1351 Harbour porpoise
Phocoena phocoena (L. 1758)

Fig. 1 Harbour porpoise (photo by K. Świstun)

I. INFORMATION ON SPECIES

1. Systematic affiliation

Order: Cetartiodactyla
Infraorder: Cetacea
Genus: Porpoises Phocoenidae

2. Legal status and threat to the species

International law
Habitat Directive – Annex II
Bern Convention – Annex II
Bonn Convention – Annex II

National law
Protection of species – strict protection (species requiring active protection)

Category of threat IUCN
IUCN Red List – Baltic subpopulation CR (critically endangered)

Polish Red List of Animals. Vertebrata – CR (critically endangered)

3. Species description

Harbour porpoise is the only representative of the toothed cetaceans (*Odontoceti*) as well as the Porpoise genus which constantly occurs in the Baltic Sea. It is one of the four known subspecies of the porpoise *P.p. phocoena* whose range covers the waters of the North Atlantic and neighbouring areas. It is also the smallest representative of cetaceans (*Cetacea*). Adult females reach a length of 1.46 m -1.89 m, while adult males 1.32 m-1.78 m with a body weight up to 70 kg (GDOŚ 2015).

Harbour porpoise has a spindle-shaped body with a small triangular dorsal fin in the middle of the ridge. The horizontal tail fin located on the lateral-flattened tail is responsible for movement of the species. Body colour is dark grey and black in the dorsal part and turns into pale cream towards the abdomen parts . The colour of the dorsal and caudal fins is the same as the colour of the ridge. Body coloration is an individual feature and can serve as an identification attribute (Carwardine 1995, Macdonald 2006, Reid et al. 2003).

Teeth of porpoise is one of the morphological feature that distinguish them from dolphins. They are bluntly finished, very small and flattened (Carwardine 1995).

4. Biology of the species

Harbour porpoises occur mostly in small groups or solitary, however large herds up to several hundred individuals can be observed in areas rich in food or during species migration (Jefferson et al. 2008, Koschinski 2002, Reid et al. 2003). Animals reach the maximum age of 24 years with an average of 15 years. It is estimated however that most individuals reach only the age of 7-8 years (Klinowska 1991, Lockyer 2003).

The breeding period is between May and August and the mating season from June to August. Animals reach sexual maturity at the age of 4 years (Lockyer 2003) and the pregnancy lasts eleven months. The calves usually stay with their mother until the next birth which does not happen every year. It was shown that the average annual birth rate is up to 0.99 (ibid).

Harbour porpoises, as a food opportunists (Santos and Pierce 2003, Sveegaard 2011), hunt for small fish of no more than 25 cm size, especially herring and sprat (GDOŚ 2015). The food composition of harbour porpoises caught in the Polish Marine Areas (POM) determined on the basis of stomach content analysis indicates that besides herring and sprat, porpoises also feed on species such as gobies and sand eels that occur in shallow sandy basins (Malinga 1993, Malinga et al. 1997, Skóra and Kuklik 2003).

5. Habitat conditions

Harbour porpoises occur mainly in shallow coastal waters where they dive for up to 2 minutes (Teilmann et al. 2007). They can dive however at larger depths exceeding 200 m staying under water for over 5 minutes (GDOŚ 2015). Beside environmental factors (such as depth, distance from the shore, temperature or freezing of marine areas) the availability of the food seems to be the most important factor affecting the distribution and occurrence of this species in the Baltic Sea (ibid). At the same time, intensity of underwater noise is an important anthropogenic pressure resulting in masking and drowning of echolocation signals of porpoises, passing and limiting access to optimal habitats and foraging areas, or even loss of hearing and finally death of animals (ibid.).

6. Species distribution

Historical data indicates that the harbour porpoise was widespread in the Baltic Sea in the first half of the last century (Ropelewski 1952, Kinze 1994). Species has been systematically caught in the Polish

waters since the 70s of the 14th century. In the 20s and at the beginning of the 30s of XX century the number of individuals caught in fishing nets reached 75 individuals per year, mainly in the Gulf of Gdansk (Ropelewski 1957) . Until the mid-30s of the last century several hundred individuals from by-catch (ibid) were recorded annually. Taking into account the data published by the Sea Fisheries Office (also included in Ropelewski (1957)) it should be stated that the stock size of the species in the Polish waters was significant. Since the second half of the 1930s there is no information about the presence of harbour porpoises in PMA until 1950 when the first finding of species was recorded (Ropelewski 1957). At the end of the 1980s, the Marine Station of the Institute of Oceanography, University of Gdańsk started to collect data on porpoises observations at sea and on by-catch or dead specimens found on the shore (Malinga 1993, GDOŚ 2015).

Estimation of the harbour porpoise population was carried out twice during sea expedition called SCANS (Small Cetacean Abundance in the North Sea and Adjacent Waters) which took place in 1994 (SCANS I) and 2005 (SCANS II), only in the western part of Baltic (Hammond et al 2002, SCANS II 2006). The numbers of porpoises in the Baltic Sea were estimated on the basis of visual observations from airplane and ship in 1995, 2001, 2002 and 2004 (GDOŚ 2015). A small number of observations (3 specimens in 1995 and 2 specimens in 2002) allows to estimate harbour porpoise population at 599 specimens (1995) and 93 specimens (2002), but the obtained results are of a high level of uncertainty (Ibid.).

The latest data on the distribution of harbour porpoises and their abundance in the Baltic Sea were obtained as part of a comprehensive acoustic monitoring of the species in 2011-2013 (SAMBAH 2017). The population in the north-eastern Baltic has been estimated at 447 individuals, and in the south-western part at 13,742 (ibidem). At the same time it was shown that in the period from May to August (*i.e*. during the reproductive period), there is a spatial separation of two subpopulations of the species previously described in the literature (Wangi Berggren 1997, Verfuß et al., 2007). Subpopulation of the Baltic Proper is concentrated in the southeast of Oland (Central Bank area), while the western Baltic subpopulation remains concentrated in the areas to the west from Bornholm (SAMBAH 2017).

Recently (2016-2018), acoustic monitoring of species was performed in the Pomeranian Bay and in the vicinity of Stilo Bank within the framework of the Pilot project (Opioła 2016). Analysis of the collected data showed significant differences in porpoise occurrence between these areas – in the Pomeranian Bay, there was found ten times more days of positive detection (average 4.56 DPD) than in Stilo Bank area (average 0.32 DPD). At the same time, it was shown that the presence of porpoises in both areas is seasonal – in the Pomeranian Bay the maximum DPD values were recorded in summer months, while at Stilo Bank in spring (Opioła 2018).

II. METHODS

1. Concept of species monitoring

Harbour porpoise monitoring methodology within the State Environmental Monitoring framework (SEM) is based on the previously applied method of passive acoustic monitoring of the species within the SAMBAH project (2017) and the project entitled: "Pilot implementation of monitoring of marine species and habitats in 2015-2018" (Opioła 2016). Both projects demonstrated high effectiveness of this type of monitoring and high quality of the data obtained allowing both the assessment of individual indicators and their comparison over time. Similar monitoring type based on C-POD devices was also implemented in Finland, Sweden, Germany and Denmark (ICES 2018).

In order to maintain the continuity of monitoring and data homogeneity as well as the data analysis, it is recommended for State Environmental Monitoring to use same type of devices for passive

marine acoustic monitoring (C-POD) and analytical tools adapted for species identification. It is also recommended to conduct monitoring in the following periods at the same research stations, what will enable comparison of test results in subsequent monitoring cycles and will allow to determine long-term changes in the harbour porpoise population. Monitoring should be carried out continuously for at least 24 months in the period of evaluation (6 years), but should not start earlier than 3 years after the end of the previous monitoring.

It is recommended that the harbour porpoise monitoring periods will be consulted within HELCOM Marine Mammals EG in line with the expert group emphasizing the importance of simultaneous monitoring for the feasibility of parametric evaluation of the species (HELCOM 2018).

2. Indicators and assessment of the conservation status of the species

It should be emphasized that indicators and threshold values for this species have not been agreed within HELCOM so far. Therefore, it is recommended that a revision of national indicators should be made when indicators are agreed at the international level (HELCOM) taking into account the specificity of harbour porpoise occurrence in Polish zone of the Baltic Sea.

Population status indicators

Table (Table 1) presents indicators for the status assessment of the 'Population' parameter, table (Table 2) presents the method of valorisation of indicators.

Table 1. Indicators for assessing the status of the harbour porpoise 'Population' parameter

Indicator	Unit	Indicator description
Spatial occurrence	presence / absence	presence or absence of individuals at all research stands on which recording devices were exposed during monitoring;
Time occurrence	presence / absence	presence or absence of individuals in each month of the year during monitoring;
Density	Individuals (N) / km^2	the density calculated based on the results obtained, including: the number of minutes of positive detection (DPM) and the effective detection area (v / EDA) in accordance with the formula described in point 3 (Description of monitoring studies)
Days of positive detection (DPD)	Quantity of DPD	the number of days during which the presence of the porpoise was recorded
Mortality	Number of animals from by-catch and dead animals bearing traces of by-catch or intentional killing	number of dead individuals found in fishing nets and on the beach (reported by fishermen or WWF Poland, MSIOUG) or observed during monitoring with traces of by-catch or intentional killing

Table 2. Valuation of indicators for assessing the status of the harbour porpoise 'Population' parameter

Indicator	Assessment		
	FV favourable status	**U1** unfavourable inadequate status	**U2** unfavourable bad status
Spatial occurrence	presence at all research sites N = 100%	presence at half of research sites N = 50% or >50%	presence at less than half of research sites N <50%
Time occurrence	presence at least one in all months of the year (all	presence from 6 to 11 months (all sites	presence in less than 6 months (all sites

Indicator	Assessment		
	FV favourable status	**U1** unfavourable inadequate status	**U2** unfavourable bad status
	sites included)	included)	included)
Density	the average density is the same or higher compared to the results of the previous monitoring for all research sites	intermediate state between FV and U2	the average density is lower compared to the results of the previous monitoring for all research sites
Days of positive detection (DPD)	the average DPD is equal or higher at all sites compared to the results of the previous monitoring	intermediate state between FV and U2	the average DPD is lower at all sites compared to the results of the previous monitoring
Mortality	If = 0	If = 1	If >1

Habitat status indicators

Table (Table 3) presents indicators for the status assessment of the 'Habitat' parameter, while table (Table 4) presents the method of valorisation of indicators.

Table 3. Indicators for assessing the status of the harbour porpoise 'Habitat' parameter

Indicator	Unit	Indicator description
Impulsive noise	GES/ subGES	Determined on the basis of results of the assessment of descriptor 11 under MSFD
Continuous noise	GES/ subGES	Determined on the basis of results of the assessment of descriptor 11 under MSFD

Table 4. Valuation of indicators for assessing the status of the harbour porpoise 'Habitat' parameter

Indicator	Assessment		
	FV favourable status	**U1** unfavourable inadequate status	**U2** unfavourable bad status
Impulsive noise	GES of the Bornholm Basin assessed as part of the assessment for MSFD reporting	subGES of the Bornholm Basin and GES of the Gotland and Gdansk basins assessed as part of the assessment for MSFD reporting	subGES of the Bornholm Basin and at least one subGES of the Gotland or Gdansk basins assessed as part of the assessment for MSFD reporting
Continuous noise	GES of the Bornholm Basin assessed as part of the assessment for MSFD reporting	subGES of the Bornholm Basin and GES of the Gotland and Gdansk basins assessed as part of the assessment for MSFD reporting	subGES of the Bornholm Basin and at least one subGES of the Gotland or Gdansk basins assesse as part of the assessment for MSFD reporting

Conservation prospects

Evaluation of conservation prospects is an attempt to predict the conservation status of the harbour porpoise in the Polish sector of the Baltic Sea in the perspective of 10−15 years by the expert judgement. It takes into account both current data on population status and species habitat as well as implemented protective measures (e.g. approved national species protection plans) and observed threats (potential risks related to anthropogenic pressures) and their trend in the long-term perspective. It is important that the assessment include not only the results of the monitoring studies, but also all available information regarding the above-mentioned issues resulting from systematic scientific or monitoring research outside SEM (e.g. data from the Marine Station of the Institute of Oceanography University of Gdańsk or WWF Poland).

Conservation prospects obtain a favourable status (FV) only if both the population and the habitat are in good condition (FV) and if in the considered period of time (10-15 years) no increase in the impact of negative factors is predicted, mainly the number of by-caught animals and rise of underwater noise impact, which can worsen this condition. The U1 status (unfavourable inadequate) can only be assigned if the population and habitat are in a favourable status (FV), but there are factors that negatively affect both parameters and in the perspective of 10-15 years they will worsen the current condition. In the case when the assessment shows that the current state of both the population and the habitat will be deteriorating, the protection perspectives should be assessed as unfavourable bad (U2).

Overall assessment

The overall assessment of the species conservation status is equal to the lowest status of one of three parameters: ‘Population’, Habitat’ or ‘Conservation prospects’. The method of aggregating all indicators and parameters is presented on Fig. 1

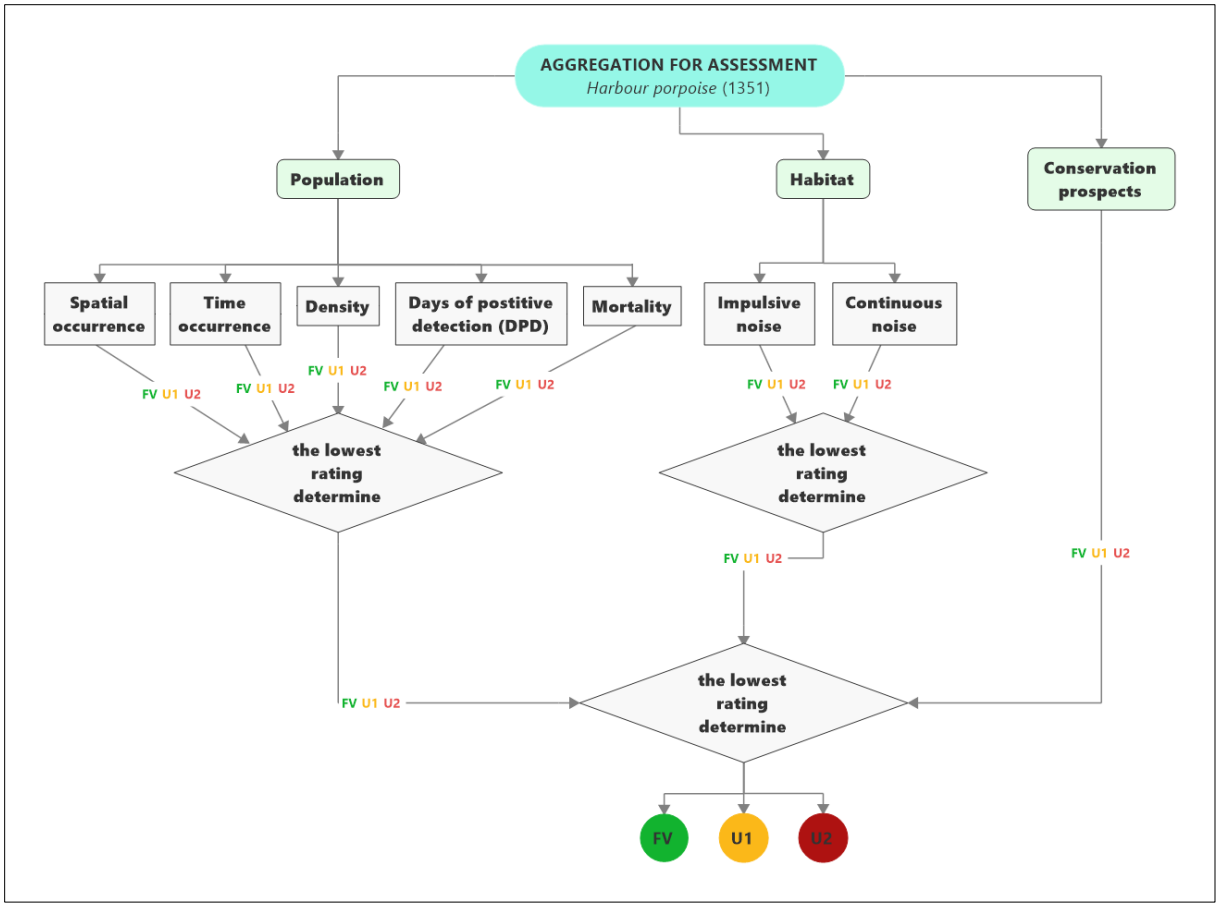

Fig. 1. Diagram of aggregation of indicators and parameters to assess the state of protection of the harbour porpoise

3. Description of monitoring

Selection of monitoring sites

The 'monitoring site' is defined as the marine area within which the research stations with C-PODs are located.

Three sites were chosen for monitoring activities: Pomeranian Bay (the same stations), Stilo Bank (four stations and one new within Ostoja Słowińska (PLH220023)) where Pilot monitoring was carried out in 2016-2018 (Opioła 2018) and Gulf of Gdańsk. In the Gulf of Gdańsk, four stations should be compliant with the SAMBAH project and one station should be located in the Puck Bay taking into account the local conditions (fishing, shipping, tourism) and in consultation with maritime administration. In general, monitoring should be carried out at the three above-mentioned sites, each with five research stations (location of C-POD devices for passive acoustic monitoring).

It is recommended to consider a monitoring site in the area of the Polish Middle Bank area after agreeing the rules and frequency of monitoring activities established within the HELCOM Marine Mammals Expert Group.

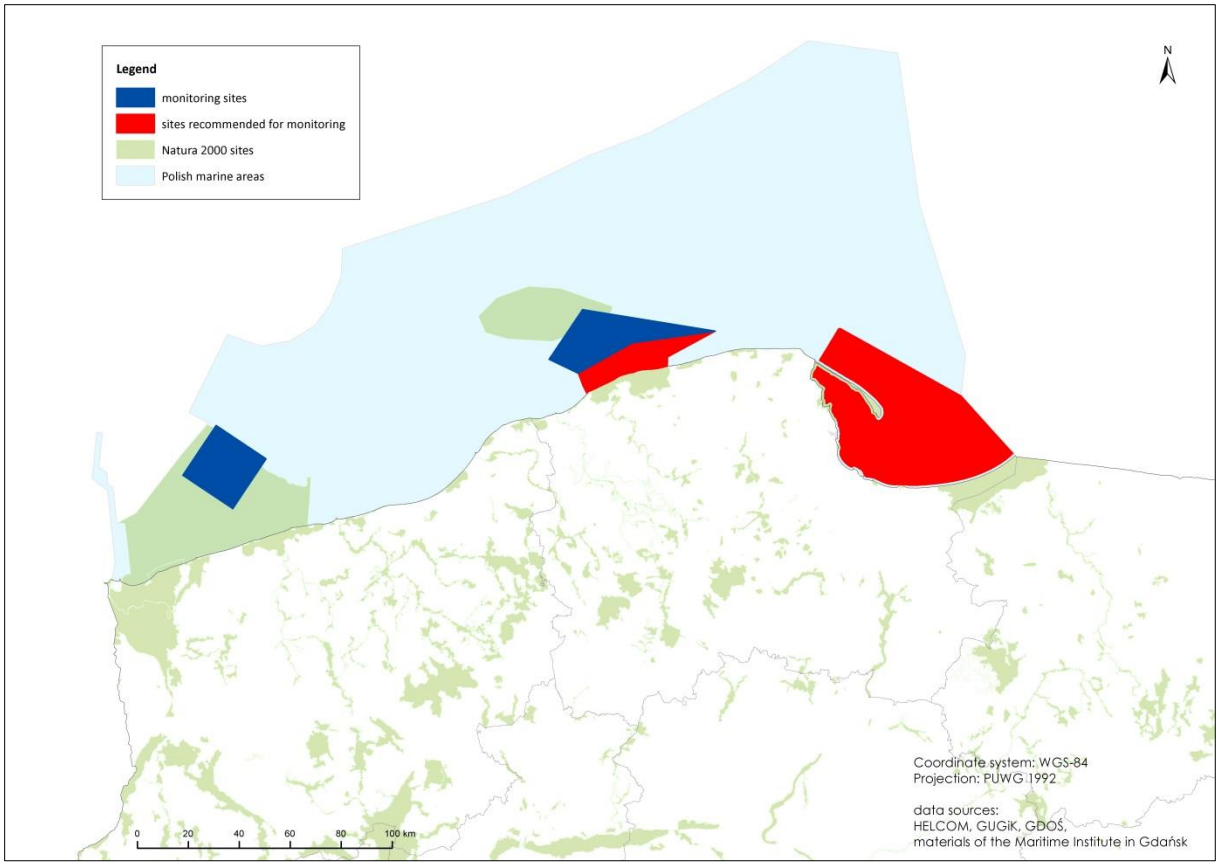

Fig. 2. Sites for the harbour porpoise monitoring

The method of investigation

At least 10 days before the start of the 24-month study, the first submmersion of the devices at the monitoring stations should be performed. Consequently, the risk of postponing monitoring will be minimized due to weather conditions or accessibility of basins. Devices for passive acoustic monitoring are immersed at stations compatible with stations monitored in SAMBAH (2017) and MGiSM (Opioła 2018). An acoustic release is used to allow devices to be collected on the next service planned at the time every 6 to 8 weeks. Planned periods of equipment operation should not be longer due to the possibility of equipment loss (storms, trawling) and hence loss of acoustic data. The devices should be placed 5 m above the bottom and anchored in a way that ensures permanent fixing of the system, one meter under the acoustic fender. With the launch of the release, the buoyancy buoy emerges by lifting the device that can be taken from the sea surface together with the anchorage system.

All activities during services , like *e.g*. placement of recording devices and exchange of memory cards, should be documented in the field forms presented in point 4 (Field forms for the site monitoring with C-POD devices).

The assessment of individual population status indicators is made on the basis of the analysis of acoustic data by means of software dedicated to a given device brand allowing for species determination. The result of the analysis performed are the values of: Positive Detection Days (DPD) and Positive Detection Minutes (DPM).

Assessment of indicators, calculated on the basis of a comparison of the current monitoring results with the previous ones, must be based only on data from the same research stations (see Opioła 2018). At the same time, due to the possible data deficiencies associated with the loss of devices,

their damages or failures, it is necessary to calculate the measurement performance coefficient (EP) for each research station and include it when calculating the final DPD and DPM coefficients before comparing them with the results from the previous monitoring.

Determination of population status indicators

Spatial occurrence. Based on the analysis of acoustic data it is determined whether at each site at least one day of positive detection (DPD) was recorded during the entire monitoring (within 24 months), regardless of the station on which it was recorded.

Time occurrence. Based on the analysis of acoustic data from all stations, it is determined whether at least one day of positive detection (DPD) was recorded, regardless of the research site throughout the year (every month) during monitoring.

Density. According to the methodology used by the SAMBAH project, the density of harbour porpoise at each station is calculated using the formula (Thomas and Burt 2014):

$$\hat{D}_{m,d} = \frac{n_{m,d}(1-\hat{c})}{T_{m,d}\hat{v}_m\hat{p}_c}$$

where:

$D_{m,d}$- density of harbour poprpoises [N/km^2]

$n_{m,d}$- minutes of positive detection [DPM]

$\hat{c}$ – mean number of false positive detection

$T_{m,d}$- total number of minutes of detection [min]

v_m- effective detection area (EDA) [km^2]

p_c- the probability of harbour porpoise detection

Based on the results of field experiments carried out as part of the SAMBAH project, the value of coefficients "vm" and "pc" was assumed to be constant: vm = 0.025km2; pc = 0.84 (Thomas and Burt 2014). In connection with the additional Hel1 classifier used in the analysis of acoustic data, the value of coefficient "c" was negligible in the calculations.

For each research site, the average density of porpoise should be calculated (based on the results for all stations within) and compared with the results obtained for the previous monitoring at the same research sites.

Days of positive detection (DPD). For each station, the sum of positive detection days (DPD) for the entire monitoring duration is calculated and then, after taking into account the measurement efficiency factor, the average DPD for the monitoring site is calculated. This value is compared with the value obtained in the previous monitoring at the same monitoring site.

Mortality. Information on the number of fisheries caught by fishermen is obtained from the reports of the Ministry of Economy and Sea Fisheries, WWF Poland, the Marine Station of the Institute of Oceanography of the University of Gdańsk and observations obtained as part of the monitoring.

Determination of the habitat status indices

Impulsive noise. Based on the assessment of descriptor 11 (impulsive noise) carried out as the update for MSFD reporting, the assessment should be performed in accordance with the valorisation presented in the table (Table 4).

Continuous noise. Based on the assessment of descriptor 11 (continuous noise) carried out as the update for MSFD reporting, the assessment should be performed in accordance with the valorisation presented in the table (Table 4).

If reference levels for each of the porpoise habitat indicators are determined and published, it is recommended to start using them to assess the "*Habitat*" indices.

4. The date and frequency of investigations

It is recommended to carry out monitoring using C-POD devices continuously for 24 months in the period covered by the assessment, but not earlier than 3 years from the end of the previous species monitoring. When the experts from HELCOM Marine Mammals EG, HELCOM define new terms and frequency of monitoring studies then terms and frequency of harbour porpoises studies in Poland should be adjusted.

5. Equipment and materials for investigations

Devices for passive acoustic monitoring, along with hardware and software, in a minimum number of 16 pieces (*i.e.* at least one device as spare, being in the equipment during periodic services). As part of SAMBAH monitoring in 2012-2014 (SAMBAH 2017) and MGiSM in 2016-2018 (Opioła 2018), C-POD devices were used (Chelonia Ltd.), while using these devices in monitoring is carried out (or is planned its implementation since 2018) in the countries of the Baltic Sea basin: Germany, Finland, Denmark or Sweden (ICES 2018). Therefore, it is recommended to use these devices in order to ensure the continuity of the applied methodology and compliance of the conducted tests with those applied in other areas of the Baltic Sea. It is recommended that the results of acoustic data analysis be developed in accordance with the methodology developed by previous monitoring programs, used both in the development of SAMBAH (2016) and MGiSM data (Opioła 2018).

6. Examples of harbour porpoise research forms

Field form C-POD			
Institution: *Maritime Institute in Gdańsk*			
Site: *Pomeranian Bay*			
Station: *CPOD01*	Coordinates: *54.12345 14.54321*		
CPOD ID: *device identification number* (*e.g*. CPOD1)	Depth of C-POD [m]: *10 m*	service ID: *number of service (e.g.. Service-1)* SERVICE A	Planned: YES/NO /underline the appropriate/
*Type of activity: 1 = collection, 2 = turning of, 3 = turning on, 4 = inserting SD card, 5 = removing SD card, 6 = submersion	Type of anchoring system: 1 = acoustic release, 2 = other: /underline he appropriate/	/ underline he appropriate / Turning on: 1 = without problems, 2 = few trials, 3 = double flicking, 4 = other problems (describe in the comment) In accordance with the technical procedure: YES/NO	Turning off: 1 = without problems, 2 = low battery (LED not flashing), 3 = other problems (describe in the comment) / underline he appropriate /

Type of activity*	**Date**	**Time (UTC)**	**Card ID**	**Comment**
1	*2018-07-08*	*12:00*	*e.g. CPO6000-3*	*Fill in if necessary, e.g. additional information on the type of activity*
2	*2018-07-08*	*12:10*	*e.g CPO6000-2*	

Compiled by:	**Checked by:**	**Approved by:**
Date: 2016-08-04	Date: 2016-08-05	Date: 2016-08-06
Signature – Full name:	Signature – Full name:	Signature – Full name:

DATA ACCESS FORM
Institution: *Maritime Institute in Gdańsk*
Site: *Pomeranian Bay*

Card ID	**Date of downloading data**	**File name***	**Data quality (good/bad/lack of data)**	**Full name of person downloading data**	**Comment**
CPO6000-3	*2018-07-10*	*CPO600020180708100*	*GOOD*		

**ID of CPOD setting (station) + date of submersion + CPOD number*

Compiled by:	**Checked by:**	**Approved by:**
Date: 2018-07-10	Date: 2018-07-11	Date: 2018-07-12
Signature – Full name:	Signature – Full name:	Signature – Full name:

7. Species protection

The Baltic harbour porpoise is a species included in the national red book (Głowaciński 2001) and is also a critically endangered species according to the IUCN. It is strictly protected species and requires active protection measures (Journal of Laws item 1348). In 2015, the harbour porpoise Protection Program (GDOŚ 2015) was adopted. It takes into account both the identification of threats to the species and formulates protective actions that should be taken including the start of species monitoring in the Polish Marine Areas (PMA).

Due to the special threat posed by by-catch in fishing nets and increase in anthropogenic pressure from underwater noise, the protective measures should primarily take into account reduction of by-catch and the reduction of disturbances caused by underwater noise in key areas.

At present, the use of pinger devices as an active source of noise (minimizing the probability of by-catch in fishing nets) is limited to ICES Division no. 24. Boats fishing in this area have been equipped with pinger devices as part of the project "Protection of mammals and seabirds and their habitats". Due to the lack of sufficient data describing the spatial occurrence of porpoise in PMA, it is necessary to include data obtained in the previous research (including the SAMBAH project (2017) and SEM) to specify the requirements for pingers usage in fisheries divisions.

There are four Natura 2000 areas where harbour porpoise is protected species: Puck Bay and Hel Peninsula (PLH220032), Ostoja Słowińska PLH220023, Ostoja on the Pomeranian Bay PLH990002 and the Wolin and Uznam area (PLH320019). It should be emphasized that no protection plans were created for the abovementioned areas which would enable proper management and monitoring of the harbour porpoise (Skóra and Pawliczka 2015).

Insufficient identification of occurrence, population size and biology of this species in PMA is also the reason for the lack of implementation of protective measures despite the formal species protection.

8. Literature

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