1 Executive summary

This Workshop considered bycatch of cetaceans in gillnet and pelagic trawl fisheries throughout Europe's seas. These seas were split into five main regions (Baltic, Kattegat/Belt Seas, North Sea, Atlantic, Mediterranean); the Atlantic was further subdivided when considering porpoises. Limited information was available for the Black Sea and European macrosnesia.

Abundance estimates of the key cetacean species were pooled and estimates of bycatch limits (take limits) were made for each species and region based on 1.7% of the best estimate of abundance.

Effort data for all gillnet fisheries were pooled for each region and existing records of bycatch rate were used to generate crude likely minimum and maximum bycatch rates for each area. In this way the given levels of effort were used to generate likely bycatch totals for the relevant species.

Wherever existing recorded bycatch rates suggest total bycatch levels in the region of the take limits further monitoring is proposed. Where existing bycatch records and estimates of fishing effort suggest bycatch rates are likely well below take limits monitoring should not be required. Where existing effort levels and likely bycatch rates suggest total bycatches are likely in excess of the take limits, mitigation measures are proposed.

This method of triage for these fisheries is crude but necessary as information remains poor in most regions, especially the Mediterranean and Iberian regions.

A review of ongoing mitigation measures in Europe suggests that the measures required under regulation 812/2004 are being poorly implemented in general.

Pingers are the most viable method to minimize bycatch, and recent studies have suggested using pingers at wider spacing which would make deployment cheaper for the fisheries involved.

The market for pingers is currently so limited that commercial research and development has been stifled though there are promising areas for such work.

Other measures include fishery closures, temporary, permanent or area based, changes in gear type, and modifications to gear (technical measures) such as exclusion grids in trawls or stiffened gillnets. Technical measures other than pingers remain to be proven as adequate.

Table 1. Pooled abundance estimates for each of the Management Regions proposed by the workshop together with the associated 1.7% take limits.

Species	Region	Abundance	1.70%
Bottlenose dolphin	Atlantic N (V, VI, VII, VIIIa,b)	21,049	358
Bottlenose dolphin	Atlantic S (VIIIc,d,e, IX)	9,820	167
Bottlenose dolphin	North Sea	1,026	17
Common &/or Striped	Atlantic	343,586	5,841
Common (&/or Striped)	North Sea	5,022	85
Harbour porpoise	Atlantic N (V, VI, VII, VIIIa,b)	153,977	2,617
Harbour porpoise	Atlantic S (VIIIc,d,e, IX)	2,831	48
Harbour porpoise	North Sea + Skagerrak (IIIa N)	205,751	3,498
Harbour porpoise	Kattegat (IIIa S), Belt Seas	14,030	238
Harbour porpoise	Baltic (inlcuding all of Subdivision 24)	4,856[1]	83

ICES Subdivision III was split by the workshop into southern and northern regions (Kattegat and Skagerrak respectively); the pro-rated abundance estimate for porpoises in Subdivision III was arbitrarily split in two for expedience, allocating half to the North Sea-Skagerrak region and half to the Kattegat-Belt seas region (Table 1). Harbour porpoises in the Atlantic were also split into a northern (V to VIIIab) component and a southern (Iberian) component as there is an apparent hiatus in distribution between these two areas.

[1] Note: this figure is derived using the methodology described here for expedience in examining the likely scale of bycatch in each of these regions. It does not imply any revised estimate of abundance of porpoises in the Baltic.

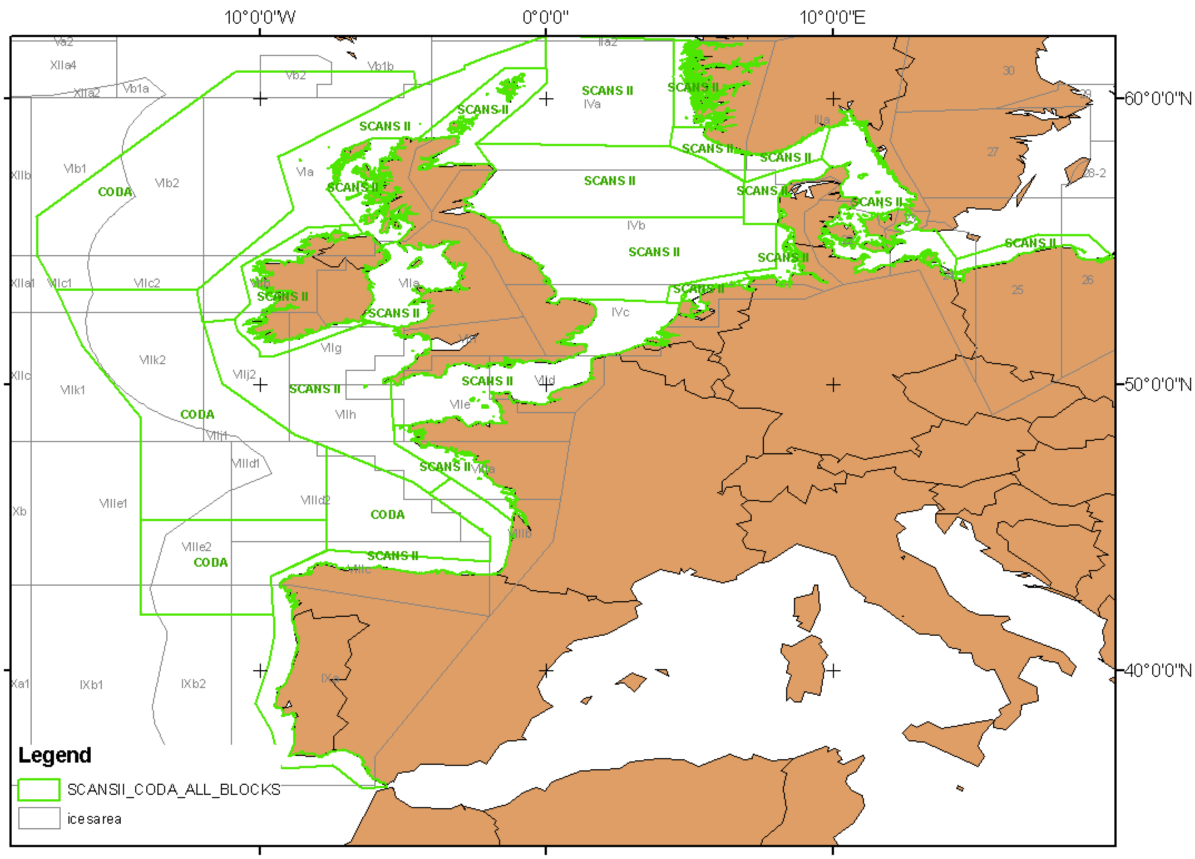

Figure 1. SCANS and CODA survey blocks overlying ICES subdivisions.

No basin wide surveys exist for the Mediterranean and the workshop therefore had to rely on a patchwork of smaller scale studies that provide a very incomplete overview of cetacean abundance in this region. These are summarized below and in Table 2. Due to lack of appropriate data, the workshop could only provide 'ball park' type estimates based on informed opinions.

3.2.2 Mediterranean –striped dolphin *Stenella coeruleoalba*

Striped dolphins occur throughout Mediterranean waters, with a preference for open, offshore waters. The species is the most abundant cetacean in the Mediterranean with a population in the western Mediterranean (excluding the Tyrrhenian Sea) estimated in 1991 at 117 880 (95%CI=68 379–214 800) (Forcada *et al.*, 1994). Surveys in 2010 estimated the abundance in the Tyrrhenian Sea at about 100 000, and in the Ionian Sea (including Gulf of Taranto) at 30 500 (95%CI = 20 215–45 866) (Panigada and Lauriano, pers. comm.). Surveys were also conducted in Adriatic but no results are yet available. There is no abundance estimate for the seas off North Africa, in the Aegean Sea or the extreme eastern Mediterranean. It would not be unreasonable to suggest that the total Mediterranean population may be in the region of 500 000.

3.2.3 Mediterranean –bottlenose dolphin *Tursiops truncatus*

There are approximately 9500 bottlenose dolphins in Spanish waters (including the Balearics) (Cañadas and Hammond, 2006; Gomez de Segura *et al.*, 2006; Forcada *et al.*, 2004). Further east, the total population size is unknown but is likely to be in the 10 000s based on observed densities in areas that have been surveyed. There is considerable structure in the overall population with many subpopulations that ideally require assessment at a fine geographical scale. This structuring also has implications for bycatch assessments.

Table 2a. Mediterranean: possible abundance levels.

AREA	SPECIES	APPROX ABUNDANCE	1.7% LIMIT
Western Mediterranean	Striped dolphin	120 000	2040
	Bottlenose dolphin	10 000	170
Tyrrhenian Sea	Striped dolphin	100 000	1700
Ionian Sea	Striped dolphin	30 000	510
Adriatic	Striped dolphin		
	Bottlenose dolphin		
Total Mediterranean	Striped dolphin	500 000	8500
	Bottlenose dolphin	50 000	850

The scale of static net and pelagic trawl fisheries in each region is considered below, together with the likely levels of bycatch by applying crude indicative bycatch rate estimates, where feasible, to the collated fishing effort data. Potential or indicative annual bycatch levels are then compared with the calculated 1.7% limits.

3.2.4 Black Sea

There have been no coordinated surveys of the Black Sea's cetaceans. The Black Sea's common dolphins form a subspecies: *Delphinus delphis ponticus*. There is good evidence of a great decline in population size in past decades; however, preliminary data for some parts of the basin suggest that it is currently at least several 10 000s, and possibly 100 000 or more (Reeves and Notabartolo di Sciara, 2006).

There is no estimate of present total population size of Black Sea harbour porpoises, *Phocoena phocoena relicta* although the available information suggests that present abundance is several thousand or possibly even the low tens of thousands (Reeves and Notabartolo di Sciara, 2006).

There is no estimate of total population size of Black Sea bottlenose dolphins, *Tursiops truncatus ponticus*, but information from incomplete surveys suggests that the current population size is not less than several thousands of animals (Reeves and Notabartolo di Sciara, 2006).

Table 2b. Black Sea: possible abundance levels.

AREA	SPECIES	APPROXIMATE ABUNDANCE	1.7% LIMIT
Black Sea	Common dolphin	100 000	1700
	Harbour porpoise	30 000	510
	Bottlenose dolphin	3000	50

3.3 Bycatch rates observed in European fisheries

Likely bycatch rates were obtained both from published estimates and from interrogation of national bycatch monitoring databases. Where feasible, these rates were expressed as days at sea per animal caught and/or tonnes of fish landed per animal caught, and were subsequently used to determine the likelihood that a given level of fishing effort or landings within each region could be considered likely to take as many as 1.7% of the best estimates of animal abundance.

Table 3 summarizes available bycatch rates for the sea areas and species of highest abundance/main concern in European waters. These are expressed in a variety of units, corresponding to available information. It is not straight-forward to translate between these units, so no effort has been made to do this. There are also notable differences in reported bycatch rates between fleets operating in approximately the same sea areas.

Table 3. Bycatch rates derived from observer schemes in European waters for the commonest species of cetaceans in European waters.

Sea Area	ICES	Rates
Harbour porpoise – gillnet		
Baltic	24–30	No rate recorded, very low population size
Belt Seas + Kattegat (IIIa south)	21–23	Germany: (note includes some Baltic): No bycatch in 41 km net in 400 hours total soak time.
North Sea + Skagerrak	IV and IIIa north	Denmark: 1 animal per 1.7 tonnes landed (Vinther and Larsen, 2004) Norway: 1 animal per 6.4 tonnes landed (Bjorge *et al.*, 2010) UK: 1 animal per 5.0 tonnes landed (UK annual reports); 1 per 13.5 days; Netherlands: 1 animal per 48 days (February–May IVc only) (Netherlands annual reports)
Northern Atlantic waters	VI, VII, VIIIa	UK: 1 animal per 22 days (hake 1 per 10 days, flatfish 1 per 68 days); Ireland: 1 porpoise per 4.8 days at sea France: 1 animal per 62 days (France annual reports)
	VIIIb-j and IX	Portugal: 0.026 animals per vessel per year.
Black Sea		High bycatch rates in April–June (see text)
Common dolphin – gillnet		
North Atlantic waters	VI, VII, VIII and IX	UK: 1 animal per 5.0 tonnes landed; flatfish nets less risky (UK annual reports) UK: 1 dolphin in 53 days(21 days for hake, 114 for flatfish) France: 1 animal per 247 days (France annual reports) Portugal: 1.35 animals per vessel per year
Azores		Only nets within 500 m of shore and in less than 30 m depth allowed
Canary Island waters		No information available
Madeira		No nets allowed
Common dolphin – pelagic trawl		

SEA AREA	ICES	RATES
North Atlantic waters	VI, VII, VIII and IX	Netherlands: 1 animal per 613 days fished (no bass, much mackerel/horse mackerel) (Netherlands annual reports) UK: 1 animal per 1.2 days fished in bass fishery only (UK annual reports). Non-bass pelagic trawl no bycatch in VI (coverage = 500 days) France: 1 animal per 8.3 days fished (bass/tuna fishery only, no bycatch in mackerel/horse mackerel) (France annual reports and 2010 Ifremer report) Ireland: albacore 47.5 days per dolphin Spain: no information available for VHVO trawls
Azores		No trawls
Canary Island waters		
Madeira		No trawls
Striped dolphin – pelagic trawl and [Italian long surface-set-nets]		
Mediterranean	NW Basin (ES, FR, IT)	France: 1 animal per 245 days fished (France annual reports) [Italy: Few recent observations, large in past, no reason to expect change]
Bottlenose dolphin – gillnet		
Mediterranean	NW Basin (ES, FR, IT)	Italy: 0.29 animal per vessel per year (based on study off Sardinia) (Italian annual reports)
Black Sea		No information
Bottlenose dolphin – pelagic trawl and purse-seine		
Mediterranean	NW Basin (ES, FR, IT) Tyrrhenian Sea and south of Sicily Adriatic	France: 1 animal per 61 days fished (France annual reports) Italy: 0.6 animal per purse-seine vessel per year (Italy annual reports) Italy: 0.001 animal per pelagic trawl vessel per year (Italy annual reports)
Black Sea		No information

In addition to the above, no bycatch of marine mammals was recorded by Denmark, Netherlands or UK in pelagic trawl fisheries in the North Sea (Danish coverage = 4–7% of fleet; Netherlands coverage = 410 days; UK coverage = 174 days).

3.4 Regional considerations

To estimate the fishing effort we have chosen to use sea days throughout this report. Days at sea were calculated for each trip of a vessel by calculating the difference between dates of leaving and re-entering port. The fishing effort is also represented by total landings where possible as an alternate metric. The estimates of static gear usage include use by regular gillnets, tanglenets and trammelnets while pelagic trawls contains both single (otter) and also pair trawls.

3.4.1 Baltic

The Baltic has been split into two parts western Baltic (Area 21, 22, 23) and Baltic (Area 24, 25, 26, 27, 28, 29, 30, 31, 32) (Table 4). The former region is included below with the Kattegat (Section 3.4.2, Table 5).

3.4.1.1 Estimation of fishing effort

For both areas Danish and Swedish effort data are taken from the National EU logbook statistics. More detailed data exist from both countries however data are collected on the most feasible level for comparison with other nations.

The data from the Swedish logbook reported on monthly coastal journals (fishermen using boats with a length below 10 metres or when fishing for cod with a length below 8 metres) is reported in soak-time multiplied by the number of fishing gear units. To get an approximate number of the days at sea the monthly reports were extrapolated with the mean number of fishing days per boat and month calculated from the daily journal.

For German fisheries the data are reported from logbook data (vessels larger than 8 m). Germany however has a very large proportion of vessels below 8 m and therefore a large quantity of effort data are missing. These boats are mostly using gillnets near the coasts and are only obliged to give landing data on a monthly basis. Within the German DCF programme, on-board observers participated in 13 trips of 10 German commercial gillnet vessels in the period from August 2009 to June 2010. These trips covered the whole German Baltic coast. During the trips, a total of 920 nets (ranging from 22.5 to 50 m in length), totalling 41.1 km net length were deployed, with a total soak time of 403 hours. The height of the nets ranged from 1 to 6 metres. No bycatch of harbour porpoises was observed. No bycatch of harbour porpoise has been recorded during commercial catches with towed gear observed in at least the last five years.

Data from Finland are taken from a report on the commercial marine fisheries in Sweden by the Finnish Game and Fisheries Research. The report can be found at: http://www.rktl.fi/www/uploads/pdf/uudet%20julkaisut/tilastoja_4_2010.pdf. However at this point there is uncertainty about the effort data including fishing days. Published data are for fishing days categorized by net type, and one fisherman can have one or more net types. A minimum effort can be assumed based on the net type that is most widely used (36–45 mm mesh = 70 049 days fished) while the total must be less than the sum of all fishing days for all net types (117 007).The data in the northern areas have been generalized. In this area it is possible to get more detailed statistics on effort as well as length distribution data which could be useful in further bycatch analysis.

From Poland data on landings and fishing effort come from the database of the Fisheries Monitoring Centre/ Ministry of Agriculture and Rural Development. Considering landings, sprat and herring are the most important by volume, while cod, which is targeted by smaller vessels, is economically the most important. ICES Areas 25 and 26 are the most important, both for small-scale as well as larger fleet. Less fishing is conducted in Area 24 due to limited quotas available there. The Polish fleet in 2009 consisted of 804 vessels of which 592 were vessels below 12 m. Vessel numbers will be further reduced in 2010 due to a fleet adjustment programme. Taking into account size of the Polish fishing fleet it is obvious that fishing effort is concentrated in the coastal zone. The main fishing gears used by vessels up to 12 m are gillnets, while bigger vessels are using mainly bottom trawls. Pelagic trawls are used by the biggest vessels fishing for pelagic species. ICES Areas 25 and 26 are the most important, both for small-scale as well as larger fleet. Less fishing is conducted in Area 24 due to limited quotas available there.

Lithuanian data originated from logbooks (R. Statkus, pers. comm.).

In general nearly all countries were able to supply the Workshop with effort data, except Estonia and Latvia. Data for German vessels less than 8 m is also lacking. Effort data are however in many cases accessible at higher resolutions than the data scaled here. For example data on haul time or gillnets soak time are available from several countries, however data on sea days and landings were reported in the tables (Table 4 and 5) below to make the data as uniform as possible. Data tabulated below are therefore minimum estimates.

Table 4. Fishing effort for the Baltic (Statistical Divisions 24–32) in a) sea days and b) tonnes of fish landed. Records from most recently available year.

A) SEA DAYS	TOTAL	SWEDEN	DENMARK	GERMANY	POLAND	LITHUANIA	FINLAND
Gillnet effort	>146 787	23 527	5285	11 990	34 337	1599	>70 049
Trawl pelagic	16 100	1337	948	1283	6886	712	4934
Trawl bottom	21 411	4865	5436	4479	6631		

B) LANDINGS (TONNES)	TOTAL	SWEDEN	DENMARK	GERMANY	POLAND	LITHUANIA	FINLAND
Gillnet	24 155	4170	1817	6599	9321	371	1877
Trawl pelagic	423 574	115 140	61 701	21 639	103 797	13 291	108 006
Trawl bottom	841 828	26 075	20 358	18 497	14 153		

Gillnet effort is high in the Baltic compared for example with the North Sea. It is particularly high in Finland where the data suggest the highest effort levels are to be found, although catches are lower than in some other areas. How these data may be related to porpoise bycatch is currently unclear.

3.4.1.2 Why bycatch rates may not become available and may not be necessary for the Baltic (SD 24–32)

Although extensive data on actual bycatch have been collected, especially in Sweden, Poland and Germany, it has not yet been possible to calculate bycatch rates for the Baltic (ICES Statistical Divisions 24–32). In the years 2000–2005, for example, fishermen delivered five porpoises bycaught in Area 24 to the German Oceanographic Museum. Between 1990 and 1999, Polish fishermen delivered on average five bycaught porpoises per year (Skora and Kuklik, 2003 in NAMMCO Special Publ.5). The Swedish Museum for Natural History recorded 14 bycaught porpoises between 1990 and 1999. All these data, however, constitute absolute minima as participation in these schemes is/was absolutely voluntarily. Therefore, no rates can be extrapolated from them, and the extreme rarity of the Baltic harbour porpoise population may make it virtually impossible to obtain such information in the near future.

For the Baltic, on the other hand, bycatch rates (per population or per gear type) may not be required immediately as both the Jastarnia Plan (ASCOBANS 2002 and 2009) and the recent IUCN evaluation of this population as "critically endangered" (Hammond *et al.*, 2008) provide evidence that any bycatch needs to be avoided completely if further population decline is to be avoided. Based on old survey results of 1995, Berggren *et al.* (2002 in Biol. Cons 103) modelled the population development under certain scenarios of anthropogenic removal and found that an annual basin-wide removal of three or more individuals will prevent recovery. Since then a further population reduction has been documented by a 2002 survey that used similar techniques to those used in 1995 (Berggren *et al.*, 2004 in IWC document SC/56/SM7).

3.4.1.3 Conclusions–Baltic

There are no abundance data or any bycatch estimates for the statistical Divisions 25 to 30 in the Baltic. However from information available we can conclude that abundance increases towards the west of statistical Division 24.

Considering the fact that static nets are the type of gear with the highest probability of catching harbour porpoises (compared to trawls for example), there is a need to monitor the gillnet fisheries to obtain bycatch estimates. Regulation 812/2004 only covers boats over 15 metres for monitoring which is a very small part of the fishing fleet for all Baltic countries. However for statistical reasons any reliable bycatch estimate would require very high % coverage of all gillnet fisheries. In the northern parts even a very high % observer coverage might not provide conclusive result due to the low abundance of harbour porpoises there.

There appears to be little evidence that trawl (including pelagic trawl) fisheries provides a threat to harbour porpoises in the Baltic or elsewhere suggesting that any observational effort should be placed on gillnet fisheries.

As far as mitigation methods concerned, there is no evidence that gillnets set from vessels less than 12 metres long do not also pose a threat to porpoises, yet these are exempt from using pingers under regulation 812/2004. According to the length distribution of the vessels in all Baltic countries there is only a small proportion of the fleet which is above 12 metres and most of these boats are trawlers. Therefore a very small proportion of all set gillnets in the Baltic are equipped with pingers according to the regulation. This is a general problem throughout European waters.

Mitigation measures according to Regulation 812/2004 are not yet extended either to the relatively higher density areas of the harbour porpoise such as Area 21 to 23. Nor do they extend to areas such as Area 25 to 28 where there is high fishing effort and low abundance estimates, and where a decrease of bycatch is crucial. Today pingers are the only proven mitigation measure and therefore they are the measure which needs to be applied to reduce incidental catches of cetaceans in the areas currently outside the scope of Regulation 812.

However in the Baltic there are seal-fisheries interactions and reports have suggested that pingers might increase this interaction including both depredation of fish as well as bycatch of seals. Alternative fishing gears could usefully be considered in the longer term as mitigation in the southwest Baltic (ICES 24 east).

The current formulation of Regulation 812/2004 refers exclusively to bottom-set gillnets. There are, however, also surface and midwater-set gillnets with big mesh sizes (80 mm or greater) commonly used, and there is evidence that they also pose a threat of bycatch for harbour porpoises. It is not clear whether surface-set and midwater-set gillnets are currently covered by 812/2004.

3.5 Kattegat and Belt Seas (western Baltic)

The fishing catch and effort data from Denmark, Sweden and Germany were extracted by use of the same methods as mentioned above for the Baltic, and are presented in table 5.

Table 5. Fishing effort for the Kattegat and the Western Baltic and Belt Seas (Statistical Divisions 21–23) in a) sea days and b) tonnes of fish landed. Records from most recently available year.

A) Sea days	Total	Sweden	Denmark	Germany (Vessels > 8 m)
Gillnets	32 305	12 635	10 358	9312
Pelagic trawls	597	58	453	86
Bottom trawls	20 677	3466	13 132	4079

B) Landings (tonnes)	Total	Sweden	Denmark	Germany (Vessels > 8 m)
Gillnets	4825	1470	2565	790
Pelagic trawls	13 376	2938	9404	1034
Bottom trawls	18 547	1875	11 998	4673

3.6 Published information on porpoise bycatch in the Kattegat—Belt Sea region

3.6.1 Sweden

There are four different sources of bycatch rates from the Swedish West Coast:

a) Berggren (1994) reported 150 porpoises bycaught per year in Swedish waters (average for 1988–1991) out of which 70% (105 animals p.a.) were caught in the Kattegat region. Of these porpoises, 72% were bycaught in bottom-set gillnets.

b) Carlström *et al*. (2002) observed that 90% of all bycatch reported from Swedish waters occurred in the Kattegat, where 80% took place in bottom-set gillnets. According to an observer programme, in 1995 and 1996 “one bycatch event [was observed] per 28 hauls”.

c) Berggren *et al*. (2002) quote Berggren (1994) and Clausen and Andersen (1988) for the Kattegat with 63 porpoises bycaught p.a. in the Swedish Kattegat and 31 porpoises bycaught p.a. in the Danish Kattegat, respectively, resulting in a (historical) minimum of 94 porpoises in the entire Kattegat per year.

d) Lunneryd *et al*. (2004) reported on the results of a telephone survey among Swedish Kattegat fishers in 2001. They extrapolated the reported bycatch to a total of 114 porpoises bycaught in a year.

3.6.2 Germany

In 2009, several documents were presented to ASCOBANS estimating the porpoise bycatch in the German part of the Baltic covering parts of the Belt Seas (ICES statistical Division 22) and of the Baltic (ICES statistical Division 24) that are included in the Kattegat-Belt Seas Region used in this report.

Herr *et al.* (2009) (Document AC16/Doc.62 (P)) used stranded carcasses and investigated them for net marks as indication for bycatch. “When considering only animals in good to moderate states of conservation (12% of the total number) 47% were classified as (suspected) bycatch. In case that 47% of porpoises (147 animals found in total) found in 2007 have been bycaught, estimates would result in a total of 69 bycatches in that year.” This estimate, however, neither differentiates between the two porpoise stocks involved nor between the two different ICES areas.

Scheidat *et al.* (2008) (Document AC16/Doc.33 (P) in Endang. Spec. Res. 2008) used ten aerial surveys between March 2003 and May 2006 to estimate the abundance of porpoises in the German part of Baltic and immediately adjacent Danish waters. Their estimates range from 457 to 4610 animals, but eight estimates were between 1400 and 2900 porpoises. The authors compared each of their survey results with an older estimate by Rubsch and Kock (2004) Document AC11/Doc. 10(P) of 57 porpoises bycaught in the G*erman* part of ICES statistical Divisions 22 and 24. These data indicate that the lowest annual bycatch rate is 1.78%. For the eight abundance estimates between 1400 and 2900 porpoises, the bycatch mortality rates are estimated to lie between 2.8% and 6.1% of the population per year.

3.6.3 Estimations of bycatch rates for the Kattegat including inner Danish waters (Area 21, 22, 23)

Table 1 suggests that a total annual bycatch of porpoises should be less than 238 in this region. Drawing on the summary information above, and using a large number of assumptions the information given above can be used to try to estimate current likely levels of bycatch in this region.

For the German Baltic Sea and according to Herr *et al*. (2009), in 2007 the minimum bycatch amounted to 69 animals. This number can be compared with the known German set-netting (gillnet and trammelnet) effort in ICES Area 22: 9205 days at sea, 67 244 hours soaking time, or 790 t landings. Assuming that this fishery likely caused the bycatch then the maximum number of days per porpoise bycatch in this area is around 133, or 0.001 bycatches per hour of soak time or 0.0075 bycatch events per day at sea, or 0.0010 bycatch events per hour of soaking time, or one porpoise for at most every 11 tonnes of fish landed. Assuming the same rates could be applied to the remainder of the fleet fishing in the wider area, then one might expect a minimum of about 242 animals to be caught using the days at sea metric (32 304/133) or 423 using the landings metric (4824/11.4), both of which minima exceed the 1.7% of abundance (238 in Table 1).

The available evidence therefore suggests that fishing effort is high enough to cause concern for the population level conservation or recovery of harbour porpoises in this area. At the least more detailed observational studies are required to obtain better estimates of bycatch rates. Given that this area is adjacent to the depleted stock of Baltic porpoises, bycatch mitigation would be justified on the grounds both of intrinsic bycatch rate in the area and to ensure that any recovery of the Baltic population deriving from animals using this area is not jeopardized. It can also be argued that pingers should be used in gillnets by all vessels, regardless of their length, in this area too.

3.7 The North Sea and Skagerrak

Fishing data were collated for all nations fishing in the North Sea. The main Norwegian fisheries with high bycatches of harbour porpoise are gillnet fisheries for cod (stretched half mesh of approximately 10 cm) and gillnet set for anglerfish (stretched half mesh of 18 cm). These fisheries are conducted mainly by vessels less than 15 m total length. There are poor statistics for the fishing effort of this segment of the fishing fleet. However, the landing statistics (provided by the Directorate of Fisheries) for the target species are good and are therefore used to estimate bycatches of marine mammals. Eighteen Norwegian vessels less than 15 m operating gillnets for cod and anglerfish are contracted to provide information on catch of target species fish and bycatch of marine mammals. The ratio of bycaught marine mammals, e.g. harbour porpoise, per metric tonne of target species and the total landing statistics for the same fish species, gear type and vessel category will be used to extrapolate to the total bycatch. This extrapolation is not completed but data are available for three years (2006–2008). The workshop used the latest year (2008) of landings data to estimate likely maximum fishing effort for the Norwegian gillnet fleet based on the lowest reported landings per day at sea among neighbouring fleets (0.2T per day). The Norwegian days at sea are therefore likely an overestimate.

For German fisheries in the North Sea, including IIIa North (Skagerrak), logbook data from 2009 were aggregated for two fleet segments (gillnet, incl. trammelnets and pelagic trawling) to give effort and landing data. Effort was calculated as days at sea. Days at sea were calculated for each trip of a vessel by calculating the difference between dates of leaving and re-entering the harbour. According to EU regulations, only vessels greater than ten metres are obliged to fill out logbooks in Germany. The same is true for the UK, though port officials also record the number of days at sea by smaller boats, some of whom fill in logbooks on a voluntary basis. Belgian effort data are complicated by the fact that, although only three vessels are involved, fishing days not days at sea are recorded, and total landings are not easily separated between VIId and IVc. Some extrapolation has therefore been required.

Table 6 summarizes reported gillnet effort and landings by vessels from European Member states and Norway fishing in the North Sea and Skagerrak. Fishing effort has declined considerably since the early and mid 1990s, and although effort data (days at sea) were not available for all nations, it seems unlikely, based on landings, that there weremore than 35 000 days at sea by registered fishing vessels using static nets during the most recent year for which there are data.

Table 6. Summary of gillnet effort in the North Sea.

Member State	Subdivision	Days at Sea	Landings Live wt
UK	IVA	694	1126
	IVB	1000	317
	IVC	4304	742
Belgium	IVC	420	143
Netherlands	IIIA	2	
	IVB	14	
	IVC	3562	
Denmark	IIIA(N)	5428	2880
	IVA	39	69
	IVB	5322	4308
	IVC	399	206
Sweden	IIIA(N)	950	223
Norway	IVA(N)	2267	453
	IVA(S)	3837	767
	IIIA(N)	2907	581
Germany		1014	704
France		2200	
Totals		34 359	>12 519

Taking the bycatch reference level of 3500 porpoises per year from Table 1, it is clear that for bycatch to reach such levels, average bycatch rates must exceed one animal every ten days at sea. While this is feasible, it seems unlikely: average bycatch rates in the UK fisheries that have been observed run at around 13.5 days at sea per animal, but this figure is skewed because a lot of observer effort was deliberately focused on large meshed fisheries with a very high bycatch rate. More typical values from UK fisheries are around 20–25 days per porpoise. In the Netherlands one animal was taken per 48 days of observation. Rates of around 20 days per porpoise would yield a bycatch of about 1700 porpoises.

On the other hand, when landed weight of fish is considered, higher rates have been reported in Danish fisheries, where the average tonnage of fish landed per porpoise was as low as 1.7, compared with 5 tonnes in the UK and 6.4 in Norway. Despite not having data for all member states, over 12 500 tonnes of fish landed from static net fisheries could suggest, using these figures, annual bycatch totals of between 1950 and 7300 porpoises.

Furthermore, strandings of relatively large numbers of porpoises along the Dutch and Belgian coasts in recent years, of which 7 to 70 % were diagnosed as having died as a result of fishery entanglement (Haelters and Camphuysen, 2009; Leopold and Camphuysen, 2006; Wiersma, 2009; Osinga *et al*., 2008), seem to indicate that these suspected bycatches originate from small coastal fisheries in IVc that are not covered by the 812 regulation. Also, it has been suggested that a largely undocumented coastal recreational gillnet fishery contributes to the total bycatch. The workshop was unable to determine how important recreational fisheries (which extend all the way along the continental European shoreline) might be in contributing to bycatch within the North Sea as a whole, due to the lack of documentation on their scale. Within the pilot pinger project in the Netherlands all participating fishermen have a permit from the government to land bycaught harbour porpoises. If bycatch occurs the animals are brought to the Department of Pathobiology at the University of Utrecht for further examination.

While current registered fishing effort levels do not suggest unsustainable take levels, there is enough uncertainty about overall average bycatch rates to warrant further monitoring of fisheries in the North Sea, which have received very little bycatch monitoring since the 1990s.

Table 7. Summary of pelagic trawling in the North Sea.

Member State	Days at sea	Landed weight (tonnes)
UK	551	78 182
The Netherlands	246	
Sweden	155	15 563
Germany	250	13 984
Denmark	1982	155 365
Totals	3183	263 094

Pelagic trawling in the North Sea accounts for relatively few days at sea compared with those in the Atlantic or compared with gillnet fishing. While some bycatches of cetaceans in pelagic trawls in the North Sea have been reported in the past (Couperus, 1997), there are none from recent years. Porpoise bycatches in pelagic trawls are only very rarely recorded, and delphinids seem more vulnerable. In recent years 174 days at sea on UK pelagic trawlers and 410 days on Dutch pelagic trawlers have been monitored in the North Sea with no cetacean bycatch reported. No bycatches have been reported in other monitoring schemes either. This suggests that monitoring these fisheries could easily be scaled back as bycatch rates appear to be too low to be of concern.

3.8 Atlantic

The two primary bycatch species in the Atlantic region are harbour porpoises and common dolphins. In this context we treat common and striped dolphins together because the CODA and SCANS surveys could often not distinguish between the two species during the survey, so that joint abundance estimates were calculated. Among identified striped/common dolphins, the abundance estimates presented in the CODA report suggests about 36% were striped dolphins and 64% were common dolphins. A single northeastern Atlantic stock of common dolphins is thought to inhabit the region from Portugal to Scotland. Harbour porpoises may be split into two stocks or populations, one around the Iberian Peninsula and another extending from western Scotland through the Irish and Celtic Seas and Atlantic shelf to Biscay.

A wider range of fish species is targeted here with static nets than is the case in the Baltic or North Seas, and many more boats, the majority of which are <12 m, are involved over a very large area. Pelagic trawl fisheries are also extensive, yet despite a great deal of monitoring bycatch is recorded relatively infrequently in most of these. Two exceptional fisheries are the pelagic pair trawl fisheries for bass and for albacore tuna, both of which have been reported to have high bycatch rates in some years. The high bycatch rates in the tuna fishery appear to be sporadic. Underlying rates appear more consistent in the bass fishery, but recent mitigation measures have led to a substantial reduction in the bycatch rate in the UK bass fishery at least. It makes little sense to consider these two high bycatch rate fisheries with the other pelagic trawl fisheries, and they are not therefore considered in Table 8. Much lower bycatch rates, though still highly variable year to year, have been reported in a few of the remaining pelagic trawl fisheries.

3.8.1 Quantifying fishing effort in the Atlantic region

A database compiled by STECF SGMOS 10-04 for all EU countries was unfortunately not available for this Workshop. Differences may therefore exist in fishing effort between that database and the information presented here. Some countries provided logbook data for this workshop, but these are available only for vessels greater than 10 m in length. Other countries used complete fishing effort by using activity information of all vessels in their fleet.

Data from the UK were extracted from official logbook records and include fishing effort and landings by 1197 vessels using static nets, and 66 pelagic trawlers. Catches by pelagic trawlers are dominated by herring and mackerel, but also include quantities of sprats, sardines, horse mackerel, blue whiting and anchovies. Gillnet vessels land a wide variety of species, but anglerfish, hake, gadoids, and flatfish are all important. An important distinction needs to be made between most of the pelagic trawl fisheries and the bass pair trawl fishery. Among 405 days sampled on UK single and pairtrawlers fishing in the Atlantic region, no cetacean bycatch has been observed. Among 496 observed days at sea by bass pairtrawlers a total of 515 common dolphins was recorded bycaught, and although that implied bycatch rate has been very substantially reduced in recent years, it is clear that the bass fishery cannot be considered in the same category as the other pelagic trawl fisheries.

Fishing effort by vessels from Denmark, Germany and Belgium is relatively restricted in the Atlantic, though German and Danish pelagic trawl vessels and Belgian and German gillnetters do operate in Division VII. A substantial Dutch pelagic trawl fleet also operates mainly to the west of Ireland fishing for mackerel and horse mackerel, and sporadic bycatches mainly of white sided dolphins and common dolphins have been reported during the last two decades with regular observer coverage.

The French observations at sea and bycatch records were summarized for three years 2007–2009. The number of days of observation and the bycatch were summed over the three years for common dolphin, striped dolphin, bottlenose dolphin, long-finned pilot whale and harbour porpoise. The bycatch rate of common dolphins in pelagic pair trawling is likely to be an underestimate as some experimental hauls with the deterrent Cetasaver (that would probably have had higher catches without such a deterrent) were included in the estimate.

The bycatch in Area VIIe/d is obtained from Paimpol project (VIIe) for 2007–2008 and from Filmancet project for 2009 with observations at either end of the English Channel (VIIe and VIId). Some observations on French vessels working with set-nets in Area VIIf,g suggest a much higher bycatch rate in that area than in the other investigated areas (VIIe, VIId, VIII).

A higher bycatch of common dolphins in the tuna pair trawl fishery was observed in two trips in August 2009 with two different pair teams. The sporadic nature of high bycatches requires that average bycatch levels need to be calculated covering several years for pelagic pair trawling, as has been done in this report.

The fishing effort of the fleets is indicated by the number of vessels and number of days at sea. The number of days at sea is an approximation in some cases. The number of boats is distributed by vessel size classes for set-nets as there is a large distribution of lengths and a great number of French vessels.

The Irish pelagic trawl fleet is one of the largest in the Atlantic region, while gillnetting is more limited in comparison. Pelagic trawling is prohibited among the Spanish and Portuguese fleets; but species caught by pelagic trawls elsewhere are fished using Very High Vertical Opening (VHVO) nets by the Spanish fleets.

The static net fleets of Spain and Portugal dwarf those of other nations in the region. Very limited information is available on any bycatch rates among Spanish or Portuguese fleets. Spanish data on the numbers of vessels and effort could not be found, and the only indication of the scale of Spanish gillnet fleet activity that Workshop members could find was a paper by Lopez *et al.* (2003) that indicated 1068 inshore gillnet vessels, 535 offshore gillnet vessels and ten distant water gillnet vessels working from Galicia alone at that time. These 1600 or so vessels were estimated to make about 370 000 trips per year; assumed to be mainly day trips here. This figure ignores gillnet effort from other parts of northern Spain. In Portugal, the gillnet fleet is polyvalent; most boats have licences for multiple gears (mostly gill/trammelnets, demersal longlines and traps and pots). In 2009, 1960 polyvalent boats operating in IXa (excluding small boats operating in rivers and estuaries) were issued 4532 gill/trammelnet licences (average of 2.3 licences per boat). Many of these boats have more than one licence for different mesh or gear type, thus fishing effort (days at sea) for this fishery is difficult to determine. However, these 1960 polyvalent boats were estimated to have made about 392 000 trips in 2009.

Table 8. Fishing effort in days at sea and landed tonnage (wet weight) for static net fisheries in the Atlantic split to northern (ICES Divisions V, VI, VII, VIIIab) and southern (ICES Division VIIIc,d,e, IX) regions.

Division	Gillnet fleets	Days at sea	Landings (wet weight, tonnes)
Northern Region (V,VI,VII,VIIIab)	United Kingdom	33 546	8957
	Belgium	60	
	Germany	441	
	Ireland	3195	1964
	France	57 000	
	Northern Region total	94 242	
Southern Region (VIIIc,d,e, IX)	Spain (Galicia only)	370 000	
	Portugal (approximately)	392 000	
	Southern Region total	>762 000	
	Atlantic Total	856 242	

The approximate scale of total porpoise bycatches in Atlantic waters can only be suggested from the number of days at sea. There is thought to be a separation of porpoise populations somewhere in the Bay of Biscay, with a separate population centred on the Iberian Peninsula and another one or more on the Celtic Shelf and further north. When considering porpoises therefore the northern and southern halves of this region are treated separately.

Observed bycatch rates in Irish, French and UK fisheries have been reported in terms of the number of days at sea per porpoise from as frequently as every five days of fishing (Ireland) to between ten days and 68 days (mean 22 days) among UK fisheries and 62 days in French fisheries. Clearly some differences will be expected across the region and between fisheries with differences in fishing methods and porpoise density. But the overall range of bycatch rates may be used to suggest that, given 94 000 days at sea in this region per year, total porpoise bycatches could run from just over 1400 to over 18 000 porpoises in the extreme. Though the latter figure seems unlikely, because it implies a mean rate of one animal every five days at sea throughout the region, the mean observed UK value across all fisheries observed there, of one animal per 22 days at sea, would still suggest over 4200 animals could be taken, compared with a bycatch reference limit of about 2600. Although there is no clear evidence that porpoise bycatch rates exceed a sustainable level in the northern part of the Atlantic region, there is clear evidence that the scale of the fishery here means that this is quite feasible, and that further monitoring, co-ordinated among member states and stratified by region and by static net gear type should be undertaken.

The situation is more alarming in the Spanish and Portuguese fisheries, where there is evidence of porpoise populations having declined substantially (Casinos and Vericad, 1976) and where the size of the static net fleets exceeds those in the northern region by an order of magnitude. A likely current fleet effort of over 760 000 days at sea and an estimated porpoise population of only about 2831 animals with an implied bycatch reference

Table 15. Number of gillnets set on the three sections of the Romanian coast (from Radu *et al.*, 2008).

	Sector	Shad	Turbot	Spiny dogfish	Grey mullet	Gobies	Total
1	Southern	145	1387	50	10	170	1762
2	Central	215	870	90	40	20	1235
3	Northern	2468	3029	260	300	-	5823
Total		2828	5286	400	350	190	9054

Bycatches also occur in non-EU countries around the Black Sea, also affecting the same populations of cetaceans as off Bulgaria and Romania (Birkun, 2008). A bycatch rate of 120 small cetaceans (118 harbour porpoise, two bottlenose dolphin) were recorded in 78 km of fishing net examined off the Crimea. These equated to an average rate of 1.76 small cetaceans per kilometre for bottom-set turbot nets and 1.16 for bottom-set dogfish nets. Maximum bycatch rates were recorded in June.

3.11 European Macronesia

European Atlantic Islands (Madeira, Azores and the Canaries) generally have limited shelf area for fisheries and most fishing and much of the cetacean fauna are therefore of an oceanic variety. Nevertheless there is some limited information on gillnet activity and some further information relating to bycatch of cetaceans in these areas.

3.11.1 Legal framework

Trammelnets, driftnets and gillnets directed at demersal and deep-sea species are forbidden in the Azores by a Regional Regulatory Decree (Portaria nº 91/2005, 22 December 2005).

The same decree allows bottom-set gillnets but limits its use to an area within 500 m from the coastline and to depths less than 30 m. Maximum length of bottom-set gillnets allowed per boat is 500 m, maximum height of the panel is ten m, minimum distance between consecutive gillnets is 200 m, minimum mesh size is 100 mm and maximum soak time is twelve hours.

According to information provided from the Fisheries Inspection Service of the Azorean Regional Government, 143 boats were licensed to use bottom-set gillnets in 2008, 135 in 2009 and 123 in 2010.

3.11.2 Fishing effort

Estimating the effort and landings of this fishery is challenging because it is a multispecies fishery prosecuted by small open-deck vessels that frequently use two or three different types of gear during a daily fishing trip, which makes it difficult to accurately estimate the catch made by each gear used. In addition, these boats do not keep logbooks and are not suitable for observers.

In 2008 landings made by bottom-set gillnets increased substantially meeting the monitoring criteria under the Portuguese National Programme for the Collection of Data (NPCD) in the fisheries sector. Thus, in 2009, landings of small open-deck boats began to be classified by métier based on the catch composition and on the weight of each species in relation to the total catch. Given the characteristics of the boats and average soak time of the nets (10–12 hours), it is assumed that the number of fishing days corresponds to the number of landings. Table 16 provides a summary of fishing effort of the Portuguese-Azores gillnet fishery in Subarea Xa2, according to information retrieved from landing data. In 2010, the NPCD monitoring programme of bottom-set gillnets was expanded to include interview surveys to fishermen in all the islands of the archipelago.

3.11.3 Cetacean bycatch rates

There are no reports of bycatch of cetaceans in gillnets in the area, although there is no dedicated observer or monitoring programme.

Table 16. Fishing effort by gillnets in Subarea Xa2 in 2009. Number of vessels licensed to use gillnets, number of vessels with registered landings, number of days at sea (equivalent to the number of landings) and total catch landed. All vessels are <12 m.

Country	Fleet	Area	Gear type	N° vessels licensed	N° vessels landed	Days at sea	Landings (tonnes)
Portugal	Azores	Xa2	Gillnets-bottom-set	135	70	3245	375.7

4 Evaluation of mitigation measures

Term of reference: *Provide an evaluation of mitigation measures currently in place and an assessment on the most recent developments of mitigation measures used to reduce the incidental catches of cetaceans, including information on cost.*

The Workshop noted that SGBYC has provided an overview of the mitigation measures in place in the European Union annually, on the basis of National Reports under Regulation 812. The workshop members provided a brief overview of current initiatives which are summarized below.

4.1 Mitigation measures currently in place

National reports on the implementation of Regulation 812/2004, and the reports of the ICES SGBYC, make it clear, that the mitigation requirements under 812/2004 have been poorly implemented. In addition there are no official records of the numbers of boats that are carrying pingers at present. Nevertheless, there are reports of a number of countries of some vessels have been using pingers, as well as initiatives in others to improve uptake.

In Denmark three types pingers were made available to the industry between 2005 and 2007. In 2007 about 30 vessels may have been required to use pingers under Regulation 812/2004 while in 2008 ten vessels were reported to be using pingers. The Danish fishery inspectorate undertakes some monitoring of pinger use, but there is no systematic monitoring or regulation system for controlling pinger use.

In Poland some 500 pingers have been bought and distributed but there is no plan to check on how they are being used. The number of pingers bought would only be sufficient for about half of the over twelve meter vessels required to use them under Regulation 812/2004, which in turn is only about 1/3 of the Polish fleet using gillnets in ICES statistical Division 24.

In the UK there are thought to be around ten vessels fishing in the North Sea that might be required to use pingers; but there is no easy way to determine this because net lengths and mesh sizes of gillnets are not recorded reliably in the fleet activity data. In ICES Division VII there are about 19 UK registered gillnet vessels over 12 m in length; trials of existing pingers in 2003–2005 showed that none of the devices then on the market were suitable for these vessels. An ongoing extension trial of louder devices (DDD-02 and DDD-03) under derogation has led to the adoption of these devices by an increasing number of UK gillnet vessels. There are nine vessels currently testing the devices, while a further six have expressed some interest in becoming involved in the trials.

At least four vessels in Ireland are thought to be using pingers of a variety of designs in the Celtic Sea and the Irish government have provided grant aid for provision of pingers to fishermen although uptake has been minimal.

In Belgium a project 'WAKO II' (2009–2011; www.ilvo.vlaanderen.be/wako) aims at an integrated assessment of direct ecosystem effects of trammelnet and beam trawl fisheries for the Belgian part of the North Sea. This includes a quantification of the major direct effects on benthos, fish, seabird species and marine mammals and the relation with actual fishing effort. The study includes the participation of independent observers on board static gear fishing vessels during a number of fishing trips, and a voluntary logbook-keeping by three fishermen. In this logbook detailed gear type, gear length, depth of deployment, soak time, location and bycatch of marine mammals are reported. The bycatch of one porpoise has so far been reported by one of the fishermen in a small mesh trammelnet for sole (logbook data from May 2009 to October 2009).

Control and enforcement agencies in a number of countries have indicated that current regulations are practically unenforceable given the difficulties in testing whether devices are operational or whether fishermen have deployed them on gear. On this basis the German and Danish authorities commissioned a study to develop a pinger monitoring device which would permit inspection of set-nets to determine if pingers were functioning properly. Monitoring without fishermen necessarily being onsite or retrieving their nets was an additional requirement.

A final version, the PG1102 (ETEC), was manufactured in October 2008 and was designed to provide a detection distance of 400 m. This permitted detection of two digital pingers simultaneously when deployed at 200 m distance apart. Various operational range tests have been carried out by German and Danish researchers. Maximum detection distance was 900 m for analogue pinger types (Fumunda, Airmar, and AquaMark 300) and 400 m for the digital AquaMark 100. The detection range was limited to 50 m when tests were carried out from a mother ship with the auxiliary engine running. The final version has been available from December 2008 and is now used routinely by the German and Danish authorities (ICES, 2009d).

The Workshop concluded that implementation of the mitigation measures as prescribed in Regulation 812/2004 has been limited although it is likely that the use of pingers by these vessels has reduced the total number of incidental deaths of harbour porpoises over the past few years. A combination of factors associated with cost, reliability, etc. has resulted in sporadic uptake by fishermen despite legal requirements. There is quite a negative perception about these devices among fishermen around Europe, which remains a problem.

4.2 Effectiveness for different species

The effectiveness of ADDs deployed on bottom-set gillnets is well established for harbour porpoises using basic tonal 10 kHz pingers (Cox *et al*., 2001; Culik *et al*., 2001, Koschinski and Culik, 1997; Kraus *et al*., 1997; Trippel *et al*., 1999; Palka *et al*., 2008) and more recently using more complex multi signal ADDs such as DDDs (ICES, 2010).

With respect to common dolphins, there is little evidence that commercial pingers are effective in gillnets. Previous studies carried out on the effect of ADDs on bycatch of marine mammals in the California driftnet fishery using Dukane Netmark 100 pingers initially showed significant reductions in bycatch of short beaked common dolphins (Barlow and Cameron, 1999) but this reduction seems to have been temporary with little difference observed in bycatch rates before and after the wide scale introduction of pingers over a longer period of time (Anon., 2003a).

Under an EU funded project called NECESSITY, Ifremer in France carried out major research and development of an ADD called a CETASAVER for common dolphins in pelagic trawls. They have also tested various models of commercially available ADDs such as the DDD02F in direct playback experiments and although some positive results were obtained no acoustic signal has been identified which has elicited a strong behavioural response in common dolphins in all geographic areas at all times of year (Anon., 2007). Nevertheless the use of DDDs in the UK pelagic trawl fishery for bass has been a substantial reduction in bycatch rate.

In the case of bottlenose dolphins, the majority of studies have been carried out in relation to reduction of depredation and damage to fishing nets as opposed to bycatch mitigation or deterrent effect of ADDs, (Gazo *et al*., 2008, Buscaino *et al*., 2009). The University of Barcelona conducted experiments between September and October 2001 and 2002, to test the use of pingers (Aquamark 100) in deterring bottlenose dolphins from predating fish in trammelnets. This study indicated that pingers have no significant effect on the catch of targeted species and can therefore be considered as a passive element in the fishing gear. The effect of the pingers on the frequency of depredation on nets was not clear. One study has been carried by BIM in collaboration with other Irish partners on the effect of a prototype ADD, the AquaTech 363 interactive on bottlenose dolphins in the Shannon Estuary with positive results (Leeney *et al*., 2007). Limited information exists on the effects of commercially available ADDs on the behaviour of this species.

No research has been carried out on the effect of ADDs on other species such as minke whales, Atlantic white sided dolphins or pilot whales in European waters. Some limited research has been carried out on striped dolphins, which have also been reported quite commonly as bycatch. A striped dolphin and a harbour porpoise were subjected simultaneously to acoustic sounds similar to common ADD devices. The effect of the alarm was judged by comparing the animals' respiration rate and position relative to the alarm during test periods with those during baseline periods. As in a previous study on two porpoises with the same alarm, the porpoise in the present study reacted strongly to the alarm by swimming away from it and increasing his respiration rate. The striped dolphin, however, showed no reaction to the active alarm (Kastelein *et al*., 2006).

4.3 Pinger spacing

On the issue of pinger spacing it was noted that the originally proposed spacings had been suggested in order to minimize the possibility of bycatch through pinger failure. A number of studies have been carried out on maximum effective spacing of ADDs on gillnets in terms of cetacean bycatch reduction. The advantages of using a higher spacing and therefore fewer ADDs include reductions in pollution from lost or damaged pingers, noise pollution and associated potential porpoise habitat exclusion, lower cost and less handling for fishermen. Theoretical considerations alone suggest that wider spacing should be possible (and indeed this has been demonstrated in fishery trials), but also indicate that loud ambient (background) noise, "white noise"?? could theoretically mask the noise that pingers make. Again, theoretical considerations suggest higher frequency sound sources (e.g. around 100 Khz) though subject to greater attenuation loss than lower frequency (e.g. 10 Khz) devices, should be less affected by masking noises such as those produced naturally.

The most successful trial carried out to date took place in the Danish North Sea hake gillnet fishery in 2006. The trial was carried out using Aquatec Aquamark 100 pingers deployed on nets at a spacing of 455 m or 585 m. A 100% reduction in porpoise bycatch rates was observed in nets with 455 m spacing and a 78% reduction in bycatch in nets with 585 m spacing. Bycatch observed in these spacing groups was significantly different from bycatch observed in the control nets. No significant difference was observed between the two pinger spacing groups however (Larsen and Krog, 2007). On the basis of this trial the Danish authorities were granted a derogation for their vessels to use a spacing of 400 m, compared with the 200 m spacing required in the regulation.

BIM carried out a pinger spacing trial in the Celtic Sea hake and cod gillnet fisheries in 2006 using Aquamark and Fumunda pingers. A total of 152 stations/samples were observed; 22 of 200 m spacing, 27 of 600 m spacing and 96 controls (no pingers attached). A total of seven harbour porpoises were observed as bycatch in control deployments and no bycatch was observed in any nets with Aquamark pingers spaced at 200 or 600 m. No significant difference occurred between spacings of 200 m and 600 m but neither was any significant difference found between these treatments and control treatments due to the relatively small number of bycaught animals (Cosgrove and Browne, 2007a).

Ifremer also carried out a pinger spacing experiment in 2008 using DDD02, Aquamark 100 and Marexi pingers in a French trammelnet fishery in the Iroise Sea in the Bay of Biscay. The nets were made up of three panels of 270 and 700 mm stretched mesh with a buoyant headrope and weighted footrope. Marexi pingers were spaced 200 m apart, Aquamark 100 pingers 400 m apart and DDD02 pingers were spaced at varying distances ranging from 1600 m to 4300 m. A total of 158 fishing operations, 37 with pingers and 121 without, were observed with a bycatch of two harbour porpoises in the former and three in the latter. No statistical test was applied to the data and no significant results were obtained (Morizur *et al*., 2009a).

4.4 Collateral effects

Pingers have been proven to have a deterrent or bycatch reducing effect on harbour porpoises (Cox *et al*., 2001; Culik *et al*., 2001, Koschinski and Culik, 1997; Kraus *et al*., 1997; Trippel *et al*., 1999, SMRU *et al*., 2001) and this has obvious benefits in terms of reduction in mortality and conservation of the species. Some concerns have been raised, however, over collateral effects such as habitat exclusion and habituation (which may lead to a reduction in pinger efficacy in the longer term). A number of studies have been carried out to address these issues particularly in the case of harbour porpoises. With regard to habitat exclusion, Cox *et al*., 2001 found a decrease in porpoise echolocation encounter rate by 84%, measured at the position of one Dukane pinger, while Carlstrom *et al*., 2009 found that Dukane pingers reduced porpoise echolocation encounter rate by 50–100% at PODs (self contained porpoise echolocation detectors that log the occurrence of echolocation clicks) placed up to 500 m away. The authors of the latter paper suggest that widespread use of pingers may not be suitable in coastal areas, as this may restrict the movements and distribution of harbour porpoise.

Two trials have been undertaken in the UK to determine the effective range of DDD-02 devices used on gillnet fisheries. To address the question of acoustic exclusion from foraging areas, two DDD-02s were attached to a single short fleet of tanglenets set in coastal waters off the Lizard Peninsula in Cornwall. A series of PODs were deployed in a range of distances initially between 1 km and 7 km from the experimental net string. The nets with the DDD-02s was deployed, removed, deployed and removed again at approximately two week intervals and the number of porpoise and dolphin clicks were recorded during each of the control and both of the deployment periods. The ratio of the mean number of detections-per-day during periods with and without active DDDs was plotted by distance from the net string. In 2007 there were no detections by the Pod on the string (500 m from the DDD), whereas the rate of porpoise and dolphin clicks was more or less the same between deployment and control periods beyond about 1.5 km from the source. In 2008 the trial was repeated with Pods deployed more densely distributed close to the string, from 0 to 3 km. During this trial lower click detection rates were recorded for both porpoises and dolphins during periods of DDD deployment out to 2.5–3 km, suggesting a more aversive response in the second year. It was not known why this might be the case, but the experiment suggested a possible deterrent effect out to 1.5 to 2.5 km. The results of these trials were used to estimate the approximate area from which dolphins and porpoises might be excluded if DDDs were widely used on UK gillnets in the southwest of England. Assuming a deterrent effect out to about 2 km, and assuming that on a peak fishing day around 1500 km of net might be deployed by locally based boats, if DDDs were deployed on nets at a spacing of 4 km, then a maximum of about 1.5% of the total Celtic Sea area might be ensonified enough to displace porpoises and dolphins (ICES, 2009a).

In terms of habituation, Cox *et al*., 2001, found a 50% reduction in pinger deterrent effect within four days of constant pinger operation. Carlstrom *et al*., 2009, found an element of habituation at one of the experimental sites. The authors concluded that long-term habituation was more likely to happen (i) close to shore, where porpoise density was lower and animals may have passed through the sound of several pingers on their way in or, (ii) close to the pingers. The results of this study also suggested that intermittent exposure to pinger sound may cause habituation if the exposure is repeated over time. The analysis by Palka *et al*., 2008, of US data collected over more than a decade, however, showed no evidence of temporal trends in the bycatch rates, suggesting that any habituation by harbour porpoises to pinger sounds had not been sufficient to limit the effectiveness of the pingers.

Other collateral effects such as the dinner bell effect are less well known with cetaceans but more common with pinnipeds (Mate and Harvey, 1987). It was noted that seal depredation (dinner bell phenomenon) had become an issue in Sweden when pingers were tested, but as yet no development work had been done to address this issue. Higher frequencies should be less audible to seals, so in theory devices might be designed to deter cetaceans while being inaudible to seals. The workshop noted that in some areas and for some gears and dolphin species, depredation on nets can lead to bycatch or even retaliatory killing by fisherman. For this reason measures designed to alleviate depredation can also reduce dolphin mortality. In this context the development of interactive pingers might be advantageous not only because of the reduction in "acoustic pollution" compared with continuous pingers, but also in minimizing the possibility of the "dinner-bell phenomenon".

Noise pollution is referred to as a collateral effect in publications such as Kastelein *et al*., 2007, and online forums such as http://oceanlink.island.net/ocean_matters/noise.html, http://www.smartgear.org/smartgear_winners/smartgear_winner_2007/smartgear_winner_2007special/ but no other detailed studies have been carried out directly on noise pollution effects of pingers.

Overall the collateral effects of pingers, particularly habituation and habitat exclusion are unproven and it seems reasonable to assume that the proven efficacy of pingers at reducing harbour porpoise bycatch currently outweighs any potential negative collateral effects.

4.5 Cost and technical specification

The workshop was fortunate to have the participation of several people from the pinger manufacturing sector who were able to provide up to date information on pinger developments; unit prices were obtained during the meeting and subsequently from manufacturers. Pinger manufacturers pointed out that sales of pingers have so far fallen well below expectations, and that profits generated had been nowhere near enough to fund any further development of pinger technology. It is expected that should the market volume increase prices will be driven down both by competition and by economies of scale. Regulation 812/2004 specifies in some detail what the characteristics of pingers should be, which means that any new design has difficulty in gaining legal recognition. Although the regulation stresses that the development of new devices should not be hindered by Annex II that describes pinger characteristics, and allows a two year derogation for the testing of new devices, two years is not a very long time to demonstrate the effectiveness of a new device in a seasonal fishery. The workshop also learned of possible plans to establish a pinger manufacturers' association to ensure that pingers on the market fulfil certain minimum technical and operational standards. How these standards might be defined remains to be worked out.

Annual costs of deploying ADDs vary considerably in relation to the technology employed in the devices and the rate of loss in specific fisheries. The costs are not considered to be insignificant for gillnet fisheries and these costs combined with poor reliability and negative impacts on fishing operations have discouraged uptake of ADDs and compliance with the regulations. Several countries have, however, instigated grant aid schemes or provided fishermen with pingers free of charge. This has helped but is not uniform across Member States.

Cosgrove *et al*., 2006 estimated the projected costs associated with fitting out 20 km of fishing gear (considered typical for Irish and UK vessels >15 m) with four of the commercially available ADDs. Fumunda FMDP-2000 were the most expensive at the outset due to a smaller spacing of 100 m and the unit cost of €67. Airmar were the cheapest to purchase at €46 per unit, so the total initial fit out cost is not prohibitive despite the lower maximum spacing of 100 m. Aquamark 100 were the most expensive unit to purchase at €104, but this price was offset by their maximum spacing of 200 m. Savewave Dolphin Saver-High Impact System was the cheapest pinger to fit on the gear initially with a relatively inexpensive unit cost of €60 and a smaller number of pingers required due to a higher maximum spacing of 200 m. These costs are summarized in Table 17.

Table 17. Initial Outlay Costs for different pinger types (based on 20 km of gillnets).

	Airmar	Aquamark	Fumunda	Savewave	DDDs
No. pingers required	200	100	200	100	50
Unit cost (€)	46	80	67	60	200.70
Total Outlay	€9200	€10 400	€13 400	€6000	€10 035

Source: Cosgrove *et al*., 2006 and others updated

The workshop also noted that ongoing field trials of pingers are discussed annually at SGBYC, and details are available in the Annual Reports of SGBYC. Nevertheless several members of the workshop provided updated information on ongoing field trials.

The workshop concluded that currently ADDs provide the most simple and effective solution although so far they are only proven for a reduction of harbour porpoise bycatch in set-net fisheries. Numerous trials have shown that pingers of several types can reduce porpoise bycatch by around 90%. ADDs, however, are expensive, where many are required (e.g. for set-net fisheries), require periodic maintenance to check and replace batteries, can interfere with net setting and hauling and can be unreliable. Further technical work is required to make these devices more robust and easier to check that they are functioning correctly.

The technical specifications of pingers that are currently available are shown in Annex 1.

4.6 Ongoing mitigation trials

4.6.1 France

Experiment with set-nets in French fisheries are ongoing in addition to the pinger spacing trials reported. Trials in the eastern Channel with Aquamark 100 and the new DDD-03 in which the power management was improved compared with DDD-02 are continuing. The spacing is the same as used previously and commercial nets are used as standard. The experiment started in April 2010. As of September 2010, eight comparative fishing operations were achieved with no bycatch in the control or pingered nets.

Mitigation in French pelagic trawling was initiated within the EU Necessity project. The main bycatch species in pelagic trawling is the short-beaked common dolphin. The effects of several commercial pingers and some experimental devices were tested on the behaviour of common dolphins in the Bay of Biscay. The DDD-01, DDD-02 and a prototype of CETASAVER were observed as having a scaring effect on groups in the wild. However, similar experiments in Spain and in Ireland demonstrated that these pingers sometimes have no noticeable effect on common dolphin behaviour. Some further tests with the 'CETASAVER' device were carried out on commercial pair pelagic trawling with the French fishing industry in the presence of observers (Morizur *et al.*, 2009). The CETASAVER is directional and was placed inside the trawl at a distance of 200 m from the entry of the trawl. Trials were done in 2007, 2008 and 2009, in the bass pelagic pair trawl fishery where the highest bycatch rates had been observed. Alternate tows were used to compare with and without pinger. A decrease of bycatch by 50% was observed over all tows. A total of 143 hauls with Cetasaver resulted in a bycatch of ten common dolphins, compared with 150 control hauls with 22 common dolphins. The Cetasaver has now been commercialized by Sodena.

4.6.2 UK

The UK has also tested ADDs in pelagic trawls. Over 40 tows have been observed in the pelagic trawl fishery for bass using a DDD-02F device between 2006 and 2009 with no concomitant common dolphin bycatch. DDDs were initially placed on the footrope of the trawl at the mouth of the trawl in these trials (pers. comm. Simon Northridge). Observations thus far suggest that these devices are effective in minimizing the bycatch of common dolphins in pelagic trawl fisheries for bass, although the reasons why this is so are not understood (ICES, 2009a). The UK has also tested DDDs in gillnet fisheries for common dolphin bycatch but no bycatch has been observed in nets with or without these deterrents to date so the results are inconclusive.

An extension trial with the English industry has been described above, but the trial also has an experimental purpose, which is to determine the optimal spacing of the DDDs that are being tested. Observers are working with eight participating vessels and locations of each device as it is deployed and recovered will be compared with the locations of any bycaught animals to calculate the shortest straightline distance between the bycatch and the nearest device. So far no bycaught animals have been recovered closer than 1.5 km from the nearest pinger.

4.6.3 Portugal

In Portugal, the SafeSea project intends to test mitigation measures to decrease local fisheries interactions with cetaceans. At the moment, pilot studies using pingers (Fumunda 10 Khz and a new Fumunda 70 Khz not yet commercially available) involve 30 boats among a small sardine purse-seine fleet in the Central Portuguese coast (recently certified by the Marine Stewardship Council) as well as some boats using gill/trammelnets in the north of Portugal. Also, in the upcoming months, acoustically enhanced trammel and gillnets (barium sulphate impregnated nets produced by BetterGear, Inc) have been acquired and will be tested. In these studies, voluntary logbooks are being kept by the skippers to record gear type, gear length, depth of deployment, soak time (for gill/trammelnet trials) or set (for the purse-seine fishery) time, location and bycatch or interaction with marine mammals.

4.6.4 Denmark

In Denmark and evaluation of the available pingers, testing methods and spacing was carried out between 2005 and 2007. Airmar, Aquatec, Fumunda, and Savewave were all tested, measuring battery life and load at breaking. Minimum operational battery life ranged from two months for the Fumunda devices (which have replaceable batteries) to nine months for the Savewave devices, and 23 months for Airmars and Aquatecs. Loads at breaking were very low for the Savewave device and 150 kg for the Airmar devices, 400 kg for the Fumunda and 450 kg for the Aquatecs. Operational problems included the fact that all devices became entangled at times on meshes of nets while stored in net pounds on board, wet switches on some were oversensitive so that they did not switch off when on board, and problems going through net haulers. Spacings of up to 450 m were found to be effective for Aquatec pingers.

4.6.5 Netherlands

In the Netherlands a recent collaborative project has tested Savewave devices with a group of ten large-mesh gillnet fishermen. Unfortunately the devices were insufficiently robust and practically unworkable for use in this fishery and currently plans are underway to re-start the trials using other types of pinger.

4.6.6 Ireland

A trial was carried out by Bord Iascaigh Mhara (BIM) in Ireland in February 2009 to test if recordings of killer whale vocalisations could have a deterrent effect on common dolphins, ultimately with a view to incorporating the sound into an interactive deterrent device developed by BIM for use in pelagic trawl fisheries (Cosgrove, 2009). Seven pairs of different recordings from killer whales were used during the trial on groups of common dolphins located off the south coast of Ireland. Each pair of control and test signals contained background noise to ensure that if significant differences in response occurred that it would be possible to conclude that the dolphins responded to killer whale calls rather than any other sound stimulus. The background noise in the samples slowly increased in amplitude during the first 30 seconds, so as to avoid a startle response from the rapid onset of an unfamiliar sound. For the test sequence five killer whale calls from the same recording were spliced into the recording after 30 seconds. The control and test treatments were presented to the same group of dolphins in random order. During the first trial no evasive behaviour was observed during the test periods. As no reaction was observed a number of different killer whale sequences were tested subsequently but no changes in behaviour were recorded. A further study has just been completed in January 2010 on two further groups of dolphins off the southeast coast of Ireland. Again no effect was observed from either group.

4.7 Alternative mitigation measures

Other mitigation options include Passive acoustic devices; acoustically dense netting materials; exclude devices and other gear modifications; operational and time/area closures and alternative gears. These are comprehensively reviewed in Anon., 2010 in a report for the European Parliament referred to earlier. This and other studies have shown that no practical alternative mitigation measures to ADDs currently exist. Excluder devices have been tested extensively in pelagic trawl fisheries although fish losses have been shown to be sizeable in some trials. They can also be difficult to install, maintain and handle (grids) in large pelagic trawls, and mixed results have been obtained in trials carried out to date. In the UK bass pair trawl fishery these allowed about a quarter of animals detected inside the trawls to escape, and although higher escape rates may have been achievable, subsequent successful trials using acoustic measures have led to the shelving of further development of exclusion devices.

Nets that are impregnated with barium sulphate have been tested in several places with mixed success and little agreement as to which characteristics of these nets could reduce bycatch rates. Further trials are being proposed in Germany and Portugal, and as reported by SGBYC a large multinational project coordinated by the Bycatch Consortium based at the New England Aquarium (MA, USA) is currently making a detailed study of such nets in trials in South America. Results are expected in 2011.

Potential alternative fishing gears including the use of pots have also been considered. Studies in a number of countries including Sweden, Norway, Canada, Faroe Islands and Iceland are reported by the ICES Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) (ICES, 2009). In Germany a series of small-scale feasibility studies were conducted to find out whether codpots could fully or partly replace gillnets and this was reported by SGBYC in 2009. Two cruises on a research vessel in August and October 2008 were carried out to compare catches of cod with (Norwegian Type) pots set pelagic and on the bottom with catches of gillnets fished nearby. The results for the trials were very disappointing because only one cod was caught in eleven pots. The 50 gillnets showed a mean catch of 12 kg/day of cod and 74 kg/day of flounder. Subsequently commercial fishermen have also been equipped with a limited number of codpots. Catch rates have been more encouraging and closer to catch rates in gillnets although further work is required before it is felt likely fishermen will adopt this method of fishing. Costs for switching to alternative gears also remain a major disincentive for fishermen (ICES, 2009).

It is noteworthy that the dramatic decline in gillnet effort in the North Sea, while a consequence of fishery management measures (cod take limits and a ban on some skate landings) as well as apparent declines in fish catch rates (turbot) has also had the effect of greatly reducing the likely level of porpoise bycatch (see above).

The workshop was unable to identify any of these alternative measures as a specific remedy for any particular EU fishery/cetacean interaction, though none can be ruled out as potentially useful measures. At present pingers remain the only proven and viable means of reducing cetacean bycatch without resorting to limiting effort or closing fisheries.

5 Identification of the most efficient mitigation measures

Term of Reference: *Following the assessment made in point b) identify the most efficient mitigation measure for each species concerned by Reg.812/2004 and according to the fishing gear in use.*

Regulation 812/2004 covers all species of small cetacean, but following guidance from the European Commission, the workshop focused on the "main" species that have been recorded as bycaught in each sea-area under consideration. In addition the focus was also on those gears that currently appear to present most risk to small cetaceans (we note above that other gears are worthy of further investigation). Table 18 summarizes the workshop's recommendations for various fisheries.

Table 18. Summary of recommendations for mitigating bycatch in certain fisheries.

Gillnets

Species	Sea-area	Comment
Harbour porpoise	Baltic	Mitigation measures recommended (species depleted)
	Kattegat/Belt Seas	Mitigation measures recommended
	North Sea	Develop monitoring programme, especially southern North Sea
	Atlantic (north)	Improve monitoring programme. ?? mitigation?
	Atlantic (Iberia)	Mitigation measures recommended (species likely decline requires further research)
	Black Sea	Mitigation measures recommended
Common dolphin	Atlantic waters incl. Alboran Sea	Continue monitoring
Bottlenose dolphin	Western Mediterranean	Insufficient information but sub-structured population adds to risk

Pelagic trawl

Species	Sea-area	Comment
Common dolphin	Atlantic waters	Mitigation measures recommended for bass and tuna fisheries
Striped dolphin	Mediterranean	Insufficient information
Bottlenose dolphin	Mediterranean	Mitigation measures probably recommended, low information

Long surface-set-nets

Species	Sea-area	Comment
Striped dolphin	Mediterranean	Mitigation measures probably recommended, low information

6 Discussion and conclusions

The following section summarizes some of the main points in the reviews of fishing effort and bycatch rates above, but also highlights some emergent issues that arose during discussions at the workshop.

6.1 Areas outside the scope of Reg. 812/2004 where measures would be necessary to be applied to reduce the incidental catches of cetaceans

The workshop only reviewed the scale of gillnet and pelagic trawl fisheries in the European Union and Norway, and tried to describe these in terms of their likely risk to cetacean conservation. Other fisheries are known to be associated with some levels of cetacean bycatch but these were not dealt with in much detail. The workshop recognized that there is a lot of information that has been collected under the DCF and previous discard sampling schemes across many different types of fishing gear, and reiterated the view expressed by SGBYC that such data could and should be collated to assess the scale of cetacean bycatch in other fisheries at a European level.

Concerning pelagic trawl fisheries, it is clear that most of these present little or limited threat to cetacean populations and a large number of fishing trips and days at sea have been monitored under Regulation 812/2004 without any cetacean bycatch having been observed. There is a clear case to refocus monitoring activity.

The bass and tuna pair trawl fisheries are the exception, and relatively high rates of cetacean bycatch have been observed here. However, mitigation measures have been developed and tested and are in the process of being refined. There is a clear case for mitigation measures to be adopted in these fisheries.

Gillnet fisheries remain a threat to cetacean populations in several areas, but pingers, the only so far identified effective mitigation measure for harbour porpoises that does not require effort control or fishery bans, are expensive and may have adverse collateral effects. It therefore makes no sense to attempt to deploy pingers in all gillnet fisheries. A more focused approach would deploy pingers in critical areas with harbour porpoise populations and fisheries while at the same time develop or improve monitoring schemes in areas where there is evidence of a potentially dangerous level of bycatch to identify subregions or métiers where pingers may be most effectively deployed.

Levels of gillnet fishing in the Baltic are high, notably in Finland, but the absence of cetacean sightings in Finnish waters does not immediately suggest the need for widespread pinger deployment there. The western end of the Baltic, on the other hand has a level of porpoise density that engenders a measurable level of porpoise bycatch and that would seem to be a useful place to focus mitigation attempts.

Similarly the Kattegat and Belt Seas have areas of high porpoise density and high gillnet activity. It is unclear whether rates of porpoise bycatch here may exceed sustainable limits, and increased levels of monitoring would be sensible.

The level of gillnet fishing effort in the North Sea has almost certainly declined considerably since the 1990s and with the current scale of activity by the registered fishing fleet there is no conclusive evidence of immediate conservation threat to harbour porpoises.

The large variation in data however implies a possible threat. Also, the unknown scale of recreational fishing effort remains a concern, as does the possibility that static net effort may yet increase if fuel prices continue to rise, and if and when landing restrictions on cod, ray and dogfish among other species are eased. It would be sensible to monitor gillnet fisheries especially in the southern North Sea to determine whether ongoing gillnet fisheries there have higher than 'usual' bycatch rates, but equally importantly some quantification of unregistered gillnet activity would help define the likely scale of the threat.

In the Atlantic region none of the fisheries alone would seem to be sufficiently large to impact the common and striped dolphin populations, yet the combined effects of gillnet, pelagic trawl and other fisheries bycatch could easily be exceeding the sustainable level of removal. It is also the case that the 1.7% level adopted for the purposes of this report may in fact be too high for common dolphins which appear to have a much slower rate of reproduction than porpoises. For these reasons detailed and widespread monitoring is required across the region, especially for those fisheries where little has yet been done, to obtain a more precise estimate of the overall total bycatch level.

Porpoise bycatch in the northern Atlantic region appears likely to exceed sustainable take levels at current levels of fishing activity based on known bycatch rates, but further sampling is required to determine whether currently known rates (mainly from UK and Ireland) are representative of the wider region. It seems very likely, given the apparently large-scale of Spanish and Portuguese gillnet fishing that porpoise populations in the Iberian region are compromised by these fisheries, and mitigation coupled with an adequate monitoring scheme would appear essential.

Very little is known about gillnet fishing effort or cetacean bycatch in the Mediterranean, but there is a clear potential threat to bottlenose dolphins at least given the putative size of their population and the scale of static net fisheries there. The fact that Regulation 812/2004 makes no mention of these fisheries means that no adequate monitoring of static net fisheries or description of fleet dynamics has been undertaken.

Very high bycatch rates of cetaceans have been reported from the Black Sea, which is not mentioned in Regulation 812/204 and should clearly be included.

Gillnetting is less of a concern in European Macronesia because it is relatively limited. However there and elsewhere other fisheries that are not covered by Regulation 812/2004 could be of some concern, though this remains to be investigated.

For example, approximately 100 Spanish and 60 Portuguese longliners receive a licence to operate with surface longlines in Subarea Xa (outer 100 nautical miles of the Archipelago of the Azores) every year (data from the Fisheries Inspection Service of the Azorean Regional Government). There is little information on fishing operations and effort and on incidental captures of cetaceans for this fishery, making it difficult to estimate bycatch rates. However, observers placed on board a Spanish longliner fishing west of the Azores reported two false killer whales (*Pseudorca crassidens*) whales taken in 56 monitored sets (Hernandez-Milian *et al*., 2008). Results from an ongoing monitoring programme conducted by the University of the Azores also indicate that false killer whales frequently interact with longline gear by depredating fish caught, which may result in the animals becoming hooked or entangled, leading to serious injury or death. Thus, an observer scheme is necessary to obtain reliable estimates of bycatch rates of cetaceans in the longline fishery operating in the area.

In mainland Portugal, the purse-seine fishery is operated by a fleet of about 124 seiners (average total length around 20 m, 50 t GRT and 300 HP of engine power) and recent average landings of 50–60 thousand tonnes a year. This is an artisanal fishery targeting small pelagics, mainly sardine (Atlantic sardine) which makes the bulk of the catch (>80%). Common dolphins and other dolphins were observed to interact with fishing activities during a small-scale observer programme (Wise *et al*., 2007). Small cetaceans were observed to sink, gather or disperse schools of fish and damage gear. Mean cpue and fishing effort values did not change significantly in the presence of dolphins ($H = 0.06$ and $H = 0$, both $p>0.05$).

The fishery was certified in January 2010 by the Marine Stewardship Council, thus a monitoring programme has been created to provide data for the criteria measuring the effect of the fishery on bycatch of protected species (cetaceans, turtles and birds). Presently, the SafeSea project – Portuguese Wildlife Society and the Portuguese Fisheries Research Institute (IPIMAR) run observer schemes to monitor catches composition as also protected species interactions. From observer schemes and skipper interviews, occasional interactions and incidental captures occur, mostly with common dolphins, although it is the fishery with the highest rate of live release (>60%) with an estimated annual removal of 0.96% of the local population (using one year of observation and inquiries). Interactions with birds and turtles still need to be evaluated and studies are still in progress.

In mainland Portugal there is a coastal beach-seine fishery that operates mainly during spring and summer in shallow water sandy areas along the west coast (mainly in the North and Centre). The fleet is composed of a small number of boats (30–40). A total of 19 accidental captures and 16 confirmed deaths of small cetaceans have been reported recently in the North and Central Portugal for the last two summer seasons (2009–2010). The main interaction is with Common dolphins (66,67%) followed by the harbour porpoise (27,78%) and bottlenose dolphins (5,55%).

Sporadic records of bycatch of both porpoises and dolphins in bottom trawls also occur throughout much of Europe. These incidents have been little studied and it is as yet unclear whether there could be any local cause for concern. Member States should be encouraged to ensure such bycatch events are reported under DCF monitoring.

The workshop also repeatedly recognized that Regulation 812/2004 is mainly focused on size classes of vessel that have limited impact on cetaceans. The regulation requires certain fleets of gillnetters and pelagic trawlers to be monitored to obtain bycatch estimates with a specified level of precision. “Pilot studies” are required for vessels under 15 m in the same fleets, and in general these have been poorly implemented by member states because the Regulation does not specify the levels of sampling required for under 15 m vessels in such studies. A similar length criterion is used for those fleets of netters that are required to use pingers. In this case only boats of 12 m and more are required to use pingers. These vessel length criteria for specific actions (monitoring and mitigation) mean that only a very small proportion of the total European Fleet (Table 19) is impacted in any meaningful manner by the Regulation.

Table 19. Data available to the Workshop on Fleet Length Categories by Member State.

All gear types				
Nation	<12 m	>12 m	Fleet Size	% <12 m
Denmark	2317	512	2829	82%
Germany	1358	363	1721	79%
Sweden	1169	232	1401	83%
Poland	589	203	792	74%
Finland	3174	97	3271	97%
Lithuania	146	48	194	75%
Estonia	861	85	946	91%
Latvia	685	103	788	87%
Gillnetters only				
UK	1462	40	1502	97%
Ireland	22	49	71	31%
France (Atlantic)	744	144	888	84%
France (Mediterranean)	442	15	457	97%

Regulation 812/2004 is also focused through fishery regulations at commercial fisheries, yet anecdotal evidence indicates that some bycatch also occurs in recreational fisheries, not included in Regulation 812/2004. The legislation on recreational fisheries with gear potentially leading to bycatch of small cetaceans is very diverse throughout the member states of the EU. In many cases little information exists about type of gear, length of gear, effort, number of vessels or fishermen undertaking fisheries from the shore without vessels, fishing area, etc. and virtually no information exists about bycatch rates in these fisheries. Observers on board cannot be used easily on small vessels.

As professional fishermen are bound by Regulation 812/2004, which in some cases requires adaptations of fishing methods and financial consequences, it would make sense that also recreational fisheries are looked at (especially fishing effort), and that potential mitigation methods in these fisheries are investigated. As recreational fisheries are not managed by the CFP, this would have to be done by national authorities, who should evaluate the interest in maintaining the use of set-nets in recreational fisheries in some areas.

To illustrate the scale of recreational static gear fisheries in the Baltic for example with data from Finland, where the number of recreational fishers is quoted to have been reduced from 2.1 Mio in 1999 to 1.9 Mio in 2005, with the number of active boaters having decreased from 300 000 in 1999 to 230 000, with a total annual catch of 7600 t (2005) to 12 600t (2002) in marine waters.

Monitoring of fisheries is problematic for many member states because on-board observer monitoring can be very expensive. This is particularly the case when a target level of precision in the final bycatch estimate is being attempted. A more pragmatic approach would be to do sufficient monitoring to be sure that the level of bycatch was less than (or more than) some predefined reference limit. This approach is outlined in the report to the European Parliament (Anon., 2010). Furthermore, recent monitoring of small vessels using video monitoring techniques shows that cheaper and more flexible approaches to observer monitoring are feasible.

The workshop also noted that the terminology relating to gear types within the Regulation is at times ambiguous, for example references to bottom-set gillnets may exclude certain gear types such as midwater fixed nets or trammelnets that should be included. Very High Vertical Opening trawls are also not defined in the regulation. Requiring vessels that use nets of 400 m or less to use pingers is another example of a poor fishery definition that can easily be circumvented by extending net lengths.

The workshop noted that prescribing areas and fisheries for monitoring can conflict with the dynamic nature of both cetaceans and fisheries that can shift from year to year. Changes in porpoise density in the southern North Sea for example may have contributed to an apparent increase in fishery interactions in his region since the Regulation was drafted. A more flexible approach should be implemented to ensure member states can react to such shifts in distribution.

Regarding other mitigation measures, the workshop identified the potential of time area closures as one possible mechanism, though did not have time to examine this issue in detail and was unaware of any easily identified region or time within European waters that would help minimize cetacean bycatch. Changing fishing gears, as is being tried in Sweden is one potential means of reducing gillnet effort while maintaining fishery employment, though alternative gears need to be efficient and will require *in situ* testing to ensure this approach is effective. Exclusion devices have been tried in pelagic trawl fisheries, and showed some promise, but acoustic deterrents appear to be easier and more effective. Acoustic deterrent measures have been demonstrated effective in some pair trawl fisheries and could be adopted there.

Finally the workshop re-iterated a concern commonly voiced by many ICES working groups, that European fishing effort data are unreliable, unavailable or too difficult to compare and collate for effective management. In particular the standardization of effort data and gear definitions used by member states must be addressed. These issues must be resolved to allow assessment of this regulation to be effectively carried out.

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Annex 1. Comparisons of technical specifications of available pingers

Sound source and manufacturer	Signal type	Signal duration (ms)	Signal interval (s)	SLpulse (dB re 1 µPa @ 1 m)	SLcycle (dB re 1 µPa@ 1 m)	SPL @ 6 m (dB re 1 µPa)	Frequency spectrum and peak levels at 1 m (dB re 1 µPa)	Spacing	Cost (100+) ex VAT
DRS-8 transmitter by Ocean Engineering Enterprise	600 Hz tonal 'known effect' reference sound	300	4	172	161	177			
DRS-8 transmitter by Ocean Engineering Enterprise	3 kHz tonal 'known effect' reference sound	300	4	202	-	-			
Fumunda F10 by Fumunda Marine Pty Ltd, Australia	Tonal signal 9.6 kHz	300	4	132	130	128	Harmonic energy up to 73 kHz, 3rd and 5th harmonic -10 dB. 0.02-0.1 kHz -60 dB.	100 metres	€67
Airmar gillnet pinger by AIRMAR Technology Corporation, USA	Tonal signal 9.8 kHz	309	3.5	134	124	125	Harmonic energy up to 50 kHz -30 dB. 0.02-0.1 kHz -30 to -60 dB.		
AQUAmark 100 by Aquatec Group Ltd, UK	Tonal and sweep signals	Random Avg 304 Min 213 Max 358	Random Avg. 12.2 Min. 4.2 Max 22.6	148 (SD 3.7) (n=16)	Avg 133 Max 142 Min 130	143 (SD 1.6) (n=16)	Tonal levels +7 dB with peaks at 64.4 kHz (136 dB) and 128 kHz (100 dB). Sweep signals peaked between 44-54 kHz & 60-80 kHz, LF peaks at 0.75 (-34 dB) & 1.6 kHz (-50 dB).	200 m 400–500m with derogation	<€80 4 yr life typ, no battery costs
AQUAmark 200* by Aquatec Group Ltd, UK	Tonal and sweep signals	Random Avg 282 Min 272 Max 293	Random Avg 12.1 Min 3.7 Max 21.1	134 (SD 1.26) (n=16)	Avg 118 Max 123 Min 120	130 (SD 1.5) (n=16)	Tonal peaks at 21 & 42 kHz (126-130 dB) and 63-104 kHz (-5 to-15 dB). Sweep signals peaked between 10-14 kHz & 48-53 kHz. LF peaks at 0.7 kHz (-15 dB).	200m	<€80 4 yr life typ, no battery costs
AQUAmark 210 by Aquatec Group Ltd, UK	Tonal and sweep signals	Random	Random 4-30 s	150	Max 150	-	Sweep signals and tonals between 5 kHz & 160 kHz.	100–200 m	<€88 1–2 yr life typ, no battery costs
AQUAmark 363 interactive by Aquatec Group Ltd, UK	Various sweep signals	300 ms	Random <15s apart	167			35-90 kHz Resonance frequencies, <160 KHz frequency band, 175 SLpeak dB re 1 µPa@ 1 m/Vrms	Not in production	Not in production

SaveWave endurance by SaveWave BV, The Netherlands	Sweep signal	Random Avg. 295 Min 196 Max 393	Random Avg 14.5 Min 8.2 Max 21.1	134 (SD 0.41) (n=14)	Avg 117 Min 117 Max 117	132 (SD0.7) (n=12)	Sweep 5.3–110 kHz. Peaks between 7–95 kHz 112–116 dB. LF contribution 0.5–3 kHz -40 dB. Pulse duration proportional to time intervals.		
SaveWave white high impact by SaveWave BV, The Netherlands	Sweep signal	Random Avg 529 Min 197 Max 852	Random Avg 11.39 Min 2.65 Max 18.24	140 (SD 0.58) (n=17)	Avg 126 Min 131 Max 125	141 (SD0.43) (n=17)	Sweep 5–95 kHz 115 dB. Peaks between 7.5-54 kHz +12 dB. LF contribution 0.75–2.4 kHz -20/-35 dB.		
SaveWave black high impact by SaveWave BV, The Netherlands	Sweep signal	Random Avg 318 Min 229 Max 427	Random Avg 14.6 Min 8.8 Max 23.0	143 (SD 0.67) (n=13)	Avg 127 Min 127 Max 126	143 (SD1.0) (n=12)	Sweep 33–97 kHz 108 dB, Peaks between 50–95 kHz (+10 dB). LF contribution 6 to 9 kHz–40 dB.		
LongLife Dolphin Saver by SaveWave BV., The Netherlands	randomized sweeps	100-600 ms randomized	1-6 sec randomized	?	?		60–240 KHz powerful double mirrored harmonics	150 metre	€49.90
DDD 03 by STM Products, Italy	Start sequence			165, pkk	153	160	5–250 kHz, Resonance frequency 50 and 150 kHz, Peak frequency (150 kHz) 120 dB re 1µPa rms	400 m	Max €223
	FM	Random Avg Min 500 Max 9000	Random Avg 100 SD 50				5–250 kHz, Resonance frequency 50 and 150 kHz, Peak frequency (150 kHz) 120 dB re 1µPa rms		
	Clicktrains	100					5–80 kHz		
DiD interactive by STM Products, Italy	Start sequence			165, pkk	153	160	5–250 kHz, Resonance frequency 50 and 150 kHz, Peak frequency (150 kHz) 120 dB re 1µPa rms		
	FM	Avg Min 500 Max 9000					5–250 kHz, Resonance frequency 50 and 150 kHz, Peak frequency (150 kHz) 120 dB re 1µPa rms		
	Clicktrains						5–80 kHz		

Source: Anon, 2007 and updates.

Annex 4. Technical minutes from the Review Group for EC Request for Evaluation of Aspects of EC Regulation 812/2004

- RGREV812
- By correspondence, deadline 12 October 2010
- Participants: Nicole LeBoeuf, USA (Chair), Mette Bertelsen and Michala Ovens, ICES Secretariat
- Expert Group: WKREV812

Introduction

Given the scale of the task, the diversity of the fisheries covered, the general paucity and variable nature of the available data, the reviewers congratulate workshop participants on the considerable amount of work produced in a short period of time. The difficulty of their work was evident and illustrates many fundamental issues that must be overcome, if ICES is to provide the client with a meaningful assessment regarding the scope and effectiveness of Regulation 812/2004. Indeed, without the systematic collection of key data related to fishing effort and distribution, cetacean distribution, abundance and population structure, and the nature of interactions between the fisheries and cetaceans, little more could be undertaken at this workshop. This presents serious challenges for the client in making targeted fisheries management decisions to minimize the impacts of specific fisheries on vulnerable cetacean populations.

The workshop was tasked with answering three (Terms of Reference) ToRs based on a request from the European Commission. These are:

> *ToR1. Identify areas outside the scope of Reg. 812/2004 where measures would be necessary to be applied to reduce the incidental catches of cetaceans.*
>
> *ToR2. Provide an evaluation of mitigation measures currently in place and an assessment on the most recent developments of mitigation measures used to reduce the incidental catches of cetaceans, including information on cost.*
>
> *ToR3. Following the assessment made in point 4) identify the most efficient mitigation measure for each species concerned by Reg.812/2004 and according to the fishing gear in use.*

General comments

The overall lack of data complicated the task of drawing clear conclusion during the workshop. Still, the reviewers noted that sections of the report would benefit from restructuring and/or reworking of the narrative to form clear findings and conclusions. Many of the results of the authors' work is lost in the text and could be missed by the Advice Drafting Group, therefore, potentially losing an opportunity for ICES to provide clear advice to the client. For example, two of the reviewers noted that, in many of the area descriptions in Section 3, it is unclear what the relevance of the effort and bycatch data presented is and where it's being used. As one reviewer noted, "The report is very difficult to follow making it difficult to disentangle areas/fisheries that are currently covered from those that are not." Another reviewer noted that "it would be helpful if key findings from each of the area summaries are clearly concluded at the end of each section, specifying the fishery, why it is absent from the current regulation and a qualitative assessment of the risk to cetaceans."

Many of the reviewers' comments, particularly those related to ToR1, are geared toward revising the document to improve its overall value and ultimate use of the authors' hard work. The reviewers recognize the challenge given the variability of data considered. However, without clear findings regarding how variable and lacking data make analysis and forming advice even more difficult, the client may not be as well-served as they could be. Indeed, in some cases, it is the opinion of the reviewers that more work should be done to improve the workshop report before advice can be developed. For example, two of the reviewers noted that the inclusion of an ICES division map showing the areas covered and not covered by the regulation in EC waters would facilitate understanding of the workshop participants' findings. In addition to more general concerns, the reviewers' comments below reflect consideration of how the workshop participants addressed the ToRs with suggestions for follow-on work where needed.

ToR1. Identify areas outside the scope of Reg. 812/2004 where measures would be necessary to be applied to reduce the incidental catches of cetaceans

Overall, the reviewers' comments acknowledged that, in some respects, the scope of ToR1 may have exceeded the ability of the workshop participants due to the lack of available data. In nearly all areas of information fundamentally required to determine whether or not the provisions of Reg. 812/2004 should be applied outside the current scope of the regulation data were lacking. Where data were available to workshop participants, they were not provided (nor were they collected) in standardized or comparable formats, making summary analysis and consideration in the formulation of advice difficult. For this reason, particularly with respect to this ToR, the reviewers suggest that the Advice Drafting Group strongly encourage the client to provide information needed to conduct the requested assessment and that it act with precaution when developing recommendations for the conservation of priority cetacean species. That said, the workshop participants should be encouraged to revisit this ToR and do some major revisions of the report before it could be said that the Workshop has met and fully addressed the ToR.

Definitions – The reviewers concur with the workshop participants regarding the general lack of accurate and practical definitions within Reg. 812/2004 and the obvious potential for this to lead to diminished levels of compliance by fishers. Further, the reviewers note that without a clear understanding of what vessels and gear types are governed by the regulation, the client's ability to monitor and enforce compliance, as well as to evaluate the effectiveness of the measures in place will be difficult. Indeed, this lack of understanding of what gear is and is within the scope of Reg. 812/2004 made interpretation of the workshop participants' findings relative to ToR1 challenging. One of the reviewers suggested that perhaps FAO gear classifications should be used. Whatever approach is taken, it is clear that until accurate and practical definitions are developed, the implementation of effectiveness of Reg. 812/2004 will be hampered. Workshop participants identified some of the gear types, as well as other basic concepts, needing to be more clearly defined. Given how fundamental definitions are to the usefulness of regulations, the reviewers would like to see this work further progressed in consultation with the client.

Data gaps – The reviewers highlighted some of the data gaps and/or potential resources of additional information below. One reviewer noted that it is unfortunate that the workshop participants did not access the EC effort database as they should have been able to access the most recent SGMOS report or made a request to the commission to obtain it. The EC the Data Collection Framework classifies fishing gears, mesh size, target species and area of operation into fairly well defined métiers e.g. GNS_120_Cod_VIIf,g which translates into static gillnets with a mesh size of 120 mm targeting cod in ICES Subdivision VIIf,g. It would have been useful to have a matrix of métiers (using the DCF or national definitions) using the gear types of concern, and to have these classified as having a high, medium or low risk of cetacean impact. This would also have allowed for easy identification of métiers that currently fall outside the regulation and those that are not of concern. It is important that any regulation of this type focuses on the problem fisheries or those where there is few data but based on expert judgement may potentially have a problem.

Indeed, one reviewer noted that there is has been significant strides made in the standardization of fishing effort data and the associated gear groupings over the past few years and disagrees with the workshop participants' assessment. In the view of the reviewer, the main problem is the lack of available data for vessels under 10 m as they are not legally obliged to complete EC logbooks. This lack of information and of standardized information across areas and across fisheries poses significant difficulties to anyone seeking to understand and mitigate fisheries-cetacean interactions with scarce information on vessel effort, cetacean distribution, and the interactions.

The workshop participants identified two possible effort metrics to estimate total bycatch; animals caught per days at sea and animals caught per landed tonnes target species. Two reviewers noted the limitations of using such data as correlates for interactions between fisheries and cetaceans and that using landings data may be appropriate when raising data for a given year. However, applying a bycatch/landings ratio across to landings data in future years is likely to result in a biased estimate as landings fluctuate year on year. In practice, applied effort such as bycatch/days at sea is more appropriate, particularly where information on the amount of gear deployed and soak time is available because it more closely correlates with potential fisheries interactions with cetaceans. The reviewers acknowledged that workshop participants utilized the best information available to them in their analysis. However, neither of these metrices are ideal for estimating bycatch but are being used due to fundamental information gaps (e.g. soak time for gillnets and on-board observer reports for a variety of needs), preventing full treatment of the subject.

This is evident in Table 3, where the entries under the far right column are nearly impossible to compare and/or to synthesize in a meaningful way. All that the workshop participants have been able to do in this case is to place information from various fisheries in one location, although little other value added has been offered due to a lack of comparable information. Further, the lack of information on the cetacean population structure prevents managers from assessing fisheries impacts and prioritizing the application of mitigation measures. The reviewers note that, within increasing regularity, fisheries managers are using risk assessment methodologies to assign conservation and management priorities based upon the likelihood for each fishery to interact with bycatch species. Risk assessment can be a useful tool for focusing bycatch mitigation measures, but also relies on a minimum amount of information. It is not clear to the reviewers where even the most basic data needs of a risk assessment model would be satisfied without further data collection requirements, but two reviewers recommended that this be investigated further.

Further, with regard to the contents of Table 3, one reviewer noted that the table presents estimates of bycatch rates for different cetacean species, gears and areas. In addition, the reviewer indicated that the figures given in the Table 3 should be considered as minimum estimates given that they only present data from some, but not all, gillnet fisheries in an area that have had some level of monitoring e.g. there are have been observer programmes operating on the cod and pollack bottom-set gillnet fisheries in the Skagerrak and Kattegat (1995–1997) but not on other gillnet fisheries targeting other fish species e.g. dogfish, flatfish. This is important because these levels are later used together with effort data for pooled gear types (from Table 5) to determine total cetacean bycatch which then may lead to an underestimate of bycatch if some of these other fisheries experience higher bycatch rates. Ultimately this total estimate is then compared with the 1.7% limit calculated on cetacean abundance (which may be overestimated for many species and areas due to errors in the abundance estimates presented in Tables 1, 2 and Black Sea) and used for the assessment and recommendations where mitigations are needed or not needed. The reviewers think corrections are necessary and where appropriate limitations and biases should be expressed in the text before or after these Tables.

There are a number of issues to address in the Section regarding the Baltic Sea and the bycatch of harbour porpoise. There are more data available on bycatch then given in the report that should be included e.g. data are available for Poland for the period 2000–2005 when 18 (?) animals were recorded bycaught and Lithuania where 2 (?) animals were recorded as bycatch for the same time period. There must also be some data on porpoises recorded as bycatch between 2005 and 2010? The important conclusion however for the critically endangered Baltic Sea harbour porpoise is that any bycatch needs to be avoided completely if further population decline is to be avoided.

Regarding the Kattegat-Belt Sea region there are several estimates of bycatch presented from previous studies. Many of these numbers are based on the number of collected or reported dead porpoises found in fishing gear. It should be stressed that these only represent minimum bycatch whereas those based on observer programmes may represent an estimate of bycatch for the fishery covered by the observer programme if extrapolated to the total effort of the fishery.

The attempt to provide absolute estimates of bycatch is important, particularly in relation to the 1.7% threshold; however, one reviewer noted that this may be a far bigger task than can be achieved in a three-day workshop given the other questions. We understand that the idea is to raise sampled trips to provide a global estimate, but it is not clear where this has been done. In addition, for some areas, e.g. in Section 3.6.1 bycatch estimates are provided/used, but these are from observations prior to the introduction of Reg. 812/2004, raising the question regarding are these rates still relevant. If the view is that they are, then could be implied that the regulation has been ineffective (for those vessels >12 m in length to which the regulation applies) and this should be commented on. If the rates are associated with areas/métiers that are not covered, then this should be stated more clearly. The difficulty in this task is exacerbated by a lack of understanding of the population structure of these species and the rarity of the bycatch events themselves. This is particularly troubling in the Mediterranean where information on both fisheries and cetacean population structure and abundance is sorely lacking.

Structure of Report and clarity of findings – The reviewers believe that through structural and clarifying modifications to the report, significant improvements in the value of the workshop participants' findings can be achieved for the client. For example, the reviewers interpreted ToR1 to mean that the client is specifically asking which fisheries are currently not covered by the regulation within a given area, whether ICES advises including them and, if so, why. While this is answered (only partially in many cases), it is often buried in the text and it is not clear what the justification is. For example, the authors note that all static nets, pelagic and semi-pelagic trawls should be encompassed by the regulation. What is unclear is whether all these gears are 'likely' to have an impact on cetaceans and what would be required; bringing these under observation programmes and the application of mitigation (deterrent) devices or both. All of these gears are deployed in a wide range of areas, including waters up to depths of 600 m (legal maximum depth) in the case of deep-water monkfish and hake fisheries. In all cases, it is the combination of both the gear and its deployment (depth and area) that influence the likelihood of cetacean bycatch. It is possible that ICES could be viewed as advising the inclusion of fisheries that have a low likelihood of capture simply based on the gear type without consideration being given to their operational parameters e.g. depth and area and their potential interaction with cetaceans.

In order to meet the ToR, one reviewer suggested that the authors should therefore have considered all fisheries not covered by 812/2004, including recreational fisheries as a way to logically begin the discussion. In order to get an overview, it would have been very useful to include a table listing both fisheries covered by Reg. 812/2004 and those not covered by the regulation and where bycatch is known/likely to occur. Even fisheries with likely very low bycatch levels would be relevant because they may affect already threatened cetacean populations. Similarly, another reviewer suggested that the report would benefit by the inclusion of a matrix or table of fisheries that shows the workshop participants' views on whether each fishery poses a potential threat to cetaceans and are not currently covered by the regulation. In short, the report should more clearly articulate the areas (geographic) and fisheries (by gear and area) where, consistent with ToR1, measures would be necessary to be applied to reduce the incidental catches of cetaceans. This table should also include fisheries currently covered by the regulation to identify where there is implementation issues e.g. lack of compliance or where current measures are insufficient relative to the 1.7% threshold. See below for a suggested format.

FISHERY	814/2004	THREAT	OBSERVER COVERAGE	FURTHER MEASURES	ADD TO REG?	COMMENTS /JUSTIFICATION
GNS_120_COD_IV_u12	N	H	N	Y (obs)Y (mit)	Y	High effort in area with high population of cets. Bycatch in over 12 m vessels
GNS_220_Monk_VII_14–48 m	N	L	Y	N	N	Low bycatch due to depth of operation results in low interaction. Remove observer coverage

With this information more apparent, the report findings could be restructured focus on those fisheries that workshop participants believe should be covered by Reg. 812/2004 (those which are currently not) or where there are problems with the regulation if applicable, with associated justification.

One reviewer noted that there is considerable text in the report estimating fishing effort and landings for a number of fisheries that are currently covered by the regulation. It is not clear to the reviewers why such detail on these given that they are included in the regulation anyway. Is this to assess if they are in breach of the 1.7% criteria or to justify the inclusion of subcomponents of the m–tier not currently covered e.g. vessels under 12 m for mitigation of under 15 m for observation? It should be made clear where there is emphasis on these fisheries rather than those currently outside the regulation.

Finally, the reviewers noted that the findings in this section of the report should finish with a series of clear conclusions in terms of which fisheries are currently not under Reg. 812/2004, but which should be to address cetacean bycatch and with what mitigation. Where there is an absence of data preventing a clear course with regard to specific mitigation measures, the reviewers suggest that the report indicate where decision-making is significantly limited by the availability of information. Without more firm and definitive conclusions, there is a risk that the client will revert back to ICES for further clarification.

Omissions and Errors – One reviewer also noted a number of omissions in the data. Clearly, there is a significant problem with the bycatch of dolphins are of considerable concern, but the application of DDD's have greatly reduced the take in recent years. It is noted that there is no data from the French bass fishery which caught almost nine times that of the UK in 2004 (Pawson *et al*., 2007), yet there is no attempt to use the dolphin/target catch ratio to provide an estimate of total dolphin bycatch for the entire fishery yet despite the apparent success of the devices used on UK vessels the recommendation from the report is fairly weak in terms of application to other fisheries.

To answer this ToR, it was necessary to review up-to-date information regarding cetacean distribution and abundance. One reviewer noted that the abundance estimates for harbour porpoise given in Table 1 appear incorrect for Skagerrak, Kattegat, Belt Sea and the Baltic. If the numbers for Skagerrak, Kattegat and Belt Sea are added (16 025+6018+14 030) this results in 36 073 for the area, but the SCANS-II 2005 estimate for this combined area was 23 200. Something is not right and this needs to be corrected. If the numbers in Table 1 are not intended to be added together, then this must be clearly indicated and because some of the sea areas appear in more than one region e.g. Belt Seas, some listed regions likely need to be deleted to avoid double counting. It would also help to add the ICES subregion number for each region in Table 1. Further, the estimate given for the Baltic also needs to be corrected (as also pointed out by Mark Tasker in the draft report). Similarly the numbers for the North Sea given in Table 1 for harbour porpoises and other species do not add up to the estimates provided by SCANS-II. All numbers given in Table 1 need to be checked and corrected. Further, a reviewer suggested that the decision to split the harbour porpoises into different regions should ideally be based on information about the genetic population structure and follow the most recent findings (in this case Wiemann *et al*., 2010 *Conservation Genetics* 11:195–211).

A reviewer also noted that the total abundances for striped and bottlenose dolphins given in Table 2 (500 000 and 50 000, respectively) seem arbitrary with very little support given that available estimates only add up to about half of these numbers. It would be more appropriate to give a minimum estimate (and possibly range) for each species (with support of data) and then calculate the 1.7% based on this. The table (without Table number or legend) showing abundance of cetaceans in the Black Sea is also misleading where e.g. an estimate of 100 000 is given for common dolphins based on "preliminary data for some parts of the basin suggest that it is currently at least several 10 000s, and possibly 100 000 or more (Reeves and Notabartolo di Sciara, 2006)." The problem with putting such numbers in a table with associated 1.7% bycatch limits calculated is that they tend to be used as actual estimates. It would be more appropriate and precautionary to put a minimum estimate (and possibly range) of abundance in the Table for which there is some data to support and then calculate the 1.7% limit on this number. Given that the outcome and recommendations of the workshop participants are based on the known distribution and abundance of cetaceans in the area together with information on the fisheries it is imperative that the best, most recent and correct information is used. Therefore the section on cetacean abundance and calculation of 1.7% bycatch limit needs to be corrected and revised. This also means that wherever in the text the information from Tables 1, 2 and Black Sea have been used also need to be corrected.

With regard to the potential impact of recreational fisheries on cetaceans, the reviewers acknowledge the difficulties posed in collecting reliable effort and landings information for such fisheries. Still, given that this could be a potentially substantial portion of the overall fishing effort (depending on the area) that is not covered within the scope of Reg. 812/2004, one reviewer would have liked to see more discussion of potential impacts on this point.

Mentioned in brief within Section 3.8.1, was the issue of cumulative impact with specific reference to comment and striped dolphins captured in the Atlantic region. The reviewers compliment workshop participants for raising this issue, but would have liked to have seen it more broadly emphasized across other species, fisheries, and geographic region, particularly where cetacean species of conservation concern are believed to be found. Where basic data on fishing effort, interactions with cetaceans, and cetacean population structure are largely unavailable, the client's understanding of potential cumulative impacts of multiple fisheries on vulnerable cetacean populations is practically unobtainable. One reviewer suggested that this be considered further by the workshop participants as they synthesize their thoughts on whether certain fisheries should be included within Reg. 812/2004.

ToR2. Provide an evaluation of mitigation measures currently in place and an assessment on the most recent developments of mitigation measures used to reduce the incidental catches of cetaceans, including information on cost

The report provides a good summary overview of devices currently in place and the recent developments. However, a table listing fisheries by area and country where mitigation measures (e.g. pingers) should be implemented and where they actually are being used would be useful. It is clear from the report that there are potentially a number of policy implementation issues relating primarily to control and enforcement. These issues should be brought out in the discussion and conclusions. The background on technical developments is useful and demonstrates that there is considerable ongoing research and commercial developments being undertaken.

Two of the reviewers acknowledged that there is naturally a large focus on pingers as mitigation measure in the report. The reviewers consider this reasonable given that pingers constitute the vast majority of mitigation measures in use now and in further development. Still, the workshop findings highlight many of the ongoing challenges with using pingers, from those related to efficacy to matters of basic compliance. There is a short section (Section 4.7) included about alternative mitigation measures (which also have been covered elsewhere by ICES), but it would have been constructive to include a more comprehensive review of other mitigation measures in the report. For example, there is extensive experience in the US from using time-area closures which may provide useful insights for trials and potential implementation of this mitigation measure in Europe. Further, the potential for using alternative gear to replace gillnets (e.g. fishpots) also need further discussion in the context of the ToR. The consideration of any and all methods for mitigating bycatch is particularly critical for decision-making related to cetacean populations with the most critical conservation status (e.g. harbour porpoise taken in Spanish and Portuguese gillnet fisheries). Reg. 812/2004 considers this by offering dispensation for fisheries using experimental mitigation measures, although as mentioned in the report, the terms of this provision are unclear.

One of the reviewers agreed with the conclusions made by the workshop participants relative the use of pingers as mitigation measures outweighing the unproven collateral effects (e.g. habituation and habitat exclusion) of pingers on cetaceans. Still, there remains a need further resolve some of the remaining concerns with the use of pingers and to emphasize and incentivize the study of other mitigation measures. One reviewer noted that further mention of this was warranted.

ToR3. Following the assessment made in point 4) identify the most efficient mitigation measure for each species concerned by Reg.812/2004 and according to the fishing gear in use

The workshop participants were asked to identify the most efficient mitigation measures for each species. All three reviewers indicated that the workshop participants only partly addressed this ToR. There was no identification of the type of mitigation measure recommended for each species, fisheries and area. Although the group identified the species, general gear type, and wider geographic area, there are no specific suggestions as to the type of device should be applied. It appears that more time and information may be needed to consider the question and this should therefore be revisited by the workshop participants or by some follow-up to the Workshop.

Discussion and conclusion

With regard to Section 6, as with the document more generally, the reviewers recommended that the authors' conclusions be more clearly stated. Overall, the workshop participants should be commended for the large body of work that they have conducted. It was a difficult task given the general lack of detailed information available for many of the fisheries where interactions with cetaceans occur/likely occur. As highlighted in the report "the European fishing effort data are unreliable, unavailable or too difficult to compare and collate for effective management. In particular the standardization of effort data and gear definitions used by member states must be addressed." These issues should be a priority to resolve to allow a full assessment of Reg. 812/2004 to be effectively carried out. Still, the report would benefit from considerable restructuring and "tightening" of the findings. Many statements and some of the information discussed in this section should be moved up to the relevant section of the report (e.g. in Section 6.1 there are a number of paragraphs that directly deal with information presented earlier in the report). Two reviewers noted that the text needs to be edited and where there are qualitative statements, they should be supported by some quantitative data and references, for example the following statement: "The level of gillnet fishing effort in the North Sea has almost certainly declined considerably since the 1990s and with the current scale of activity by the registered fishing fleet there is no conclusive evidence of immediate conservation threat to harbour porpoises".