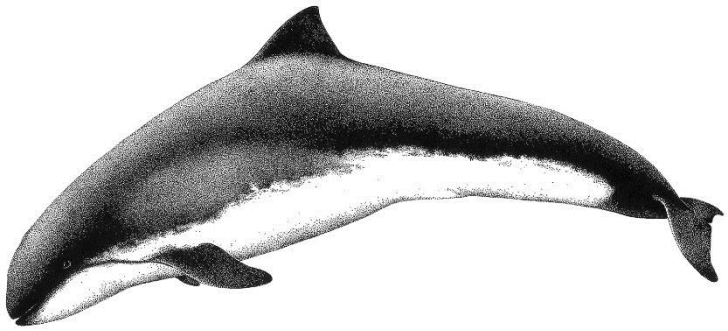
Monitoring of marine mammals in the area of the offshore wind farm "Bałtyk Środkowy III”

Final report with research results



Bałtyk Środkowy III Sp. z o.o.

Final report, v3

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Monitoring of marine mammals in the area of the offshore wind farm "Bałtyk Środkowy III"

Final report with research results

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ABBREVIATIONS

C-POD	Continuous porpoise detector
DPD	Detection positive day
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
HELCOM	The Baltic Marine Environment Protection Commission
IUCN	International Union for Conservation of Nature
MPA	Marine Protected Area
OWF	Offshore wind farm
OWF BP	Offshore wind farm Bałtyk Północny
OWF BŚ II	Offshore wind farm Central Baltic II
OWF BŚ III	Offshore wind farm Central Baltic III
PSZW	License for construction and use of the artificial islands, installations and devices in the Polish maritime areas
UTC	Coordinate Universal Time
cm	Centimeter
GB	Gigabite
Hz	Herz
kHz	Kilo Herz
km	Kilometer
kg	Kg
m	Meter
V	Volt

1 Non-technical summary

1 Nowadays, the offshore wind farms are of a growing interest around the world. Also in Poland, they have recently become an area of interest as a potential source of renewable energy. Thus, plans for the construction of a marine wind farm within the Polish EEZ have been implemented. As one of the potential power plant locations, the BŚ III site situated nearby the Słupsk Bank, was chosen.

As the construction, operation and decommissioning of a marine wind farm is associated with a number of activities which can impact the marine ecosystem, such impacts need to be comprehensively assessed. To conduct such assessment, it is primarily essential to have knowledge on the use of the area of interest by organisms. It is necessary to investigate which species occur in the area, what is their abundance, frequency of occurrence, seasonality and importance of the site to their ecology. A special focus has to be put on the organisms most prone to disturbances connected with the investment due to their ecology, as well as species of a special concern due to their conservation status.

Among the animals potentially vulnerable to disturbances connected with the offshore wind farm construction are marine mammals. In the Polish Baltic Sea four marine mammal species occur – the harbour porpoise (*Phocoeana phocoena*), grey seal (*Halichoerus grypus)*, harbour seal (*Phoca vitulina*) and the ringed seal (*Pusa hispida*), and they risk to be affected by the wind farm implementation. Therefore, it was necessary to investigate if the location of a planned wind farm has a significant importance to the Baltic mammals. This report refers to the monitoring of marine mammals conducted in the BŚ III planned offshore wind farm area for the need of the environmental impact assessment (EIA). Data obtained during the study serves as a baseline to the use of the BŚ III location and adjacent waters by marine mammals and is essential to be used in the impact assessment study. The methods used during the research were based on international standards, as well as Polish guidelines.

2 Monitoring of marine mammals was carried out with the use of both acoustic and visual means. The acoustic monitoring was dedicated to porpoises and was conducted with continuous porpoise detectors (C-PODs). C-PODs are fully automated, static data loggers which record all sounds in the high frequency spectrum, which includes echolocation signals of porpoises. Recorded sounds are stored in the memory cards and analysed with a specific software supplied by the CPOD developer. The analyses are based on algorithms which classify sounds into groups of different sound sources, among which are porpoise-made signals. In order to verify results obtained with algorithms, they are visually validated. The use of C-PODs is internationally accepted for investigating presence and seasonality of porpoises in the areas of interest (e.g. Kobllitz et al., 2013; SAMBAH, 2014). The acoustic monitoring at the BŚ III site was conducted between 14 October 2012 and 30 November 2013. Three C-PODs were deployed at three research stations located in different parts of the study area and collected data continuously. Devices were serviced and data was collected at intervals of several weeks during the maintenance cruises on the m/y Dr Lubecki vessel.

The visual monitoring of marine mammals was an essential part of the baseline investigations as so far they provide the only means to estimate density and abundance for this species on a large scale. In addition, the survey flights provide the only possible visual confirmation of the acoustic data that was gathered with the CPODs. This is vital especially in very low density areas, as BŚ III as CPODs are prone to false positives, i.e. wrongly identifying acoustic signals as being from porpoises. Furthermore, porpoise calves can only be identified using visual surveys. Finally, the surveys can be used to observe seals that transit the area, although it is usually difficult to identify species from a plane.

All large scale surveys on harbour porpoise undertaken so far in the Baltic indicate a clear seasonal pattern with the highest densities in summer compared to winter and early spring (consequently, we

planned the surveys to be undertaken mainly during spring - late summer with the two surveys in fall as control surveys. No surveys were planned to be undertaken during the winter time.

The observations were made during six flights taking place in different parts of the year – on 12 October 2012, 19 November 2012, 8 April 2013, 7 June 2013, 7 July 2013 and 12 September 2013, with a methodology following international standards. Data was collected during one-day surveys, under good or moderate weather conditions. Surveys were made at a flying height of 600 ft (183 m), along parallel line transects located at 10 km distances apart, which covered the BŚ III location and a wide area beyond it. Observations were made by two qualified observers, sitting on different sides of the plane and continuously searching for marine mammals.

The acoustic monitoring resulted in collection of complete data sets for two of the research stations. At one of the stations, due to equipment loses, 62% of the whole monitoring period were covered. The data gap did not however pose consequences to the validity of the results, as thanks to the monitoring design a good coverage of area and time could be obtained even with some data losses. The acoustic surveys were conducted according to plans and a great majority of a survey area was covered during each of the flights. Small parts of the transects which could not be covered due to weather conditions or military activities did not impact the quality of the obtained data.

The monitoring conducted at the BŚ III area revealed presence of three species of marine mammals within the planned wind farm location and adjacent waters. The recorded species were the harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Activity of all recorded animals was very low. During the acoustic monitoring, five days with porpoises detections were recorded along the year. The visual monitoring resulted in observations of nine marine mammal individuals in total, out of which five were porpoises and four were seals. One of the seals was the grey seal, two individuals were the harbour seals and one was an unidentified specimen. All the animals were adults. No calves were observed.

Based on the obtained results, it was concluded that BŚ III constitutes a location of a low activity of marine mammals. Due to the low number of recorded animals no seasonal trends of this activity could be assessed. Lack of observations of harbour porpoise calves indicated that the study area is not of special importance for the breeding activity of these animals. Based on obtained data, some conclusions on harbour porpoise foraging activity could be made, however. It was concluded that the BŚ III area might be used by porpoises for foraging. Such a suggestion is based on the fact that the study area hosts fish species which are among the main prey items of porpoises (sprat, cod and herring) and which are quite abundant in some parts of the year, especially in the summer time. The recorded presence of porpoises seemed to be correlated with this abundance of fish, as summer months were within the periods of a high number of porpoises detections. Thus, the animals recorded during our study might have occurred there due to a good food base, especially when considering that porpoises follow places with food abundance in their migration.

Use of the monitored area as a feeding ground could also be expected for the grey seals, as they have foraging habits similar to porpoises. The grey seals also mainly feed on sprat, cod and herring and have foraging grounds in different areas located even at long distances apart. The BŚ III location could be one of such sites due to the availability of prey found in this region. Use of the study area by harbour seals was not assumed to be expected, as this species feeds close to its haul-out sites (Dietz, 2013) which do not exist in Poland. A similar situation concerns the ringed seal, as it was not recorded in the monitored area, and its occurrence in Polish waters is generally low with no haul-out sites. For all the mammal species it was concluded that the BŚ III area might be located within the animals' migration routes.

2 Introduction

As part of the environmental impact assessment (EIA) for the Polish offshore wind farm (OWF) planned in the BŚ III area – near the Słupsk Bank, Bałtyk Środkowy III Sp. z o.o. has commissioned DHI to conduct the baseline studies on marine mammals and to assess the impacts on this group of marine life on the basis of the maximum variant solution.

In the Polish EEZ of the Baltic Sea four species of marine mammals are reported: the harbour porpoise *Phocoena phocoena*, grey seal *Halichoerus grypus* , harbour seal *Phoca vitulina* and the ringed seal *Pusa hispida*. The construction, operation and decommissioning of a marine wind farm is associated with a number of activities, for example pile driving, seabed preparation, sediment removal and deposition, cable laying and vessel movement. These activities can have impacts on marine mammals which have to be assessed. In order to conduct such an assessment it is necessary to investigate the spatial and temporal use of the project area by marine mammals. The objective was therefore to collect data on seasonal abundance and distribution of porpoises and seals in the project area and adjacent waters. A special focus was put on the harbour porpoise (*Phocoena phocoena),* as a species potentially most influenced by the offshore wind farm construction. The methods applied during the monitoring followed international standards used for similar investments (e.g. German Standards for Environmental Impact Assessments for Offshore Wind Farms), as well as Polish Guidelines (BSH, 2013; Stryjecki, 2011).

Due to the suspected low numbers of marine mammals and uncertainties in the status of the harbour porpoise in the Polish Baltic, the monitoring programme was planned to comprise both acoustic and visual means. The use of two monitoring methods aimed at enhancing the chance of detecting porpoises individuals and therefore providing a better overview on the occurrence of the species in the planning area.

The key components of the research approach were:

- For harbour porpoises and seals, abundance and distribution were investigated using six large-scale aerial surveys undertaken following the distance sampling approach (for details see Buckland et al., 2001).
- Occurrence (presence/ absence) of harbour porpoises in the study area was investigated using passive acoustic monitoring devices deployed at different locations within the project site.

This report describes the investigations results of the 13 months study period – between 14 October 2012 and 30 November 2013 - and thus has the status of a baseline report.

2.1 Biology and occurrence of marine mammals in the Polish EEZ of the Baltic Sea

In the Polish EEZ of the Baltic Sea, four species of marine mammals occur: the harbour porpoise (*Phocoena phocoena*) and three species of seals - the harbour seal (*Phoca vitulina*), grey seal (*Halichoerus grypus*) and the ringed seal (*Pusa hispida*).

2.1.1 Harbour porpoise

The harbour porpoise belongs to the family *Phocoenidae*, a family which also includes the Vaquita (*Phocoena sinus*) and Burmeister's porpoise (*Phocoena spinipinnis*), and is among the smallest cetaceans in the world. Female porpoises have an average length of 150-160 cm and weigh 60 to 65 kg, while males have an average length of 140-145 cm and weigh 46-50 kg (Lockyer, 2003). Harbour porpoises are rotund in shape with a dark dorsal side and a ventral side which is white or light grey in colour. They are distinguishable from other cetaceans by having a small triangular dorsal fin (Fig. 1).

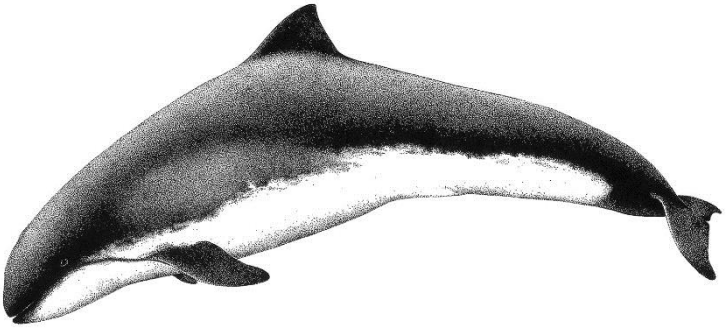

Fig. 1 Drawing of the harbour porpoise (courtesy of M´. Buerkel; Hamburg).

In the European waters, the maximum life expectancy of harbour porpoises is 15 – 20 years (Lockyer, 2003). Females are sexually mature at the age of 3-4 years on average, while males slightly later (Klinowska, 1991; Lockyer, 2003). The breeding season lasts from June to August, while mating is observed between May and September. The gestation period is 10 – 11 months and females give birth to a single calf. Calves are nursed for 8 – 10 months, but can stay close to their mother until the new calf is born (Locker, 2003). In the breeding and lactation seasons, porpoises are found around the Baltic, including the Polish waters (WWF Polska, Hel Marine Station).

Harbour porpoises are usually found in coastal waters with depths below 200m. The animals can dive to depths of down to at least 220 m and stay submerged for up to five minutes, however most dives are shallow with a duration of two minutes or less (Otani 1998, Otani 2000, Bjørge 2009). Porpoises live either solitary or in small groups (Jefferson et al., 2008). The aggregations are found in the regions with abundance of food and during the common migrations (Read, 1999; Reid et al., 2003). In the Baltic Sea porpoises are found mostly swimming alone or in small groups of 2 - 3 individuals, often comprised of a mother and her calf. In the summer time, females usually stay in one area, while males and calves can migrate long distances (Koshinski, 2002).

Daily movement patterns of harbour porpoises vary. Telemetry studies in the Bay of Fundy, Canada, indicate daily mean distances travelled between 15 and 58 km per day (Read and Westgate 1997). Teilmann (2000) reported that porpoises can travel up to 80 km per day in Danish waters. This was later confirmed in extensive telemetry studies reporting a maximum movement of 100 km per day (Sveegaard, 2011). Based on movement patterns of 63 individual porpoises, Teilmann et al (2008) could identify several high density areas and seasonality in occurrence. Based on surveys undertaken in the south Western Baltic between 2002 and 2006, Gilles et al (2007) found a very strong gradient in porpoise abundance with much higher densities in the western part compared to the eastern part. Results also showed a strong seasonal pattern with highest numbers in late summer and lowest numbers in winter and early spring (Gilles et al. 2007).

Porpoises mainly forage close to the sea bottom or close to the surface and are opportunistic feeders (Bjørge 2009). They have limited capabilty of energy storaging and therefore need a constant availability of a food base. Thus, they do not have determined breeding sites and their occurrence is dependant on the food availability. They can migrate over long distances searching for prey and stay in the areas where it is abundant (Koopman, 1998; Locker, 2003, Locker, 2007, Koshinski, 2002). Porpoises feed on a variety of fish depending i.e. on the region and season. In the Baltic Sea region, their main prey items are herring sprat and cod (ICES, 2006). Their diet also often contains benthic and demersal species (Read 1999, Borjesson *et al.* 2003).

Similarly to all other odontocets, porpoises use an echolocation system to communicate, orientate themselves in the water, search for prey and detect obstacles and barriers. They emit sound signals (clicks) and analyse their echoes coming from refraction on objects. The band of emitted signals is spatially relatively narrow and therefore the animal can identify only objects located in front of them. The signals are of a high frequency, mostly within the range of 120 – 130 kHz and are emitted in so-

called trains - series of successive clicks (e.g. Amundin, 1991). The hearing range of porpoises is within 16 and 140 kHz, with the best sensitiveness between 100 and 140 kHz (120 – 130 kHz) (Kastelein et al., 2002).

The abundance and distribution of harbour porpoise in the North Sea and the western Baltic Sea have been sampled twice on a large scale indicating little change in the overall abundance between 1994 and 2005 (340,00 and 375,000; Hammond et al. 2002; Hammond et al. 2013; SCANS, 2006). One has to note here that these estimates came with large statistical variation so that smaller changes in population size were undetected (Thomsen et al., 2011). Throughout their range, density of porpoise differs. In the Baltic, there is a sharp decline in porpoise abundance from West to East, i.e. from the inner Danish waters to the Baltic proper with very low density reported in the latter, including Polish waters. Historical data indicates that porpoises were distributed widely throughout the Baltic and that the current situation is the result of a decline due to many factors with direct catches and by-catch in fisheries potentially the most severe (Koschinski, 2002).

2.1.1.1 Status of the harbour porpoise in the Polish Baltic

The exact status of the current harbour porpoise population in the Polish Baltic Sea is uncertain, although its abundance is generally found to be very low (Skóra, 1991; Koschinski, 2002; Gillespie et al., 2005). Some studies indicate that the Polish coast forms a part of the easterly border of the species distribution in the Baltic, with its very low numbers in this area (Gillespie et al., 2005; Verfuß et al., 2007). The most recent investigations show that harbour porpoises do occur with some regularity in the eastern part of the Baltic. In the years 2009 – 2011, the Hel Marine Station of the University of Gdańsk conducted acoustic monitoring of porpoises with 48 C-PODs in the Puck Bay (a part of the Gdańsk Bay, eastern Baltic). The study revealed occurrence of animals throughout the year, with most of the detections made in the winter months (Kosecka et al., 2013). It is worth no note here that the detectors were placed in very close vicinity to each other and in adjacent rows. Thus, multiple detections could have been gathered on very few animals on repeated visits to the area. As a consequence it is questionable if the obtained results are conclusive beyond providing information on mere presence/ absence of an unknown number of porpoises in a very small area. The confirmation and source of information on the presence of porpoises in the Puck Bay are also the by-catch reports collected by the Hel Marine Station. During the years 1986 – 2009, the Marine Station recorded 69 by-catch events, out of which most happened in March (Kosecka et al., 2013).

Among the studies on porpoises in the Polish Baltic Sea is also the monitoring conducted within the framework of a joint WWF Polska and Hel Marine Station project 'Support of restoration and protection of the Baltic mammals in Poland' („Wsparcie restytucji i ochrony ssaków bałtyckich w Polsce"), finished in the 2012 and currently continued under the name 'Protection of the habitats of marine mammals and birds' („Ochrona siedlisk ssaków i ptaków morskich"). The projects include collecting data on sightings, strandings and by-catches of porpoises along the Polish coast since the year 2009 until present, revealing that strandings and sightings are being reported in the whole study area (eighteen strandings and foursightings of porpoises)(WWF Polska, 2013; WWF database available online: http://link.wwf.pl/baza_ssaki/public/mapa/mapa).

Relevant information on the porpoises activity in the Baltic Sea is going to come from the large scale EU project Static Acoustic Monitoring of the Baltic Harbour Porpoise (SAMBAH). The SAMBAH project is the largest acoustic monitoring of cetaceans around the world and aims to provide more information about the poorly known population of the Baltic porpoises, especially of its central, eastern and northern parts. During the project works, the monitoring was conducted around the Baltic which has never happened before. Measurements were conducted for two years, between 2011 and 2013. Detailed results of this monitoring are not open to the public yet and are expected to be released by the end of 2014. However, the preliminary results of SAMBAH have already been published, presenting rates of porpoise detections obtained during the study. According to this data, the Polish waters represent areas of a low detection rate, indicating a low occurrence of the animals in the Polish EEZ (SAMBAH press release, 2014) (Fig. 2).

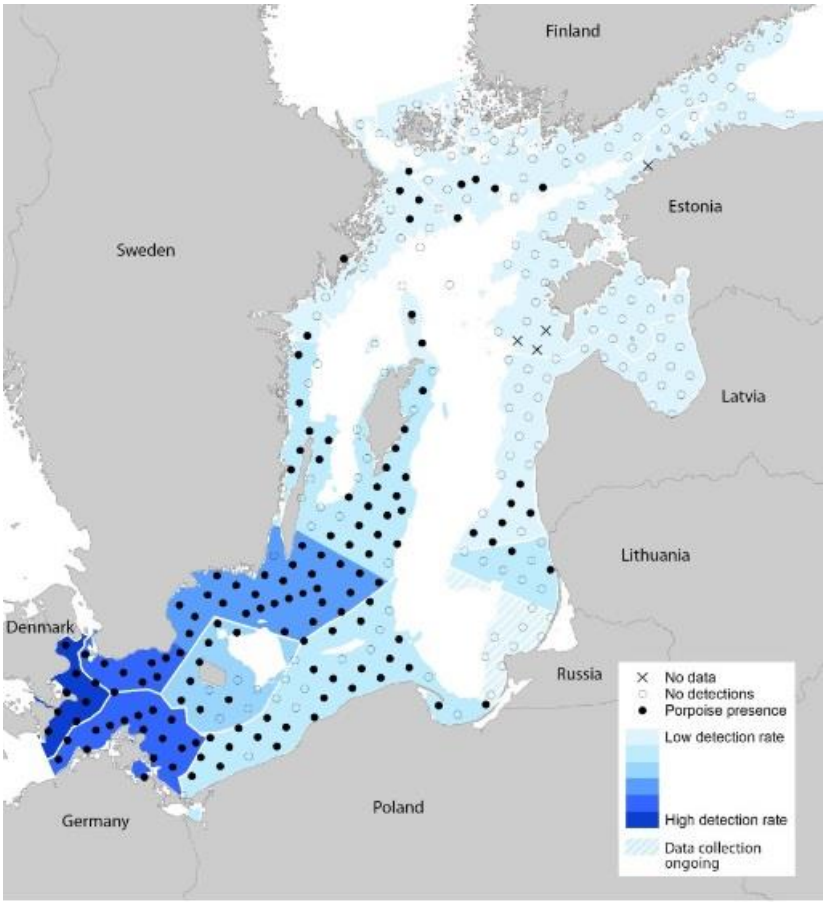

Fig. 2 Preliminary results of the SAMBAH project showing overview of porpoise detection rates around the Baltic Sea (SAMBAH, 2014)

The population structure of porpoises in the Baltic is still under discussion. The harbour porpoises in the Baltic may consist of two separate populations, one in Kattegat, Skagerrak and the Belt Seas, and one in the Baltic proper. The Baltic proper harbour porpoises are on the IUCN red list (Hammond et al., 2008) and considered a critically endangered separate population. However, it is still debated whether this separation into two genetically distinct populations is correct (Palmé et al., 2008). The evidence for such a separation is not unambiguous. A study by Wiemann et al. (2010) provided some genetic support for a separation of the porpoises between the Kattegat, Skagerrak, Belt Sea and the inner Baltic Sea, with suggested geographical boundaries at the Linhamn/Dragør ridge and south of Fyn/Sjælland perhaps as far east as Darss Sill (Wiemann et al., 2010). Galatius et al. (2012) investigated the presence of a separate inner Baltic Sea population using a geometric morphometric method to compare harbour porpoises from different areas. Their results also indicated the presence of a separate population in the inner Baltic Sea population, though they were not able to define any clear boundaries for this stock. The number of samples available for analysis dictated the power of genetic analysis of the population structure, which could be the reason for the inconclusive results so far presented. It is thus not conclusively proven that the porpoises of the Baltic proper can be viewed as a separate population meriting separate management.

2.1.2 Seals

2.1.2.1 Grey seal

The grey seal (*Halichoerus grypus*) (Fig. 3) belongs to the *Phocidae* family, to the genus *Halichoerus*. Grey seals are found in temperate coastal waters throughout the North Atlantic (Hall, 2009).

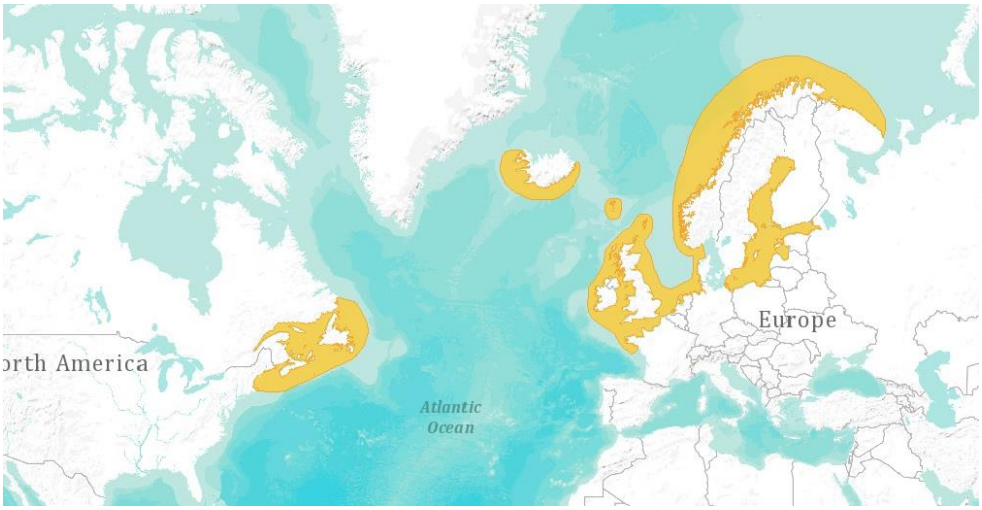

Fig. 3 World distribution of the grey seal (The IUCN Red List of Threatened Species; 2013; http://www.iucnredlist.org/)

The grey seals occurring in the Polish Baltic waters belong to the Baltic population. Once numerous (up to 100 000 individuals at the beginning of the 20th century (Kokko et al. 1999, Harding & Harkonen 1999)) the population declined to only 2000 in late 1970s (Boedeker et al, 2002). Since the 1980s the number of individuals is steadily increasing, in 2012 the annual counting survey during the moulting season of this species revealed a number of 28000 individuals. Although the number of seals is growing, recolonization of the southern Baltic is very slow (HELCOM,2013).

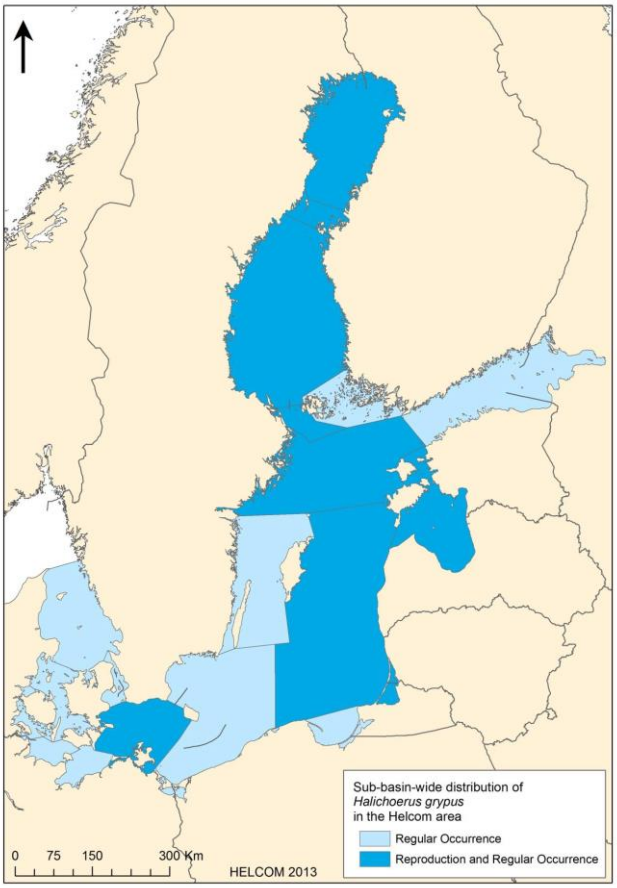

Fig. 4 Distribution of the grey seal in the Baltic Sea (with distinction to reproduction and regular occurrence and regular occurrence regions) (HELCOM,2013)

The species exhibit sexual dimorphism, males are larger in size, their muzzle is more convex than in females. Adult males weighing 170-300 kg and adult females weighing 100-190 kg (Hall, 2009), an average body length is 1,65 – 2,1 m (Fig. 5). Grey seals gather in groups for breeding moulting and hauling. They reach ages of 25 and 35 for males and females, respectively. Female grey seals become sexually mature at 3 to 5 years of age, while males reach sexual maturity at the age of around 6 years. Due to male competition for breeding females, the social maturity of males is however closer to 8 years. The gestation period is approximately 8 months, but due to delayed implantation of the egg, birth is given around 10-11 months after mating (Hall, 2009). Most females give birth to a single pup each year in February-March (Bonner, 1979). The pup is born on drifting ice or land with a white lanugo fur. The pup is weaned after approximately two weeks and then the female goes into oestrous. Mating likely takes place in the water (Hall, 2009).

Fig. 5 Adult male grey seal

Grey seals have relatively large foraging ranges (comparing to harbour seals) (Thompson, 1996). Their diet varies widely due to location, season and prey availability (Stenman & Poyhonen, 2005). Grey seals forage on a wide range of fish species, main prey items are herring, sprat, cod, lavaret and salmon (ICES, 2006 c,d).

Telemetry data collected on seal pups released to the Baltic by the Hel Marine Station reveals that grey seals migrate through the Polish waters of the Baltic (Fig. 6). Migrations are recorded also for the area of the planned offshore wind farm (WWF Polska, 2013).

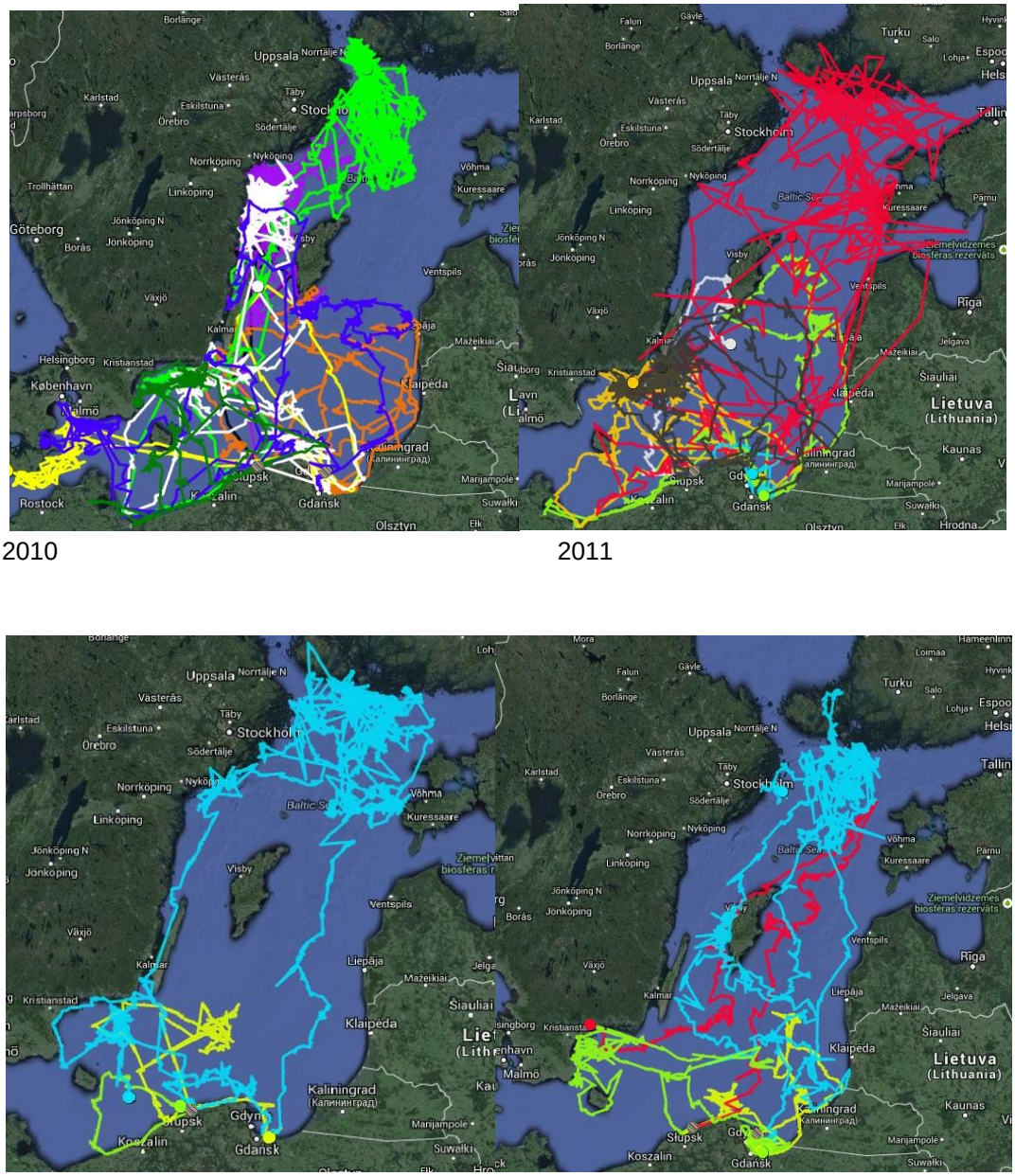

Fig. 6 Migration routes of young grey seals released to the Baltic by Hel Marine Station, University of Gdansk in 2010, 2011, 2012, 2013 (wedrowkifok.wwf.pl/)

2.1.2.2 Harbour seal

Harbour seal (*Phoca vitulina*) (also known as common seal) (Fig. 7) belongs to the family *Phocidae* and is found in coastal waters mainly in the boreal and temperate regions of the Northern hemisphere (Burns, 2009).

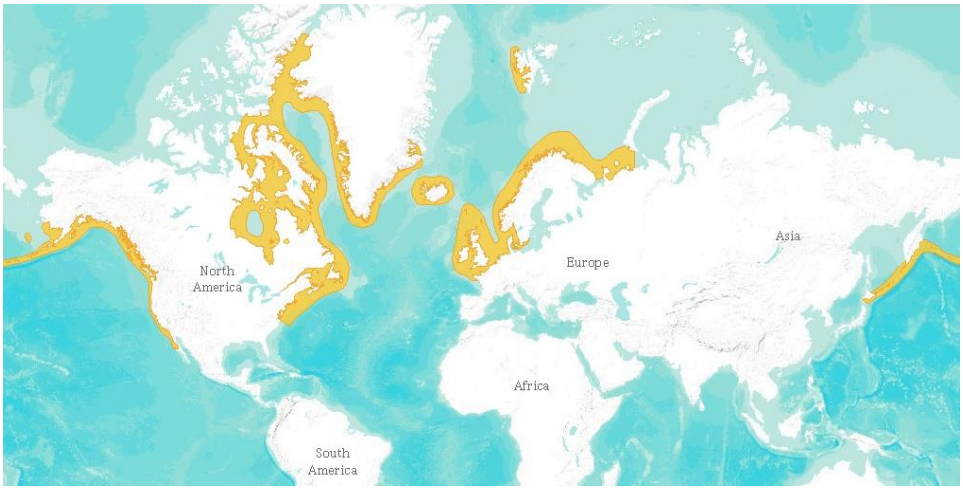

Fig. 7 World distribution of the harbour seal (the IUCN Red List of Threatened Species; 2013; http://www.iucnredlist.org/)

Harbour seals are divided into five different subspecies based on distribution and genetic information, with the Baltic Sea seals belonging to the subspecies *Phoca vitulina vitulina*.

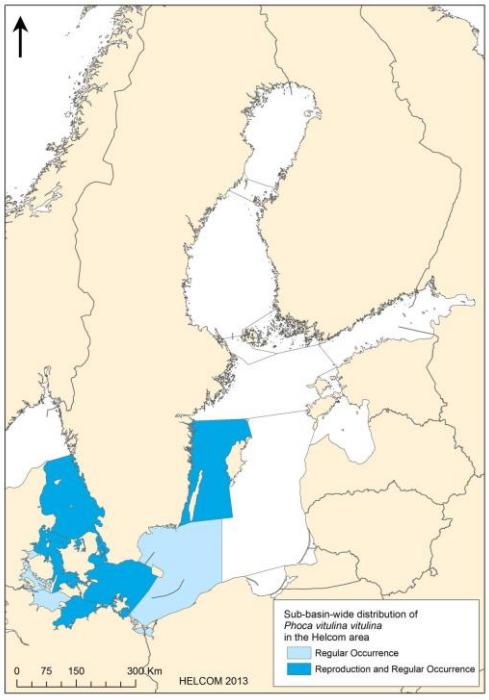

Fig. 8 Distribution of the harbour seal in the Baltic Sea (with distinction to reproduction and regular occurrence and regular occurrence regions) (HELCOM, 2013)

The number of harbour seals in the Baltic Proper is estimated to be around 800 individuals (Härkönen et al, 2013)

Harbour seals exhibit a high degree of site fidelity, and often remain relatively close to their haul-out sites (Dietz, 2013; Olsen, 2014). Adult female harbour seals are on average 146 cm in length and weigh 67 kg, while adult males on average are 156 cm and weigh 75 kg. Maximum known age of this species is 36 years. (Harkonen, 1990). Harbour seals are light grey to darker grey on the dorsal side with white and dark grey spots and a lighter ventral side (Jørgensen, 2003).

Fig. 9 Harbour seal (Photo: Marcel Burrkhard)

Harbour seals become sexually mature at around 3 to 5 years. Most mature females give birth to a single pup each year. Time of birth vary widely due to geographic range of the species from March to September(IUCN). The gestation period is 10-11 months (Burns, 2009), and the foetus has a white lanugo coat. Birth takes place on sheltered beaches, sandbanks or rocks. Unlike the grey seal this lanugo fur is shed before birth and harbour seal pups are born with the adult fur coat, which enables them to follow their mother into the water shortly after birth (Burns, 2009). Mating takes place after the nursing period, primarily in July (Jørgensen, 2003). Mating takes place in the water, where males may attract females using underwater vocal displays (Van Parijs, 2000).

Harbour seals usually feed rather close to their haul-out sites (Dietz, 2013), and generally forage in shallower areas (<100 m)(Tollit, 1998). Harbour seal diet is mostly comprised of pelagic, demersal and benthic fish species, and they will generally feed on locally and seasonally abundant prey species (Härkönen, 1991). However, though the harbour seal as a species is quite generalistic in prey preference, individuals may be very selective.

2.1.2.3 Ringed seal

The ringed seal (*Pusa hispida*) is a member of the *Phocidae* family. On a global scale, the ringed seal is one of the most abundant seal species in the Arctic and closely associated with ice for essential parts of its life cycle. The animal is therefore very vulnerable to changes in the ice cover due to global warming (Hammill, 2009; Sundqvist, Harkonen et al., 2012).

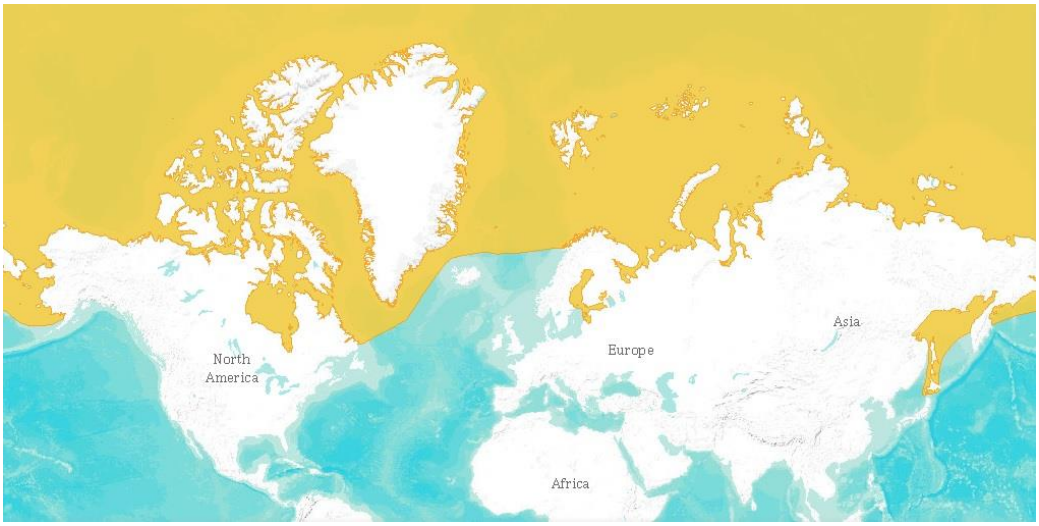

Fig. 10 World distribution of the ringed seal (The IUCN Red List of Threatened Species; 2013; http://www.iucnredlist.org/)

Ringed seals present in the Baltic Sea belong to a separate subspecies *Pusa hispida botnica*. The number of individuals in the Baltic Sea is estimated to 10 000 (HELCOM,2013). The species inhabits mainly the northern part of the Baltic Sea, although it is seen sporadically on the polish coast (Fig. 11).

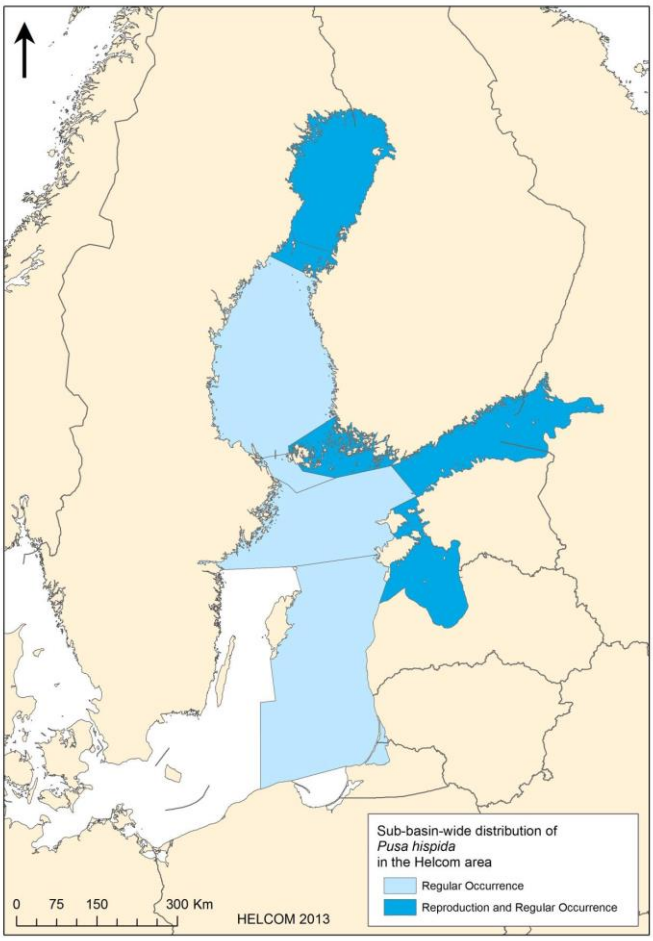

Fig. 11Distribution of the ringed seal in the Baltic Sea (with distinction to the reproduction and regular occurrence and regular occurrence regions) (HELCOM, 2013)

Male and female ringed seals are of equal size. They have a light grey ventral side and dark dorsal side with light grey or dark grey rings (Hammill, 2009). Ringed seals grow up to be 1,5 – 1,75 m long and weigh less than 120 kg (HELCOM,2013) (Fig. 12).

The life expectancy of ringed seals is long with ages of up to 46 years documented (Hammill, 2009). They become sexually mature at 4 to 6 years of age and females give birth to a single lanugo covered pup each year. As for the other seals in this family the gestation period is approximately 11 months, including a delayed implantation period (Hammill, 2009). The pups are born on the fast ice in February- March (Sinisalo, Jones et al., 2008) in small lairs under the snow which mothers excavate close to a breathing hole. This is likely for protection against predators (Hammill 2009). The pups shed the white lanugo coat after 2-3 weeks (Hammill, 2009), but nursing continues for 4-6 weeks (Sinisalo, Jones et al., 2008). Breeding is thought to take place immediately after weaning, with males defending underwater territories and mating taking place under water. During the breeding seasons males emit a strong odour (Hammill, 2009).

Fig.12 The ringed seal observed in the Polish coast (photo: Paweł Bloh)

Ringed seals generally forage on fish as well as invertebrates (Hammill 2009). For ringed seals in the northern part of the Bothnian Bay the main prey species found were three-spined stickle backs (*Gastrerosteus aculaetus*), Baltic herring (*Clupea harrengus*) and smelt (*Osmerus eperlanus*) (Suuronen and Lehtonen, 2012).

2.1.2.4 Status of seals in the Polish EEZ

The investigations on the occurrence of seals in the Polish Baltic have shown that nowadays among three species are reported in this area (the grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina*) and the ringed seal (*Pusa hispida*)); the grey seal is most abundant (Tab. 1).

Tab. **1** Records of seals in the Polish waters of the Baltic recorded between 1 January 2007 (Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) and 31 January 2014 during the monitoring conducted by WWF Poland and Hel Marine Station for the projects 'Support of restoration and protection of the Baltic mammals in Poland' and 'Protection of the habitats of marine mammals and birds' (based on: http://link.wwf.pl/baza_ssaki/public/mapa/mapa)

Species	spring	summer	autumn	winter	total
Halichoerus grypus **(grey seal)**	302	663	392	161	1518
Phoca vitulina **(harbor seal)**	31	28	10	13	82
Pusa hispida **(ringed seal)**	6	8	4	2	20
Pinnipedia unidentified	146	152	59	35	392
total	485	851	465	211	2012

The records of seals concern observations of migrating and resting individuals or groups, strandings or by-catches. Although seals are known to occur in the Polish Baltic, recently there is no well-documented breeding activity in the area. There were two records of newborn harbour seals in the Gdańska Bay (WWF Polska, 2013)., However, information as to where they were born is not known.

At present, as for the harbour porpoise studies, the study concerning seals' occurrence in the Polish Baltic has for several years been continuously conducted by WWF Polska and Hel Marine Station of the University of Gdańsk, within a framework of two consecutive projects - 'Support of restoration and protection of the Baltic mammals in Poland' („Wsparcie restytucji i ochrony ssaków bałtyckich w Polsce") and 'Protection of the habitats of marine mammals and birds' („Ochrona siedlisk ssaków i ptaków morskich"). Monitoring is conducted by marine mammal observers (volunteers) from shore, together with collection of reports on seals' presence from random observers, as well as reports on strandings or by-catches.

According to the available data, obtained during the WWF and Hel Marine Station projects, seals occur along the whole Polish coast and in all the seasons of the annual cycle. Since 1 January 2007 (Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) up to the end of January 2014, a total number of 2012 individuals of seals were observed, out of which 86% (1725 individuals) were living specimens. Among the three species observed, a great majority of records concerned the grey seal - 75% (1518 individuals). The harbour seal constituted 4%, while the ringed seal constituted 1% of all the records (Fig 1 – 4 in the Annex 1).

The largest abundance of seals occurs in the Gdańsk Bay (86 % of all the observations), while within a bay - in the wildlife reserve Mewia Łacha ('Seagull Sandbank'). Nowadays, the reserve hosts a haul-out site of the grey seal, where the animals find good conditions to rest - quietness and no disturbances from people. Seals appear in this area especially in the summer time and their abundance is recorded to be increasing every year. In the summer of 2013, the number of observed seals exceeded 100 individuals (WWF Polska database, available online: http://link.wwf.pl/baza_ssaki/public/mapa/mapa).

The occurrence of seals in the Polish EEZ was confirmed also by HELCOM, according to which the whole Polish Baltic is regularly visited by the grey seal, the western part of it by the harbour seal and a small area in the northern-most part of Polish waters by the ringed seal (HELCOM, 2013) (Fig 1 – 4 in the Annex 1).

2.2 Protection status of marine mammals of the Polish Baltic Sea

The Baltic harbour porpoise is one of the most endangered species among marine mammals of Europe. In the IUCN (International Union for Conservation of Nature) red list of endangered species, the animal is classified as 'critically endangered' in the criterion C2a (Hammond, 2008). Thus, the species is listed in numerous legislation acts concerning species protection, both on international and regional scale.

Among the most important acts aiming to protect harbour porpoises are:

- Bern Convention

The Bern convention is the Convention on the Conservation of European Wildlife and Natural Habitats (1979 in Bern, Switzerland). The convention aims at the conservation of wild flora and fauna and their natural habitats, mainly focusing on the species and habitats of which conservation requires the cooperation of several states and further promotion of such cooperation. Particular emphasis is given to endangered and vulnerable species, including endangered and vulnerable migratory species. The harbour porpoise is listed in the Annex II comprising "strictly protected fauna species". The tool for implementing the provisions of the Bern Convention is the Habitat Directive (92/43/EEC). Poland ratified the convention on 12 July 1995 and implemented it on 1 January 1996.

- Habitat Directive

The Habitat Directive stays within the framework of the Bern Convention and European Union, and agrees on the conservation of the natural habitats of wild fauna and flora. In the directive, the harbour porpoise is listed in the Annex IV, which includes animal and plant species of community interest requiring strict protection. It is also listed in the Annex II (including all cetaceans) in which all relevant member states are legally obliged to protect the harbour porpoise by designating MPAs, referred as Special Areas of Conservation (SAC). In Poland, areas of a special concern for the harbour porpoise protection are designed under Natura 2000 and include: Puck Bay and a part of the basin in the Hel Peninsula Region (PLH-220032) and waters of the Pomeranian Bay adjacent to Wolin and Uznam Islands (PLH-20019).

- Bonn Convention (CMS)

The Bonn Convention (1979) is the Convention on the Conservation of Migratory Species of Wild Animals and relates to the conservation of migratory species throughout their range. The Baltic harbour porpoise is listed in the Annex II as a migratory species having an adverse status of preservation and for which it there is a need of international agreements in order to keep its protection it and control. An example of such agreement is ASCOBANS. Poland ratified the convention in 1996 and is involved in the ASCOBANS agreement.

- ASCOBANS

ASCOBANS is a regional 'Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea'. As the harbour porpoise is the only cetacean resident to the Baltic Sea it has become the flagship species of the Agreement. In 2002 under the aegis of the ASCOBANS Secretariat, a special working group composed of representatives of international conventions, ministries, fishermen and environmental groups has developed a recovery plan for the Baltic harbour porpoise – 'Jastarnia Plan' (ASCOBANS, 2002), which recommends a programme of which the overall aim is to restore the Baltic population of porpoises. Poland has been a part of the agreement since 18 January 1996 and its obligations arise from the objectives of the agreement, which include:

A. Decreasing by-catch of porpoises
   - reduction of the fishing effort in selected types of fisheries,,

- replacement of the fishing methods which use equipment known to be associated with a high risk of porpoise by-catch (eg. gillnets and bottom-set gillnets) in favour of alternative fishing gear considered less harmful
- summary of standard data on the fishing effort
- implementation of the use of the acoustic harassment devices (pingers) within a short-term period

B. Research works and monitoring
C. Establishment of the Marine Protected Areas – dedicated to porpoises
D. Increasing social awareness

- Washington Convention (CITES)

CITES - the Convention on International Trade in Endangered Species of Wild Fauna and Flora - is an international agreement between governments. It aims to ensure that international trade of wild animals and plants specimens does not threaten their survival. The harbour porpoise is listed in Annex II which includes species which do not face extinction, but strict control on their international trade is necessary to avoid them to become endangered. In Poland the convention was ratified on 12 December 1989 and implemented on 12 March 1990.

- HELCOM/ Helsinki Convention

HELCOM is known as the 'Convention on the Protection of the Marine Environment of the Baltic Sea Area'. It covers the whole Baltic Sea giving consideration to the specific needs of this sea, as well as concerns the decreasing population of the harbour porpoise in the Baltic. The convention recommends avoidance of by-catch, collection of data on threats and population, and reporting of the obtained data every three years. Furthermore, based on the Baltic Sea Protected Areas (BSPAs), HELCOM recommends establishment of marine protected areas. The HELCOM Baltic Sea Action Plan focuses on the development of a good ecological status of the Baltic marine environment by 2021 and addresses all the major environmental problems affecting the Baltic marine environment. In Poland the convention was ratified on 8 November 19979 and implemented on 3 May 1990.

- Polish law

In Poland, the harbour porpoise has been protected since 1984. Currently, it is listed in:
- The Regulation of the Minister of Environment concerning the species protection of 12 October 2011 protection (Journal of Laws No. 237, item. 1419). The porpoise is listed in Appendix 1 as the species under strict protection and requiring an active protection.
- The Nature Conservation Act which prohibits anyone from catching, disturbing (including photographing and filming), hunting, killing and possessing seals (and parts of their bodies) live or dead.
- The "Polish Red Book of Animals" (Głowaciński ed., 2001).

The legislation acts concerning protection of the Baltic Seals include:

- The Bonn Convention

The Bonn Convention lists the harbour seal in the Annex II, as migratory species having an adverse status of preservation and for which it there is a need of international agreements in order to keep its protection it and control.

- The Bern Convention

The Bern Convention lists the harbour seal and the ringed seal in the Appendix III, concerning species requiring protection by the countries being the parties of the convention.

- The Helsinki Convention

The grey seal, the harbour seal and the ringed seal are concerned in the HELCOM recommendation 27 - 28/2 and considered important components of the natural heritage of the Baltic Sea region. HELCOM recommends protection, monitoring and designation of the Marine Protected Areas for seals

- The Habitat Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

The grey seal and the harbour seal are listed in the Appendix II of the Habitat Directive which includes plant and animal species important for the community and which conservation requires the designation of special areas of conservation.
In Poland, areas of a special concern for the harbour seal protection are designed under Natura 2000 and include: Refuge at the Vistula mouth (PLH220044), Vistula Lagoon and Vistula Spit (PLH280007), Kashubian Clifs (PLH220072), Puck Bay and a part of the basin in the Hel Peninsula Region (PLH-220032) and Słowińska Refuge (PLH2200023).

- Proposal for a Regulation of the European Parliament and of the Council on trade in seal products

The proposal regulates the laws concerning trade of seal products and it concerns the grey seal, the harbour seal and the ringed seal.

- Polish law
  - The Nature Conservation Act concerning the grey seal, the harbour seal and the ringed seal.
  - The Regulation of the Minister of Environment concerning the species protection of 12 October 2011. Protection (Journal of Laws No. 237, item. 1419), which lists the grey seal, the harbour seal and the ringed seal in the Appendix 1 as the species under strict protection and requiring an active protection.

3 Description of the project area

Polenergia plans to build the offshore wind farm “Bałtyk Środkowy III” in the Polish Exclusive Economic Zone of the Baltic Sea. The project “Bałtyk Środkowy III” is situated outside the borders of Polish territorial waters, approximately 23 km from the shore (Fig.13 , Tab. 2).

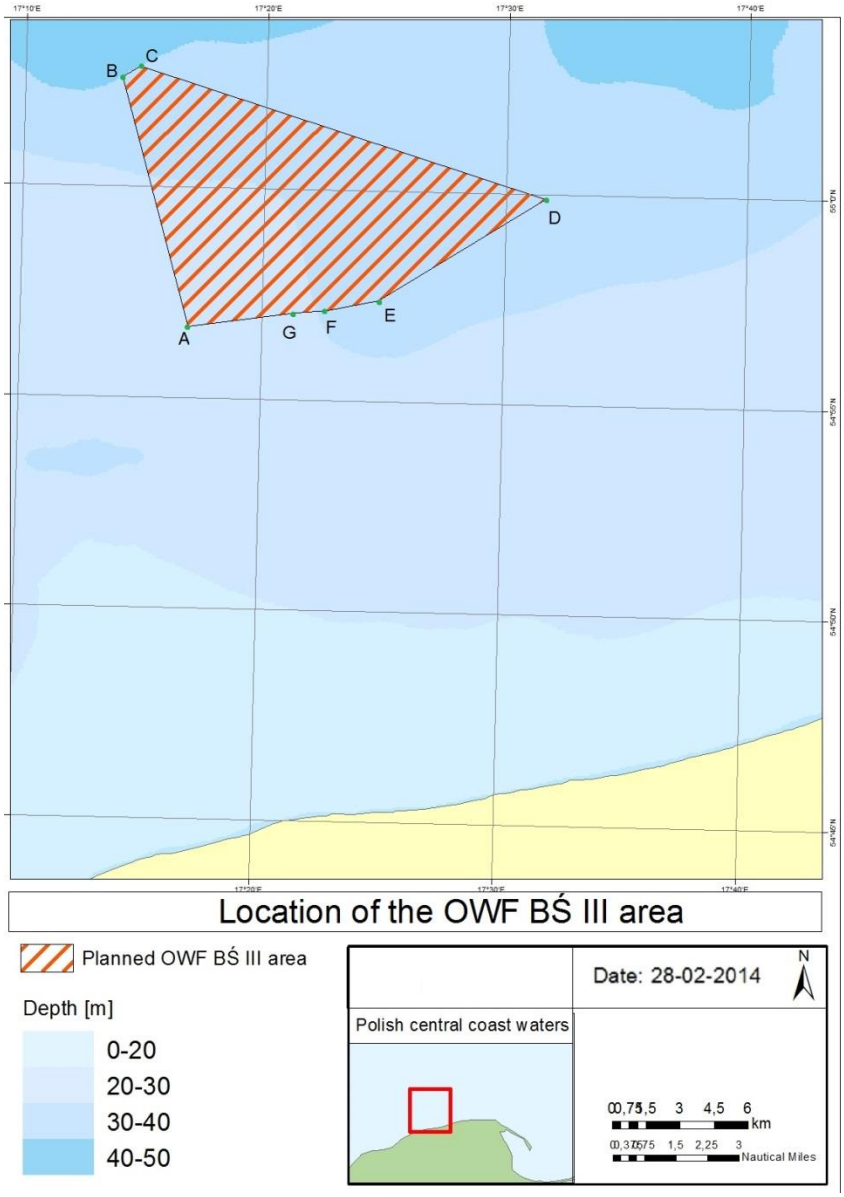

Fig. 13 Location of the OWF BŚ III area in relation to the Polish coast

Tab. 2 Coordinates of the points defining the boundaries of the OWF BŚ III area

OWF BŚ III location (WGS 84)		
Point	**Latitude**	**Longitude**
A	54° 56' 42,424"N	17° 16' 57,430"E
B	55° 02' 35,801"N	17° 14' 00,653"E
C	55° 02' 52,125"N	17° 14' 45,028"E
D	54° 59' 55,268"N	17° 31' 37,853"E
E	54° 57' 24,641"N	17° 24' 47,597"E
F	54° 57' 09,443"N	17° 22' 42,654"E
G	54° 57' 05,517"N	17° 21' 25,617"E

The total area of the farm is approximately 117 km^2 according to PSZW (license for construction and use of the artificial islands, installations and devices in the Polish maritime areas, obtained on 30 March 2012).

This area, as defined in PSZW, is reduced by the 500 m buffer zone from the inner boundary of the project implementation area, excluded from location of any structural elements of the farm. The size of the buffer 1 (500 m) is approximately 23 km^2. Size of the buffer 2 depends on the rotor size.

Therefore the maritime area available for implementation of the project is the area defined by PSZW, reduced by the area of buffer and reaches 89 km^2).

The BŚ III area is localised within the region characterised by humid – temperate climate conditions typical for the southern Baltic Sea.

4 Methodology used and activities carried out during the research period

4.1 Data collection

In order to collect data on marine mammal activity in the studied area, a passive acoustic monitoring, as well as a visual monitoring from an aircraft were carried out. The two different methods were used for increasing the effectiveness of the monitoring, as well as obtaining more data.

4.1.1 Passive acoustic monitoring

Acoustic monitoring was used to assess if harbour porpoises are present in the BŚ III area and, if so, if there is any seasonality of their occurrence.

For the passive acoustic monitoring, the continuous porpoise click-detectors were used (C-PODs, Chelonia Limited, UK – Fig. 15 C-PODs are fully automated, static data loggers of ultrasonic tonal sounds, which means that only sounds above a frequency of 20 kHz are stored. The C-POD consists of an 80 cm long plastic pipe (diameter 90 mm) containing a hydrophone with electronic filter and amplifier, as well as a SD flash card for data storing. Depending on the energy consumption, the ten 1.5 V batteries supply sufficient energy for 8 to 12 weeks of deployment. The SD flash card can save 4 GB of data. The hydrophone records sound omni-directionally, within the frequency range of 20–160 kHz. For each sound, the main frequency, duration, intensity, bandwidth and the envelope of frequency spectrum are logged. The envelope shows frequency on the x-axis and amplitude on the y-axis and indicates at which frequencies the amplitude is highest. Since harbour porpoises have very narrow frequency range with main energy around 130 kHz, their click envelope is quite characteristic and can be used for detection.

Use of C-PODs for detecting harbour porpoises is internationally accepted and these devices were also used in the SAMBAH project with the methodology of monitoring comparable to ours (e.g. Koblitz et al, 2013; SAMBAH, 2014) .

Fig. 15 C-POD (photo by Nick Tregenza)

The overall recording range of the C-POD for porpoise clicks is approximately 300 m (see investigations by Thomsen & Piper 2004; Gauger et al. 2012). During the monitoring at the BŚ III study site there were three C-PODs deployed at three localisations - stations 4, 5 and 6, which aimed at covering different parts of the area (Fig. 16, Tab. 3). Distances between the stations were between ca. 7 and 14 km and the instruments were localised at the depth around 30 m. The distances between the C-PODs localisations chosen for the project were suitable to detect the presence of porpoises in the studied area, at the same time avoiding the repetitive detections of the same individuals what could result in overestimations.

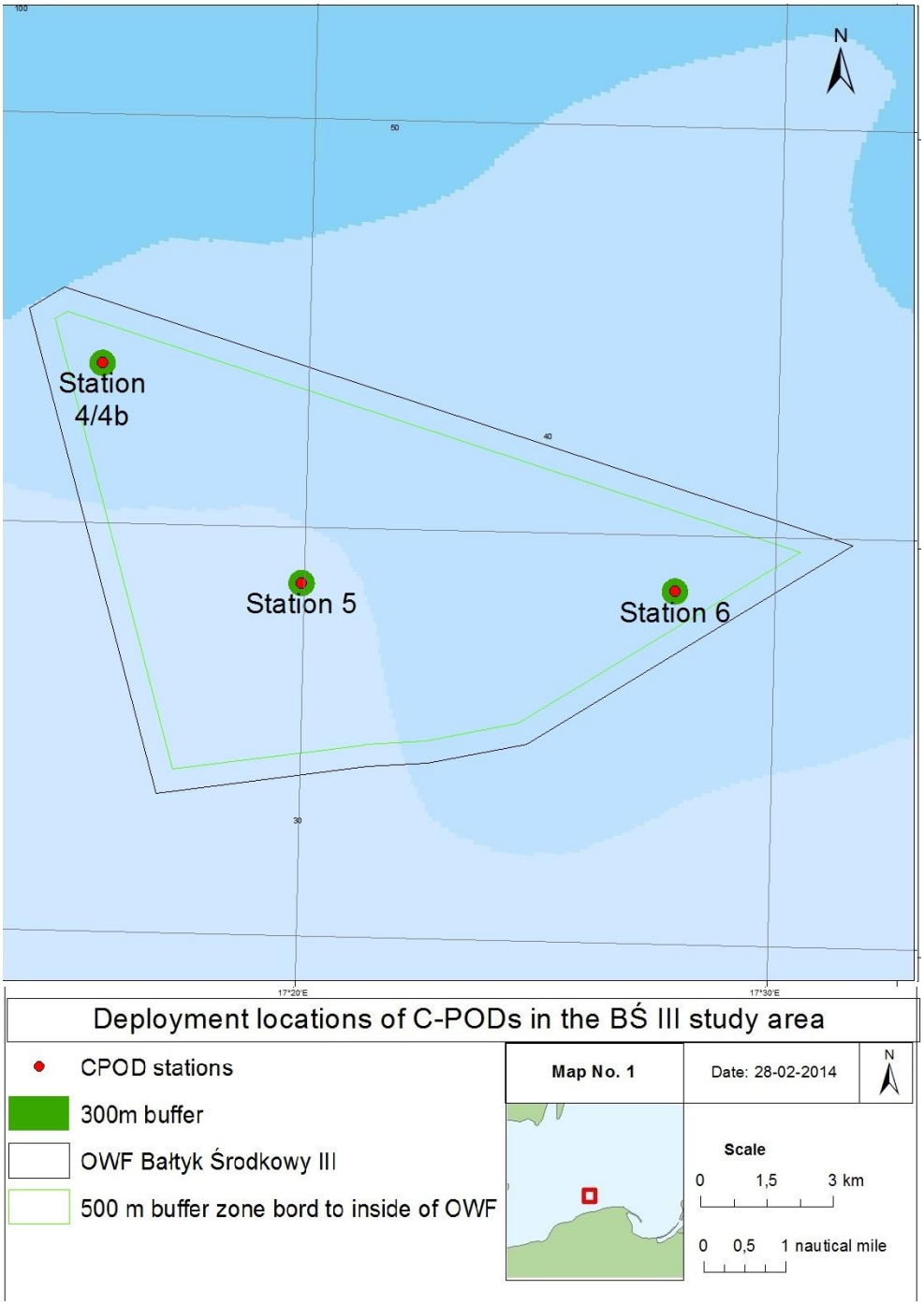

Fig. 16 The BŚ III study area with C-PODs deployment locations (red circles). The green area indicates the detection range of C-PODs

Tab. 3 Coordinates of C-PODs deployment locations at the BŚ III area (coordinates system WGS 84

	Coordinates	
Station	**Latitude**	**Longitude**
4	55°01'56,800" N	17°15'36,100" E
5	54°59'18,948" N	17°19'56,835" E
6	54°59'18,909" N	17°27'52,932" E

For deployment of the acoustic devices a safe anchor system was used (Fig. 17 - 18). A yellow warning buoy with a flashing lantern (2 nm range) marked the position of a heavy 600 kg concrete anchor block. The anchor was meant to protect the system against drifting by heavy currents or fishing gear. The anchor was connected via a 50 m long Tajfun rope to a small 90 kg anchor stone. A 10 m long danline rope with two loops (5 and 7 m above ground) was connected to the anchor. C-PODs were attached to the upper loop at each of the stations. Originally, for service procedures and security of the systems, an acoustic release system was used (Fig. 17). The acoustic release equipment was connected to the top of the danline rope. When the releaser was triggered, a submerged floating ball (size: 28 cm) surfaced and the small anchor stone could be retrieved together with the C-POD. However, as during the project works there were some problems with such a release system, at the later stages of the project it was changed into the simpler one. Instead of the acoustic releasers, the pop-up buys and floating ropes were used, which were much easier to operate and thus, retrieve the instruments (Fig. 18). C-PODs rotated between the different fixed locations over the entire term of the project.

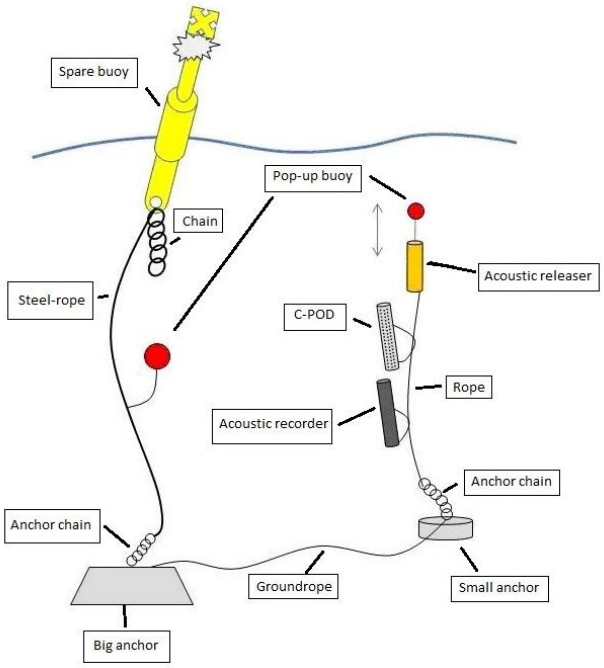

Fig. 17 Scheme of the anchor system used in the study area with the acoustic releaser system. (In the picture the acoustic recorded recorder can be visible, which was also part of the measuring set; see the ambient noise report.)

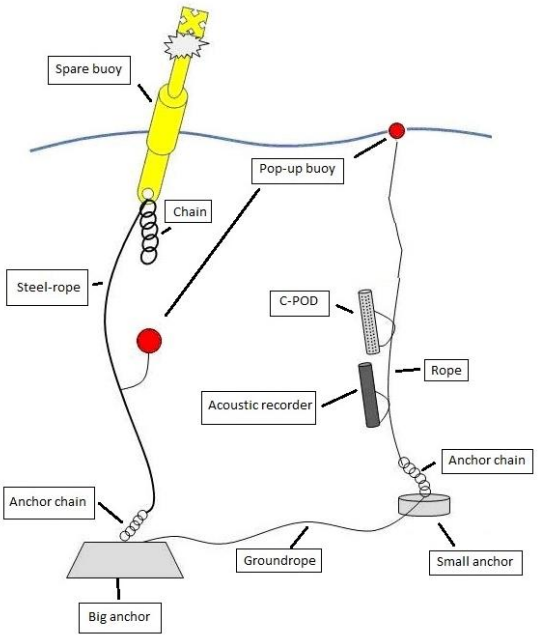

Fig. 18 Scheme of the anchor system used in the study area after replacing acoustic releasers by pop-up buoys. (In the picture the acoustic recorded recorder can be visible, which was also part of the measuring set; see the ambient noise report.)

The acoustic monitoring campaign began on 14 October 2012, when the mooring systems with C-PODs were deployed at the stations 4, 5 and 6 (Fig. 16, 19 and 20). At each of the stations, one mooring system with one C-POD was deployed (Tab. 4). From then on, the C-PODs were collecting acoustic data. The deployment of the instruments was carried out on the vessel owned by the Maritime Institute – r/v IMOR.

Acoustic instruments were serviced and data sets were collected during the maintenance cruises. The maintenance was carried out on the private ship-owner vessel - m/y Doktor Lubecki. Originally, the maintenance was planned to be carried out at six weeks' intervals, which aimed at decreasing the possibility of data losses. However, during the project, changes to the planned schedule had to be introduced, as many times the weather conditions made it impossible to work on the sea. Yet, the memory cards and the batteries used in C-PODs can record data for longer periods than our planned intervals (e.g. during the SAMBAH project, the maintenance of instruments was carried out every two – three months). Therefore, the six weeks' intervals were planned for safety, and longer brakes between the service cruises were acceptable. Detailed information from the cruises is presented in the table 4.

During the service cruises, apart from maintenance of the equipment and data collection, any necessary changes and improvements to the methodology used were introduced. Such works included for example a new solution for the acoustic releasers installation (upside-down in relation to their previous position in the water) at the beginning of the project, as well as replacement of the acoustic release system by the pop-up buoy system at the later stages of the project works. Any changes aimed at making the monitoring more efficient and increase safety during working on board. The monitoring finished on 30 November 2013, when the instruments from all of the three stations (4, 5 and 6) were retrieved and the last set of data was collected (Tab.4). Overall, the instruments were recording data for 259 (station 4) and 421 (station 5 and 6) days (see the results).

Fig. 19 The acoustic devices ready for the deployment

Fig. 20 Deployment of the mooring system

Tab. 4 Detailed information on C-PODs collecting data during the monitoring period at the BŚ III area

year	month	date of the cruise	no of the station	no of the C-POD	retrieval	deployment	comments
2012	October	14.10.2012	4	1862		+	first deployment of the equipment
			5	1999		+	
			6	1928		+	
	November	28.11.2012	4	1862			service not possible due to end of a day and w etaher deterioration
			5	1999	+		service successful, data collected
				327		+	
			6	1928	+		
				302		+	
	December	no cruise due to harsh w eather conditions					
2013	January	8.01.2013	4	1862			service not possible due to technical problems
			5	327	+		service successful, data collected
				2061		+	
			6	302			service not possible due to technical problems
		25.01.2013	4	1862	+		service successful, data collected
				327		+	
			6	302	+		
				1862		+	
	February	no cruise					
	March	13.03.2013	4	327	+		service successful, data collected
				302		+	
			5	2061	+		
				1862		+	
			6	1862	+		
				327		+	
	April	16.04.2013	4	327			equipment not found
			5	1862	+		service successful, data collected
				2209		+	
			6	327	+		
				2210		+	
		26.04.2013	4	327			equipment lost
				2061		+	deployment of the new set of the instruments
	May	no cruise					
	June	12.06.2013	4	2061	+		service successful, data collected
				2210		+	
			5	2209	+		
				1999		+	
			6	2210	+		
				2209		+	
	July	10.07.2013	4				equipment not found
			5	1999	+		service successful, data collected
				2209		+	
			6	2209	+		
				2061		+	
	August	21.08.2013	4		-	-	retrieval not possible du to technical problems
			5	2209	+		service successful, data collected
				2061		+	
			6	2061	+		
				1862		+	
	September	no cruise					
	October	3.10.2013	4		-	-	retrieval not possible du to technical problems
			4b	2061		+	deployment of the new set of instruments
			5	2061	+		service successful, data collected
				327		+	
			6	1862	+		
				2209		+	
	November	30.11.2013	4		-	-	equipment not found
			4b	2061	+		successfull last retrieval of the instruments, data collected
			5	327	+		
			6	2209	+		

4.1.2 Aerial surveys

The visual monitoring of marine mammals was an essential part of the baseline investigations as they provide so far the only means to estimate density and abundance of porpoises on a large scale (see Hammond et al. 2002). In all investigations undertaken so far, there is a very clear correlation between sighting rates and absolute densities (see e.g. Thomsen et al. 2007, 2007), so a low number of sightings indicate a low density area. In addition, the survey flights provide the only possible visual confirmation of the acoustic data that was gathered with C-PODs. This is vital especially in very low density areas as BŚ III as C-PODs are prone to false positives, i.e. wrongly identifying acoustic signals as being from porpoises. Furthermore, porpoise calves can only be identified using visual surveys. Finally, the surveys can be used to observe seals that transit the area, although it is usually difficult to identify species from a plane.

As outlined earlier, all large scale surveys on harbour porpoises undertaken so far in the Baltic indicate a clear seasonal pattern with highest densities in summer compared to winter and early spring (see, for example Gilles et al. 2007). Consequently, we planned the surveys to be undertaken mainly during spring - late summer with the two surveys in fall as control ones. No surveys were planned to be undertaken during the winter time.

The visual data on porpoise activity was collected during dedicated aerial surveys. There were six aerial surveys conducted - on 12 October 2012, 19 November 2012, 8 April 2013, 7 June 2013, 7 July 2013 and 12 September 2013 (Tab. 5).

Collection of data during the aerial surveys followed international standards (Hammond, 2002; Thomsen et. 2004, SCANS, 2006;BSH 2013.Data was collected only under good or moderate survey conditions (below Beaufort Sea State 3, visibility more than 5 km) and at a flying height of 600 ft. (183 m). Survey speed was approximately 100 knots (185 km/h, 115 mph) (). For safety reasons, only twin-engine high-wing planes were used. The plane type was a Partenavia P-68 Observer (Bioflight A/S, Holte; Fig. 21).

Fig. 21 Photo of the aircraft, pilot (black survival suit) and one observer - Jörg Hofmann (orange survival suit).

During the surveys in the year 2012, the study area comprised of approximately 6,000 km^2 covering the OWF BP and OWF BŚ III sites, while in the year 2013, the surveyed area included approximately 4545 km^2 covering the OWF BŚ II and OWF BŚ III sites (Fig. 22). During each of the flights, a total of six parallel transects were surveyed with a 10 km distance between the transects. The distances between the transects followed the international standards and were designed so that the recounting of animals was avoided (Hammond, 2002; Thomsen et. 2004, SCANS, 2006;BSH 2013.. Total transect length ranged from 426,76 km, up to 641,23 km. Due to different survey conditions during the flights, the survey effort varied amongst replicate surveys (Tab. 5 and 6, Fig. 23 - 28). The length of each of the flights was approximately one day.

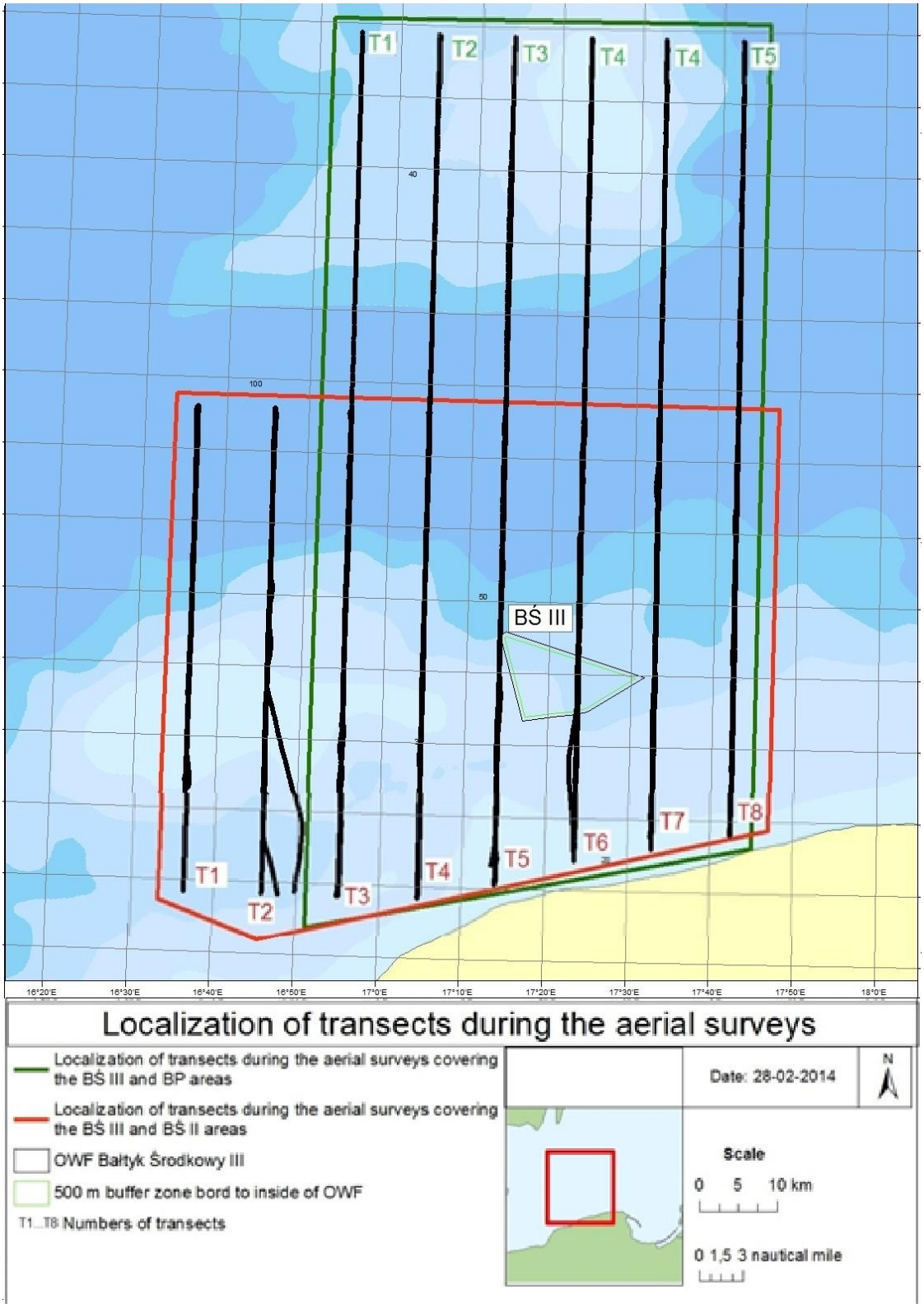

Fig. 22 Localisation of transects during the aerial surveys. In 2012 aerial surveys covered the BŚ III together with BP areas, while in 2013 – the BŚ III together with BŚ II

Tab. 5 Overview of the aerial surveys conducted during the visual monitoring of marine mammals at the OWF BŚ III area (T1 – T7 indicate numbers of transects during the flights)

year	season	date	aircraft	pilot	observers	comments
2012	autumn	12.10.2012	Partenavia P-68	Jesper Padborg	Scott Wischhof, Jörg Hofmann	covered completely, apart from the national park in the south; smaller parts invalid for higher seatstate (T2, T3, T6)
		19.11.2012	Partenavia P-68	Kasper Roland	Scott Wischhof, Jonas von Pein	transect 1 not covered for early fog at the airport; some parts shorter in the south for fog near the coast (T3, T4)
2013	spring	8.04.2013	Partenavia P-68	Henrik Vestergaard, Kasper Hoberg	Ina Kammigan, Annika Hill	transect 1 started north of the waypoint due to military activity
	summer	7.06.2013	Partenavia P-68	Wilfried Mielke, Peter Cipra	Ina Kammigan, Katharina Fließbach	in the southwest of the transect, a military active area which could not be covered (T1, T2)
		7.07.2013	Partenavia P-68	Wilfried Mielke, Peter Cipra	Jörg Hofmann, Miriam Waldmann	very long break (> 4 h) caused by a military activity
	autumn	12.09.2013	Partenavia P-68	Felix Schröder, Peter Cipra	Karsten Kohls, Katharina Fließbach	in the southwest and southeast military active areas which could not be covered (T1, T2, T6, T7)

Tab. 6 Detailed information on aerial survey transects during the flights for the marine mammals monitoring at the BŚ III area

year	season	flight date	n° of flight	observation height (m)	two-sided total transect length (km)	left side valid transect length (km)	right side valid transect length (km)
2012	autumn	12.10	1201	183	641,23	592,88	592,88
		19.11	1202	183	510,18	499,43	499,27
2013	spring	8.04	1301	183	466,96	447,30	426,30
	summer	7.06.	1302	183	448,24	428,94	448,24
		7.07.	1303	183	468,50	468,50	468,50
	autumn	12.09.	1304	183	426,76	426,76	426,76

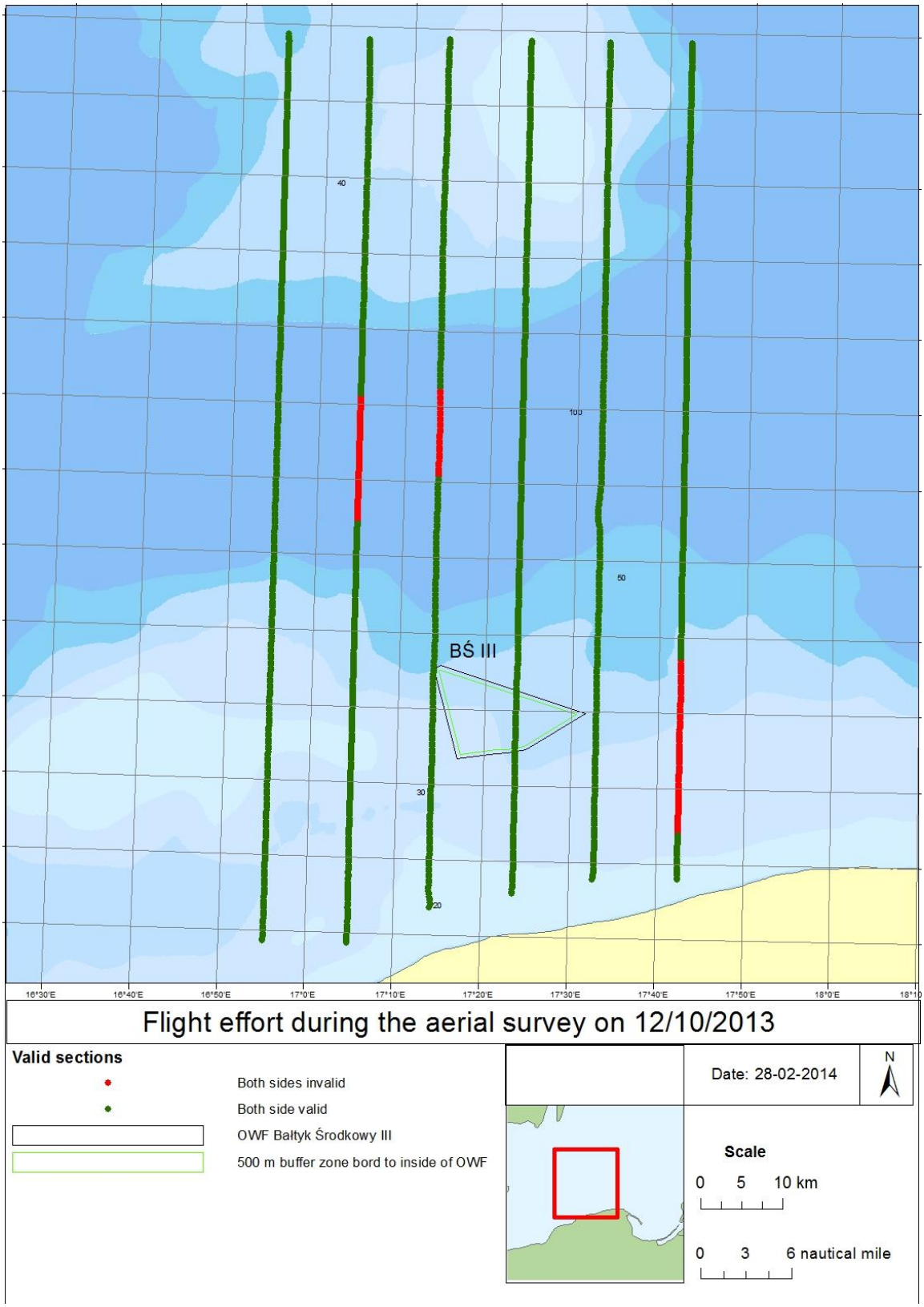

Fig. 23 Sketch of the flight effort made during the aerial survey on 12 October 2013 (grey shades indicate valid sections with appropriate sighting conditions)

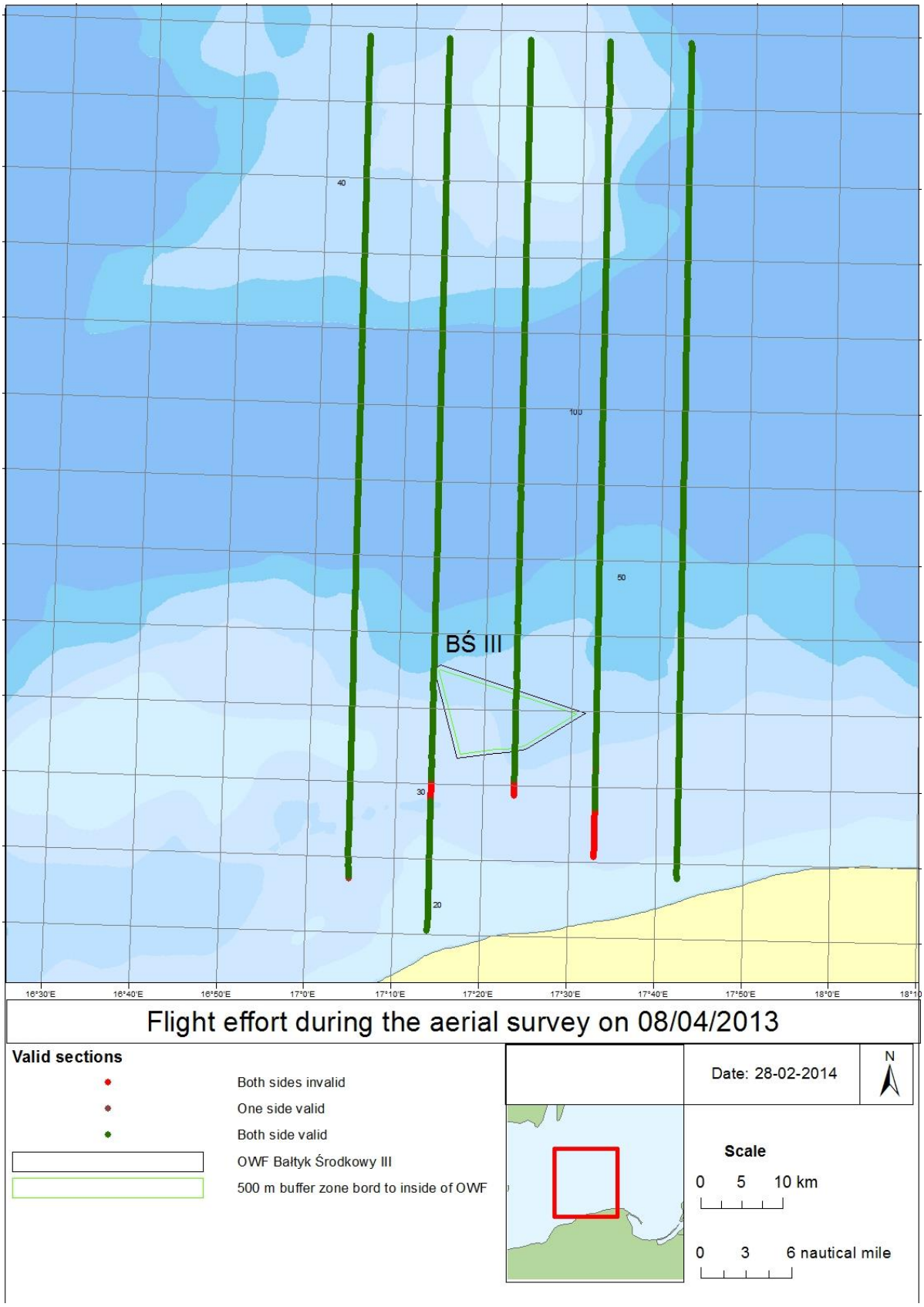

Fig. 24 Sketch of the flight effort made during the aerial survey on 19 November 2012 (grey shades indicate valid sections with appropriate sighting conditions)

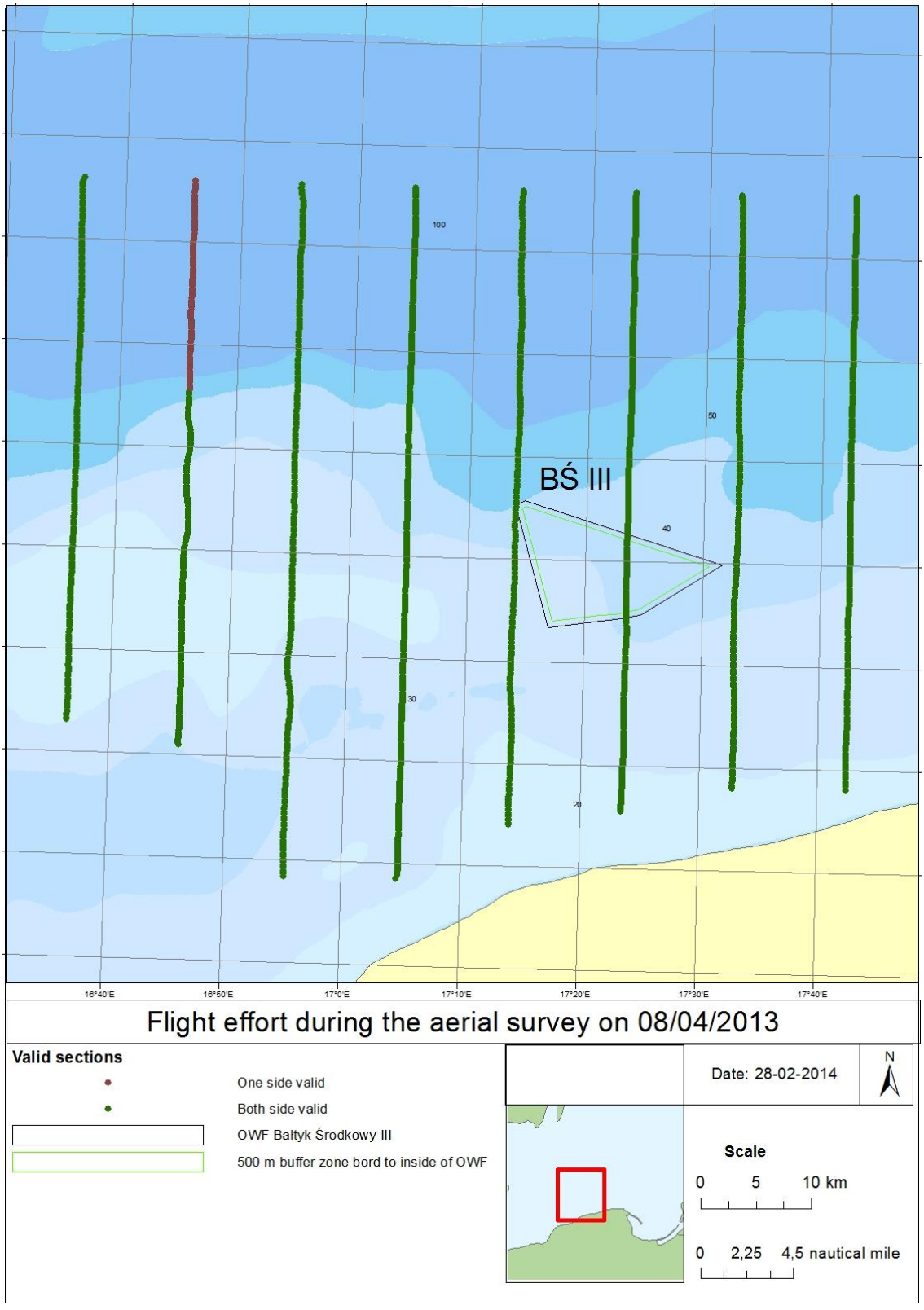

Fig. 25 Sketch of the flight effort made during the aerial survey on 8 April 2013 (grey shades indicate valid sections with appropriate sighting conditions)

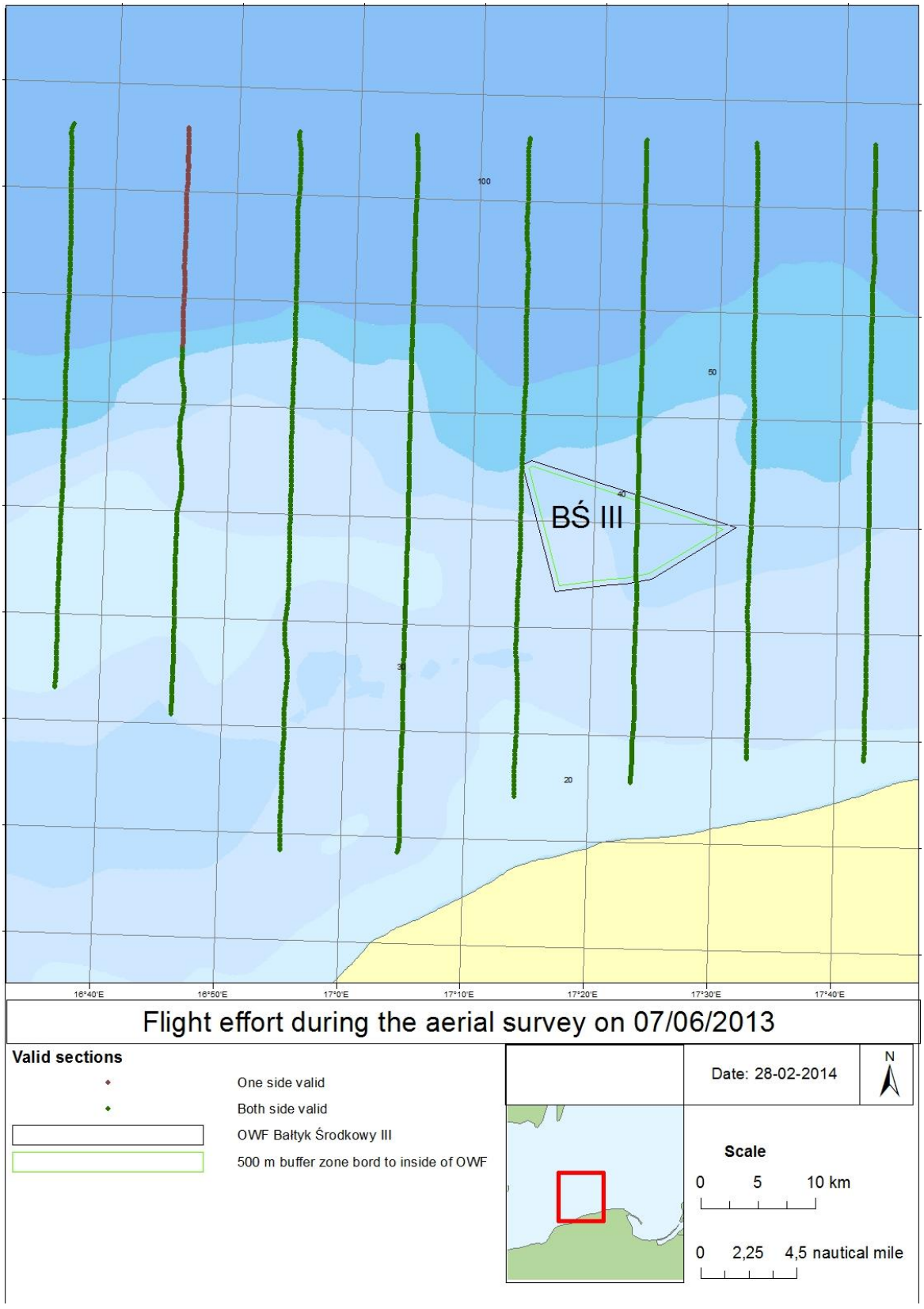

Fig. 26 Sketch of the flight effort made during the aerial survey on 7 June 2013 (grey shades indicate valid sections with appropriate sighting conditions)

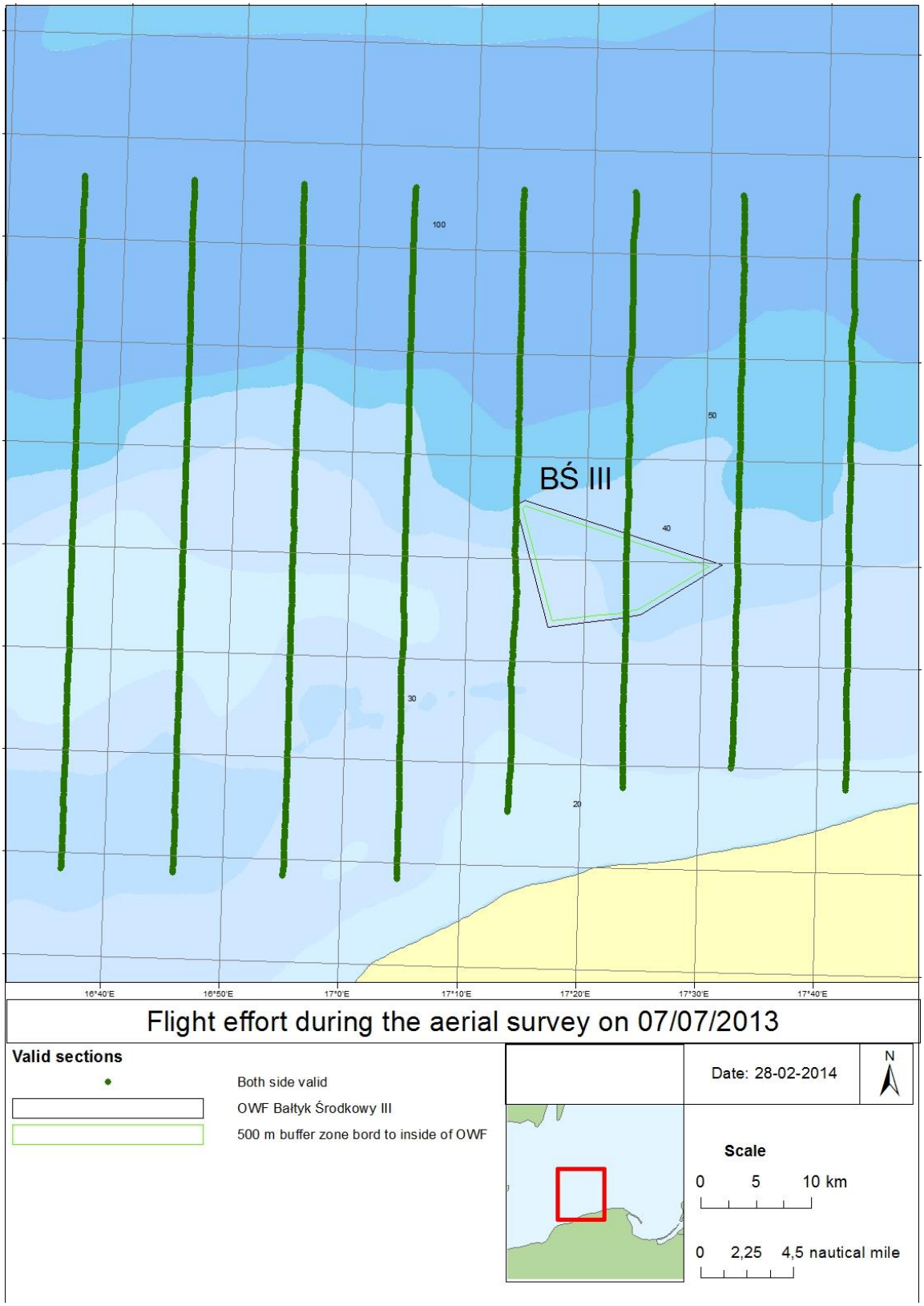

Fig. 27 Sketch of the flight effort made during the aerial survey on 7 July 2013 (grey shades indicate valid sections with appropriate sighting conditions)

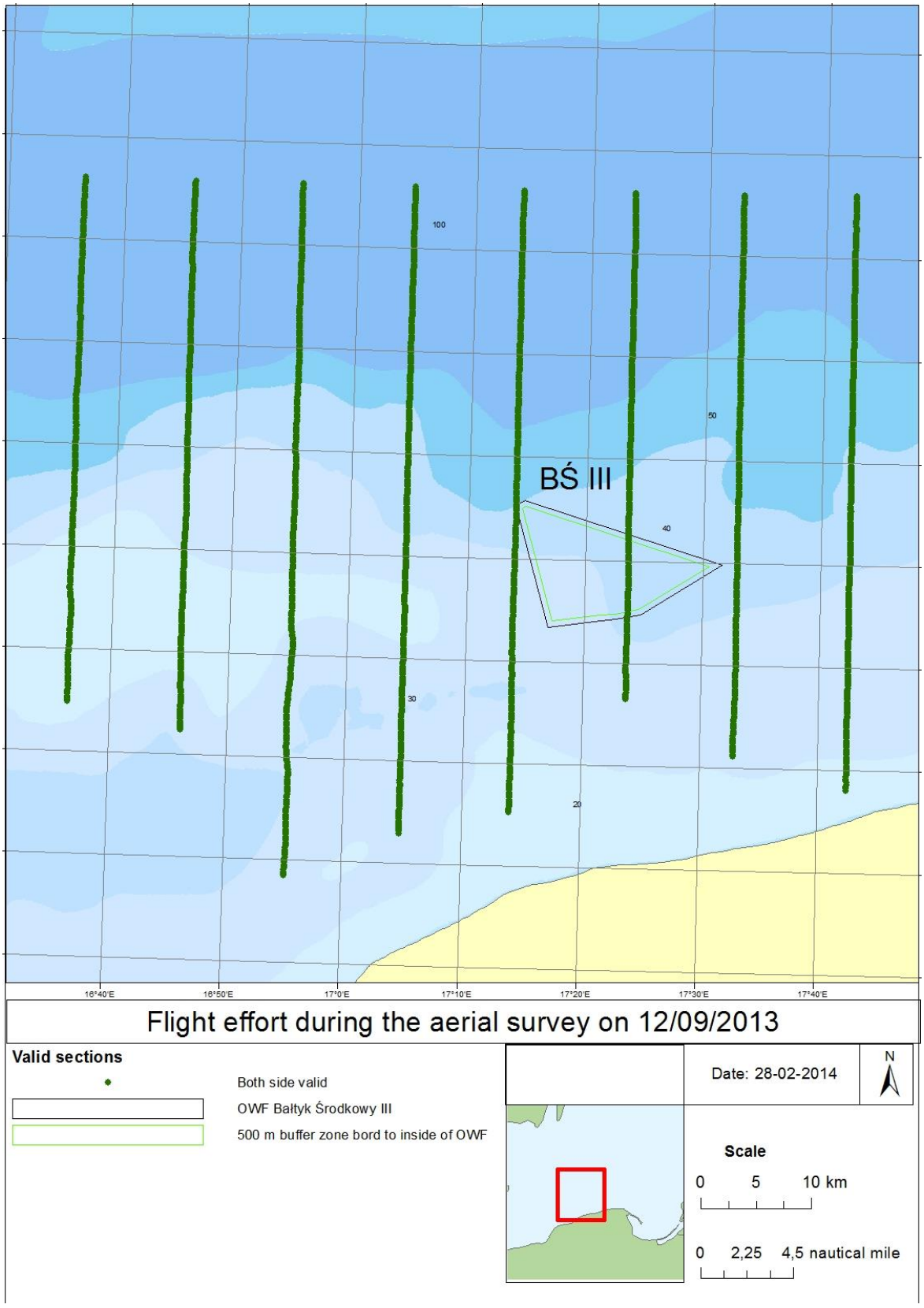

Fig. 28 Sketch of the flight effort made during the aerial survey on 12 September 2013 (grey shades indicate valid sections with appropriate sighting conditions)

The surveys were carried out following the distance sampling method of Buckland et al. 2001. Two experienced principal observers were placed at bubble windows which provided visibility directly below the plane and search angle = 0° ÷ <60° (where 0° is directly below the plane) (Fig. 29). Observ-

ers were acoustically isolated from each other through ear plugs and headphones. From the onset of the survey, the observers searched continuously for porpoises and other sea mammals. For each sighting, the exact time was noted (UTC, synchronized with on-board GPS) and recorded aurally on a dictaphone. The sighting angle was measured with an inclinometer (Suunto PM 5 / 360 PC) and also recorded. From the declination angle and the aircraft altitude, the perpendicular distance to the sighting was calculated. Additionally, data on group size and composition (presence of calves), travel direction and the behaviour of the animals was recorded.

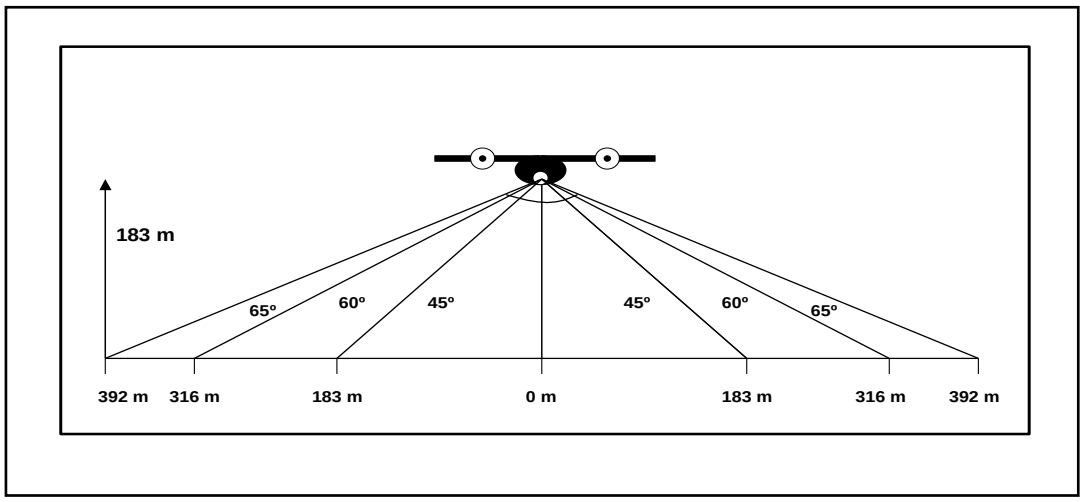

Fig. 29 Distance of sighting points from transect in relation to sighting angles (flight height = 183 m; from Thomsen et al. 2004)

The flight-track was logged and stored continuously in 3-second intervals by two GPS-units. Weather conditions (sea state, glare, cloud reflections, cloud coverage, precipitation and turbidity) were recorded at the start of each transect and whenever conditions changed (Annex 2).

It is worth noting that our visual monitoring was the first visual survey conducted in the Polish Baltic in different seasons of the year (before there was a singe aerial survey conducted in the Polish Baltic during the SCANS II project (SCANS, 2006).

4.2 Overview of the project activities conducted and assessment of the quality of results obtained

The harsh weather conditions appearing at the study site relatively often along the year, as well as problems with the instruments losses meant that it was impossible to carry out the project activities exactly according to the original plans. Table 7 presents an overview of the activities carried out and data obtained, as well as reasons for changes to the plans originally made for the monitoring. Table 8 includes a summary of completeness and quality of collected data.

Tab. 7 Overview of the activities planned for the marine mammals monitoring at the BŚ III study site, activities carried out and comments

Activities planned during the marine mammals monitoring for the EIA in the OWF BŚ III area	Activities carried out during the marine mammals monitoring for the EIA in the OWF BŚ III area	Comments
Marine mammals monitoring with a use of acoustic and visual method. For the acoustic monitoring - porpoise click detection with the use of C-PODs (continuous porpoise detectors) for twelve full months plus one month (not complete) when the monitoring started in the period October 2012 – end of October 2013. Three C-PODs at the study area, each one at a different station. Service of C-PODs and data collection during maintenance cruises. The cruises in six weeks intervals , during every cruise service of each station. For the visual monitoring - dedicated aerial surveys in the autumn, spring and summer months. Six surveys planned, out of which two in autumn 2012 and four in spring/ summer 2013.	Porpoise click detection with C-PODs between 14 October 2012 and 30 November 2013. Three C-PODs at the study area, deployed at the stations 4, 5 and 6 each. At the stations 5 and 6, no loses of the instruments, data collection during the whole period of the research. At the station 4, the instruments lost twice, data covering the periods 13 March 2013 – 25 April 2013 and 12 June 2013 – 2 October 2013 missing.. Twelve maintenance cruises – on 14 October 2012, 28 November 2012, 8 and 25 January 2013, 13 March 2013, 16 and 26 April 2013, 12 June 2013, 10 July 2013, 21 August 2013, 3 October 2013 and 30 November 2013. Aerial surveys on 12 October, 2012, 19 November 2012, 8 April 2013, 7 June 2013, 7 July 2013 and 12 September 2013.	Monitoring with C-PODs one month longer than the planned period. Service cruises in changed intervals due to harsh weather conditions on the sea making it impossible to carry out all the maintenance activities according to the planned dates. Acoustic monitoring at the stations 5 and 6 during the whole planned period. At the station 4, two gaps in the data collection caused by the loses of recording instruments. The first loss for unknown reasons. The second lost due to suspected entanglement of the instruments and harsh weather conditions making it impossible to conduct a complicated action of retrieval. Aerial surveys as planned.

Tab. 8 Summary of completeness and quality of data collected during marine mammals monitoring at the BŚ III study site

Acoustic monitoring		
station	**completness of data colected**	**quality of data collected**
4	62%	good
5	100%	good
6	100%	good
Visual monitoring		
six planned aerial surveys successfully conducted		

The EIA assessment described in this report was the first large scale monitoring campaign for marine mammals in support of an offshore wind farm license application in Polish waters. As the study site is placed in the area where poor weather conditions appear often, various difficulties had been expected. However, in spite of difficulties, a majority of the project activities was carried out according to the plan and important data on the marine mammals activity in the project area was collected. Regarding the acoustic monitoring results, complete data was obtained for the stations 5 and 6, while data representing the station 4 covered 62% of the research period. All the acoustic data collected was of a good quality. The visual monitoring was successful - all the aerial surveys planned were conducted and during each of them a great majority of the survey area was covered. It must be emphasised that the gap in acoustic data from the station 4 had no consequences for the validity

of the results, which can be justified by comparing our methodology with internationally accepted methodology of the SAMBAH project. During the SAMBAH monitoring of porpoises, C-PODs were distributed around the Baltic at distances of ca. 20 km from each other, while in our research, C-PODs were located at distances of 7 - 14 km apart. Thus, even losing some data from one of the stations, we still had a good coverage of the area. Moreover, during the period for which data from the station 4 was missing (spring/ summer season), there were aerial surveys conducted at the study site, which completed information on the porpoises activity.

Data obtained during the marine mammals monitoring gave a basis for the description of the general status of marine mammals at the area of a planned offshore wind farm. It provided information on the species occurring in the region and the scale of their occurrence. Due to the low numbers of animals recorded, it was however not possible to assess the absolute abundance, behaviour or clear seasonality of the animals recorded at the site. However, the data collected, especially in conjunction with the literature data, is the source of important information on the presence of marine mammals activity in the planned wind farm area and has to be taken into account during the EIA of the planned investment.

4.3 Other activities carried out

During the whole period of the BŚ III project, in order to improve the methodology used and increase the effectiveness of EIA activities carried out, there was a number of discussions within DHI staff, as well as between DHI and other institutions involved in the project (e.g. Maritime Institute in Gdańsk, Envia (vessel broker) and owners of individual vessels).

On 18 and 19 October 2012 a meeting was held in the Maritime Institute in Gdańsk. The main objective of the meeting was to discuss the methodologies of different aspects of baseline studies/surveys and EIA report being the main part of the development projects for Bałtyk Środkowy III The meeting also aimed to exchange information on responsibilities division and schedule of the project, in order to facilitate common understanding, increase productivity and ensure safety during operations on the sea.

Among the issues which numerous discussions concerned, were the improvements to the mooring system used, so that the monitoring was more efficient. Other important topics taken into consideration during the project meetings were safety during the activities on board, as well as improvements to the vessel ‘Doctor Lubecki’. One of the suggestions implemented by the owner of the ship was the installation of a new winch.

During the whole period of the project a lot of attention was put into increasing qualifications of people involved in the project, as well as expanding knowledge in the topics covered by the project. For this reason, DHI staff participated in different courses, conferences and workshops held around the world.

4.4 Data analysis

4.4.1 Acoustics

Collected data was downloaded and processed using C-POD.exe (Chelonia Ltd., UK). Analyses with the C-POD software followed standards given by Nick Tregenza (C-POD’s manufacturer and author of the software) and internationally accepted for the Baltic Sea, as the area of low porpoises abundance. As the primary classification of the collected sounds, the KERNO classifier was used. Through the KERNO classifier algorithm, the C-POD software automatically identifies click trains (clusters of clicks) and puts them into four different quality classes (e.g. high or moderate quality) according to the probability of being random or coming from porpoises. Moreover, based on the frequency, interval between clicks and other parameters, the sources of the click trains are classified into four different species classes – as narrowband high frequency species (i.e. porpoises), sonars, other cetaceans or unknown sources.

Apart from the KERNO-classifier, the data was analysed using a secondary classifier - HEL1 - the algorithm developed especially for the eastern part of the Baltic Sea to check for false positives (the clicks classified as made by porpoises, while their real source is different). The use of secondary classifiers is recommended by the C-PODs manufacturer for areas with low porpoise abundance, and aims in validation of the results obtained with the primary classifier. There are different secondary classifiers implemented in C-POD.exe and they work for different geographic areas. The HEL1 is one of them and was developed in February 2010 as a result of the workshop on the classification of harbour porpoise clicks that was held in Hel (Poland) in February 2010. The HEL1 classifier removes most of the false positives from the detection results, however, in the case of very low number of detections, a visual validation of the results is always necessary. Thus, in order to confirm the correctness of the automatic classification, each revealed porpoise detection was visually validated.

4.4.2 Sightings

After the flights, the GPS-tracks (Positions and UTC time/date) were imported into the SQL-Database (Fulmar). During the import, tracks were filtered to identify transects and these were named. Gaps or mistakes (track points out of area) were corrected. All the information from dictaphones was transcribed into the same database and associated by time with the track. Based on the observer field notes detailing conditions (Annex 2), the effort and observations (possible double sightings of main observers under the plane) were assigned valid or invalid for each of the observers.

After Buckland et al. (2001), between 60 and 80 sightings are necessary to derive a robust density estimate from aerial surveys. Our own experience from very extensive surveys undertaken in the North Sea indicates that estimates can be undertaken with a lesser count, although some conditions have to be fulfilled (for example a relatively even distribution of sightings across the transects). As a tool for smaller areas with lower sightings, Thomsen et al. (2004) provide details on how to estimate absolute densities using a global detection function that is derived based on the sightings which are pooled from all surveys undertaken in a given period. The same method was applied for the SCANS I and II surveys (Hammond et al. 2002, 2006). Yet, in this case, the overall number of sightings was still too low to make any reliable density estimates. The description of results will thus be restricted to a general occurrence of porpoises and other marine mammals.

5 Results

5.1 Acoustic monitoring results

During the acoustic monitoring of marine mammals at the BŚ III study site, C-PODs from the stations 5 and 6 collected data covering 421 days which gives a representation of the whole time span of the research. C-PODs at the station 4 recorded data covering 259 days, which is 62 % of the monitoring period. Periods of time with no data from the station 4 include 13 March – 25 April 2013 and 13 June – 2 October 2013 (Tab. 9). Gaps in the data sets were caused by losses of the recording instruments (see chapter 3.1).

Analysis of the data, including classification with the KERNO and HEL1 algorithms along with a visual validation, revealed five detection positive days (DPD) during the whole monitoring period, which means five records of the harbour porpoise presence in vicinity of the monitored stations . Records were made for all of the stations (4, 5 and 6), as well as for all seasons of the annual cycle. During the winter time, one detection was registered on 24 December 2012 (station 6). During spring, two detections were made – on 4 and 26 May 2013. In the summer time, there was one detection on 30 June 2013, while in autumn, the record came from 28 October 2013 (Tab. 10).

It is worth noting that some of the detection positive days classified by the algorithms had to be rejected during the visual validation of data as they represented either false positives.

Tab. 9 Overview of data collected during the acoustic monitoring with C-PODs at the BŚ III study site

station	no. of days with data collection	%of the monitoring period	periods with no data	comments
4	259	62%	13 March – 25 April 2013; 13 June – 2 October 2013	gaps in data caused by the loses of instruments
5	421	100%	-	data complete
6	421	100%	-	data complete

Tab. 10 Number of detection positive days (DPD) with the narrowband-high frequency (NBHF) species encounters and harbour porpoise encounters, revealed by the KERNO and HEL1 classifiers and visually validated for the data collected during the acoustic monitoring of marine mammals at the BŚ III study site

year	season	month	station	no. of DPD with NBHF encounters - KERNO classifier	no. of DPD with harbour porpoise enounters - HEL1 classifier	no. of DPD - visual validation of HEL results	comments
2012	autumn	October*	4	0	0		*concerns period 13 - 31.10.2012
			5	2	0		
			6	1	0		
		November	4	0	0		
			5	0	0		
			6	2	0		
	winter	December	4	0	0		
			5	4	0		
			6	8	2	1 detection rejected, 1 detection **accepted**	rejected detection on 8.12.2012 - false positive; detection accepted on 24.12.2012
2013		January	4	2	0		
			5	0	0		
			6	8	0		
		February	4	7	1	detection rejected	rejected detection on 13.02.2013 - false positive
			5	0	0		
			6	1	0		
	spring	March	4 *	1*	1*	detection rejected -	*concerns period 1 - 12.03.2013; 13.03. - 31.03.2013 no data; rejected detection on 3.03.2013 - false positive
			5	2	0		
			6	0	0		
		April	4*	0*	0*		*concerns period 26 - 30.04.2013; 1 - 25.04.2013 no data
			5	2	0		
			6	4	1	detection rejected	rejected detection on 14.04.2013 - false positive
		May	4	1	**1**	**accepted**	detection on 27.05.2013
			5	3	1	**accepted**	detection on 4.05.2013
			6	2	0		
	summer	June	4*	0*	0*		*concerns period 1 - 12.06.2013; 13 - 30.06.2013 no data
			5	1	0		
			6	1	**1**	**accepted**	detection on 30.06.2013
		July	4	-	-		no data
			5	1	0		
			6	0	0		
		August	4	-	-		no data
			5	0	0		
			6	0	0		
	autumn	September	4	-	-		no data
			5	0	0		
			6	0	0		
		October	4*	0*	0*		*concerns period 3 - 31.10.2013; 1 - 2.10.2013 no data
			5	3	1	**accepted**	detection on 28.10.2013
			6	0	0		
		November	4	0	0		
			5	3	0		
			6	0	0		

5.2 Visual survey results

During six aerial surveys conducted for the visual monitoring of marine mammals at the BŚ III area, nine individuals of marine mammals were recorded. Among the animals observed, five specimens were harbor porpoises and four belonged to seals. The porpoises were recorded in April (two individuals), June (one individual) and July (two individuals) 2013. All the animals were adult. Observations of seals were made in October 2012 - one unidentified individual and April 2013 – one individual of the grey seal and two individuals of the harbor seal. Details of the records and their distribution are presented in the table 11 and figures 30 - 33. Pictures of the animals observed were not taken, as it is very difficult to do. Trials of taking pictures might result in losses of observations of other animals present in the observed area during the survey.

Tab. 11 Observations of marine mammals at the study area made during the aerial surveys in autumn 2012 and spring, summer 2013 (coordinates system WGS 84

year	season	flight date	n° of transect	observation time (UTC)	coordinates		species observed	n° of individuals	age	behaviour
					lattitude	longitude				
2012	autumn	12.10.2012	1201	11:17:11	55,3243	16,9198	unidentified seal	1		sw imming
		19.11.2012	1202	no observations						
2013	spring	8.04.2013	1301	12:20:19	55,1559	16,9207	*Halichoerus grypus*	1		sw imming
			1301	13:07:46	55,1182	17,2345	*Phocoena phocoena*	2	adult	sw imming
			1301	13:23:41	55,1583	17,3937	*Phoca vitulina*	2		sw imming
	summer	7.06.2013	1302	09:40:40	55,2633	17,7085	*Phocoena phocoena*	1	adult	sw imming
		7.07.2013	1303	10:25:05	55,213	16,9217	*Phocoena phocoena*	1	adult	sw imming to the south
			1303	11:32:50	54,9225	17,393	*Phocoena phocoena*	1	adult	sw imming to the w est
	autumn	12.09.2013	1304	no observations						

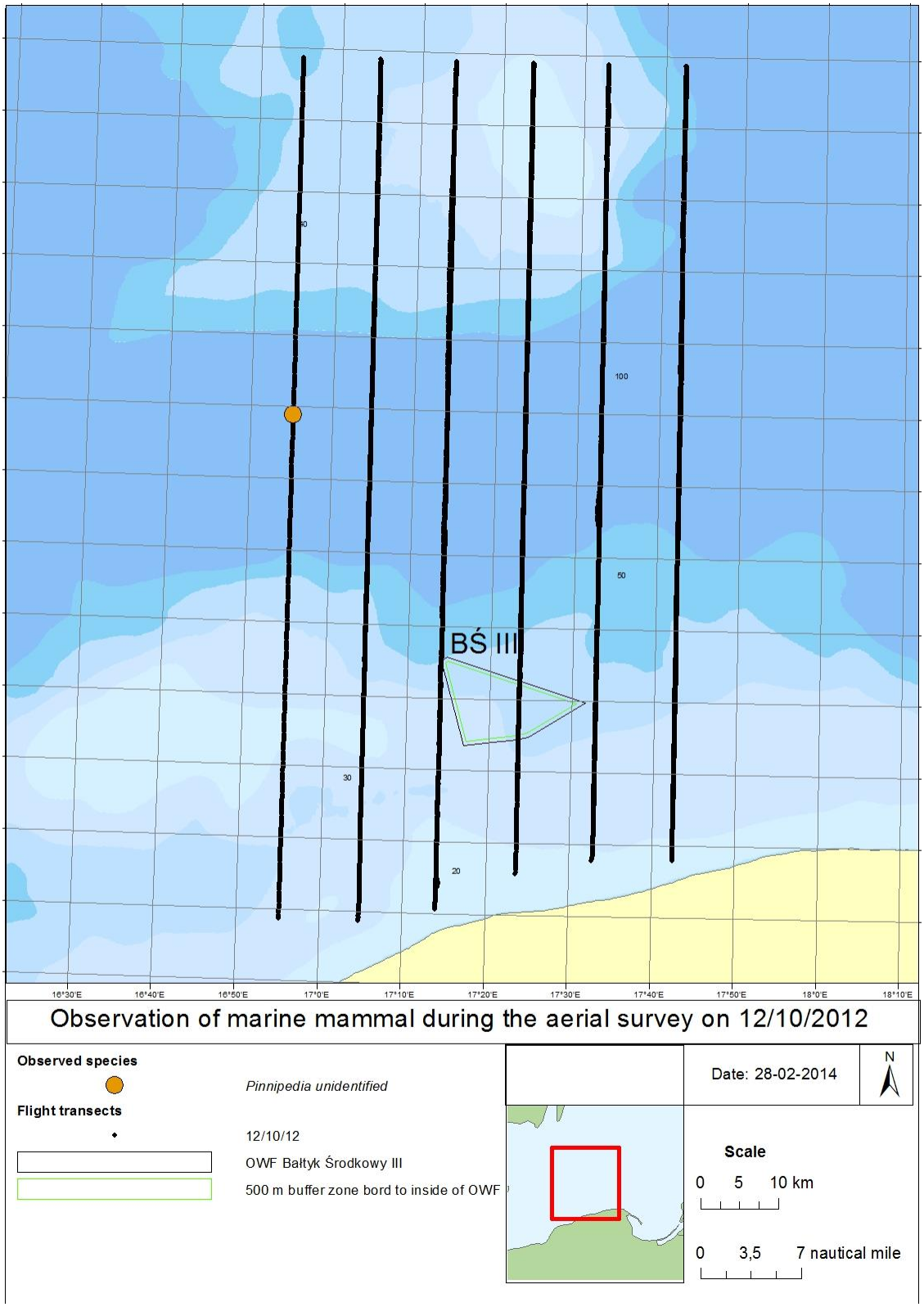

Fig. 30 Observation of marine mammal at the study area made during the aerial survey on 12 October 2012

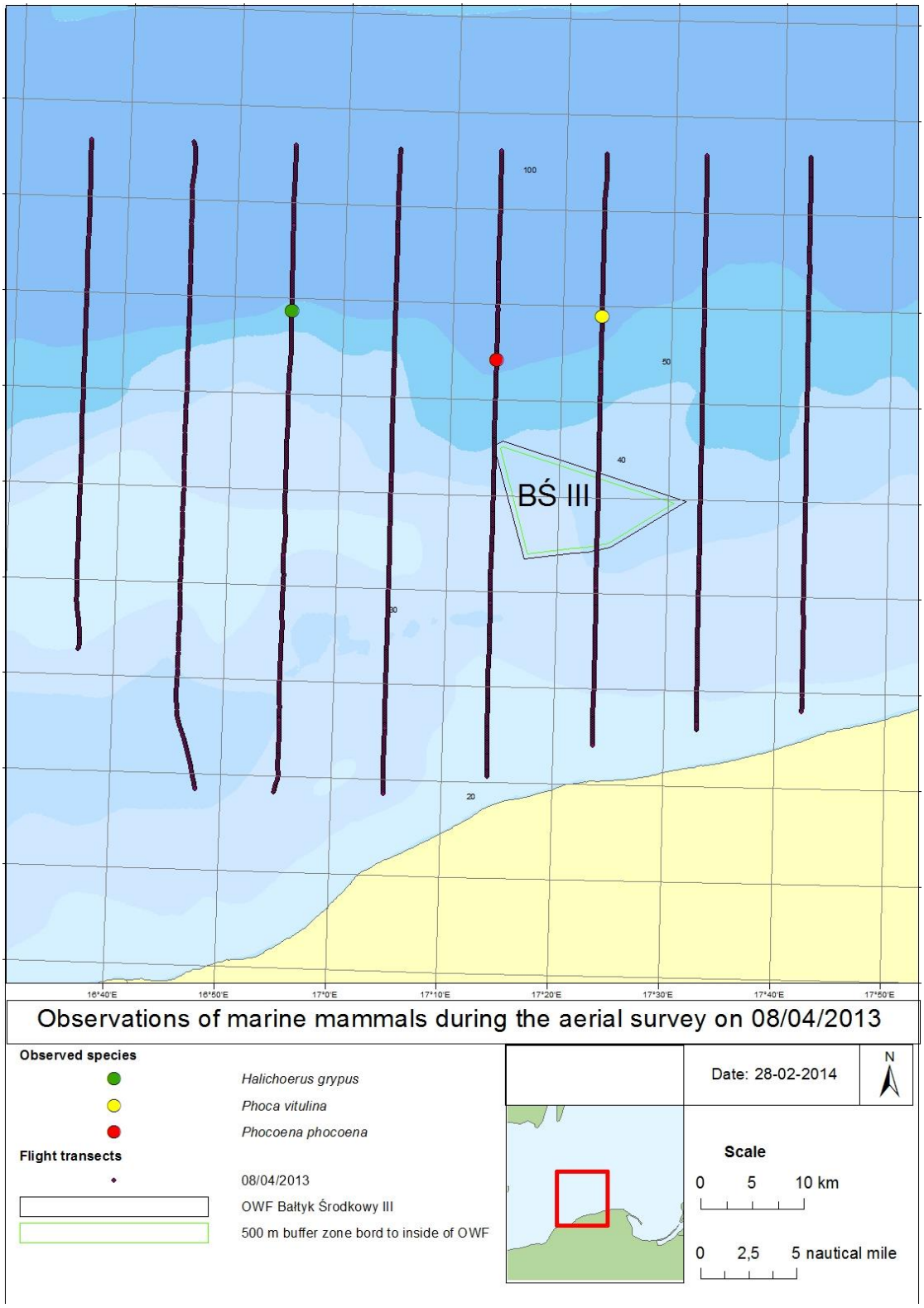

Fig. 31 Observations of marine mammals at the study area made during the aerial survey on 8 April 2013

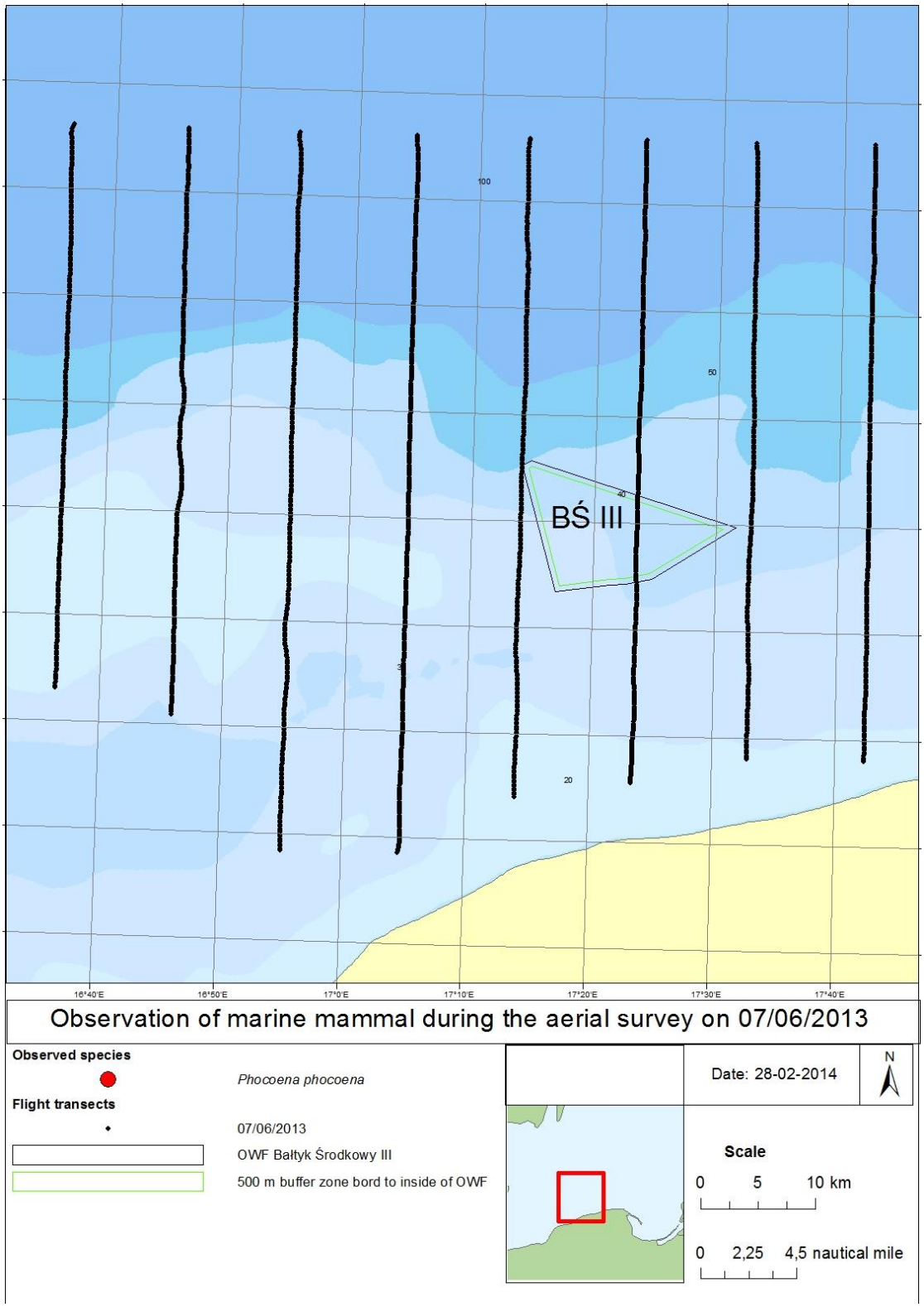

Fig. 32 Observation of marine mammal at the study area made during the aerial survey on 7 June 2013

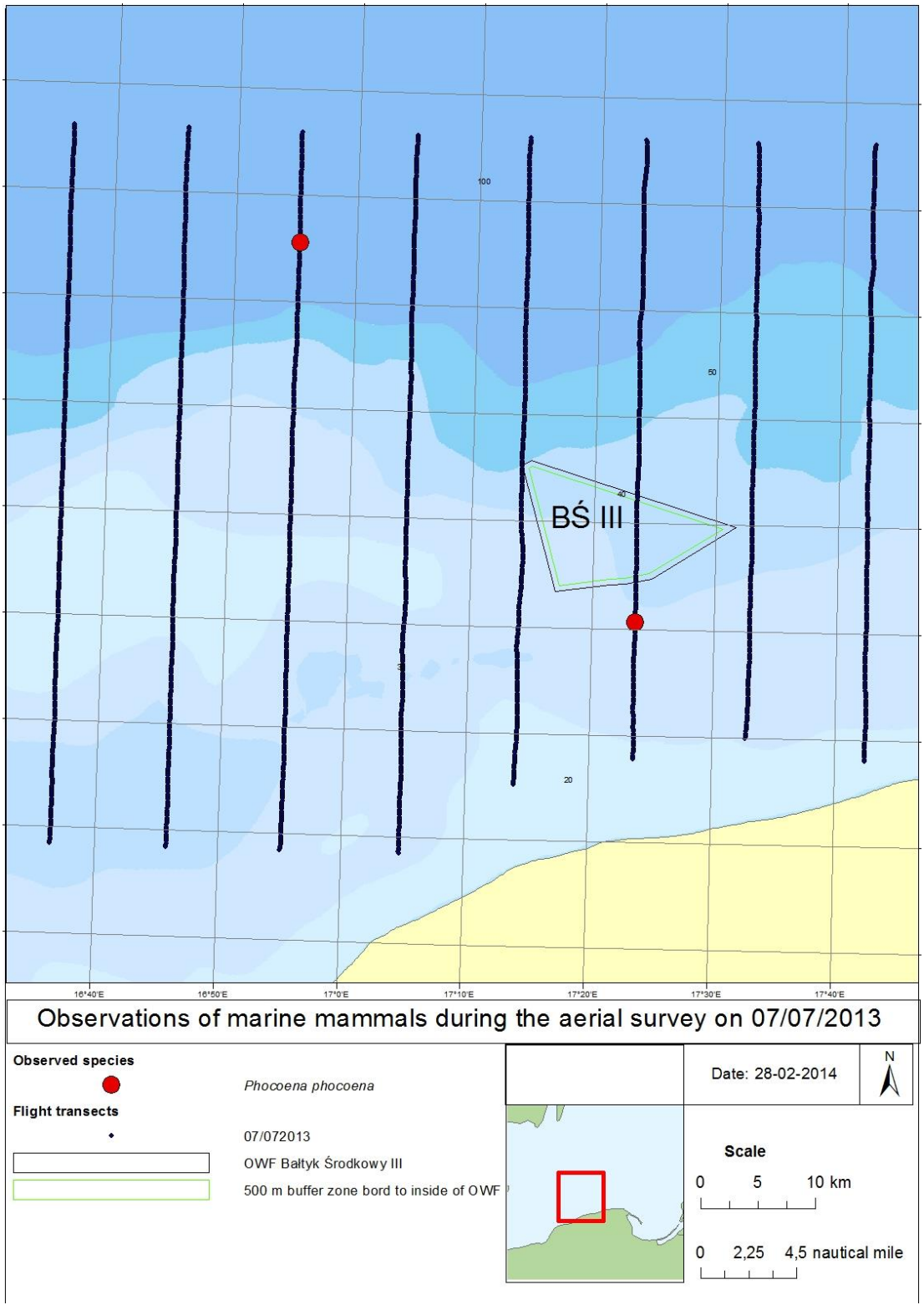

Fig. 33 Observations of marine mammals at the study area made during the aerial survey on 7 July 2013

6 Discussion

6.1 Status of marine mammals at the study site

The results of both acoustic and visual monitoring at the BŚ III study site revealed that marine mammals do occur in the area of the research. Among the animals recorded were both harbour porpoises and seals. The species of observed seals included grey seal, harbour seals and individuals of unidentified species. Marine mammals were recorded in all of the seasons of the annual cycle, with most of the records made in spring season (Fig. 34).

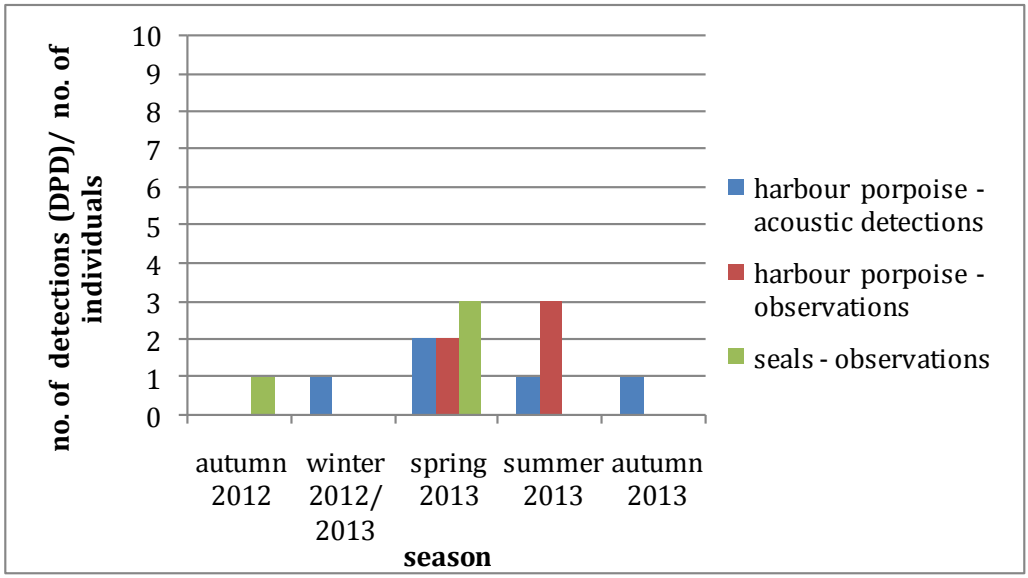

Fig. 34 Number of records of marine mammals made during different seasons of the acoustic and visual monitoring at the BŚ III study area (DPD – detection positive day)

As presented in figure 34, during the spring 2013, a total of seven mammals records was made, which represented two days with positive acoustic detections of harbour porpoise, observations of two individuals of this species during the aerial surveys, as well as sightings of three individuals of seals. In the summer season, the number of harbour porpoise records was the same as during the summer time – there were four records of this species, within which three included visual observations and one was an acoustic detection. Seals were not sighted in the summer. It is important to notice, that during the winter period the aerial surveys were not conducted so individual porpoises and seals that have travelled through the area might have gone undetected. Yet, acoustic monitoring in winter showed only one detection indicating that activity was low.

The distribution of marine mammals recorded during the monitoring is presented in the figure 35. It is visible that harbour porpoises occur both within the area of the planned offshore wind farm and in the wide area beyond it (based on the aerial surveys results – up to over 30 km from the buffer zone of the BŚ III area). Seals were observed out of the BŚ III site, also up to over 30 km from the BŚ III site buffer zone.

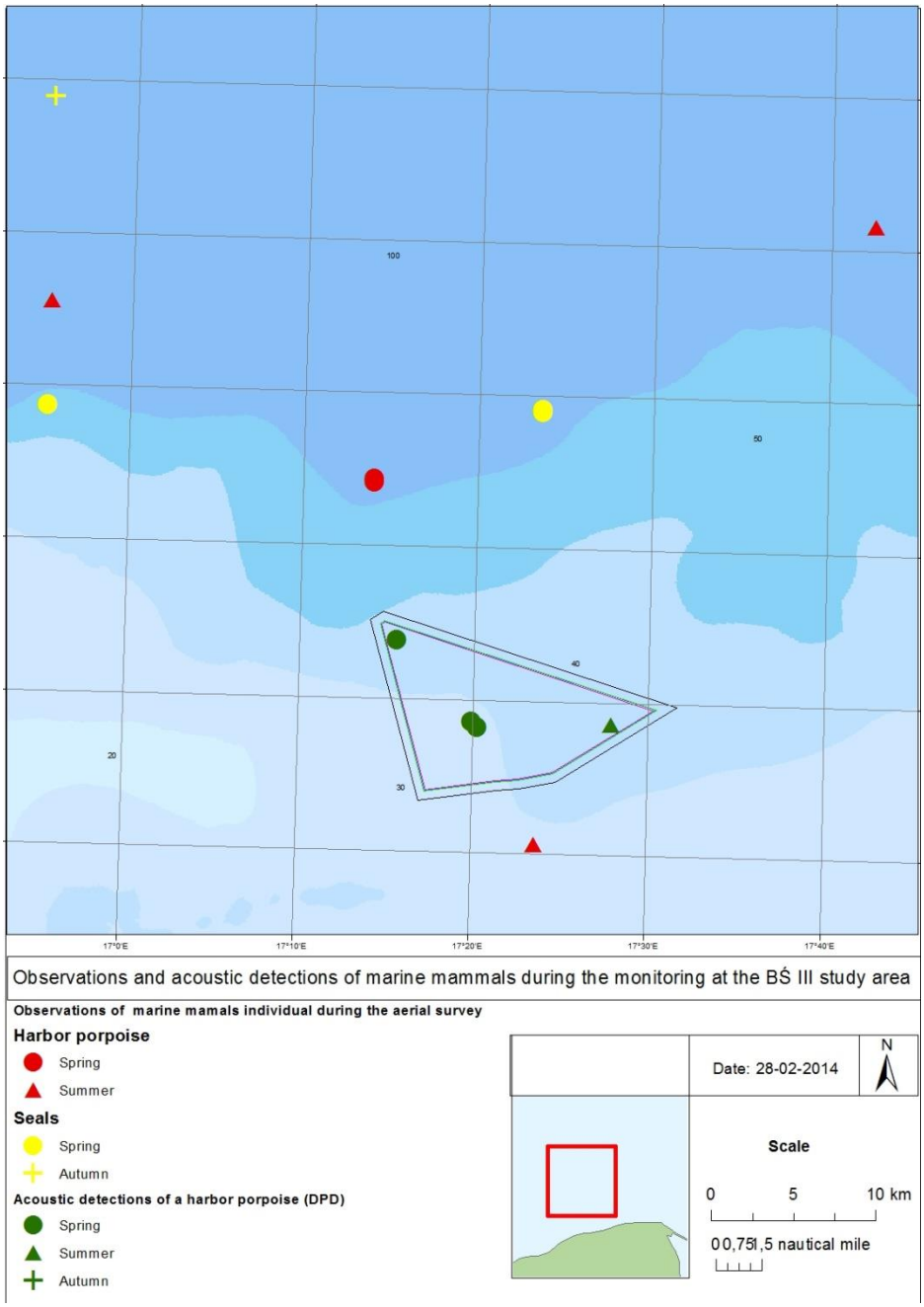

Fig. 35 Distribution of records of marine mammals made during different seasons of the acoustic and visual monitoring at the BŚ III study area (DPD – detection positive day)

6.2 Harbour porpoise

Monitoring of marine mammals conducted at the BŚ III area confirmed that harbour porpoises are present in open waters of the Polish Baltic, however their activity is very low. Such results are in line with other studies conducted and published so far (e.g. Koschinski, 2002; Gillespie, 2005;SCANS, 2006 ;; SAMBAH, 2014) which show a low rate of porpoises occurrence in Polish waters. Detailed information on the areas of special importance for porpoises in the Polish Baltic is not known yet. However, published preliminary results of SAMBAH present this region as the area of low acoustic detection rate (SAMBAH, 2014).

It is worth here to emphasise the importance of joining the acoustic monitoring method with the visual surveys, which makes the conclusion on the low abundance of the porpoises in the BŚ III area more reliable. The aerial surveys have proven to be by far the best method to document abundance and distribution of marine mammals on a large scale. Most investigations on porpoises clearly show that the probability of missing a porpoises that is present either due to observer mistakes or the animals being submerged and not detectable, is between 0,20 and 0,3 (Hammond et al. 2002; Thomsen et al. 2004, 2005, 2006, 2007). This means that for every animal counted, between two and four are missed. Since during the visual monitoring at the BŚ III site, 1-2 animals were seen per single survey (zero-count surveys are not included), it is likely that on any given flight no more than eight porpoises occurred in the study area. This would yield absolute density estimates that are extremely low in comparison to other investigations (see, for example Thomsen et al. 2005 for an overview). Even if we assume that due to random errors numbers could fluctuate, it is clear that the area of BŚ III is comprising a low density of harbour porpoises, as was shown also by the acoustic monitoring.

Based on visual monitoring data obtained during our research, it might be assumed that the area in and around the BŚ III wind farm, is not of a particular importance for the porpoises as a breeding site, as no calves were observed during any of the surveys.

As it is reported, porpoises show a migratory behaviour on a regional scale in response to changes in water temperature and availability of prey (Koschinski, 2002). They are opportunistic feeders and migrate to the areas with abundance of fish to forage. In the Baltic Sea region, their main prey items are herring sprat and cod (ICES, 2006). Their diet also often contains benthic and demersal species (Read 1999, Boerjesson *et al.* 2003). Based on this knowledge and data on the fish stocks in the study site, the animals recorded in the BŚ III area and adjacent waters might have occurred in this region to forage. The monitoring of ichtyofauna conducted in the BŚ III area by National Marine Fisheries Research Institute (MIR) in the period parallel to our study time, showed the presence of fish species which make up the diet of porpoises. According to MIR data, the most abundant species recorded in the area of BŚ III were sprat, cod, herring and flounder which all belong to species preferred by porpoises (MIR, 2014). Moreover, revealed by MIR, significant increase in the sprat and herring abundance in the early summer time (July, 2013) coincided well with a higher number of porpoises detections in this season shown in our study. Thus, it could be concluded that BŚ III serves as a feeding ground for porpoises; however, considering the low number of porpoise records, its importance does not seem to be significant. Moreover, we have no certainty about the reason for porpoise presence in the research site, as no unequivocal behaviour was observed during the visual monitoring. It is therefore also possible that recorded animals just migrated through the study region.

Based on the research made at the BŚ III site it is difficult to clearly assume on the seasonality of porpoise occurrence in the monitored area. Since there were very few records of animals made along the year, any trend identified on the basis of such data would be highly prone to random errors. As can be seen in the figure 21, our research showed a higher rate in the porpoise occurrence in the spring/ summer period. Such a result does not stay in line with results obtained during other along-year studies in the Polish Baltic waters – in the Puck Bay. The acoustic monitoring of porpoises conducted in the Puck Bay by Kosecka et al. (2013) in the years 2009 – 2011 showed higher numbers of porpoise detections in the winter months. Also the by-catch events recorded in the Bay by the Hel Marine Station between 1986 and 2009 were of a higher rate in the cold month of March (Kosecka et al., 2013). However, as the character of these two studies differed from our study (see the introduction), as well as there is no data on the porpoise movements around the Polish waters, it is difficult to compare results of these investigations and draw any conclusions. More information on porpoises' seasonality which could be important for our research is suspected to come from the SAMBAH project due to similarity of its methodology to ours (Koblitz et al., 2013), however this data is not published yet.

6.3 Seals

With regard to seals, there is no up-to-date study indicating the haul-out sites of seals along the Polish coast adjacent to the open waters of the Baltic. However, there is one known grey seal haul-out site located in the Gdańsk Bay. The grey seals use the sand bank at the mouth of Vistula River as a resting site and their numbers there are increasing every year. Occasionally, also the harbour seals and ringed seals are observed at the Vistula mouth (WWF Polska, 2013). Moreover, according to HELCOM (2013), seals do regularly occur in the Polish waters. The grey seal is reported to be a regular visitor in the whole Polish Baltic, while the harbour seal visits its western part. The ringed seal regularly appears on the smallest scale - in the northern-most part of the Polish EEZ (Fig. 4, 7 and 10) (HELCOM, 2013). Also the land observations of seals along the Polish coast by WWF Polska and the Hel Marine Station, confirm occurrence of these animals on the Polish beaches and in coastal waters. The records of seals' activity concern mostly single individuals resting on the beach or stranded (Fig. 1 - 4 , Annex 1)(WWF Polska, 2013; WWF Polska database, http://link.wwf.pl/baza_ssaki/public/mapa/mapa). Furthermore, based on the radio-tracking data collected on seal pups released to the Baltic by the Hel Marine Station, it is known that seals migrate through the Polish waters of the Baltic. Migrations are recorded also for the area of the planned offshore wind farm (WWF Polska, 2013) (Fig. 6).

Occurrence of seals in the waters adjacent to the BŚ III site was also recorded during our research. The records were made in the autumn and spring, however due to their low number (four individuals in total) as well as the limited number of aerial surveys, it is not possible to draw any conclusions on the seasonality of seals' presence in the study area.

Considering data on the ichthyo-fauna stocks, which indicate sprat, herring and cod as the most abundant fish species in the BŚ III area (MIR, 2014), along with knowledge on the feeding behaviour of seals, it could be concluded that the study site serves as a feeding ground for the grey seal. The grey seals, similar to porpoises, migrate following the abundance of prey. They can swim long distances searching for food and feed in the areas where fish is available ((Thompson, 1996). They forage on a wide range of fish species, among which the main prey items are herring, sprat, cod, lavaret and salmon (ICES, 2006 c,d). Therefore, the reported abundance of grey seal preferable preying in the BŚ III area, might attract this species for using the study region as a feeding site. Another situation concerns the harbour seal. Use of the research location as a feeding ground by this species is not expected, due to its different foraging habits. Harbour seals, on the contrary to grey seals, do not migrate long distances searching for food, but forage close to their haul-out sites (Dietz, 2013). As there is no such site in the Polish Baltic, it could be concluded that harbour seals do not appear at the BŚ III site for feeding. A similar situation concerns the ringed seal, which occurs in Polish waters in low numbers and does not have any haul out sites along the Polish coast (WWF, 2013; HELCOM, 2013).

7 Conclusions

Conducted monitoring showed occurrence of three mammal species in the investigated site – the harbour porpoise, grey seal and the harbour seal. The investigation also clearly shows a very low activity of porpoises and seals in the BŚ III area and adjacent waters Seasonal trends were difficult to discern due to the very low number of detections. However, most records of marine mammals activity were made in spring which is in line with expectations. Absence of harbour porpoises calves indicated that the study area do not serve as an important breeding site for this species. It was however concluded that BŚ III might serve as a foraging ground for porpoises and grey seals due to abundance of their prey species in some parts of the year and a migratory behaviour of these animals. The harbour seal was excluded from such an assumption as this species usually stays relatively close to its haul-out sites which do not exist in the Polish waters. The ringed seal was not recorded during the monitoring, however it might be expected to sporadically occur in this region. For all the marine mammals it was concluded that BŚ III might be located within the areas of their migration routes.

7.1 Technical deficiencies and gaps in knowledge

The results of this study have attempted to reduce uncertainties about the abundance and distribution of marine mammals at the planned BŚ III offshore wind farm site and adjacent waters. Yet, there are still open questions that are being addressed in larger scale studies (see BIAS and SAMBAH projects):

- With regard to the harbour porpoise distribution in the Baltic in general and Polish waters specifically, the SAMBAH projects will fill some of the gaps in our knowledge. So far, the very preliminary results confirm our findings that porpoise occurrence in Polish waters is low. It is hoped that the project will shed light especially on the seasonal trends in occurrence and perhaps some statements on suitable porpoise habitat based on habitat modelling (see Skov and Thomsen 2008).

- Uncertainties remain about the designation of distinct porpoise stocks in the Baltic. Identifying subpopulations is crucial when it comes to Nature Conservation and ideally such investigation should be undertaken using a combination of telemetry studies and genetic analysis.

- Its furthermore unclear, if BŚ III and adjacent areas are used by porpoises for breeding. Some have postulated breeding areas for the species based on high number of sightings of calves (see for example for northern Frisia. Scheidat et al. 2004) .Others (see for example Thomsen et al. 2006, 2007) have found calving rates to be fairly identical between areas of high and low densities indicating that porpoise calving occurs with the same rates across different areas. In the case of BŚ III mother and calf pairs cannot be ruled out but this is likely to be an extremely rare occasion.

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WWF Polska data base: http://link.wwf.pl/baza_ssaki/public/mapa/mapa
http://geoserwis.gdos.gov.pl/mapy/

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Annex 1

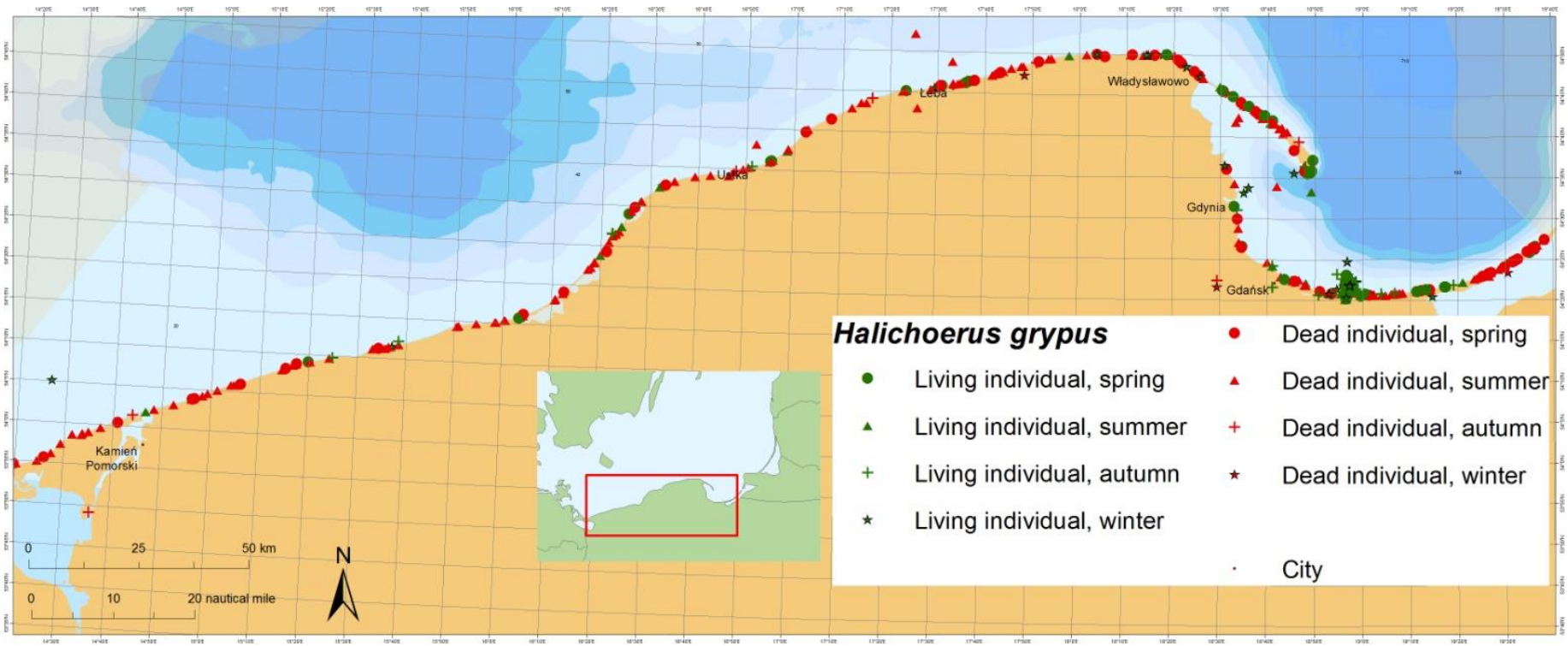

Fig. 1 Occurrence of grey seals in the Polish waters of the Baltic between 1 January 2007(Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) and 31 January 2014 during the monitoring conducted by WWF Poland and Hel Marine Station for the projects "**Support of restoration and protection of the Baltic mammals in Poland" and 'Protection of the habitats of marine mammals and birds' (based on: http://link.wwf.pl/baza_ssaki/public/mapa/mapa)**

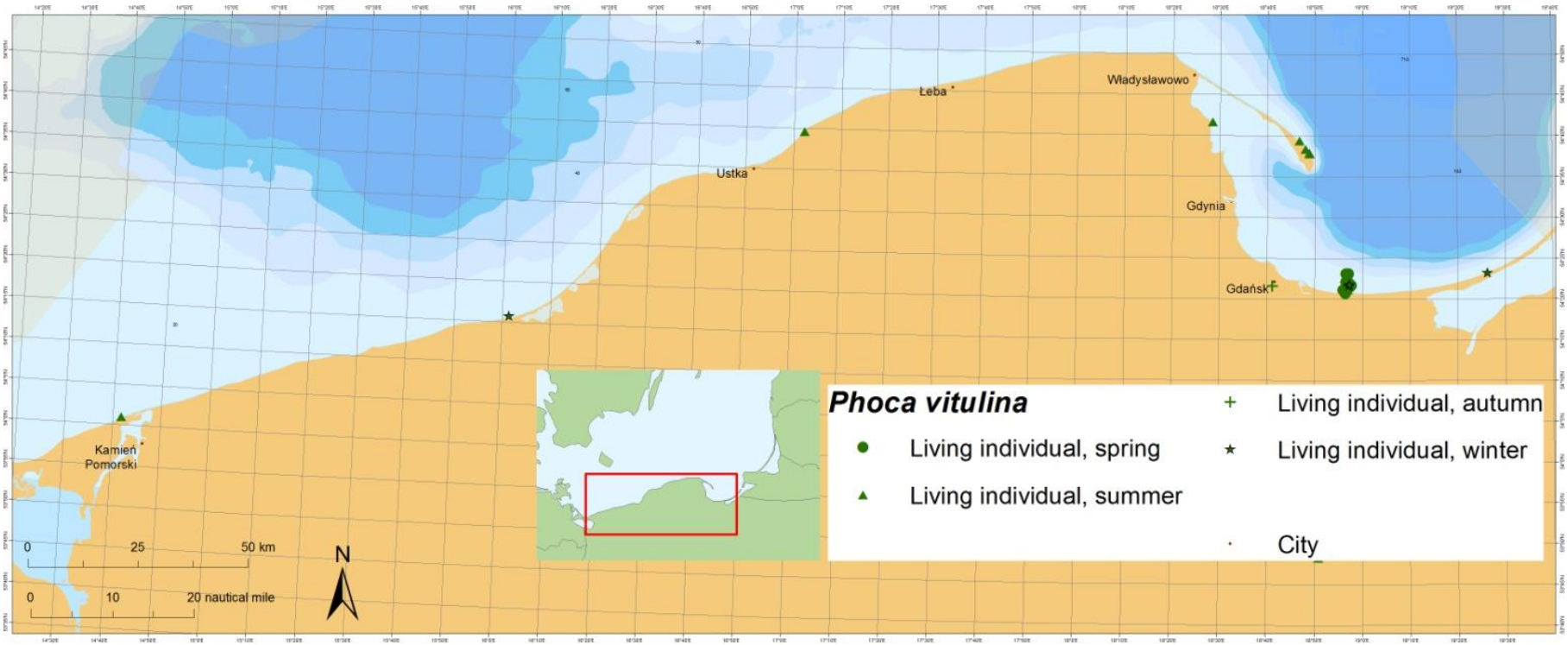

Fig. 2 Occurrence of harbour seals in the Polish waters of the Baltic between 1 January 2007 and 31 January (Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) 2014 during the monitoring conducted by WWF Poland and Hel Marine Station for the projects "**Support of restoration and protection of the Baltic mammals in Poland" and** 'Protection of the habitats of marine mammals and birds' (based on: **http://link.wwf.pl/baza_ssaki/public/mapa/mapa**)

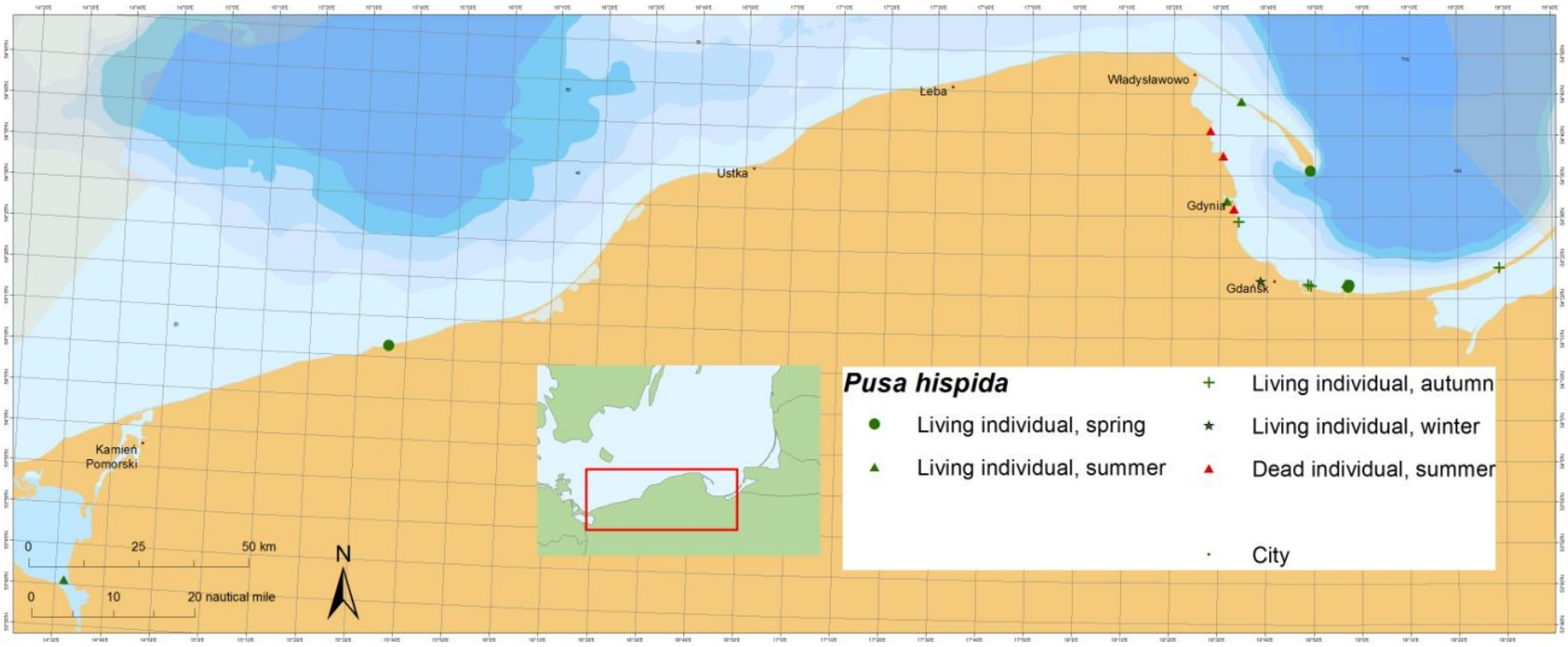

Fig. 3 Occurrence of ringed seals in the Polish waters of the Baltic between 1 January 2007 (Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) and 31 January 2014 during the monitoring conducted by WWF Poland and Hel Marine Station for the projects "**Support of restoration and protection of the Baltic mammals in Poland" and 'Protection of the habitats of marine mammals and birds' (based on: http://link.wwf.pl/baza_ssaki/public/mapa/mapa)**

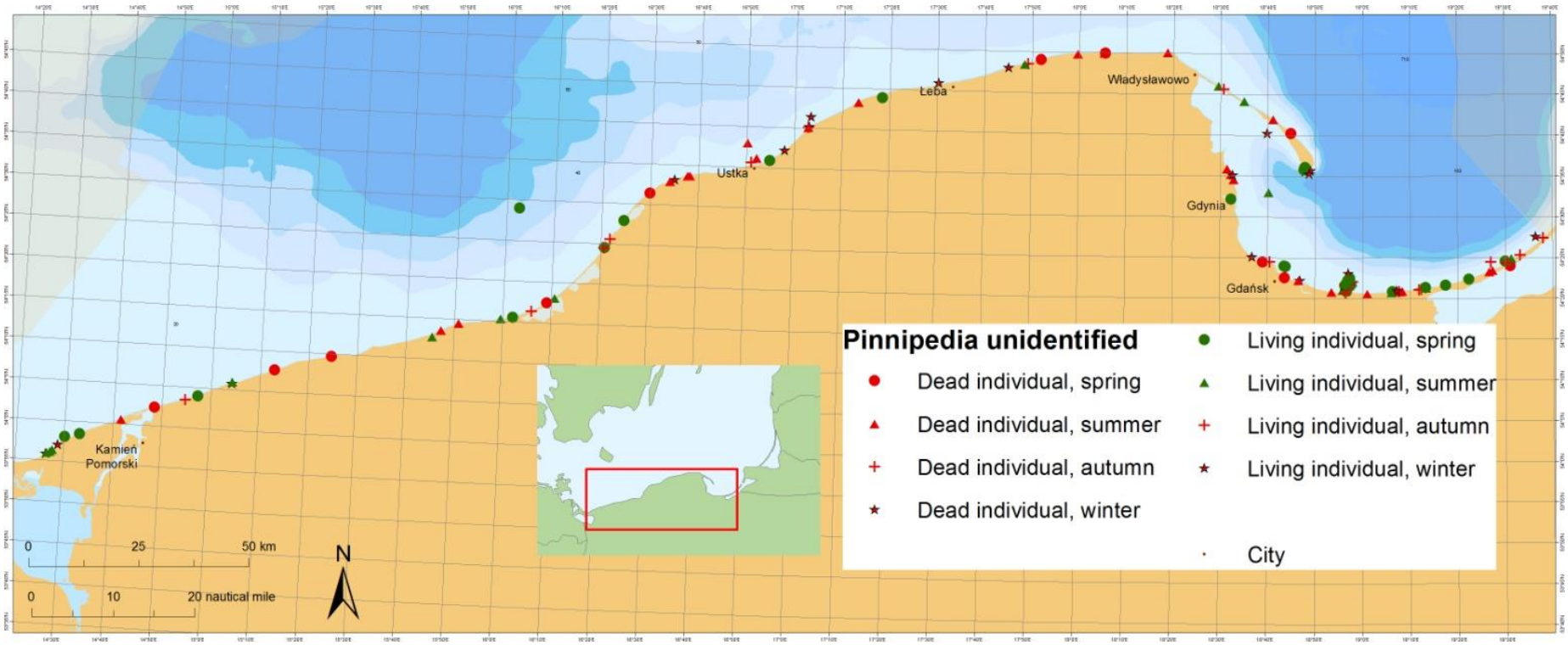

Fig. 4 Occurrence of unidentified seals in the Polish waters of the Baltic between 1 January 2007 (Vistula Mouth only)/ 1 January 2009 (the whole Polish coast) and 31 January 2014 during the monitoring conducted by WWF Poland and Hel Marine Station for the projects "**Support of restoration and protection of the Baltic mammals in Poland" and** 'Protection of the habitats of marine mammals and birds' (based on: **http://link.wwf.pl/baza_ssaki/public/mapa/mapa**)