PROGRESS REPORT

on

THE CONSERVATION PLAN

FOR THE HARBOUR PORPOISE POPULATION

IN THE WESTERN BALTIC, THE BELT SEA AND THE KATTEGAT

2020-xx-xx

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The views and recommendations expressed in this report are the author's own

PROGRESS REPORT on THE CONSERVATION PLAN FOR THE HARBOUR PORPOISE POPULATION IN THE WESTERN BALTIC, THE BELT SEA AND THE KATTEGAT

Background & History

Following the establishment of a Recovery Plan for Baltic Harbour Porpoises (the Jastarnia Plan) and a Conservation Plan for Harbour porpoises in the North Sea, it was decided at the 18th Meeting of the ASCOBANS Advisory Committee (AC 18 Bonn, Germany) in 2011 that there should also be a Conservation Plan for porpoises inhabiting the waters between these two regions, i.e. the Western Baltic, the Belt Sea and the Kattegat. Concern had been expressed over potential declines in harbour porpoise abundance in this region from the two wide-scale surveys of SCANS in 1994 and SCANS II in 2005.

A draft paper containing background information and proposed objectives and measures for the 'gap area' not covered by the Jastarnia Plan was commissioned following a recommendation by the 7th meeting of the Jastarnia Group (Copenhagen, Denmark, February 2011). This paper was reviewed and refined by the 8th meeting of the Jastarnia Group (Bonn, Germany, 31 January – 2 February 2012), and again, following the 19th Meeting of the Advisory Committee (AC19), Galway, Ireland (20-22 March 2012). It was formally adopted by the 7th Meeting of the Parties in Brighton, UK, in September 2012.

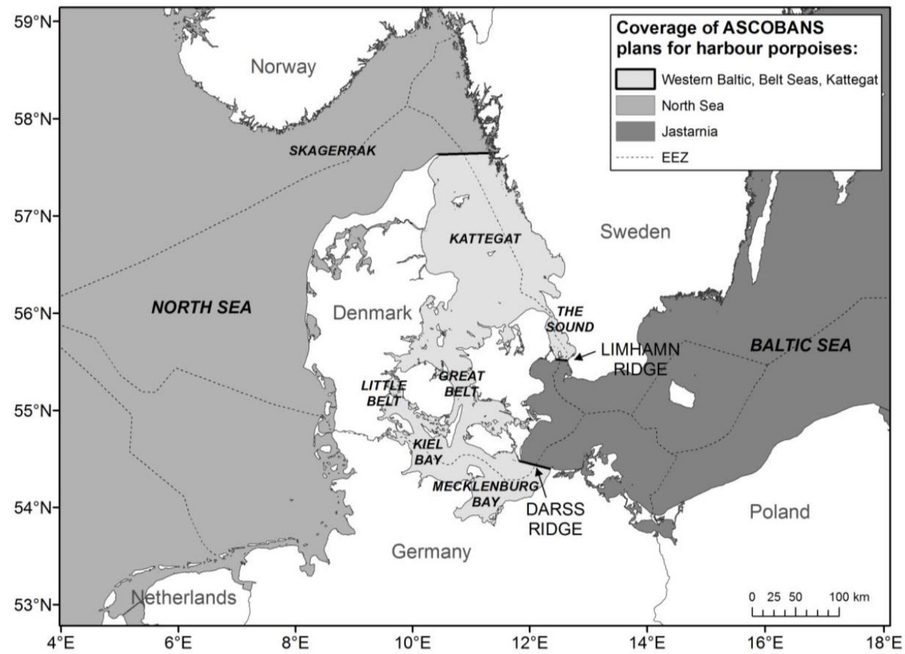

Figure 1. Map of the North Sea and the Baltic indicating where the geographical area covered by the Plan for the population in the Western Baltic, the Belt Sea and the Kattegat adjoins that of the ASCOBANS North Sea Plan and the ASCOBANS Jastarnia Plan. The dashed line indicates the national borders of the Exclusive Economic Zone (EEZ) (Source: ASCOBANS, 2012)

The draft plan (ASCOBANS, 2012) covered the 'gap area', and included the waters north and west of the Darss and Limhamn ridges up to the north-western border of the Baltic Sea as defined by HELCOM (i.e. a line from the northern point of Denmark to the coast of Sweden at 57°44.43'N) (see Figure 1). This area is now referred to as the Western Baltic, the Belt Sea and the Kattegat (shortened to WBBK).

A series of actions have been proposed in the WBBK Conservation Plan (ASCOBANS, 2012). Progress on each of these is reviewed below.

Actions

1. *Actively seek to involve fishermen in the implementation of the plan and in mitigation measures to ensure a reduction in bycatch*

Germany

Germany has been investigating alternative management approaches and the use of alternative fishing gear. The "Stella" Project, established in November 2016 and due to run until December 2019, has a number of strands: building data, modifying gillnets, investigating the feasibility of alternative gear, creating incentives for data collection, synthesizing the results, and promoting social responsibility within the German Baltic EEZ. This inter-disciplinary project is funded by the Federal Agency for Nature Conservation (BfN), and conducted by the Thünen Institute of Baltic Sea Fisheries. It will engage fishermen of the Baltic Sea, and amongst other tasks, will synthesise the results of the various disciplines - fisheries biology, fishing technology and social sciences, and derive policy advice for decision makers, considering also the interest of nature conservation.

Commented [IC2]: Need to update on the Stella project

There has been a voluntary agreement with fishers since 2013 in Schleswig-Holstein, for the conservation of harbour porpoises and sea ducks in the German Baltic. This has involved the Fishery Association and Fishery Protection Union of Schleswig-Holstein, the Baltic Sea Information Centre (OIC), and the Ministry of Energy Transition, Agriculture, Environment and Rural Areas Schleswig-Holstein (MELUR). The result has been a reduction in the total length of gillnets in the months of July and August to 4km for boats >8m, to 3km for boats between 6 and 8m, and to 1.5km for boats <6m. In addition, almost 1,700 alternative "pingers" (Porpoise Alerting Devices or PALs) are being handed out to fishers through the OIC in Eckernförde.

Commented [IC3]: Is there any information now on a possible monitoring program for the PAL effort?

Denmark

Denmark was the first country in Europe to trial the use of Remote Electronic Monitoring (REM) to assess bycatch, in 2008, operating on pelagic trawl fisheries (Ulrich *et al.*, 2013, 2015). Since 2010, they have been used routinely in Danish fisheries (Kindt-Larsen *et al.*, 2012). It has proved to be a cost-effective and accurate method of monitoring. Part of its success has been due to the relationship built up between fisheries authorities and fishers themselves, through a mixture of trust and incentives. Collaborations with the fishing industry have also taken place in exploring mitigation measures such as pingers, and the use of alternative fishing methods. The developing and testing of pingers continues, directly involving fishermen, as well as testing the use of lights and low nets to reduce bycatch.

Commented [IC4]: Any results available?

Modelling of the acoustics of gillnets has been conducted in conjunction with the Thünen Institute so as to better understand how porpoises become entangled and find ways to improve their detection. This programme started in 2016 and is scheduled to continue until 2020. However, so far, the development of acoustically reflective gillnets has failed to identify a suitable material.

Commented [IC5]: Results on actylic pearls, I assume this is the same project?

Sweden

The Swedish authorities are holding dialogue meetings with fishermen concerning the regulation of fisheries in protected areas, both for specific areas and more generally, the latter in conjunction with the Swedish Agency for Marine & Water Management (SwAM). Voluntary use of pingers occurs in ICES SubDivisions 21 and 23.

More info about SLU Aqua's projects on REM, alternative gear etc – largely the same info as in the Jastarnia report, though, so a bit of copy/paste

Key Conclusions and Recommendations *All three Range States are actively engaged in collaborative projects with fishermen but there is always scope to do more. Denmark has had a long history of working with fishermen on pinger deployment and over the last ten years, with remote electronic monitoring. Such measures could be applied more widely with good effect through the region.*

2. Cooperate and inform other relevant bodies about the conservation plan

Explicit information about the Conservation Plan has not been disseminated to the public in any of the three countries. However, several of the actions recommended within the Plan have been promoted within each country. The raising of public awareness of harbour porpoises generally has been implemented, particularly within Germany.

In **Germany**, sightings and strandings programmes involving the public are well developed. For Schleswig-Holstein, they are coordinated by the Terrestrial and Aquatic Wildlife Research (ITAW) in Büsum, and for Mecklenburg – Vorpommern they are administered by the German Oceanographic Museum in Stralsund, who have also produced an app "OstSeeTiere" (Baltic Sea Animals) (https://www.deutsches-meeresmuseum.de/wissenschaft/ infothek/sichtungskarte/).

Public engagement activities include an exhibition "Die letzten 300" in collaboration with NGOs NABU and OceanCare as well as with ASCOBANS. The exhibition displayed the many works received as part of the creative competition, and was on display in the German Oceanographic Museum from January – April 2015, and visited by an estimated 30,000 people. Every year, the museum also participates in the International Day of the Baltic Harbour Porpoise coordinated by ASCOBANS, with specific activities and information for the public. The museum has a marine mammal science education project (http://dev.marine-mammals.com/), and focuses mainly on school activities and educating teachers. In 2017, it produced an app ("Be the Whale") depicting a humpback whale, and in 2018 is doing the same using the beluga. Although not focused upon the harbour porpoise, these are designed to make children aware of dangers to cetaceans in general. Noise, pollution and bycatch are all included as threats as well as shipping in general (ship strikes) and prey depletion. Although located in the Baltic Proper, the museum serves the public over a much wider region and their conservation education activities are clearly relevant to the Western Baltic region to which this Conservation Plan applies.

Commented [IC6]: Link no longer working. New info about this?

Public awareness activities, public sightings and strandings schemes are much less developed in Denmark and Sweden, although in **Sweden**, between 2016-2018 a total of 220 stranded animals were reported by a voluntary network. Records of strandings are collected opportunistically by the Swedish Natural History Museum (NRM) in collaboration with the Gothenburg Museum of Natural History. 38 porpoises were necropsied in 2016-2018: whereof 26 were from the Belt Sea population distribution range. 13 of the necropsied animals had signs of bycatch. The aim for this programme is to continue to undertake necropsies at the level of 20 animals/year.

Commented [IC7]: More details? Where were these reported?

Commented [IC8]: Move to 8 population health etc

In **Denmark**, there is no comprehensive coordinated stranding scheme although reporting is encouraged (see https://fimus.dk/en/about-the-museum/emergency-management-for-marine-mammals/). There is also no public sighting reporting scheme any more although this is planned to be resurrected in 2019. On the other hand, porpoise research in Denmark has focused upon fisheries interactions, the effects of noise, and developing management strategies within SACs.

Key Conclusions and Recommendations *Germany has a long history of working with stakeholders and the general public on conservation issues. There have been similar schemes in Denmark and Sweden mainly at a local level, but the NGO movement is less developed. Efforts should be made to address this in those countries, particularly with respect to citizen science projects.*

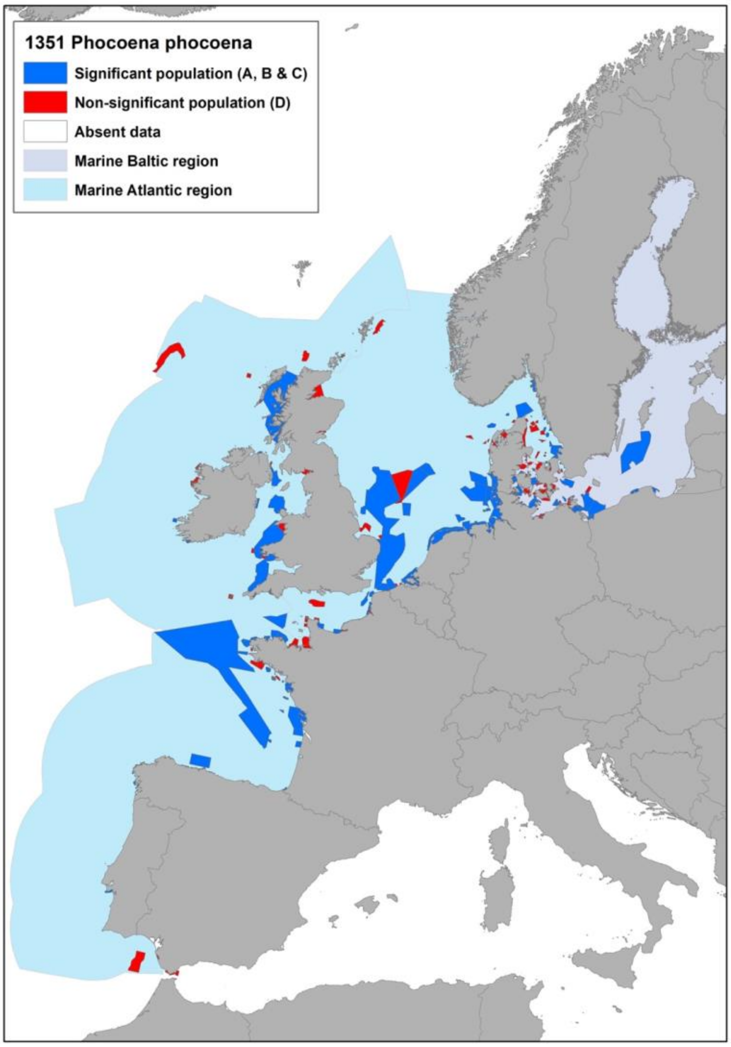

Figure 2. Natura 2000 sites designated in Europe for harbour porpoise (Source: European Commission)

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Commented [IC10]: Replace map with one more zoomed in on the WBBK area

3. *Protect harbour porpoises in their key habitats by minimizing bycatch as far as possible*

In recent years, there has been a concerted effort to identify and establish Natura 2000 sites as Special Areas of Conservation (SACs) under the EU Habitats Directive. Figure 2 shows the Natura 2000 sites established for harbour porpoises across Western Europe, as of 10 August 2018. It can be compared with those identified from analysis of surveys, passive acoustic monitoring, and satellite tracking of individuals (Figure 3, from ASCOBANS, 2012, however the Natura 2000 sites layer is outdated and is missing several new sites, notably in Swedish waters).

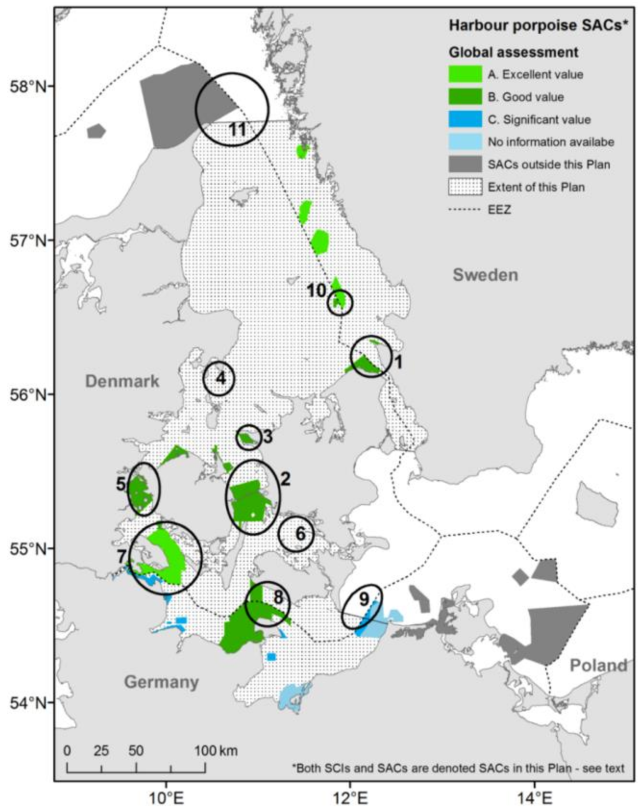

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Figure 3. Special Areas of Conservation (SACs) designated according to the EU Habitats Directive for harbour porpoises (i.e. where harbour porpoises are part of the selection criteria and listed as Population Status A, B, or C) by Denmark, Germany and Sweden within the Western Baltic, Belt Sea and Kattegat. Colours refer to the global assessment of each site to harbour porpoises (from ICES WGMME, 2011, and also http://eunis.eea.europa.eu/sites.jsp). Black circles indicate areas of high porpoise density identified by satellite tracking, surveys and passive acoustic monitoring: Northern Sound (1), Great Belt (2), Kalundborg Fjord (3), northern Samsø Belt (4), Little Belt (5), Smålandsfarvandet (6), Flensborg Fjord (7), Fehmarn Belt (8), Kadet Trench (9), Store Middelgrund (10) and Tip of Jutland (11). The order of the numbers is arbitrary. Please note that this map is outdated and missing new Natura 2000 sites for porpoises, notably in Swedish waters (Source: ASCOBANS, 2012)

The next step is to develop management plans for these SACs, and then to implement these. In most of these areas, in all countries, there are no management plans in place, see table X.

In Denmark, the Nature Agency contracted Aarhus University to produce a report to assess the importance and status of all the Natura 2000 sites in Danish waters (Sveegaard *et al.*, 2018). In 2010, 16 sites of Community importance (SCIs) were designated in Danish waters for harbour porpoises in accordance with the EU Habitats Directive. The designation was based on a review of existing knowledge at the time. Since 2011, harbour porpoises have been monitored as part of the Danish monitoring programme, NOVANA, both within the SCIs and in their entire range. The report presents an update of knowledge since 2010 and describes the distribution and hotspots of harbour porpoise in Danish waters, including changes over time. The significance for harbour porpoises of each of the 84 Danish marine SCIs is evaluated by comparing the site with the updated knowledge presented in the report. Of the 84 SCIs, 21 are assessed as being of major importance, 16 as medium importance, 25 as low importance, and 22 as no importance. The 16 SCIs designated for harbour porpoises are evaluated separately in relation to changes in density and importance since 2010: In 14 SCIs, data indicate no or minor changes and in two sites, ”Flensborg Fjord, Bredgrund og farvandet omkring Als” and ”Maden på Helnæs og havet vest for”, data indicate a decrease.

Key Conclusions and Recommendations *Several Natura 2000 sites now exist in the Western Baltic, Belt Sea and Kattegat. The next step is to develop management plans for each site and ensure there is mitigation measures in place to minimise adverse effects of human activities such as fisheries and noise disturbance. There should also be adequate regular monitoring of porpoises in and around those areas.*

4. Implement pinger use in fisheries causing bycatch

Germany

In 2016, Germany had fisheries operating in some of the areas listed in Annex I to Reg. 812/2004 where the use of pingers is mandatory (Figure 4). Fishing vessels use analog and digital pingers commercially available. In order to carry out compliance monitoring, the personnel of the competent federal and state authorities were equipped with Pinger Detector Amplifiers (Etec model PD1102) and trained accordingly. The detectors determine whether a pinger in the water actually emits its ultrasonic signals. The use of such detectors proves difficult in practice, since pinger signals can be masked by engine noise from control vessels. The relevant legal norm (Article 2, paragraph 2, Reg. 812/2004) requires that the pingers only have to function at the time of deployment. It is therefore irrelevant to check nets already set, as possible violations could not be punished. The legal framework for the detection and prosecution of violations should therefore be further optimised.

Federal fishing protection vessels carried out a total of five inspections in 2016 on fishing vessels obliged to use pingers. No violations were found. In the state of Mecklenburg-Vorpommern (Baltic Sea), no inspections of acoustic deterrent devices were carried out in 2016. The 4 gillnetters ≥12m registered in Mecklenburg-Vorpommern were not encountered in ICES Division 3.24 during the setting of gillnets in the course of sea inspections. Coastal waters of Schleswig-Holstein in the Baltic Sea do not fall within the scope of Annex I of Reg 812/2004 (see Figure 4).

Commented [IC12]: Create table of all N2k sites for hp in the area and list pop status, status of management plan etc for each area

Here it becomes relevant to maybe change the borders between action plans, since fex the new Swedish area “Sydvästskånes utsjövatten” will end up in the Jastarnia plan but is really more relevant for the Belt sea population.

Commented [IC13]: I assume this is still the most recent?

Commented [IC14]: Is this continued for the technical measures regulation where the same areas are specified for pinger use?

Commented [IC15]: Updates from later years?

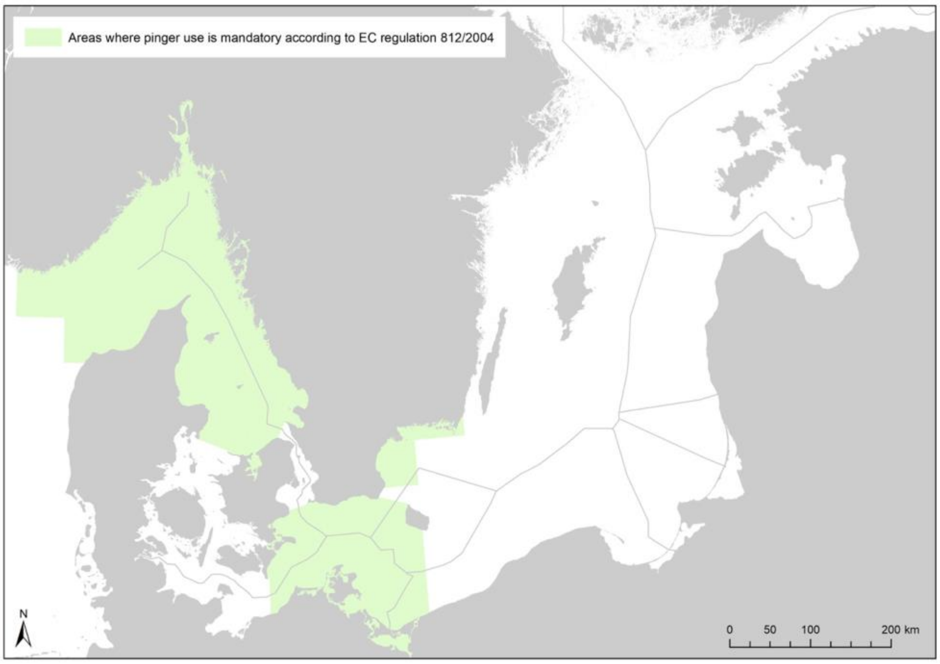

Figure 4. Areas where pinger use were mandatory under EC Regulation 812/2004, and now are mandatory under Regulation 2019/1241, on bottom set gillnets and entangling nets from vessels ≥ 12 m.

Since XXXX, almost 1,700 alternative "pingers" (Porpoise Alerting Devices or PALs) are being handed out to fishers through the OIC in Eckernförde to be deployed by the gillnet fishery in Schleswig – Holstein. The PALs were designed to serve as an alerting device rather than as a deterrent, by increasing their rate of echolocation (Culik *et al.*, 2015), and trials in a Danish fishery using REM to monitor bycatch rates indicated a 70% reduction when PALs were deployed (Culik *et al.*, 2017). However, the size of the effect was much less than with pingers, and its effectiveness appears to vary regionally, with no effect detected when tested in a Danish North Sea fishery as well as in a gillnet fishery for cod in Iceland. Reasons for the different results are unclear but it is may be that different porpoise populations are responding differently to the signals. To date, there is no clear evidence that PAL operates as an alerting device, Karin Tübbert (who identified the signal) describing it as causing the animals to move away.

Commented [IC16]: What year did this start? How many PALs are now in operation?

Commented [IC17]: Where in Denmark?

Denmark

Figure 4 shows the areas where pinger use is mandatory according to the old regulation 812/2004 and the new 2019/1241. These areas are clearly not based on any harbour porpoise distribution data. A total of 23 Danish vessels were obliged to use pingers in 2015. The Danish fisheries inspection authorities conducted a total of six inspections on vessels with an overall length of 12 m or above, and 64 inspections on vessels under 12 m. One violation was reported for lack of pingers from these

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inspections. No further monitoring of pinger use in Danish seas were conducted in 2015. No information is available for 2016 or 2017.

Commented [IC19]: Is pinger use monitoring ongoing or not?

Sweden

Sweden reported that the implementation of pingers as was laid down in Reg. 812/2004 now 2019/1241 (see Figure 4), most likely are not being implemented in regulated fisheries in Sweden. However, very few gillnet vessels in Sweden are over 12 m and hence required by the Regulation to use pingers. In 2015 a project started with the purpose of implementing pingers on a voluntary basis on boats below 12 m and hence not obliged to use pingers according to the regulations. After discussions with fishermen Banana pingers were chosen for the project. The fishermen consider the Banana pinger to be practical to use and that the bycatch of harbor porpoises decreased. The fishermen report their catch, effort and bycatch. The voluntary pinger use has continued in 2016-2019. In 2018, seven fishermen used pingers voluntarily in the cod and gillnet fisheries in the Öresund Sound, ICES Divisions 3.21 and 3.23.

Commented [IC20]: Update?

In the area where pingers have been used in the commercial lumpfish fisheries in southern Sweden, a study looking at the distribution and displacement of harbour porpoises in relation to commercial fisheries with pingers is currently taking place. Preliminary results show that harbour porpoise detections in the area are low when fisheries with pingers are carried out. However, when fisheries have stopped, the harbour porpoise detections do increase and are at the same levels as areas where no fishing with pingers has been carried out. No habituation to the pingers have been detected. The study continues in 2018.

Commented [IC21]: Update/final results available?

Key Conclusions and Recommendations *Pingers are deployed in parts of the static gillnet fisheries by the fleets of all three Range States. However, compliance with regulations is not fully checked or enforced throughout the region, and is very likely not fully implemented.*

Given the arbitrary delimitation of areas where pingers should be used under Regulation 2019/1241, and the 12 m vessel size limit which clearly has nothing to do with bycatch risk, countries should carry out bycatch risk modelling and implement pinger use, or when possible introduction of alternative fishing gear, in areas and fisheries with high risk of bycatch.

The German PAL system needs further investigation to determine to what extent it functions as an alerting rather than deterrent device, and to establish its potential in different situations. A scientific monitoring scheme should be implemented as soon as possible.

Commented [IC22]: Check status/plans on this

5. *Where possible, replace gillnet fisheries known to be associated with high porpoise bycatch with alternative fishing gear known to be less harmful*

Germany

A voluntary agreement has been in place with fishermen since 2013 in Schleswig-Holstein, resulting in a reduced length of gillnets deployed in the months of July and August. The STELLA Project aims to develop alternative management approaches, fishing gear and techniques towards minimising conflicts with gill net fisheries and the conservation of marine birds and mammals including harbour porpoise in the German EEZ of the Baltic Sea. It is funded by the Federal Agency for Nature Conservation (BfN) and is run by the Thünen Institute for Baltic Sea Fisheries.

Commented [IC23]: Results from Stella on alternative gear?

Denmark

Research is underway to improve the catch efficiency of cod pots, with investigations on the use of Push-Up traps for cod. There are also studies developing and testing small-scale Danish seine nets for cod. Research on these alternative fishing methods is being conducted in collaboration with SLU (Swedish University of Agricultural Sciences), Sweden, and is due to run from 2017-2020.

Commented [IC24]: Any new results?

Sweden

In the Swedish small-scale coastal fisheries, alternative fishing gear is continuously being developed. Since 2014, there has been funding opportunities for fishermen to put forward their ideas for selective fishing gear to the "Secretariat for selective fishing gear" funded by the Swedish Agency for Water Management. The purpose of the secretariat was to enable the fishing industry to develop selective fishing gear to help the transition to the new landing obligation. Projects were carried out by the Swedish University of Agriculture Science in cooperation with the fishermen involved. In 2016, the secretariat funded projects regarding size and species selectivity in benthic trawl fisheries for cod, shrimp and crayfish, a project developing multifunctional pots for fishing for cod and lobster, a project developing pots for shrimp fisheries and a project regarding trap net fisheries for mackerel, cod and herring (Nilsson, 2018). Developing selectivity grids in trawls prevent bycatch of certain fish species as well as birds and marine mammals. Pot and trap-net fisheries are fisheries with high selectivity with regard to marine mammals, birds and undersized fish. Developing these fisheries prevents an increase in for example gillnet fisheries which can have high bycatch rates for both birds and marine mammals.

Commented [IC25]: Is this funding scheme still ongoing? New results or projects?

Several studies have been undertaken to evaluate the catch efficiency of different cod and lobster pots and what factors affect the pots' catch efficiency (Ljungberg *et al.*, 2016; Hedgärde *et al.*, 2016; Nilsson, 2018). This is done partly by looking at the behaviour of cod in relation to cod pot models and other fisheries related factors such as soak-time. The entry rate of cod entering pots gives an indication on the pots' catch efficiency and by studying the entry rate in relation to factors such as cod pot model, number of fish inside the pot and current, you can get information on what factors affect the cod pots' catchability. Results showed that the number of entrances on the pot and the number of cod already inside the pot affected the entry rate of the cod entering the pot (Hedgärde *et al.*, 2016). Another study showed that using a funnel on the entrance opening to the fish holding chamber also affects the entry behaviour of cod while entering the pots however it increases the pots catch efficiency (cpue) due to the decreasing number of cod exiting the pots (Ljungberg *et al.*, 2016).

An alternative to both trawl and gillnet fisheries is bottom seine netting, such as Danish Bottom Seine. Bottom seines are generally considered less damaging than bottom trawls (ICES, 2006) and well-managed seine fisheries generally have minor ecosystem impacts (Morgan and Chuenpagdee, 2003). In 2016, the Swedish University of Agriculture Science has continued to develop a seine net modified for small open boats and tried it for pelagic and demersal species as a possible alternative to gillnet fisheries. The development is still under progress and the upcoming years there will be a focus on evaluating the seines environmental impact on the benthic habitat.

Commented [IC26]: New results?

Key Conclusions and Recommendations *Studies are ongoing in all three countries to find alternative fishing methods that are less harmful to marine wildlife including porpoises. These should be strongly encouraged, and knowledge gained should be shared widely across the fishing industry and other marine stakeholders.*

6. Estimate total annual bycatch

Germany

Germany monitored under the DCF observer programme, trying to follow the requirements of Reg. 812/2004 as much as possible. In one fleet segment, covering vessels under 15 m that use gillnets with mesh sizes >=110 mm in the Baltic Sea, one bycatch of a harbour porpoise was reported by a fisherman to DCF observers in 2016. In 2017 no bycatch was reported to DCF observers.

Commented [IC27]: Correct?

Denmark

No specific monitoring programmes for incidental bycatch of cetaceans have been undertaken in recent years in Danish fisheries. Instead, observer data on incidental catches of marine mammals was collected under the Data Collection Regulation scheme (DCR). In the latest year of reporting (2017) one harbour porpoise was reported bycaught in area 27.3.b.23.

Sweden

Until 2016 the monitoring effort conducted by Sweden was part of the EU Data Collection Framework where on-board observer data are mainly from trawl fisheries but also pot fisheries for crayfish. No bycatch of cetaceans was observed. In 2017 and 2018 a dedicated monitoring survey was carried out to monitor bycatch of marine mammals and birds. In 2017 in gillnet fisheries in Subdivision 23, all together 36 DaS were observed and two harbour porpoises were observed bycaught in large mesh gillnets. Dedicated onboard studies has been carried out in 2018 and 2019 as well.

Commented [IC28]: Any new results from this project?

Key Conclusions and Recommendations *Dedicated monitoring of marine mammal bycatch in is not undertaken in any of the Range States, covering a sufficient part of the fleet of higher risk fisheries to arrive at reliable estimates. Reliance upon the EU Data Collection Framework risks seriously under-recording porpoise bycatch. Remote electronic monitoring appears to be much more effective but has not yet been developed sufficiently to be applied widely to the extent needed. Until all these issues are addressed, an assessment of the true level of bycatch of harbour porpoise in the region will not be realised.*

7. Estimate trends in abundance of harbour porpoises in the Western Baltic, the Belt Sea and the Kattegat

The abundance of harbour porpoises in northern European waters has been estimated three times from internationally coordinated large-scale dedicated surveys; SCANS (Small Cetacean Abundance in the North Sea and Adjacent waters) in July 1994 (Hammond *et al.*, 2002), SCANS-II in July 2005 (Hammond *et al.,* 2013), and SCANS-III in July 2016. Previously, the abundance for the population inhabiting the Kattegat, Belt Sea, the Sound and Western Baltic was estimated to be 27,767 (CV = 0.45, 95% confidence interval (CI) = 11,946-64,549) in 1994, and 10,865 (CV=0.32, 95% CI = 5,840-20,214) in 2005 (Teilmann *et al.*, 2011). Although this represents a 60% decline in the point estimates, the wide confidence limits result in no significant trend.

Following the abundance survey in July 2016, a trend was determined from the three SCANS surveys for harbour porpoises in the Skagerrak, Kattegat and Belt Seas (see Figure 5). This indicated a slight but non-significant (p=0.81) increase of 1.24% (CV-0.30; 95% Cis of -39% to +67%), for the three abundance estimates (ICES, 2017). The results of a power analysis showed that the data used have 80% power to detect an annual rate of change of 3.7%.

In addition to the three SCANS surveys, the Kattegat / Belt Sea Management Unit was surveyed in July 2012 (Viquerat *et al.*, 2014). That estimate is compared with one for the equivalent area from the July 2016 SCANS survey (see red dots in Figure 5). They also show no significant change between surveys. The 2012 survey gave an abundance estimate of 40,475 ((CV=0.24; 95% CI: 25,614-65,041), whereas the 2016 survey gave an abundance estimate of 42,324 (CV=0.30; 95% CI: 23,368-76,658).

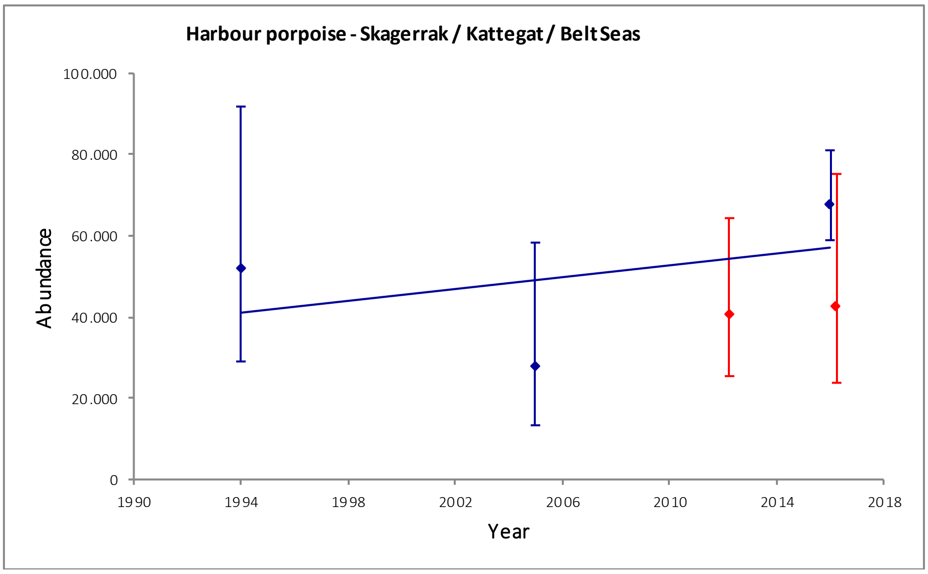

Figure 5. Estimates of abundance (error bars are log-normal 95% confidence intervals) for harbour porpoise in the Skagerrak / Kattegat / Belt Seas area (blue dots and line) and Kattegat / Belt Seas ICES Management Unit (MU) (red dots). All estimates are from SCANS surveys, except Kattegat/Belt Seas in 2012 (Viquerat *et al.*, 2014) (Source: ICES, 2017)

Table 1 summarises porpoise abundance estimates from each survey, with the SCANS estimates subdivided into the original blocks (Skagerrak, Kattegat and Belt Seas) and then within the management unit area of the Kattegat and Belt Seas.

Commented [IC29]: Can this instead say "within the management unit area for the Belt Sea harbour porpoise population"? Would that be correct?

Table 1. Abundance estimates for harbour porpoise in the Skagerrak, Kattegat and Belt Seas and for the management unit area of the Kattegat and Belt Seas. 1994 & 2005 estimates are revised from Hammond *et al.* (2002) and Hammond *et al.* (2013) respectively, 2012 estimate from Viquerat et al. (2014), and 2016 estimate from Hammond *et al.* (2017), see also ICES WGMME (2017). Note that the areas of coverage for each survey are not strictly comparable.

Year	Area	Estimate	CV (95% CI)
1994	Skagerrak, Kattegat, Belt Seas	51,660	0.30 (29,058-91,841)
2005	Skagerrak, Kattegat, Belt Seas	27,901	0.39 (13,345-58,333)
2016	Skagerrak, Kattegat, Belt Seas	67,691	0.22 (16,607-38,748)
1994	Kattegat, Belt Seas	27,767	0.45 (11,946-65,549)
2005	Kattegat, Belt Seas	10,865	0.32 (5,840-20,214)
2012	Kattegat, Belt Seas	40,475	0.24 (25,454-64,361)

2016	Kattegat, Belt Seas	42,324	0.30 (23,807-75,244)

The 1994 & 2005 Kattegat & Belt Seas estimates from Teilmann *et al*. (2011) are not strictly comparable to more recent ones because although taken from the SCANS (1994) & SCANS II (2005) surveys, these violate the formal assumption of equal coverage probability because the survey was designed to achieve that over the whole block (which is a larger area).

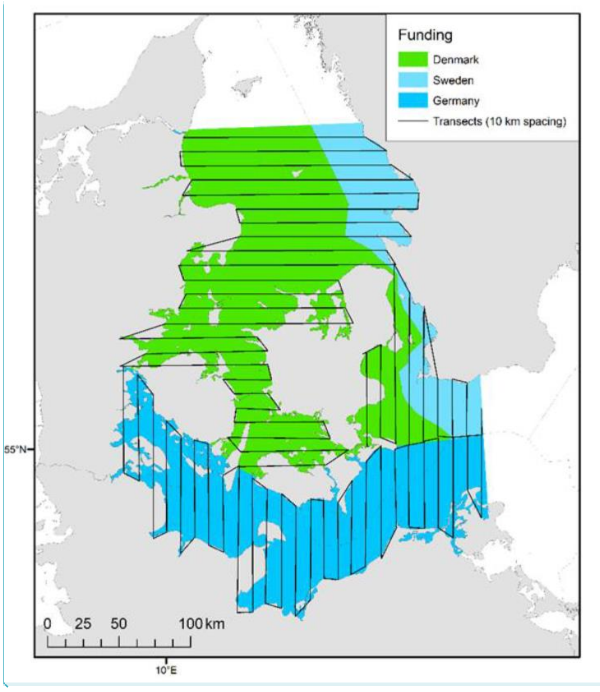

Figure 6. Proposed transect design for international survey, 2020

A mini-SCANS survey is being planned for summer 2020, co-funded by Denmark, Germany, and possibly Sweden. The transect design for the proposed survey is illustrated in Figure 6.

Commented [IC30]: Update design? And is it still happening?

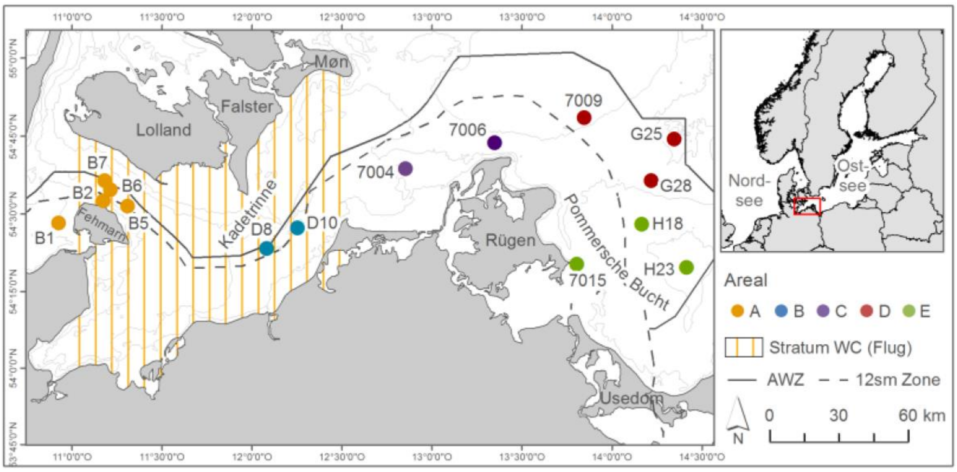

Figure 7. Locations of C-PODs deployed as part of the German Acoustic Monitoring Programme

Monitoring in Danish waters involving C-PODs and other acoustic surveys was conducted from 2011-2016, but then ceased. However, a new period of acoustic monitoring began in 2017 and is due to continue until 2021. Acoustic monitoring in German waters of the WBBK area continues using C-PODs (see Figure 7). Germany also has an established monitoring programme of their waters using visual and digital aerial surveys within the WBBK region (to 13.5° E around the island of Rügen). This is funded by BfN, with surveys in summer every two years. Around Fehmarn, however, the surveys are undertaken annually. There are also winter surveys (in association with seabird monitoring) around the "Pommersche Bucht". In Sweden, 14 acoustic monitoring stations in the WBBK area were added into the national monitoring programme in 2019, see Figure X.

Commented [IC31]: Add more details and a map?

Commented [IC32]: In the map it doesn't look like aerial surveys extend that far east?

Commented [IC33]: Correct? Since when?

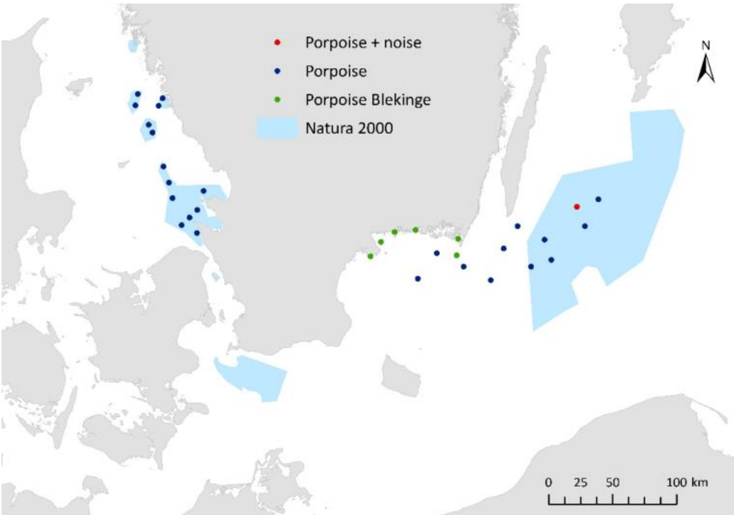

Figure 8. Locations of C-PODs deployed as part of the Swedish Acoustic Monitoring Programme. In total 14 stations are located within the WBBK area.

Key Conclusions and Recommendations *The SCANS III survey in July 2016 has provided a recent abundance estimate of approximately 42,000 porpoises for the area of the WBBK management unit. There is a proposal to carry out a MiniSCANS survey of the area in summer 2020. This should make it possible to better establish a trend for this population. No attempt has been made as yet to visually monitor seasonal variation in abundance. Acoustic monitoring provides some measure of this but so far has been patchy in space and time. It is recommended that monitoring, both visually and acoustically, is extended, ideally to fill those gaps. For the region as a whole, coverage could usefully be raised to the level currently undertaken by countries in the southern North Sea, with both summer and winter covered on an annual basis.*

8. Monitoring population health status, contaminant load and causes of mortality

Germany

Only Germany has a dedicated stranding scheme, which operates in both Schleswig-Holstein and Mecklenburg-Vorpommern. The scheme is administered in the former region by the Terrestrial and Aquatic Research Institute (ITAW) in Büsum, and in the latter region by the German Oceanographic Museum in Stralsund.

Since German waters span the transition zone, it is difficult to know how many animals come from the Baltic Proper and the Belt Sea population, respectively. In 2017, 94 animals were reported stranding in Schleswig-Holstein and 58 in Mecklenburg-Vorpommern. Necropsies are undertaken on fresh specimens to determine cause of death and collect life history information. Kesselring *et al.* (2017) investigated the first signs of sexual maturity for a period of almost two decades (1990-2016). Ovaries from 111 female harbour porpoises stranded or bycaught from the German North Sea and Baltic Sea were examined for the presence and morphological structure of follicles, corpora lutea and corpora albicantia. They found that whereas there were no significant differences in the demographic structure of females between the two regions, the average age at death differed significantly with 5.70 (± 0.27) years for North Sea animals and 3.67 (± 0.30) years for those in the Baltic Sea. By comparing the age structure with the average age at sexual maturity, it has been estimated that around 28% of the female harbour porpoises found dead along the German Baltic coast of Schleswig-Holstein had lived long enough to reach sexual maturity. In comparison, about 45% of the dead females from the North Sea had reached sexual maturity. They concluded that growing evidence existed to suggest that the shortened lifespan of Baltic Sea harbour porpoises is linked to an anthropogenically influenced environment with rising bycatch mortalities probably due to local gillnet fisheries since about 30% of the animals sampled were thought to be by-caught.

Commented [IC34]: Update w new info

Denmark

The Danish Nature Agency is funding the dissection and necropsy of 25 stranded or bycaught porpoises per year in order to examine health and cause of death. However, since there is no stranding scheme in place to collect these animals, the actual numbers of examined specimens are much lower, e.g., from 2008-2016, 0-5 porpoises were dissected per year. A review of Danish strandings (see Table 2) was published recently by Kinze *et al.* (2018). Between 2008 and 2017 34 porpoises have been autopsied (see https://fimus.dk/wp-content/uploads/2018/10/Beredskabsrapport-2017-1.pdf).

The seven specimen from the waters around Bornholm

Table 2. Summary of harbour porpoise strandings for the period 2008-2017 divided by zoo-geographical region Outer Danish Waters (ODW), Inner Danish Waters (IDW) and the Waters Around Bornholm (WAB)

	Zoo-geographical region			
Year	**ODW**	**IDW**	**WAB**	**Total**
2008	149	75	0	**224**
2009	49	84	1	**134**
2010	73	46	0	**119**
2011	97	50	1	**148**
2012	66	52	3	**121**
2013	102	34	0	**136**
2014	78	43	0	**121**
2015	9	13	1	**23**
2016	57	19	1	**77**
2017	51	18	0	**69**
Total	**731**	**434**	**7**	**1172**

Sweden

In Sweden, records of strandings are collected opportunistically by the Swedish Natural History Museum (NRM) in collaboration with the Gothenburg Museum of Natural History. 38 porpoises were necropsied out of 220 stranded animals reported in 2016-2018: two from the Skagerrak (North Sea conservation plan area) and 26 from the Kattegat & Belt Seas. 13 of the necropsied animals had signs of bycatch. The aim for this programme is to continue to undertake necropsies at the level of 20 animals/year, and from 2020 a program for monitoring of disease in marine mammals is started. In addition, samples from around 660 porpoises, collected mainly during the 1990s, have been donated to the museum.

Commented [IC35]: Update?

Commented [IC36]: More info from Jasmine and Aleksija about this!

In all three countries, the protocols used for examining strandings, and for undertaking necropsies, have been the ones recommended from the pathology workshops held by the European Cetacean Society (Kuiken & García Hartmann, 1992; Kuiken, 1996; García Hartmann, 2001).

Key Conclusions and Recommendations *For studies of health status, contaminant loads and causes of death, there needs to be a well-developed stranding reporting scheme with regular necropsies undertaken of a reasonable sample size. Germany has such a scheme and performs necropsies on a routine basis. However, neither Sweden nor Denmark have well-established stranding schemes, although Sweden does perform necropsies on a sample of stranded animals. There is a need to establish a more comprehensive stranding reporting scheme in those countries, and in particular in Denmark, to have routine necropsies undertaken.*

9. Ensure a non-detrimental use of pingers by examining habitat exclusion and long-term effects of pingers

A number of studies have examined possible long-term effects of pingers through habitat exclusion (Carlstrom *et al.*, 2002, 2009; Hardy *et al.*, 2012; Kyhn *et al.*, 2015; Teilmann *et al.*, 2015). The latest study (Kyhn *et al.*, 2015) examined the effects of 2 types of pingers (Airmar: 10 kHz tone; Save-Wave

Black Saver: 30–160 kHz sweep) on the presence of wild harbour porpoises, at two sites in Jammerland Bay in the Great Belt, Denmark. Pinger spacing within the areas was similar to that used in commercial fisheries. Two scenarios were tested: (1) pingers were periodically activated and deactivated during six periods resembling the deployment and recovery of nets in a gillnet fishery, and (2) pingers were active continuously for 28 days. T-PODs were deployed, four within the pinger areas and three in control areas, all detecting porpoise echolocation activity throughout the entire study. During the periodic-exposure scenario, the porpoise detection rate was reduced by 56% when pingers were active. The reduction was larger for the SaveWave pingers (65%) than for the Airmar pingers (40%). There was a tendency for the encounter rate to increase after the first 2–4 periodic exposures, which could indicate gradual habituation. During the continuous-exposure scenario, the detection rate was reduced by 65% throughout the 28 days with no sign of habituation. In the control areas (2.5, 3 and 5 km distant), neither a decrease nor an increase in detection rate was observed, suggesting that porpoises were displaced either <2.5 km or >5 km away. The authors concluded that if pingers are used as deterrent devices, the impact of habitat exclusion needs to be considered concurrently with mitigation of bycatch, especially when regulating fisheries in Marine Protected Areas.

Another study took into account not only the direct effects but also the sub-lethal population level effects of pinger use resulting from e.g. reduced foraging efficiency, and showed through the use of an individual-based model that a combination of time-area fishing closures and the use of pingers was likely the most beneficial way of mitigating bycatch (Beest et al. 2017).

Since this study, further studies in Denmark have tried to better understand behavioural responses of porpoises in the presence of pingers so as to improve their effectiveness without deleterious side effects. This research continues.

Commented [IC37]: Would be very interesting to see further results on this?

Sweden has in 2015-2018 carried out an extensive long term study on the distribution and displacement of harbour porpoises in relation to commercial gillnet fisheries with pingers. The results are currently being analysed. Preliminary results do not indicate permanent displacement nor habituation of harbour porpoises due to extensive longterm use of pingers in commercial fisheries.

Commented [IC38]: Final results available?

Germany is currently not undertaking studies of possible habitat exclusion or habituation in the presence of pingers. Although the Thünen Institute's development of PAL devices was to tackle the acoustic deterrent issue, there remains uncertainty whether those devices serve only an alerting function or also deter animals in the same way as pingers do.

Key Conclusions and Recommendations *Scientists from the Range States have led much of the research that has been undertaken to date on the interactions between porpoises and pingers. The main objective is to ensure that with pinger deployment, porpoises are alerted to the presence of a net in a manner that avoids entanglement whilst not being deterred enough that it excludes them from important habitat for significant periods of time resulting in a population impact. Studies continue to investigate the efficacy of this potential mitigation measure. These should be encouraged.*

We strongly recommend close monitoring of the large-scale deployment of PALs in German Baltic waters. The ability of these devices to decrease bycatch, as well as their effects on harbour porpoise distribution and behaviour, needs to be investigated.

10. Include monitoring and management of important prey species in national harbour porpoise management plans

In general, studies are largely lacking on the effects of prey depletion on porpoise energetics and its impact upon population dynamics. A major gap exists in understanding prey preferences and how diet varies in time and space. In the WBBK region, however, important work has been undertaken by Danish and German researchers. Sveegaard *et al.* (2012) examined the stomach contents of 53 harbour porpoises collected between 1987 and 2010 in the Öresund Sound (ICES SubDivision 23) that links the western Baltic with the Kattegat (high season, April-Oct, n=34 porpoises; low season, Nov-Mar, n=19 porpoises). A total of 1,442 individual specimens from thirteen fish species were identified. The distribution in terms of occurrence and number of fish species differed between seasons, indicating a seasonal shift in prey intake. During the high-density season, the mean and total prey weight per stomach as well as the prey species diversity was higher. However, no difference was found in the number of prey species between the two seasons, indicating a higher quality of prey in the high-density season. Atlantic cod was found to be the main prey species in terms of weight in the high-density season while Atlantic herring and Atlantic cod were equally important during the low-density season. They considered that prey availability and predictability were likely to be the main drivers for harbour porpoise distribution in this region.

More recently, Andreasen *et al*. (2017) analysed a much larger sample, a data set including 339 stomachs collected over a 32-year period (1980–2011) from the western Baltic Sea (ICES SubDivisions 22-24) with a few additional samples from the Kattegat (ICES SubDivision 21). As is usually the case, the stomach contents were mainly hard parts of fish prey and in particular otoliths. In this study, the bias originating from the differential residence time of otoliths in the stomachs was addressed by use of a recently developed approach. Atlantic cod and herring were the main prey of adult porpoises, constituting on average 70% of the diet by mass. Juvenile porpoises also frequently consumed gobies, the mass contribution by gobies averaging 25%, which was as much as cod. In this region, other species such as whiting, sprat, eelpout, and sandeels were of minor importance for both juveniles and adults. The diet composition differed between years, quarters, and porpoise acquisition method. Yearly consumption rates for porpoises in the western Baltic Sea were obtained in three scenarios on the daily energy requirements of a porpoise in combination with an estimate including the 95%CLs of the porpoise population size. Cod of age groups 1 and 2 and intermediate-sized herring were estimated to suffer the highest predation from porpoises in this region.

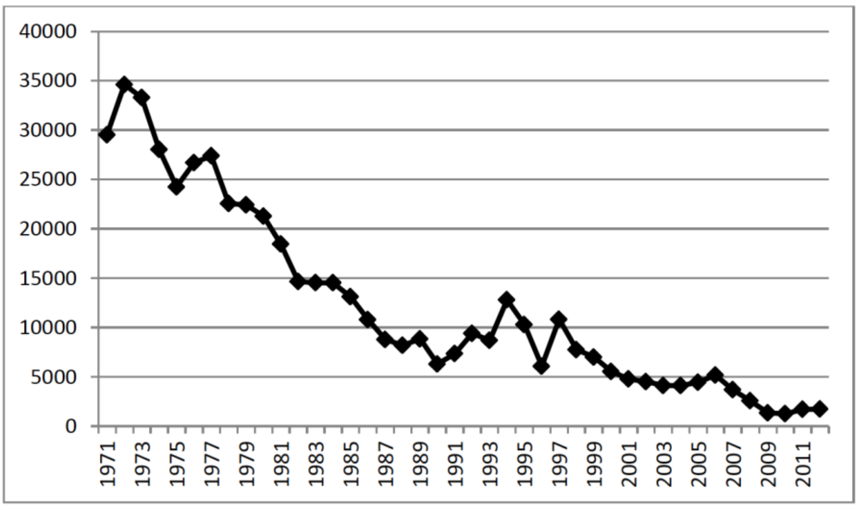

Figure 8. Spawning stock biomass (SSB) trend for the Kattegat cod stock (Source: HELCOM 2013)

The stocks of cod and herring in the region have changed markedly over the last fifty years. The spawning stock biomass of cod in the Kattegat (ICES SubDivision 21) has declined from around 35,000 tonnes in the early 1970s to around 2,000 tonnes by the early 2010s (Figure 8). Cod spawning aggregations have been observed in the central and southern part of the Kattegat (HELCOM, 2013).

Commented [IC39]: Are there new numbers?

The Western Baltic stock of cod (ICES SubDivisions 22-24), on the other hand, has fluctuated over the same time period, declining markedly between the early 1970s and early 1990s, but recovering somewhat since then (Figure 9). However, there is no sign of a full recovery in stock size from the historical levels (ICES, 2012), with it suffering from a fishing mortality above sustainable levels, and reduced recruitment (Oceana, 2016). Spawning takes place in the Sound, in the Belt Sea, and at various locations in the Arkona basin (HELCOM, 2013).

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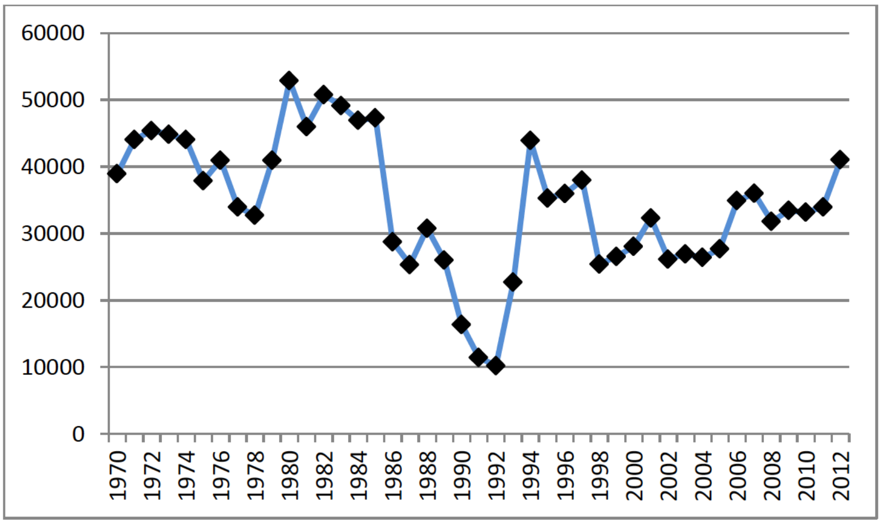

Figure 9. Spawning stock biomass (SSB) trend for the Western Baltic cod stock (Source: HELCOM, 2013)

The Western Baltic cod stock has been recovering slowly and the spawning stock biomass (SSB) has increased since 2014. However, the fishing mortality has been above the target for MSY (above FMSY levels) and recruitment has been low. ICES identified the mixing of eastern and western stocks that occurs at the borders of their distribution ranges as a major issue and introduced a new approach, which now gives advice separately for both stocks in SubDivision 24 (instead of only taking a fishing zone into account). To solve the problem posed by eastern cod caught in SubDivision 24 (and to protect the western Baltic cod stock), ICES proposed setting a separate sub-TAC for SubDivisions 22-23. This would ensure that eastern stock's catches allocated for the western stock will only be taken out in SubDivision 24 where mixing occurs and will not hamper the survivability of fish in SubDivisions 22 and 23. For the first time, in 2016, ICES decided to incorporate recreational catch data for western cod stock's status assessment. The estimation of recreational catches is a minimum estimate for the whole period as it only includes German data. The German data are considered reliable after 2005 and were extrapolated for previous years. With these figures alone, recreational catches are at 2,558 tonnes, which is over 30% of the total proposed commercial quota. This calls for a well-thought-out management decision to either reduce the TAC (Total Allowable Catch) or allocate part of it for recreational fishermen and to restrict their pressure on this stock until it can recover (Oceana, 2016). In accordance with the MSY framework, ICES advised that the total catch of Western Baltic cod in 2016 should not exceed 7,797 tonnes.

Cod stocks have been subject to a management plan since 2007 (European Commission, 2007). In 2014, the Commission presented a proposal for a new and revised fisheries management framework, the first multi-annual plan to be agreed under the reformed Common Fisheries Policy (CFP)21. However, the legislative process has been delayed due to stalled negotiations, resulting from differences in positions between the European Parliament (rightfully introducing changes to the final text that are much more in line with the reformed CFP and MSY objectives than the original proposal) and the Council of Ministers. Until it is adopted, the old cod management plan, which ICES identified as no longer able to be considered precautionary, is still in force (Oceana, 2016).

Commented [IC41]: Repeats the para before and should be shortened and updated

Commented [IC42]: Update

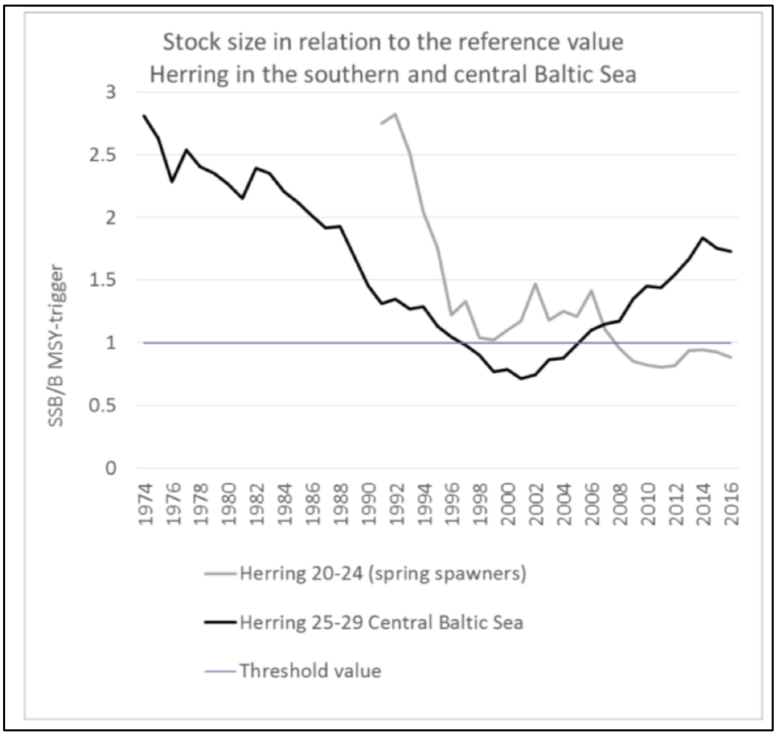

Figure 10. Trend in ratio of spawning stock biomass (SSB) to maximum sustainable yield (MSY) for spring spawning herring in ICES SubDivisions 20-29 (Source: HELCOM, 2017a)

Important stocks of spring spawning herring exist in the Skagerrak (ICES SubDivision 20), Kattegat (ICES SubDivision 21) and Belt Seas (ICES SubDivisions 22-24). A comparison of the spawning stock biomass and assessment of maximum sustainable yield shows a marked decline for the stock in ICES SubDivisions 20-24 during the 1990s, steadying thereafter but at a much lower level (Figure 10; HELCOM, 2017a). The SSB of this stock is just above one third of what it was in the 1990s when the time series began, and has been decreasing since 2006, with the lowest ever level observed in 2011. Since then, it has increased somewhat, just above the precautionary level, and ICES now classifies the stock to be at full reproductive capacity. Fishing mortality was at an historical low (below FMSY) in 2014. The ICES advice in order to achieve MSY means that catches in the whole distribution area should be no more than 52,547 tonnes, for subdivisions 22-24 this means a TAC of 26,274 tonnes (Oceana, 2016).

Commented [IC43]: Update

Figure 11 shows the distribution of fishing effort leading to extraction of fish of three target species, and harbour porpoise prey species (cod, herring and sprat) for the Kattegat, Belt Seas, Western Baltic and Baltic Proper.

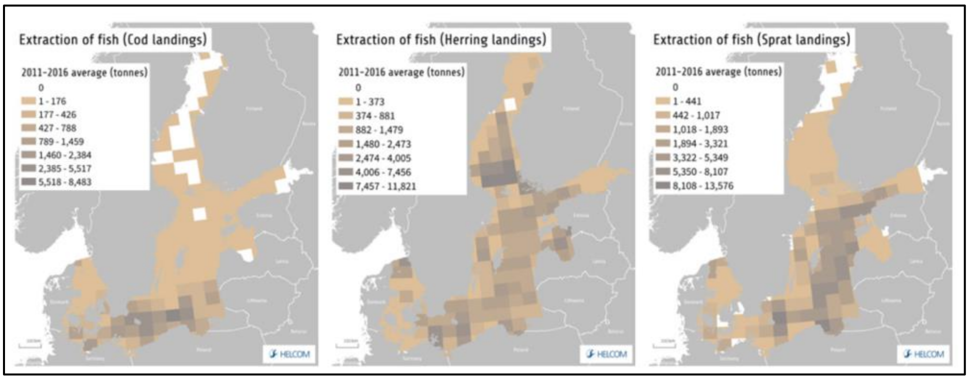

Figure 11. Spatial distribution of commercial landings of cod, herring and sprat in the Baltic Sea (Source: HELCOM, 2018a)

Herring biomass is dependent on the size of the cod stock, which is its main predator, and on the size of the sprat stock, with which it competes for food. For herring, there are also large differences in growth rates between regions: individuals are small in the northern areas and larger in the south. These could have implications for top predators like harbour porpoise.

Commented [IC44]: Add something on body condition of herring/sprat and the possible connection to harbour porpoise body condition?

The state of cod and herring stocks may impact upon harbour porpoises in various ways: by triggering shifts in their main areas of concentration, switching to other prey, and/or reduced body condition which could lead to lower reproductive rates. These relationships need to be investigated further. The same applies to porpoises in the Baltic Proper where high fishing mortality has led to long-term changes in the stock sizes of various fish species (cod, herring and sprat in particular) (HELCOM, 2018a).

Commented [IC45]: And condition

Key Conclusions and recommendations *Recent studies have provided insight into the diet of porpoises in the region, illustrating the importance of cod and herring for adult porpoises whilst juveniles also consumed a significant quantity of gobies. Both cod and herring stocks have declined in the Skagerrak, Kattegat and Belt Seas but cod populations are showing some signs of recovery in the Western Baltic. Trends in the stocks of these important prey species could potentially affect porpoise reproductive rates and possibly also survival rates. It is recommended that studies investigate in more detail predator-prey interactions at an ecosystem level.*

Commented [IC46]: Is this still true?

11. Restore or maintain habitat quality

One of the main human pressures that can affect the environment in which harbour porpoises live is the production of underwater noise. It may cause behavioural changes to both porpoises and their prey, mask communication, and even have physiological impacts. Underwater noise can be divided into continuous low frequency sounds largely derived from shipping, and low and mid frequency impulsive sounds derived from sources such as seismic survey airguns, pile driving, detonations and active sonar. For this reason, under the EU Marine Strategy Framework Directive, two indicators were developed for Descriptor 11 on the introduction of energy/noise:

- 11.1. Distribution in time and place of loud, low and mid frequency impulsive sounds
- 11.2. Continuous low frequency sound

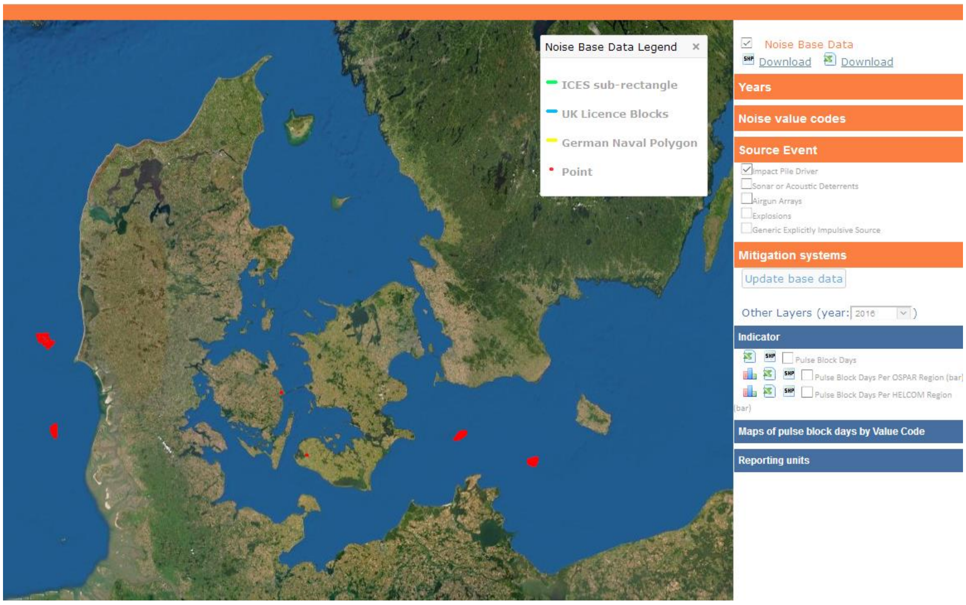

Figure 12. Noise Map of Impulsive sound produced from pile driving between 2010 and 2018 (Source: ICES database)

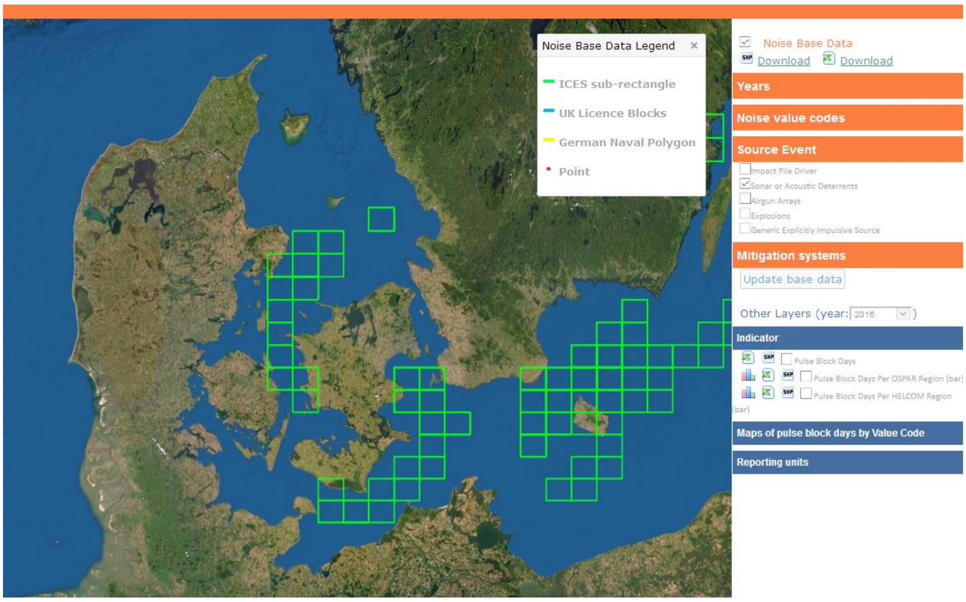

Figure 13. Noise Map of Impulsive sound produced from sonar or ADDs between 2010 and 2018 (Source: ICES database)

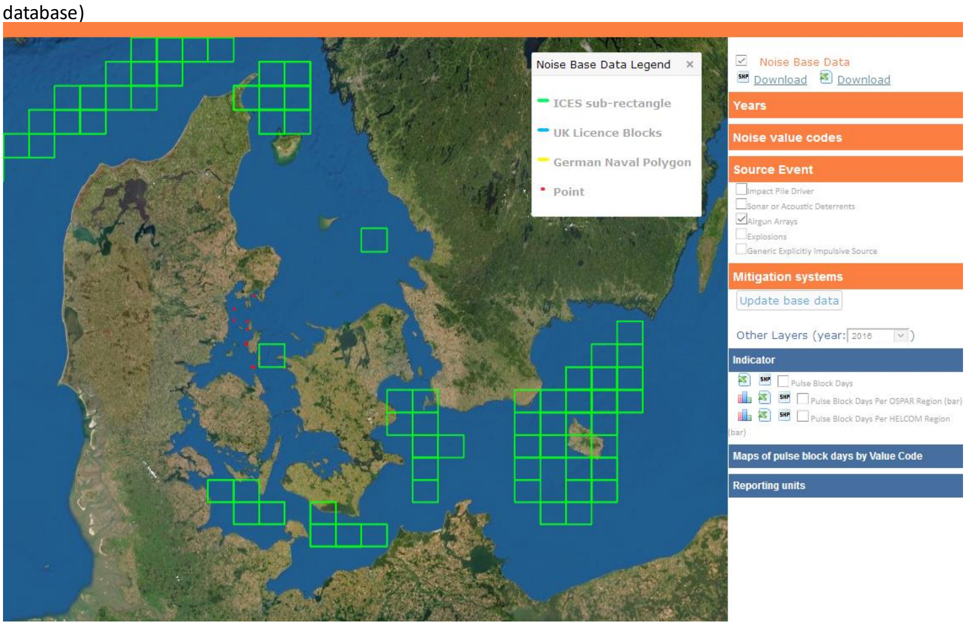

Figure 14. Noise Map of Impulsive sound produced from airgun arrays between 2010 and 2018 (Source: ICES database)

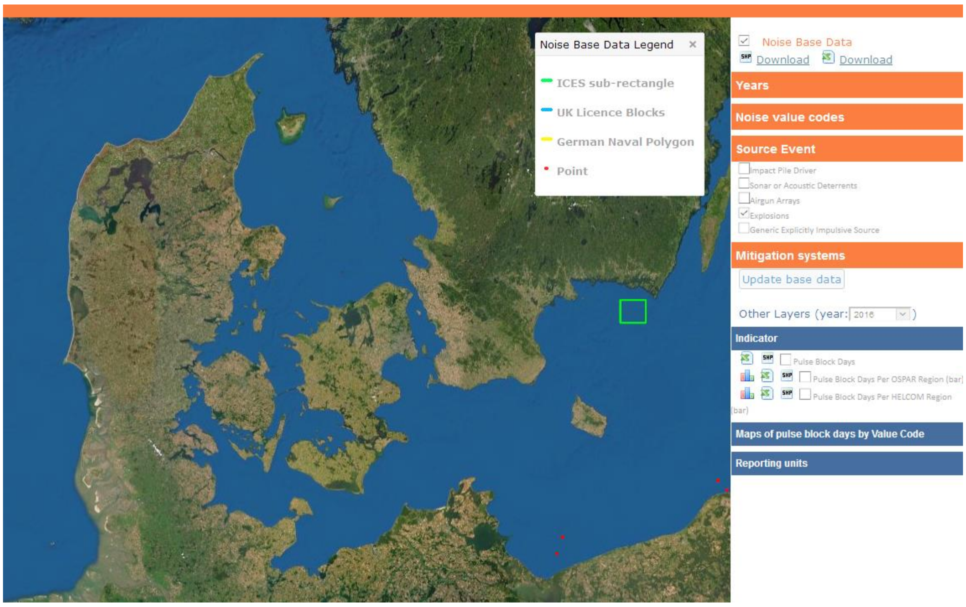

Figure 15. Noise Map of Impulsive sound produced from explosions between 2010 and 2018 (Source: ICES database)

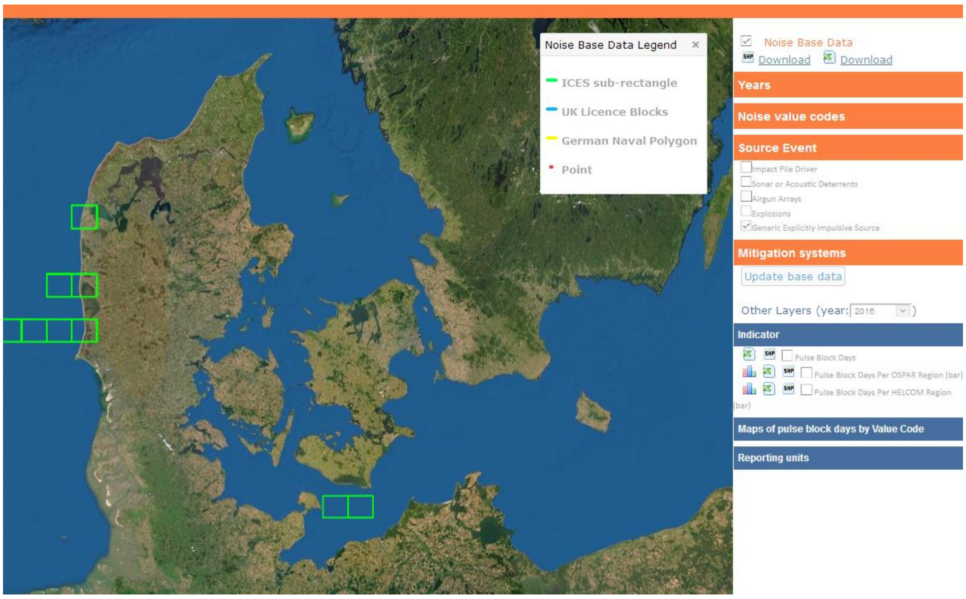

Figure 16. Noise Map of Impulsive sound produced from generic impulsive sources between 2010 and 2018 (Source: ICES database)

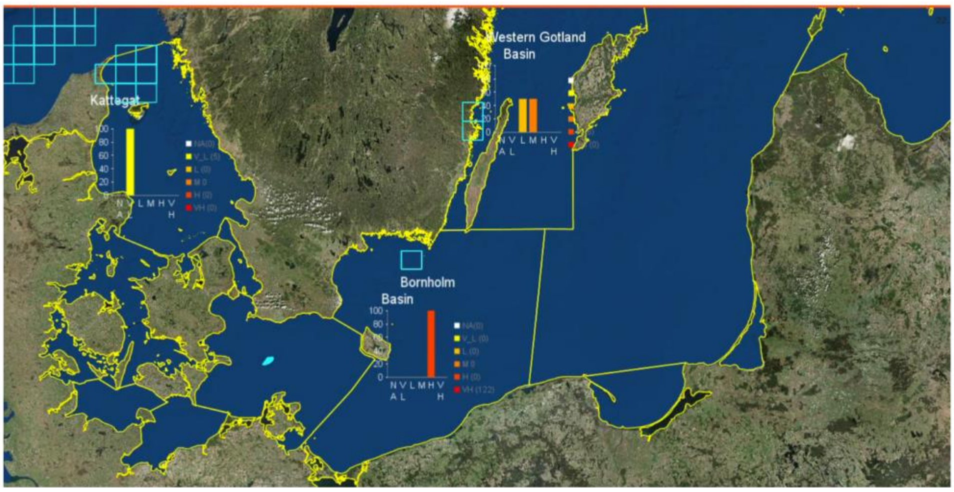

Figure 17. First draft of the graphs of pulse block days per HELCOM sub-basin based on data from the regional registry (Source: HELCOM, 2017b)

For Indicator 11.1, ICES have set up a registry in support of HELCOM and OSPAR. This registry provides an overview of the spatial and temporal distribution of impulsive noise events over the frequency band of 10 Hz to 10 kHz causing a “considerable” displacement (http://www.ices.dk/marine-data/data-portals/Pages/underwater-noise.aspx). “Considerable” displacement is defined as displacement of a significant proportion of individuals for a relevant time period and at a relevant spatial scale. Data are slowly being entered. Maps downloaded on 10 August 2018 showing the blocks with activity for each of the main source types for the years 2008-16, are depicted in Figures 12-16.

Commented [IC47]: Update maps

Denmark, Germany and Sweden have all contributed data to ICES (see, for example, Tougaard & Schack, 2018) although there are probably more still to come before these maps fully reflect the usage of a variety of sources of impulsive sound active within the Western Baltic, Belt Sea and Kattegat. These are three types of gaps: 1) activities that have to be reported but are not. These should reduce as procedures for reporting improve; 2) activities that can be reported, but are not mandatory. These. include military activities. It is to be hoped that navies will cooperate to ensure as comprehensive reporting as possible; and 3) activities that do not have to be reported, but are likely to cause significant disturbance. Those include sources above 10 kHz such as seal scarers and some sonars. Work is underway in TG-Noise and elsewhere, to address this issue.

In some areas, seal scarers have the potential to be a significant issue although there is no evidence as yet that it is one in the WBBK area. Since it may become an issue in the future, some regulation of their use now would be advisable.

Commented [IC48]: Are seal-scarers used at all? I didn't think they were.

The ICES noise register also allows for the calculation of pulse block days by time period (e.g. year) for each of the five categories of sources. A start on this has been made in the Western Baltic and Belt Seas (Figure 17). An example of how marine noise budgets might be examined is discussed in Merchant *et al.* (2018). This method could usefully be adapted for use by HELCOM in the WBBK and Baltic areas, and more generally for the entire OSPAR area.

For indicator 11.2, the trends of ambient noise measured in 1/3 octave bands centred at 63 and 125 Hz are to be monitored. In the Baltic marine region, the LIFE+ project called BIAS (Baltic Sea Information on the Acoustic Soundscape), running from September 2012 – August 2016, measured the ambient noise during 2014 and modelled monthly soundscape maps based on the measurements, data on AIS traffic and environmental covariates (www.bias-project.eu). In addition to the MSFD centre frequencies, BIAS also measured the ambient noise at 2 kHz, as a compromise between the hearing ranges of herring, seals and the harbour porpoise. Figure 18 shows the 38 recording stations used to monitor continuous noise. In the Belt Seas, Denmark in 2018 increased the number of recording stations from one to four, and will further increase this to a total of six stations in 2019.

Commented [IC49]: Update, and add information on stations in other countries

The BIAS project produced soundscape maps in 2016, showing the underwater noise generated by commercial vessels, the major source of human-induced underwater noise in the Baltic Sea. The study area extended into the western Baltic and Belt Seas but not the Kattegat. Seasonal soundscape maps were produced for each of the demersal, pelagic and surface zones. These soundscape maps will serve as a baseline for the development of monitoring and assessment of ambient noise in this region. Figure 19 shows noise maps across the whole water column for the three centre frequencies, 63 Hz, 125 Hz, and 2 kHz.

It is important to note, however, that since porpoises are high frequency echolocators with a hearing range most sensitive above 15 kHz (maximum sensitivity c. 125 kHz) (Kastelein *et al.*, 2002, 2015), the MSFD frequencies are unsuitable for assessing direct impact of continuous noise on this species (Hermannsen *et al.*, 2014; Dyndo *et al.*, 2015; Wisniewska *et al.*, 2018). On the other hand, they may function as proxies for higher frequencies. The issue with higher frequencies of course is that they do not propagate very far from the source (just a few hundred metres at frequencies above 100 kHz), which means that a noise map may simply be a map of the location of the sources.

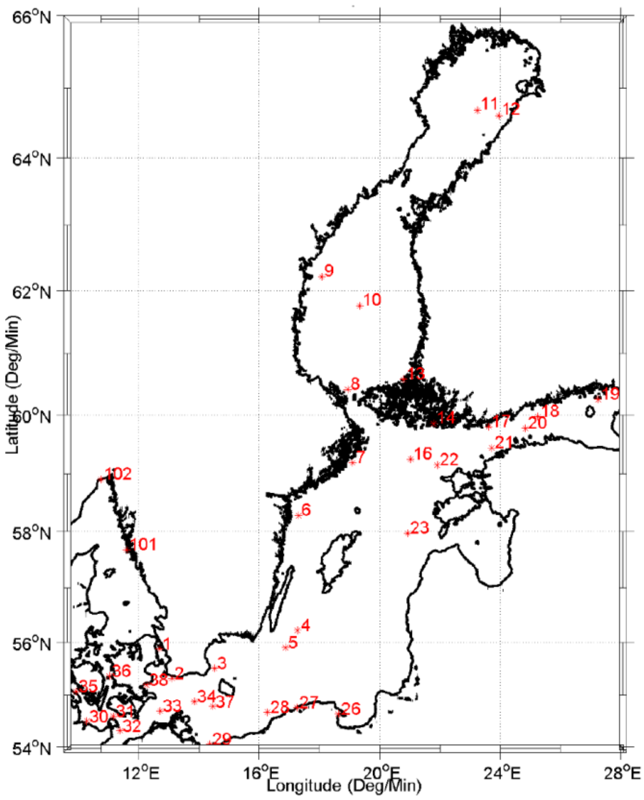

Figure 18. Baltic Sea Regional Map showing the positions of the acoustic measurements carried out by the BIAS Project (Source: Folegot *et al*., 2016)

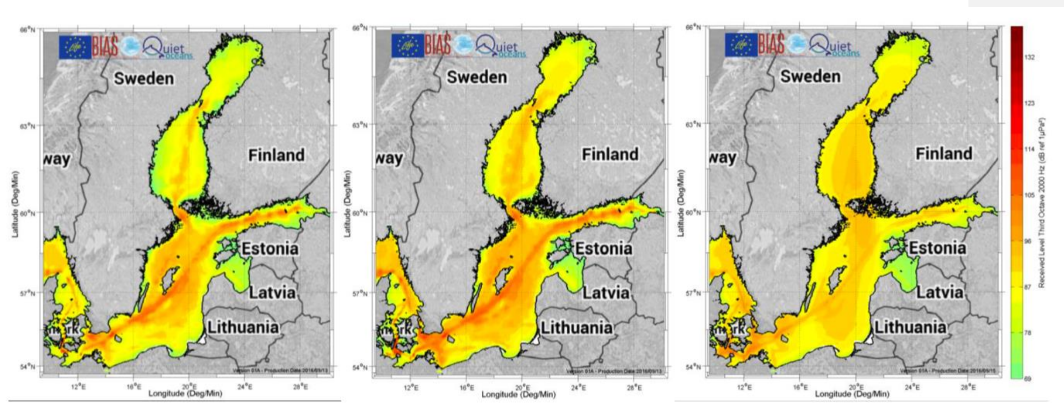

Figure 19. Annual median noise maps for the full water column for the 63 Hz third-octave (left), the 125 Hz third-octave (middle), and the 2kHz third-octave (right) (Source: Folegot *et al*., 2016)

The BIAS project focused upon modelling shipping noise. which generates most sound at low frequencies, below 1 kHz. However, Hermannsen *et al.* (2014) using a broadband recording system in four heavily ship-trafficked marine habitats in Denmark, found that vessel noise from a range of different ship types substantially elevated ambient noise levels across the entire recording band from 0.025 to 160 kHz at ranges between 60 and 1000 m. These ship noise levels are estimated to cause hearing range reduction of >20 dB (at 1 and 10 kHz) from ships passing at distances of 1190 m and >30 dB reduction (at 125 kHz) from ships at distances of 490 m or less. They conclude that a diverse range of vessels produce substantial noise at high frequencies, where toothed whale hearing is most sensitive, and that vessel noise should therefore be considered over a broad frequency range, when assessing noise effects on porpoises and other small toothed whales. Ship noise extending to higher frequencies and thus potentially affecting toothed whales and dolphins has been reported also by other authors (see, for example, McKenna *et al.*, 2012; Williams *et al.*, 2014; Veirs *et al.*, 2016; Southall *et al.*, 2017). Of relevance to the porpoise in particular is that recreational craft are generally not equipped with AIS and so are un-monitored, yet those craft usually produce sounds at frequencies of 1-15 kHz. Veirs & Veirs (2006) found that recreational vessels on average increased background noise 5 – 10 dB higher than the average of large commercial ships. It would therefore be prudent to establish better ways to monitor these craft.

Presently, shipping (continuous noise) and piling (impulsive noise) are considered to constitute the two major sources of underwater noise in the Baltic Sea. In the 2013 HELCOM Copenhagen Ministerial Declaration, it was agreed that the level of ambient and distribution of impulsive sounds in the Baltic Sea should not have a negative impact on marine life, and that human activities that are assessed to result in negative impacts on marine life should be carried out only if relevant mitigation measures are in place. Also, as soon as possible and by the end of 2016, using mainly already on-going activities, countries should:

- establish a set of indicators including technical standards which may be used for monitoring ambient and impulsive underwater noise in the Baltic Sea;
- encourage research on the cause and effects of underwater noise on biota;
- map the levels of ambient underwater noise across the Baltic Sea;
- set up a register of the occurrence of impulsive sounds;
- consider regular monitoring on ambient and impulsive underwater noise as well as possible options for mitigation measures related to noise taking into account the ongoing work in IMO on non- mandatory draft guidelines for reducing underwater noise from commercial ships and in CBD context;

The goal of the Baltic underwater noise roadmap is to make every effort to prepare a knowledge base towards a regional action plan on underwater noise in 2017/2018 to meet the objectives of the 2013 Ministerial Meeting, and of the EU MSFD for HELCOM countries, being EU members.

By 2018, a review of sound sources and their impacts upon marine life had been made, along with a summary of potential underwater noise mitigation measures that could be employed for the different sound sources (HELCOM, 2018a). Harbour porpoise was identified as one of the priority species (along with harbour seal, ringed seal, grey seal, cod, herring and sprat). A map compiling noise sensitive areas derived from biological data on noise sensitive species so far identified has also been produced (see, Figure 20), and incorporated in the latest version of the State of the Baltic Sea report (HELCOM, 2018b). An inventory of noise mitigating measures already used in the Baltic Sea region has been compiled (HELCOM 2017b). The inventory shows that at least three countries (Germany, Denmark, Sweden) are implementing measures to reduce the impact of noise on the marine environment, i.e. by exclusion of noise generating activities for a certain time period or from certain areas, restriction of anthropogenic underwater noise to a certain level, and use of noise reducing techniques (Table 3).

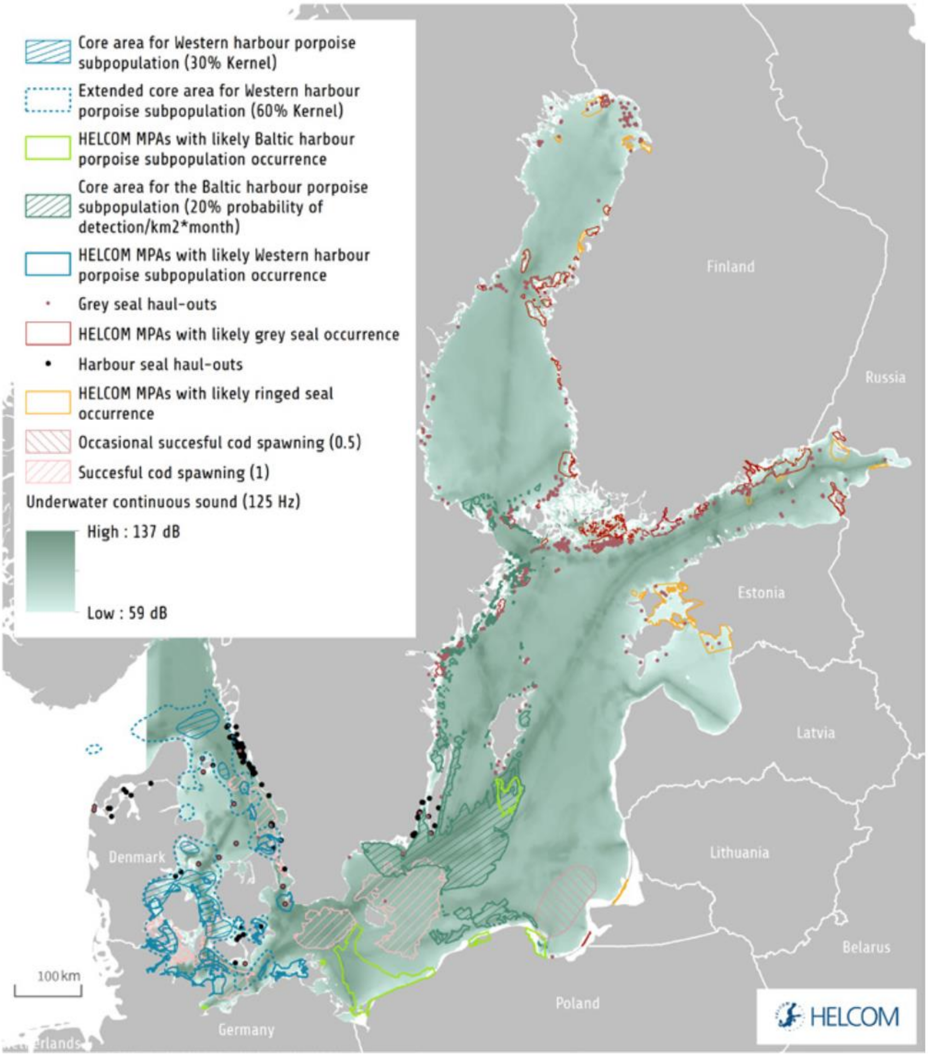

Figure 20. Example of how information on the distribution of sound can be compared with important areas for species that are sensitive to sound. The example shows areas identified so far (based on HELCOM, 2016). The soundscape shown is the sound pressure level (dB re 1uPa) for the 125 Hz frequency band occurring 5% of the time, for the whole water column (surface to bottom) in June 2014 (Source: HELCOM, 2018b).

Table 3. Summary of Progress made by countries within the Baltic Sea on noise mitigation actions (Source: Ruiz & Lalander, 2017)

Exclusion of noise generating activities for a certain time period	DK*, FI*, SE
Exclusion of wind farms in Nature Conservation Areas (Maritime Spatial Planning)	DE
Restriction of anthropogenic underwater noise to a certain level	DE, DK, SE
Exclusion of noise generating activities from certain areas (e.g. wind farms)	DE, SE
Spatio-temporal exclusion or limitation of noise causing activities	DK*, SE
Usage of alternative techniques	SE
Modification of operational state of noise source, e.g., reducing ship speed	SE
Refraining from applying activities (e.g. by refrain from using explosives when decommissioning offshore constructions)	SE
The environmental courts may impose any of these restrictions as conditions for granting a project license. For shipping over 500 tonnes, the Swedish Transport Agency may propose "Areas to be avoided" through the IMO. Two such areas were implemented in the Baltic in 2005. No speed restrictions for larger vessels have been proposed, though regional authorities have implemented coastal "Consideration Areas" which include speed restrictions for motorboats. The Swedish Armed Forces use a marine biological calendar when planning exercises to minimize environmental disturbance.	SE

**Potential measure*

It should be borne in mind that a comparison of progress across countries is not entirely straightforward. For example, the Danish legislation works differently from German legislation especially. It is not based on fixed exposure limits, but underwater noise must be included in any environmental impact assessment, and is thus part of the assessment for any new activity and project proposed. In fact, most countries operate a similar procedure to Denmark under EU regulations.

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Whereas shipping noise is thought to have greatest potential effect upon baleen whales due to their good hearing at low frequencies, where ships produce most noise power, recent findings indicate significant energy also generated at medium- to high-frequencies. Dyndo *et al*. (2016) conducted an exposure study inside Kerteminde harbour in the Danish Belt Sea where the behaviour of four harbour porpoises in a net-pen was logged while they were exposed to 133 mainly small or medium vessel passages. Using a multivariate generalised linear mixed-effects model, they showed that low levels of high frequency components in vessel noise elicit strong, stereotyped behavioural responses in porpoises. Since such low levels will routinely be experienced by porpoises in the wild at ranges of more than 1,000 metres from vessels, this suggests that vessel noise may be a substantial source of disturbance in shallow water areas where there are high densities of both porpoises and vessels.

Wisniewska *et al*. (2018) used animal-borne acoustic tags to measure vessel noise exposure and foraging efforts in seven harbour porpoises in highly trafficked coastal waters of Denmark. Tagged porpoises encountered vessel noise 17–89% of the time and occasional high-noise levels coincided with vigorous fluking, bottom diving, interrupted foraging and even cessation of echolocation, leading to significantly fewer prey capture attempts at received levels greater than 96 dB re 1 mPa (16 kHz third-octave). They postulated that if such exposures occur frequently, porpoises, with their high metabolic requirements (see, for example, Wisniewska *et al*., 2016), may be unable to compensate energetically leading to negative long-term fitness consequences. Bas *et al*. (2017) studied the effects of marine traffic on the behaviour of porpoises in the Istanbul Strait at the entrance to the Black Sea.

This was significant in looking specifically at responses of porpoises to large ships under natural conditions. The observations indicated reaction ranges of some few hundred metres. Some years earlier, Evans *et* al. (1994) studying reactions of porpoises to different vessels in Shetland, found strong negative reactions to large ships at ranges of two kilometres. One might expect similar findings to occur in the presence of large vessels in the Baltic Sea Region.

Of impulsive sound sources, pile driving during marine construction (for example of offshore wind turbines) has received much research attention in the last two decades. As noted in ASCOBANS (2012), During the construction phase of the Nysted wind farm in the Danish Western Baltic a strong decrease in harbour porpoise presence up to 10 km away from the construction site was found to have occurred (Carstensen *et al*., 2006). Subsequent monitoring of the operational phase showed that the negative effect persisted even after several years (Teilmann *et al*., 2009). Pile driving has generally been found to be the most disturbing activity during wind farm and other construction work, causing a decrease in porpoise density up to 17 km away, although porpoises appear to react differently at different sites and to sometimes come back to the area after construction has finished (Tougaard *et al*., 2009; Brandt *et al*., 2011; Scheidat *et al*., 2011; Siebert *et al.,* 2012; Dähne *et al*., 2013). This probably depends on the nature of the construction activity, noise attenuation due to seabed features, prey availability, and the importance of the area to the porpoises, as well as the presence of other disturbance factors besides noise. Studies on the effectiveness of different mitigation measures have taken place in German waters in recent years. These include the use of gravity-based foundations or alternative installation procedures (Koschinski & Lüdemann, 2014), air bubble curtains (Lucke *et al*., 2011; Dähne *et al*., 2017), and acoustic deterrents such as seal scarers (Brandt *et al*., 2012).

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The production of guidelines on the impacts of particular impulsive sound sources, and when new noisy activities can commence, have formed a series of publications as well as reports funded by the Danish Energy Agency. Noise sources include pile driving (Danish Energy Agency, 2015; Tougaard, 2015; Clausen *et al*., 2018; Nabe-Nielsen *et al*., 2018) and seismic surveys (Tougaard, 2016; van Beest *et al*., 2018). Tougaard & Dähne (2017) have emphasised the importance of consideration to frequency weighting in the context of underwater noise regulatory frameworks. Whether and how this is applied has significant implications, as indicated also from several reviews of noise exposure criteria (see Southall *et al*., 2007; Finneran *et* al., 2016; NMFS, 2016; Houser *et al*., 2017).

Key Conclusions and Recommendations *Underwater noise has the potential to be an important human stressor affecting porpoises and their habitat. It can cause a range of effects from the masking of sounds through behavioural responses affecting foraging or reproduction to actual physiological damage. Under the Marine Strategy Framework Directive, countries are obliged to monitor both continuous noise as produced by shipping, and impulsive noise from sources such as seismic, sonar, pile driving, seal scarers, and explosions. Some of this has started in the WBBK area, although there is still more to be done before one can establish that the region is in good environmental status.*

It is highly recommended that all countries that do not have national guidance documents on EIA procedures to assess noise impact on e.g. harbour porpoises, noise limits/thresholds and control programmes, should develop and implement such documents and programmes.

Summary of Progress in Implementation of the Plan

Table 4 provides a qualitative assessment of progress by each of the Member States on the various actions identified as priorities. Progress has been variable since the adoption of the plan in 2012. Some aspects (e.g. the monitoring of noise and understanding of the potential impacts of different sources) have received a lot of attention, whereas others (e.g. adequate monitoring to derive robust bycatch estimates, and implementation of effective mitigation measures to reduce bycatch) have made less progress.

Table 4. Summary of Progress in the Implementation of the Conservation Plan

	Actions from the WBBK Conservation Plan for HP	Priority		SE	DK	DE
1	Implementation of the CP: co-ordinator and Steering Committee	High		Co-ordinator for 2020		
2	Actively seek to involve fishermen in the implementation of the plan and in mitigation measures to ensure a reduction in bycatch	High		1	1	2
3	Cooperate and inform other relevant bodies about the conservation plan	High		0	0	0
4	Protect harbour porpoises in their key habitats by minimizing bycatch	High		1	1	1
5	Implement pinger use in fisheries causing bycatch	High		1	1	1
6	Replacement of high risk gillnets with alternative gear	High		1	0	1
7	Estimate total annual bycatch	High		0	1	0
8	Estimate trends in abundance in the Western Baltic, the Belt Sea and Kattegat	High	Large scale	2		
			Reg/survey	1	2	2
9	Monitoring population health status, contaminant load and causes of mortality	Medium		1	0	2
10	Ensure non-detrimental use of pingers by examining habitat exclusion and long-term effects of pingers	Medium		1	1	0
11	Include monitoring & management of important prey species in national HP management plans	Medium		0	0	0
12	Restore or maintain habitat quality	Medium		0	0	0

Priority Recommendations

1) Monitor and estimate bycatch. Specifically estimate total annual bycatch
2) Set up stranding/reporting schemes and collection of stranded/bycaught animals in Denmark so that the number of necropsies can be increased
3) Put in place guidelines for underwater noise in the entire WBBK and Jastarnia areas, similar to those existing in the German North Sea
4) Continue studies to examine habitat exclusion and long-term effects of pinger deployments
5) Continue large-scale as well as national surveys and monitoring of abundance and distribution

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