Agenda Item 6.1.3	Further Implementation of the Agreement Species Action Plans Conservation Plan for Harbour Porpoises in the North Sea (North Sea Plan)
Information Document 6.1.3a/Rev.1	**Progress Report on the Conservation Plan for the Harbour Porpoise in the North Sea**
Action Requested	Take note
Submitted by	Harbour Porpoise Coordinator

Note:
Delegates are kindly reminded to bring their own document copies to the meeting, if needed.

PROGRESS REPORT

on

THE CONSERVATION PLAN FOR THE HARBOUR PORPOISE

IN THE NORTH SEA

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Sea Watch Foundation and Coalition Clean Baltic

CONTENTS

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

PROGRESS REPORT ON
THE CONSERVATION PLAN FOR THE HARBOUR PORPOISE IN THE NORTH SEA

Background and History

The 5th International Conference for the Protection of the North Sea (Bergen, Norway, 20-21 March 2002) called for a recovery plan for harbour porpoises in the North Sea to be developed and adopted (Paragraph 30, Bergen Declaration). Germany volunteered in 2003 to draft a recovery plan within the framework of ASCOBANS, and in association with Range State Norway.

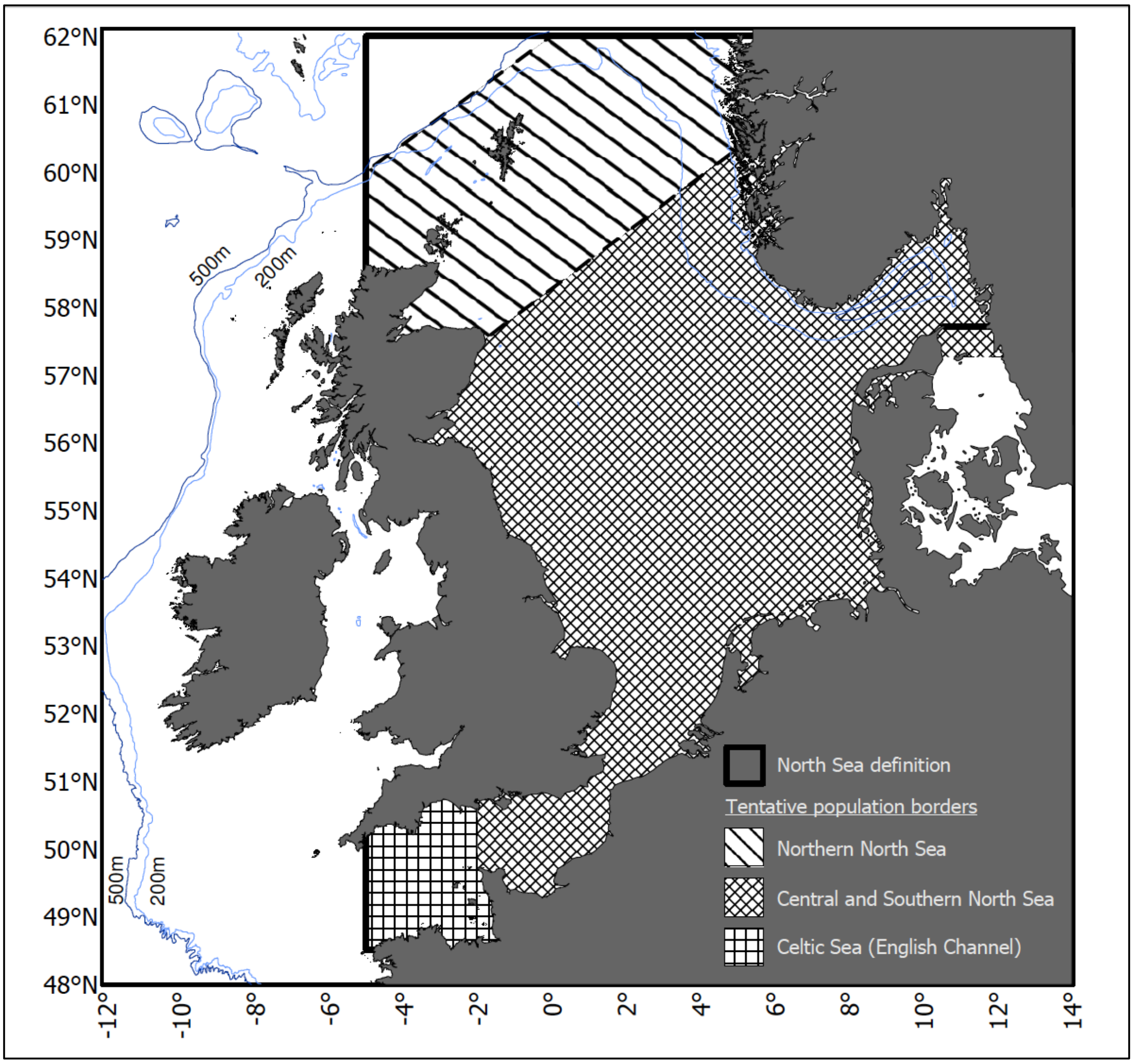


Figure 1. Area covered by the North Sea Conservation Plan (as defined at the 5th International Conference on the Protection of the North Sea in Bergen, Norway, 20 – 21 March 2002) showing the tentative harbour porpoise population borders (Source: ASCOBANS, 2009a)

A recovery plan for the harbour porpoise in the North Sea was developed and submitted to the 13th Advisory Committee meeting of ASCOBANS in Tampere, Finland in April 2006 (ASCOBANS, 2006) along with a background document on the porpoise population structure, distribution, abundance and threats in the region, prepared by Eisfeld and Koch (2006). From this, a conservation plan was drafted and presented at the 16th Advisory Committee meeting of ASCOBANS in Brugge, Belgium in April 2009 (ASCOBANS, 2009a). The change in name from a recovery plan to a conservation plan resulted from the fact that wide-scale surveys of the region in July 1994 and July 2005 indicated little change in overall population size for the species in the North Sea. The area under consideration included all of the North Sea, the Skagerrak, and the English Channel, with some tentative population borders set (Figure 1). The conservation plan was formally adopted at the 6th Meeting of the Parties in Bonn, Germany in September 2009 (ASCOBANS, 2009b).

During the 17th Advisory Committee meeting of ASCOBANS in Bonn, Germany in October 2010, terms of reference for a Steering Group were developed (ASCOBANS, 2010b, 2011a). The first meeting of the Steering Group took place in Bonn, Germany, in May 2011 (ASCOBANS, 2012a). Since then, meetings of the Steering Group were held annually prior to each Advisory Committee meeting between 2012 and 2015 (ASCOBANS, 2013, 2014, 2015a, 2016). There was no Advisory Committee meeting between September 2015 and September 2017, so the 6th meeting of the North Sea Group was held intersessionally at Wilhelmshaven, Germany in June 2017.

Between 2009 and 2010, two part-time consultants were contracted for the initial coordination of the conservation plan (Leaper & Papastavrou, 2009, 2010). In 2011, a new part-time coordinator was appointed, and continued in this role until 2014 (Desportes, 2012, 2013a, b, 2014).

The North Sea Conservation Plan initially proposed 12 actions (ASCOBANS, 2009a). Action 1 was the implementation of the plan through establishment of a co-ordinator and a Steering Committee. Seven of the remaining eleven actions were rated as high priority, centred around the most pressing conservation issue, that of bycatch (Actions 2-6), but including also monitoring trends in distribution and abundance (Action 7), and reviewing stock structure (Action 8). The three other actions rated as medium priority included the collection of incidental data on porpoises through stranding networks (Action 9), investigation of the health, nutritional status and diet of porpoises in the region (Action 10), investigation of the effects of anthropogenic sounds (Action 11), and collection and archiving of data on anthropogenic activities within a GIS (Action 12). Since 2011, the North Sea Group has focused on the eight priority actions, whilst also briefly reviewing progress on the other actions in the form of an Implementation Table.

ACTION 1 Implementation of the Plan through establishment of a Coordinator and a Steering Committee

A Steering Group was established in 2011 and has been maintained ever since. Its work has been undertaken mainly through annual meetings but there has also been exchanges by e-mail intersessionally. At each meeting, one or more representative of each range state usually attends, along with interested parties from NGO groups or other marine stakeholders. Between ten and twenty-one persons have participated in each of the meetings. Peter Evans (Sea Watch Foundation) has chaired the group since 2014 and was re-elected at the 6th Meeting of the North Sea Group.

After a gap of three years, funding was agreed upon for a part-time coordinator (to cover all three conservation plans) at the 23rd Advisory Committee meeting of ASCOBANS in Le Conquet, France in September 2017. It was agreed that the Sea Watch Foundation (UK) would take on the coordination of the three action plans for 2018. In January 2019, ASCOBANS again asked for Expressions of Interest to fill the role as Coordinator of the ASCOBANS harbour porpoise action plans, and Coalition Clean Baltic received the contract for the task in March 2019. In 2020, coordination of the action plans was divided between Coalition Clean Baltic and the Sea Watch Foundation with the Jastarnia Plan coordinated by Coalition Clean Baltic and the North Sea Plan by Sea Watch Foundation.

ACTION 2 Implementation of existing regulations on bycatch of cetaceans

Over the last ten years, the main regulation on bycatch affecting harbour porpoise in the North Sea to date has been Council Regulation (EC) 812/2004 (hereafter Reg. 812/2004) which required at-sea observer schemes to monitor bycatch rates for vessels 15m or over and mitigation using acoustic deterrent devices 'pingers' for vessels exceeding 12m, for specific fisheries (see Action 5 for further details). EU Member States were required to submit a report to the European Commission annually, documenting how they had implemented this regulation. Table 1 summarises the extent of compliance from 2007-2018 in terms of report submissions from countries with EEZs within the North Sea region under consideration.

Table 1. Summary table of coastal EU Member States (MS) regarding the status of Reg. 812/2004 report submissions to the European Commission (Green = Yes for report with data on observer effort (either days at sea or other measurement, e.g. effort per haul or set); Pale grey = Yes for report with no data on observer effort (either days at sea or other measurement); Darker grey = As for pale grey but report only received in 2019; Orange = no report submitted; *** No Reg.812/2004 report but reports on cetacean bycatch observations made under DCF sent to the Commission. Some of this information was made available at the meeting; **** Data made available at the WGBYC meeting in 2020; (Source: ICES WGBYC 2020).

Coastal Member State of the EU	Monitoring (Art. 4-5)	Report Reg 812/2004 & effort data provided											
	Fishing in areas affected	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Germany DE	Yes								***				
France FR	Yes							****					
Ireland IE	Yes												
Netherlands NL	Yes										****		****
United Kingdom UK	Yes												
Belgium BE	Yes												
Denmark DK	Yes												
Sweden SE	Yes							****	****		****	****	

Generally, range states submit national reports to the European Commission on the implementation of reg. 812/2004 in June, summarising data collected in the previous year (Jan-Dec). The reports are available on request to the ICES WGBYC meeting in the following year; hence the 2020 WGBYC meeting reviewed reports summarising 2018 data. As noted by ICES WGBYC (2020), the quality and scope of the information provided in the annual reports continues to be variable, with some member states simply repeating the information provided in previous years.

Most countries rely on the Data Collection Framework (DCF) sampling programme to monitor marine mammal and other protected species bycatch; however, the UK has a dedicated protected species bycatch monitoring programme (PSBMP) for the purposes of meeting the requirements of Reg. 812/2004 and the EU Habitats Directive. Relying only on observations carried out under the DCF may lead to under estimation of bycatch events as some bycatches may be missed by the observers who focus mostly on other tasks (e.g. fish sampling). This is a concern moving forward to protected species data collection under the EU-MAP (ICES WGBYC 2019, 2020) following the repeal of the Reg. 812/2004 which has been replaced by Regulation EU 2019/1241 (hereafter the "technical measures regulation") on 14 August 2019.

Member States also have obligations under Article 12 of the EU Habitats Directive: "Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned."

Within the EU, there are initiatives currently to improve synergies in general monitoring and reporting (see, for example, ICES 2018, ICES WKDIVAGG 2018).

Key Conclusions and Recommendations *Almost all EU Member States have been submitting annual reports in relation to Reg. 812/2004, although there can be a time delay and the content does not always fulfil the objectives of providing reliable estimates of bycatch and instigating adequate mitigation measures to reduce bycatch. National reports should be consistent across countries with a comparable level of detail, and sufficient information on vessel numbers of all sizes actively operating different gears, and fully monitored vessels; the reports should be of easier access to the wider community which would allow greater scrutiny and should ultimately lead to improvements. Member States should ensure that the monitoring under the EU-MAP fulfils the requirements of environmental legislation such as the Marine Strategy Framework Directive and the Habitats Directive. Member States should also observe fully their obligations under these directives, and the resolutions adopted by Parties to ASCOBANS should be fully implemented.*

ACTION 3 Establishment of bycatch observation programmes on small vessel (<15 m) and recreational fisheries

Small vessels

Establishing bycatch observation programmes on small vessels is important to gain a more complete picture of the scale of the problem, especially given that harbour porpoise bycatch occurs mostly in gillnets, which are usually deployed from smaller vessels. However, scaling up bycatch rate estimates to fleet level estimates requires information on fisheries effort. Most countries do not have fisheries effort data for vessels below 10m, although this segment represents a non-negligible segment of the fleet. As an example, **Germany** has no effort data for vessels <=10m, which are not required to keep a logbook and have to record their catches only in monthly landing declarations (DE, AR 812/2004 2013) and part-time fishermen do not have to report effort at all. The German gillnet fleet in the North Sea was composed in 2008 of 30 vessels <7.5 m, 20 vessels between 7.5-15m, and only a single one >15 m (Kock, 2010). In 2012, the German fleet (across all gear types and all areas fished) was estimated to total 1,551 vessels, of which 74% (1,150) were 10 m or less length (Masters, 2014).

The same is true for **Denmark**, where vessels <=10 m and part-time fishers do not have to report fishing effort. In 2012, the Danish fleet was estimated to amount to 2,743 vessels, of which 78% (2,150) were 10 m or less in length (Masters, 2014). Observer data on incidental catches from Danish gillnets have been collected under the Data Collection Regulation scheme (DCR). In 2016, monitoring was carried out on vessels <15 m in area 27.3.a (5 fishing days; 2.0% coverage; two bycaught harbour porpoises), and vessels <15 m in area 27.4 (4 days; 2.2% coverage; zero porpoise bycatch) (ICES WGBYC, 2019). By comparison, with REM deployed, a bycatch of around 30 porpoises was recorded, highlighting the failings of a reliance upon a DCF scheme for monitoring porpoise bycatch. In 2017, monitoring was carried out on vessels <15 m in area 27.3.a (15 days at sea; 0.8% coverage; one bycaught harbour porpoise), vessels <15 m in area 27.4 (4 days at sea; 0.8% coverage; zero porpoise bycatch), and vessels >15 m in area 27.4 (15 days at sea; 0.5% coverage; zero porpoise bycatch), however the REM monitoring data collected from 9 vessels in 2017 are currently being analysed.

In **Sweden,** the fleet was estimated to total 1,394 vessels in 2012, of which 70% (975) were 10 m or less in length (Masters, 2014). A pilot project with on-board observers dedicated to observing bycatch of marine mammals in gillnet fisheries has been carried out in the south of the country. All together there was 36 observed DaS and two harbour porpoises were recorded as bycaught in Area 23 in large meshed gillnets. Due to the low monitored effort, no total bycatch numbers can be estimated. Total effort for all Swedish gillnet fisheries (i.e. including the Baltic Sea) was 19,471 DaS in 2017.

In the **UK**, only vessels greater than 10 m are obliged to fill out logbooks. Some smaller vessels fill in logbooks on a voluntary basis, and port officials the record the number of days at sea by these boats. In 2010, of the 622 registered UK fishing vessels using gillnets in areas VIIefghj, only 22 of these were over 12 m (S. Northridge in Desportes, 2014). And in 2014, of 6,406 fishing vessels, 79% (5,032) were 10 m or less in length (Masters, 2014). In 2016, there were 6,191 fishing vessels recorded active with the same percentage, 79% (4,876) 10 m or less in length (Marine Management Organisation, 2017).

In **France,** of 7,143 vessels in 2012, 73% (73% (5,196) were 10 m or less in length whereas **Belgium**'s small fleet of 212 vessels were all above 10 m, and mainly above 15 m length (Masters, 2014).

In the **Netherlands**, of 850 vessels in 2012, 36% (308) were 10 m or less in length (Masters, 2014). In the Netherlands, an REM project has been running from 1 June 2013 to 31 March 2017, including 14 vessels (Scheidat *et al*. 2018). In total 8133 fishing days of bottom-set gillnet fishing were analysed, with a total of 13 harbour porpoises recorded bycaught in this time. The bycatch rate was calculated to 0.004 animals/net length km for trammel nets and 0.0006 for single-walled gillnets. The bycatch rate for all net types combined (0.0011) was applied to calculate bycatch numbers, resulting in an estimate of 88 animals for the complete study period (95% C.I. 6–170; C.V. 14.54) and an annual average of 23 animals (95% C.I. 2-44). Other bycatch sources, such as recreational gillnet fishery or non-Dutch gillnet vessels were not included. The scale of the average annual mortality for the Dutch porpoise population was assessed to be between 0.05 and 0.07% (for the study period).

Clearly, overall, the great majority of the fleet is composed of vessels below 10m length and their fishing effort may be substantial. In the case of the **UK**, data from Masters (2014) indicate that the effort by vessels 10 m and below constitutes 53% of the total drift and fixed net effort, while the value of their landings represents 40% (Masters, 2014). There is monitoring of small vessels by some countries, for example the UK and Denmark (the latter by REM), and this should be extended to others.

Recreational fishing

Member States have given little attention to their recreational fisheries, in term of bycatch monitoring and mitigation, although bycatch is known to occur in several countries (e.g., Denmark, Belgium, Netherlands). In all Member States in the North Sea area, except Germany, fishing with static nets is allowed with some restriction in terms of platform or length of nets (Desportes 2013). Good estimates of recreational effort are not available for any Member State in the North Sea (Desportes, 2014).

The **Danish** AgriFish Agency launched in 2012 an initiative for assessing bycatch of harbour porpoise in recreational fisheries (AgriFish 2012, 2013). Fisheries inspectors checking the legality of the used equipment must report the bycatch if any and a mandatory field has been included for this purpose in their reporting scheme. A total of 1,840 checks of recreational fishing gear was conducted in 2012 but no harbour porpoise was reported bycaught (AgriFish 2013). However, the report does not indicate the inspection strategy.

In 2013, the **Netherlands** conducted an impact assessment of the effects of set net fisheries on the conservation of harbour porpoises in the Natura 2000 area Noordzeekustzone. For this assessment, existing data on bycatch in set nets, both commercial and recreational were analysed (AC21/Inf.12.1.g). The report of the study is in Dutch and the results on recreational fisheries were not communicated further. The 2018 Dutch National Report to ASCOBANS does not indicate whether the programme for collecting effort and bycatch data in recreational fisheries has been implemented.

Belgium is the only country annually reporting bycatch in recreational fisheries (and as such, known to the EU). Although Member States have not formally reported any initiatives towards the mitigation of harbour porpoise bycatch in recreational fisheries since the adoption of the Conservation Plan (Desportes, 2014), Belgium twice implemented mitigation methods in recreational fisheries. In 2001, Belgium banned recreational fishing with gill nets below the low water line as a measure to protect marine mammals and particularly porpoises. Further measures were taken in 2006, limiting the kind of nets, their height and length (ASCOBANS AC14/Doc.19pp).

Reg. 812/2004 requires Member States to establish pilot/scientific studies of the <15 m sector of their fleet but this is largely ignored. Furthermore, as noted earlier, there is overall limited compliance to the EU Habitats Directive requirements amongst Member States with regards to monitoring and assessment of the impact of bycatch on harbour porpoise populations.

Key Conclusions and Recommendations *Small vessel (<15 m) and recreational net fisheries are known to cause porpoise bycatch in and around the North Sea (see, for example, Bjørge & Moan, 2016), and yet are inadequately monitored (Desportes 2014). Although there are challenges in terms of placing observers aboard these small vessels, remote electronic monitoring has proven successful in Denmark (Kindt-Larsen et al. 2016) and the Netherlands (Scheidat et al. 2018). Attention needs to be paid across the region to more effective bycatch monitoring of these fisheries that, although required under Reg. 812/2004, is rarely implemented. With the new Technical Regulations now introduced, there should be greater focus upon monitoring bycatch from these small vessel fisheries.*

ACTION 4 Regular evaluation of all fisheries with respect to extent of harbour porpoise bycatch

Fishing effort in the North Sea has varied a great deal over the last 50 years. ICES (2020) estimate that, currently, around 6,600 fishing vessels from nine nations are active in the Greater North Sea (see Figure 2, for map of defined area) with an annual landing of about two million tonnes of fish compared with twice that amount in the early 1970s (see Figure 3). Largest numbers of vessels come from the UK, Norway, Denmark, the Netherlands, and France.

Since 2003, total fishing effort has declined (Figure 4). However, profitability of many of the commercial fleets has actually increased in recent years due to the improved status of many fish stocks, reduced fleet sizes, lower fuel prices, and more efficient fishing gears (ICES 2020).

Denmark, Norway and the United Kingdom account for a high proportion of landings (Figure 3) although fishing effort is highest in the UK fleet (Figure 4). Herring and mackerel, caught using pelagic trawls and seines, account for the largest portion of the pelagic landings, while sandeel and haddock, caught using otter trawls/seines, account for the largest fraction of the demersal landings. In order to provide a better understanding of the current nature of each country's fishing fleets in the North Sea, how they are comprised by vessel size, fishing gear and target species, the following descriptions have been summarised from ICES (2020).

The **English** fleet in the Greater North Sea has more than 1,140 vessels. Medium-size demersal trawlers (26 vessels, 18–24 m and 24–40 m) primarily target *Nephrops*, cod, and whiting. The small vessel (< 10 m) fleet (around 900 active vessels) operates in the eastern English Channel and coastal North Sea and catches a diversity of fish and shellfish species. Medium and large beam trawlers (about 40 vessels) account for the major share of the plaice landings. Three vessels (>50 m) operate in the pelagic fishery targeting mackerel, herring, and horse mackerel.

The **Scottish** North Sea fleet comprises around 1,000 vessels. More than 120 demersal trawlers (almost all >10 m) fish for mixed gadoids (cod, haddock, whiting, saithe, and hake,) and for groundfish such as anglerfish and megrim. A fleet of 139 trawlers fish mainly for *Nephrops* in the North Sea: 48 of these vessels (<10 m) operate on the inshore grounds, while 91 (>10 m) operate over various offshore grounds. Pot or creel fishing is prosecuted by over 650 vessels (mostly <10 m) targeting lobsters and various crab species on harder inshore grounds. Scallop fishing is carried out by around 80 dredgers (mostly >10 m). Limited amounts of longlining and gill netting are also conducted by Scottish vessels. Significant catches of pelagic species are harvested by 18 large vessels, primarily using pelagic trawls.

The **French** fleet in the North Sea is composed of more than 600 vessels. The demersal fisheries operate mainly in the eastern English Channel and southern North Sea and catch a variety of finfish and shellfish species. The largest fleet segments are gill- and trammel netters (10–18 m) targeting sole, demersal trawlers (12–24 m) catching a great diversity of fish and cephalopod species, and dredgers catching scallops. Smaller boats operate different gears throughout the year and target different species assemblages. There is also a fleet of six large demersal trawlers (>40 m) that target saithe in the northern North Sea and to the west of Scotland. The pelagic fishery is prosecuted by three active vessels catching herring, mackerel, and horse-mackerel.

The **Belgian** fishing fleet is composed of about 70 vessels, primarily beam trawlers both above and below 24 m in length. Few vessels are smaller than 12 m. Most of the catch is demersal species; sole is the dominant species in value, and plaice the dominant species in volume. Other important species include lemon sole, turbot, anglerfish, rays, cod, shrimp, and scallops.

The **Dutch** fleet in the Greater North Sea consists of about 500 vessels. The main demersal fleet is the beam-trawl fleet (275 vessels, of which 85 are >24 m and 190 are < 24 m) that operates in the southern and central North Sea, targeting sole (dominant in value) and plaice (dominant in volume) as well as other flatfish species. Until the recent EU-wide ban on pulse trawling most of the >24m beam trawlers have used pulse trawls. Most of the smaller beam trawlers ("Eurocutters") seasonally target shrimp or flatfish. Pelagic freezer trawlers (7 vessels, >60 m) target pelagic species, mainly herring, mackerel, and horse mackerel.

The **German** North Sea fishing fleet comprises more than 200 vessels. Beam trawlers constitute the largest fleet component (around 180 vessels, 12–24 m) and target brown shrimp in the southern North Sea. Six large demersal trawlers (>40 m) target saithe in the northern North Sea (and in waters to the north of the North Sea). Several mid-sized otter trawlers and beam trawlers (24-40 m) target saithe, cod, sole, and plaice. Less than 10 vessels (mainly >40 m) operate in the North Sea pelagic and industrial fisheries that primarily target herring, but also catch horse mackerel, mackerel, sprat, and sandeel.

The **Danish** fleet comprises 1,400 vessels, of which 600 vessels operate in the Greater North Sea demersal fisheries. Smaller vessels (<12 m) constitute the greatest proportion of the fleet (although they account for less than 5% of the Danish fisheries catch value) hence the importance for monitoring their potential bycatch impact upon harbour porpoise. The most important demersal fisheries target cod, plaice, saithe, northern shrimp, and *Nephrops* using bottom trawls and seines. The most important industrial and pelagic fisheries are prosecuted by around 30 large vessels (>40 m) and around 200 smaller (12–40 m) vessels; these fisheries target herring and mackerel for human consumption, and sandeel, sprat, and Norway pout for reduction purposes (i.e. fish meal and oils).

The **Swedish** fleet in the Greater North Sea comprises more than 400 vessels. The demersal fleet is highly diversified, catching several species in the Kattegat and Skagerrak, mainly *Nephrops*, northern shrimp, cod, witch, flounder, and saithe. The passive gear fleet is composed of around 300 vessels, of which 94 vessels (30 vessels of 10–18 m, 64 vessels <10 m) target *Nephrops*. The 15 vessels in the pelagic fleet target sprat, herring, and sandeel.

The **Norwegian** North Sea fleet is composed of about 1585 vessels. 85% of these catch demersal species, including fish, crustaceans, cephalopods, and elasmobranchs, and 30% catch pelagic species, including herring, blue whiting, mackerel, and sprat. Approximately 60% of the fleet targeting demersal species are small vessels (< 10 m) that operate near the Norwegian coast using traps, pots, and gillnets, catching crabs, squid, and several fish species. Medium-sized vessels (10–24 m) mainly target *Nephrops* and crabs using pots and traps, shrimp using trawls, and cod, saithe, ling, and monkfish using gillnets. The industrial fleet (5 vessels of 24–40 m; 25 vessels >40 m) target Norway pout and sandeel for reduction purposes. The offshore fleet (>40 m) is predominantly otter trawlers, but also includes seiners and longliners. Larger vessels (>24 m) account for most of the landings of saithe, ling, cod, tusk, hake, haddock, herring, blue whiting, mackerel, and sprat.

The **Faroe Islands** also fish in the Greater North Sea, but information is lacking on this fleet.

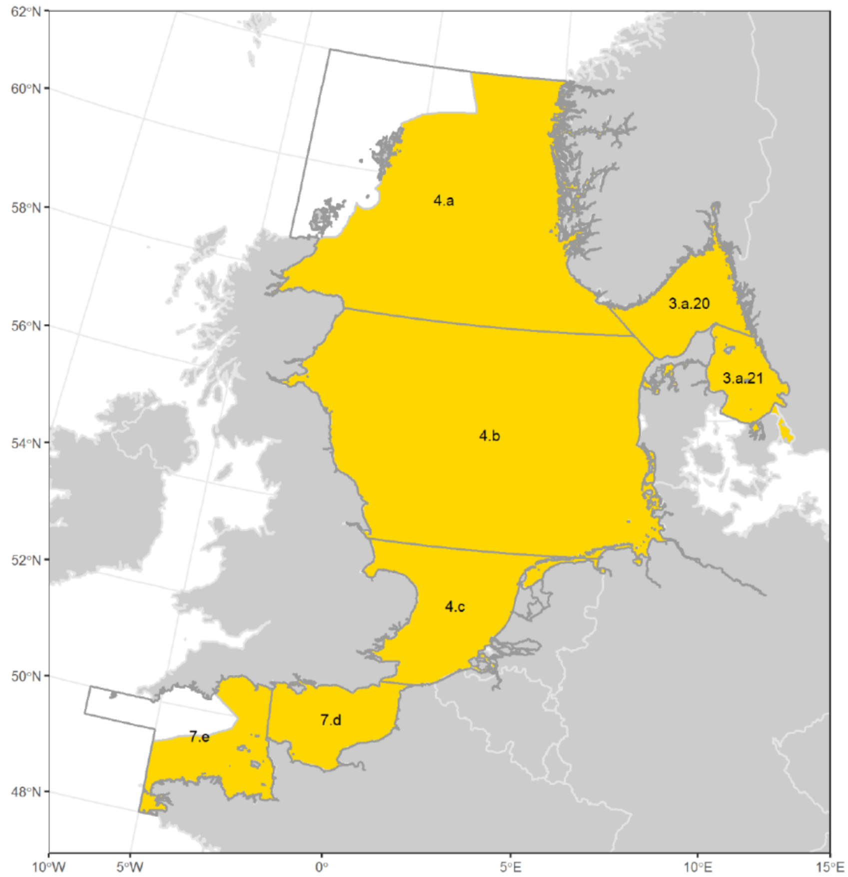


Figure 2. The Greater North Sea ecoregion (in yellow) as defined by ICES. The relevant ICES statistical areas are shown (Source: ICES 2018b)

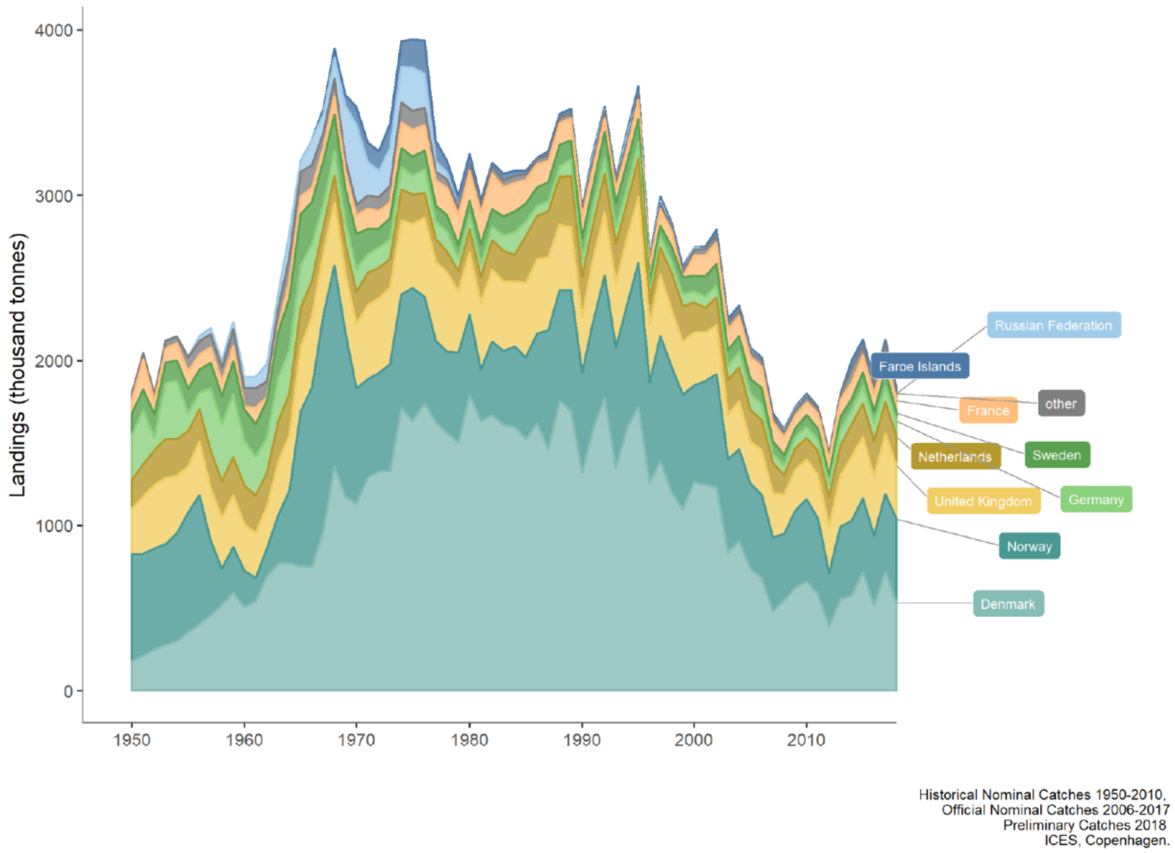


Figure 3. Landings (thousand tonnes) from the Greater North Sea in 1950–2018, by country. The nine countries having the highest landings are displayed separately and the remaining countries are aggregated and displayed as "other" (Source: ICES 2020)

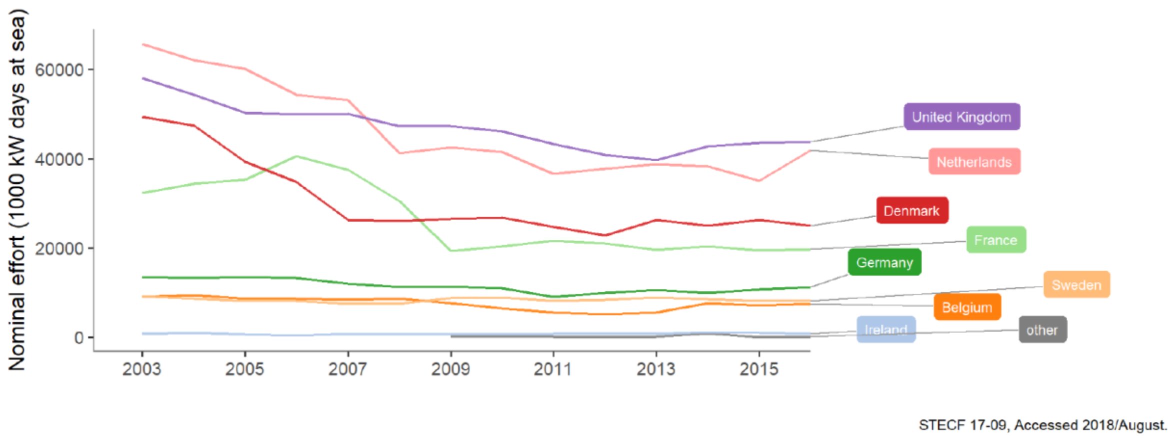


Figure 4. Greater North Sea fishing effort (thousand kW days at sea) in 2003–2017, by EU nation. STECF data are not available after 2016. (Source: ICES 2020)

The spatial distribution of fishing gear varies (Figure 5). Static gear is used most frequently in the English Channel, the eastern part of the Southern Bight, the Danish banks, and in the waters east of Shetland. Bottom trawls are used throughout the North Sea, with lower use in the shallower southern North Sea where beam trawls are most commonly used. Pelagic gears are used throughout the North Sea.

Static gears such as set gillnets are widely recognised to be the gear type posing the highest risk of bycatch to porpoises in the region. Landings from static gear in the North Sea have remained rather constant over the last ten years in contrast to pelagic trawling which has increased markedly recently (Figure 6). Small and medium-sized boats using static gear target flatfish and demersal fish.

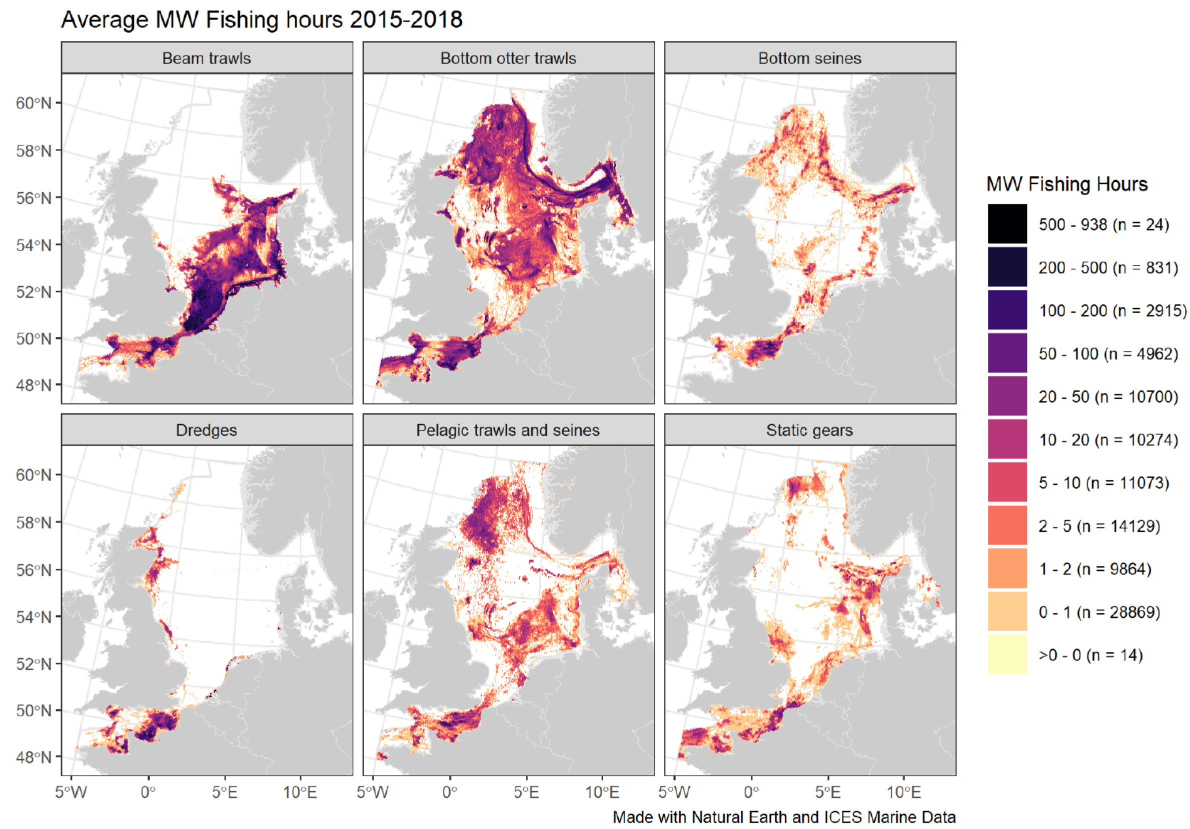


Figure 5. Spatial distribution of average annual fishing effort (mW fishing hours) in the Greater North Sea during 2015–2018, by gear type. Fishing effort data are only shown for vessels >12 m having vessel monitoring systems (VMS) (Source: ICES 2020)

Recreational fisheries also occur in the North Sea targeting a wide range of species, but few of these fisheries are monitored or evaluated.

A detailed review of the implementation of Reg. 812/2004, and assessment of the bycatch issue is undertaken annually by the ICES Working Group on Bycatch of Protected Species (see, for example, ICES WGBYC 2016, 2017, 2018, 2019, 2020). The last annual bycatch estimate, overall, for the Greater North Sea was between 1,175 and 2,126 porpoises in 2017 (ICES WGBYC, 2019). A bycatch estimate has not been made yet for 2018 (ICES WGBYC 2020). Unless otherwise stated, the summaries below are drawn from the latest ICES WGBYC report (2020).

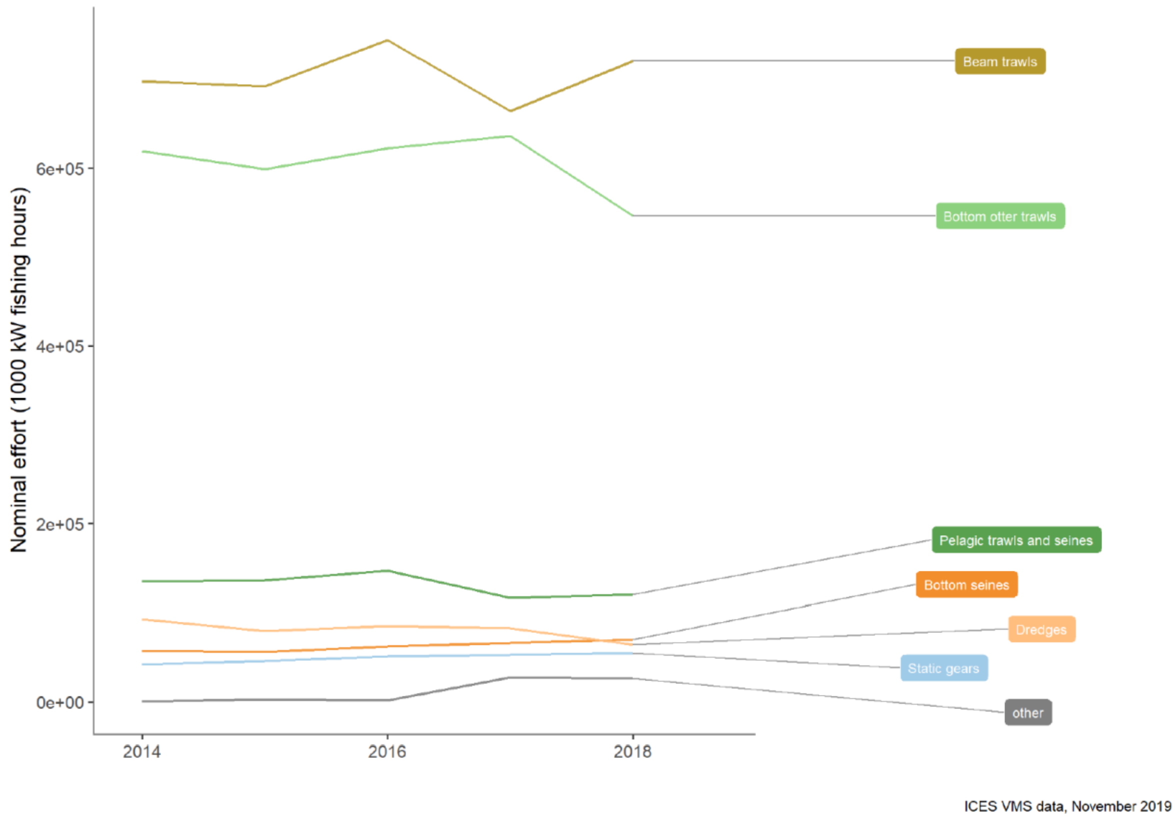
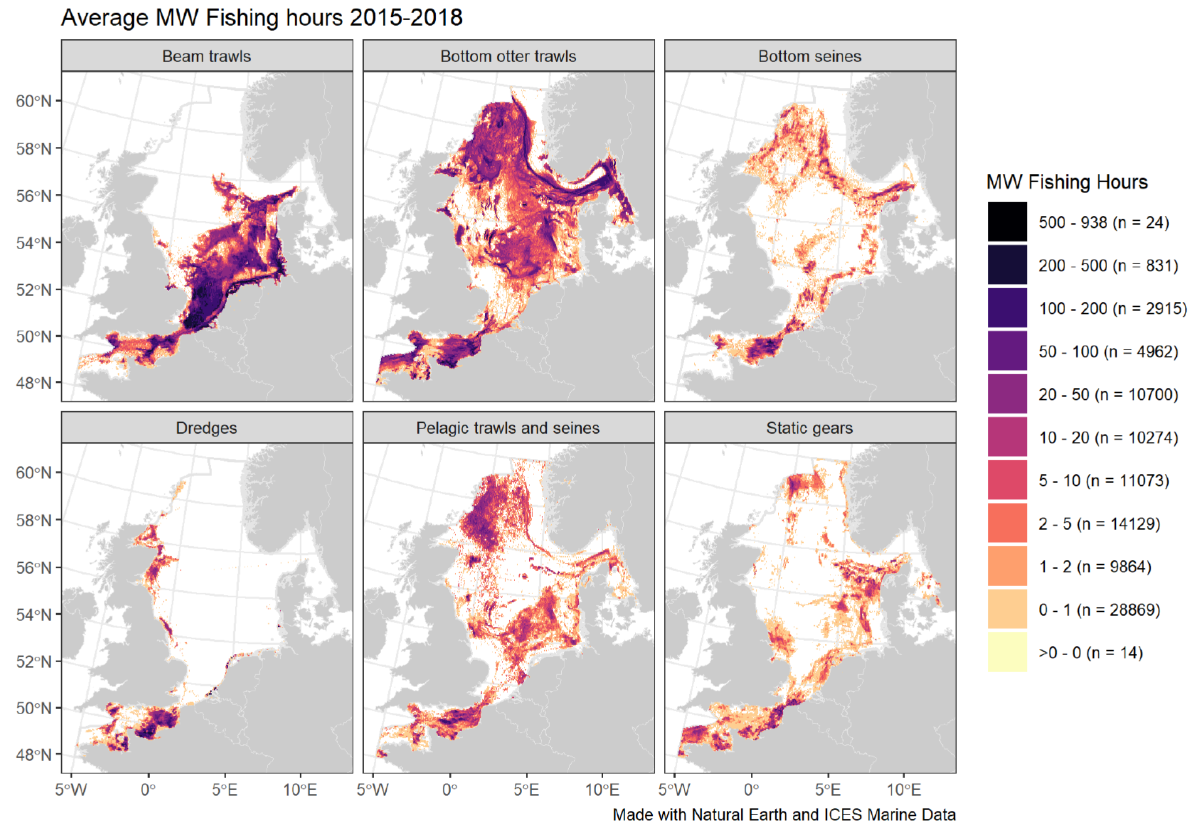


Figure 6. Commercial landings (thousand tonnes) from the Greater North Sea in 2014–2018, by gear type (Source: ICES 2020)



United Kingdom has a dedicated protected species bycatch monitoring programme (PSBMP) for the purposes of meeting requirements of Reg. 812/2004 and the EU Habitats Directive. In 2018, 172 dedicated bycatch monitoring days were conducted during 150 trips on board static net vessels and 129 dedicated bycatch monitoring days during 36 trips on pelagic trawlers. A further 25 dedicated bycatch monitoring days were achieved in longline fisheries and 13 dedicated days in ring net fisheries. Over 100 days of non-dedicated sampling in static net fisheries was also conducted under other English, Welsh and Northern Irish fishery monitoring programmes, and roughly 600 days of non-dedicated sampling was undertaken under those same programmes mainly in a variety of demersal trawl fisheries. Observations of cetacean bycatch from all sampling (dedicated & non-dedicated) included one harbour porpoise reported from the southern North Sea (Division 4c), reported during dedicated monitoring in static net gears (large mesh tangle net).

To estimate total bycatch in the UK static net fleet, key assumptions were made in the treatment of the underlying fishing effort and observed monitoring data. Therefore, bycatch estimates are likely biased, and will likely underestimate bycatch for larger offshore vessels and overestimate for smaller inshore vessels. However, with this caveat in mind, the “best” estimate of harbour porpoise bycatch for 2017 in all UK net fisheries in the absence of pingers is 1,282 animals (range:718 - 2402; CV=0.08), and if all over 12 m boats used pingers in relevant areas the estimate is 1,098 animals (range: 587-2615; CV=0.10) (ICES WGBYC 2019). No bycatch estimate was reported in ICES for 2018.

In **France,** the programme OBSMER manages all the observations at sea as required by various fishery regulations. During 2017, a total of 701 fishing trips and 855 days at sea were monitored by observers. A total of 197 trips and 158 days at sea were dedicated to set nets in areas requiring pingers under the Regulation (Subareas 4 and 7). A total of eight harbour porpoises were recorded bycaught in 2017, however none within the North Sea region: three in towed gears in Divisions 27.8b, 27.7g and 27.8a, and five in trammel nets in 27.8a and b. The low coverage of metiers (1.5% for towed gears and <1% for static gears) by at sea observers did not allow production of estimates of total cetacean bycatch (ICES WGBYC 2019). During 2018, a total of 867 fishing trips and 1,991 days at sea were monitored by observers. For towed gears in subareas 7 and 8 and in the Mediterranean**,** the sampling covered 206 fishing trips (115 in the Mediterranean and 91 in subareas 7 and 8), representing 254 days at sea. For passive gear in ICES subarea 8, the sampling covered 274 fishing trips, representing 321 days at sea. In addition, for set nets, there were 176 fishing trips, representing 180 days at sea, in the areas covered by pingers (subareas 4 and 7**).** Incidental catches of cetaceans across all the samples taken at sea during 2018 totalled two harbour porpoises.

The French stranding network is co-ordinated by the Joint Service Unit *Observatoire Pelagis*, UMS 3462 University of La Rochelle/CNRS, dedicated to monitoring marine mammal and seabird populations, and funded by the Ministry in charge of the environment and the French Agency for Biodiversity. It consists of around 400 trained volunteers distributed along the French coast who collect data according to a standardised observation and dissection protocol. More than one thousand small cetaceans were recorded along the French coasts in 2018 (mostly common dolphins in the Bay of Biscay). Along the French coasts the use of a drift prediction model allowed an estimate of the proportion of dead cetaceans at sea that sink or that would never get stranded according to the dominating winds and tides (Peltier et al., 2016). The strandings recovered are probably a fraction of dead cetaceans at sea. The total number of harbour porpoise dead at sea was therefore estimated at 910 individuals [570; 1 800] in the Bay of Biscay and the Channel.

In **Belgium,** no observer scheme was in place in 2018 to monitor bycatch of marine mammals. Fishing trips were only observed on board vessels with towed gear to fulfil other monitoring requirements. No bycatch of marine mammals was observed during fishing operations. Due to the small number of vessels affected, Belgium states that commercial fishing practices in the country have a limited impact on the marine mammal populations.

Along the coast, a stranding network is organised and centralised by the Royal Belgian Institute of Natural Sciences (RBINS), maintaining, in cooperation with the University of Liège, a single database which can partly be consulted online. 89 strandings of harbour porpoises were recorded in 2018, and 10% of examined carcasses presented evidence of death in fishing gears. This compares with 93 stranded harbour porpoises (ICES area 4.c) in 2017 (ICES WGBYC 2019). Of 34 animals examined, 9 were found to have been caught incidentally in fishing operations (26.5%), although it is not possible to be sure in what type of fishing gear. The number of stranded porpoises was relatively low in 2019 (the lowest since 2010), with 51 animals (Haelters *et al.* 2020). Remarkably few animals washed ashore during spring and summer (compared to previous years). More than half of the animals were in an advanced state of decomposition, and often the cause of death could no longer be determined. Four porpoises were recorded as bycaught, four others as a result of predation by a grey seal.

In the **Netherlands**, EU Council Regulation 812/2004 requires observer coverage in ICES areas 6, 7 and 8 in pelagic trawling fisheries for the period of 1 December – 31 March (fleet segment NLD003) and outside this area in all areas year round (fleet segment NLD004). The Netherlands reported for 2018 that, during 11 fishing trips, 63 days and 170 hauls were observed in fleet segment NLD003, and 121 days and 304 hauls were observed in fleet segment NLD004. With a total number of fleet days of 456 in fleet segment NLD003 and 922 in fleet segment NLD004, the coverage was 13.8% and 13.1%, respectively. Thus, the target of the Pilot Monitoring Scheme (PMS) of 10% for NLD003 and 5% for NLD004 was fulfilled. In addition to these trips, one observer trip was carried out on board a foreign flagged trawler which makes the total number of monitored trips by the Netherlands twelve. The observer effort onboard the foreign trawler consisted of 12 days (46 hauls), covering approximately 6.5% of the total Dutch monitoring effort. The observed bycatch rate of 0.00 dolphins per day in the pelagic fishery in 2018 is in line with the findings in 2006 -2017 when the observed bycatch rate was 0.00-0.01 dolphins per day.

The Dutch strandings network consists of a consortium of a large number of organisations and volunteers. The observation effort is unequal along Dutch coasts (approaching 100% in western coasts, but very low in uninhabited Frisian islands and Wadden Sea). Post-mortem research has been carried out on a selection of strandings (approximately 10-20% of all stranded individuals) since 2008 at the Faculty of Veterinary Medicine of Utrecht University. A total of 476 harbour porpoise carcasses were detected along Dutch coasts in 2018, which is the highest number registered for any country along the coasts of the North Sea. According to the decomposition status of carcasses, necropsies were performed on 12% of them. The proportion of porpoises with bycatch evidence related to the number of examinations reached a maximum of 12% in the North Sea in the Netherlands.

Germany monitored bycatch under the DCF observer programme for the 2018 reporting period. Fishing effort was only recorded for vessels >10 m in overall length (North Sea), since data on the fishing gear and mesh sizes used are unavailable for smaller vessels. The sampling intensity required under the Regulation 812/2004 was not possible in some fleet segments for technical reasons or owing to a lack of capacity in the sampling programme tailored to the requirements of the EU fisheries data collection programme. Sampling effort in pelagic trawls in subareas 6, 7 and 8 was 22 out of a total fishing effort of 237 days (9.3%). There was no sampling in static nets ≥80 mm in divisions 6a, 7a,b, 8a,b,c and 9a (total fishing effort 189 days). No bycatches of marine mammals were observed during sampling.

National Park Rangers patrol the coastline regularly throughout the year, ensuring a constant observation effort. Marine mammal carcasses that can be retrieved are collected and submitted for investigations at the University of Veterinary Medicine in Hannover and are usually kept in a deep-freeze storage until necropsies can be carried out by official veterinarians. The advanced decomposed status of strandings recovered along the eastern coasts of the North Sea (according to prevailing winds) reduces the possible necropsies and examinations, and therefore the determination of cause of death. For the year 2018, 116 strandings of harbour porpoises were recorded. Only one out of 25 porpoises examined presented evidence of bycatch.

Denmark reported no specific monitoring programs for incidental bycatch of marine mammals during 2018 in the Danish pelagic trawl fishery (ICES WGBYC 2020). The reason for not continuing previous monitoring programmes from 2006-2008 was that the observer schemes, with a coverage of up to 7%, had no records of incidental bycatch of cetaceans. A much higher coverage would be needed to detect any bycaught cetaceans and other marine mammals in the Danish pelagic trawl fishery but this was also considered to be a very expensive task compared to the likely outcome. Also, no dedicated monitoring according to the Regulation No. 812/2004 took place in the Danish gillnet fishery. Instead, observer data on incidental catches of marine mammal in gillnets was collected under the national Data Collection Regulation scheme (DCR). As the DCR program's main purpose is to monitor discards of fish, the observer coverage of gillnet vessels was in general very low, except in Subarea 27.4. Gillnetters usually have a low discard and therefore observer hours to monitor these fisheries have not been prioritised. However, video monitoring onboard gillnet vessels was continued in 2018 by DTU Aqua (Technical University of Denmark) on board 8 vessels, all less than 15 metres length. The data from 2018 have not yet been fully analysed. DTU Aqua are working on a consolidated analysis of all REM data from 2010-19.

The stranding network is run by the Danish Nature Agency in collaboration with the Fisheries and Maritime Museum and the Zoological Museum, Natural History Museum of Denmark. Post mortems on stranded marine mammals are conducted by the National Veterinary Institute. Twenty-five harbour porpoises were recorded stranded dead along the coasts of Denmark (all Danish seas) in 2018. Examinations were performed on two individuals, and one of them presented evidence of bycatch. The proportion of bycaught porpoises determined from stranding events in Denmark cannot be determined due to the very low number of necropsies performed.

Sweden has no dedicated national marine mammal at-sea observer schemes focusing on the bycatch of marine mammals. The monitoring effort conducted and provided by Sweden is part of the EU Data Collection Framework where on-board observer data are mainly from bottom otter trawl fisheries and also pot fisheries for crayfish. In addition, in 2017, Sweden started a pilot project monitoring bycatch of marine mammals and birds in gillnet and trammel net fisheries targeting cod and lumpfish in the south of Sweden with dedicated onboard observers. The project continued in 2018. This survey was part of a pilot project with the aim of collecting information on bycatch in fisheries for DCMAP. In the report, Sweden has included data from this survey along with monitored effort which is part of the standard EU Data Collection Framework. In 2018, a total of 32 trips/DaS were carried out with onboard observers. However, when summarizing the total number of trips/DaS per métier, it adds up to 43 observed trips. This is due to the fact that data are presented per métier and since fishermen can fish with two different gears on the same trip, the number of observed trips/observed DaS can exceed the total number of observed trips/DaS. The dedicated observer scheme along the Swedish coast gave valuable information regarding bycatches of harbour porpoises in gillnet fisheries; two harbour porpoises have been reported bycaught. No harbour porpoises were reported bycaught in bottom otter trawls or pot fisheries reported through the EU Data Collection Framework.

Reports of observations of both live and dead harbour porpoises are collected through a web-based system by the Swedish Museum of Natural History (SMNH), funded by the Swedish Agency for Marine and Water Management (SwAM). A limited number of carcasses are collected for necropsy and sampling (since 2016, up to approximately 20 per year) by SMNH in collaboration with the National Veterinary Institute, funded by SwAM. Neimane *et al*. (2020) compiled data from necropsies of 89 stranded and 11 bycaught (handed over by fishermen) harbour porpoises, collected from 2006 to 2019. In addition, during this period, a total of 460 encountered dead harbour porpoises were reported by the public. This can be regarded as a minimum number of strandings as Sweden has a long coastline with archipelagos, and the reporting system is voluntary and opportunistic. Of all reported dead animals, 27% were from the summer management range of the North Sea population (as defined by Sveegaard *et al*. 2015), 69% from the summer management range of the Belt Sea population (as defined by Sveegaard *et al.* 2015), 3% from the area west of this in the southern Baltic Sea, and none within the summer management area of the Baltic Proper population (as defined by Carlén *et al.* 2018). The collected carcasses were examined for health status, reproductive status, cause of death etc. Bycatch and likely bycatch were the most common causes of death (36%) for the collected stranded animals for which cause of death could be determined (n=61).

In the Appendix, table A1 shows figures for the number of porpoises recorded bycaught in the North Sea from various observation schemes, and table A2 shows data from stranding schemes for some countries bordering the North Sea.

Key Conclusions and Recommendations *Estimates of bycatch rates require extrapolation from sampling of a limited number of vessels (by visual observers or remote electronic monitoring) to entire fleets according to gear type. Besides issues of low sampling rate, there remain problems over determining fishing effort in a way that will yield meaningful overall estimates. Days at sea have been the traditional metric for effort. For vessels above 15 m length, data on days at sea are mandatory; although not mandatory for vessels below this length, those data are often also available. Databases are also maintained by ICES and apply to all fishing vessels, with effort expressed in days at sea. Fishing effort in the form of hours fished can also be derived from VMS data and is available for fishing vessels over 12 m, whilst vessels >10m record effort in their logbooks in terms of days fished. These different measures are not easily equated with one another, as has been demonstrated for static nets and midwater trawls by ICES WGBYC (2018).*

Obtaining estimates that reflect the true amount of fishing effort by gear type is fundamental to the assessment of bycatch. We are currently far from obtaining spatio-temporal measures of net length and soak time for static gear but this should be a target to aim for. The other part of the equation is a sampling procedure that adequately reflects the actual number of porpoises bycaught per unit effort across all vessels causing bycatch. Currently, this is far from being met.

Countries should take full-account of the necessary sampling protocols for cetaceans and other protected, endangered and threatened species, and carry out bycatch monitoring in the relevant métiers with sufficient observer coverage. We urge parties to ensure there is a significant improvement in the consistency of bycatch data at a regional scale through the EU-MAP.

ACTION 5 Review of current pingers, development of alternative pingers and gear modifications

Acoustic deterrent devices such as pingers are a required mitigation measure for vessels of 12 m length or more operating relevant gillnet fisheries in any part of the North Sea (Table 2, Figure 7).

Area	Gear	Period
ICES sub area IV and division IIIa	Any bottom-set gillnet or entangling net, or combination of these nets, the total length of which does not exceed 400 meters	1 August – 31 October
ICES sub area IV and division IIIa	Any bottom-set gillnet or entangling net with mesh sizes ≥ 220 mm	All year
ICES divisions VIId and VIIe	Any bottom-set gillnet or entangling net	All year

Table 2. Requirement for pinger use under Council Regulation (EC) 812/2004 in the North Sea

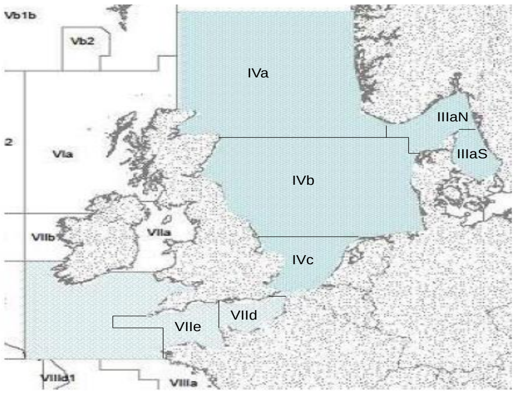


Figure 7. Pinger use - areas and gears regulated under CR (EC) 812/2004 in the North Sea, Skagerrak and Kattegat, and the Channel and Celtic Sea (ICES WGBYC, 2011)

Below is a summary of each country's progress in usage of pingers within their fleets. Unless stated otherwise, it has been compiled from the latest report of the ICES Working Group on Bycatch (ICES WGBYC 2020).

In 2018, of 26 **United Kingdom** registered vessels of ≥12m using nets, 22 fished in Divisions 7defghj and thus required pingers (ICES WGBYC 2020). Three vessels fished in subarea 4 and are assumed to have been required to use pingers (as all reported using meshes >220mm). One of these vessels fished in both Subareas 4 and 7, while two of the 26 over 12m vessels did not fish in any areas requiring the use of pingers under Reg. 812/2004. Overall, we conclude that during 2018, 24 over 12m UK registered vessels fished in areas and with gears that require the use of pingers. In 2018, there were no records of vessels over 12m using encircling gillnets.

During 2018, eight trips where pingers were used (as per Reg. 812/2004) were monitored, amounting to 77 observed hauls. Porpoise bycatch rates overall remain substantially (83%) lower when pingers are used according to the UK Government guidelines compared with when pingers are not being used, and there is no evidence of any change in pinger efficacy over time. The guidelines on pinger use which were produced in 2012 and agreed with industry, state that DDD pingers should be placed no more than 4 km apart, either to the buoy ropes at each end of a net fleet, or if net fleets more than 4 km are used, pingers should be attached to the floatline and/or buoy ropes so that no part of the net fleet is more than 2 km from an active pinger.

Royal Navy and other relevant national marine enforcement officers checked for compliance with Reg. 812/2004 whilst carrying out at-sea inspections; this is a task, which is included as a regular inspection requirement in the relevant fishing areas. Inspections of >12 m gillnetting vessels are carried out according to a risk-based enforcement approach. In English and Welsh waters, 10 inspections of >12 m static net vessels were carried out at sea and in port in the relevant areas during 2018. Inspections took place in ICES Subareas 4 and 7, and included 6 UK, 2 German and 2 Norwegian vessels. One infringement was detected on a UK vessel, which had no pingers on board and was given an official written warning. At-sea inspections (in line with the risk-based enforcement model) are the primary monitoring tool for the Regulation, but vessels are also checked in port for pinger presence by Marine Management Organisation (MMO) coastal officers.

In Scottish waters, Marine Scotland's Marine Protection Vessels (MPVs) completed 7 at-sea inspections on gillnetters in ICES Division 4a (Northern North Sea) during 2018. No infringements were detected during this boarding. Pingers were noted to be in use during the inspections and one specifically noted the pinger to be of the STM DDD03 type. Marine Scotland received no intelligence regarding lack of pinger use during 2018. There were no reports of any cetaceans being caught during the inspections, which included a period aboard the fishing vessels while the net was being hauled.

The main concentration of netting effort in Scottish waters continues to be outside the North Sea along the continental shelf edge west of the Shetland Islands, but with some netting effort taking place up to the 6 NM limit around Shetland. Compliance operational priorities during 2018 did not focus on this sector and Marine Scotland will also continue to base the majority of their at-sea inspection activities on a risk assessed basis. However, previous reports from observer trips in this area indicate that a variety of pinger types are used by the vessels involved.

Many of the UK vessels affected are using a device that does not meet the acoustic criteria specified in Annex II of the 812/2004 Regulation. The UK ran a series of trials of the DDD-03 pinger, which was initially tested for efficacy between 2008 and 2011 and extended with EMFF funding during 2010-2011. Following this work, the device (DDD-03L - manufactured by STM products in Italy) was authorised for use by the UK Government's Department for the Environment and Rural Affairs (Defra) under the derogation contained in Article 3(2) of the Regulation.

These pingers continue to be effective at reducing harbour porpoise bycatch; since 2008, observed bycatch rates in pingered nets have been 83% lower than in unpingered nets. The effects of pingers, in terms of the number of porpoise deaths avoided by their use to comply with Reg. 812/2004, was explored: the current best estimate of porpoise bycatch in all UK gillnet fisheries ranges between 718 and 2,402 animals (best estimate 1,282; CV=0.08) in the absence of pingers, and between 587 and 2,615 animals (best estimate 1,098 CV=0.10) if all over 12 m boats used pingers in relevant areas (ICES WGBYC, 2019).

In **Belgium**, the two vessels operating set nets do not meet the basic conditions, namely the length of the ship, to have this obligation imposed. As in recent years, there was therefore no scientific monitoring of the use of pingers on vessels in 2018.

In **France**, a total of 9 netters (GNS-GTR) fishing in Subarea 7 were equipped with STM DDD03L pingers in 2018 in accordance with Reg. 812/2004. No infringements were found in 2018 during the checks conducted in the areas and on the vessels covered by Regulation (EC) No 812/2004.The decree of 15 April 2014 permits the use of STM DDD03L acoustic deterrent devices by French fishing vessels

The **Netherlands** reports that according to Reg. 812/2004, the Dutch fishery does not include fleet segments in which pingers are mandatory. The use of pingers is obligatory in ICES subarea 4 for vessels larger than 12m for the period 1 August until 31 October, using nets that do not exceed 400m length (the regulation intends to cover set nets fishery at wrecks, where relatively short net lengths are being used). Most of the Dutch set gillnet fleet fishing in this period for sole use much longer nets. Thereby, no acoustic deterrents are in use by Dutch gillnet fishers.

In 2018, **Germany** had fisheries operating in some of the areas listed in Annex I to Reg. 812/2004 where the use of pingers is mandatory. Fishing vessels use analogue and digital pingers commercially available. No data are available on the number of vessels equipped with pingers. Compliance monitoring was done by competent authorities using Pinger Detector Amplifiers (Etec PD1102) when nets were in place. Due to masking of pinger signals by the inspection vessel noise, the relevant equipment is difficult to use. The relevant provision (Article 2(2) of Regulation (EC) No 812/2004) merely requires pingers to be operational when setting the gear. Thus, no penalties can be imposed for any infringements found using the current procedure. The legal framework for the detection and prosecution of infringements needs to be further improved. In 2018, federal fishing protection vessels inspected a total of three fishing vessels obliged to use pingers. No violations were found.

In a systematic study, the acoustic reflectivity of a variety of objects in different shapes, sizes and bulk characteristics (e.g. Young's Modulus, density) were simulated and experimentally verified in a water tank. First simulation results indicated that commercially available acrylic glass spheres of less than 10mm diameter exhibited promising characteristics with up to -42dB target strength at 130 kHz (the peak frequency used by harbour porpoise). Echograms taken with the sonar of FRV "Clupea" revealed that the net with spheres was highly visible at 120 kHz compared to a standard gillnet.

In order to test the efficacy, a set of modified nets were tested against a set of standard gillnets in the Turkish Black Sea turbot fishery with a total of 10 hauls conducted. The analysis is in progress, but it seems advisable to carry out further trials and conduct a behavioural experiment where porpoises are observed around standard and modified gear. At the moment, the pearl net is tested in the Swedish lumpsucker fishery with F-PODs attached to both ends of the string in order to examine the porpoise echolocation behaviour around the nets.

In **Denmark**, a total of 17 Danish vessels (57% of the total number of vessels) engaged in fishing activities in ICES areas 3a and 4 in fleet segments FPN, GN, GNS, and GTR with mesh sizes above 220 mm, were obliged to use pingers in 2018.

The pinger type "AQUAmark100" has previously been used in the Danish gillnet fisheries, where the use of pingers is mandatory. However, this pinger model is no longer available in Denmark, so other types are now being used. The Danish Fishermen's Association report that a 10 kHz pinger is now the most widely used pinger in Danish commercial fisheries because batteries can easily be changed. The 10 kHz pinger, however, does not have the same effectiveness as the AquaMark 100, so the distance between these is mandated to be 200 m. The latest derogation applies not only to the AQUAmark100, but to also other acoustic deterrent devices, which scientifically are proven to be as effective.

Monitoring of pingers is a mandatory part of the general inspection of gillnet vessels in Denmark. When a gear inspection is conducted, the fisheries inspector registers whether there is a requirement for use of pingers on the gear. If there is a requirement, the activity and distance between pingers is checked. In 2018, the Danish fisheries inspection did not conduct any inspections on vessels with an overall length of 12 metres or above, due to a large organizational change and transfer of responsibility to another ministry (formerly the Ministry of Food and Agriculture, now the Ministry of Foreign Affairs). Similarly, no inspections were carried out for foreign vessels in 2018. It is expected that the Danish Fisheries Agency will conduct inspections again in 2019.

Denmark is continuing trials of both pingers and lights as a means to mitigate bycatch of harbour porpoises and seabirds, as well as conducting research on the behaviour of porpoises around pingers. Denmark is also continuing the development and testing of fishing gear as alternatives to gillnets primarily for catching cod and flatfish. This includes both small-scale Danish seines and baited pots.

Sweden expressed uncertainty over whether pingers have been implemented on boats and in fisheries where they are mandatory. In 2007, fishermen conducting fisheries in areas where pingers were mandatory, were given pingers. Pingers have a lifetime of two years so one must assume that those pingers are not working anymore. There is limited enforcement to control the use of pingers, and no equipment to be able to see if the pingers are functioning. However, there has been increased pinger use in southern Swedish waters and along the west coast. In 2018, 13 fishermen voluntarily used pingers (Banana Fish tech and Future Oceans) in the lumpfish and cod fisheries in subdivisions 21 and 23 (Kattegat and Belt Seas). Pingers are lent to the fishermen from year to year. Seven fishermen were using pingers in the lumpfish fishery and three fishermen in the cod gillnet fishery. Fishermen reported their fishing effort and use of pingers to the Swedish University of Agriculture Science.

In the area where pingers have been used in the commercial lumpfish fisheries in southern Sweden, a study looking at the distribution of harbour porpoises in relation to a commercial fishery 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 the fishery ceases the harbour porpoise detections increase and are at the same levels as areas where no fishing with pingers has been carried out. The study will be finalised in 2020.

There is also a project implementing cod pots as an alternative to gillnet fisheries for cod. In 2018, two fishermen are using cod pots as an alternative to gillnets. Development of alternative gears to gillnet fisheries targeting species such as cod is ongoing.

Key Conclusions and Recommendations *Pingers are mandatory in certain gillnet fisheries in the North Sea for EU Member States. However, pinger use is not implemented by all countries, and the level of enforcement is very variable between countries.*

More research is needed to find mitigation measures that are both practical and effective. Pingers have the potential to temporarily deter porpoises from foraging areas. However, more effort is needed to develop alternative gears which may be the most desirable long-term solution to porpoise bycatch.

ACTION 6 Finalise a management procedure approach for determining maximum allowable bycatch limits in the region

Whereas the ultimate goal should be for zero bycatch, the intermediate conservation objective under ASCOBANS has remained 'to restore and/or maintain stocks/populations to 80% or more of their carrying capacity'. The ASCOBANS Meeting of the Parties in 2000 (MOP3) had concluded that a total anthropogenic removal rate of more than 1.7% of the population had to be considered unacceptable, and an interim measure should be to ensure that overall mortality is reduced to a level that will allow recovery of populations. Several different criteria have been proposed as limits to anthropogenic mortality that may still allow conservation objectives to be met. These criteria include simple percentages of the best population abundance estimate and more complex procedures that account for uncertainty and other information about the population. Scheidat *et al*. (2013) reported new estimates of abundance for porpoises in **Dutch** waters, and applied several methods to calculate maximum anthropogenic mortality limits from these estimates. They considered whether these mortality limits would meet the objective of the ASCOBANS agreement and other international obligations, and how these limits might be applied at a national level rather than the biological population level. They recommend the use of management procedures for setting mortality limits that take into account available data including associated uncertainties and biases, and whose performance has been extensively tested through simulation.

In July 2015, an ASCOBANS workshop (ASCOBANS, 2015b) was held in London to consider further development of management procedures for defining the threshold of 'unacceptable Interactions'. From a societal perspective, environmental limits and triggers for action were considered as 1) intermediate steps to help drive progress towards achieving the ASCOBANS aim of zero bycatch; 2) they should be based on clearly defined conservation objectives which reflect broad societal views and have been developed and agreed with managers, scientists and stakeholders; 3) they should be used as a tool to help make decisions on the conservation and sustainable use of the marine environment and balance competing priorities; 4) they should be developed to take into account total anthropogenic removals; 5) they should be used to indicate a ‘critical’ or ‘unacceptable’ point in the environment that should not be exceeded without endorsing that any removals are ‘acceptable’; 6) they should be used to ‘trigger’ more urgent and stronger management action where levels of bycatch have been identified as being of a high level of concern (e.g. likely to lead to population extinction or failing to meet conservation objectives); 7) they should be used to prioritise the targeting of effective management measures, ensuring the investment of effort/financial resources into reducing, or quantifying more precisely, bycatch levels is proportionate to the scale of the problem i.e. different management responses may be appropriate for fisheries with close to zero bycatch, with levels close to but below the environmental limit/trigger, and for those above; 8) they should be ‘tuned’ to help managers determine whether conservation objectives are being achieved and to target management measures effectively; and 9) they should be accompanied by a clear guidance on how they should be applied and interpreted, including clarity on the nature of appropriate management action.

Since then, the **UK** has been working on developing a Removals Limit Algorithm (RLA) to set limits to anthropogenic mortality of small cetaceans to meet specific conservation objectives, with an example implementation for bycatch of harbour porpoise in the North Sea (Hammond *et al*. 2019). This RLA was developed to set limits to anthropogenic mortality of small cetaceans that allow specified conservation objectives to be met. This development picks up from previous work of a similar nature presented to the IWC in 2005-2009 as part of the SCANS-II project that became stalled until recently. The RLA is very similar in concept to the Catch Limit Algorithm (CLA) of the IWC’s Revised Management Procedure. The RLA comprises a simple one-line population model which is fitted to a time series of estimates of abundance to estimate population growth rate and depletion, which are then used in a removals calculation. The RLA is tuned through computer simulation of a more complex population model that is assumed to represent reality to set limits to anthropogenic mortality that allow the specified conservation objects to be met. The robustness of the RLA is determined by assessing its performance in a range of computer simulation tests describing uncertainty in our knowledge of population dynamics, the data, and the wider environment.

As an example, the RLA was applied to bycatch of harbour porpoise in the North Sea using abundance estimates from SCANS surveys (1994, 2005, 2016) and a time series of bycatch estimates constructed by making a number of strong assumptions about effort for most fleets and appropriate bycatch rates. Using a particular tuning level that reflects a conservation approach and which is appropriate if maximum net productivity is 2%, the removal limit was 1,856 animals per year for a six-year period until a new survey estimate is assumed to become available in 2022. The analysis indicated that there was little support for the population of harbour porpoises in the North Sea being heavily depleted or for the current carrying capacity to be less than 350,000 animals. Using a tuning level that led to slightly less robust results and that is appropriate if a maximum net productivity is 4%, the removal limit was 4,641. However, the RLA developed is entirely dependent on the conservation objectives; further work would be needed if the conservation objectives were different from those assumed (Hammond *et al*. 2019)

Other countries have not yet developed a similar management procedure approach for determining maximum allowable bycatch limits in the region. **Denmark** has focused upon implementing monitoring to show whether there was a bycatch problem. They consider environmental limits as important steps towards achieving zero bycatch, but they had to be understandable and achievable within a realistic time frame to help managers implement appropriate bycatch mitigation measures. They believe that the need for improved population estimates and better bycatch data are priorities, along with a consideration for whether marine protected areas were the best approach to protecting highly mobile species like the porpoise.

A joint NAMMCO/IMR harbour porpoise workshop that took place in Tromsø, Norway, in December 2018 assessed the North Sea harbour porpoise population through a population dynamic production model (NAMMCO & IMR 2019). This model used as input data estimated time series of bycatch levels and population size, and hence did not specifically estimate maximum allowable bycatch limits for the region. The model estimated that the population of harbour porpoise in the North Sea has been stable (increasing very slowly) since around 2005 (Figure 13), whilst subject to an average annual by-catch of around 4,500 animals (range 2,500-6,700) during this period.

In September 2019, an OSPAR-HELCOM workshop was held in Copenhagen to examine possibilities for developing indicators for bycatch of birds and mammals (OSPAR-HELCOM 2019). The following conservation objective was proposed: "Minimise and where possible eliminate incidental catches of all marine mammal and bird species such that they do not represent a threat to the conservation status of these species". An interim management objective was that "The mortality rate from incidental catches should be below levels which threaten any protected species, such that their long-term viability is ensured." However, this needs to be expressed quantitatively for harbour porpoise. The RLA exercise undertaken by Hammond *et al*. (2018) set this at 80% of carrying capacity within a 100-year period. In simulation tests, this equates to the median population level being at 80% of carrying capacity for 50% of cases. The IWC in applying CLA to manage whale stocks proposed a threshold of 72% of carrying capacity within a 100-year period.

Both RLA and CLA fit a population dynamics model to a time series of abundance estimates and removals data. They assume a population with density-dependent growth and subject to anthropogenic removals. Model simulations are used to tune the parameters of the RLA until the conservation objectives are met, at which point the limit to removals can be determined. This method is data demanding as it requires regular estimates of population size, total bycatch, and other sources of mortality. None of these are known very well even for a well-studied species such as the harbour porpoise in the North Sea. PBR estimates are less data demanding and tend to use a threshold of 50% of carrying capacity reached for 95% of cases over a 100-year period. A decision needs to be reached for how one sets the threshold quantitatively to take account of large uncertainty that exists over what is the likely carrying capacity, the population structure, the current size of the demographic population (= management unit), the actual bycatch rate, and an assessment of all other sources of mortality.

Key Conclusions and Recommendations *There remains a debate as to what society should set as conservation objectives. The RLA approach developed within the UK sets some numerical parameters to establish an environmental limit and potential trigger for action for harbour porpoises experiencing bycatch in the North Sea. A number of assumptions have to be made including the accuracy of the annual bycatch estimate, the overall population size, demographic trend and structure, reproductive and mortality rates, carrying capacity, and the impact levels of other anthropogenic activities. Bearing in mind those caveats, it was concluded that current levels of bycatch in the North Sea are not causing serious depletion of the harbour porpoise population.*

A continuing discussion should take place amongst Member States to agree a consistent and well-defined conservation objective across the region, and to set environmental limits and triggers over a practical time scale. There needs to be further consideration of the utility of the RLA approach vs alternatives such as PBR, bearing in mind the various uncertainties one experiences. This discussion is crucial for answering the questions on levels for Good Environmental Status (GES) under the EU Marine Strategy Framework Directive, as well as Favourable Conservation Values under the EU Habitats Directive.

ACTION 7 Monitoring trends in distribution and abundance of harbour porpoises in the region

Coordinated efforts to monitor harbour porpoise abundance in the North Sea in recent times have involved 1) SCANS III where the entire region was surveyed by a combination of aerial and vessel surveys in July 2016 (Hammond *et al*. 2017; see Figure 8), and 2) the DEPONS Project where aerial surveys were undertaken annually in spring, summer and autumn in the southern North Sea across the EEZs of Belgium, the Netherlands, Germany, and Denmark (Gilles *et al*. 2016, Peschko *et al*. 2016).

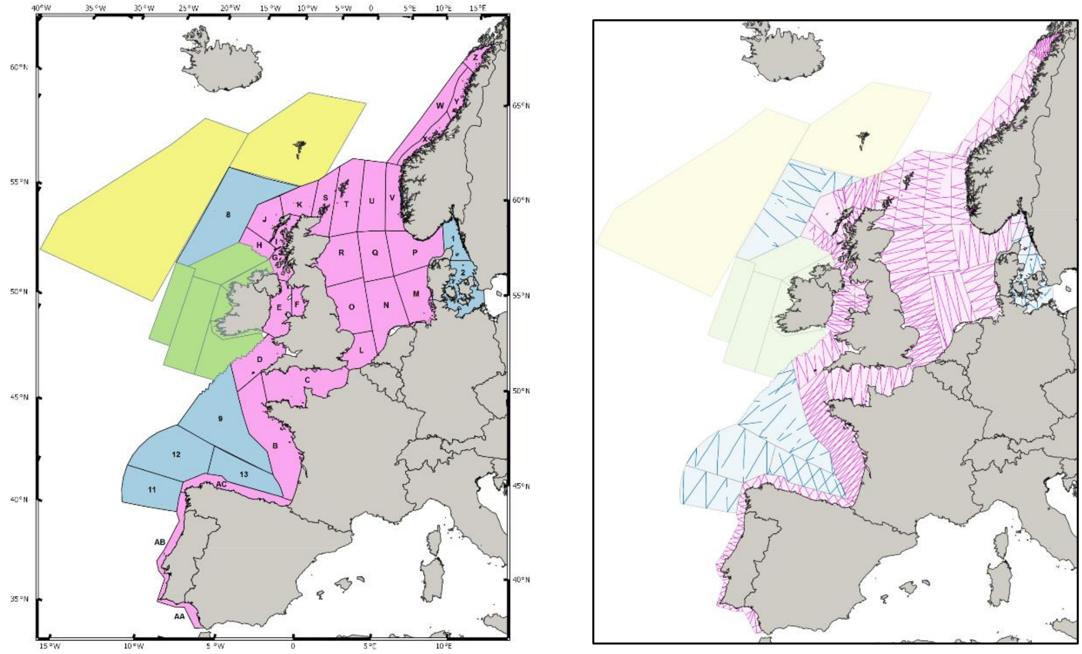


Figure 8. Area covered by SCANS-III and adjacent surveys. SCANS-III: pink lettered blocks were surveyed by air; blue numbered blocks were surveyed by ship. Blocks coloured green to the south and west of Ireland were surveyed by the Irish ObSERVE project. Blocks coloured yellow were surveyed by the Faroe Islands as part of the North Atlantic Sightings Survey in 2015 (Source: Hammond *et al*. 2017)

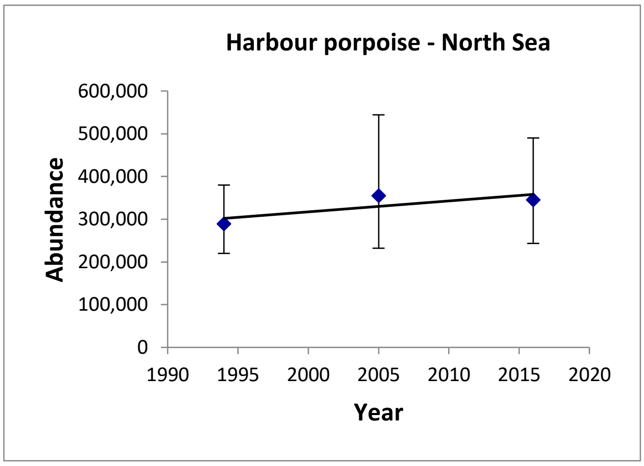


Figure 9. Estimates of abundance (error bars are log-normal 95% confidence intervals) for harbour porpoise in the North Sea Assessment Unit. Trend lines are fitted to time series of more than two abundance estimates (Source: Hammond *et al.* 2017)

The SCANS III survey in July 2016 yielded an abundance estimate of 345,373 porpoises (CV=0.18) in the North Sea (Hammond *et al*., 2017). The equivalent estimate for July 2005 was 355,408 (CV=0.22)

(Hammond *et al*., 2013) and for July 1994 was 289,150 (CV=0.14) (Hammond *et al*., 2002). A trend analysis showed no significant change between 1994 and 2016 (Figure 9).

For the period 2005-2013, using aggregated visual survey data from the international SCANS II survey as well as more frequent small-scale national surveys, Gilles *et al.* (2016) produced model-based average estimates for porpoise numbers in all of the North Sea extending to the Dover Strait (but not further west), for three seasons, Spring (Mar-May), Summer (Jun-Aug), and Autumn (Sep-Nov). These were 372,167 (CV=0.18) (Spring), 361,146 (CV=0.20) (Summer), and 223,913 (CV=0.19) (Autumn).

The OSPAR intermediate assessment in 2017 used data from large-scale visual surveys such as SCANS (Hammond *et al.* 2002), SCANS-II (Hammond *et al.* 2013), SCANS-III (Hammond *et al.* 2017), CODA (CODA 2009), NASS (www.nammco.no) and NILS (e.g. Solvang *et al.* 2015) to infer distribution of abundance of cetaceans, including harbour porpoise, in the OSPAR area. The assessment could not detect any trends in abundance of harbour porpoises, although the shift in distribution from Northern to Southern North Sea between SCANS (1994) and SCANS-II (2005) is clear, and is confirmed by small-scale national surveys showing increasing numbers of porpoises occurring in French, Belgian, Dutch and German waters (e.g. Gilles *et al.* 2009, 2011, Haelters *et al.* 2011, Scheidat *et al*. 2012; Peschko *et al.* 2016).

Belgium, the **Netherlands**, **Germany** and **Denmark** have continued national monitoring with aerial surveys of the southern North Sea on an annual basis, but other Range States (**Norway, Sweden, France** and **UK)** have not been undertaking regular wide scale surveys of their waters, although **France** has conducted surveys in relation to marine renewable energy development.

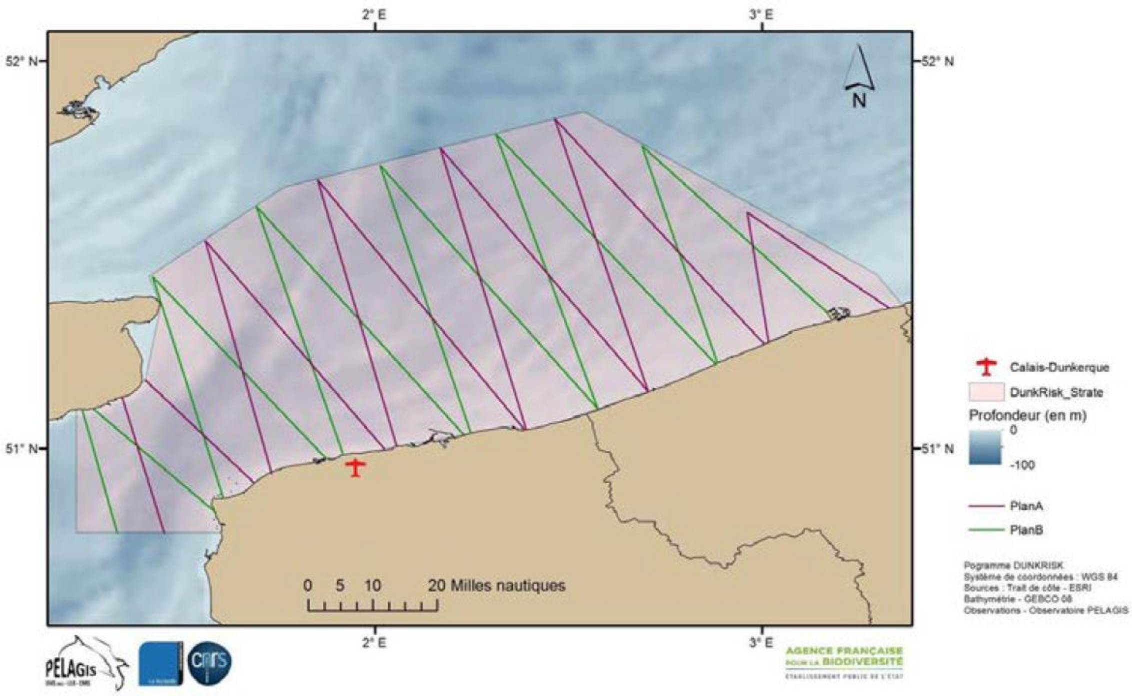


Figure 10. PELAGIS Project Aerial Surveys undertaken by France during 2017-2018
(Source: ICES WGMME, 2018)

During 2017–2018, a **French** survey was dedicated to estimate marine mammal and seabird relative abundance and distribution in the area of Dunkirk before construction of an offshore windfarm (Virgili et al., 2018). The survey effort covered 9400 km^2 distributed as follows: 37% in France, 37% in Belgium and 26% in UK. Observations were collected following a standardised aerial survey protocol (Laran et al., 2017). Four sessions were realised on 6–7 April (1526 km), 13–14 June (1534 km), 7–8 August (1532 km) and 4–5 December (1463 km). In 2018, two sessions were realised on 6–7 March (1256 km) and 4–5 May (1526 km).

The most sighted marine mammal species was the harbour porpoise and the number of observations reflected a high seasonality for this species (Table 3). Harbour porpoise distribution also differed between the sessions (Figure 10). The results show the importance of the eastern part of the Channel for porpoises, although there were strong seasonal differences both in distribution and relative abundance (Figure 11, ICES WGMME 2018).

Table 3. Number of sightings (on effort) of harbour porpoises during the aerial survey (Virgili *et al*. 2018)

	April 2017	**June 2017**	**Aug 2017**	**Dec 2017**	**Mar 2018**	**May 2018**
Harbour porpoise	315	100	35	202	147	321

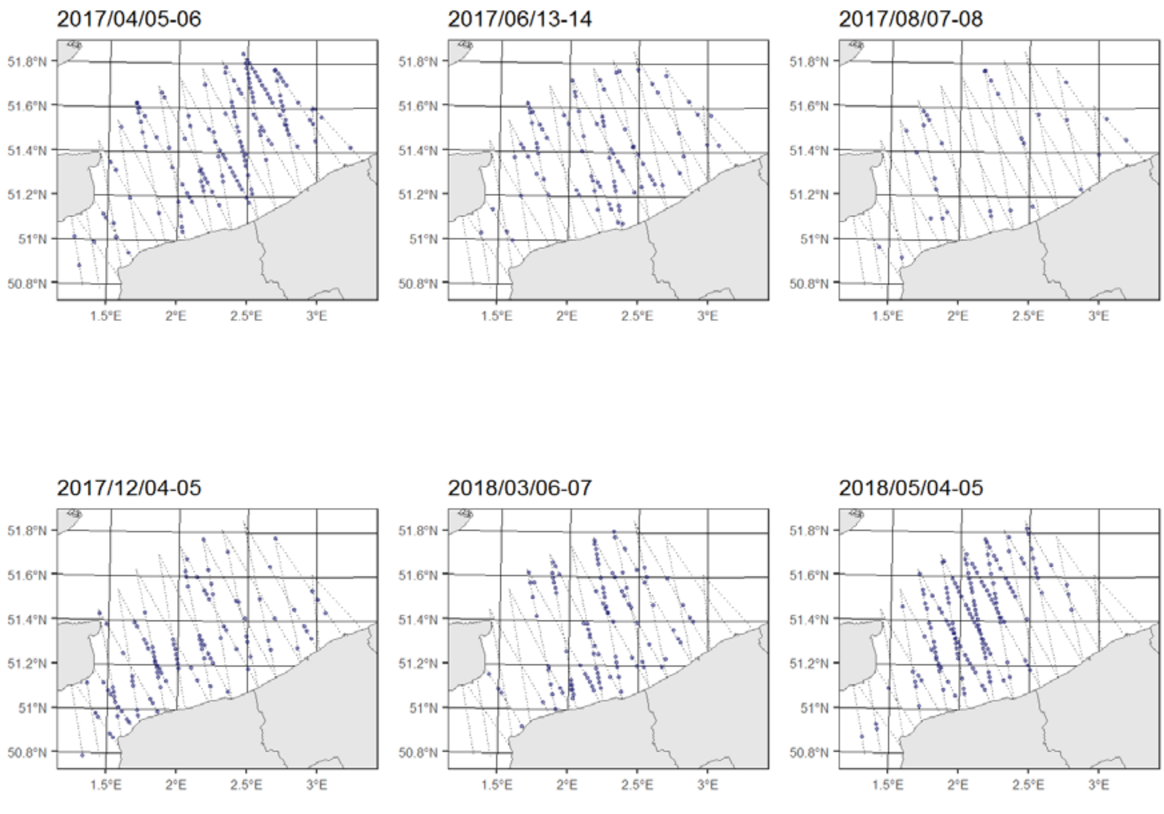


Figure 11. Observations of harbour porpoises from the PELAGIS Project Aerial Surveys undertaken by France in the eastern Channel during 2017–2018. Dotted lines are the transect lines, and blue dots are the detections of harbour porpoises. (Source: ICES WGMME 2019)

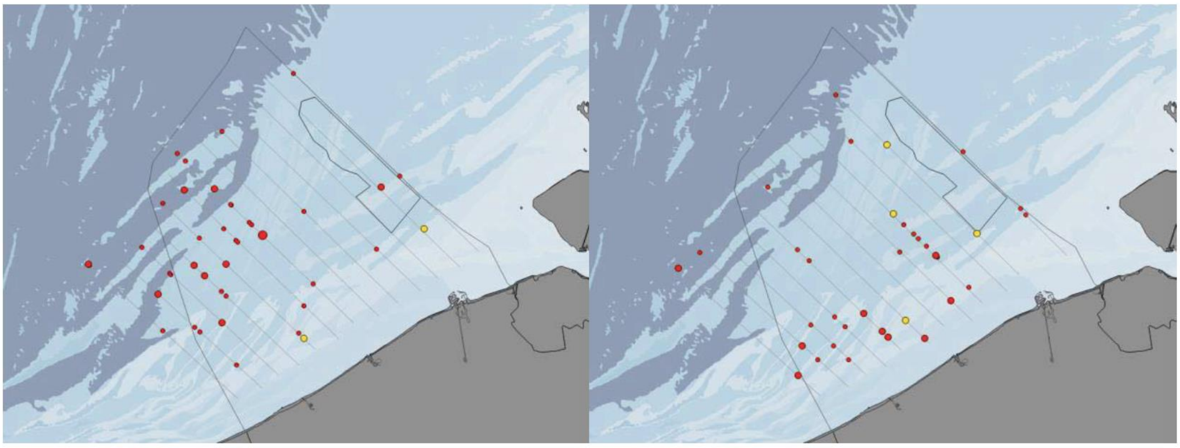


Figure 12. Observations during the survey in June (left) and August (right) 2019: porpoises (red) and seals (yellow); the flight lines and wind farm area (polygons) are shown in grey (RBINS data from Haelters *et al*. 2020)

In **Belgium**, the Royal Belgian institute for Natural Sciences (RBINS) completed three aerial surveys in 2018. Densities in July and October were in line with previous surveys, with on average 0.7 and 0.6 animals/km² respectively. The survey in April yielded a remarkably high average density (5.7 animals/km² in the survey area) with 404 animals sighted during the survey that lasted 3h44' (on effort time). The animals were not evenly distributed, with very high densities (over 15 animals/km²) between the Westhinder anchorage area and the Northinder Traffic Separation System, a zone that is proposed as an offshore windfarm area (to be confirmed in the new marine spatial plan 2020–2026) (ICES WGMME 2019). Two aerial surveys were completed in 2019 (Figure 12). Observed harbour porpoise densities in June and August were normal, with on average 0.72 and 0.62 animals/km² respectively (Haelters *et al.* 2020; ICES WGMME 2020).

In the **Netherlands**, Geelhoed & Scheidat (2018) analysed the results of their aerial surveys across the Dutch EEZ (Figure 13) for the years 2012-2017. Maps of porpoise distributions for each of those years are shown in Figure 14. Distribution patterns of porpoises differed between seasons and years, although a band of higher densities from the southern part of the Dutch Continental Shelf to the area north of the western Wadden Isles was visible in all seasons (Geelhoed & Scheidat, 2017). Calves were only seen in July. The abundance estimates in spring (*n*=63,408-66,685) were in the same order of magnitude as summer (*n*=41,299-76,773). The total abundance estimates in spring and summer correspond to a maximum of 17-21% and 7-23% of the southern North Sea population respectively. The abundance estimates are not strictly comparable to those given above from SCANS surveys and the DEPONS Project different Effective Strip Widths (ESWs) were used in the analysis. However, they do highlight the fact that, in recent years for at least part of the year, a substantial proportion of the porpoise population in the southern North Sea and the eastern Channel utilises the Dutch Continental Shelf.

Between 13–18 July 2018, and between 16 July-4 August 2019, the entire Dutch Continental Shelf was again surveyed along the same pre-determined track lines, resulting in a total distance of 5182.0 km (3039.8 km in 2018 and 2142.2 in 2019) of effort. The resulting total number of harbour porpoises on the Dutch Continental Shelf was estimated at 63 514 animals (CI = 34 276–119 734) and 38,911 individuals (CI = 20,791-76,822) respectively. Neither the DCS abundance estimates, nor the abundance estimates per subarea show a trend (Geelhoed *et al*. 2020). The harbour porpoise distribution from this survey is shown in Figure 15.

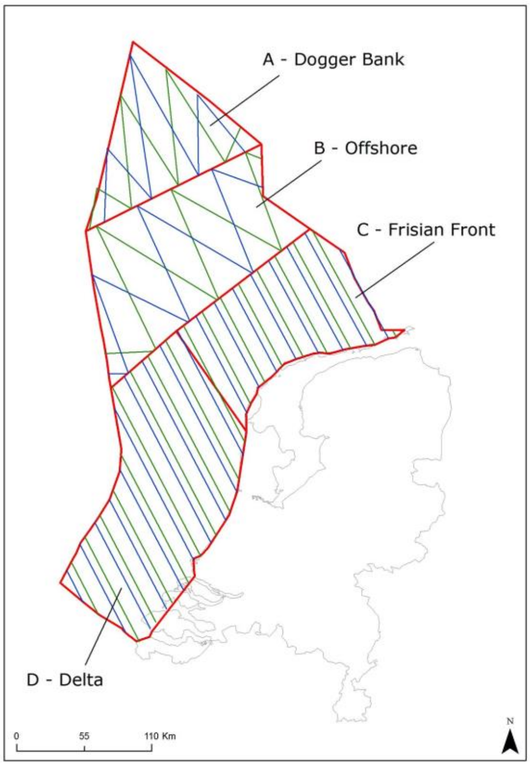


Figure 13. Map of the Dutch Continental Shelf with the planned track lines in study areas A – Dogger Bank, B – Offshore, C – Frisian Front and D – Delta. Colours indicate sets of track lines (Source: Geelhoed & Scheidat, 2018)

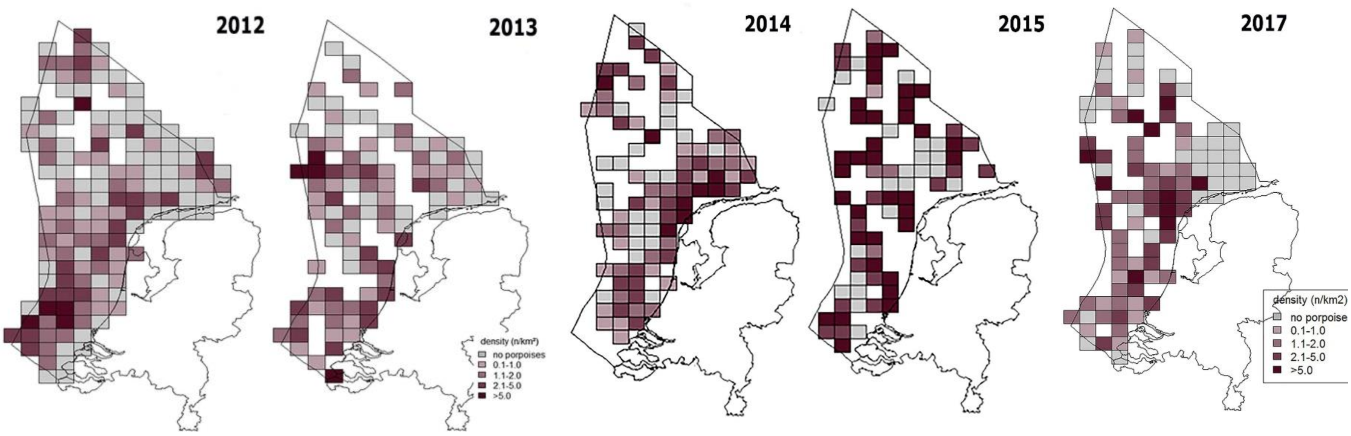
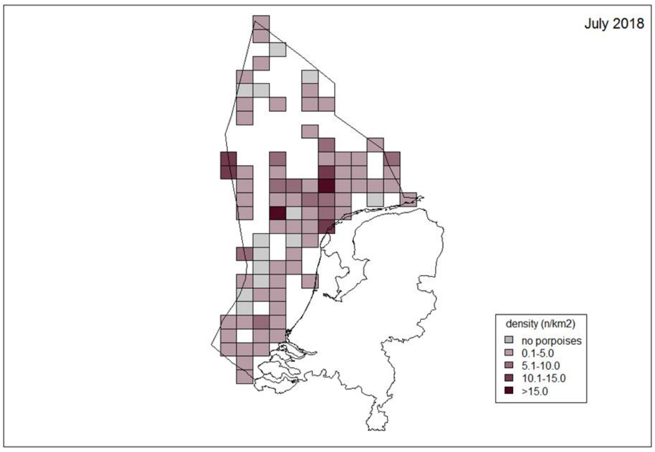


Figure 14. Density distribution of harbour porpoises (animals/km²) per 1/9 ICES grid cell, spring 2012 to 2017. Grid cells with low effort (<1 km^2) are omitted (Source: Geelhoed & Scheidat 2018)



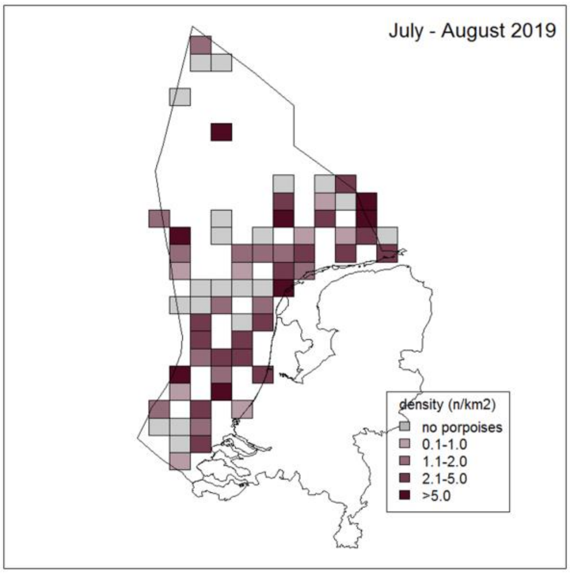


Figure 15. Density distribution of harbour porpoises (animals/km²) per 1/9 ICES grid cell, July 2018 and July-Aug 2019. Grid cells with low effort (<1 km^2) are omitted (Source: ICES WGMME 2019, Geelhoed *et al*. 2020)

In **Germany**, with funding from BfN (Federal Agency for Nature Conservation), aerial surveys are undertaken every year in spring and summer in the area of three Natura 2000 areas (Dogger Bank, Borkum, Sylt Outer Reef), whilst every two years, complete coverage of the German EEZ and 12 nm zone was made. In 2017, the strata and transect design for the visual monitoring of harbour porpoises was revised in an effort to harmonise the national monitoring efforts for cetaceans and seabirds and to provide a survey design for potential future digital surveys. This resulted in the design of new study areas for the aerial line transect surveys in the German North Sea and Baltic Sea (Figure 16, ICES WGMME 2019).

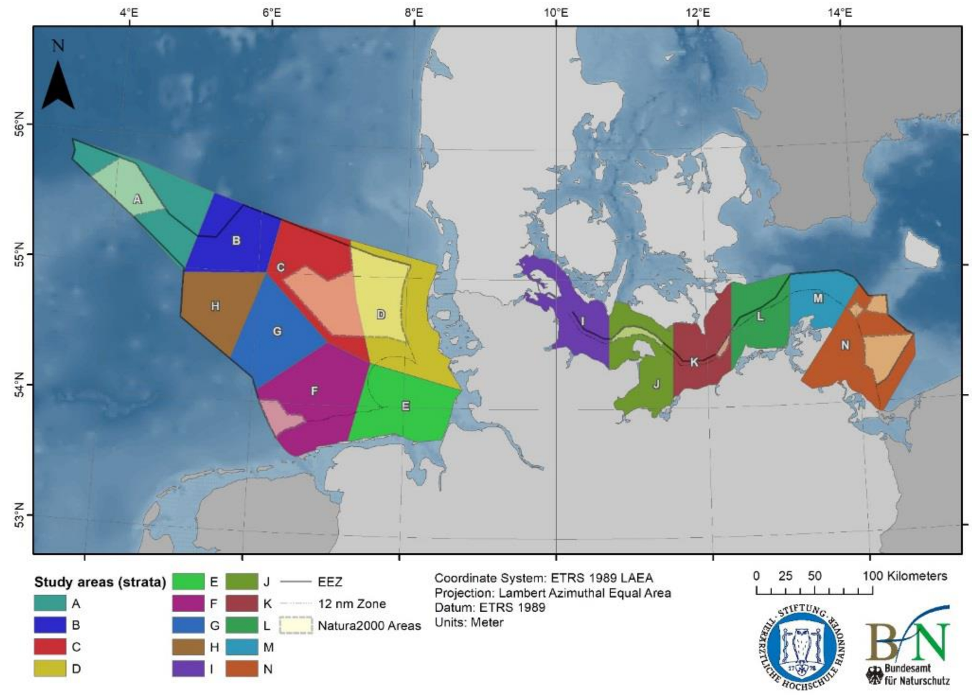


Figure 16. Newly designated study areas for the visual monitoring of harbour porpoises in the German North and Baltic Sea

In spring 2017, one aerial line transect survey was conducted near Borkum Reef Ground and a total of 18 harbour porpoise groups (23 animals, incl. two calves) were sighted along 559 km of effort. Due to logistical reasons and bad weather, no surveys could be conducted in the North and Baltic Sea during summer 2017. In spring 2018, a total of 163 harbour porpoise groups (179 animals, no calves) were recorded along 1459 km of effort in three areas in the North Sea (Borkum Reef Ground, Weser-Elbe estuary and Dogger Bank. In summer 2018, a total of 166 groups (200 animals, incl. 14 calves) were observed under 2077 km of effort in four study areas in the North Sea (Weser-Elbe estuary, Sylt Outer Reef West and East, and Dogger Bank. In spring 2019, a total of 145 harbour porpoise groups (172 animals, seven calves) were recorded along 1516 km of effort in three aerial survey strata in the North Sea (Figure 17a). In summer 2019, a total of 245 harbour porpoise groups (318 animals, including 12 calves) were observed along 3694 km of effort in all eight study areas in the North Sea (Figure 17b).

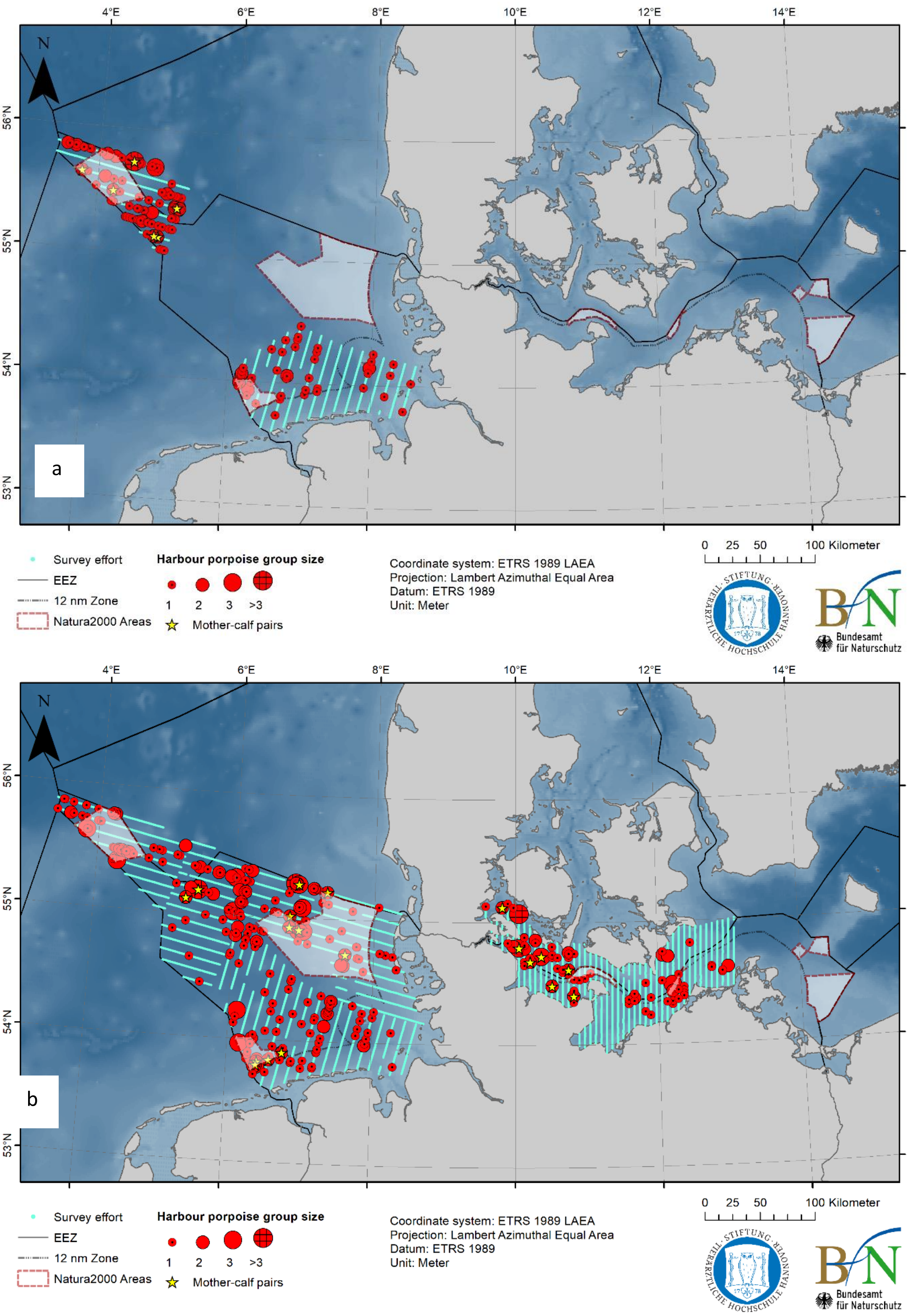


Figure 17. Survey effort and harbour porpoise sightings during aerial surveys in the German North and Baltic Sea during a) spring 2019 and b) summer 2019. Harbour porpoise group sizes are indicated using group size dependent red circles; yellow stars mark mother-calf pairs; blue lines indicate covered transect lines (i.e. survey effort). (Source: ICES WGMME 2020)

Effort corrected density and abundance estimates were generated using a bootstrapping approach, also correcting for availability and perception bias. In spring 2017, the abundance for Borkum Reef Ground in the North Sea was estimated to be 2862 (95%CI: 1175–4656) animals, at 0.44 (0.19–0.76) animals/km². In spring and summer 2018, the German North Sea was not entirely covered, allowing abundance and density estimates only for the individual areas (ICES WGMME 2019). In spring 2019, the German North Sea was not entirely covered, allowing abundance and density estimates for individual areas only; survey block 'Dogger Bank (A)' with 7707 (95% CI: 4005–12 405), at 1.36 (0.71–2.20) animals/km²; 'Borkum Reef Ground (F)' with 3315 (95% CI: 1605–6150) animals, at 0.54 (0.26–1.01) animals/km² and 'Weser-Elbe estuary (E)' with 887 (95% CI: 296–1981) animals, at 0.20 (0.05–0.45) animals/km² (Table 3; ICES WGMME 2020).

Table 3. Summary of effort corrected, bootstrapped density and abundance estimates for summer 2019 in the German North. N = estimated abundance of harbour porpoises; $N_{95\%CI}$ = 95% confidence interval around N; D = density estimate of harbour porpoises in ind./km²; $D_{95\%CI}$=95% CI around D; s = average group size (Source: ICES WGMME 2020)

area	season	N	$N_{95\% CI}$	D	$D_{95\% CI}$	$\hat{s}$
Dogger Bank (A)	summer 2019	4597	2219 – 7439	0.81	0.39 - 1.32	1.26
Offshore I (B)	summer 2019	4809	2807 – 7974	1.22	0.71 - 1.79	1.44
Sylt Outer Reef West (C)	summer 2019	5879	3002 – 11594	0.98	0.50 - 1.93	1.54
Sylt Outer Reef East (D)	summer 2019	2465	926 – 4707	0.36	0.13 - 0.68	1.20
Weser-Elbe estuary (E)	summer 2019	1122	191 – 2473	0.26	0.04 - 0.57	1.08
Borkum Reef Ground (F)	summer 2019	5992	3432 – 9953	0.98	0.56 - 1.63	1.23
OWF (G)	summer 2019	2337	1098 – 3653	0.57	0.27 – 0.90	1.19
Offshore II (H)	summer 2019	551	203 – 1068	0.16	0.06 – 0.31	1.00
All North Sea areas	summer 2019	27752	20151 - 39690	0.69	0.50 – 0.98	1.30

In **Denmark**, monitoring of harbour porpoises is carried out through the national monitoring programme NOVANA. Every year in July/August aerial surveys are conducted in the southern Danish North Sea and Skagerrak, covering the five Natura 2000 areas for harbour porpoises in this region. In the Skagerrak area (Figure 18a) a total of 47 porpoises were observed in groups of up to 4 individuals. The average group size was 1.5. In the North Sea area (Figure 18b) 41 porpoises were observed, with an average group size of 1.08. Calves were observed in both survey areas.

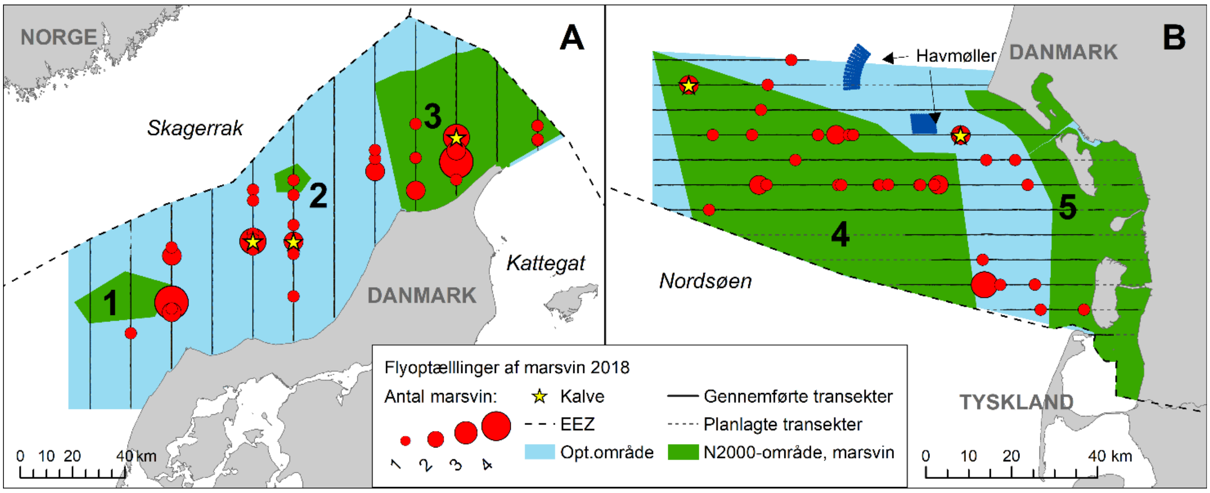


Figure 18. Aerial surveys of harbour porpoises in A) Skagerrak on 29 July 2018 and B) the North Sea on 2 August 2018. The green areas indicate Natura 2000 areas 1) Gule Rev, 2) Store Rev, 3) Skagens Gren and Skagerrak, 4) Sydlige Nordsø and 5) The Wadden Sea with Ribe Å, Tved Å and Varde Å west of Varde. No. of porpoises observed shown by the size of red dots and yellow stars indicate that calves were seen. Blue areas indicate offshore windfarms.

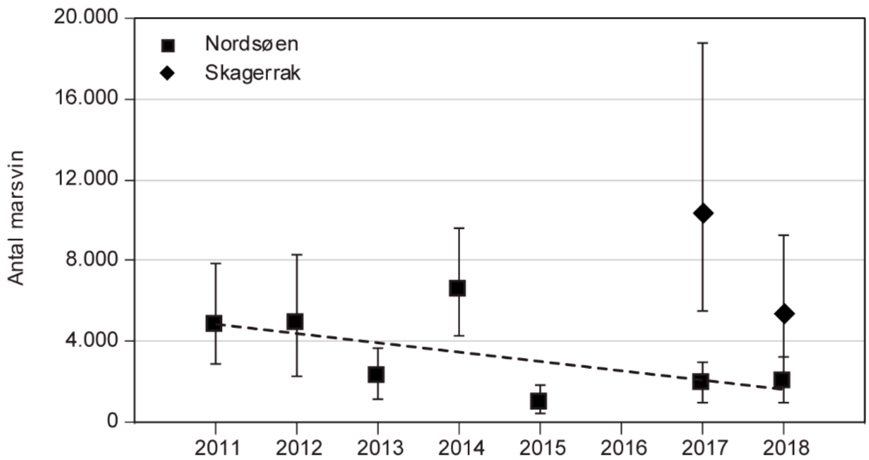


Figure 19. Estimated abundance of harbour porpoises in the Danish North Sea (2011-2018) and Skagerrak (2017-2018), respectively. Vertical lines indicate the 95% confidence interval. Dashed lines indicate the trend for the North Sea population.

The total abundance in the southern North Sea survey area in 2018 was estimated to be 2,013 individuals (95% CI: 954-3,186). This is comparable to 2017, but in general a declining trend is found. Large variations are found in the estimates especially from 2013 to 2015. These variations are assumed to be a result of the method, which only gives a snapshot of the distribution and abundance. Furthermore, annual differences in temperature, currents, timing of prey migrations and so on will influence the annual estimates. Consequently, long time series are essential to monitor the long-term trend within an area.

In Skagerrak, the total abundance in 2018 was estimated to be 5,323 individuals (95% CI: 2,415-9,233). 40% of the observations were within the large Natura 200 site 'Skagens Gren og Skagerrak'. The Skagerrak area was previously monitored using a slightly different method and comparable estimates are thus not possible prior to 2017. The abundance estimated in 2018 is lower than in 2017, but more years of data are needed to determine the trend.

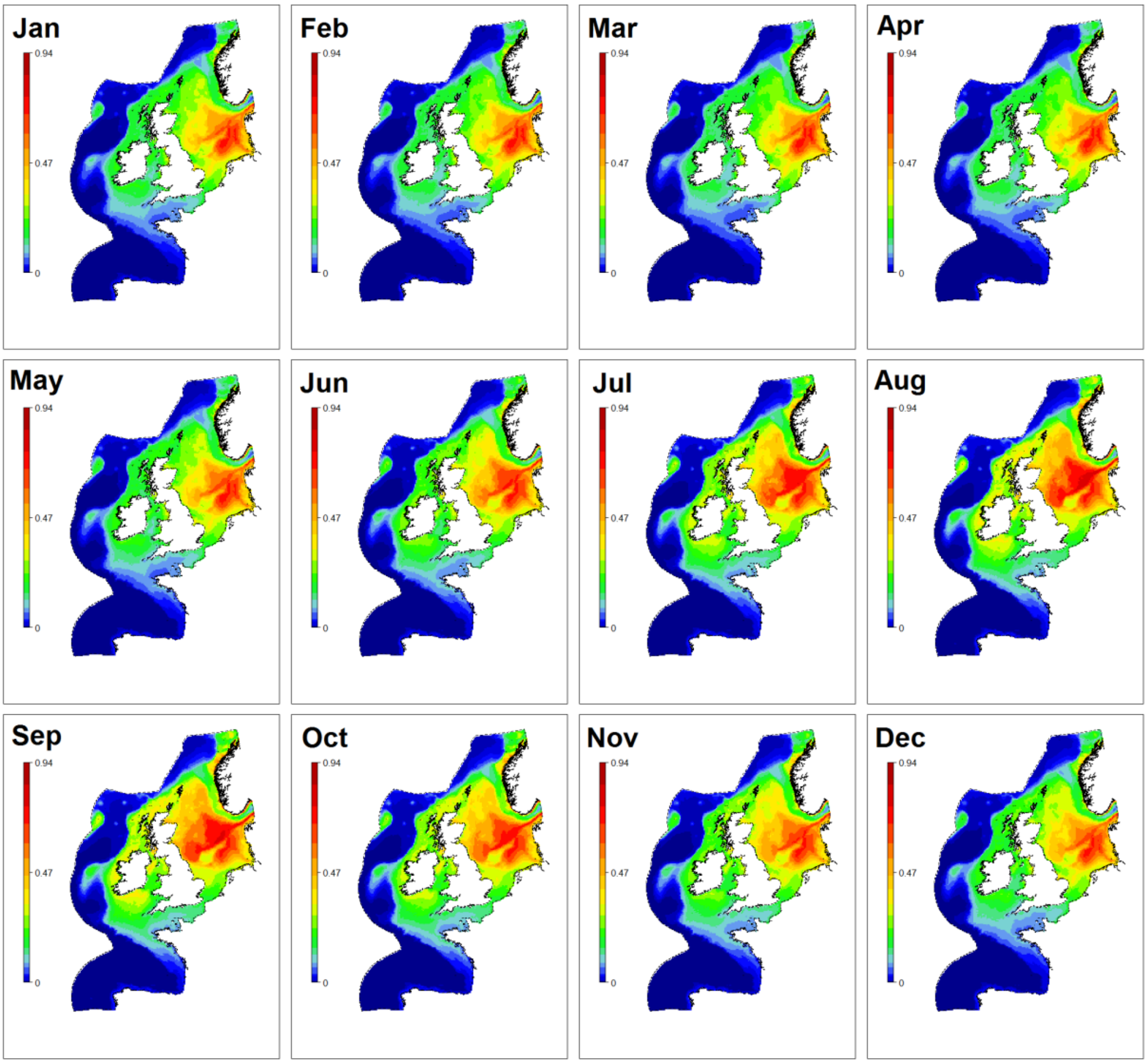


Figure 20. Monthly modelled density distributions of harbour porpoise averaged over the period 1980-2018 (Source: Waggitt *et al*. 2020)

Since 2014, the joint NERC-Defra funded Marine Ecosystems Research Programme has been collating dedicated survey data and undertaking modelling to derive abundance estimates and distribution patterns for all cetacean and seabird species occurring regularly in **NW European seas**. The project has collated around three million km of cetacean survey effort from more than fifty research groups in Northwest European seas covering the period 1978–2018 (Waggitt *et al*. 2020). Collectively, these surveys are being used to test ecological questions/hypotheses using a variety of modelling approaches, and to generate potentially useful data products. Using hurdle models that incorporate a range of environmental parameters believed to influence prey distributions and prey capture availability for different cetacean species, integrating the probability of encountering the species and its abundance, density maps of the 12 most common species have been produced at monthly temporal and 10 km spatial resolution across the past three decades. Monthly summaries of harbour porpoise distribution are shown in Figure 20. These highlight the importance of the North Sea for harbour porpoise in the context of NW European shelf seas.

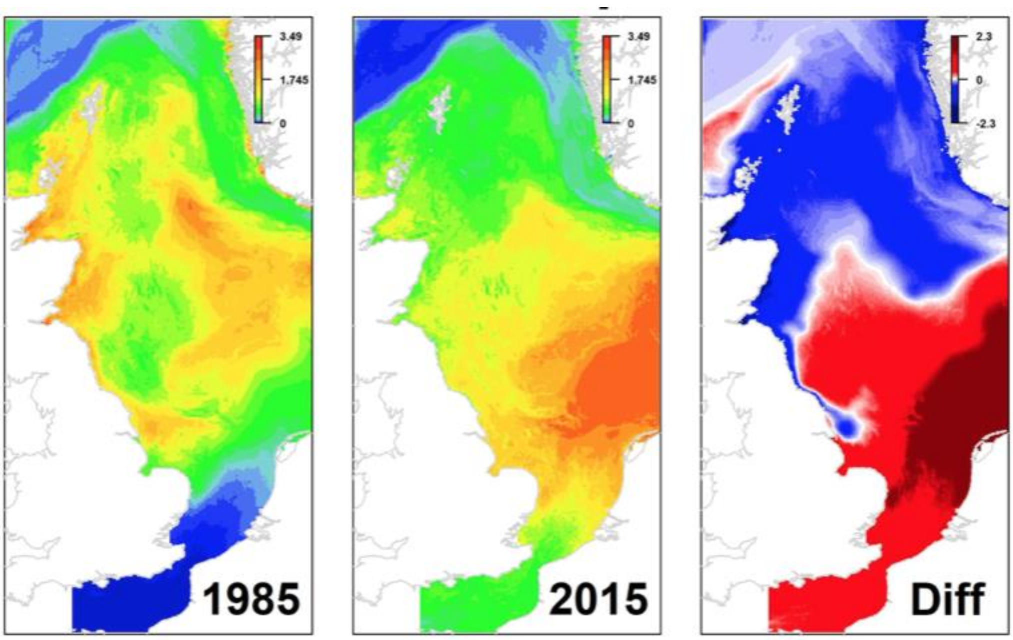


Figure 21. Long-term changes in modelled density distributions of harbour porpoise between 1985 and 2015. Red = increase in density; blue = decrease in density (Source: Waggitt & Evans, Marine Ecosystems Research Programme)

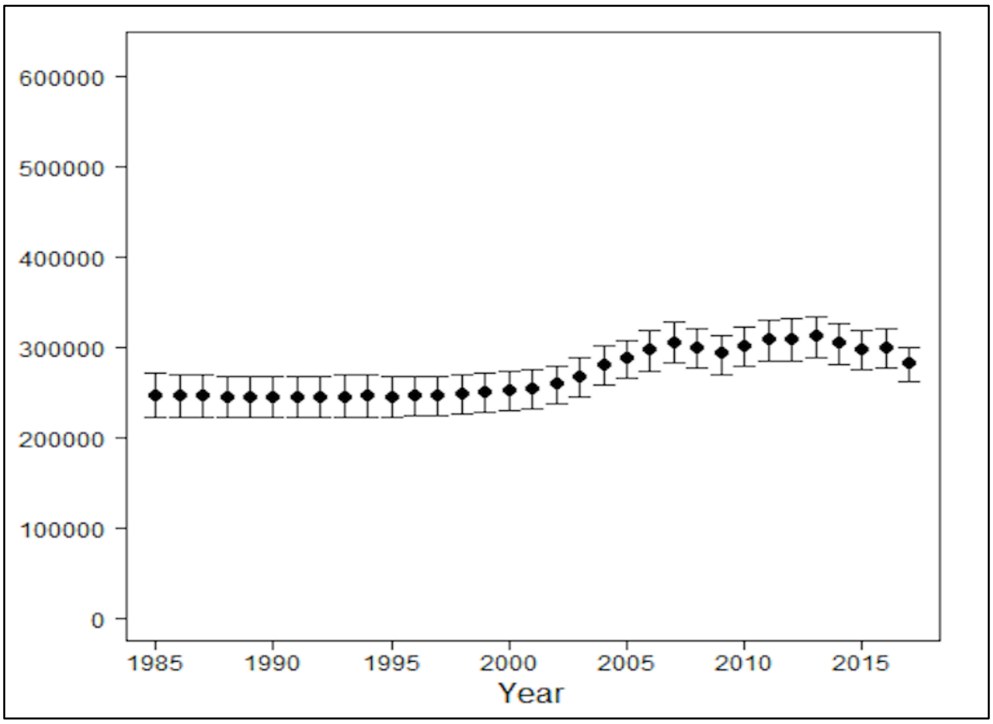


Figure 22. Annual trends in modelled abundance of harbour porpoise in the North Sea, 1985-2018 (Source: Evans & Waggitt, Marine Ecosystems Research Programme)

Figure 21 shows clearly the general southward shift in density distributions away from the northern North Sea since the 1990s, already established from earlier studies (Camphuysen 1994, 2004, Evans *et al*. 2003*,* Kiszka *et al*. 2004, 2007, Hammond *et al.* 2013).

Model based abundance estimates for the North Sea indicated a general declining trend between the mid-1980s and mid-2000s but more widely varying values since then with no obvious trend (Figure 22). These results are preliminary and further refinements continue.

In addition to visual surveys, acoustic monitoring (largely using C PODs) continues to be undertaken at a number of coastal locations in the **UK**, **the Netherlands**, **Germany** and **Denmark**, often in association with marine renewable energy developments. These have led to a series of publications in recent years (UK: Williamson *et al*. 2016, 2017; Germany: Dähne *et al*. 2017; Denmark: Nabe-Nielsen *et al.* 2018).

Key Conclusions & Recommendations *The harbour porpoise population within the North Sea (including the eastern half of the English Channel) is estimated in the region of 250,000-350,000 animals. There has been no significant change in abundance since the mid 1990s.*

Regular visual monitoring by aerial survey is now being undertaken on a seasonal and annual basis in the southern North Sea involving a number of countries. Winter months remain less well covered, and areas in the central and northern North Sea are largely unmonitored except by decadal wide-scale surveys and some local windfarm-related visual and/or acoustic monitoring. The northernmost part of the North Sea is relatively poorly monitored. It is recommended that these gaps are filled and that every Member State has a regular programme of monitoring across its entire EEZ.

ACTION 8 Review of the stock structure of harbour porpoises in the region

Currently, within ICES, harbour porpoises in the North Sea are considered within a single assessment unit equivalent to ICES Areas 4.a, 4.b, 4.c, 7.d, and 3.a.20 (ICES WGMME 2013, Figure 23). This encompasses all of the Skagerrak, the North Sea up to a line parallel with the Faroe Islands, and the eastern half of the English Channel. A recent joint NAMMCO & IMR workshop on the status of harbour porpoises in the North Atlantic (NAMMCO & IMR 2019) discussed assessment units of harbour porpoises in the North Atlantic, and decided to keep most of the borders for the North Sea assessment unit from ICES WGMME 2013 intact, with the exception that the border between the Belt Sea and North Sea assessment units was moved south into the Kattegat Sea, in accordance with Sveegaard *et al.* 2015 (Figure 24, detail in Figure 25).

Earlier, the ASCOBANS Population Structure workshop when reviewing multiple lines of evidence had proposed two management units within the North Sea divided by an arbitrary line separating the northern and eastern sector from the southern and western sector (Evans and Tiedemann, 2009). The lines of evidence suggesting sub-structuring within the North Sea included skeletal and tooth ultrastructure variation (Kinze 1985, 1990, Lockyer 1999, De Luna *et al*. 2012), genetic analyses (Walton 1997, Tolley *et al*. 1999, Andersen *et al*. 2001, De Luna *et al*. 2012), dietary studies (Aarefjord *et al*. 1995, Bjørge 2003), stable isotope studies (Das *et al.* 2003), contaminant loads (Das *et al*. 2004, Lahaye *et al*. 2007), and telemetry studies (Teilmann *et al*. 2008; Sveegaard *et al*. 2011). Details of their findings are given in Desportes (2014).

A number of authors allude to differences in ecology between animals from the north-eastern and southern/western North Sea, particularly with respect to feeding. There are obvious differences in the bathymetry and oceanography of these two regions, being much deeper in the north-east than in the southernmost North Sea. If porpoises in the north-eastern North Sea are feeding mainly upon pelagic prey (for which skull characteristics, particularly of the buccal cavity, have developed – see De Luna *et al*., 2012) whilst those in the southernmost North Sea are taking fish primarily off the bottom (with equivalent changes to the size of the buccal cavity), then these may represent separate management units with a potential boundary following bathymetric and oceanographic changes.

De Luna *et al*. (2012) and Andersen *et al.* (2001) found significant differences between porpoises from the British North Sea and those from the Danish North Sea, as well as differences between porpoises from Norway and both the Danish North Sea and the British North Sea. Wiemann *et al.* (2010) also showed significant sub-structuring between the Danish North Sea and Norway. Thus, the presence of three Management Units might also be considered (Desportes 2014).

Sveegaard *et al*. (2015) reviewed harbour porpoise management areas in the Baltic, Belt Seas and Kattegat combining information from genetics, morphology, acoustics and satellite tracking. They concluded that porpoises in the Western Baltic, Belt Seas and Kattegat represented a separate management unit to those in the Baltic Proper and recommended a northern boundary halfway down into the Kattegat (along an east-west line drawn at 56.95°N) (see Figure 24).

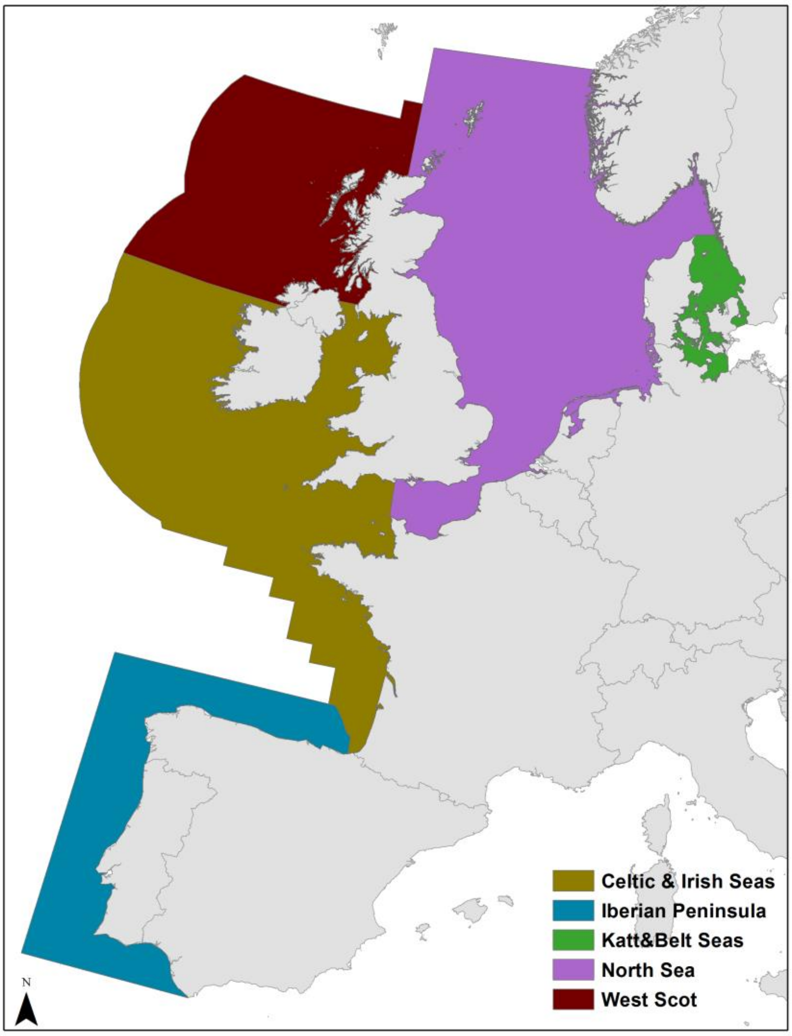


Figure 23. Assessment Units for the Harbour Porpoise
as proposed by ICES WGMME (2013)

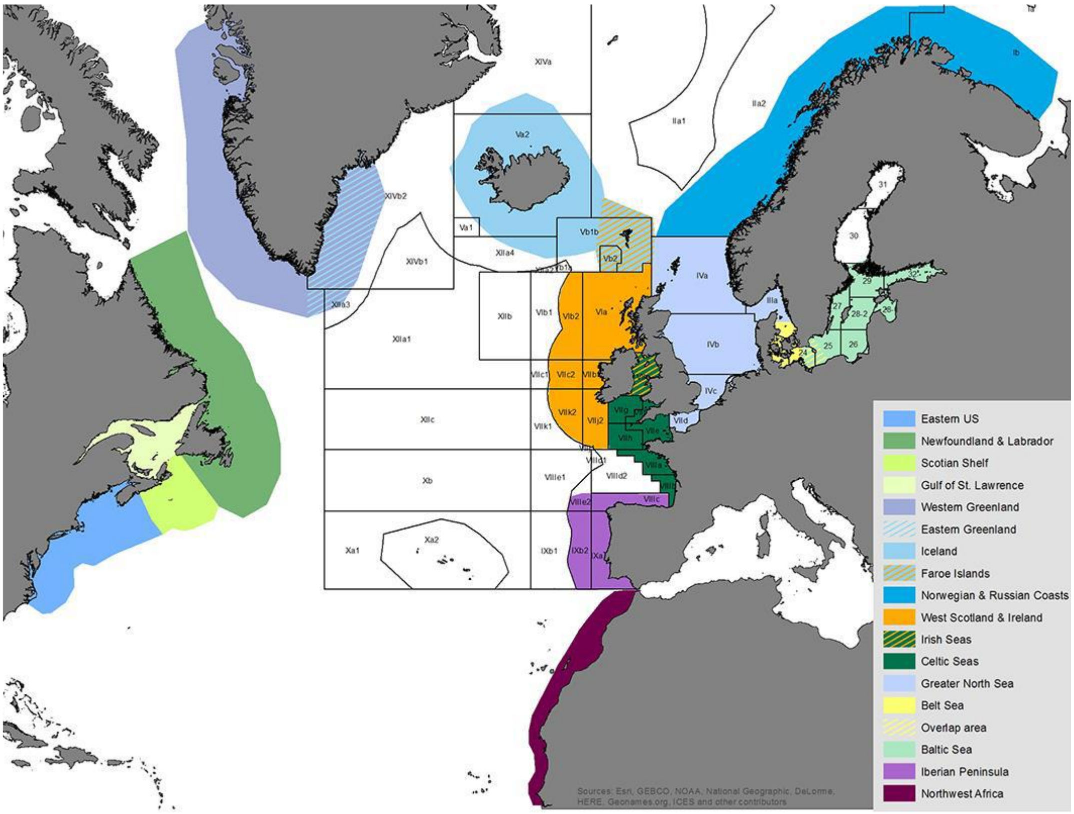


Figure 24. Assessment units for harbour porpoise in the North Atlantic as proposed and used during the joint NAMMCO/IMR workshop, with the ICES fishing areas superimposed. (Source: NAMMCO & IMR 2019).

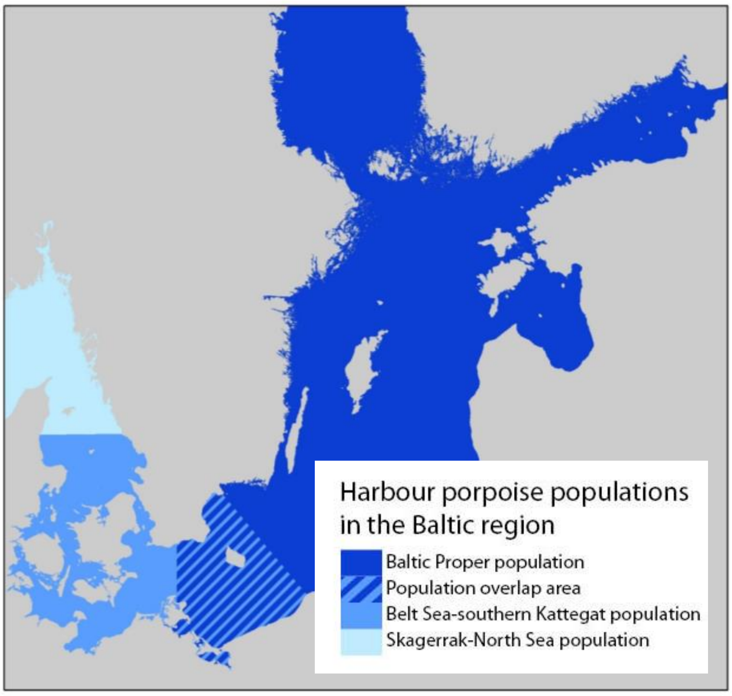


Figure 25. Harbour porpoise populations in the Baltic region. Blue shading indicates the borders proposed for the management unit of the Belt Sea population by Sveegaard *et al.* (2015) and for the Baltic Proper population by Carlén *et al*. (2018). All borders are for the summer half-year only.

At the south-western end of the ICES WGMME North Sea assessment unit area, Fontaine *et al* (2017) analysed the fine-scale genetic and morphological variation in harbour porpoises around the UK by genotyping 591 stranded animals at nine microsatellite loci. The data were integrated with a prior study to map at high resolution the contact zone between two previously identified ecotypes meeting in the northern Bay of Biscay. Clustering and spatial analyses revealed that UK porpoises are derived from two genetic pools with porpoises from the southwestern UK being genetically differentiated, and having larger body sizes compared to those from other UK areas.

South-western UK porpoises showed admixed ancestry between southern and northern ecotypes with a contact zone extending from the northern Bay of Biscay to the Celtic Sea and Channel (Fontaine *et al*. 2017). Around the UK, ancestry blends from one genetic group to the other along a southwest–northeast axis, correlating with body size variation, consistent with previously reported morphological differences between the two ecotypes. They also detected isolation by distance among juveniles but not in adults, suggesting that stranded juveniles display reduced intergenerational dispersal. This would be expected if adults show some philopatry and faithfulness to particular breeding areas, as suggested in harbour porpoises, especially in females (mtDNA and satellite tagging studies both indicate greater philopatry for females than males), and then disperse again the rest of the year (e.g. for foraging). Identifying where a boundary might exist in the English Channel between porpoises from a southwestern ecotype and those from the North Sea is difficult given the distribution of samples from along the south coast of England and lack of knowledge of their exact origins (due to passive drift). For the time being, there seems no reason to recommend a change to the western boundary to the North Sea assessment unit proposed by ICES WGMME (2013).

The challenge in determining where management boundaries should lie is that different authors have used different sampling divisions, there are geographical gaps in sampling, sample sizes in these have varied a lot, and the precise origins of the samples are rarely known. Some of the key areas of potential management unit boundaries that have been poorly sampled include the north-eastern North Sea south and west of Norway and the central English Channel.

Key Conclusions & Recommendations *There is still some uncertainty over the extent to which there is sub-structuring of harbour porpoise populations in the North Sea, with one, two, or three areas suggested as Management Units. It would be useful to obtain further samples for some of the boundary areas – Danish vs Norwegian Skagerrak, northern Kattegat, southern vs western Norway, Shetland vs Orkney/Scottish mainland, for analysis using a range of approaches (skull morphology, genetics, etc).*

The possibility of further sub-structuring should be explored in the central North Sea from the Danish and north German coasts across to eastern Britain since there are signals of differentiation on an east-west as well as north-south axis. Analyses are best conducted on samples where the precise original location is known. This is obviously not possible with most stranded animals sampled, but even with individuals that have been bycaught, care needs to be taken to ensure that the precise location of that bycaught animal is recorded.

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 high and medium priorities. Progress has been variable since the adoption of the plan in 2009. Some aspects (e.g. the monitoring of distribution and abundance, at least in the southern North Sea) have received a lot of attention, whereas others (e.g. adequate monitoring to derive robust bycatch estimates particularly of recreational fisheries and vessels less than 15 m length, and the implementation of effective mitigation measures to reduce bycatch) have made less progress.

Draft criteria for assessment of progress in implementation actions under the harbour porpoise conservation plan are proposed below.

Draft Status Assessment Criteria for Progress of the Implementation of the Actions of the North Sea Conservation Plan

1. **Implementation of the CP: co-ordinator and Steering Committee**
   Yes/No

2. **Implementation of existing regulations on bycatch of cetaceans**

   Enforcement policy
   N.A. – Not applicable
   0 – No activity
   1 – Some enforcement of high-risk fisheries
   2 – Full enforcement of some high-risk fisheries
   3 – Full enforcement of all high-risk fisheries

   Dedicated observer programme
   N.A. – Not applicable
   0 – No activity
   1 – Research project on bycatch monitoring (under Reg. 812/2004)
   2 – Robust bycatch monitoring of part of relevant fisheries (under Reg. 812/2004)
   3 – Robust bycatch monitoring in all relevant fisheries (under Reg. 812/2004)

   Monitoring under the Habitats Directive
   N.A. – Not applicable
   0 – No activity
   1 – Research project on bycatch monitoring
   2 – Robust bycatch monitoring of part of relevant fisheries
   3 – Robust bycatch monitoring in all relevant fisheries

3. **Establishment of bycatch observation programmes on vessels smaller than 15 m length, professional and recreational fisheries**

   N.A. – Not applicable
   0 – No activity
   1 – Research project on bycatch monitoring
   2 – Robust bycatch monitoring of part of relevant fisheries
   3 – Robust bycatch monitoring in all relevant fisheries

4. **Regular evaluation of relevant fisheries, extent of harbour porpoise bycatch**

   N.A. – Not applicable
   0 – No estimates available
   1 – Estimate of bycatch available from research project, for part of the fisheries
   2 – Robust estimate of bycatch available for >50% of relevant fisheries
   3 – Robust estimate of bycatch available for all relevant fisheries

5. **Review of current pingers, development of alternative pingers, and gear modification**

   N.A. – Not applicable
   0 – No activity
   1 – Research projects ongoing on fisheries closures, effort reduction, alternative gear, ADDs and/or ghost net removal
   2 – Clear guidelines and regulations on bycatch mitigation with the aim of reducing bycatch to zero in harbour porpoise MPAs and/or high-risk areas, EU delegated acts in place where relevant, ghost net removal carried out in some parts of the distribution range
   3 – Clear guidelines and regulations on bycatch mitigation in all national waters, delegated acts in place where relevant, ghost net removal carried out in larger scale within the distribution range

6. **Review of management procedure approach for determining maximum allowable bycatch limits**

   N.A. – Not applicable
   0 – No activity
   1 – Some research into a management procedure approach
   2 – Maximum allowable bycatch limits determined

7. **Monitoring trends in distribution and abundance of harbour porpoise in the North Sea**

   Large-scale
   N.A. – Not applicable
   0 – No activity
   1 – Surveys carried out every 10-12 years, results with CVs for abundance estimates of above 0.4
   2 – Surveys carried out every 10-12 years, with CVs for abundance estimates of between 0.2 and 0.4, maps of harbour porpoise density
   3 – Surveys carried out every 6 years, with CVs for abundance estimates of 0.2 or less, maps of harbour porpoise density

   Regional/surveys
   N.A. – Not applicable
   0 – No activity
   1 – Some monitoring going on, at local/national scale, not continuously
   2 – Continuous (year-round) monitoring for at least two years every six years
   3 – Continuous (year-round) monitoring for the entire six-year cycle

   Regional/modelling
   N.A. – Not applicable
   0 – No activity
   1 – Some density modelling taking place, at local/national scale, not continuously
   2 – Continuous (year-round) density modelling for at least two years every six years
   3 – Continuous (year-round) density modelling for the entire six-year cycle

8. **Review of the stock structure of harbour porpoise in the North Sea**

   N.A. – Not applicable

0 – No activity
1 – Samples collected from some carcasses found within the Greater North Sea, but no analysis in last year
2 – Samples collected from some carcasses found within the Greater North Sea, some analysis completed (genetics, life history, morphometrics etc.) in last year
3 – Samples collected from over 90% of carcasses found within the Greater North Sea, and all possible analyses completed (genetics, life history, morphometrics, etc.) in last year

9. Collection of incidental harbour porpoise data through stranding networks

N.A. – Not applicable
0 – No activity, no plan or guidance on how to act in case of a stranding
1 – Samples collected from some carcasses from within the Greater North Sea, no analysis carried out
2 – Some analysis and assessments completed on certain organs or tissues, and/or some necropsies carried out
3 – Full necropsies (according to ASCOBANS protocol) conducted for at least 20 carcasses in good enough condition, and samples analysed for health indicators, e.g. contaminant levels and life history parameters. Regular (at least every 6 years) assessments of results

10. Investigation of the health, nutritional status and diet of harbour porpoise in the North Sea

N.A. – Not applicable
0 – No activity, no plan or guidance on how to act in case of a stranding
1 – Samples collected from some carcasses from within the Greater North Sea, no analysis carried out
2 – Some analysis and assessments completed on certain organs or tissues, and/or some necropsies carried out
3 – Full necropsies (according to ASCOBANS protocol) conducted for at least 20 carcasses in good enough condition, and samples analysed for health indicators, e.g. contaminant levels and life history parameters. Regular (at least every 6 years) assessments of results

11. Investigation of the effects of anthropogenic sounds on harbour porpoise

N.A. – Not applicable
0 – No activity
1 – Research projects in place to improve knowledge
2 – Threshold limits of disturbance in place for continuous **or** impulsive underwater noise.
3 – Threshold limits of disturbance in place for continuous **and** impulsive underwater noise.

Mitigating effects of underwater noise
N.A. – Not applicable
0 – No activity
1 – Mitigation measures under development or being tested, available mitigation methods used to some extent
2 – Research on the effectiveness of mitigation measures ongoing. National and/or OSPAR guidelines under development.
3 – Mitigation measures in place for continuous and impulsive noise in the harbour porpoise distribution range. National and/or OSPAR guidelines in place.

12. Collection and archiving of data on anthropogenic activities and development of GIS

N.A. – Not applicable
0 – No activity
1 – Some collection of data on some anthropogenic activities potentially impacting porpoises
2 – Regular collection of data on all anthropogenic activities potentially impacting porpoises

Table 4. Qualitative Assessment of Progress in the Implementation of the ASCOBANS North Sea Conservation Plan for the Harbour Porpoise (undertaken August 2020)

	Actions from the North Sea Conservation Plan for HP	Priority		SE	DK	DE	NL	BE	FR	UK
1	Implementation of the CP: co-ordinator and Steering Committee	High		Coordinator currently in place						
2	Implementation of existing regulations on bycatch of cetaceans - e.g. EC 812/2004 & Habitat Directive (HD) (* Table 1ab, ICES WGBYC 2012)	High	Vessels requiring pingers	yes	17	yes	na	na	9	24
			No. of vessels using pingers	?	?	?	na	na	?	?
			Enforcement policy	0	?	?	?	na	?	3
			Dedicated observer prog	0	2	0	1	0	2	3
			Monitoring under HD	0	2	0	1	0	2	3
3	Establishment of BYC observation programmes on vessel smaller than 12m long, professional and recreational fisheries	High	Professional	1	1	0	1	0	1	1
			Recreational	na	1	na	0	0	1?	na
4	Regular evaluation of relevant fisheries, extent of HP BYC:	High		0	0	0	0	0	1	1
	Gillnet fisheries =>15m vessels, dedicated, % DAS observed			0	0	0	0	0	?	?
	Gillnet fisheries <15m vessels, dedicated, % DAS observed			0	?	0	?	0	?	?
	Cetacean scheme appended to DCF / DCR schemes			no	yes	yes	yes	no	yes	yes
	DCF observations in 2018 in NS, % DAS observed			0	?	0	0	0	?	?
5	Review of current pingers, dev. of altern.pingers and gear modif.	High		2	2	2	na	na	2	2
6	Finalise a management procedure approach for determining maximum allowable byctch limits	High		General progress ICES WGMME, WGBYC, OSPAR (MSFD)						
				1	1	1	1	1	1?	1
7	Monitoring trends in distribution and abundance of HP in NS	High	Large scale	SCANS III undertaken in 2016						
			Reg/survey	1	2	2	2	2	1	1
			Reg/modelling	1	2	2	2	2	2	1
8	Review of the stock structure of HP in NS	High		1	1	1	1	1	1	1
9	Collection of incidental HP data through stranding networks	Medium		1	1	3	3	3	2	3
10	Investigation of the health, nutritional status and diet of HP in NS	Medium		1	2	2	2	1	1	3
11	Investigation of the effects of anthropogenic sounds on HP	Medium		1	2	2	2	2	1	2
12	Collection and archiving of data on anthropogenic activities and development of a GIS	Medium		1	1	1	1	1	1?	1

Except for Action 2, ref. pinger use: na = non applicable; **-1**, situation is less good than at the adoption of the plan in 2009, **0** = no progress, **1** = small progress or at experimental level; **2**, steady progress; **3**, fully implemented.

Priority Recommendations

1) Improve quality and availability of fishing effort data for the region, by gear type, vessel size category, season, and country
2) Investigate options for more cost-effective bycatch monitoring, particularly to include vessels less than 15 metres length
3) Investigate gear specific solutions to mitigate bycatch, including alternative fishing methods to static gillnetting
4) Improve the information provided by countries relevant to the Conservation Plan

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APPENDIX I

Table A1. Bycatch for harbour porpoise in the North Sea, as reported by Parties, from various observation schemes

Country	Year	ICES area/ subarea	Metier (level 3)	Type of monitoring	Days at sea monitored	% fleet monitored	Species bycaught	Number of specimen	Bycatch rate (No of specimens/ monitored DaS
UK		7	GNS/GTR	Dedicated	217		Harbour porpoise	5	0.023
DK	2017	27.3.a	GNS	DCF	15	0.8	Harbour porpoise	1	0.067
SE		3.a.23	GNS	Dedicated	36	0.18	Harbour porpoise	2	0.056
NL	2013-2017		GNS/GTR	REM	8133		Harbour porpoise	13	0.0016

Notes: Data have been taken from the WGBYC Report (2019) and show monitored metiers where bycatch was observed in the North Sea during 2017 (the latest year of reporting).

Dedicated = at sea Protected Species Observer Scheme
DCF = Data Collection Framework
REM = Remote Electronic Monitoring
GNS = Static Gillnet
GTR = Trammel net

*Only the northern part of ICES Subarea 3a is in the North Sea Plan area. However, the resolution of the fisheries and monitoring data currently do not enable allocation of the effort to a particular part of 3a.

Table A2. Overview of harbour porpoise strandings, necropsies, and bycatch determination for the North Sea (input provided by France, Belgium, The Netherlands, Germany, Sweden, and the United Kingdom, source ICES WGMME 2019, 2020; ICES WGBYC, 2020)

country	year	Area: ICES MU	Area: Sea	number of recorded strandings*	all stranded porpoises necropsied**	number of necropsied porpoises with: known cause of death	unknown cause of death	cause of death bycatch	% of strandings necropsied	% bycatch of: all stranded animals necropsied	all animals necropsied with known cause of death
FR	2013	NS	NS	313	1	1^	0	0	**0.3**	0	**0**
FR	2014	NS	NS	181	10	3^	7	3	**5.5**	30	**30**
FR	2015	NS	NS	131	6	5^	1	3	**4.6**	50	**60**
FR	2016	NS	NS	262	2	2^	0	1	**0.8**	50	**50**
FR	2017	NS	NS	168	1	1^	0	1	**0.6**	100	**100**
FR	2018	NS	NS	182	73	73	0	26	**40.1**	36	**36**
BE	2016	NS	NS	137	116~	33^	83	21	**84.7**	18.1	**63.6**
BE	2017	NS	NS	94	85~	25^	60	9	**90.4**	10.6	**36.0**
BE	2018	NS	NS	89	30	30	0	3	**33.7**	10	**10**
NL	2014	NS	NS	582	57	24	33	2***	**9.8**	3.5	**8.3**
NL	2015	NS	NS	309	32	28	4	1***	**10.4**	3.1	**3.6**
NL	2016	NS	NS	661	68	54	14	2***	**10.3**	2.9	**3.7**
NL	2018	NS	NS	476	57	57	0	7	**12.0**	12.3	**12.3**
DE	2015	NS	NS	109	109	-	-	3****	**100********	2.8	**2.8**
DE	2016	NS	NS	126	126	-	-	2****	**100********	1.6	**1.6**
DE	2017	NS	NS	91	91	-	-	5****	**100********	5.5	**5.5**
DE	2018	NS	NS	116	25	24	0	1	**21.6**	4.0	**4.0**
SE	2016	NS	NS	19	4	3	1	1	**21.1**	na	**na**
SE	2017	NS	NS	19	20	6	1	1	**30.0**	na	**na**
SE	2018	NS	NS							na	**na**
UK	2016	NS	NS	248	39	39	0	1	**15.7**	2.6	**2.6**
UK	2017	NS	NS	185	33	33	0	1	**17.8**	3.0	**3.0**
UK	2018	NS	NS	183	20	20	0	2	**10.9**	10.0	**10.0**

*some databases include live strandings that don't survive, partial finds of porpoises, and/or bones.
**where known, animals that were bycaught and brought in by fishermen were not included in the stranded data
*** cause of death code used: hpr - high probability of bycatch, pr - probable bycatch; animals considered possible bycatch not included
**** all strandings undergo a post mortem examination but not necessarily a full necropsy
^database includes animals with known cause of death that were not necropsied. These animals are not included here
^^Numbers not final
~This includes animals where the cause of death was determined without a necropsy
na not applicable (as sample size too low to give a representative %)

Remarks (from data contributors):

- The percentage of animals stranded that are necropsied varies greatly between countries. The highest percentage is for Germany where all strandings undergo post mortem examination but may not receive a full necropsy, and Sweden where relatively few strandings are recorded. For the remainder, it is between 10 and 20%.
- Bycatch rates are similar for the UK and the NL. However, they are much higher for Belgium (and Sweden). These differences need explaining. The sample sizes for Sweden are too small to draw many conclusions.
- The ICES MU to which the data apply has been included but in the case of the UK, needs checking.
- The difference in numbers of recorded porpoise strandings between the UK and the Netherlands is striking, with many more in the NL despite its much shorter length of coastline.

APPENDIX II

Life history parameters of the harbour porpoise

Here, life history parameters of harbour porpoises in the North Sea and the greater north Atlantic has been summarised, largely based on reviews by Graham Pierce (presentation to the ASCOBANS North Sea group in 2018), Fiona Read (2016) and Sinead Murphy and others at the NAMMCO & IMR harbour porpoise workshop (2019).

In general, female harbour porpoises grow to be larger than males, and some differences in size seem to occur between areas/subpopulations, most notably porpoises off the Iberian Peninsula are larger than their conspecifics further north. Sexual maturity generally occurs between 2-5 years of age, but differs between sub-populations with ASM being lower in northern areas (for example Iceland and Greenland) than in the southern North Sea.

Harbour porpoises reproduce seasonally, with calving taking place during summer, in general between May and August but often with a peak in June or July, and conception soon after that, supporting the gestation period of between 10-11 months. The female lactates for 7-12 months, and can be simultaneously pregnant and lactating, sometimes giving birth to one calf each year. However, the pregnancy rate varies between areas, from around 0.4 in the northern North Sea and around Ireland to almost 1 in eastern Canada and Iceland. The seasonality of calving and lactation means that special attention should be paid to important areas for harbour porpoises during summer, when calving and mating takes place, as well as during autumn and winter when young calves are entirely dependent on their mothers for survival. During these times populations are likely extra sensitive to any disturbances which may influence the interaction between male and female during mating, and possibly even more important, the interaction between mother and calf during lactation.

Harbour porpoises have a rather short lifespan compared to many other cetacean species. They can live to be over 20 years old, but many do not live past the age of 12 (Lockyer and Kinze, 2003). In the German North Sea, females reach sexual maturity at around 4.95 years of age, and it is estimated that only approximately 55% of females live long enough to participate in reproduction (Kesselring et al., 2018, 2017). Given that the fertility of female harbour porpoises seem to be negatively impacted by PCBs (Murphy et al., 2015) and females often do not give birth to one calf each year, the overall reproduction rate may be cause for concern.

Concerning annual adult mortality, which has recently been discussed in relation to the MSFD bycatch indicator under D1, there are a few relevant studies available. For UK waters, Lockyer (1995) found the annual adult mortality to be 0.20 for males and 0.18 for females. Kinze (1990) estimated total annual adult mortality to 0.13 in Danish waters. Hammond et al (2019) estimated annual natural mortality to 0.15 for age 0, 0.13 for age 1 and 0.09 for age 2+ years, based on Winship (2009).

In summary, we see a need for continued collection of samples and analysis of life history parameters in harbour porpoises in European waters, to increase sample sizes and follow any changes occurring. Also, assessments of life history parameters in relation to pollutant levels should be undertaken, for example, it should be investigated if the lower pregnancy rates found in some areas may partly be due to higher contaminant loads in those areas.

Table A3a. Variation in life history parameters for harbour porpoise across its North Atlantic range, males.

Area (years)	**Maximum length (cm)**	**Mean adult length (cm)**	**Mean adult weight (kg)**	**Maximum age (years)**	**Length at sexual maturity (cm)**	**Age at sexual maturity (years)**	**Length at physical maturity (cm)**	**Asymptotic length at physical maturity ± SE/SD (cm)***	**Asymptotic weight at physical maturity ± SE/SD (cm)***	**Age at physical maturity (years)**	**Males**
NWIP	189 (N=136)			19 (N=77)	151 (154-171) (N=47)	3.8 (N=47)	162 (N=47)			10 (N=47)	Read (2016)
Galicia, NW Spain	176 (N=27)			9	155	5					Lens (1997), Lopez (2003)
Portugal (1981-1994)	175 (N=15)										Sequeira (1996)
Scotland, northern North Sea (1992-2004)	170 (N=252)			20 (N=138)	132.2 (N=145)	5.0 (N=64)	151 (147-155)	147.2		~5	Learmonth et al. (2014)
Northern North Sea (2001-2003)	160			12	130-138	3.5-6					Pierce et al. (2005)
UK (1985-1994)	163 (N=114)	145		24 (N=114)	130-135 (N=114)	>3 (N=114)	145	145	50		Lockyer (1995; 2003)
Ireland (2001-2003)	157 (N=19)				4-8	131-146					Pierce et al. (2005)
Denmark (1938-1998)	167	145	50	23	130-135.5 (N=96)	3-4	145				Lockyer & Kinze (2003)
Kattegat/ Skagerrak (1988-1991)	163	141.6						142 (n=201)			Hedlund (2008)
Belt Sea								>130			Karstad et al. (1993)
The Netherlands	147 (N=5)			12.5 (N=2)							Pierce et al. (2005)
France (2001-2003)	165 (N=17)			14 (N=12)							Pierce et al. (2005)

West Greenland (1988-1989, 1995)	158 (N=91)	141.5		17 (N=91)	127 (123-130)(N=91)	2-2.45 (N=94)	141.5 ± 1.4	141.5 ± 1.4	51.177 ± 1.824		Lockyer et al. (2003)
Greenland				17? (sex not mentioned)		2.7 (1995, SE=0.03) 3.1 (2009, SE=0.08)					NAMMCO (2013)
Iceland (1991-1997)	165 (N=794)			16 (N=615)	135.6/135	1.9/2.6 /2.9	150	149.6	51.7		Ólafsdóttir et al. (2003)
Gulf of Maine (1989-93)	157			15*		>3 (3-4) (N=31)	143 ± 1.25			~5*	Read & Hohn (1995)
Canada, Bay of Fundy				17				144			Read & Hohn (1995), Read & Gaskin (1990)
Canada, eastern Newfoundland (1990-1991)	155.5				135.1 (SE=0.02)	3		142.9 (SE=1.2)			Richardson et al. (2003)
Southern North Sea (1955-~1975)	151					~5		~130-135			Van Utrecht (1978)
Faroe Islands				>10		5					NAMMCO & IMR (2019)

Table A3b. Variation in life history parameters for harbour porpoise across its North Atlantic range, females.

Area	Maximum length (cm)	Mean adult length (cm)	Mean adult weight (kg)	Maximum age (years)	Length at sexual maturity (cm)	Age at sexual maturity (years)	Length at physical maturity (cm)	Asymptotic length at physical maturity ± SE/SD (cm)*	Asymptotic weight at physical maturity ± SE/SD (cm)*	Age at physical maturity (years)	Females
NWIP	202 (n = 127)			18 (n = 71)	169 (161-202) (n = 60)	5.5 (n = 60)	185 (n = 60)			10 (n = 60)	Read (2016)
Galicia, NW Spain	202 (n = 38)			9	166 (n = 35)	3					Lopez (2003)
Portugal (1981-1994)	208 (n = 22)										Sequeira (1996)
Scotland, northern North Sea (1992-2004)	173 (n = 227)			20 (n = 132)	138.8 (n = 190)	4.35 (n = 111)	164 (157-171)	158.4		~5	Learmonth et al. (2014)
Northern North Sea (2001-2003)					>140	4.5 (CL ± 0.2886)					Pierce et al. (2005)
UK (1985-1994)	189 (n = 96)	160		22 (n = 96)	140-145	3	160	160	55		Lockyer (1995; 2003)
UK (1990-2012)						4.92					Murphy et al. (2015)
Ireland (2001-2003)	175 (N=27)			11 (N=21)	>140/>150	3.67 (CL±0.33) (Irish Sea)					Pierce et al. (2005)
Denmark (1938-1998)	189	160	65	23	143 (136-151) (n = 59)	3.5 (n=25)	160				Lockyer & Kinze (2003)
Kattegat/ Skagerrak (1988-1991)	171 (n = 232)	156.7				4.32 (3.76-4.87)		156 (n=201)			Hedlund (2008)
German North Sea and German Baltic Sea				19		4.95 (±0.6)					Kesselring et al (2017)
Belt Sea							153	152.4 (±5.5)			Karstad et al. (1993)
The Netherlands	160 (N=19)			12 (N=14)							Pierce et al. (2005)
France (2001-2003)	192 (N=14)			24 (N=9)							Pierce et al. (2005)

West Greenland (1988-1989, 1995)	166 (n = 85)	154		12 (n = 85)	138-142 (n = 85)	2.95-3.63 (n = 84)	154 ± 2.6	154.0 ± 2.6	64.391 ± 1.960		Lockyer et al. (2001, 2003)
Greenland				17? (sex not mentioned)		3.7 (1995, SE=0.03) 3.5 (2009, SE=0.03					NAMMCO (2013)
Iceland (1991-1997)	174 (n = 474)			20 (n = 354)	138/147.6 /146	2.1/2.8/ 3.2/4.4	160	160.1	77.5 (including pregnant)		Ólafsdóttir et al. (2003)
Gulf of Maine (1989-93)	168			17*		3.36/3.15/3.27 (n=99)	158 ± 1.56			~7	Read & Hohn (1995)
Canada, Bay of Fundy				17		3.15-3.44		155			Read & Hohn (1995), Read & Gaskin (1990)
Canada, eastern Newfoundland	162				146.4 (SE=0.03)	3.1 (SE=0.07		156.3 (SE=2.9)			Richardson et al. (2003)
Southern North Sea (1955-~1975)	186					~6			~150		Van Utrecht (1978)
Southern North Sea (2001-2003)					>130	~5					Pierce et al. (2005)
Faroe Islands				>9		3					NAMMCO & IMR workshop (2019)

Table A3c. Variation in life history parameters for harbour porpoise across its North Atlantic range, calving and seasonality

Area	Annual Pregnancy rate	Ovulation rate/year	Gestation period (months)	Lactation period	Calving interval (years)	Calving season	Mean birth date	Mating season – Activity of mature males	Mating season – Ovulation/ conception period in females	Mean conception date in females	Newborn weight (kg)	Newborn length (cm)	Sex ratio in foetuses males: females	**Calving and season-ality**
NWIP	0.54 (n = 13)				1.89	May-Aug						85 (84.5-90)		Read (2016)
Scotland, northern North Sea (1992-2005)	0.34-0.4 0.42 (n = 33)		10-11 months	June-Nov			end May - end June	Apr-Jul		end July - early August	6.84	76.4		Learmonth et al. (2014)
UK (1985-1994)						June (May-Aug)					~5kg	65-70		Lockyer (1995; 2003)
UK (1990-2012)	0.50													Murphy et al. (2015)
Ireland (2001-2003)	0.4													Pierce et al. (2005)
Denmark (1938-1998)		0.61	10 months	>8 months	1.5	June (Mar-Aug)		June (May-Aug)/July -Sept		August	4.5-6.7	65-75 cm	1.1:1	Lockyer & Kinze (2003), Lockyer (2003)
Kattegat/ Skagerrak (1988-1991)	0.57	0.91 (0.65-1.18)												Hedlund (2008)
Belt Sea			10-11 months											Karstad et al. (1993)
West Greenland (1988-1989, 1995)		0.73/0.76 -1.38				late summer		Aug	Aug			70?		Lockyer et al. (2003)
Greenland					1 year									NAMMCO (2013)

Iceland (1991-1997)	0.98	0.98		≤7 months	1 year	June (May-July)	Mid June	Summer	June-Aug?	June-Aug?		75-80	1.2:1	Ólafsdóttir et al. (2003)
Gulf of Maine (1989-93)	0.93		10.6 months	8-12 months	~1 year	June-July		late June - early July	late June - early July			108 (SE=1.4)	0.93 (n = 14)	Read & Hohn (1995)
Canada, Bay of Fundy						May		late June						Read (1989)
Canada, eastern Newfoundland	0.83		10.8 months			Early June	Early June	July	Early July	July				Richardson et al. (2003) + unpublished data
Southern North Sea						May-Aug						74.3		Lockyer (2003)/Addink et al. (1995)/Pierce et al. (2005)
Northern North Sea (2001-2003)						June-July				July-Aug				Pierce et al. (2005)
German North Sea (1990-2000)							27 June (6 June - 16 July)							Hasselmeier et al (2004)
Southern North Sea (1955-~1975)			~11 months			peak in June							67-90 (n = 10)	Van Utrecht (1978)

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APPENDIX III

Diet of the harbour porpoise

The harbour porpoise in the North Atlantic feeds mainly on small shoaling fish from pelagic and demersal habitats, and in general it seems porpoises in any one area tend to feed on two-four main species of prey. There seems to have been a shift from clupeid fish species to sandeels and gadoids in some areas, which may be related to a decline in herring stocks during the 1960s (Santos and Pierce, 2003). While herring and sprat are rather high in energy, gadoids are less so, and such shifts in diet may influence the time that individuals have to spend foraging. Based on analyses of $\delta^{13}C$ and $\delta^{15}N$, Das and colleagues (Das et al., 2003) found that harbour porpoise in the southern North Sea has a slightly lower trophic position than harbour seal, grey seal, white beaked dolphin and cod, reflecting a higher proportion of zoo-planctivorous fishes in their diet compared to that of other top predators.

The table below summarizes diet studies of harbour porpoises, mainly from the northeast Atlantic, but with some examples from other areas. Frequency of occurrence of prey species are ranked from 1-5 where 1 is the most important prey species in the respective study. In the northern North Sea (Scotland), the main prey species are whiting, sandeel, clupeids such as herring and sprat, as well as cephalopods. Trisopterus spp. and other gadoids also occur quite frequently, as well as mackerel in some cases. In the UK and southern North Sea, gobids are generally the most frequently occurring prey, together with sandeel and gadoids. Clupeids and cephalopods are also rather frequent.

In contrast, harbour porpoises further north, such as the Norwegian coast, Iceland and Greenland, have a rather large proportion of capelin in their diet, while porpoises in the Black Sea feed on gobids but also on flatfish such as flounder and dab, as well as whiting. Off the northwest Iberian Peninsula, gadiods such as *Trisopterus* spp, silvery pout and blue whiting seem to make up most of the prey together with gobids and sardines.

Table A4. Summary of diet studies for harbour porpoises. Frequency of occurrence of prey species are ranked from 1-5 where 1 is the most important prey species in the respective study

Area (sampling years)	**Sea area**	**n**	**Capelin** *Mallotus villosus*	*Clupeidae*	**Herring** *Clupea harrengus*	**Sprat** *Sprattus sprattus*	**Greater Argentine** *Argentina silus*	**Sardine** *Sardina pilchardus*	*Gadidae*	**Cod** *Gadus morhua*	**Whiting** *Merlangius merlangus*	**Haddock** *Melanogrammus*	**Blue whiting** *Micromesistius*	**Silver hake** *Merlucius bilinearis*	**Silvery pout** *Gadiculus argentus thori*	**Saithe**	**Scad** *Trachurus trachurus*	*Trisopterus spp.*	**Sandeel** *Ammodytidae sp.*	**Gobies** *Gobidae*	**Sand smelt** *Atherina presbyter*	**Sardines** *Sardina pilchardus*	**Hagfish** *Myxine glutinosa*	**Poorcod** *Trisopterus*	**Norway pout** *Trispoterus esmarkii*	**Pearlsides** *Maurolicus spp.*	**Sole** *Solea solea*	**Dab** *Limanda limanda*	**Flounder**	**Mackerel** *Scomber scumbrus*	**Redfish** *Sebastes*	**Atlantic horse mackerel** *Trachurus trachurus*	*Trachurus spp.*	**Snailfishes** *Liparidae*	*Zoarcidae*	*Urophysis spp.*	**Cephalopods**	**Reference**
Eastern Canada (1969-1972)	North Atlantic	81			1					3				4																2								Smith & Gaskin 1974
Bay of Fundy, Canada (1985-1987)	North Atlantic	127			1					3				2																								Recchia & Read 1989
Bay of Fundy, Gulf of Maine, Canada	North Atlantic				1									2												4										3		Gannon et al. 1998
Skjálfandi Bay, Iceland (2011-2012)	North Atlantic	28	1							2																								3				Koponen 2013
Iceland (1991-1997)	North Atlantic	1047	1		5				3										2												4							Víkingsson et al. 2003

	UK	Scotland (1992-2010)	Scotland (1992-2003)	Scotland (1992-1996)	Scotland (1965-1971)	Scotland (1959-1965)	Irish waters (1989-1994)	Ireland (1992-2013)	Norway (1985-1990)
	North Sea	North Sea/ North Atlantic	North Sea/ North Atlantic	North Sea/ North Atlantic	North Sea/ North Atlantic	North Sea/ North Atlantic	Celtic Sea/ Atlantic	Celtic Sea/ Atlantic	North Sea/ North Atlantic
			188	72	41	52	26		109
									3
								4	
				2	2	1	2		1
				4	4	2			
									5
	1	x	4				1		
		x			4	3			
		1	1	1	1	1	1	2	
		x		4					
									2
			5	3			1	1	
	2	2	2	1	3				
	3								
									4
					4				
					5	3			
		x	3	2				3	
	Martin 1996	Read et al. 2014	Santos et al. 2004	Santos 1998	Rae 1973	Rae 1965	Rogan & Berrow 1996	data from Emer Rogan	Aarefjord et al. 1995

France	Southern North Sea (2010-2013)	Belgium (1997-2011)	Netherlands (2003-2014)	Netherlands (1989-1995)	Netherlands (2006-2014)	Netherlands (2005-2012)	German North Sea
North Sea	North Sea	North Sea	North Sea	North Sea	North Sea	North Sea	North Sea
17	52	64	600	62	829	74	34
		4	4		4	2	
	2						
	5	3	3		3	3	
				1			
1							
2							
				5			
	3	2	2	4	2	4	1
	1	1	1	2	1	1	
	4						
							2
				3	5		
Desportes 1985	Mahfouz et al. 2017	Haelters et al. 2012	Schelling et al. 2014	Santos 1998	Leopold 2015	Leopold et al. 2015	Benke et al. 1998

Western Baltic (1980-2011)	The Sound, Baltic Sea	Denmark	Denmark/ Sweden (1985-1990)	Kattegat/ Skagerrak (1989-1996)	Germany	Bay of Biscay, Channel, France (1988-2003)
Western Baltic	Kattegat/ Belt Sea	Skagerrak/ Kattegat/ Belt Sea	Skagerrak/ Kattegat/ Belt Sea	Skagerrak/ Kattegat/	North Sea/ Baltic Sea	Channel/ Bay of Biscay
339	53		138	112		29
4	2		1	1 juv		
5	5		5	juv		
	4			x juv	3	
1	1	1				
2	5	1	2			
						1
						2
5	5		4	juv	1	
3	3		3	4 juv		5
						3
				2		
				3		
					2	
					4	
						4
						x
Andreasen et al. 2017	Sveegaard et al. 2012	Källquist 1974	Aarefjord et al. 1995	Börjesson et al. 2003	Lick 1991 Lick 1993	Spitz et al. 2006

Black Sea	Galicia (1991-1995)	NWIP (1990-2010)	Denmark (1989-1992)	Poland (1986-	Baltic Proper (1960-1961)	Western Baltic (2006-2008)	German Baltic Sea
Black Sea	Bay of Biscay/ Iberian Peninsula	Bay of Biscay/ Iberian Peninsula	North Sea/ Skagerrak/ Kattegat/ Belt Sea	Baltic Sea	Baltic Sea	Western Baltic	Western Baltic
4000	6		58	27	50	75	27
			3	1	2	4	2
				2	1	5	
	2						
		x					
			5		3	1	3
4			1			3	
		2					
	2						
	1	x					
	3	1					
	3				5		
1	3	x	4	3	4	2	1
3							
2							
		3					
			2				
Tsalkin, 1940, quoted from Tomilin 1957	Santos 1998	Read et al. 2014	Santos 1998	Malinga et al. 1997	Lindroth 1962	Ross et al. 2016	Benke et al. 1998

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