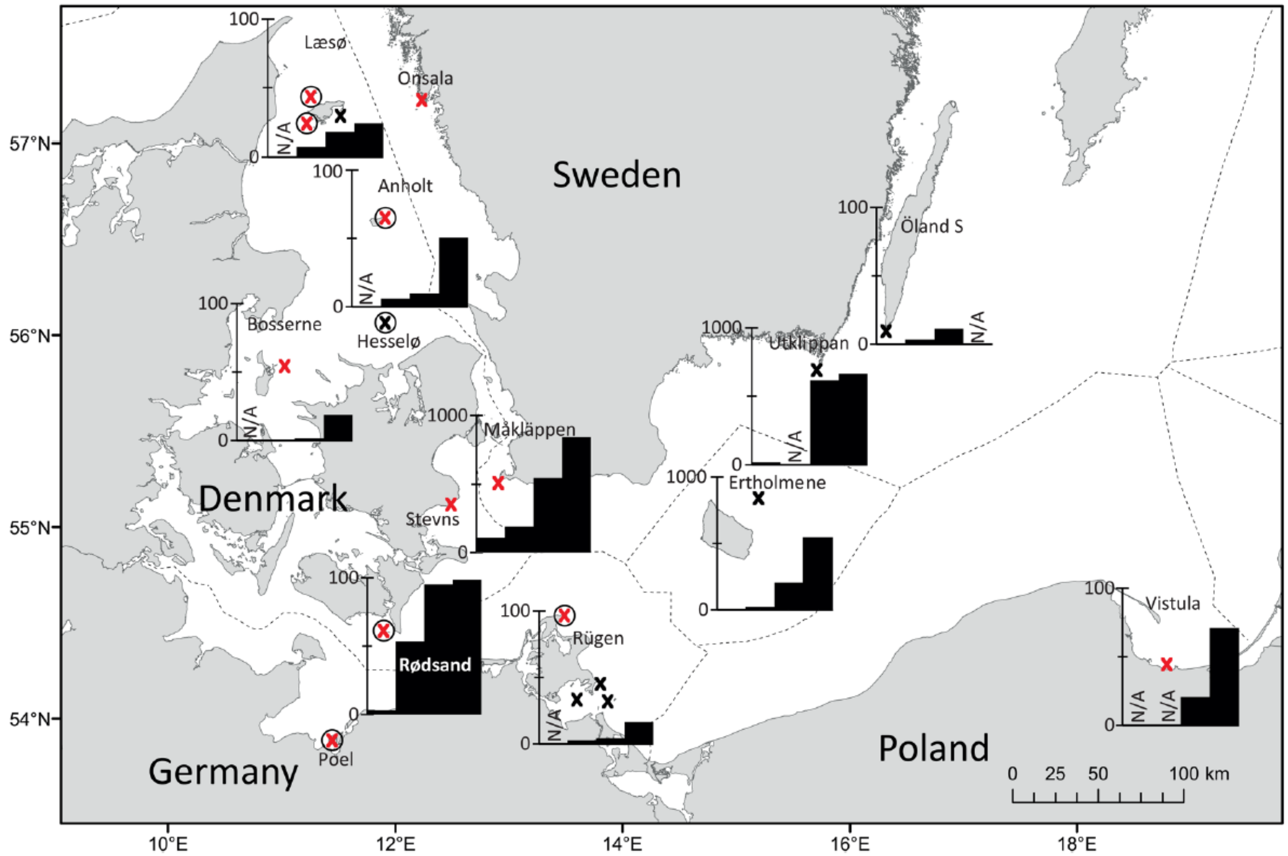

Figure 4-11. Map of important grey seal haul-out localities (crosses) in Kattegat and southern Baltic Sea. Column charts show moult abundance of grey seal haul-out with more than 10 grey seals recorded, or total counts of several haul-outs around the main island in the cases of Rügen and Læsø. First bar represents the average count during the years 2001-2005, second bar 2006-2010, third bar 2011-2015 and fourth bar 2016-2019. Red crosses denote haul-outs with and black crosses without breeding activity after 1990, circled crosses denote haul-outs with historic breeding activity. N/A means data are not available. From: Galatius et al. 2020.

4.2.3 HABITAT USE AND DENSITY ESTIMATES AROUND THE EIB PRE-INVESTIGATION AREA

Good knowledge about habitat use of grey seals on the Baltic Sea coastlines exists from observations of the number of animals at haul-out sites, where they are mainly counted during the moulting period. Little is known about grey seal density and habitat use offshore. Some information comes from telemetry studies, which show that grey seals undertake longer foraging trips from their haul-out sites than harbour seals do, and they also show much larger dispersal distances. Grey seals in Scotland for example were reported to show movement patterns on two geographical scales: local, short and repeated trips between haul-out sites and discrete offshore areas about 40 km from the coast, similar to harbour seals, and longer distance travels to areas up to 2,100 km away (McConnell et al. 1999). In McConnell et al. (2012), five grey seals in the Rødsand lagoon – one adult and four juveniles were satellite tracked. These seals also showed similar local movement patterns as well as far distance trips, sometimes far up north into the Baltic Proper. Two such examples are shown in Figure 4-12. Both of these animals as well as the other three did not spend much time near the EIB pre-investigation area, but just seemed to be travelling through on their way up to Öland, Gotland or beyond. Dietz et al. (2015) tagged five grey seals from Rødsand, five from Falsterbo and one from Ålandsøerne (Figure 4-13). These animals also showed some local movements as well as long distance trips to other haul-out sites. Movement was largely focused on local areas around haul-out sites, and the EIB pre-investigation area only seems to be used for travelling through (Figure 4-13). Even though these studies impressively show the very long distances grey seals are generally able to cover, these studies also underline, that grey seals usually do not enter the pre-investigation area for foraging ore other activities, hence, based on these two studies, no particular relevance of the pre-investigation area as a feeding or hunting ground for grey seals can be deduced.

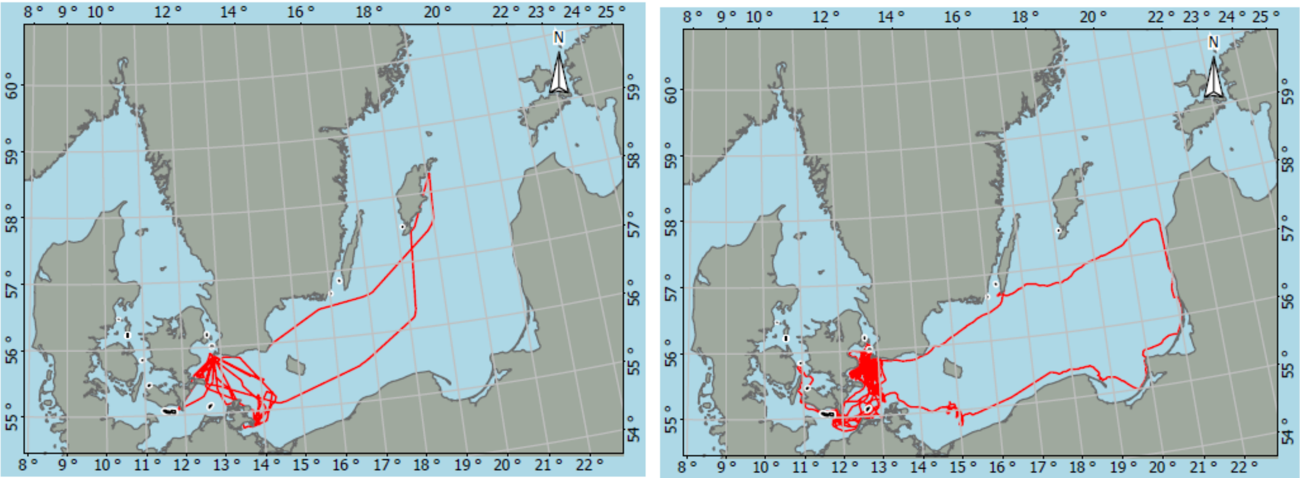

Figure 4-12. Example of tracks from two radio-tracked grey seals, captured and tagged in the Rødsand lagoon. From: McConnel et al. (2012b).

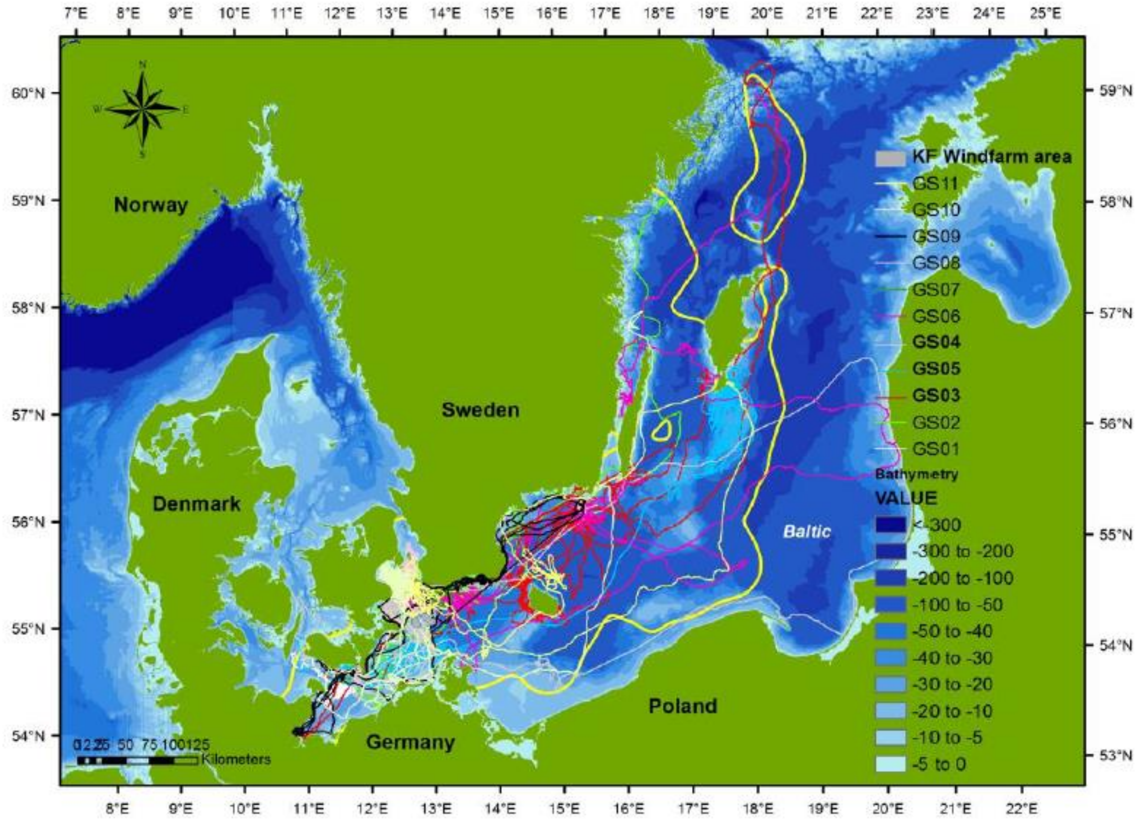

Figure 4-13. Map showing the migration routes and the 95 % Kernel ranges (yellow polygon) for 11 grey seals tagged between 2009 and 2012 at Falsterbo (5 seals), Rødsand (5 seals) and at Ålandsøerne (1 seals). From Dietz et al. (2015).

Further information on the occurrence of grey seals in the EIB pre-investigation area can be taken from digital aerial and ship-based surveys conducted for the German OWF planning area O-1.3in close proximity to the pre-investigation area (IBL Umweltplanung GmbH 2020). Results from these surveys are shown in chapter on harbour seals above in section 4.1, but are summarized in relation to grey seals again. A total of 13 seals were detected during 20 aerial surveys conducted throughout the year between 2016 and 2018 (Table 4-2), of which one could be identified as a grey seal, while the others were unidentified seals. Seal densities calculated from these data ranged between 0 and 0.01 ind./km² and were thus generally very low. Seal density calculated for all data would be 0.002 ind./km². During 24 ship-based surveys in the same period, a total of nine seals were detected (Table 4-3). Of these, seven were grey seals, one was a harbour seal and one was unidentified, which led to the conclusion that during aerial surveys, most seals were most likely grey seals. This gave an overall sighting rate of only 0.28 ind./100 km during ship-based surveys. The seasonal and geographical distribution of sightings during both aerial and ship-based surveys showed that sightings can occur throughout the year and throughout the pre-investigation area. In conclusion, no specific foraging ground could be identified based on marine mammal surveys conducted in relation to the OWF project area O-1.3 ~2 km from the EIB preliminary project area.

4.3 HARBOUR PORPOISES

4.3.1 CONSERVATION STATUS

Whilst the status of the global population (Braulik et al. 2020) and the European population (Sharpe & Berggren 2023) of the harbour porpoise is classified by the IUCN as least concern (LC), the situation in the Baltic Sea is heterogeneous. The Baltic Sea is inhabited by two seperate populations of harbour porpoise, namely the Belt Sea population primarily inhabiting Kattegat, the Belt Sea and the Western Baltic, as well as the Baltic Proper population primarily inhabiting the Baltic Proper.

The abundance of the Belt Sea population is assumed to be stabile with an estimated abundance of 17,301 individuals (Unger et al. 2021), while the Baltic Proper populations with an estimated abundance of approximately 500 individuals (SAMBAH 2016) and a declining trend is categorized as critically endangered (CR) (Carlström et al. 2023), which is the highest threatened status (IUCN 2007, Hammond et al. 2008). The Baltic Proper subpopulation is considered to be decreasing. The HELCOM Red List lists the Baltic Proper subpopulation as CR and the Western Baltic subpopulation as VU (HELCOM 2013d). The national Danish Red List classified the harbour porpoise as LC (Den Danske Rødliste 2019; ecos.au.dk), the German as highly threatened (Meinig et al. 2020), and the Swedish lists the Baltic Proper subpopulation as CR (The Swedish Red List 2020) (see also Table 4-5).

Like all cetacean species, the harbour porpoise is included in Annex II and IV of the EU Habitats Directive (92/43/EEG), meaning that it requires strict protection, including the designation of Special Areas of Conservation (SACs) by the European member states. EU member states are required to maintain a “favorable conservation status” of harbour porpoises. All whale species are also covered by the EU Marine Strategy Directive, where distribution, number and bycatch must be reported and evaluated according to descriptor 1.
The harbour porpoise is listed in Appendix II of the Bern Convention, meaning that it is strictly protected in member states. The harbour porpoise populations of the North and Baltic Seas are further included in Appendix II of the Bonn Convention (CMS Secretariat 2015). The CMS daughter agreement ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas) hosts a recovery plan for the Baltic harbour porpoise (Ascobans 2016) and a conservation plan for the harbour porpoise in the Western Baltic, Belt Sea and Kattegat (Ascobans 2012). Furthermore, the Baltic Sea states have agreed in HELCOM Recommendation 17/2 to protect the harbour porpoise in the Baltic Sea. For summary see Table 4-5.

HELCOM (2023a b) pre-core indicators both (abundance and distribution) failed for the Baltic Proper harbour porpoise population. Due to a lack of sufficient scientific data, a quantitative evaluation could not be implemented and instead, a qualitative expert-based evaluation was conducted based on the SAMBAH results from passive acoustic monitoring (PAM) in 2011-2013 (Carlén et al. 2018, Amundin et al. 2022) and historic records. The qualitative evaluation shows that the abundance and the distribution of the Baltic Proper harbour porpoise population does not achieve good environmental status HELCOM (2023c a). This is due to the very small population size of approximately 500 individuals estimated (Carlén et al. 2018, Amundin et al. 2022) and a decline in abundance and distribution over the last century when the current situation is compared to historic records.

The Danish National Center for Environment and Energy (DCE) assessed the conservation status of the harbour porpoise in Habitat Directive Article 17 from 2019 (Fredshavn et al. 2019) as follows: The population in the marine Atlantic region is considered as being of favourable conservation status. In the Baltic area, the Belt Sea population is considered as having a favourable and the Baltic Proper population a highly unfavourable conservation status. However, in the DCE Marine areas report from 2021 (Hansen & Høgslund 2021) it is stated that the entire Belt Sea population of harbour porpoises has halved since previous counts in 2012 and 2016 to approximately 17,300 individuals. On the other hand, acoustic monitoring in the Flensborg Fjord; Bedgrund and the waters around Als and Lillebælt revealed an increase in acoustic detections of harbour porpoises from 2013 to 2020 (Hansen & Høgslund 2021).

Table 4-5. Listing of the harbour porpoise in international (HELCOM 2013d, IUCN 2021) and regional conservation agreements and international and national Red Lists. LC= Least concern, VU= vulnerable and CR= Critical.

Species	IUCN	HELCOM Red List	National Red Lists	Natura 2000 (BfN 2015)	Bern Convention	Bonn Convention
Harbour Porpoise *Phocoena phocoena*	Global: LC Europe: LC Baltic Sea subpopulation: CR	Baltic Sea: CR Western Baltic: VU	DE: Highly threatened DK: LC SE: CR (Baltic Sea population)	Appendix II und IV	Appendix II	Appendix II

4.3.2 BIOLOGY, DISTRIBUTION, ABUNDANCE

The harbour porpoise inhabits temperate to cold waters throughout the northern hemisphere and is the only cetacean species resident in the Baltic Sea (Kinze 1994, Benke et al. 1998). The habitat utilisation of harbour porpoises exhibits seasonal differences. Satellite data of harbour porpoises from West Greenland, for instance, show seasonal, wide-ranging oceanic movements within the North Atlantic (Nielsen et al. 2018). Particularly in winter and spring, these animals left shallow coastal waters and crossed regions with water depths of more than 2500 meters. However, such behaviour has not yet been observed for harbour porpoises in the North Sea and Baltic Sea. In general, however, harbour porpoise habitat use is thought to be largely dependent on the availability of prey, and it has been shown that harbour porpoise habitat use correlates with strong currents and the occurrence of fronts and eddies (e.g. Johnston et al. 2005, Pierpoint 2008), where prey are usually concentrated.

Harbour porpoises in Danish waters (North Sea and Baltic Sea combined) may live up to about 23 years, however, fewer than 5 % seem to live longer than 12 years (Lockyer & Kinze 2013). Based on the study of bycaught and stranded individuals in Danish waters, Lockyer & Kinze (2013) reported both sexes to reach sexual maturity at about three years of age, with corresponding body sizes of about 143 cm in females and 135 cm in males. Ranges of mean body weight of bycaught individuals were 34-47 kg in females and 27-35 kg in males with only little seasonal variation (Lockyer & Kinze 2013). More recent data from bycaught and stranded harbour porpoises in German waters (North and Baltic Sea), however, showed that female harbour porpoises show first signs of ovulation only at a mean age of about 5 years, while average age at death was 5.7 years in the North Sea and only 3.7 years in the Baltic Sea (Kesselring et al. 2017). Newborn calves in the Belt Sea may be seen from April to October. The percentage of calves in the Belt Sea increased from May to June and reached a peak in July and August (Lockyer & Kinze 2013). The peak in mating seems to occur in July and August (Schulze 1996, Koschinski 2002, Lockyer & Kinze 2013). The gestation period is about 10 months and the lactation periods spans from 8 to 10 months, such that many harbour porpoise females are pregnant and lactating at the same time (Schulze 1996, Koschinski 2002, Lockyer & Kinze 2013). The majority of the female harbour porpoises in the Baltic were found to have a reproduction rate between 0.7 and 0.8, so mature females would produce about two calves in three years (Koschinski 2002).

The most recent published information on harbour porpoise diet in the Baltic Sea is based on stomach content analysis of 339 harbour porpoises stranded and bycaught in the Danish and German Baltic Sea between 1980 and 2011 (Andreasen et al. 2017). In summary, harbour porpoises mainly live of pelagic fish species like herring and whiting and of semi-pelagic living cod. However, during the summer and especially for juvenile harbour porpoises (not older than 4 years), demersal fish species such as gobies and sandeels also play a significant role as prey (Figure 4-14).

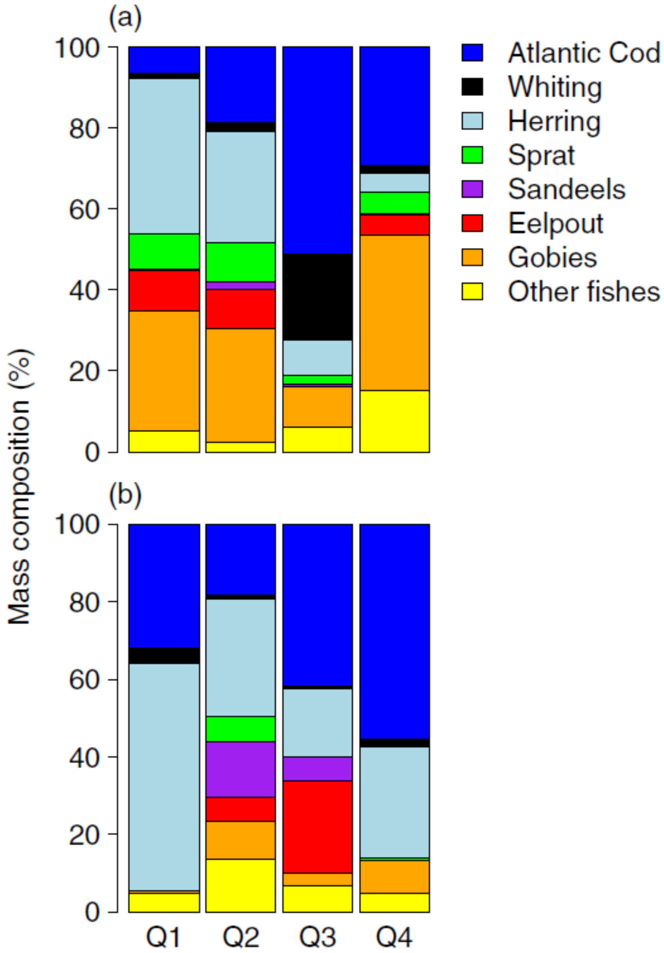

Figure 4-14. Quarterly prey mass composition in the diet of juvenile (a) and adult (b) harbour porpoises in the western Baltic Sea in the period 1980-2011. From: Andreasen et al. (2017).

Incidental information on harbour porpoise sightings, strandings and catches suggest that the historic distribution of harbour porpoises in the Baltic area once extended into the easternmost and northernmost parts of the Baltic Sea (Koschinski 2002). Still, in the early 20th century sightings were reported from Estonia and Latvia (Greve 1909 cited in Koschinski 2002) as well as from the northern Gulf of Bothnia (Levander 1905 cited in Koschinski 2002). Different reports provide evidence that harbour porpoises were abundant at least as far east as Polish waters and in Danish waters around Bornholm (Koschinski 2002). According to Koschinski (2002), many studies and even a crude examination of sighting and stranding data support the general view that the number of harbour porpoises have declined and their distributional range in the Baltic has narrowed extensively.

Danish catch statistics reviewed by Kinze (1995) showed that in the Belt Sea region a consistently increased take occurred in the second half of the 19th century when the catch rate doubled in the Little Belt area. This may have led to an overexploitation initiating the decline of the Baltic harbour porpoise population. Mean annual catch rates in the Little Belt finally decreased from 1,195 harbour porpoises between 1871 and 1892 to only about 327 harbour porpoises during the second world war (Kinze 1995). Catch statistics suggest that harbour porpoises in the Baltic Sea used to show strong migration patterns from the Baltic Proper into the Belt and Kattegat area during autumn and back into the Baltic Proper in spring (see Koschinski 2002 for review). Such strong migration patterns are no longer evident today, possibly because the present population in the Baltic Proper is so much smaller.

Harbour porpoises occurring in the Baltic Sea are thought to belong to two different (sub)populations (Belt Sea and Baltic Proper). Genetic and morphological evidence suggest that harbour porpoises inhabiting the Baltic Proper belong to a different (sub)population than harbour porpoises in the Skagerrak (which probably belong to the North Sea population of harbour porpoises) and harbour porpoises from the Belt Sea (sub)population, inhabiting the Kattegat, Sound, Belt Sea and western Baltic Sea (Wiemann et al. 2010, Benke et al. 2014, Lah et al. 2016, Tiedemann et al. 2017). Based on survey and acoustic monitoring data, Benke et al. (2014) suggested a management border for the Baltic Proper population around the Darss ridge. Sveegaard et al. (2015) provide a map with suggested overlapping zones between these populations based on survey and telemetry data. This suggested distributional border for the Baltic Proper population around the Darss ridge is west of the EIB pre-investigation area. More recently, based on the distribution of harbour porpoise detections in the Baltic region, it was suggested that animals from the Belt Sea and Baltic Proper are separated during the summer from May to October (so including the breeding season) but have overlapping distribution patterns from November to April (Carlén et al. 2018). The summer management border proposed for the Baltic Proper population of harbour porpoises by Carlén et al. (2018) lies east of the Odra Bank (running from the Swedish mainland north of the island of Bornholm in south-eastern direction at a distance of about 30 km east of the island of Bornholm) and is thus further east than the one suggested by Benke et al. (2014). Figure 4-15 taken from Sveegaard et al. (2018) shows the suggested management areas for the separate populations, their transition areas as well as the suggested summer management border for the Baltic Proper population.

From passive acoustic monitoring data collected during the SAMBAH project (for more detail see chapter 4.3.3), the number of individuals of the Baltic Proper population was estimated to consist of approx. 500 animals during summer. Regardless of the special protection status, any disturbance or even removal of animals from this small population can lead to severe consequences for the well-being of this population. The harbour porpoise population in the Belt Sea is estimated to be between 17,000 (Hansen & Høgslund 2021) and more than 20,000 individuals (SAMBAH 2016).

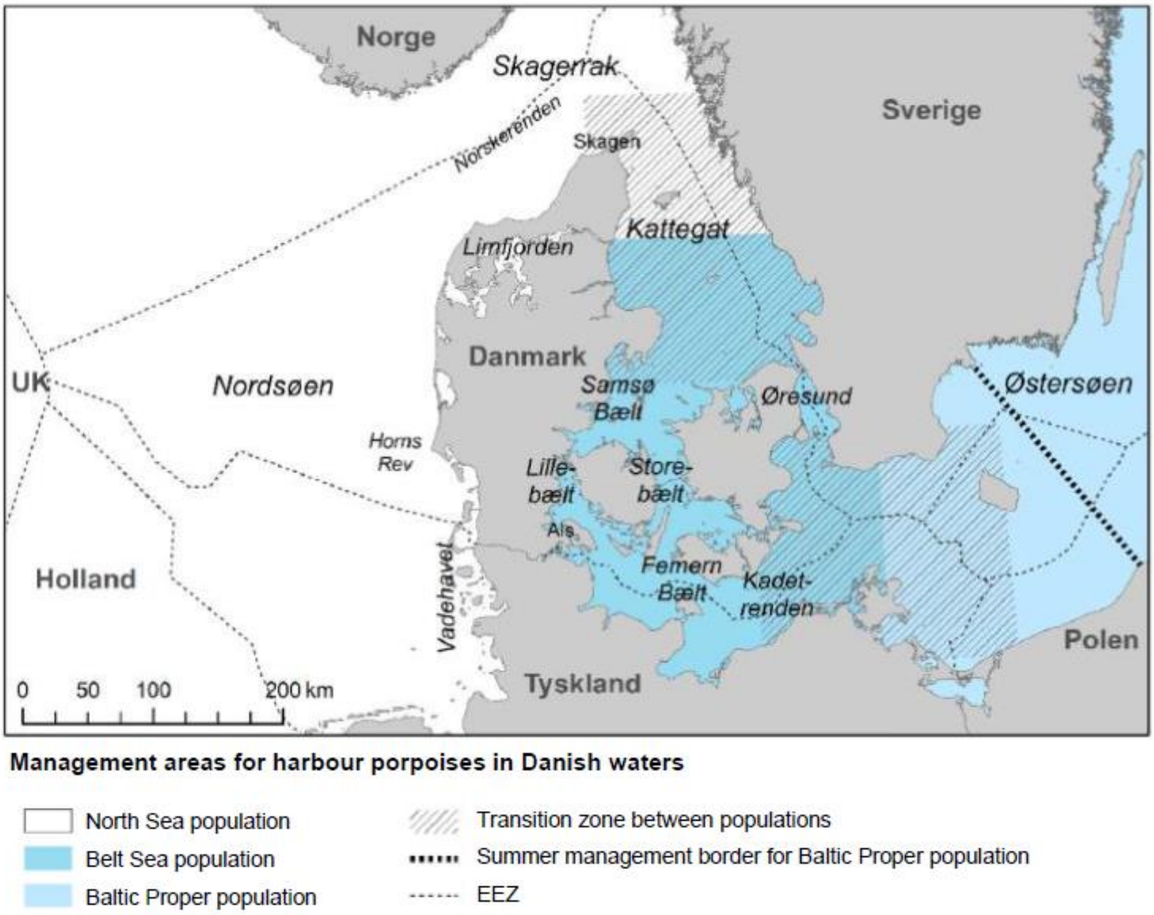

Figure 4-15. Map showing suggested management areas for the three harbour porpoise populations in Danish waters and neighbouring countries. Taken from: Sveegaard et al. 2018.

4.3.3 HABITAT USE

ABUNDANCE AND DENSITY AROUND THE EIB PRE-INVESTIGATION AREA BASED ON VISUAL SURVEYS

Information on density and abundance of harbour porpoises in the Baltic Sea exists from several different sources: visual and acoustic surveys covering different parts of the Baltic Sea. Because of differences in methodology and differences in the area covered by these surveys, it is difficult to compare estimates of abundance and densities between the surveys. This is especially the case for the visual aerial based and ship-based surveys. In this chapter we present data from visual surveys in the Baltic Sea region. We start by summarising estimates originating from the large-scale SCANS and smaller-scale Mini-SCANS visual surveys, and then go on to present estimates stemming from more regional surveys around the EIB pre-investigation area conducted during national monitoring programs and for impact assessment studies of OWF development in adjacent German waters. Acoustic surveys will be covered in the next section.

SCANS and MINI-SCANS visual survey data

The first systematic survey for harbour porpoise density in the Baltic Sea was the “Small Cetacean Abundance survey in the North Sea and adjacent waters” (SCANS-I survey) in July 1994 (Hammond et al. 2002), followed by the SCANS-II survey in July 2005 (Hammond et al. 2013), SCANS III in 2016 (Hammond et al. 2017) and SCANS IV in 2022 (Gilles et al. 2023). During the SCANS I, II and III surveys, the Baltic Sea area was covered from the Skagerrak in the north to Rügen in the east with ship-based surveys, during the SCANS IV survey it was covered by aerial surveys. Density and abundance estimates of harbour porpoises in the Baltic Sea (covering the Skagerrak, Kattegat and Belt Sea area) based on the 2016 survey were 73,573 individuals with a density of 1.15 ind./km². Estimates for 2005 and 1994 were lower but considering the large confidence intervals associated with these calculations, no clear changes in abundance could be detected (Hammond et al. 2017).

The area for which these estimates were calculated also includes the Skagerrak region and is therefore not only focused on the Belt Sea population. However, due to ongoing discussions about different populations of harbour porpoises in the Baltic Sea, it is important to define a discrete management unit for each population. This means that the area that is used by animals from one population needs to be carefully defined and abundance estimates need to be calculated for this management unit (in this management area) and their development monitored over time in order to assess the populations conservation status. Therefore, the SCANS III and IV surveys redefined a porpoise management unit for only the Belt Sea population of harbour porpoises and in between these large-scale SCANS surveys, two Mini-SCANS surveys were conducted in 2012 and 2020, especially focusing on the Belt Sea population of harbour porpoise.

Because of the methodological differences in survey methods and the area that was covered, only estimates from 2016 on can be used to assess the Belt Sea population, as it is now defined. The latest 2022 SCANS IV resulted in estimate for the Belt Sea harbour porpoise population of 14,403 individuals (Gilles et al. 2023), which is considerably lower than the 2006 estimate of 42,324 individuals (SCANS III) and from the 2012 Mini-SCANS-I estimate of 40,475 individuals (Visquerat et al. 2015), but not significantly different from the 2020 Mini-SCANS-II estimate of 17,301 individuals (Unger et al. 2021). The estimated annual decline between 2012 and 2022 is 1.5 % (Figure 4-16). However, as the very large variances in the data already suggest, the results of a power analysis show that a significant decline could only be assumed if the annual decline is at least 4.4 %. The authors state, that although a significant decline could thus not be determined, this cannot be interpreted as no decline in abundance. A statistically more robust approach is planned to shed more light on the status of this population (Gilles et al. 2023). It is difficult to make a reliable estimate of the size of the Belt Sea population from these results. However, based on this data, a decline in the population since 2012 cannot be ruled out.

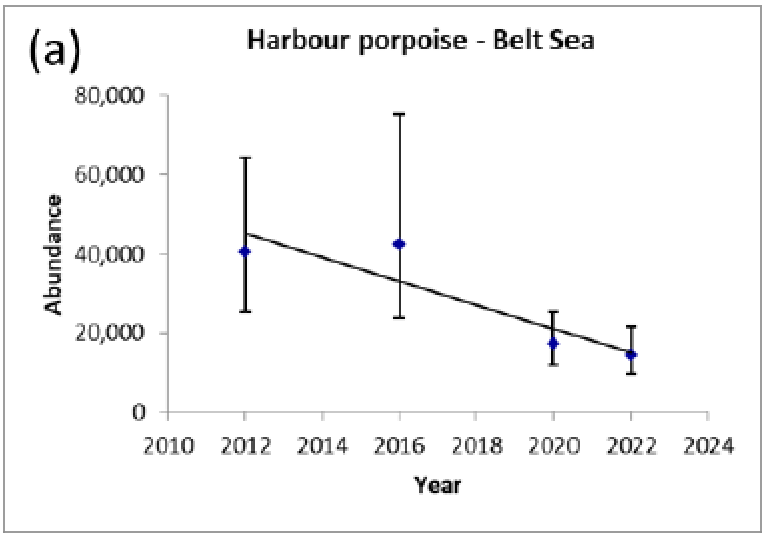

Figure 4-16. Results from Scans I-IV surveys: Abundance estimates for harbour porpoises of the Belt Sea population with fitted trend line, suggesting an annual decline of 1.52 %. Figure taken from Gilles et al. (2023).

German national monitoring data

While these large-scale SCANS surveys are useful for detecting general trends in harbour porpoise abundance within the Baltic, they provide only limited information about harbour porpoise habitat use around the pre-investigation area, as their focus on large coverage comes with a lack of detail in sub-areas as transect lines are widely spaced. Also, potential seasonal changes cannot be detected, and for a region with harbour porpoise density as low as in the Baltic Proper, these surveys are not suitable for calculating densities. More regional estimates around the pre-investigation area are available from aerial surveys conducted in German waters south of the pre-investigation area between 2002 and 2006 (Scheidat et al. 2008) and from aerial surveys conducted as baseline investigations for offshore wind farm development in these German waters between March 2016 and February 2018 (IBL Umweltplanung GmbH 2020).

From national monitoring data collected in the German part of the Baltic Sea, Scheidat et al. (2008) calculated harbour porpoise abundance estimates based on ten aerial surveys (covering between 1,921 and 3,400 km and lasting between 2 to 25 days) between 2003 and 2006 during the months March to September. They found harbour porpoise abundance to range from 1,352 harbour porpoises in March-April 2005 to 4,610 harbour porpoises in May 2005, not including one survey in March 2003 yielding an unusual low abundance of only 457 harbour porpoises. For the calculation of harbour porpoise density, they subdivided the survey area into three sub-areas, of which sub-area G represents the Pomeranian Bay from about the Darss ridge in the west to the northern and eastern borders of the German EEZ (Figure 4-17), which thus covers an area directly south of the pre-investigation area. Other than in the more westerly sub-areas, where harbour porpoise density ranged between 0.01 and 0.64 ind./km² in sub-area E (Kiel Bight) and between 0.04 and 0.35 ind./km² in sub-area F (Mecklenburg Bight), estimated harbour porpoise density in the Pomeranian Bight (sub area G) was very low with 0 to 0.06 ind./km². Only during one survey in 2002, an unusual large aggregation of harbour porpoises was detected in the most easterly area, leading to an unusual high density estimate of 1.02 ind./km², which should be treated as an outlier (Scheidat et al. 2008). Also, the estimate of 0.06 ind./km² was only observed once in April 2005, while all other 11 surveys resulted in densities of only 0-0.008 ind./km² (Scheidat et al. 2008), which is a low density of harbour porpoise. All harbour porpoise sightings conducted during these surveys are summarised in Figure 4-17 and seasonal densities per grid cell corrected for survey effort are shown in Figure 4-18. Based on these figures, the density of harbour porpoises in this sea area is to be considered very low.

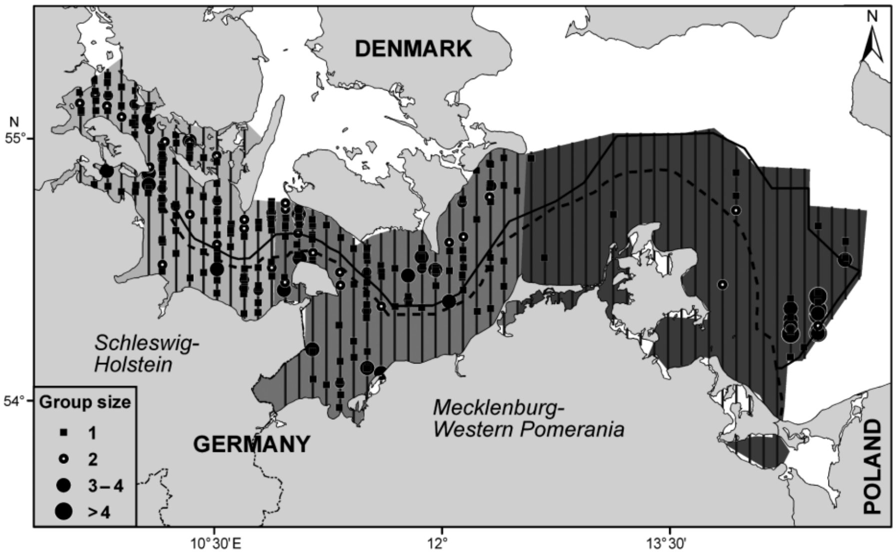

Figure 4-17. Map showing the area in the German Baltic Sea and its division into subareas for calculating harbour porpoise density estimates from aerial surveys between 2003 and 2006. Black squares and points indicate harbour porpoise sightings. Note that sightings in the easterly area originate from one survey only with an unusual high aggregation of harbour porpoises. From: Scheidat et al. (2008).

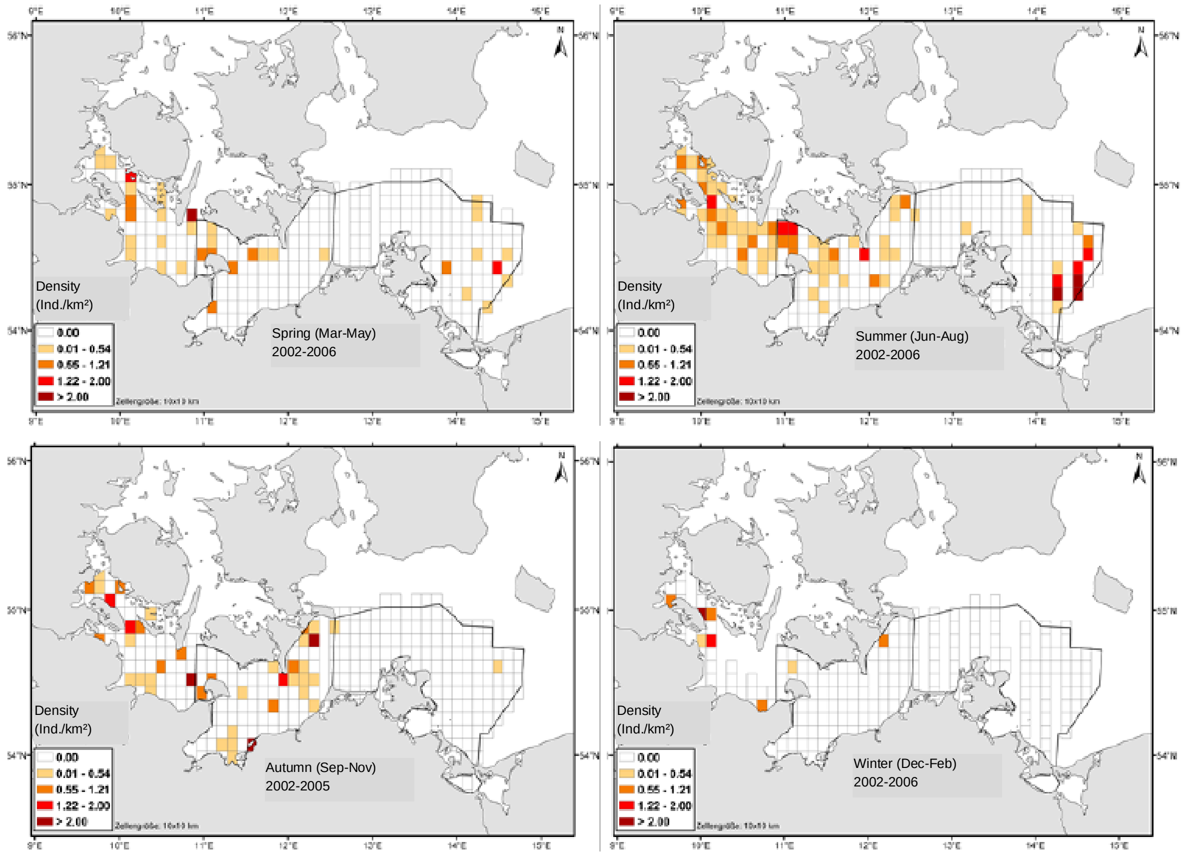

Figure 4-18. Map showing seasonal occurrence of harbour porpoises in the German area of the Baltic Sea based on sightings during aerial surveys between 2002 and 2006. Shown are density estimates per grid cell corrected for survey effort. From: Gilles et al. (2007a b).

Data from German OWF impact assessment studies

The most recent and detailed publicly available data on harbour porpoise occurrence around the pre-investigation area originates from the environmental monitoring conducted for the German offshore windfarm area O-1.3 (IBL Umweltplanung GmbH 2020). This planning area is directly adjacent to the Bornholm I South area to the south-west (Figure 4-19). Here digital aerial (HiDef) and ship-based surveys were conducted in combination with passive acoustic monitoring. The transect lines used during digital aerial surveys (Figure 4-19) and those used for ship-based surveys (Figure 4-20) mainly cover the German area south of the pre-investigation area, but also a small part of the north-western pre-investigation area. A total of 20 digital aerial surveys (5,238 km of transect line) were conducted between April 2016 and February 2018 covering all months of the year. Between March 2016 and February 2018, 24 ship-based surveys were conducted with one survey every month and a total transect line of 3,051 km.

During the 20 aerial surveys, a total of eight harbour porpoise individuals were spotted during six sightings including one mother-calf pair (five individuals in 2016 and three individuals in 2017). All sightings but one occurred between June and September. Apart from one sighting in March, no sightings occurred between April and February (Table 4-6). All but one harbour porpoise sighting (which was at the north-western edge of the aerial survey area) occurred in the southern third of the aerial survey area (Figure 4-19). Seasonal densities calculated based on these data were 0.009 ind./km² in spring 2016, 0.003 ind./km² in summer 2016, 0.002 ind./km² in spring 2017 and 0.007 ind./km² in summer 2017 (Table 4-6). As no sightings were obtained during the other seasons, densities were 0 ind./km² in both years.

These data match well with density estimates presented by Scheidat et al. (2008) for the earlier surveys in the Mecklenburg Bight (on the German side, Mecklenburg Bay is the sea area between Fehmarn and Darßer Ort on the Darss) and show that the EIB OWF area lies within an area where harbour porpoise density seems not to be substantially different from that in the rest of the Mecklenburg Bight region, which in general is a low harbour porpoise density area within the Baltic Sea.

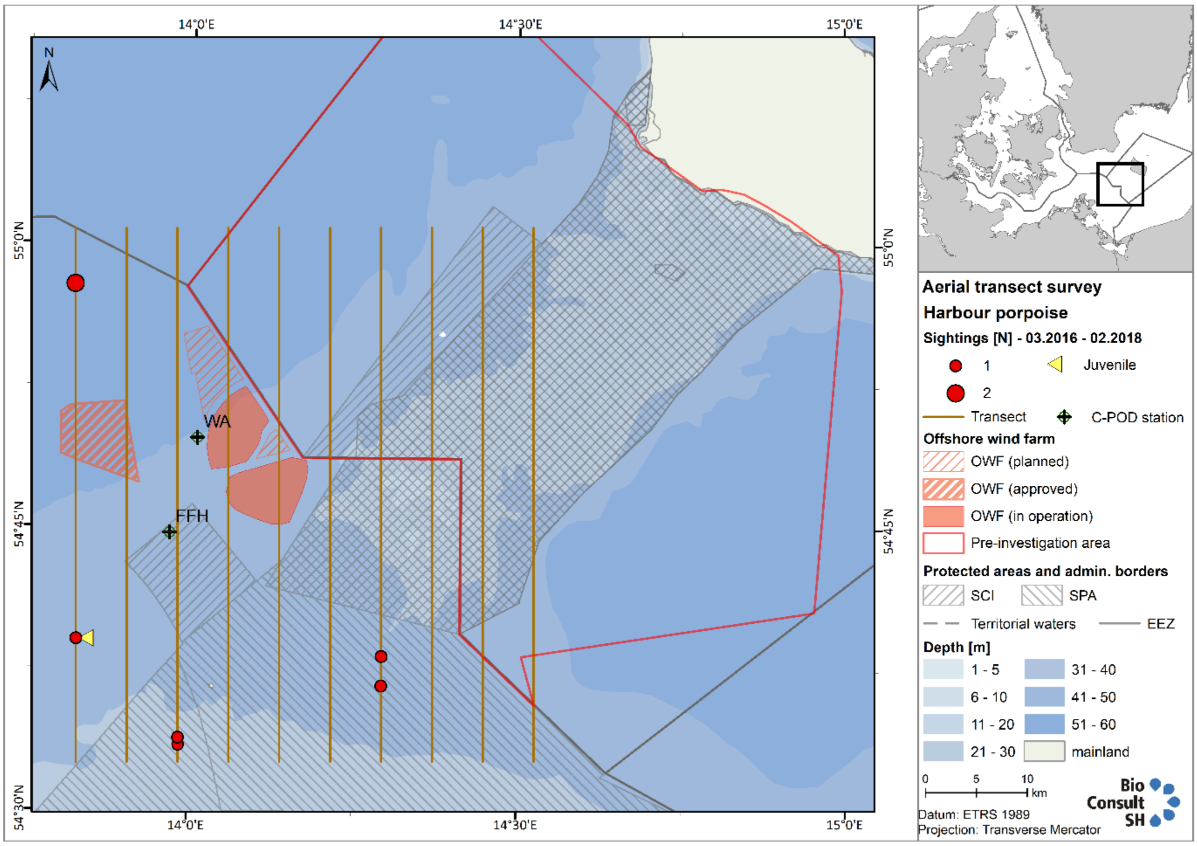

Figure 4-19. Transect design of aerial monitoring of marine mammals in the OWF project area O-1.3 in the German EEZ between March 2016 and February 2018. Red points indicate harbour porpoise sightings during surveys between April 2016 and February 2018 (10 surveys). Black crosses indicate the two C-POD positions WA and FFH used for acoustic monitoring of harbour porpoises. From: IBL Umweltplanung GmbH (2020).

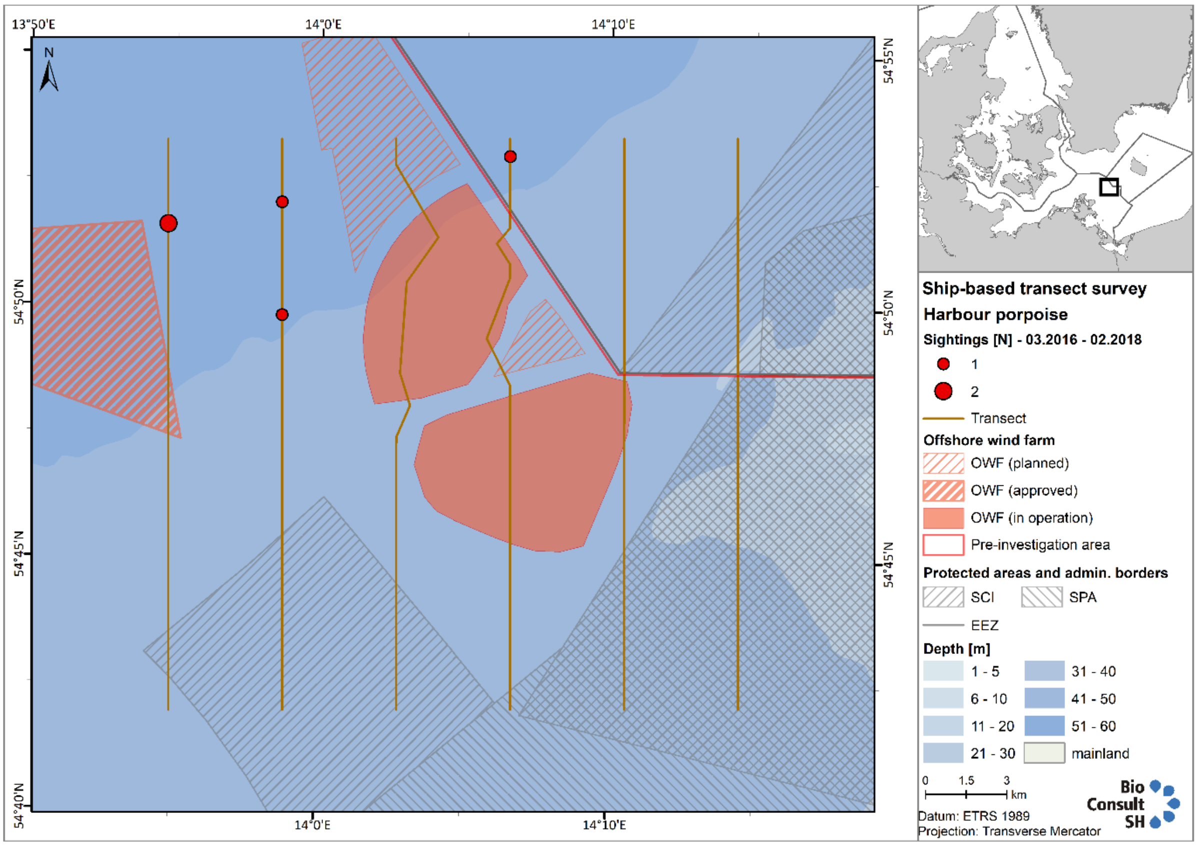

Figure 4-20. Transect design of the ship-based surveys in the OWF project area O-1.3 in the German EEZ between March 2016 and February 2018. Red points indicate all harbour porpoise sightings made during the 24 ship-based surveys. Sightings only occurred during two surveys in July and November 2016. From: IBL Umweltplanung GmbH (2020).

Table 4-6. Summary of the 20 digital aerial HiDef surveys conducted between April 2016 and February 2018 in the German OWF planning area O-1.3 including effort, number of harbour porpoises and harbour porpoise calves sighted and harbour porpoise density estimates calculated using correction factors provided by Teilmann et al. *(2013)*. **From: IBL Umweltplanung GmbH (2020).**

Date	Effort [km²]	Porpoises sighted (including calves) [n]	Porpoise calves [n]	Porpoise density [ind./km²]
20.04.2016	284.77	0	0	0
03.05.2016	284.83	0	0	0
26.06.2016	255.92	1	0	0.008
22.07.2016	285.26	2	1	0.012
26.08.2016	284.38	1	0	0.007
10.09.2016	283.09	1	0	0.008
30.10.2016	285.43	0	0	0

13.11.2016	285.08	0	0	0
28.01.2017	279.07	0	0	0
24.02.2017	285.17	0	0	0
11.03.2017	284.98	1	0	0.007
10.04.2017	285.00	0	0	0
12.05.2017	284.83	0	0	0
15.07.2017	284.12	0	0	0
07.08.2017	284.40	2	0	0.014
27.09.2017	284.53	0	0	0
31.10.2017	285.44	0	0	0
04.12.2017	285.34	0	0	0
27.12.2017	281.94	0	0	0
07.02.2018	283.68	0	0	0
Total	**5657.26**	**8**	**1**	**MV = 0.0028**

Table 4-7. Seasonal harbour porpoise density estimates for the German OWF project area O-1.3 calculated from digital aerial HiDef surveys conducted between April 2016 and February 2018. (spring: March-May, summer: June-August, autumn: September-November, winter: December-February). From: IBL Umweltplanung GmbH (2020).

Season	Mean harbour porpoise density [ind./km²]	Range [ind./km²] (min-max)	Surveys [n]
spring 2016	0	0	2
summer 2016	0.009	0.007 – 0.12	3
autumn 2016	0.003	0 – 0.008	3
winter 2016/2017	0	0	2
spring 2017	0.002	0 – 0.002	3
summer 2017	0.007	0 – 0.014	2
autumn 2017	0	0	2
winter 2017/2018	0	0	3

A total of four sightings with five harbour porpoise individuals were made at only two of 24 ship-based surveys. Three harbour porpoises were spotted in July 2016 and two in November 2016. It is obvious that harbour porpoise sightings only occurred during surveys under very calm weather conditions. These two surveys were conducted in July 2016 (3 ind.) and in November 2016 (2 ind.), and sightings were all located in the northern third of the aerial survey area (Figure 4-20). Detecting elusive harbour porpoises from a ship requires very calm sea state conditions that are rarely present. Because these ship-based surveys mainly target bird species, they are conducted at a sea state up to 3, where birds swimming on or flying above the water can still be reliably detected. Such surveys thus provide only limited information on harbour porpoise abundance, and therefore, surveys without harbour porpoise sightings may not be taken as proof of absence in this case. Instead, a focus on aerial surveys and passive acoustic monitoring is recommended.

<u>Summary</u>

The most recent estimates for the Belt Sea population of harbour porpoises by SCANS IV in 2022 (Gilles et al. 2023) indicate an abundance of 14,403 (9,555-21,769) individuals, with a density of 0.34 (0.23-0.52) ind./km² and comparisons with previous data suggest an annual 1.5 % decline since 2012, which is not statistically significant.

Visual surveys undertaken to calculate density and abundance of harbour porpoises in the Belt Sea region are few, cover different areas and were conducted by differing survey methods, such that comparison of results is difficult. No visual surveys exist for the calculation of abundance of the Baltic Proper population of harbour porpoises. Given the very low population size, such surveys are not appropriate, and thus acoustic monitoring was used instead (see next chapter).

Smaller-scale surveys do not exist from the pre-investigation area itself, but from adjacent offshore projects in German waters with survey areas extending into the pre-investigation area. These data indicate a harbour porpoise density of between 0.002 and 0.009 ind./km² in spring and summer, while no sightings were obtained during the autumn and winter seasons. Such densities are considered to be very low.

ABUNDANCE AND DENSITY AROUND THE EIB PRE-INVESTIGATION AREA BASED ON ACOUSTIC DETECTIONS

Harbour porpoise sightings during ship-based surveys conducted during SCANS-I and II in Polish, Swedish and German waters of the Baltic Proper were so rare that it was not possible to calculate reliable abundance estimates (Gillespie et al. 2005). Therefore, no more visual surveys were conducted in this region during SCANS III. It was recommended to conduct passive acoustic monitoring in the Baltic Proper instead.

SAMBAH data

In the year 2011 the SAMBAH project was launched to gain reliable assessments of abundance, distribution and habitat preferences of the harbour porpoise population in the Baltic Proper (SAMBAH 2016). Due to low abundance of harbour porpoises in the Baltic Proper and the generally shy behaviour and thus low visual detectability of harbour porpoises, it was chosen to use the well-established method of passive acoustic monitoring rather than visual surveys to reach this goal. Over a study period of two full years, data were collected at 304 C-POD (Cetacean Porpoise Detectors) positions distributed all over the Baltic Proper between 2011 and 2013. These C-PODs are underwater hydrophones with self-contained data loggers within a water-proof casing powered by batteries included in the casing. These C-PODs are designed to detect the echolocation clicks of toothed whales, especially of harbour porpoises and can automatically collect data for up to about three months after being deployed. When C-PODs are recovered, the stored data are extracted and analysed with a standardised algorithm so that, as in the case of SAMBAH, it can be calculated on how many days porpoises were present around the hydrophone. From these passive acoustic monitoring data, the SAMBAH project then calculated harbour porpoise abundances and habitat use. As mentioned in chapter 4.3.2, based on these passive acoustic monitoring data from the SAMBAH study, the number of individuals of the Baltic Proper management unit during summer was estimated at approx. only 500 animals (SAMBAH 2016). In contrast to this, the management of the Belt Sea was estimated by SAMBAH to be more than 20,000 individuals. The distribution of harbour porpoise detections from the SAMBAH project showed a strongly decreasing pattern from the south-west to the north-east during the summer months (Figure 4-21). Detections were highest in the westernmost part of the SAMBAH study area, the Danish waters east of Lolland and Sjælland and near the Darss ridge. They drastically declined towards the east, until no detections were found on the Estonian and Finnish coasts (Figure 4-21).

During winter, there was a relatively continuous decline from the south-west to the north-east, but harbour porpoise detections were found all along the Swedish and Polish coasts. Unlike the decreasing pattern of harbour porpoise detection rates from the south-west to the north-east, the distribution of detection rates in the eastern part of the SAMBAH study area was relatively continuous in winter, meaning that they did not differ much between stations. During summer, highest rate of detections were still found in the most western part. However, in the eastern part of the SAMBAH study area, there was now a concentration of harbour porpoise detections in the Swedish waters around the Hoburg and Midsjö banks south of Gotland and east of Øland (area indicated by a red circle in Figure 4-21). At the same time almost, no detections were found further north or in Swedish, Estonian, Latvian

or Lithuanian waters and also only very few were found along the Polish coast (Figure 4-21). Based on these seasonal distribution patterns, it is concluded that in winter, the Baltic Proper population of harbour porpoises shows a widespread distribution across the whole SAMBAH study area mixing with the Belt Sea population. During the summer breeding season, however, the two populations seem to be separated: The Belt Sea population moves further west and the Baltic Proper population concentrates in the detection hot spot in Swedish waters around the Hoburg and Midsjö banks south of Gotland and east of Øland (area indicated by a red circle in Figure 4-21). Hoburg and Midsjö banks are thought to represent a harbour porpoise nursery ground. A seasonal population management border that lies east of Bornholm was thus proposed (Figure 4-21). Harbour porpoise density estimates based on these detections yielded low numbers with about 0.07 ind./km² in the whole SAMBAH study area during winter and with about 0.63 ind./km² in the south-western part of the SAMBAH study area and about 0.004 ind./km² in the north-eastern part of the SAMBAH study area in summer (SAMBAH 2016). The EIB pre-investigation area lies on the eastern edge of the SAMBAH study area with relatively high detection rates towards the Belt Sea and about 80 km away from the proposed summer management border.

SAMBAH made it possible to recognise a general distribution and seasonal migration pattern for the Baltic Proper population. However, it is to be noted that the data for SAMBAH was collected between 2011 and 2013 and is therefore up to 13 years old. Changes that have occurred in the Baltic Sea since this time, such as the construction and operation of offshore wind farms, cannot yet be reflected in this data. The distribution of harbour porpoises or seasonal migration pattern, as they were derived from the SAMBAH data, may therefore be different today. It is therefore crucial that studies like SAMBAH continue, both on a small scale in form of national or regional studies and, as the SAMBAH study, in form of international large-scale studies. Differences between the SAMBAH data collected in the central Baltic Sea and more recent data are therefore understandable and even probable.

Owen et al. (2021) recently presented further monitoring data from Swedish waters near the Northern Midsjö Bank south of Øland, so the area used by probably Baltic Proper harbour porpoises during the breeding season. They found a slight increase in detection rates in their study period 2017-2020 compared to the 2011-2013 SAMBAH study period when analysing detection rates during the seasonal peak in May-October and thus during the breeding season. While this may be indicating the start of population recovery, the rate of increase (2.4 %) is still very low relative to what is likely for this harbour porpoise population in the absence of threats (Owen et al. 2021).

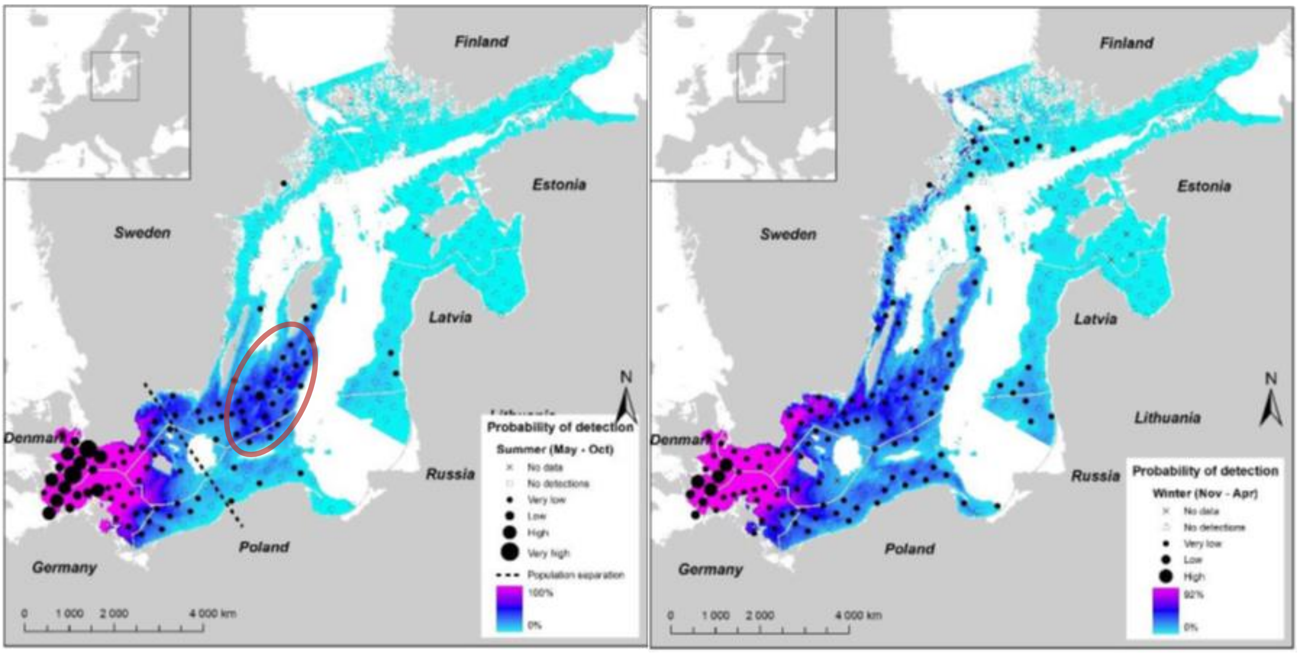

Figure 4-21. Probability of detection of harbour porpoises in the Baltic Sea in summer (May-October) and winter (November-April) as calculated from harbour porpoise detections at 304 C-POD stations deployed during the SAMBAH project between April 2011 and June 2013. The red circle indicates the high-density area around the Hoburg and Midsjö banks, which is suggested to be the breeding area of harbour porpoises from the Baltic Proper population. Taken from: SAMBAH (2016).

Mikkelsen et al. (2016) modelled harbour porpoise distribution patterns in the south-western Baltic Sea using satellite locations from 13 tagged harbour porpoises of the Belt Sea population and comparing it to harbour porpoise detections at C-POD stations in the same area used during the SAMBAH project. As satellite data were only sufficient during summer (June-August) and autumn (September-November), model results were restricted to these two seasons. A summary of C-POD data is shown in Figure 4-22, which clearly shows a decrease in harbour porpoise detections from west to east. The four stations closest to the pre-investigation area (indicated by the blue circle in the figure) are in the area with low numbers of harbour porpoise detections. While detections were still relatively high at station 7009 in summer, they were much lower at station 7010 further east and especially at stations 8009 and 8010, which are located closest to the pre-investigation area in Danish waters (Figure 4-22).

These data confirm results from the model calculated from satellite locations of the Belt Sea harbour porpoises that show high habitat suitability in the south-western part of the study area in summer and the western areas in autumn (Figure 4-23, Mikkelsen et al. 2016). The eastern area, where the pre-investigation area is located, had relatively low importance during both seasons (Figure 4-23). However, it must be considered that these results do not allow conclusions about spring and winter, nor do they give information about the importance of the region for harbour porpoises from the Baltic Proper population, as only Belt Sea animals were tagged. However, given results from (SAMBAH 2016), detections around the pre-investigation area were also low in winter (Figure 4-21).

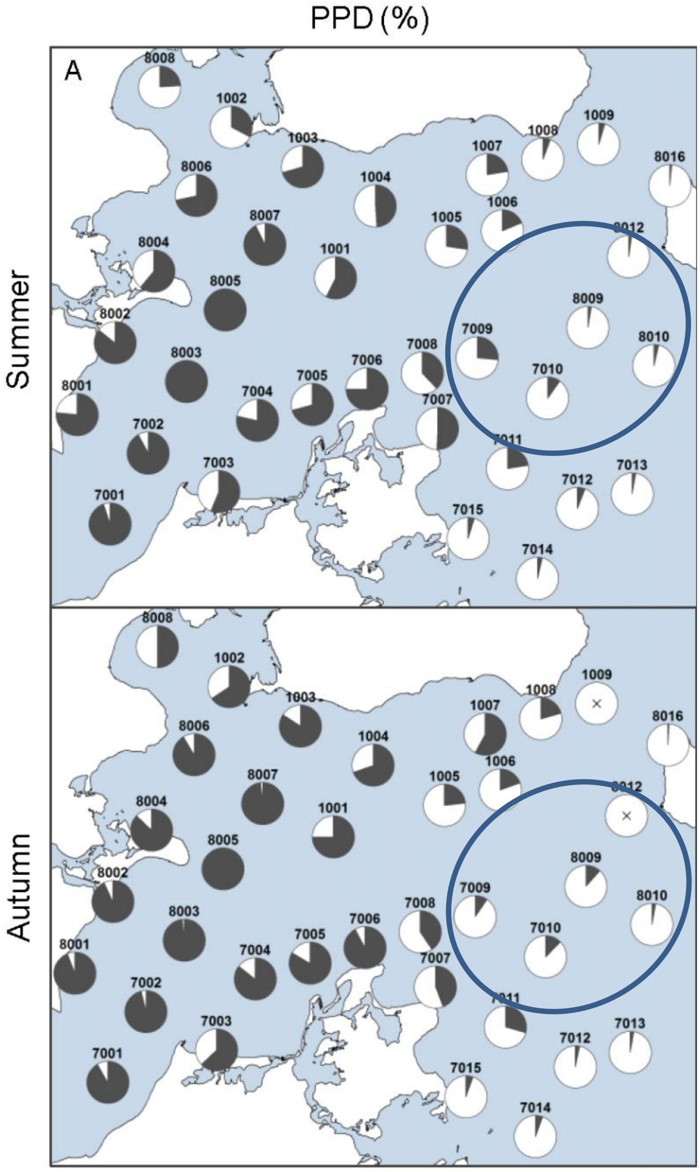

Figure 4-22. Shows the percentage of harbour porpoise positive days (PPD %) by season (summer: June-August, autumn: September-November) at the C-POD stations used during the SAMBAH project between 2011 and 2013. Stations with an x mark indicate that no clicks were recorded at that station. The blue circle indicates the five stations closest to the pre-investigation area. From: Mikkelsen et al. (2016).

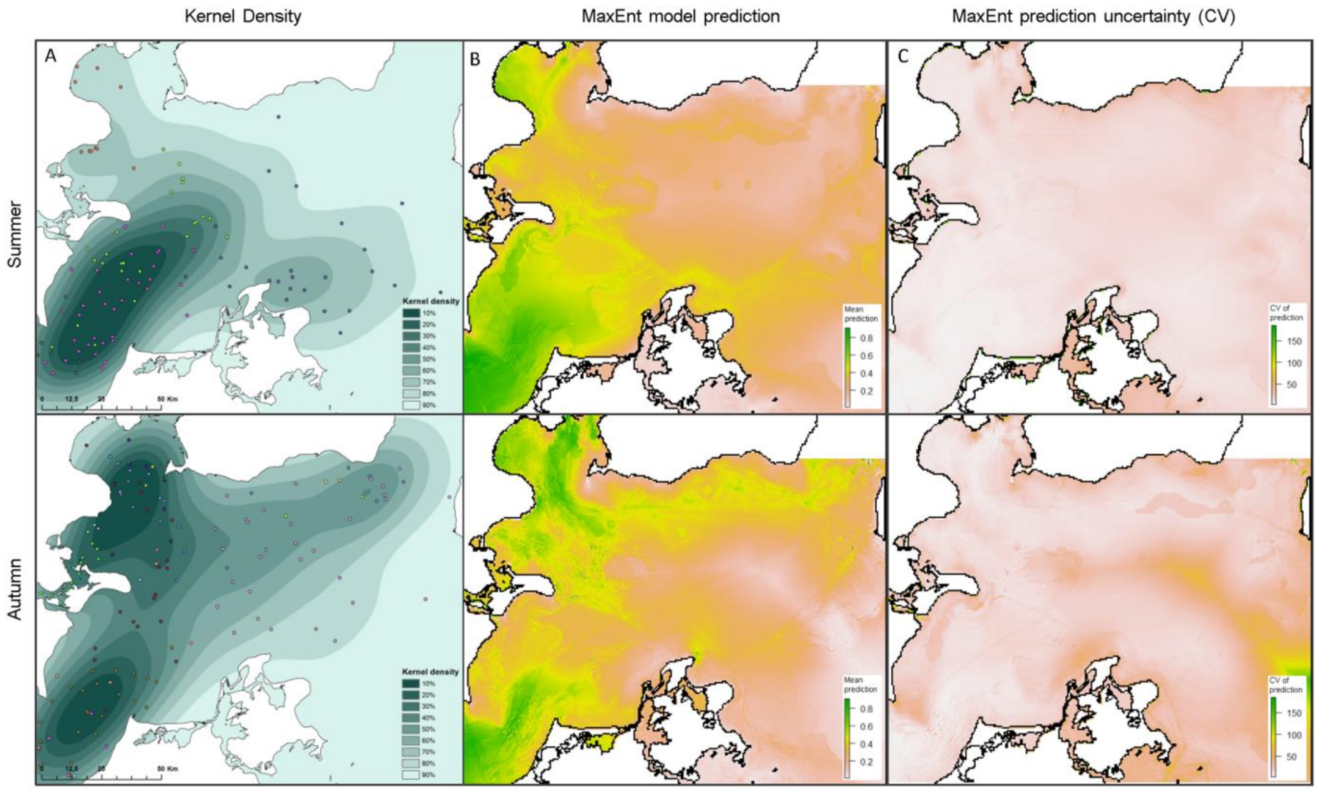

Figure 4-23. Kernel and MaxEnt results. (A) Kernel density results for summer (June-August, top row) and autumn (September-November, bottom row). (B) Mean prediction of the probability of presence of Belt Sea harbour porpoise based on 100 bootstrap models. The scale of the colouring can be interpreted as the relative probability of presence of Belt Sea harbour porpoise given the environment. (C) The uncertainty of the prediction expressed by the coefficient of variation (CV). From: Mikkelsen et al. (2016).

Danish National NATURA 2000 monitoring data

Acoustic monitoring in Danish waters around Bornholm was continued in 2018/19 using some of the C-POD positions from the SAMBAH project (Sveegaard 2020). Of these positions, 8009, 8010, 8012 and 8013 are the ones most relevant for the EIB pre-investigation area (Figure 4-24). Position 8010 is located within the EIB pre-investigation area, and position 8009 is located within the NATURA 2000 site next to the EIB pre-investigation area. For C-PODs at these two positions (8009 and 8010), only relatively continuous data were collected between June and November 2018 and between the end of February and June 2019 (Figure 4-25). These data were analysed by (Sveegaard 2020) for a note from DCE, and results are summarised in Figure 4-26, which also shows detection rates at these stations during the SAMBAH project between 2008 and 2011.

In 2008-2011, highest detections at these stations occurred during the winter months, which was mainly due to high detections between 0.2 and 0.5 DPD (detection positive days) in November, December and January at station 8009. Only little porpoise activity was recorded during the summer. By contrast, during the 2018/19 study period, highest detections were found during the summer months, but this was mainly due to high detections between 0.2 and 0.9 at station 8010 between July and September 2018, which generally revealed much higher detection rates than any of the other seven stations that collected data. Comparisons between these two study periods is difficult, however, as no data exists for station 8009 in December and January in 2018/19, the months when detections at this station were high in 2008-2011. Provided that data were recorded during summer 2008-2011 at station 8010 (which is not entirely clear based on the data presented by Sveegaard 2020), there was a remarkable increase (significance not statistically verified) in porpoise summer detections at station 8010 in 2018. Whether these detections belong to the Belt Sea or Baltic Proper population or whether such a summer increase is due to a shift in summer habitat usage by either population is presently impossible to determine.

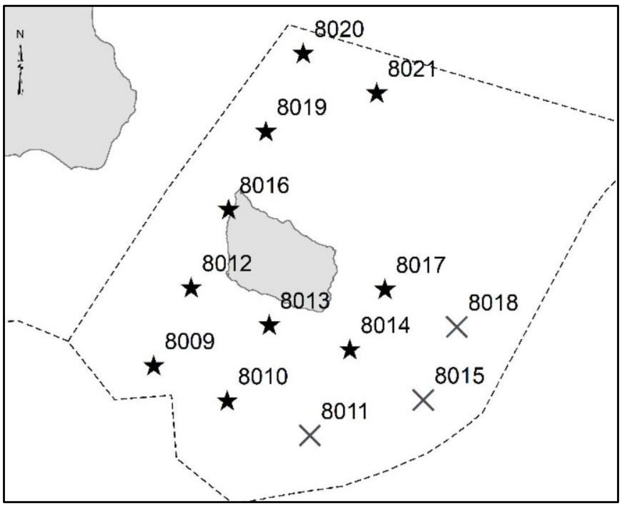

Figure 4-24. C-POD positions in Danish waters around Bornholm used during the SAMBAH project in 2008-2011 and during the 2018/19 monitoring period (crosses: stations only used during SAMBAH, stars: stations used during both study periods). Note that 8009 and 8010 are the ones most relevant for the pre-investigation area. From: Sveegaard 2020.

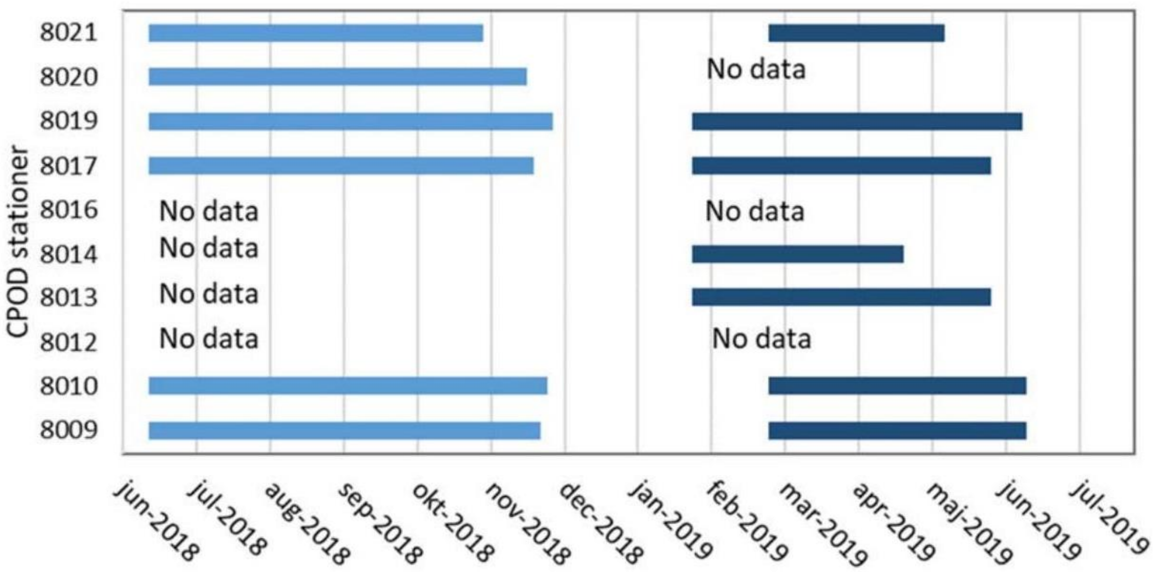

Figure 4-25. Periods with successful data recordings (indicated as blue bars) at C-POD positions during the 6-months monitoring period 2018/19 in Danish waters around Bornholm. Note that 8009 and 8010 are the ones most relevant for the pre-investigation area. From: Sveegaard 2020.

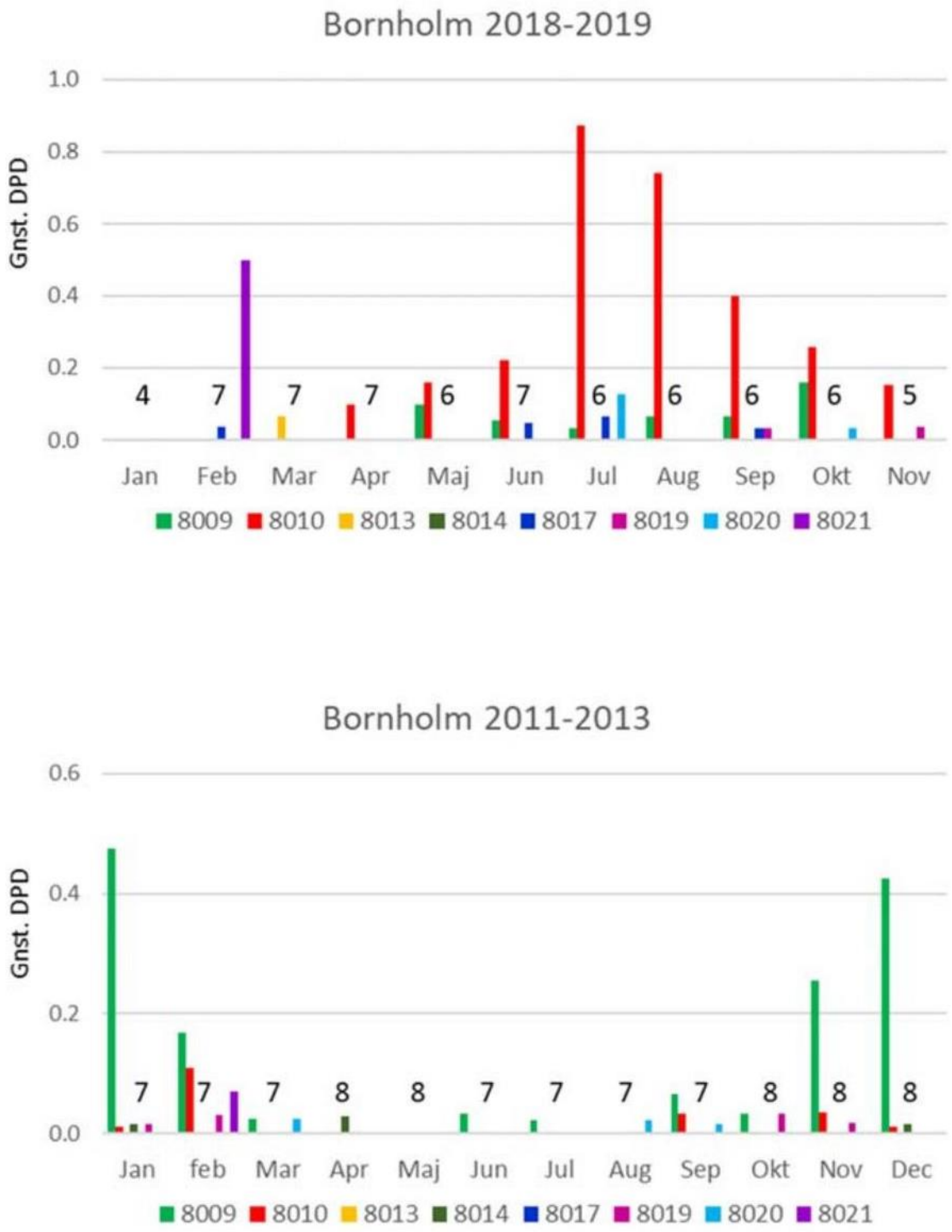

Figure 4-26. Summary of harbour porpoise detection positive days (DPD) per month at the eight monitoring stations in Danish waters around Bornholm during the monitoring period 2018/19 (upper figure) and the SAMBAH study period 2008-2011 (lower figure). Note that 8009 and 8010 are the positions most relevant for the pre-investigation area, but that data at 8009 did not exist in December and January and for the largest part of February in 2018/19. From: Sveegaard 2020.

German national NATURA 2000 monitoring data

Further C-POD data in the relevant area are available from the marine mammal monitoring project of the German Federal Agency for Nature Conservation (BfN). During this project, data were collected at C-POD stations in the eastern part of the German Baltic Sea. (Gallus & Benke 2014) summarised results at these positions obtained between 2009 and 2013. Positions closest to the EIB pre-investigation area are position 7009, 7010, G28 and G25 indicated in Figure 4-27. Two of these (7009 and 7010) were also used during the SAMBAH project. Detection probability at these stations was relatively low with less than 18 % DPD/study period and even below 8 % DPD/study period at G25, the position closest to the EIB pre-investigation area. A summary of the seasonality of detections at these stations is given by Gallus & Benke (2014) and shown in Figure 4-28. Highest detections at these positions were found from July to October, lowest detections were found between February and June. Monitoring at some of these stations is continuing until today, but so far, data are only available from annual status reports (Gallus & Benke 2014, Gallus 2019b a, Gallus & Brundiers 2019, 2020).

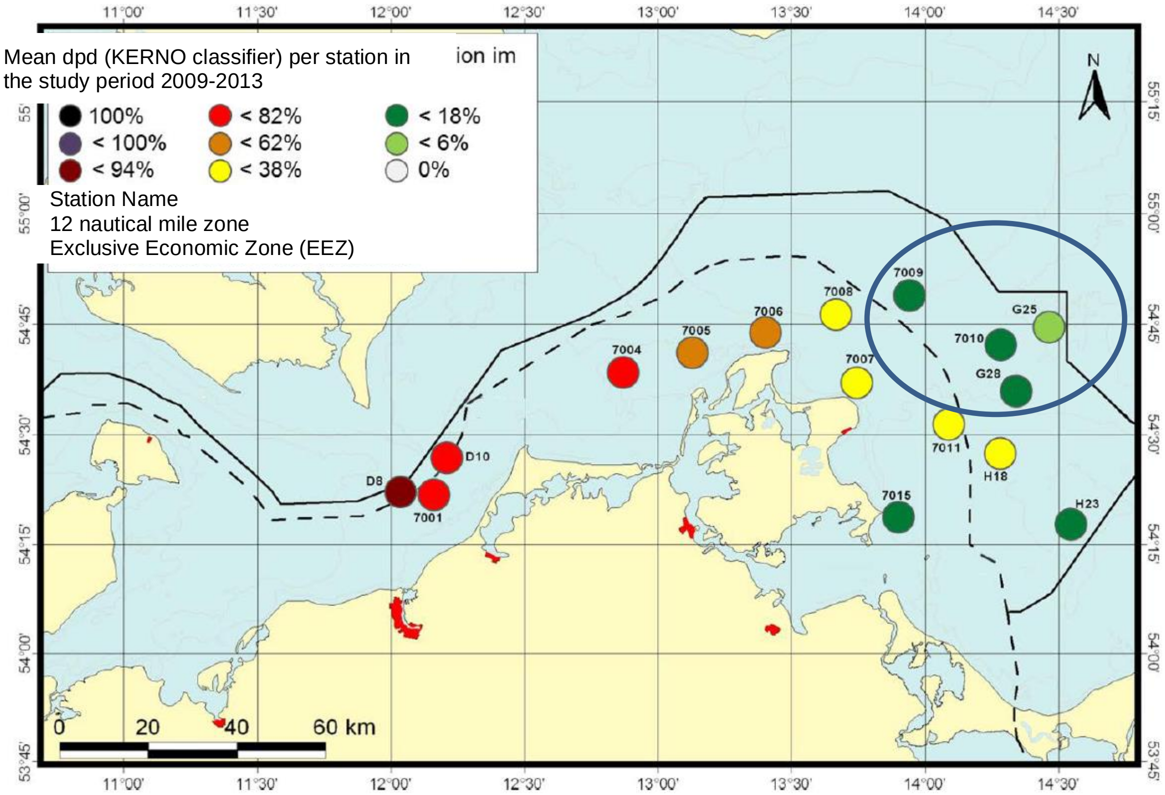

Figure 4-27. Coloured circles indicate the location of 16 C-PODs used for the marine mammal monitoring program by the German Federal Agency for Nature Conservation (BfN). Colours indicate the % detection positive days (DPD between 2010 and 2013. The blue circle indicated the four C-POD stations closest to the EIB pre-investigation area, of which data are shown in more detail in Figure 4-28. From: Gallus & Benke (2014).

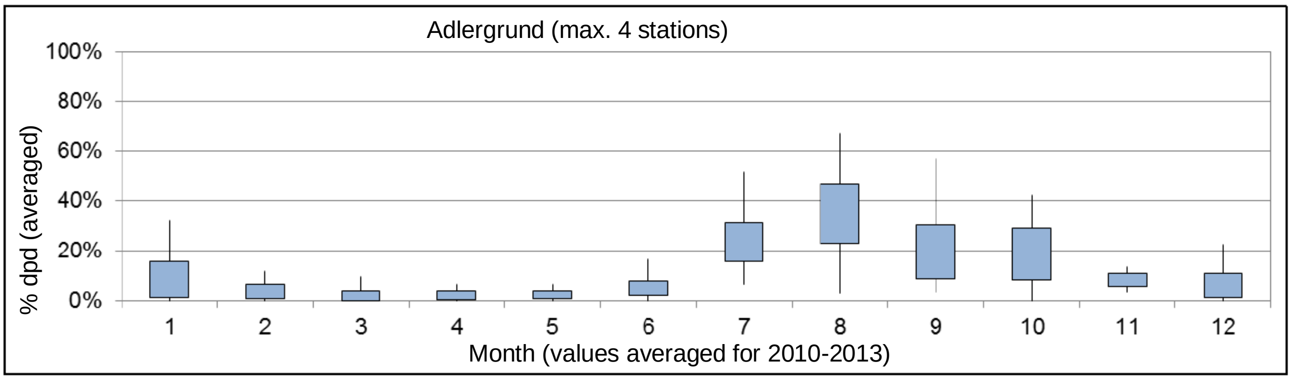

Figure 4-28. Percentage of detection positive days (DPD) averaged per months over the period 2010-2013 at C-POD stations in the "Adlergrund" (Positions 7009, 7010, G28 and G25 in Figure 4-27). From: Gallus & Benke (2014).

Figure 4-29 shows the monthly detection rates of harbour porpoises at station G25, which is closest to the EIB pre-investigation area, from 2015 to 2019. Seasonal detection rates were still quite similar each year with low detections at the beginning of the year, detections increasing in May or June, a peak between 20 and 30 % DPD/month in July and a second, usually lower peak between September and October. Detection rates were mostly far below 10 % DPD/month between November and May (Figure 4-29).

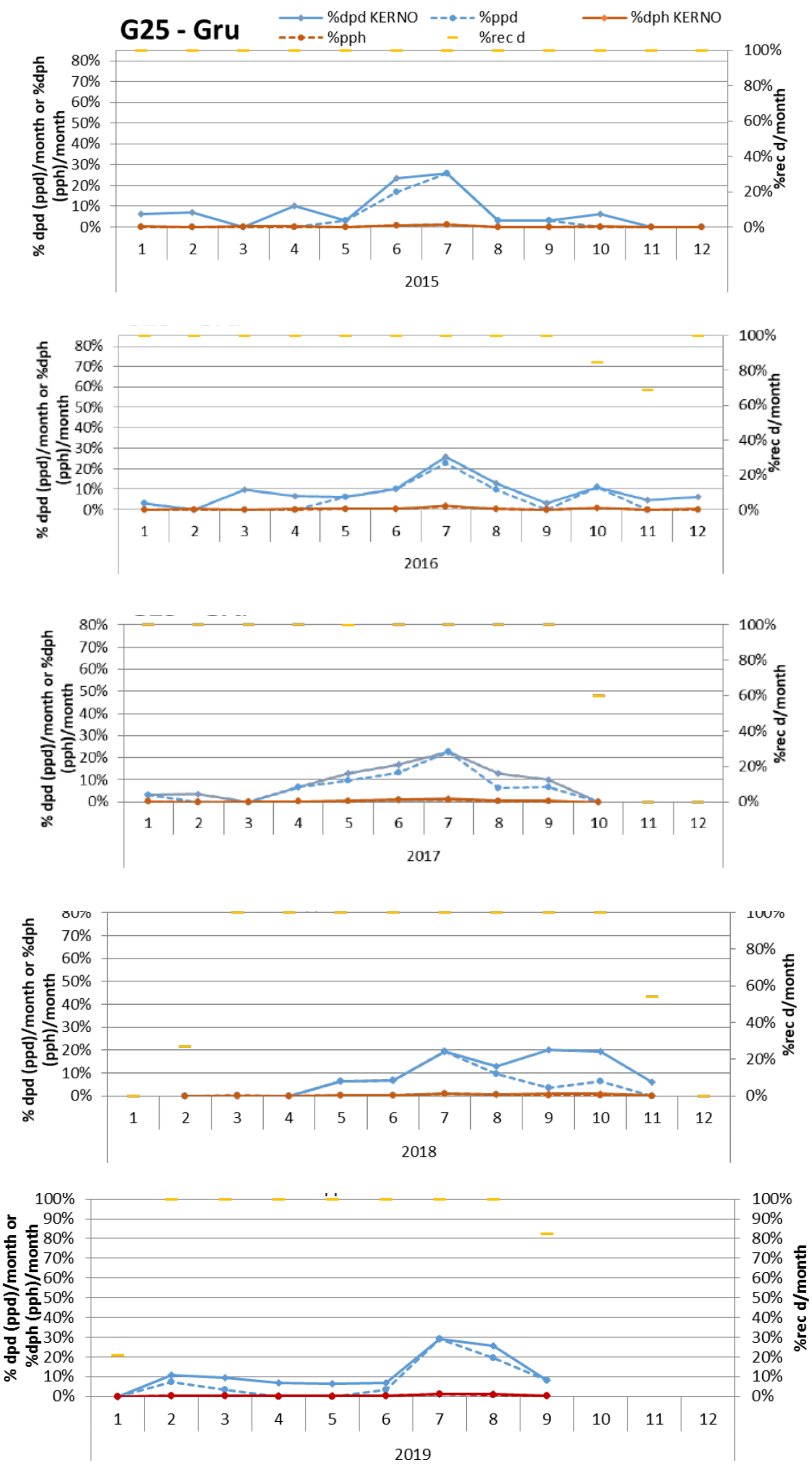

Figure 4-29. Percentage of detection positive days (DPD, blue line) and detection positive hours (dph, red line) per month and percentage of observed days per month (yellow) at C-POD station G25-Gru during 2015-2019. From: Gallus & Benke (2014); Gallus (2019b a); and Gallus and Brundiers (2019, 2020). Continuous lines and broken

lines of one colour basically show the same data; Slight differences between them stem from using the standard or the KERNO-classifier for identifying harbour porpoise clicks in the raw data.

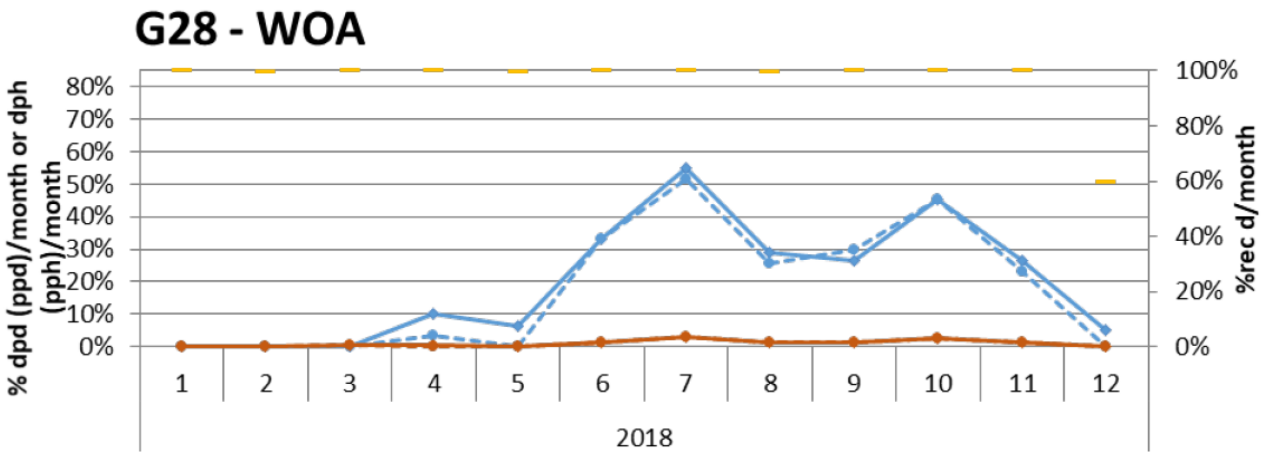

Figure 4-30. Percentage of detection positive days (DPD, blue line) and detection positive hours (DPH, red line) per month and percentage of observed days per month (yellow) at C-POD station G28 - WOA during 2018. From: Gallus & Brundiers (2019). Continuous lines and broken lines of one colour basically show the same data; Slight differences between them stem from using the standard or the KERNO classifier for identifying harbour porpoise clicks in the raw data.

Data from German offshore wind farm impact assessment studies

Acoustic monitoring of harbour porpoises was also a major part of the investigations in the German OWF project area O-1.3 directly south of the pre-investigation area (IBL Umweltplanung GmbH 2020). In addition to the aerial and ship-based surveys, data were collected at two passive acoustic monitoring stations where C-PODs were deployed (Figure 4-31). Station WA was located about 10 km and station FFH about 20 km to the south of the pre-investigation area. Data at both positions were obtained continuously from March 2016 to February 2018 with between 355 and 359 days covered per year and station (Table 4-8).

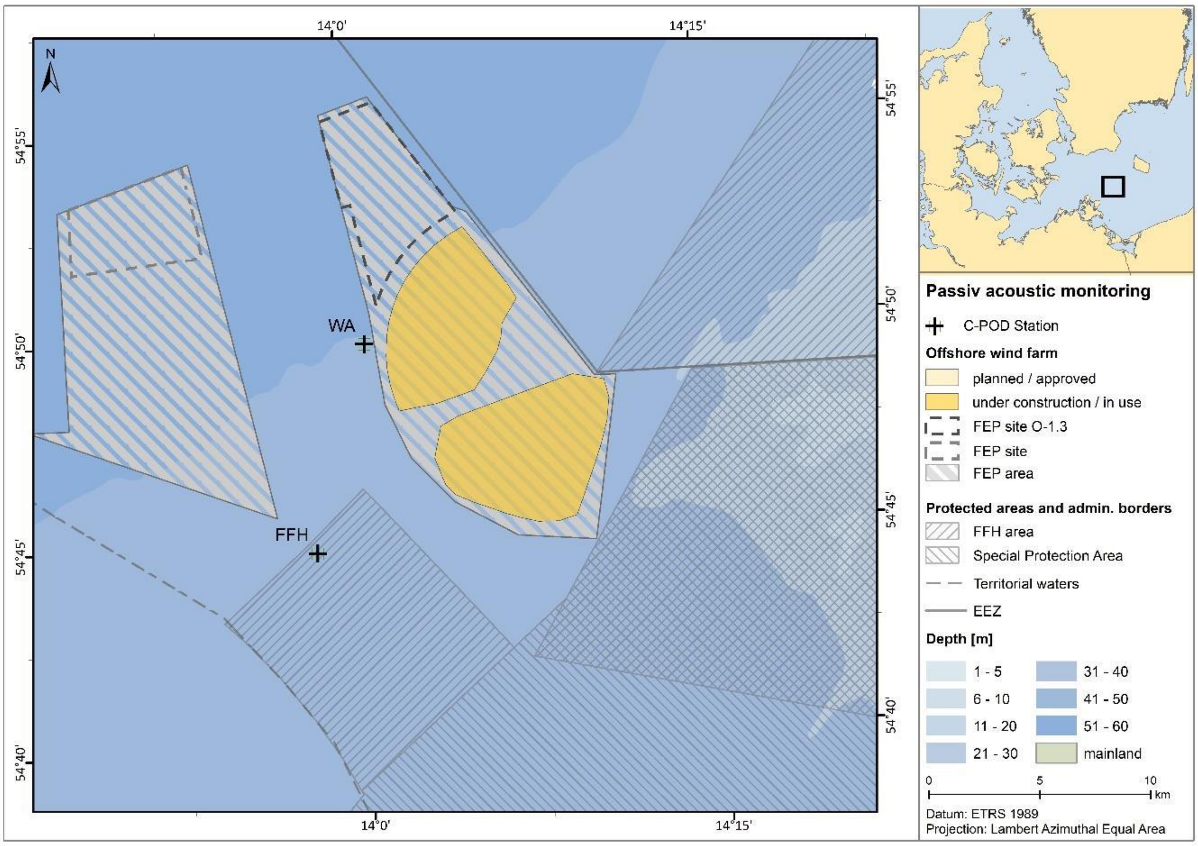

Figure 4-31. C-POD stations WA and FFH, which were used for the investigation of area O-1.3 from March 2016 to February 2018. From IBL Umweltplanung GmbH (2020).

The seasonality of detections at these two stations is shown in Figure 4-32. Detections at the station FFH were higher than at station WA further north and closer to the EIB pre-investigation area, which corresponds to results from the SAMBAH and BfN monitoring project summarised above. The seasonality at these two stations was relatively similar with relatively low detections between December and April (always 0.1 DPD/month), detections steeply increasing in June/July and reaching a peak around July and another one around October. Detections were almost continuously higher in 2017 than in 2016, and especially the summer and autumn peaks were more than twice as high as in the preceding year (Figure 4-32).

Table 4-8. Summary of harbour porpoise detection data at the two C-POD stations WA and FFH used for acoustic marine mammal monitoring in the German OWF project area O-1.3between March 2016 and February 2018. Given are the percentage detection positive days (% DPD/year), percentage detection positive hours per day (% DPH/ day) and percentage detection positive ten minutes per day (% DP10M/day). From: IBL Umweltplanung GmbH (2020).

POD station	Time of investigation	Number of days analysed	% DPD/year	% DPH/day	% DP10M/day
WA	March 2016 - February 2017	355	3.6	0.28	0.07
	March 2017 - February 2018	358	12.4	0.89	0.21
FFH	March 2016 - February 2017	359	17.5	1.13	0.24
	March 2017 - February 2018	359	31.7	2.63	0.63

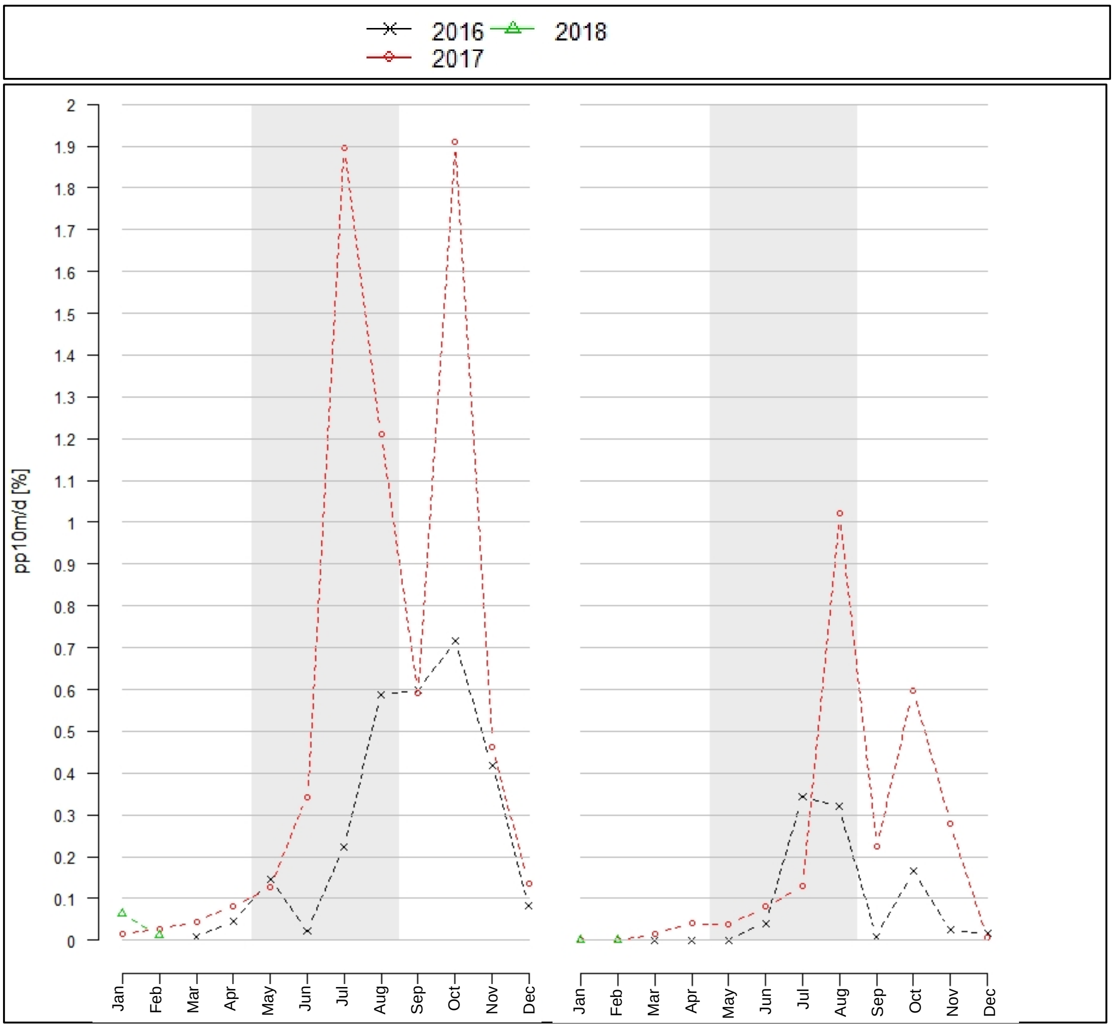

Figure 4-32. Mean monthly harbour porpoise detection rates (as % dp10m/day) at the C-POD stations FFH (left) and WA (right) between March 2016 and February 2018. From: IBL Umweltplanung (2020).

Summary

Based on the passive acoustic monitoring data from the SAMBAH study, the number of individuals of the Baltic Proper management unit during summer was estimated at approx. only 500 animals in 2011-2013 (SAMBAH 2016). The harbour porpoise population in the Belt Sea was estimated by (SAMBAH 2016) to be more than 20,000 individuals.

Based on the seasonal distribution patterns found in the SAMBAH project, it was argued that in winter, the Baltic Proper population of harbour porpoises shows a widespread distribution across the whole central Baltic Sea mixing with the Belt Sea population. During the summer breeding season, however, the two populations seem to be separated: The Belt Sea population moves further west and the Baltic Proper population concentrates in the detection hot spot in Swedish waters around the Hoburg and Midsjö banks south of Gotland and east of Øland, thought to represent a harbour porpoise nursery ground. Based on these results, a seasonal population management border was proposed that lies east of Bornholm and about 80 km east of the pre-investigation

area. Harbour porpoise density estimates based on these detections yielded low numbers with about 0.07 ind./km² in the whole SAMBAH study area during winter, about 0.63 ind./km² in the south-western part of the SAMBAH study area and about 0.004 ind./km² in the north-eastern part of the SAMBAH study area in summer (SAMBAH 2016). The pre-investigation area lies on the eastern edge of the area with relatively high detection rates towards the Belt Sea.
A model of harbour porpoise distribution patterns in the south-western Baltic Sea using satellite locations (Figure 4-23) from harbour porpoises of the Belt Sea population shows a decrease in harbour porpoise abundance from west to east (so towards the pre-investigation area) in summer and autumn, in line with acoustic detections from the same area obtained during the SAMBAH project.

Acoustic monitoring in Danish waters around Bornholm in 2018/19 (Figure 4-24) revealed relatively high harbour porpoise detection rates between 0.2 and 0.5 DPD in November, December and January, but low detection rates in summer at station 8009, close to the pre-investigation area. At station 8010 within the EIB pre-investigation area highest detections were found during the summer months, with between 0.2 and 0.9 DPD between July and September 2018 (Figure 4-26).

The German national acoustic monitoring next to the pre-investigation area found lowest detection rates at the station closest to the pre-investigation (G25) area with a maximum of between 0.2 and 0.3 DPD in July, a lower peak between August and October and detection rates mostly below 0.1 DPD/month during other times. Acoustic monitoring at two C-POD-station during an offshore windfarm project also found lower detection rates at the station closest to the pre-investigation area than at a station further south.

HARBOUR PORPOISE IMPORTANCE MAP

In a recent HOLAS III report (Sveegaard et al. 2022), data from porpoise telemetry in the Belt Sea, SCANS, SAMBAH and other national data were revisited with the aim to create a map showing the importance of areas in the Baltic Sea for harbour porpoises. Since the Baltic Proper population only consists of about 500 individuals it was not possible just to create such importance maps, solely based on density estimates maps. Therefore, the map was created in two steps: First, the importance was estimated separately for the Belt Sea population. Afterwards, a second map was prepared only considering the Baltic Proper population of harbour porpoises. Finally, both maps were merged into a single one, illustrating the importance of areas in the Baltic Sea for both the Belt Sea population and for the Baltic Proper population of harbour porpoises.

Importance of areas in the Baltic Sea for the Belt Sea population was estimated using telemetry data from 2007-2021, separately for summer and winter. With the Kernel Density tool in ArcGIS, contour lines (called isopleths) were created that encompassed 10, 50, 75 % and 100 % of harbour porpoise locations. The 50 % isopleth was then used to identify areas of high importance, the 75 % isopleth areas of medium importance, and areas outside these were categorized as being of lower importance. Then seasonal maps were merged, and this map was then compared with data from SCANS III (Lacey et al. 2022), the Belt Sea density surface model (period 2002-2016, ITAW / unpublished) and MiniSCANS II (Unger et al. 2021), after which some areas of importance were added to the map in the Kattegat and Little Belt/ Kiel Bight, giving the map shown in Figure 4-33.

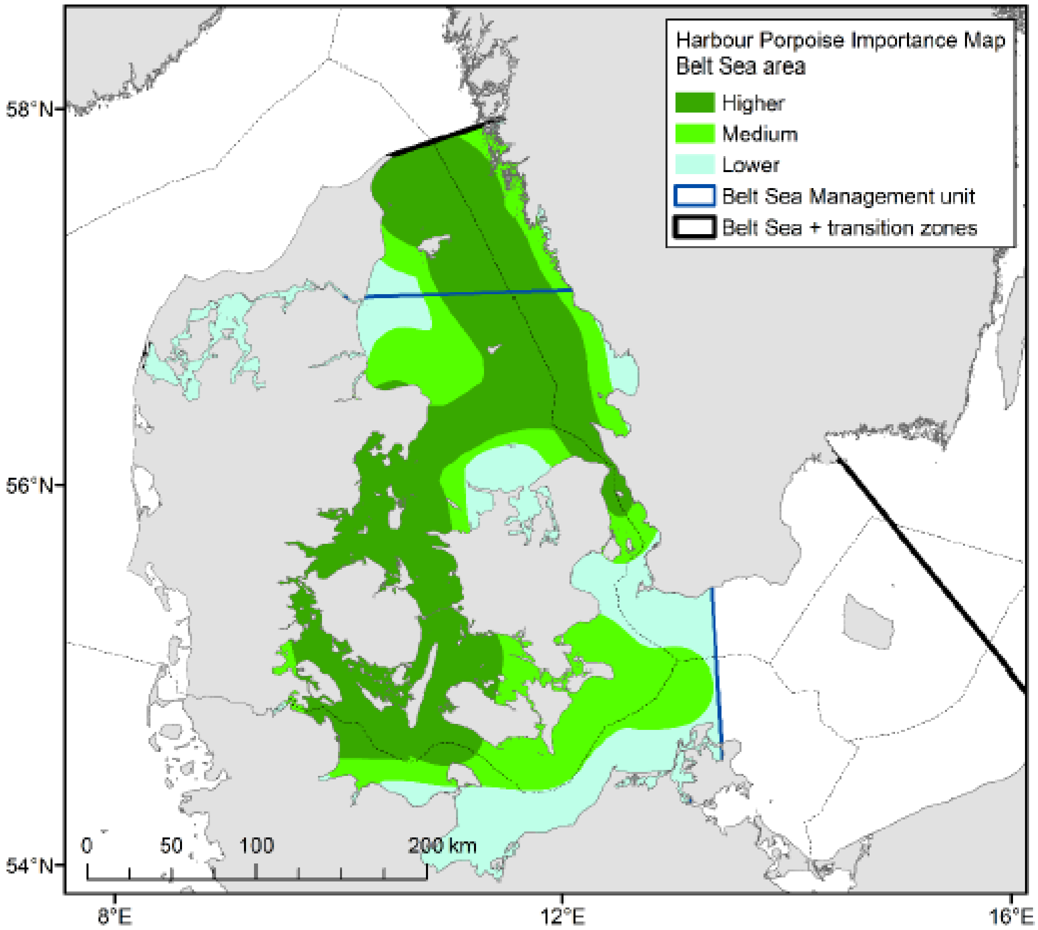

Figure 4-33. Map of the importance of different areas for the Belt Sea population of harbour porpoises. From: Sveegaard et al. (2022).

The importance map for the Baltic Proper population was based on probability of detection from SAMBAH, also first created separately for winter and summer and then merged. Areas of ≥ 20 % probability of detection were chosen to represent areas of higher importance, and areas between 10 % - 20 % of probability of detection were chosen to present areas of medium importance. A convex hull (smallest polygon containing all the 20 % (and then 10 %) detection probability areas was drawn to present the area of higher (≥ 20 %) and medium (10-20 %) importance for harbour porpoises of the Baltic Proper population. An area of high importance was added in Polish waters based on assessment of local PAM data and also an area of medium importance was added in Finnish waters, where national monitoring data indicated regular presence of harbour porpoises. Furthermore, information was added showing in what areas data are deficient, because no or only very little monitoring took place, giving the map shown in Figure 4-34. Note the summer and winter management borders that are also included in Figure 4-34.

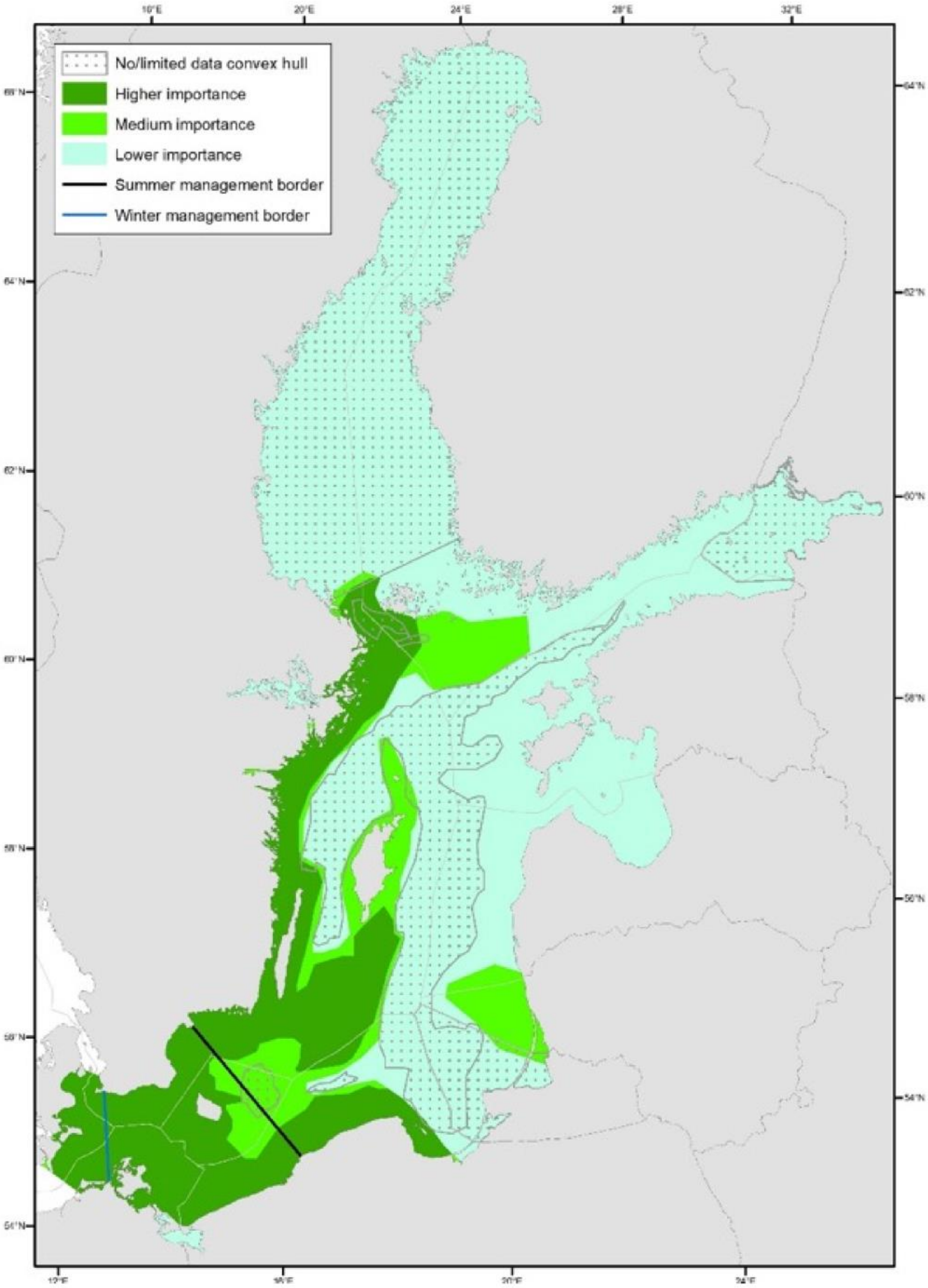

Figure 4-34. Map of the importance of different areas for the Baltic Proper population of harbour porpoises. From: Sveegaard et al. (2022).

These two maps were finally joined to gain one harbour porpoise importance map for the Baltic Sea, which is shown in Figure 4-35.

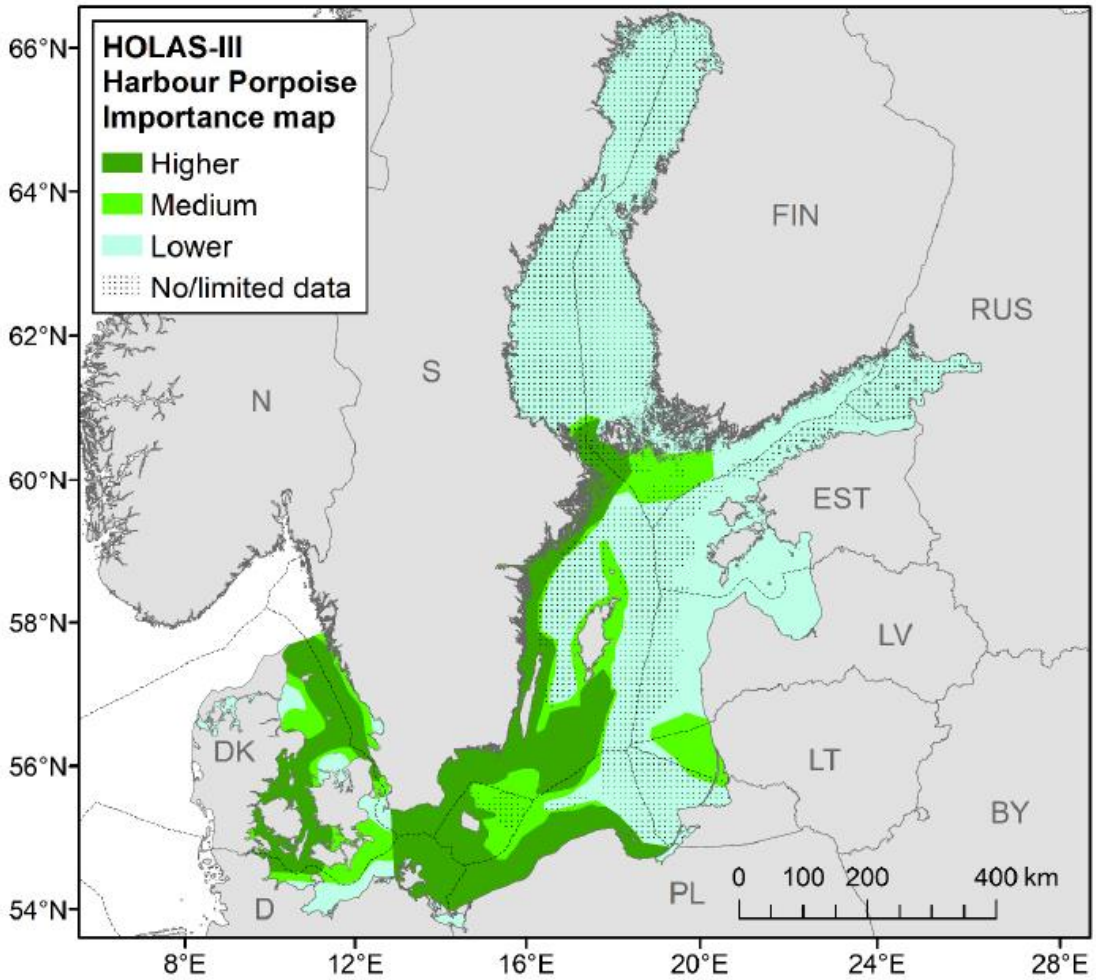

Figure 4-35. HOLAS III map of importance for harbour porpoises within the HELCOM area. From: Sveegaard et al. (2022).

5 SURVEY DATA

The purpose of this study was to determine the abundance, spatial distribution and habitat usage of marine mammals (seals and whales) within the aerial survey area in order to gain a better understanding of the importance of the pre-investigation area for these species groups. Therefore a passive acoustic monitoring for harbour porpoises (Table 5-2) and 17 digital survey flights were carried out during an almost two-year study period (Table 5-1, Figure 5-1).

Table 5-1. Sightings of marine mammals by aerial HiDef-Video surveys within the pre-investigation area. Both harbour seal and grey seal are summarised under the term "Seal" with specification of species when possible. Not identified marine mammals are summarized under the term "Marine Mammal". For harbour porpoises, it is possible to correct sightings for all submerged and therefore not visible individuals (Teilmann et al. 2013) in order to obtain density values based on the total number of individuals in the entire aerial survey area [Ind./km²]. Such a correction is not available for seals. Therefore, only the number of emerged individuals per km² is given. Submerged seals are not considered here.

Survey	Harbour porpoise	Density [Ind./km²]	Seal	Density [Ind./km²]	Marine mammal	Density [Ind./km²]
27.11.2021	0	0	0		1	0.0032
19.12.2021	0	0	1 (Harb. seal)	0.0032	0	0
10.01.2022	0	0	0	0	0	0
07.02.2022	0	0	0	0	0	0
01.03.2022	0	0	0	0	0	0
11.04.2022	0	0	3	0.0095	0	0
17.06.2022	0	0	0	0	0	0
11.07.2022	0	0	0	0	0	0
03.08.2022	5	0.030	1 (Grey Seal)	0.0031	1	0.0031
09.10.2022	0	0	0	0	0	0
14.12.2022	0	0	0	0	0	0
28.01.2023	0	0	0	0	0	0
22.02.2023	0	0	0	0	0	0
12.03.2023	0	0	1 (Harb. seal)	0.0031	0	0
09.05.2023	0	0	1	0.0031	0	0
04.06.2023	0	0	3	0.0092	1	0.0031
08.09.2023	13	0.090	3 (1 Grey Seal)	0.0092	3	0.0094
Total	**18**		**13**		**6**	

Regarding the performed survey flights a total flight distance of 9,921 km and a corresponding total area of 5,391 km² was surveyed by method. In total 37 marine mammals (13 seals including 2 harbour seals and 2 grey seals, 18 harbour porpoises and 6 unidentified marine mammals) were detected within the pre-investigation area by these surveys (Table 5-1, Figure 5-1).

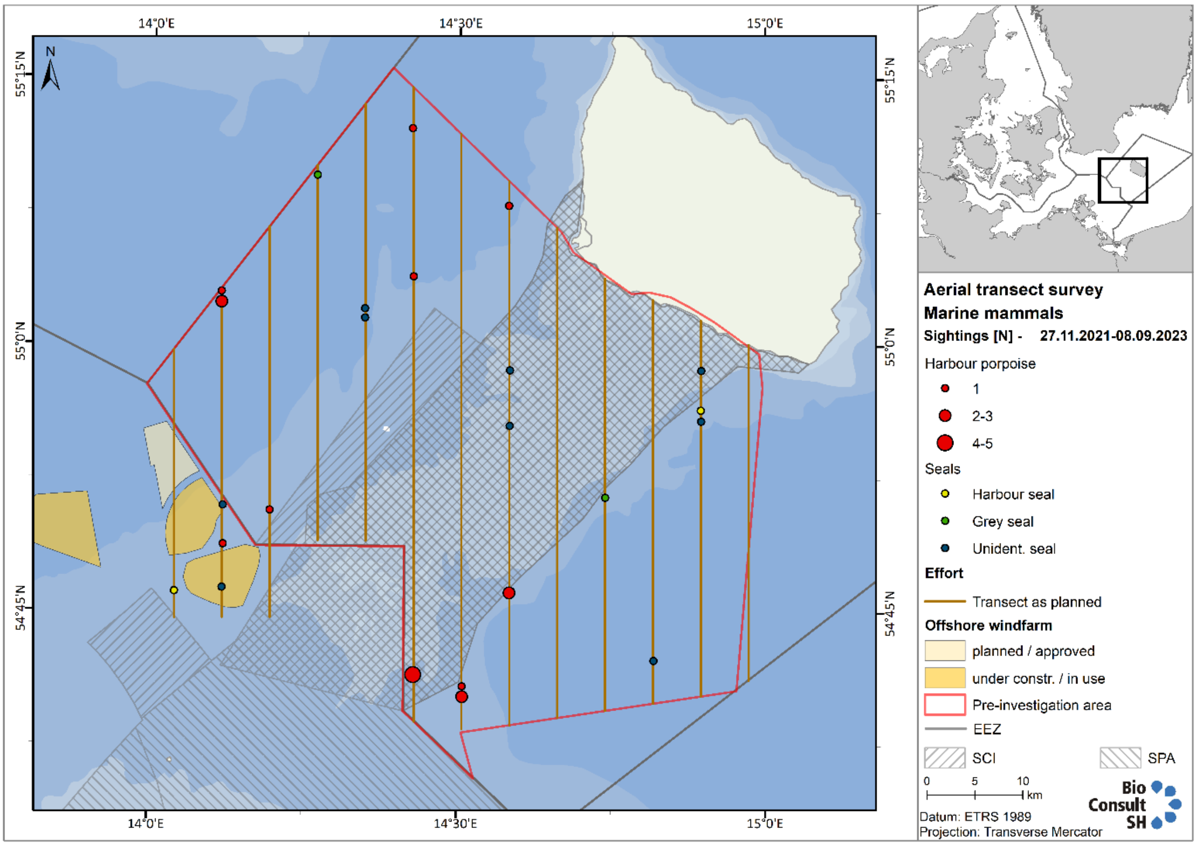

Figure 5-1. Sightings of all marine mammals by aerial transect surveys within the aerial survey area and the pre-investigation area of EIB.

Furthermore, a passive acoustic monitoring with a total of 15 C-POD stations was carried out to determine the habitat usage of the area by harbour porpoises. C-PODs are able to detect and record only click signals from harbour porpoises, that are regularly emitted for orientation or communication with each other. For details on importance of this type of orientation for harbour porpoises and the functionality of C-PODs, see section "Passive Acoustic Monitoring". However, it is important to keep in mind that C-PODs cannot record any kind of seal activities. Therefore, no conclusions can be drawn from C-POD data about the presence, activities or behavior of this species group.

Table 5-2 gives an overview of the outcome of the passive acoustic monitoring conducted within the pre-investigation area. It shows the respective percentage detection rates for all C-POD stations averaged over the entire study period. By DPD/month, DPH/d and DP10M/d, three different detection parameters are provided. Since the values of the parameters DPH/d and DP10M/d, both calculated on a daily basis (Section ”Data analysis”), are very low and thus offer only a limited opportunity to represent differences between stations, the parameter DPD/month is considered as a more suitable parameter to measure the habitat use of harbour porpoises in the pre-investigation area.

Table 5-2. Mean monthly percentage detection rates (DPD/month, mean DPH/d and mean DP10M/d) over the whole investigation period at all measuring stations for the passive acoustic monitoring of harbour porpoises. Mean percentage DPH/d and mean DP10M/d were calculated over all available recording days.

C-POD	EI 01	EI 02	EI 03	EI 04	EI 05	EI 06	EI 07	EI 08	EI 09	EI 10	EI 11	EI 12	EI 13	EI 14	EI 15
DPD/ month	17.0	30.5	31.9	31.0	8.5	14.4	3.9	22.0	16.2	4.4	11.8	11.4	25.0	15.7	16.3
DPH/d	1.0	6.2	4.9	4.9	0.4	0.8	0.2	2.3	1.0	0.3	0.9	0.9	3.7	2.0	1.8
DP10M/d	0.2	2.0	1.3	1.2	0.1	0.2	0.0	0.5	0.2	0.0	0.2	0.3	1.1	0.6	0.5

According to Table 5-2, the mean values for DPD/month vary among the station from 3.9 DPD/month at station EI_07 to 31.9 DPD/month at station EI_03. The mean value for all stations within the pre-investigation area and for the entire pre-investigation period is 17.3 DPD/month. For all stations, this means that on average on 17.3 % of all survey days at least one signal and thus the presence of at least one harbour porpoise was detected. Further details on harbour porpoises and seals (harbour seals and grey seals) within the pre-investigation area are described in the following.

5.1 SEALS

A total of 13 seals were sighted during the preliminary survey. 9 of these sighted seals could not be identified to species level. The number of sightings of seals not identified to species level is therefore greater than the number of harbour seals and grey seals identified. This can be taken as an indication that it is difficult to differentiate between these two species from the air. The probability that the seals that cannot be identified in more detail are primarily grey seals appears to be greater, as this species uses the closer resting areas (Rügen) and generally travels further distances from its resting areas. On the other hand, the balanced ratio of identified harbour seals to grey seals suggests an equal distribution of individuals of both species in the aerial survey area.

The maximum density was recorded on the 11th of April 2022 with 0.0095 individuals per km² and on the 4th of June 2023 with 0.0092 individuals per km² (Table 5-3). Otherwise, seals (including harbour seals and grey seals) were recorded in the aerial survey area throughout the year. It has to be stated, that a general correction procedure for submerged seals as (Teilmann et al. 2013) provides one for harbour porpoises is not available.

Therefore, only density values for emerged individuals per km² can be provided. Submerged seals were not considered.

The sightings of seals extended over the entire aerial survey area (Figure 5-2). Seals can be found both in the shallow water areas of the protected areas in the centre of the aerial survey area, and outside these areas. There was no evidence of avoidance or a preference for certain areas in the aerial survey area, which in the second case could indicate a special type of utilisation by this species group. One animal was also sighted outside the pre-investigation area within the German Arkona wind farm and another animal directly on the eastern boundary of the Wikinger wind farm (within the aerial survey area).

Table 5-3: Sightings of seals by aerial HiDef-Video surveys within the pre-investigation area. The term "Seal" summarizes all sightings of seals that could not specified on species level. A correction for submerged seals as (Teilmann et al. 2013) provides one for harbour porpoises is not available. Therefore, only densities of emerged individuals per km² is given. Submerged seals could not be considered.

Survey	Seal	Density [Ind./km²]	Harbour Seal	Density [Ind./km²]	Grey seal	Density [Ind./km²]
27.11.2021	0	0	0	0	0	0
19.12.2021	0	0	1	0.0032	0	0
10.01.2022	0	0	0	0	0	0
07.02.2022	0	0	0	0	0	0
01.03.2022	0	0	0	0	0	0
11.04.2022	3	0.0095	0	0	0	0
17.06.2022	0	0	0	0	0	0
11.07.2022	0	0	0	0	0	0
03.08.2022	0	0	0	0	1	0.0031
09.10.2022	0	0	0	0	0	0
14.12.2022	0	0	0	0	0	0
28.01.2023	0	0	0	0	0	0
22.02.2023	0	0	0	0	0	0
12.03.2023	0	0	1	0.0031	0	0
09.05.2023	1	0.0031	0	0	0	0
04.06.2023	3	0.0092	0	0	0	0
08.09.2023	2	0.0062	0	0	1	0.0031
Total	**9**		**2**		**2**	

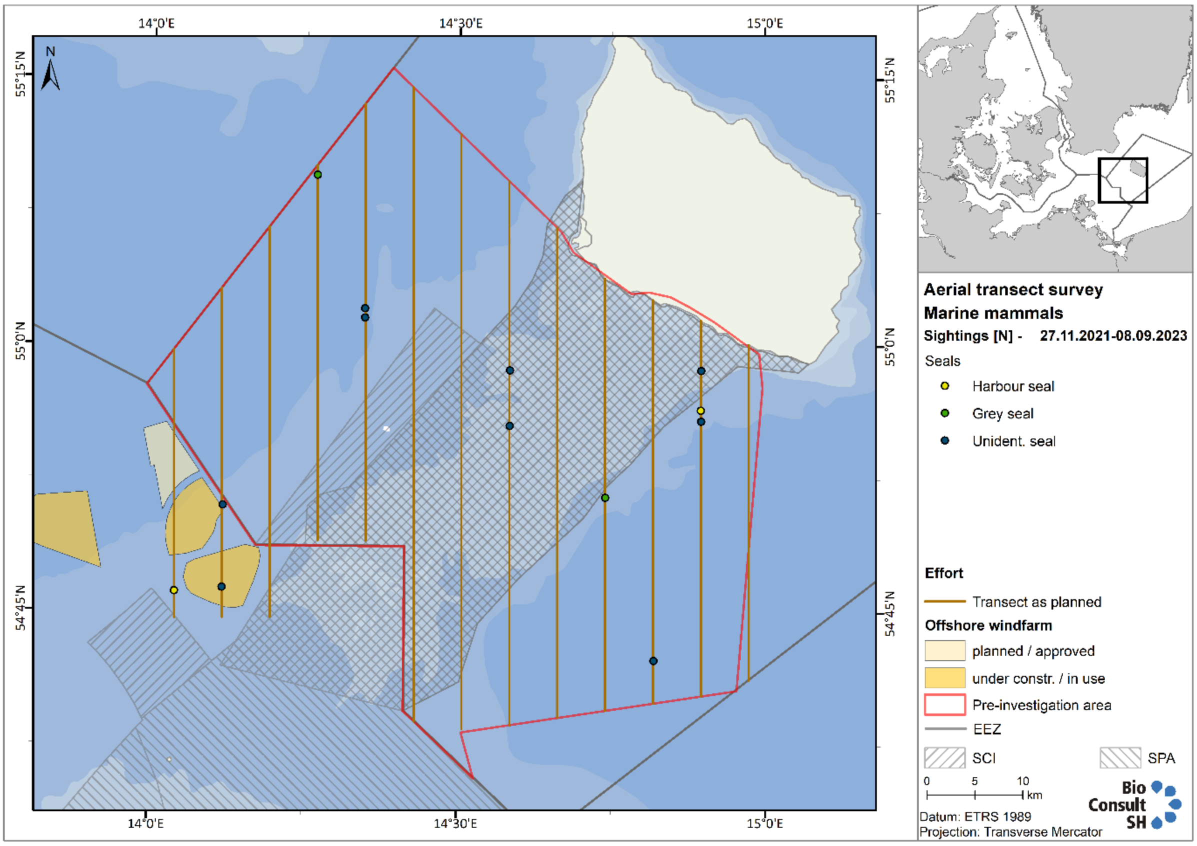

Figure 5-2. Sightings of all seals by aerial transect surveys within the aerial survey area and the pre-investigation area of EIB.

Harbour seals: With only two flights, harbour seals were detected within the pre-investigation area (Figure 5-2). One seal was sighted on the 19th of December 2021 at the north-eastern edge (Figure 5-2, yellow dots) of the pre-investigation area near the Bornholm coastline. The second one was sighted on 12th ofMarch 2023 outside the pre-investigation area on the western border of the German OWF Arkona. For both survey flights, this number of sightings corresponds to a harbour seal density of 0.003 Ind./ km² (Table 5-3). Compared to sea areas of the southwestern Baltic Sea, for example compared to the Fehmernbelt (FEMO 2023), these are very low densities. In autumn and spring the corresponding values for the Fehmernbelt are about 10 times higher.

Grey seals: Grey seals were also sighted on only two flights. One individual was counted in the pre-investigation area on the 3rd of August 2022 and a second one on the 8th of September 2023. For both survey flights, this number of sightings corresponds to a density of 0.003 Ind./ km (Table 5-3). These values are comparable to grey seal densities in the Fehmernbelt (FEMO 2023). On the 3rd of August 2022, the sighting occurred on the 4th. transect line in the far north near the border of the Swedish EEZ (Figure 5-2, green dots). The second sighting was made halfway on transect line no. 9.

5.2 HARBOUR PORPOISES

5.2.1 AERIAL SURVEYS

According to these aerial survey data the harbour porpoise is the most common marine mammal species within the pre-investigation area. In total, 18 individual sightings were noted by these surveys. Nevertheless, at only two flights harbour porpoises could be detected from digital aerial footage. On the 11th of August 2022, 5 individuals, corresponding to a density of 0.03 individual per km² (Table 5-4), and on the 8th of September 2023, another 13 individuals, corresponding to a density of 0.91 individual per km² (Table 5-4), occurred in the aerial survey area. Calves of harbour porpoises were not observed.

Table 5-4. Harbour porpoises observed within the investigation area by HiDef Video-Surveys.

Month	Effort [km²]	Harbour porpoise [Ind.]	Density [Ind./km²]
03.08.2022	318.9	5	0.030
08.09.2023	319.0	13	0.091

On the 3rd of August 2022, all 5 harbour porpoises were detected in the northwestern part of the pre-investigation area (Table 5-4). Also on the 8th of September 2023, 2 of the 13 sightings were made in the northern part of the aerial survey area (Table 5-4). The rest of them were all detected in the southeastern part of the pre-investigation area. Only 5 of these harbour porpoises were detected inside the Natura 2000 site “Adler Grund og Rønne Banke” (N252). All other detections were made outside of any designated protection areas. One of the sightings occurred outside the pre-investigation but inside the easterly edge between the two German OWP “Arkona” and “Wikinger”.

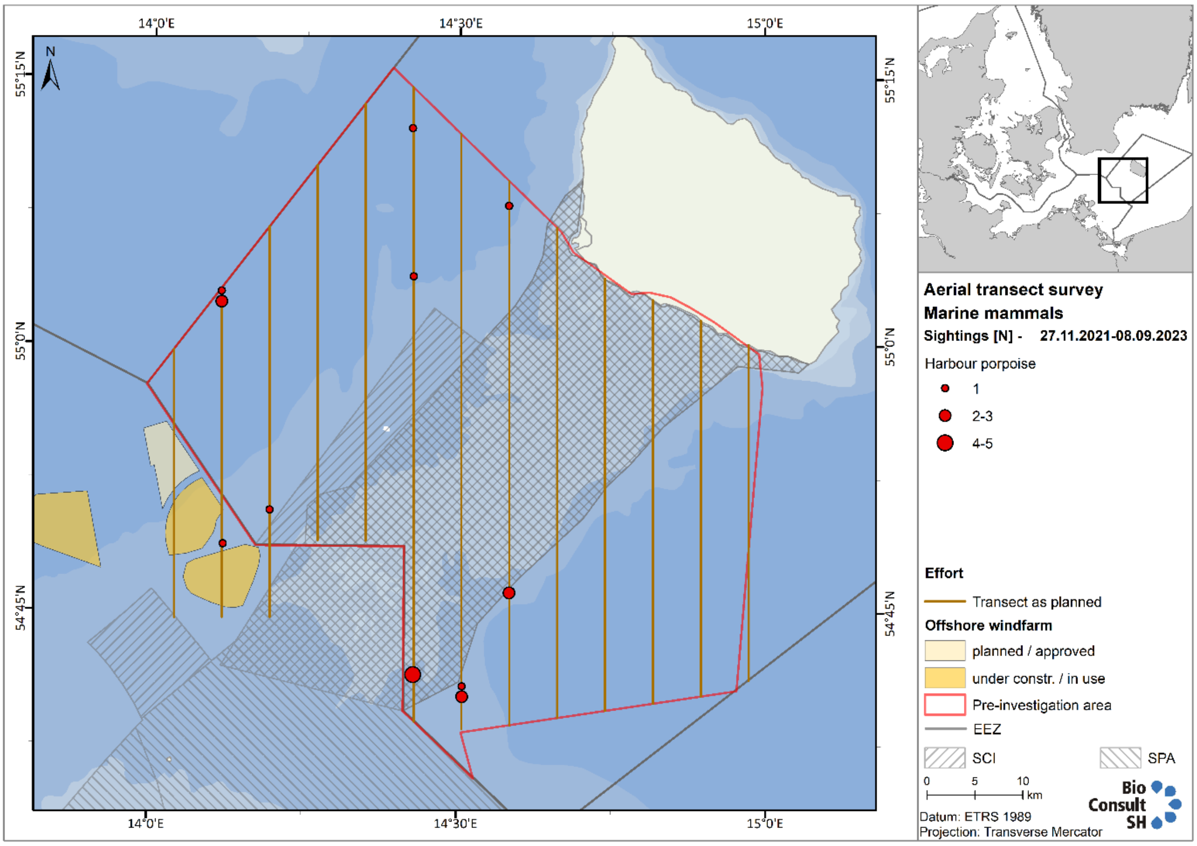

Figure 5-3. Harbour porpoise sightings by HiDef within the aerial survey area and the pre-investigation area of EIB. Sightings were made on 3.8.2022 and on 8.9.2023.

Again, compared to the Fehmernbelt (FEMO 2023), the calculated densities (Table 5-4) for the present study, are 10 times lower and thus very low. However, compared to studies conducted in more adjacent areas, such as for the German planning area O-1.3 (IBL Umweltplanung GmbH 2020), these results appear to realistically reflect the local abundance and distribution of harbour porpoises. Furthermore, it has to be pronounced that all sightings shown in Table 5-4 occurred in the summer seasons of 2022 and 2023. There were not any detections during the winter periods.

5.2.2 PASSIVE ACOUSTIC MONITORING

In addition to the aerial surveys, a passive acoustic monitoring was carried out within the pre-investigation area to determine the local habitat usage of harbour porpoises. While aerial surveys only provide a kind of snapshot of the abundance and spatial distribution of species within the aerial survey area, the use of C-PODs offers the opportunity to continuously monitor such an area for the presence of harbour porpoises. By combining several C-PODs at different positions within a pre-investigation area, such monitoring even offers the possibility of using the C-POD data to determine the time- or season-dependent spatial distribution of harbour porpoises in the area, as done for instance by the SAMBAH project (SAMBAH 2016).

The passive acoustic monitoring for harbour porpoises within the pre-investigation area lasted 23 months. As already mentioned, the mean value of the monthly percentage detection rates across all stations in the pre-investigation area was 17.33 DPD/month (Figure 5-4), which is comparable with the results of the German monitoring for planning area O-1. 3 (IBL Umweltplanung GmbH 2020) and the directly neighbouring stations of the German national monitoring for the Baltic Sea (Gallus & Benke 2014), Figure 4-28), but is quite low when compared to the German monitoring stations west of Rügen (Gallus & Benke 2014) or compared to stations in other Danish waters (FEMO 2023) in the Baltic Sea.

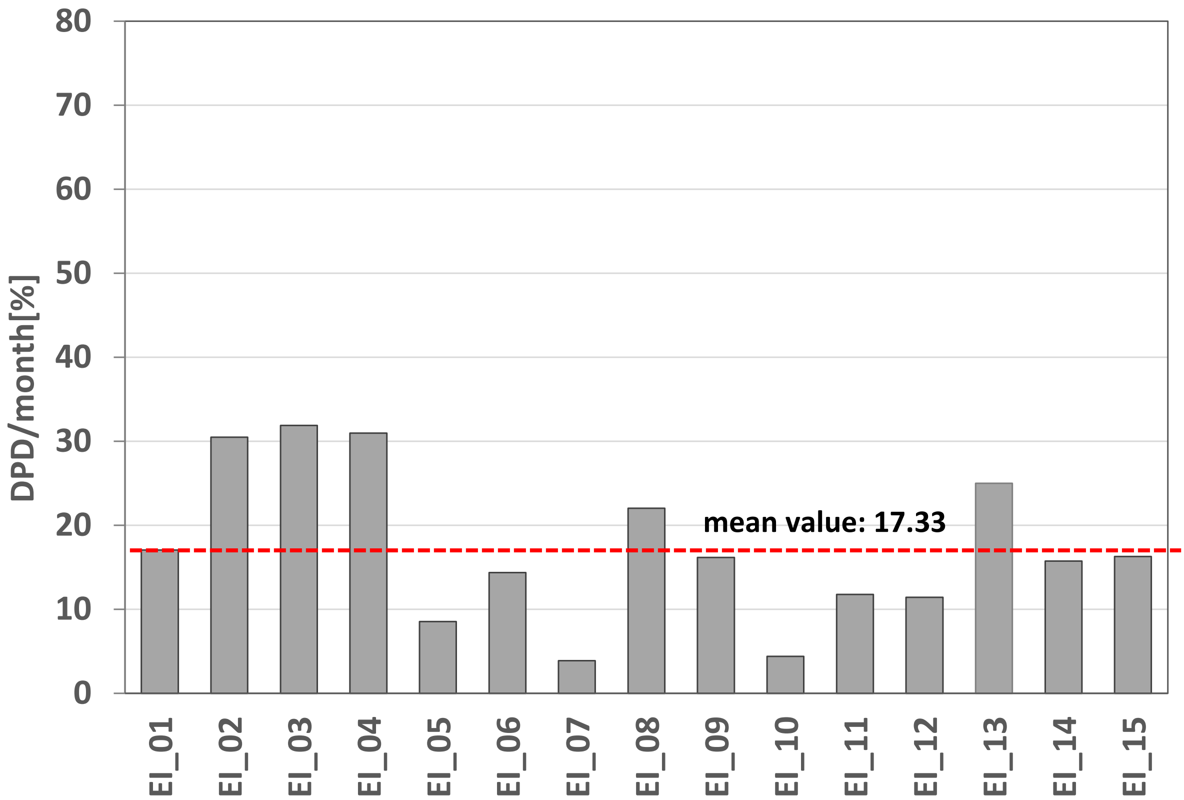

Figure 5-4. Mean detection rates of harbour porpoise signals from the passive acoustic monitoring survey conducted in November 2021 to October 2023. Detection rates are expressed as % detection positive days per month (DPD/month) for each of the individual deployed C-POD stations EI_01-EI_15. Location of the C-POD stations is shown in Figure 5-5. The red dashed line shows the mean value across all stations.

Nevertheless, there are considerable differences in the detection rates between the seasons and among the various stations (Figure 5-4). Regarding the single stations, the mean of the monthly detection rates over the entire study period varies between 3.88 DPD/t at station EI_07 and 31.88 DPD/t at station EI_03 (Table 5-2). Since the values of the parameters DPH/d and DP10M/d, both calculated on a daily basis (Section “Data analysis”), are very low (Table 5-2) and thus offer only a limited opportunity to represent differences between stations, the parameter DPD/month is considered as the more suitable parameter to measure the habitat use of harbour porpoises in the pre-investigation area.

The highest rates of more than 30 DPD/month occurred at stations EI_02, EI_03 and EI_04, which were all deployed in the north-western part of the pre-investigation area, north-west from the Natura 2000 site "Adler Grund og Rønne Banke" (N252; Figure 5-4 and Figure 5-5). In contrast, the values at the stations EI_11, EI_12, EI_14, EI_15 in the south-eastern part of the pre-investigation area, and southeast from the Natura 2000 site "Adler Grund og Rønne Banke" (N252) were markedly lower, but still above 10 DPD/month. These detection rates ranged between 11.4 DPD/month at station EI_12 and 16.3 DPD/month at station EI_15. To the south-east of the protected area, only station EI_13 recorded detection rates comparable to those at the north-western stations, with values of around 25 DPD/month.

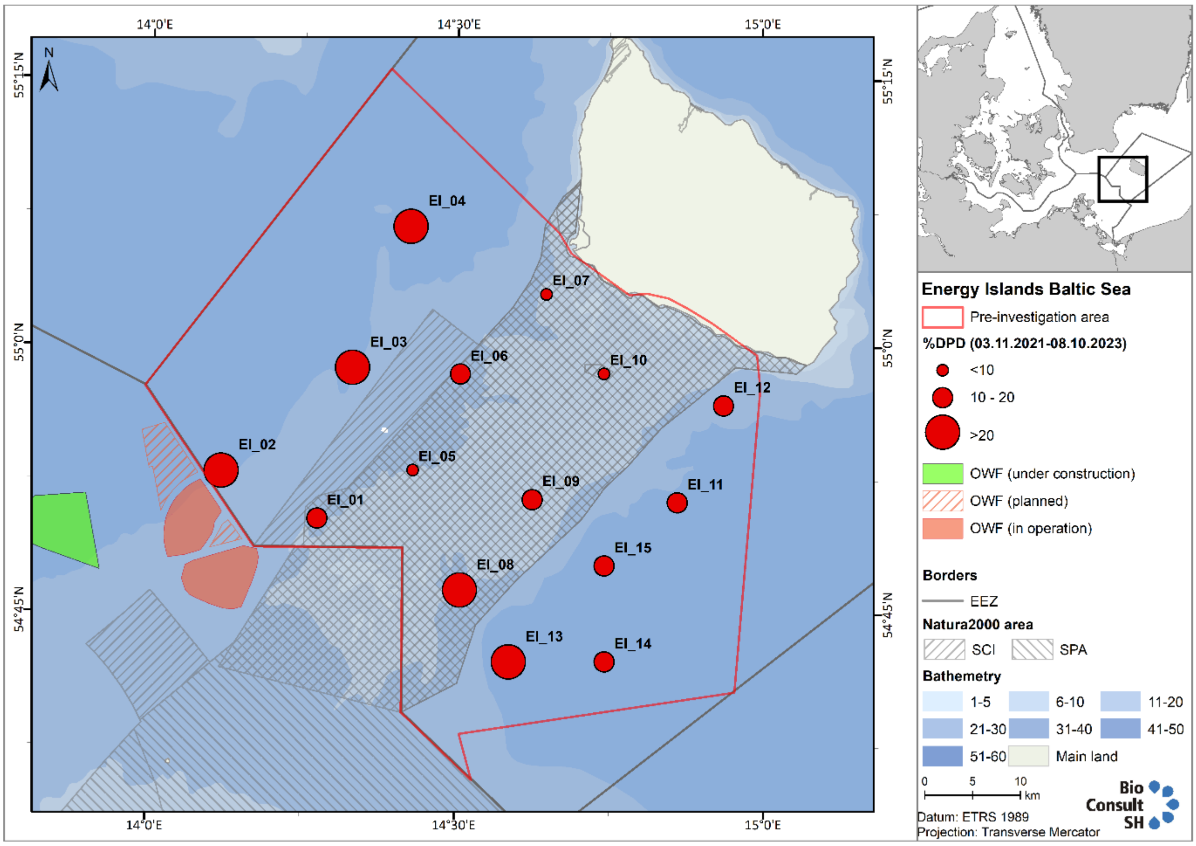

Figure 5-5. Location of the C-POD stations EI_01 to EI_15 and mean monthly detection rates (DPD/month).

The signals recorded at EI_01, EI_05, EI_06, EI_07, EI_08, EI_09, EI_10 are comparable to or a bit fewer than the signals from the stations in the southeast. The stations were all deployed inside the Natura 2000 site "Adler Grund og Rønne Banke" (N252). The mean detection rate at these stations was 12.3 DPD/month, ranging from 4.4 DPD/month at EI_10 to 22.0 DPD/month at EI_08.

The results indicate a different utilisation at the various stations by harbour porpoises. The stations in the north-west EI_02, EI_03 and EI_04 (Figure 5-5) noted more frequent harbour porpoise than the other stations in the pre-investigation area. The reason for these differences in utilisation is unclear. But it is possible that different water depths are responsible for this phenomenon. A relation between the detection rates and water depth can be seen in figure 8-1 for both summer and winter (see Figure 8-1 in the Appendix). However, the correlation, which can particularly be assumed for the summer season, was not statistically tested. But even if these rates indicate differences between the stations, the rates also indicate a comparatively general low utilisation of the entire pre-investigation area.

But despite these generally low rates in the area, it is necessary to consider these data in relation to different seasons. Therefore, the mean value of the percentage detection day rates per month (DPD/month) for each station was calculated separately for winter and summer (Figure 5-6, top and bottom).

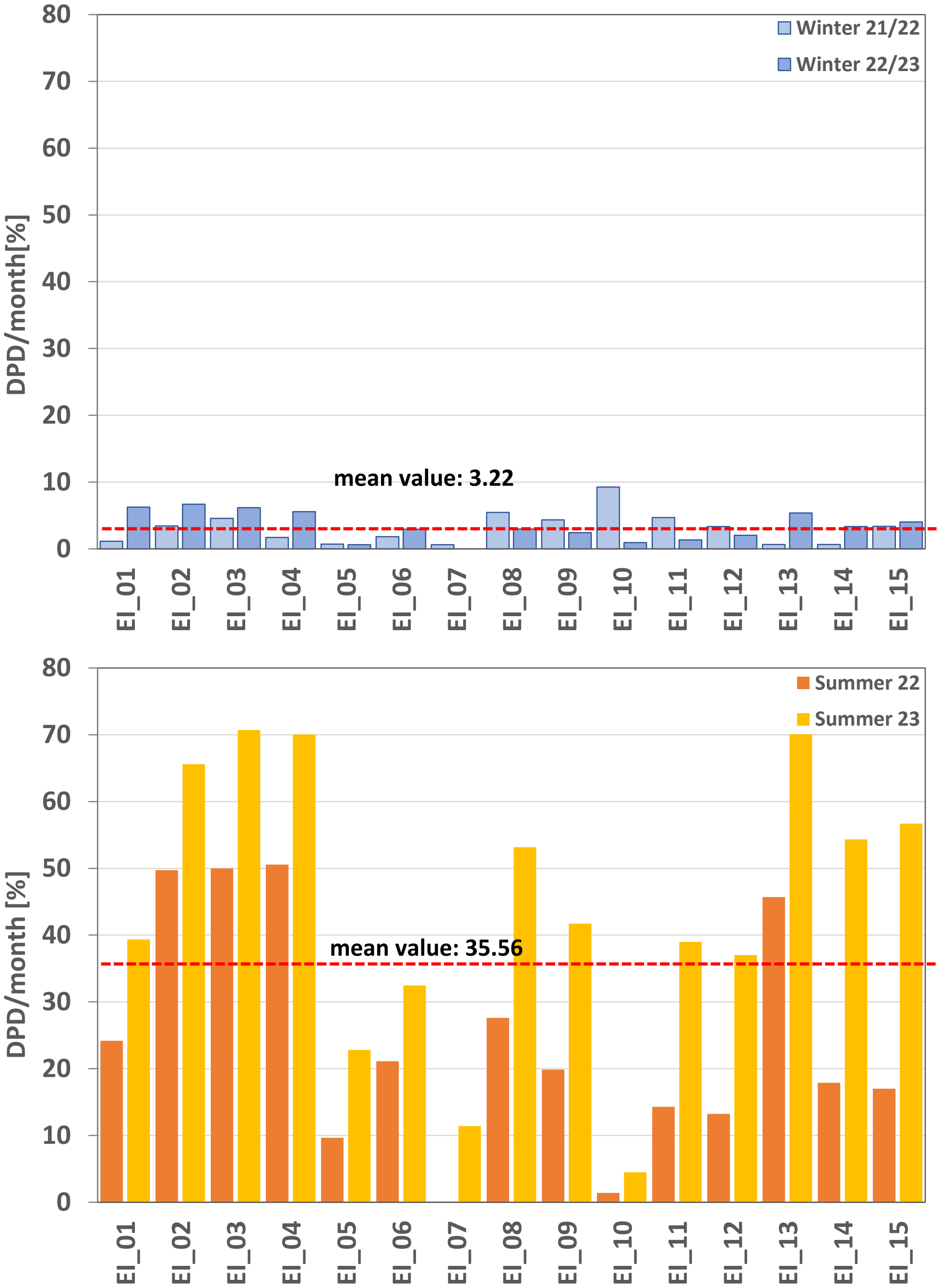

Figure 5-6. Mean monthly detection rates (DPD/month) at the passive acoustic monitoring stations for harbour porpoises for both winter periods (top) and for both summer periods (bottom). The red dashed lines show the mean values across all stations for the respective monitoring period.

Figure 5-6 clearly shows that in summer (May to October), significantly higher detection rates are recorded than in winter (November to April). The mean detection rate calculated for both winters (November to April) together, is only slightly above 3 DPD [%] for all stations. During the winter months, no station recorded rates of more than 10 DPD [%]. In the summer months (May to October), however, the average detection rate (DPD) is over 35 DPD [%] and thus significantly higher than the winter detection rate.

The highest seasonal mean values of around 70 DPD/t were recorded for stations EI_03, EI_04 and EI_13 in summer 2023. The lowest seasonal mean values were noted in summer 2022 at stations EI_07 and EI_10 with less than 2 DPD/month each. This means that the differences between the seasons do not occur to the same extent at all stations. Rather, some stations in the pre-investigation area are preferred, while other few stations consistently receive little attention from harbour porpoises. In addition, the results show that despite their comparatively low presence in the pre-investigtion area throughout the year, harbour porpoises occur with a relevant frequency at several C-POD stations during summer.

To describe the monthly and thus also the seasonal occurrence of harbour porpoises at all stations more precisely, the percentage daily rate per month (DPD/month) determined at the stations, were plotted along a time axis for the entire pre-investigation period (Figure 5-7, top and bottom and Figure 8-2 in the Appendix). The percentage daily rates per month (DPD/month) across all 15 C-POD stations show a general pattern over the entire pre-investigation. Since this general pattern is identical at all stations, it is described below as an example for just a few stations using illustrations (Figure 5-7). The illustrations not shown here can be found in the appendix (Figure 8-2).

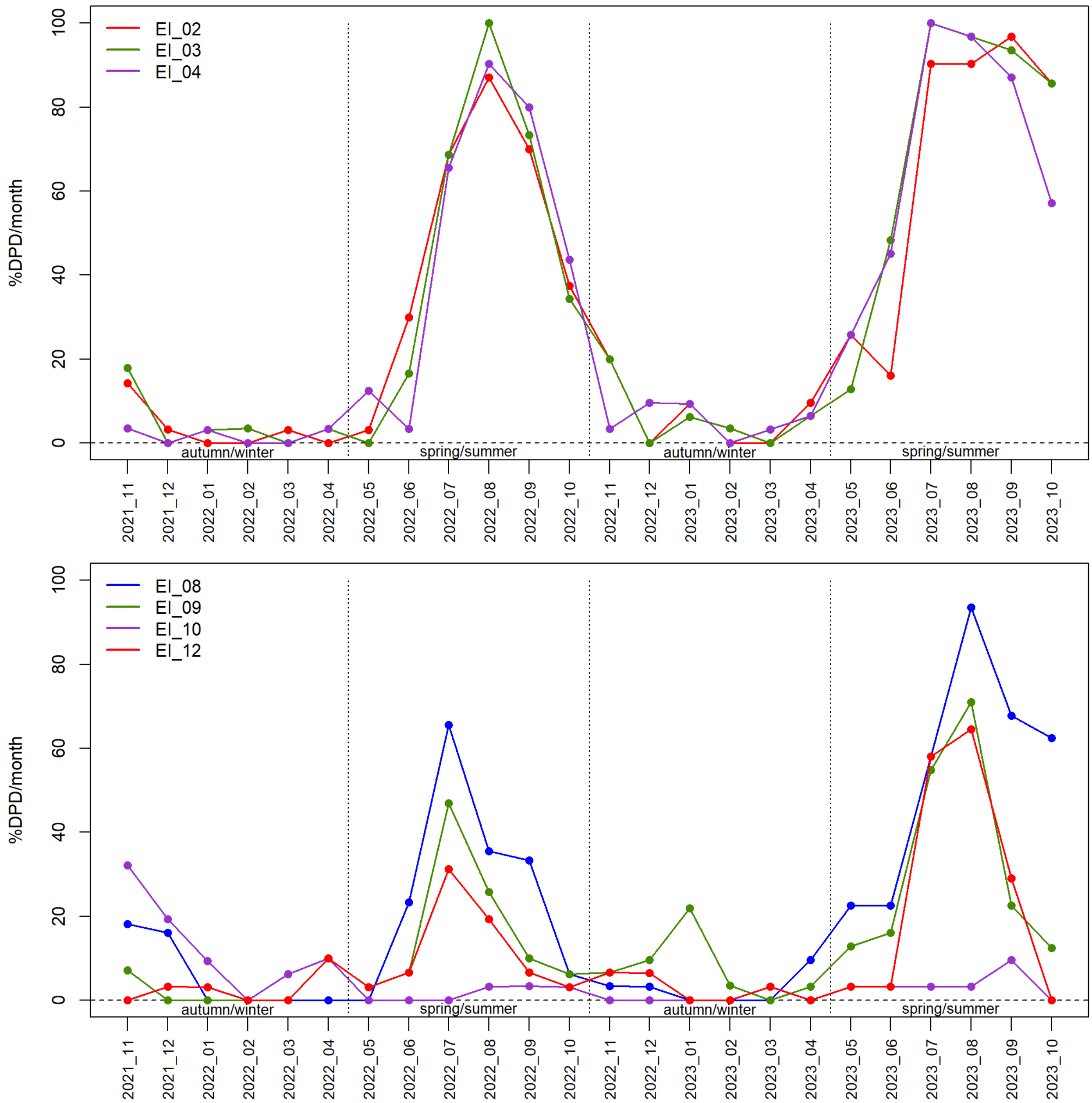

Figure 5-7. Percentage detection day rates per month (DPD/month) at the monitoring stations EI_02, EI_03, EI_04 (top) and for Ei_08, EI_09, EI_10, EI_12 (bottom) for the entire monitoring period. All stations were equipped with one C-POD.

The maximum detection rates occurred between June and September in both years but differed slightly between single C-POD stations (Figure 5-6, Figure 5-7). In both winter periods, the average detection rates (DPD/month) stayed below 10 % DPD at the monitoring stations. But even from November to April, signals from harbour porpoises were recorded at many stations. However, the detection rates (DPD/month) started increasing markedly in May reaching a maximum of 100 % DPD in July and August 2022 and in August and September

2023 (Figure 5-7), which corresponds to at least one porpoise detection every day of the month. The maximum rates were determined for station EI_04 in July 2023 (Figure 5-7) and for station EI_14 in August 2023 (Figure 8-2 in Appendix). From November onwards, the number of detections steadily decreased again, reaching a minimum between January and March in both years. In January 2023, minor detection rates of up to around 10 DPD/month occurred at some stations, for instance at EI_02, EI_03 and EI_04. These detections occurred during a period of the year when the presence of animals from the Baltic Proper population is generally possible in the area.

Remarkable is a detection rate found at station EI_09, also in January 2023, where an unusual high detection rate of just over 20 DPD/month was determined. However, when examining the raw data used for the calculation, it was found that in January, only 9 examination days instead of 28 could be included in the calculation due to a lot of background noise at this station. The determined rate is therefore subject to a certain degree of uncertainty due to the small number of examination days considered.

Overall, the quite low detection rates (%DPD) at the 15 stations indicate a general low habitat usage of the pre-investigation area. Harbour porpoises were detected on only 17.3 % of the approximately 10,000 days surveyed (365 days x 2 years x 15 stations). This suggests a low presence of harbour porpoises in the pre-investigation area. Nevertheless, a typical seasonal pattern in the occurrence of harbour porpoises was noted in the pre-investigation area: While only very few animals are detected in these waters during the winter months, harbour porpoises can be found almost daily in the northern deep-water zones during the summer from July to September. Additionally, it can be deduced from these data that a few porpoises are still present in the area in winter and thus, the presence of few individuals of the Baltic Proper cannot be excluded.

6 CONCLUSION

This report summarises the results of the two-year baseline study on marine mammals within the EIB pre-investigation area and compares them with data, results and conclusions from literature relevant to describe the status of the marine mammal species in and around the pre-investigation area. The pre-investigation area includes two planning sites for offshore wind farms (Bornholm I and Bornholm II), the Natura 2000 area "Adler Grund og Rønne Banke" (N252), habitat areas (H261, H212, H211) and the bird protection area (Rønne Banke F129) within the Natura 2000 area N252.

Three different marine mammals regularly occur within this pre-investigation area. These are the harbour seal, the grey seal and, as the only cetacean species usually occurring in the Baltic Sea, the harbour porpoise.

Harbour seals: The closest harbour seal haul-out is located at a distance of about 100 km from the pre-investigation area. Since telemetry studies have shown that harbour seals rarely make foraging trips further than 50 km away from haul-out sites, it is unlikely that the pre-investigation area is used intensively as a foraging ground by harbour seals from either the Western Baltic Sea population (nearest haul-out at about 100 km distance) or the Baltic Proper population (next haul-out at about 150 km distance). Furthermore, the tracked animals from the nearest haul-out at Måkläppen never came near the EIB pre-investigation area.

Investigations for marine mammals at the German OWF planning site O-1.3, close to the pre-investigation area, was done both ship-based and with aerial surveys. The results from the ship-based surveys were only one harbour seal (plus 7 grey seals and one unidentified seal). For the aerial surveys only 13 seals were observed during all the 20 aerial surveys, and it was not possible to distinguish between grey seals and harbour seals, thus these animals could not be identified to species level.

The aerial surveys carried out in the EIB aerial survey area also demonstrate a low abundance of harbour seals in the pre-investigation area between November 2021 and September 2023. A total of 13 seals were sighted in the pre-investigation area for all 17 flights, two harbour seals, two grey seals and nine not identifiable seals. These results confirm findings of McConnell et al. (2012) and Dietz et al. (2015) that harbour seals rarely use the pre-investigation area and its surroundings.

A function of the pre-investigation area as a breeding, foraging or feeding area for harbour seals cannot be deduced from the existing literature (see Chapter 3.1) or from the presented survey data. The low number of sightings rather indicates that the area is only occasionally visited or passed through by young migrating harbour seals.

Grey seals: The pre-investigation area is 60 km away from the nearest grey seal haul-out sites on Rügen, which are not regularly used as breeding grounds. More relevant sites, that are commonly used for breeding, are more than 100 km away from the pre-investigation area. Furthermore, data from satellite-tracked grey seals from Rødsand lagoon demonstrate that these animals easily cover distances of more than 850 km and may therefore definitely reach the pre-investigation area (McConnell et al. 2012, Dietz et al. 2015). However, the satellite-tracked grey seals from Rødsand, Måkläppen (Falsterbo) and Ålandsøerne (in total 18 individuals) showed movements which were largely focused on local areas around their haul-out sites (McConnell et al. 2012, Dietz et al. 2015), and the EIB pre-investigation area only seems to be used for travelling through.

Grey seals from local haul-out sites can therefore use the pre-investigation area for foraging or subadults may cross it on their way to distant haul-out sites (McConnell et al. 2012, Dietz et al. 2015). In this baseline investigation, only two grey seals and nine seals that could not be identified to species-level, were noted for all 17 aerial surveys performed within the pre-investigation area. This result indicates a very low abundance of grey seals in the EIB pre-investigation area. The very low sighting rates that were noted in the nearby German OWF planning area O-1.3 (IBL Umweltplanung GmbH 2020) also suggest that very few grey seals occur in this area and underline that the pre-investigation area is not an important habitat for grey seals. It is therefore concluded that the probability of the pre-investigation area being a regularly used foraging area for grey seal is very low.

Harbour porpoise: Two different (sub)populations of harbour porpoise are present in the pre-investigation area: individuals of the Belt Sea population and individuals of the Baltic Proper population. The most recent estimates for the Belt Sea population of harbour porpoises indicate an abundance of 14,403 individuals (Gilles et al. 2023) and comparisons with previous data suggest an annual 4.4 % decline since 2012, although this was not statistically significant. In contrast to this, the highly endangered Baltic Proper population of harbour porpoises is very small and estimated (based on acoustic detections from 2011 - 2013) to consist of about 500 individuals (SAMBAH 2016).

Existing data indicate the presence of harbour porpoise within the pre-investigation area (SAMBAH 2016, Sveegaard 2020, IBL Umweltplanung GmbH 2020), however, with strong seasonal differences, i.e. summer detections likely originate from animals belonging to the Belt Sea population, while winter detections likely stem from both the Belt Sea population and the Baltic Proper population of harbour porpoises (Mikkelsen et al. 2016, SAMBAH 2016, Sveegaard 2020). In general, the harbour porpoise density in the pre-investigation area, even in summer, is very low compared to more western parts of the Baltic Sea.

As few calves earlier has been sighted near the pre-investigation area (IBL Umweltplanung GmbH 2020), it cannot be ruled out that harbour porpoises occasionally also reproduce here. However, as no calves were recorded in the pre-investigation area during this investigation, the presence of females with calves from the Belt Sea population seem to be infrequent.

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Since the pre-investigation area lies within the suggested winter mixing zone of both populations, winter detections around the pre-investigation area could partly stem from individuals belonging to the highly endangered Baltic Proper population. Thus, the area might be relevant as a wintering ground for these rare animals of the Baltic Proper population. Nevertheless, the recently created HOLAS III map on the importance of areas in the Baltic Sea for the Baltic Proper population of harbour porpoises categorises the pre-investigation area as being of higher importance. This categorisation must be attributed to the observation that in winter the pre-investigation area is sporadically but regularly visited by animals of the Baltic Proper population, a population classified as critically endangered (CR) (Carlström et al. 2023), corresponding to the highest threat level (IUCN 2007, Hammond et al. 2008).

Earlier smaller-scale aerial surveys exist only from adjacent German waters (IBL Umweltplanung GmbH 2020). These data indicate a harbour porpoise density between 0.002 and 0.009 ind./km² in spring and summer while no sightings were obtained during the autumn and winter seasons. The aerial surveys within the pre-investigation area conducted for this report (17 in total) show quite similar results to what was described for the adjacent area within German EEZ, with a total of 13 individuals sighted during two flights (August 2022 and September 2023).

Acoustic detections during the present study revealed a distinct seasonal pattern of acoustic harbour porpoise detections at all 15 C-POD-stations. Detections were relatively high during the summer months (especially in July and August, when at some stations up to 100 % DPD per months were recorded), but low during the winter months, when DPD rarely were above 20 % and mostly below 10 %. This seasonal pattern seems to be in line with what was found in the Danish National Monitoring from 2019 at least at one station, where detection rates were also over 80 % in July, while winter detections were lower. However, at another station detections were around 50 % in February, a value never reached at any C-POD-position during the present investigation in winter.

The existing data and the results of the present investigations of harbour porpoises within the pre-investigation area allow for the following conclusions to be drawn:

- The pre-investigation area is regularly used by harbour porpoises from the Belt Sea population, especially in summer, for crossing and foraging.

- The abundance of harbour porpoises of the Belt Sea population in the pre-investigation area is low compared to the abundance in the Belt Sea, Mecklenburg Bight or the Kattegat, even in summer.

- Utilisation of the area by females with calves cannot be clearly ruled out for the Belt Sea population. However, its importance as such is definitely lower than that of the more western part of the Baltic Sea.

- The pre-investigation area is of great importance for harbour porpoises, as existing data show that the area is visited in winter by individuals of highly endangered Baltic Proper population.

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8 APPENDIX

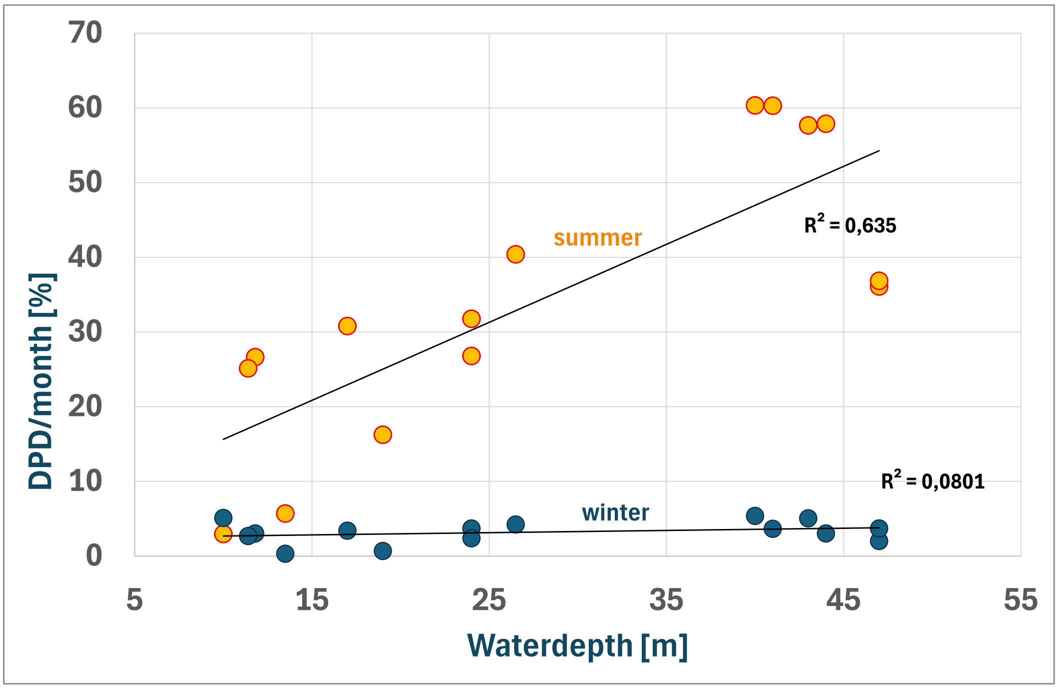

Figure 8-1. Mean percentage daily detection rates (DPD/month) in relation to the water depths at stations EI_01 to EI_15. The water depths at the C-POD stations EI_01 to EI_15 vary between 10 m and 47 m. The related data are shown separately for the summer season (May to October, orange dots) and winter season (November to April, blue dots).

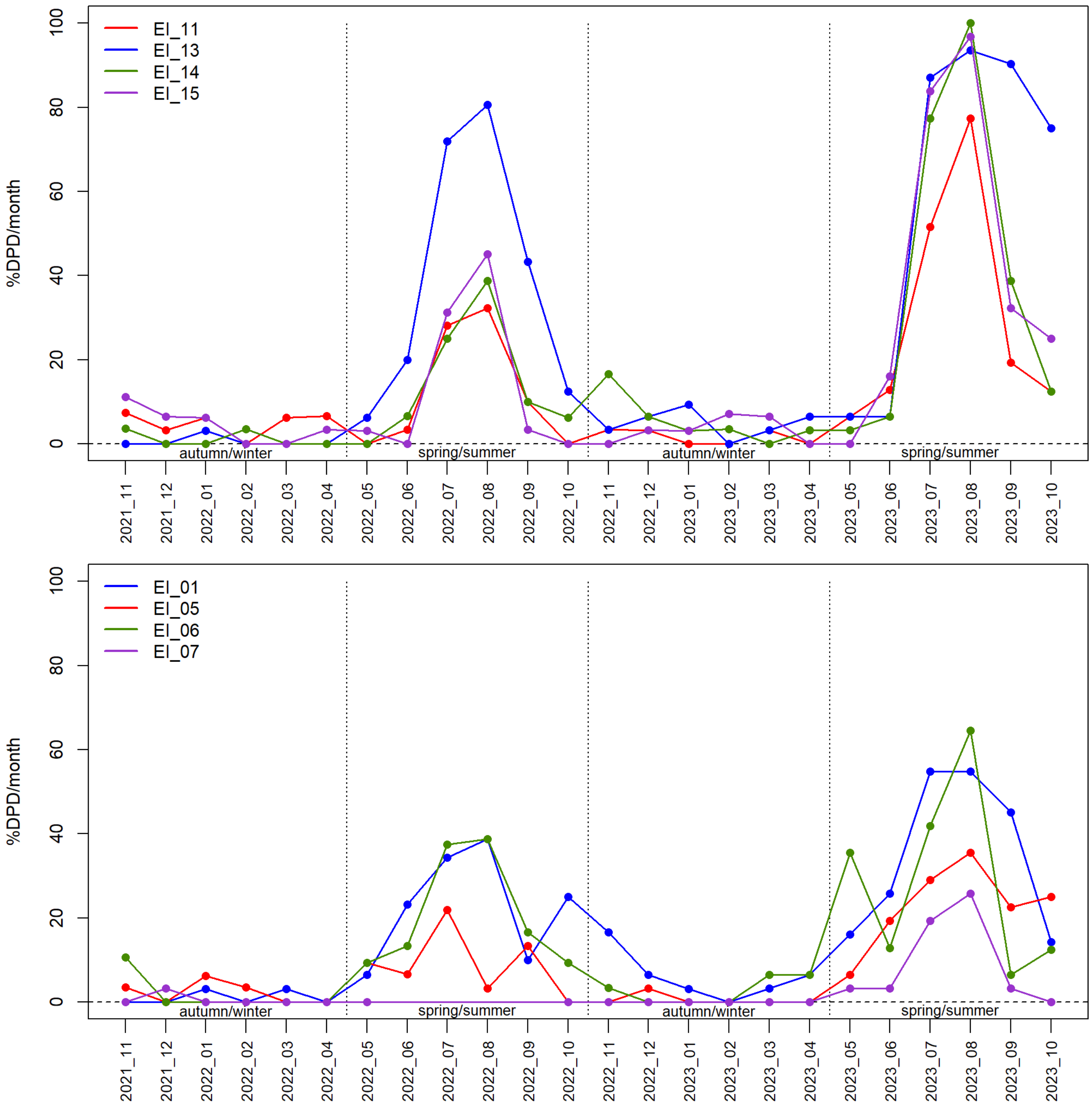

Figure 8-2. Percentage detection day rates per month (DPD/month) at the monitoring stations EI_11, EI_13, EI_14, EI_15 (top) and for EI_01, EI_05, EI_06 EI_07 (bottom) for the entire monitoring period. All stations were equipped with one C-POD.