The Price of Fish: A review of cetacean bycatch in fisheries in the north-east Atlantic

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1. Introduction - Cetacean bycatch in the north-east Atlantic

Bycatch has been described as “perhaps the greatest immediate and well-documented threat to cetacean populations globally” (Reeves *et al.,* 2005). In 2004, WDCS produced a report for Greenpeace entitled “The Net Effect?” (Ross and Isaac 2004) which reviewed cetacean bycatch in pelagic trawls and other fisheries in the north-east Atlantic.

In “The Net Effect?” the lack of information on bycatch rates, cetacean populations (including abundance, distribution and population structures) and fisheries data (such as effort data, location and methods used) is highlighted as a major issue when trying to assess the level of the problem, its significance in terms of conservation and appropriate mitigation measures (Ross and Isaac 2004).

Unfortunately, seven years after the publication of “The Net Effect?”, this lack of information still persists. ICES (2010c) claims that “it is not possible to assess precise levels of cetacean bycatch in European fisheries at present.”

New surveys have been conducted (e.g. SCANS II), and efforts continue aimed at reducing cetacean bycatch through agreements and laws such as ASCOBANS, the Habitats Directive and EU Council Regulation 812/2004. However, many countries are not sufficiently monitoring their fisheries and gaining the data needed to make valuable conservation decisions to protect small cetaceans in the north-east Atlantic.

This report aims to offer a more up-to-date look at population, distribution and bycatch figures for cetaceans threatened by bycatch in the north-east Atlantic. It also looks at recent trials of mitigation methods, considers current legislation and conservation plans and takes a look at the welfare issues involved in bycatch (a topic that was not covered by “The Net Effect?”).

2. Cetaceans Under Threat

2.1 Harbour porpoise (*Phocoena phocoena)*

2.1.1 Population and distribution

In 1994 the SCANS (Small Cetacean Abundance in the North Sea) survey estimated porpoise abundance to be 341,366 animals in an area of 1,030,063km^2 . The SCANS II survey, which took place in 2005, came up with a higher estimate, 385,617, but it must be noted that it covered a larger area

(1,370,114km^2). If only the area of the first SCANS survey is taken into consideration, then the abundance estimate is approximately 335,000 (Hammond 2006).

Although these figures suggest very little difference in harbour porpoise abundance between 1994 and 2005, the distribution of the animals has changed slightly. In 1994, the main concentration in the North Sea was in the northwest but in 2005 it was in the southwest. Increases in sightings of harbour porpoises from the Dutch coast and strandings in the southern North Sea suggest that this distribution difference reflects a real trend. These changes in distribution may have been caused by the availability of prey species (Hammond 2006).

SCANS II is not necessarily representative of harbour porpoise distribution and abundance throughout the year. For example, no harbour porpoises were detected in the Bay of Biscay during the survey, yet harbour porpoises are bycaught in this area (ICES 2010b).

The JNCC (2007) looked at density maps from SCANS and SCANS II and the 2003 "Atlas of cetacean distribution in north-west European waters" and found that there was no evidence of a decline in range in UK waters. In fact, there is evidence of an increase in range with harbour porpoises now being found in certain southern UK waters.

Goodwin and Speedie (2008) report on surveys along the west coast of the UK in 2002, 2003 and 2004 looking at five distinct regions: South West, Wales, Northern Ireland, Firth of Clyde and West Scotland. Population estimates were given for each region (excluding Wales) surveyed in 2004:

Table 1: West coast of UK harbour porpoise population estimates taken from Goodwin and Speedie (2008)

Region	**Time period of survey**	**Number of individual harbour porpoises**
South West*	May and June	163
Northern Ireland	July	387
Firth of Clyde	July	1645
West Scotland	August and September	3105
Wales	-	No data

* Surveys were only conducted on the south coast, so this population may be larger. However results from SCANS and SCANS II suggest this is a small population or one that is widely dispersed.

Though this study was unable to offer a population estimate for Wales, from 2002 to 2004, a 489km^2 area on the north coast of Angelsey, Wales, UK was studied and it was estimated that there is an abundance of 309 harbour porpoises there (Shucksmith *et al.,* 2009).

A study looking at cetaceans in the North Sea off the coast of Aberdeenshire, Scotland, UK, found that harbour porpoises were present throughout the year with more sightings in August and September. Most juveniles and calves were recorded between June and September (Weir *et al.,* 2007). Goodwin and Speedie (2008) point out that along the west coast of the UK, areas surveyed from June onwards may have an increased harbour porpoise sighting rate due to calving at that time of year.

The IUCN Red List of Threatened Species categorises the harbour porpoise population in the Baltic Sea as “critically endangered” (Hammond *et al.,* 2008). This is clearly a population that needs to be studied and protected from bycatch. The SAMBAH (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise) project, which will run from January 2010 until the end of 2014, aims to provide data for the assessment of the abundance, distribution and habitat of the harbour porpoise in the Baltic Sea (CEC 2009b).

Some studies have already been completed in the Baltic. Aerial surveys undertaken between 2002 and 2006 in the southwestern Baltic gave varying estimates of harbour porpoise abundance. In March 2003, the abundance estimate was lowest with 457 individuals. In May 2005, the abundance estimate was highest at 4,610 individuals. For all the other studies, the abundance estimates ranged between 1635 and 2905 individuals. A higher density of harbour porpoises was found in the western and central areas surveyed; east of the Darss ridge porpoise density is extremely low (Scheidat *et al.,* 2008).

Another study looked at the German Baltic Sea from the Kiel Bight to the Pomeranian Bay from August 2002 to December 2005 using long-term passive acoustic monitoring. The porpoise detectors (T-PODs) revealed a decrease from west to east in the percentage of days with porpoise detections. More porpoises were detected in summer than in winter, though they were present all year round (Verfuß *et al., 2007).*

SCANS II confirmed that harbour porpoises tend to avoid deep water and frequent areas not too close to the coast nor too far from it (Hammond 2006). Goodwin and Speedie (2008) also found that during surveys along the west coast of the UK there were more porpoise sightings around the 100m depth contour, possibly due to prey availability. This should be taken into consideration when assessing which fisheries are most likely to impact on the species.

2.1.2 Bycatch of harbour porpoises

According to ICES “there is no comprehensive information on the bycatch of harbour porpoise in fisheries in EU waters. Almost all of the EU gillnet fisheries in the North Sea are conducted without bycatch monitoring programmes, and no recent estimates of total porpoise bycatch (or that of any other marine mammal) exist for the North Sea” (ICES 2008b). In the same report, the technical annex offers a summary of harbour porpoise bycatch around the OSPAR Region II (North Sea). Unfortunately it does not offer many statistics but shows that some North Sea bordering countries are recording bycaught harbour porpoises.

Other, more regionally specific, documents provide further clues to harbour porpoise bycatch levels. These are summarised in the following table (Table 2) and section 2.1.2.1 (Bycatch of Harbour Porpoises in the United Kingdom).

Table 2: Harbour Porpoise Bycatch in the north-east Atlantic (excluding UK)

Country	Region	Dates	Bycatch figures	Source	Comments
Belgium		1999-2007	97 stranded harbour porpoises had died as a result of bycatch	Haelters and Camphuysen 2009	
Belgium		2008	13 out of 62 porpoises found dead at sea/bycaught/washed ashore were probably or definitely bycaught	ASCOBANS 2009b	Some of the carcasses still needed to be studied and many of them had unknown causes of death, so the bycatch figure may be higher still
Belgium		2009	At least 15 out of 66 porpoises found dead at sea/bycaught/washed ashore were bycaught	ASCOBANS 2010a	
Denmark		2009	No estimates of bycatch are given but 137 harbour porpoises stranded in Denmark	ASCOBANS 2010b	It is possible that some of the stranded porpoises died as a result of being bycaught
France		2007	600 harbour porpoises bycaught in ICES areas VIIIa and b in set nets	ASCOBANS 2009b	
France	Mainly ICES Area VIIIa	2007	During observed fishing efforts, 8 porpoises were observed bycaught in set-netters less than 15m	ICES 2009	
France	ICES Areas VII and VIII	2008	49 observed days at sea on pelagic vessels recorded no bycatch. 213 observed days on set-netters less than 15m recorded some bycatch	ICES 2009	

Germany	northernmost section of the German Baltic coast (Angeln and Schwansen in Schleswig-Holstein)	1987-2008	Of 247 harbour porpoise carcasses, 167 were clearly identified as bycatch. It is concluded that for the German Baltic coast, there would have been 51 bycaught porpoises in 2005, 82 in 2006 and 150 in 2007	Koschinski and Pfander 2009	
Germany	German Baltic coast	2007	69 stranded harbour porpoises had been bycaught	Herr 2009	many stranded individuals were in such a state of decay that cause of death could not be determined, and, therefore, bycatch numbers may be much higher
Germany	German Baltic coast	1996-2002	Of 185 dead habour porpoises stranded, 42 were bycaught. 57 harbour porpoises are being taken each year in the Western Baltic and 25 in the Central Baltic	Rubsch and Kock 2004	
Germany	North Sea	2007	1 harbour porpoise bycaught and out of 140 animals necropsied, 2 were diagnosed as possible bycatch	ICES 2008b	
Germany	Mecklenburg-Vorpommern	2009	52 harbour porpoises were recorded as stranded or bycaught	ASCOBANS 2010c	Porpoises have only been partially necropsied
Germany	Lower Saxony	2009	56 harbour porpoises were recorded as stranded	ASCOBANS 2010c	Necropsies have been postponed. Some of these strandings may be bycatch
Germany	Schleswig-	2009 (data	262 harbour porpoises	ASCOBANS	Causes of death not recorded

	Holstein	recorded until 04.02.10)	necropsied	2010c	
Ireland	Celtic Sea	2005-2007	355 harbour porpoises estimated bycaught	ICES 2008a	
Netherlands		1990-2000	130 stranded harbour porpoises were investigated. 58% were bycaught.	Haelters and Camphuysen 2009	
Netherlands		2006	Of 38 necropsied harbour porpoises whose cause of death could be established, 64% had died due to bycatch	Haelters and Camphuysen 2009	
Netherlands		2008	1 harbour porpoise was observed to be bycaught during monitoring programmes.	ASCOBANS 2009b	300 animals were found stranded along the Dutch coast. Of these, 82 were necropsied and, though statistics are not yet available, many of these animals were the victims of bycatch
Netherlands		2009	478 harbour porpoises stranded on Dutch beaches. 92 of them were necropsied. 41% of them died as a result of bycatch	ASCOBANS 2010d	
Norway		2006	149 harbour porpoises bycaught by coastal gillnet vessels	ICES 2008b	
Poland		2009	The Monitoring Incidental Catch of Cetaceans Scheme did not record any porpoise	ASCOBANS 2010e	There has been some bycatch and stranding of harbour porpoises in Poland but exact

			bycatch.		figures are not given.
Sweden	Swedish part of Skagerrak	2001	Estimated 25 harbour porpoises taken each year by bottom trawls	ASCOBANS 2009b	
Sweden	Swedish Kattegatt Sea	2001	Estimated 89 harbour porpoises taken each year in gillnets, trammel nets and pelagic trawls	ASCOBANS 2009b	
Sweden	North Sea, Skagerrak/Kattegatt, Southern, Eastern and Northern Baltic	Sept 2006 – Dec 2007	No bycatch recorded by observers in pelagic trawl and set net fisheries	ASCOBANS 2009b	
Sweden	Baltic and Swedish west coast	2008	26 dead harbour porpoises sent to Swedish Museum of Natural History. Most had signs of having been caught in fishing gear	ASCOBANS 2009b	
Sweden		2009	21 dead harbour porpoises were examined at Swedish Museum of Natural History. At least 4 had died from drowning	ASCOBANS 2010f	Due to state of decomposition cause of death could not be determined for all porpoises

2.1.2.1 Bycatch of harbour porpoises in the United Kingdom

Gillnet and tangle net fisheries from the UK are responsible for some of the harbour porpoise bycatch in the Celtic Sea and the Southwest (see Table 3).

Monitoring of UK fisheries under Council Regulation 812/2004 of the European Commission found that in 2008 (and for the fourth year running), no cetacean bycatch was observed (SMRU 2009). However, during monitoring that took place outside of the requirements of Regulation 812/2004, 24 harbour porpoise bycatches were observed in set net fisheries in the southwest in 2008 and this figure, along with fishing effort, was used to estimate bycatch for the whole year in fisheries which had recorded bycatch rates (see Table 3).

Table 3 - Estimates of harbour porpoise bycatch in UK fisheries 2005-2008

Year	Fishery	Area	Estimated number of bycaught animals	Source	Notes
2005-2006	Pelagic trawl and static nets	ICES area VII	460-730	Northridge *et al.* 2007	0.15% of UK vessels fishing effort was monitored and 20 harbour porpoises were observed bycaught in tangle nets and gillnets
2007	Trammel net, gillnet and tangle net	Southwest (ICES Areas VIIadefghj)	592	SMRU 2008	
2008	Gillnet and tangle net	Southwest (ICES Areas VIIadefghj)	838	SMRU 2009	

The 2005-2006 UK fishing season in the North Sea recorded no harbour porpoise bycatch (ICES 2008b). In 2008 in the North Sea (ICES area IVc) 2 harbour porpoises were bycaught in bass gillnets (SMRU 2009). This may reflect the fact there there has been a shift in harbour porpoise distribution in the North Sea as recorded by SCANS II (Hammond 2006).

In 2009, 50 harbour porpoises were necropsied and 6 of them were considered to have died due to bycatch (ASCOBANS 2010g).

2.2 Common dolphin (*Delphinus delphis*)

2.2.1 Population and distribution

SCANS II (which covered an area of 1,370,114km^2 in the North Sea and European Atlantic continental shelf waters) estimated abundance of common dolphins at 63,366 in 2005. Abundance was concentrated off the coast of Ireland, in the Celtic Sea and western Channel, and the coasts of Spain and Portugal. Also in 2005, ICES had estimated the abundance of common dolphins in the entire north-east Atlantic at 500,000 (ICES 2008a).

Surveys in an area of 968,000km^2 off the continental shelves of Britain, Ireland, France and Spain in July 2007 estimated abundance of common dolphins at 116,709 (CODA 2009). The results from these surveys also showed that more common dolphins were found in the southern half of the survey area. This is something to be considered with regards to bycatch. Trawlers fishing in the southern part of the survey area during the summer are far more likely to encounter common dolphins.

Common dolphins generally prefer offshore areas (Hammond 2006). ICES (2010b) states that in the north-east Atlantic common dolphins are more dispersed in deeper offshore waters from May to October. During November to April they are found in greater numbers in the shelf waters in the western English Channel and further offshore in parts of the Celtic Sea. Surveys in the winters of 2004 and 2005 in the western approaches of the English Channel estimated the abundance of common dolphins at 3055 in that area (WDCS/Greenpeace 2006).

2.2.2 Bycatch of common dolphins

Approximately 800 common dolphins are bycaught in EU pelagic trawl fisheries in the north-east Atlantic each year (Northridge 2006). If bycatch in other fisheries were included, this figure would, of course, be much higher.

Results from the PETRACET project estimated that about 620 common dolphins were bycaught per year in three pelagic trawl fisheries in the western Channel, Celtic Sea and Bay of Biscay. Other fisheries had zero bycatch during the study period, but were considered likely to have some level of bycatch (Northridge *et al.,* 2006).

Northridge *et al.* (2007) estimates that between 2005 and 2006, about 410 - 610 common dolphins died in pelagic trawl and static net fisheries in ICES area VII.

Sampling of pelagic trawl fisheries in sub-areas VI and IV suggested that bycatch rates there are low. The direct observations from this study saw 13 common dolphins bycaught in tangle nets and 3 in gillnets, but the majority (164) were bycaught in bass pelagic trawls.

Table 4 shows the estimated numbers of common dolphins bycaught in specific UK fisheries between the end of 2004 and 2008.

Table 4 - Estimates of common dolphin bycatch in UK fisheries 2004-2008

Year	**Fishery**	**Area**	**Estimated number of bycaught animals**	**Source**	**Comments**
2004-2005 winter season	Bass pair trawl fishery	Western Channel	139	Northridge 2006	
Oct 2005-5 April 2006 winter season	Bass pair trawl fishery	Western Channel	84	Northridge 2006	Over 90% of bass pair trawl fishing was monitored (77 common dolphins observed bycaught). 2 hauls bycaught more than 12 dolphins each
2006-2007 winter season	Bass pair trawl fishery	VIIe	Between 50 and 100	SMRU 2008	
2007	Trammel net, gillnet and tangle net	Southwest (ICES Areas VIIadefghj)	114	SMRU 2008	
2008	Gillnet and tangle net	Southwest (ICES Areas VIIadefghj)	594	SMRU 2009	

Northridge and Kingston (2009) remind us that common dolphin bycatch in gill and tangle net and pelagic trawl fisheries in the UK should not be considered in isolation. This population is also at risk in Irish, Spanish, French and Portuguese waters. Pair trawling for albacore by French fisheries in ICES area VII was responsible for approximately 57 common dolphin deaths during 2006 (ICES 2008a).

ICES also states that since 2004 there have been a lot of common dolphin strandings along the French and Spanish Atlantic coasts (ICES 2010b). Some of these may be bycatch victims. In the UK in 2009, 15 common dolphins were necropsied and of these, 9 were considered to have been bycaught (ASCOBANS 2010g).

2.3 Other species

2.3.1 Population and distribution

Surveys in an area of 968,000km^2 off the continental shelves of Britain, Ireland, France and Spain in July 2007 estimated abundance of striped dolphins (*Stenella coeruleoalba)* at 67,414; bottlenose dolphins (*Tursiops truncatus)* at 19,295 and long-finned pilot whales (*Globicephala melas*) at 25,101 (CODA 2009).

2.3.2 Bycatch of other species

Though harbour porpoises and common dolphins are the most commonly bycaught small cetaceans, other species are also at risk.

The French report to the ASCOBANS 16th Advisory Committee meeting estimates that 40 striped dolphins, 50 bottlenose dolphins and 10 long-finned pilot whales were bycaught in the summer of 2007 in ICES areas VII and VIII by pelagic trawlers (ASCOBANS 2009b).

Bottlenose dolphins are not bycaught regularly in UK fisheries, but there are incidents recorded. For example, in 2008 (and for the second year in a row) a single bottlenose dolphin was caught in set nets in the western English Channel (SMRU 2009).

3. Fisheries associated with Bycatch

“The Net Effect?” offers a comprehensive overview of the fisheries associated with bycatch but since it was written there have been changes in various fisheries and fishing effort in the north-east Atlantic. This section offers a more up to date look at pelagic trawls, bottom-set gillnets and driftnets, paying particular attention to the UK.

3.1 Pelagic trawls

Certain pelagic trawl fisheries have high bycatch rates. During a study of the bass fishery in the Bay of Biscay from December 2003 to May 2005, 75 dolphins were bycaught in only 13 tows. Eight of these tows took place in a relatively small area off the coast of Brittany showing that at certain times and in certain places, bycatch levels can be exceptionally high (Northridge *et al.,* 2006).

During the entire study period of the PETRACET project which looked at pelagic trawls in the western Channel, Celtic Sea and Bay of Biscay (ICES areas VII and VIII), 93 cetaceans were taken in 21 of 952 observed fishing operations. It is estimated that between 1900 and 1950 cetaceans are bycaught in fisheries operating in these areas each year. 96% of them are likely to be common dolphins. It is important to note that this study was focused on fisheries which have high levels of bycatch i.e. bass, tuna and anchovy and therefore estimates of bycatch may be biased upwards (Northridge *et al.,* 2006).

Although the PETRACET project concluded that the number of common dolphins being bycaught probably did not pose a conservation threat, it did point out that other fisheries operating in the area were probably incidentally taking common dolphins as well, and therefore the risk may be greater than that suggested from this 18 month study (Northridge *et al.,* 2006).

The ICES Study Group for Bycatch of Protected Species (SGBYC) highlights the fact that we do not fully understand how cetaceans interact with pelagic trawl fisheries and why they are sometimes bycaught. This lack of insight makes it difficult to find suitable mitigation techniques (ICES 2008d).

In the USA, the Atlantic Trawl Gear Take Reduction Team (ATGTRT) also recognises that it is important to fully understand interactions between trawl fisheries and marine mammals. It recommends that fishery observers should characterise cetacean behaviour in as much detail as possible during the different fishing vessel operations e.g. vessel in transit, setting nets, hauling nets. It also suggests using cameras and sonar to document cetacean behaviour around trawl nets (ATGTRT 2008).

3.1.1 Irish and UK pelagic trawl fisheries

Southall *et al* (2009) state that the Irish pelagic fleet consists of 22 RSW (Refrigerated Seawater) registered vessels and that no cetacean bycatch has been seen by independent observers in the Irish pelagic mackerel trawl fishery.

In December 2004, the UK government banned pelagic pair trawling for bass within 12 miles of the coast of the southwest of England (ICES area VIIe). The UK asked the European Commission to extend this ban to include vessels from other Member States fishing between 6 and 12 miles off the southwest English coast. This request was refused. The limited UK bass fishery operating further out than 12 miles is being monitored for bycatch (DEFRA 2009b).

Barclay (2009) quotes the EU Fisheries Commissioner Joe Borg:

> *the Commission considered, on the basis of data available, that it could not be argued that the bass pair trawl fishery poses an immediate risk of cetacean population decline in the short term which is of such a serious and non-reversible nature as to justify the adoption of emergency, and possibly disproportionate or discriminatory measures.*

It has been suggested that after the ban of pair trawling within 12 miles of the UK coast, bycatch was reduced. In the season before the ban 429 common dolphins were bycaught and in the following season (2004/2005) about 140 (Barclay 2009).

In 2005, it is estimated that 3146 tows took place in ICES areas IV, VI, VII and VIII (Northridge *et al.,* 2007). In 2006, 1768 tows were estimated to have taken place. This decrease in pelagic trawl effort was largely due to a reduction in mackerel and herring fishing in Scotland following legal changes to try and reduce over-fishing. In 2007, 2357 days were spent at sea using towed gear by UK fisheries with a total of 1866 hauls recorded (SMRU 2008). In 2008, 1519 days were spent at sea using towed gear by UK fisheries with a total of 1205 hauls recorded (SMRU 2009).

In 2007, 64 UK registered vessels were fishing with pelagic trawls (SMRU 2008). In 2008, this figure had dropped to 52 (SMRU 2009). In 2008 approximately 25% of days at sea were carried out by pair trawls (SMRU 2009).

During observations of the UK bass pair trawl fishery in ICES area VII in 2005 and 2006, 164 common dolphins were observed as bycatch. However it was estimated that 196 dolphins had been bycaught in total (Northridge *et al.,* 2007).

Northridge (2006) points out that though pelagic pair trawl boats hardly fished at all from January to March 2006, there were still a great number of cetaceans stranding on the southwest coast of the UK at that time, suggesting that this fishery is not responsible for the majority of strandings.

Table 5 shows a summary of bycatch rates by season.

Table 5: Observed Dolphin Bycatches and Bycatch Rates by Season in UK bass fishery

Season	**Hauls**	**Hauls with bycatch**	**Mortalities**	**Bycatch rate**	**% hauls with bycatch**
2000-2001	91	11	52	0.57	12.09%
2001-2002	91	3	9	0.1	3.30%
2002-2003	113	6	26	0.23	5.31%
2003-2004	131	36	169	1.29	27.48%
2004-2005	152	35	95	0.63	23.03%
2005-2006	54	9	77	1.43	16.67%
Totals	**632**	**100**	**428**	**(0.68)**	**(15.82%)**
Weighted mean:				**0.71**	**14.64%**

From Northridge 2006

3.2 Bottom-set gillnets

There is some expectation that, in the future, fishermen will start using gillnets more and that trawls will be used less. This is partly because of the knowledge that bottom trawling is detrimental to many species and habitats, but also due to economic factors. Trawlers use more fuel and with increases in fuel prices in recent years, fishermen may be tempted to change their methods of fishing (Haelters and Camphuysen 2009).

3.2.1 UK bottom-set gillnets

Harbour porpoises and common dolphins bycaught in the Celtic Sea and the western English channel in 2008 were mainly caught in monkfish and hake nets (SMRU 2009). In over 3000 observations of UK fishing operations in the Irish Sea, Celtic Sea and English Channel between 2005 and 2008, common dolphin bycatch was only recorded in nets fishing for hake, monkfish, turbot and pollack. No bycatch was observed in sole, bass or mullet static nets (Northridge and Kingston 2009).

An estimated 90,972 hauls were made using gillnets and 23,552 using tangle nets during 2005 in ICES areas IV, VI, VII, VIII and in other waters. (Northridge *et al.,* 2007). In 2006 in the same areas, gillnets accounted for an estimated 113,024 hauls and tangle nets for 47,973. The increase in static net effort has largely been in the Southwest and North Sea among small boats targeting tangle net species. During 2005 and 2006, 20 harbour porpoises and 16 common dolphins were observed bycaught in static gear in ICES area VII (Northridge *et al.,* 2007).

In 2007, 374 days were spent at sea by static net fishing boats in areas VIa, VIIabef and VIII. The number of hauls was not available (SMRU 2008). In 2008, 324 days were spent at sea by static net fishing boats in areas VIIbe and VIII (SMRU 2009).

3.2.2 Dutch and Belgian bottom-set gillnets

Belgium and the Netherlands are not known as gillnetting nations. In Belgium only 3 or 4 fishing vessels use gillnets and tangle nets. However, in the Netherlands between 60 and 70 vessels regularly use them and this number is on the increase. Danish vessels using gillnets are also known to fish in Dutch and Belgian waters (Haelters and Camphuysen 2009).

Gillnets in the southern North Sea are targeted at sole and other flatfish from March to November. The fisheries target cod in the winter and bass in the summer (Haelters and Camphuysen 2009). The WAKO II project is looking at the effects of trammel net fisheries on various ecosystem components including marine mammals in the Belgian Part of the North Sea (WAKO II 2010).

3.3 Driftnets

In 2004, with the accession of Poland, Estonia, Latvia and Lithuania to the EU, driftnet restrictions became applicable to the Baltic Sea areas under EU control (Caddell 2010).

Council Regulation 812/2004 introduced gradual restrictions on driftnets. In 2005, Member States were allowed to authorise the storage on board or the use of driftnets on no more than 60% of the fishing vessels which had used driftnets between 2001 and 2003. In 2006, a maximum of 40% of those vessels could be authorised and in 2007, only 20%. Since 1st January 2008 it has been prohibited to keep driftnets on board, or to use them for fishing (CEC 2004).

In line with the legislation, the UK’s use of driftnets was reduced until no UK fishing vessels were using driftnets. An estimated 3178 hauls using driftnets were made during 2005 by UK fisheries in ICES areas IV, VI, VII, VIII and in other waters. In 2006, 5838 driftnet hauls took place (Northridge *et al.,* 2007). During 2007, a single UK boat made three trips (amounting to nine days at sea) to try and catch sea bass using a driftnet in areas VIIe and VIIf. At the end of the season the vessel’s owner sold the nets (SMRU 2008).

Some fisheries are still using nets which greatly resemble driftnets but which have minor technical modifications meaning they can be designated as set-nets. In Poland “semi-driftnets”, for example, are used for seatrout and salmon fishing and are likely to be responsible for some bycatch (Caddell 2010 and ICES 2009). French “thonaille” nets were, controversially, used by French fishing fleets to catch Atlantic bluefin tuna and swordfish even after the ban on driftnets was put in place. In 2009 two cases were brought against France for alleged driftnet infringments. France claimed that the thonaille was not a driftnet but the European Court of Justice concluded that the thonaille should be considered a driftnet and that France had failed in its obligations to monitor, inspect and control the use of such nets (Caddell 2010).

4. Measures to reduce bycatch

4.1 Acceptable levels of bycatch

There are several different methods for calculating what are considered to be sustainable numbers of cetacean bycatch. The Scientifc Committee of the International Whaling Commission reviewed bycatch of harbour porpoises in 1995 and expressed concern for the conservation status of any small cetacean with estimated bycatch greater than 2% of a best estimate of abundance (ICES 2008d).

At the Third MoP of ASCOBANS in 2000, it was agreed that bycatch of more than 1.7% of the best available estimate of abundance was unacceptable and that in some cases even a removal of less than 1.7% would be unacceptable (Ross and Isaac 2004). In 2006, at the Fifth MoP, ASCOBANS reiterated that a precautionary objective should be to reduce bycatch to less than 1% of the best estimate of abundance (ICES 2008d).

Winship (2009) points out that this approach does not take into account possible errors in bycatch and abundance estimates or uncertainty with regard to population dynamics.

In the USA, the limits of sustainable takes are determined using the PBR (Potential Biological Removal) index (ICES 2008d). This is the maximum number of animals, excluding natural mortalities, that can be removed from a marine mammal stock while still allowing that stock to reach or maintain its optimum sustainable population (NOAA 2010c).

Using the abundance estimates from SCANS II, the ICES Study Group for Bycatch of Protected Species (SGBYC) calculated the take limits according to each criteria.

Table 6 - Annual take limits for SCANS II area

Species	Abundance Estimate	PBR	1%	1.7%	2%
Harbour porpoise	385,617	3264	3856	6555	7712
Common dolphin	63,366	438	634	1077	1267
White beaked dolphin	22,655	161	227	385	453
Bottlenose dolphin	12,645	101	126	215	253
Minke whale	18,614	145	186	316	372

From ICES 2008d

The SGBYC also considered how these figures should be interpreted. Rather than using the take limits as a 'quota' which can be reached and then having the fishery closed, fisheries should be encouraged to work towards bycatch reduction targets (ICES 2008d).

In European waters, individual cetacean populations may be threatened by different fisheries (pelagic trawls, gillnets, tangle nets) and by vessels from different countries. Bycatch reduction targets need to consider each fishery individually depending on their bycatch rates, rather than expecting all fisheries from all countries to reduce their bycatch by a fixed proportion or to a fixed limit which could be unfair or impractical for some fisheries (ICES 2008d).

4.2 Technical mitigation measures

4.2.1 Exclusion devices

"The Net Effect?" details the early trials of a dolphin exclusion device whereby a grid within a trawl net allows dolphins to pass through an escape hatch instead of getting caught in the net. The targeted fish species passes through the grid and therefore gets caught. Use of these grids seemed to reduce dolphin bycatch though no animals were seen to use the escape hatch; rather that the existence of the grid deterred the dolphins from entering the net in the first place (Ross and Isaac 2004).

Studies in 2004-2005 found that some dolphins did use the escape hatches, but that others still drowned in the nets. This may have been because they entered the nets, sensed the grid and tried to get out of the net before they had reached the escape hatch (there was only one hatch of $6m^2$) or because they had reached the escape hatch but had not realised it was there (Northridge 2006).

The following season nets were developed which offered more escape options for dolphins. This time, instead of an escape opening of $6m^2$, there were a number of openings which totalled more than $200m^2$ in area. These nets were trialed along with a prototype interactive acoustic deterrent device which was triggered by dolphin clicks and aimed to prevent dolphins entering the nets. Overall 62 days at sea were monitored in the UK bass fishery in the western Channel between October 2005 and April 2006. During this time, 77 common dolphins were bycaught and died in the nets. One pilot whale was caught but was released alive (Northridge 2006).

The EU project NECESSITY which ran from 2004 to 2007 aimed to "develop ways of modifying trawls to enable bycatch species to escape from the trawl unharmed". Bycatch included non-target fish species as well as cetaceans (NECESSITY 2007).

Selection devices were trialed which had cut-away top panels, large mesh top panels or square mesh windows so that non-target species could escape, as well as devices to block the passage of non-target species and to guide them out of the net i.e. inclined separator panels and rigid sorting grids (NECESSITY 2008).

The devices were found to be most effective when placed as far forward in the trawl as possible. However, in some trials the drag caused by the device was found to be unacceptable by the fishery. Some devices resulted in the loss of too many target fish (NECESSITY 2008).

The NECESSITY project reports that cetaceans which escape from trawls with exclusion devices are highly likely to survive, but that some animals have been observed in an exhausted state in front of exclusion devices and their survival chances are considered low. The project recognised that exclusion devices can help minimise bycatch but that they do not prevent all bycatch. Tests found an overall reduction in bycatch of 20%. Further designs need to be tested but, in seasonal fisheries, this takes time. Acoustic deterrent devices may offer a more immediate solution (NECESSITY 2008).

4.2.2 Acoustic deterrent devices (pingers)

Council Regulation 812/2004 requires the use of acoustic devices in areas and fisheries "with known or foreseeable high levels of bycatch of small cetaceans, taking into account the cost/efficiency of such requirement." It also asserts that studies are needed to look at how acoustic deterrent devices work over time (CEC 2004).

The Regulation details the fisheries where the use of acoustic deterrent devices is mandatory and the technical specifications and conditions of use of the devices (CEC 2004). However, many fisheries are not complying. ICES (2010d) points out that there are no official records of the number of boats carrying deterrents.

Denmark reports 30 vessels using pingers, whilst Sweden has 9 vessels in the Baltic using pingers (ICES 2008d). Fishermen on the west coast of Sweden have reported that pingers do reduce harbour porpoise bycatch (ASCOBANS 2010f). In Poland, 500 AQUATEC AQUAAmark 100 pingers were purchased and distributed to fishermen with vessels of 12m or more in length in January 2009 (ASCOBANS 2010e).

In UK waters, to comply with Regulation 812/2004, at least 25 UK vessels should be using pingers. In 2008, 21 of them fished in ICES areas VIIefghj and 5 in IV (one of them fished VII and IV). Only a few of the vessels in area VII were using pingers. (SMRU 2009). Concerns over effectiveness, reliability and safety of the devices are reasons cited for the lack of use (SMRU 2008, SMRU 2009).

To determine which vessels and nets in the North Sea should be using pingers, the length of each individual string of nets needs to be recorded, but this detail is often not available in the Fishing Activity Database. SMRU did not have information regarding the number of vessels fishing in area IV using pingers in 2008 (SMRU 2009).

However, the UK Small Cetacean Bycatch Research Strategy aims to have pingers on all UK set net fisheries using a mesh size greater than 220mm in ICES areas IVb and IVc. According to DEFRA (2009a) this aim has been achieved. The Strategy also recommends a legal obligation to have pingers in the North Sea set net fishery but DEFRA states that is has not been possible to identify how many vessels of more than 12m use set nets of less than 400m in the North Sea.

Some studies have shown that different species of cetacean respond differently to different acoustic deterrent devices (Carretta *et al.,* 2008; Kastelein *et al*., 2006). Balle *et al.* (2009) point out that bycatch reduction is not consistent across species, fisheries or pingers and therefore the use of the devices should not be considered as a solution to the bycatch problem.

In one study, a striped dolphin and a harbour porpoise were simultaneously subjected to sounds from the Netmark XP-10 experimental acoustic alarm. The harbour porpoise swam away from the alarm, swam faster than when the alarm was not being sounded and swam nearer to the surface. It also increased its rate of respiration whereas no reaction was recorded in the striped dolphin. It is therefore necessary to adapt acoustic devices to the species being deterred and to test the device on different species (Kastelein *et al*., 2006).

ICES (2010d) states that there are limited experimental results on the effects of commercially available pingers on bottlenose and striped dolphins.

Kastelein *et al.* (2008) found that ultrasonic pingers (70 kHz), which did elicit a response from harbour porpoises, had no or less effect on other marine animals which are often sensitive to low frequency sounds and that they did not attract pinnipeds as some acoustic devices do.

Balle *et al.* (2009) point out that acoustic deterrent devices may not be effective in the long term as cetaceans become habituated to the sound or begin to associate it with food regarding the pingers as “dinner bells”. It may be, therefore, that after an initial reduction in bycatch there is, later, an increase as the animals are no longer deterred by the sounds.

Leeney *et al.* (2007) trialed continuous and responsive pingers on bottlenose dolphins. In the trials where pingers were deployed from a moving boat, both types of pingers appeared to affect the dolphins’ behaviour, making them immediately leave the area at speed.

The cost of pingers is an important issue for fishermen. They cost between 50 and 100 Euros per device and a fisherman may require between 50 and 100 devices depending on the type of gear he is fishing with. In the USA, some gillnet fishermen have suggested that gear modifications are more cost effective than purchasing pingers (ICES 2008d). Some studies have shown that pingers can still be effective when spaced further apart, this would mean a reduction in the number of pingers required. For example, in Ireland, the government has increased the maximum spacing of pingers from 200m to 500m (ICES 2009). Additional costs include maintenance, battery replacement and replacement of units due to loss (ICES 2010d). Some countries have grants available to fishermen for purchasing pingers or offer the pingers free of charge.

Balle *et al.* (2009) point out that some studies have shown that target species may also be deterred by pinger sounds, thereby making the use of pingers unattractive to fishermen.

ICES (2009) describes a plan to use a line of pingers across the entrance to Puck Bay in Poland when there is to be intensive fishing to try and reduce bycatch by deterring porpoises from entering the Bay. This area is known to have a high level of bycatch.

Further research is needed to try and determine how and why acoustic deterrent devices affect cetaceans in order to make them more effective. Balle *et al.* (2009) summarise some of the potential reasons. It may be that cetaceans find they cannot echolocate in areas where acoustic deterrent devices are being used and therefore choose not to enter those areas. It may be that the pingers simply alert the cetaceans to the presence and situation of the nets and therefore help them to orientate themselves and avoid entanglement (this would not necessarily stop the cetaceans from feeding on the fish caught within the nets). It has also been suggested that the pingers elicit a startle response in the cetaceans which makes them move away from the area.

Another issue which needs to be considered in the design of acoustic deterrent devices, is the potential impact on the cetaceans during the deployment of the device. Depending on the signal length, source level and signal frequency, the cetaceans may not only be disturbed but they may experience pain (Balle *et al.,* 2009).

ICES recommends that manufacturers need to be encouraged to improve the reliability and robustness of their pingers. They also need to provide affordable methods for ensuring that the devices are working (ICES 2010e).

4.2.2.1 Acoustic deterrent devices (pingers) in set nets

EU Council Regulation 812/2004 states that “some acoustic devices have been developed to deter cetaceans from fishing gear, and have proven successful in reducing bycatch of cetacean species in static net fisheries” (CEC 2004).

“The Net Effect?” mentions a trial in September 2003 using pingers in the Celtic Sea hake fishery (Ross and Isaac 2004). Further trials took place in 2005 (Seafish 2005) and an extension trial took place in February and March 2006 looking at the Aquamark 100 and the Fumunda FMPD - 2000 as these had previously proven to be the most successful pingers and the manufacturers had recently made some changes to the designs (Seafish 2006). These trials found that pingers are becoming more robust and reliable. After the trial, all pingers returned a signal and battery life was 19 months for the Fumunda and 40 months for the Aquamark. However, issues regarding attachment, deployment, long term reliability and costs have not been completely resolved.

As “The Net Effect?” noted, there are a number of practical problems associated with the use of pingers. Recent trials suggest that in the UK, pingers may not be compatible with the South West offshore netting fishery as they often get entangled within the fishing nets which makes them a safety hazard for the crew. Fishermen have suggested that deploying the pingers on different parts of the net, e.g. the bridle ends, may stop entanglements. However further trials are necessary to ascertain whether the pingers are still effective when deployed on different parts of the nets (Seafish 2006).

The Jastarnia Plan (see also section 6.1.2.1) update of 2009 recommends that for the Baltic Sea “pinger use should now immediately be made mandatory in probable high-risk areas and fisheries associated with bycatch of harbour porpoises on a short-term basis (no more than 3 years) irrespective of vessel size” (ASCOBANS 2009d). The Plan recognises that the use of pingers does not result in zero bycatch but as set-nets are going to continue to be used for the next few years, pingers should be used to help reduce bycatch.

ICES (2010d) advises that acoustic deterrent devices using basic tonal 10 khz signals and more complex multi-signals on set nets are effective in reducing harbor porpoise bycatch. However, they have not found that pingers are effective in reducing common dolphin bycatch in static gear over the long term.

The Jastarnia Plan highlights some of the main concerns about pingers. It is difficult and costly to monitor the effectiveness of pingers especially as small fishing vessels are often unable to carry observers. Another concern is that the use of pingers will displace harbour porpoises from key habitat, but this risk is considered worthwhile when compared with the risk of entanglement in fishing gear. Pingers can also increase conflict between fisheries and seals. This problem may be solved by using interactive pingers (ASCOBANS 2009d).

The Jastarnia Plan also highlights some important processes that need to be carried out with the introduction of pingers. It must be ensured that the pingers are being used correctly at sea. Bycatch monitoring is a key part of any pinger programme. During the first year of pinger use a study needs to be undertaken in order to estimate the potential extent of habitat exclusion for the Baltic. After 3 years it should be expected that pingers will be replaced with a longer-term mitigation method (ASCOBANS 2009d).

A study looking at bottlenose dolphin interactions with gillnet fisheries along the east coast of the United States found that the use of Dukane NetMark® 1000 alarms did deter some dolphins from approaching the net. However, other individuals were not affected. It appeared that the dolphins were aware of the nets whether or not the alarms were deployed and that they approached the nets in order to take fish from them or to take fish discarded by the fishing vessel (Cox *et al.,* 2004).

Another study which looked at the Dukane NetMark® 1000 found that harbour porpoises were affected at greater distances than previously observed. It was concluded that pingers could be an effective way to reduce bycatch but that other solutions should be used in ecologically important habitats and along migration routes (Carlström *et al.,* 2009).

Gazo *et al.* (2008) found that bottlenose dolphins were not deterred from approaching trammel nets by pingers but that nets with functional pingers received less damage than nets with non-functional devices or without pingers.

ICES (2009) reports that trials in the southwest of the UK using the Dolphin Dissuasive Device (DDD-02F-STM Products) on gillnets have had promising results and that they may have a deterrent effect out to 2km.

4.2.2.2 Acoustic deterrent devices (pingers) in pelagic trawls

Pingers that may be effective on set nets are not necessarily going to have the same results on trawl nets (Balle *et al.* 2009). Trawling generates a lot of noise itself (engine and monitoring equipment noise and mechanical movement of the trawl gear) which has to be taken into consideration when designing pingers to go on trawl nets.

Tows in UK fisheries observed from 2006 to 2008 which were using the Dolphin Dissuasive Device (DDD-02F-STM Products) had a zero bycatch rate while tows without devices or where the devices were not working had high bycatch rates (SMRU 2009). Further observations need to be carried out, but this suggests that the devices are effective to a certain extent.

Trials using the CETASAVER device manufactured by IFREMER have also reported some reduction in bycatch suggesting the device is between 50% and 70% effective (NECESSITY 2008, ICES 2009).

Trials on pelagic trawl nets with escape hatches in the 2005-2006 season also trialed a prototype acoustic deterrent device developed by BIM on two tows. The pinger was specially designed to work in pelagic trawls and was to be activated when dolphin clicks were detected. During use of the device, 15 dolphins were bycaught, showing it to be ineffective at present. Other tests have shown that common dolphins are not affected by the signal, though bottlenose dolphins do react to it (Northridge 2006).

The effectiveness of acoustic devices varies between species, location and may even be affected by the activity the cetaceans are involved in. For example, foraging common dolphins in the Celtic Sea and Alboran Sea were not deterred by devices which did deter common dolphins that were travelling in the Bay of Biscay (NECESSITY 2008).

Studies on the use of acoustic deterrent devices in the French and British sea bass fisheries showed bycatch reductions of 40-80% on hauls with pingers compared to those without (NECESSITY 2008). Further trials are necessary to further determine the effectiveness of the devices.

4.2.3 Alerting sounds and visual cues

Research during the summer of 2006 in the Danish hake fishery used artificial porpoise click trains as alerting sounds to try to reduce bycatch. Conventional gillnets were used, half of which had PAS (Porpoise Alerting Sound) pingers attached at 130m intervals and the other half had dummy pingers. No statistical difference in bycatch was recorded between the nets with pingers and those without. Further tests on the efficiency of the pingers led to the conclusion that they would not help reduce bycatch. However, it is possible that an alerting pinger which could stimulate porpoises to a higher click rate might help reduce bycatch in the future (Kindt-Larsen 2008).

The Atlantic Trawl Gear Take Reduction Team has recommended looking into the use of predator vocalizations (e.g. killer whale) to alert small cetaceans as well as visual cues such as lights, light sticks and reflective rope (ATGTRT 2008).

4.2.4 Net modifications and length limits

"The Net Effect?" describes efforts made to use different material for gillnets in an attempt to reduce bycatch. Further studies have been conducted. One study found that porpoises were able to detect nets made of barium sulphate and nylon more quickly than they were could detect standard nylon nets. The use of such reflective nets combined with warning sounds was suggested as a means of bycatch mitigation (Koschinski *et al.,* 2006).

Mooney *et al.* (2007) looked at the acoustic reflectivity and stiffness of different net types targetting cod and monkfish. Nets enhanced with barium sulphate and iron oxide demonstrated increased reflectivity when compared with the control nets. Dolphins were considered likely to detect the nets with enough time to avoid entanglement, but as porpoises echolocate at lower levels, they may not detect the nets until they are much closer to the nets.

The stiffness of enhanced nets may be one of the reasons that bycatch is reduced; the net is less likely to collapse around the animal. However after more time spent soaked in sea water, the nets became more flexible. If stiffness is the key factor then conventional nylon nets might be produced with stiffer line with a larger diameter (Mooney *et al.,* 2007).

The direction and angle at which the cetacean approaches the net has a significant impact on whether or not it is able to detect the net, and therefore, in some circumstances, an enhanced net would not help reduce bycatch (Mooney *et al.,* 2007).

The Swedish recreational fishery limits length of nets to 180m. Denmark also limits length of nets and Finland has plans to limit certain types of gear to professional fishermen. These are all hoped to help reduce bycatch (ASCOBANS 2009c).

4.2.5 Adoption of technical mitigation methods

In Campbell and Cornwell's (2008) review of articles about bycatch reduction technology (BRT) they found that many studies assume that there are economic benefits for fishermen who use this technology. However in many cases, these economic benefits are not calculated. They recommend that "research evaluating actual economic costs and benefits will assist in assessing the potential incentives for fishers to use BRT." They also highlight the need for BRT to "utilize fisher knowledge in the creation of viable technology." This bottom-up approach leads to the development of better technology and better compliance from fishers too.

In the USA, the Harbour Porpoise Take Reduction Plan (HPTRP) was developed to reduce interactions between harbour porpoises and commercial gillnet gear off New England and the Mid-Atlantic (NOAA 2010b). One issue that has effected the success of the HPTRP is that fishers do not necessary comply with the HPTRP requirements. Pinger compliance in particular has fluctuated over time. Outreach and enforcement programmes have helped increase compliance. The National Marine Fisheries Service also uses pinger detection devices to check whether set gillnet gear has pingers present as well as open-air pinger tester devices which check whether individual pingers are working during the setting/hauling process (NOAA 2010d).

4.3 Management mitigation measures

4.3.1 Effort reduction, time/area restrictions and changes to fishing technique

The ICES Study Group for Bycatch of Protected Species (SGBYC) suggests that many bycatch problems are localised or seasonal and therefore management changes can be more effective than mitigation devices such as pingers (ICES 2008d). A reduction in fishing effort in the UK bass fishery, for example, has led to a significant decrease in the number of dolphin deaths (Northridge 2006).

However, the areas and times of year when bycatch takes place can vary significantly from year to year which makes it difficult to establish restrictions which would be effective (NECESSITY 2008).

The USA's Harbour Porpoise Take Reduction Team (HPTRT) found that although bycatch could be reduced in management areas, this could lead to increased bycatch levels outside the existing management areas. New management measures were therefore implemented including seasonal time and area closures. In specific areas, if bycatch thresholds are exceeded, additional closures may be implemented. These “consequence closure areas”, once triggered, remain in effect until bycatch levels reach the zero mortality rate goal (ZMRG) established for harbour porpoises or until the HPTRT and National Marine Fisheries Service develop and implement new measures (NOAA 2010b, NOAA 2010d).

With regard to harbour porpoises in the Baltic Sea, the Jastarnia Plan states that the animals are highly mobile and therefore Marine Protected Areas are not necessarily going to help reduce bycatch. However, the Plan recommends that the network of protected areas should be expanded and managed to improve the status of harbour porpoises and their prey (ASCOBANS 2009d).

In the USA, the Atlantic Trawl Gear Take Reduction Team recommends reducing the number of turns made by trawlers and tow times whilst fishing at night to try to reduce cetacean bycatch. It also suggests that vessels should stay in contact by radio and, if one vessel takes a marine mammal, that they can contact other vessels nearby and warn them that there are cetaceans in the area (ATGTRT 2008). These methods could be considered by trawl fisheries in the north-east Atlantic in order to reduce bycatch.

4.3.2 Alternative gear types

The Jastarnia Plan for the recovery of harbour porpoises in the Baltic Sea recommends that fishing methods that have high porpoise bycatch, i.e. set nets, should be replaced by alternative gear types. It suggests that trials be carried out using fish traps, fish pots and longlines with the aim of reducing the use of gillnets in the cod fishery (ASCOBANS 2009d). Cost-effectiveness as well as sustainability need to be proven and then the use of these alternative gear types can be implemented.

The Jastarnia Group has been considering alternative gear types such as the Norwegian two-chamber cod trap. Its effectiveness is dependent on a number of factors such as temperature, current, bait, season and density of the target species (ASCOBANS 2009c).

The NECESSITY project considered alternatives to towed gears and found that, in some cases, a trawl fishery might be replaced by using static gears or traps (NECESSITY 2008).

4.4 Bycatch management

As “The Net Effect?” suggests, it is important for management of bycatch to be tailored specifically to individual fisheries depending on what species they are fishing for, which kinds of nets they are using and where they are fishing (Ross and Isaac 2004).

The UK’s Monitoring, Control and Surveillance System (MCSS) allows boarding officers from the Royal Navy’s Fishery Protection Squadron trained by the Marine and Fisheries Agency to record bycatch witnessed during a boarding as well as information given by the Master of the vessel regarding bycatch (SMRU 2009). No reports have so far been generated by the MCSS on cetacean bycatch (ICES 2009).

The UK Small Cetacean Bycatch Response Strategy has considered the idea of implementing a mortality limit scheme. However, concern that this would be viewed as a ‘quota’ of cetaceans which would be acceptable to catch means that such a scheme will not be implemented. More detailed bycatch and abundance information would be required before a mortality limit scheme could be implemented and this would have to be done at a European level. The UK therefore aims to work at keeping bycatch levels at below 1.7% of the best population estimate (DEFRA 2009a).

Winship (2009) recommends that computer simulation can be used to evaluate the long-term performance of management procedures.

In the USA, the HPTRT has a monitoring strategy in place which involves biological measures, compliance measures, research and education and outreach components. It considers the overall effectiveness of the HPTRP as well as compliance in terms of day-to-day activity (on-going monitoring) and an annual compliance evaluation (NOAA 2010d).

5. Welfare issues

In general, research into bycatch and bycatch mitigation has been concerned with the effects on species and populations in terms of sustainability and conservation. However, there is also the issue of animal welfare to be considered. How do the individuals who are caught suffer? What effect does their death have on surviving members of their family group?

Few *in situ* studies have been done looking at the effects of entanglement on cetaceans. The difficulty of studying bycaught animals is one element, but there are important ethical implications of observing and not intervening whilst a cetacean becomes entangled and struggles until death (WDCS 2008).

5.1 Reaction to entanglement

Harbour porpoises tend to struggle violently when they find themselves entangled so that they end up more wrapped up in the net and suffer from internal and external injuries (Leaper *et al.,* 2006).

Some dolphins have been found to go into a catatonic state when entangled in fishing gear even when they would have been able to reach the surface to breathe. This may be a stress response (Leaper *et al.,* 2006).

5.2 Types of injury

The types of injury suffered by bycaught cetaceans varies according to the type of fishery and the individual's reaction to being entangled as well as the species and age of the cetacean. Juveniles may not struggle for as long as adults and may die more quickly (Soulsbury *et al.,* 2008).

The list of injuries which might be suffered is a long one including: abrasions, amputations, penetrating wounds, broken mandibles or teeth, bruising, punctured or collapsed lungs and fractured bones. External injuries may not be immediately life-threatening and indeed many live cetaceans are spotted with scars which demonstrate previous encounters with fisheries. However, these non-lethal encounters can lead to health problems and may reduce survival or fertility (Soulsbury *et al.,* 2008).

As well as being injured from entanglement in a net, cetaceans may be injured from being hauled on board the fishing vessel. These injuries tend to be far more serious and can include being crushed by the weight of fish in the net, skull fractures and amputations. As most small cetaceans hauled in are already dead, these types of injuries would usually occur *post-mortem* (Soulsbury *et al.,* 2008).

A UK study looking at bycaught harbour porpoises and common dolphins found net marks on 61.4% of the cetaceans, mainly on the tail, pectoral fins, head, beak and, to a lesser extent, the dorsal fin (Soulsbury *et al.,* 2008). Amputations were common too but it was not clear whether these had been caused by the entanglement or were suffered *post-mortem* when the animals were being cut free of the nets. 41.2% of common dolphins had broken beaks.

Figures 1 and 2 show the external and internal injuries recorded from post-mortems.

Figure 1: External injuries recorded from post-mortem data. Figures are for a generic small cetacean. From Soulsbury et al (2008).

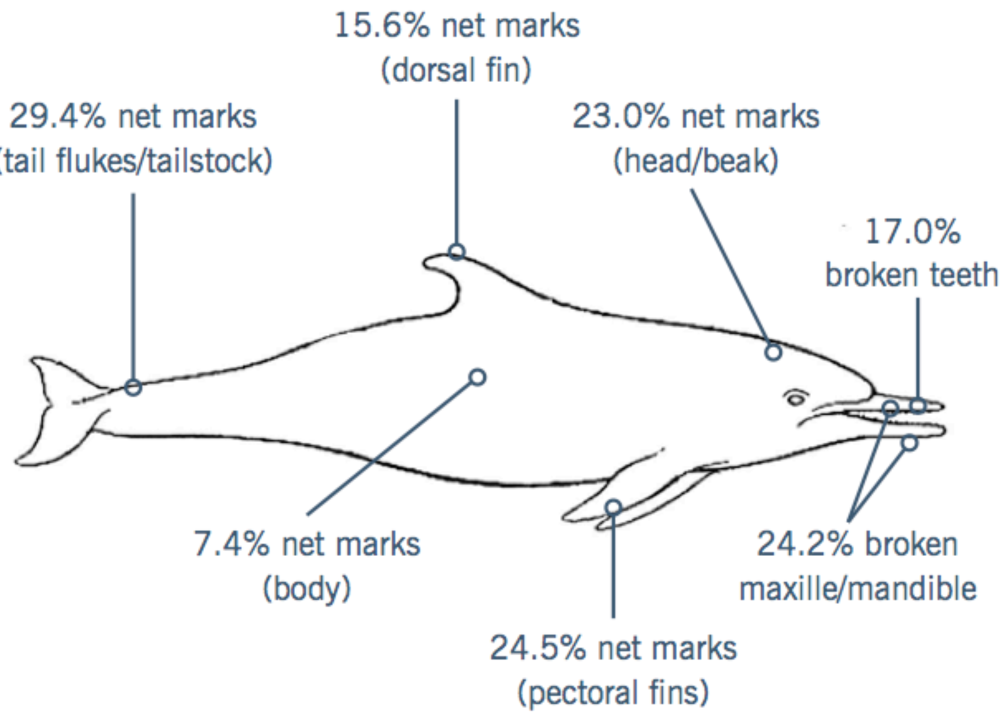
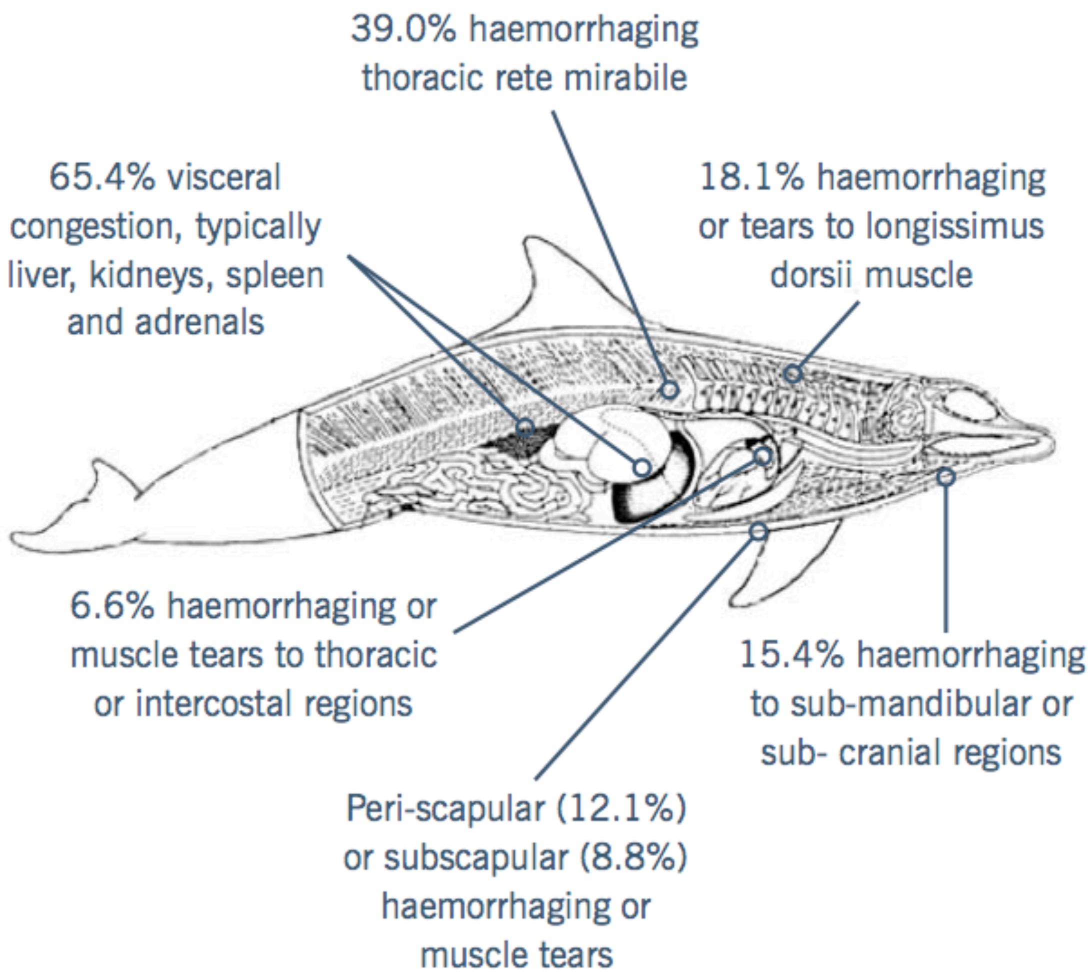


Figure 2: Internal injuries recorded from post-mortem data. Figures are for a generic small cetacean. From Soulsbury et al (2008).



5.3 Cause of death

Asphyxia is the main cause of death among bycaught cetaceans. They hold their breath until they die from lack of oxygen. Asphyxiation is considered to be extremely stressful for most species and certainly for cetaceans (Soulsbury *et al.,* 2008). There are no exact data on the time it takes for a cetacean to asphyxiate once they are bycaught. It may vary between individuals and species and the manner of entanglement. Those animals that struggle will use up more oxygen and, therefore, asphyxiation will happen more quickly. This is relevant only to those animals caught underwater and unable to surface to breathe. Animals caught in nets near the surface may be able to reach the surface to breathe despite their entanglement and so may survive longer, only dying when they become too weak to carry on.

Post-mortems on stranded dolphins who have been diagnosed as bycatch suggest that they suffered prolonged and traumatic deaths (RSPCA 2005).

5.4 Stress

Interaction with fisheries and escape from entanglement are stressful events which may have an effect on the health of the cetaceans involved and may even lead to death. Such stress-related problems may manifest themselves days or weeks after the entanglement. It has also been suggested that cetaceans who lose a member of their family or group to bycatch may suffer from stress (Soulsbury *et al.,* 2008).

5.5 Welfare of cetaceans who lose a family or group member to bycatch

Simmonds (2006) summarises the evidence for higher cognitive functioning in cetaceans. Conservation approaches should take into account the intelligence, societies, culture and potential to suffer of cetaceans especially when considering the loss of individuals (by whaling or other methods e.g. bycatch).

Cetaceans care for their young for several years (Simmonds 2004) and so an infant cetacean who loses their mother to bycatch may struggle to survive afterwards. They will suffer psychologically from the experience and physically from having no mother to feed and care from them (WDCS 2008).

The loss of an individual cetacean to a group may be significant. Relationships may be effected and vital knowledge may be lost (Soulsbury *et al.,* 2008). The suffering of one individual during entanglement is likely to cause distress to others (WDCS 2008).

It is possible that certain individuals may be more at risk of bycatch. Some studies have found that male common dolphins are more often victims of bycatch than female common dolphins (Soulsbury et al., 2008; Northridge *et al.,* 2006). Age may also be a contributing factor. The majority of bycaught harbour porpoises are juveniles. It may be that they echolocate at a different frequency to adults and therefore become aware of nets too late to avoid entanglement (Soulsbury et al., 2008)

5.6 Legislation relating to welfare

Bycatch regulation tends to focus on numbers rather than on animal welfare. Legislation relating to the 'intentional' killing of animals clearly defines welfare standards but as bycatch is 'incidental', it is not provided for in the legislation (Soulsbury *et al.,* 2008).

WDCS has pointed out that no terrestrial commercial meat production system would be tolerated which incidentally lead to the death of large numbers of sentient mammals, often in a traumatic manner. However, the production of some fish is responsible for exactly that (WDCS 2008).

6. Bycatch regulation

6.1 Existing obligations within the north-east Atlantic

6.1.1 The Baltic Sea Action Plan

In 2007, the final version of the Baltic Sea Action Plan (BSAP) was adopted. Part of the Plan is to work towards “a favourable conservation status of Baltic Sea biodiversity” and it contributes to the work of other agreements such as the EU Habitats Directive (HELCOM 2007). Working with ASCOBANS, the BSAP aims to develop a co-ordinated reporting system and database on Baltic harbour porpoise sightings, bycatches and strandings as well as monitoring and reporting bycatch of other mammals. It also aims to develop further methods for looking at how fisheries impact on biodiversity.

The BSAP urges the competent fisheries authorities to work with the Baltic Regional Advisory Council (RAC) and HELCOM to develop fisheries management so that, by 2012, bycaught animals which cannot be released alive, or without injuries, are landed and reported, and to adopt measures to minimise the bycatch of non-target species (HELCOM 2007)

By 2015, the BSAP aims to improve the conservation status of the harbour porpoise. Harbour porpoise bycatch in the Baltic Sea, by that time, should be close to zero (HELCOM 2009).

The Baltic Sea Action Plan aimed, by 2008, to evaluate existing technical measures used to minimise the bycatch of harbour porpoises and to introduce new technologies (HELCOM 2007).

6.1.2 ASCOBANS

Since 3 February 2008, the ASCOBANS area has been extended to include:

“...the marine environment of the Baltic and North Seas and contiguous area of the North East Atlantic, as delimited by the shores of the Gulfs of Bothnia and Finland; to the south-east by latitude 36°N, where this line of latitude meets the line joining the lighthouses of Cape St. Vincent (Portugal) and Casablanca (Morocco); to the south-west by latitude 36°N and longitude 15°W; to the north-west by longitude 15° and a line drawn through the following points: latitude 59°N/longitude 15°W, latitude 60°N/longitude 05°W, latitude, 61°N/longitude

4W;latitude 62N/ longitude 3W; to the north by latitude 62°N; and including the Kattegat and the Sound and Belt passages." (ASCOBANS 2009f)

The name of the Agreement in full is now “Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas” (ASCOBANS 2009f).

Since “The Net Effect?” was written, two more countries have become Parties to the Agreement. This brings the total number of Parties to ten (Belgium, Denmark, Finland, France, Germany, Lithuania, The Netherlands, Poland, Sweden and the United Kingdom). (ASCOBANS 2009f)

ASCOBANS is responsible for two important harbour porpoise conservation plans. One for the Baltic population of porpoises (the Jastarnia Plan) and one for the North Sea.

6.1.2.1 The Jastarnia Plan

The ASCOBANS Jastarnia Plan which is a recovery plan for Baltic harbour porpoises was finalised in 2002 (see “The Net Effect?”) and was revised in April 2009. It aims to reduce bycatch to two or fewer harbour porpoises per year in order to bring the population of the Baltic Sea back up to at least 80% of its carrying capacity. It also aims to improve knowledge in key subject areas and to develop more refined recovery targets as new information becomes available on population status, bycatch and other threats (ASCOBANS 2009d).

Since 2005 the Jastarnia Group (which comprises environmental and fisheries experts from countries bordering the Baltic Sea) has met every year to discuss progress and future priorities. They also make recommendations to the ASCOBANS Advisory Committee.

The Jastarnia Group has identified bycatch reduction as the highest priority for the recovery of the Baltic harbour porpoise. They recommend the following actions to achieve a reduction in bycatch:

Table 7: Actions to achieve a reduction in harbour porpoise bycatch in the Baltic Sea. Taken from ASCOBANS 2009d.

Recommendation 1	Reduce fishing effort in certain fisheries
Recommendation 2	Involve stakeholders in the work of reducing bycatch of harbour porpoises
Recommendation 3	Replace fishing methods known to be associated with high porpoise bycatch (i.e. set nets) and introduce alternative gear that is considered less harmful
Recommendation 4	Implement a pinger programme on a short-term basis
Recommendation 5	Analyse stock affinities of harbour porpoises in the “transition zone” between two or more populations of

	the south-western Baltic
Recommendation 6	Develop and apply new techniques (e.g. acoustic monitoring) for assessing trends in abundance
Recommendation 7	Develop interactive pingers or pingers using frequencies not audible to seals
Recommendation 8	Investigate possible detrimental effects of various types of sound and disturbance (including pinger signals, noise from vessels, wind parks or constructions and seabed exploration, e.g. for oil and gas) on harbour porpoises
Recommendation 9	Monitor bycatch in all fisheries known to be harmful to harbour porpoises to be able to estimate bycatch levels
Recommendation 10	Further develop sustainable alternative fishing gear with no bycatch of harbour porpoises
Recommendation 11	Compile data on fishing effort
Recommendation 12	Examine habitat preference of harbour porpoises
Recommendation 13	Investigate the prevalence of derelict ("ghost") gear and the feasibility of its removal
Recommendation 14	Expand the existing network of protected areas and improve its connectivity, while ensuring the development and implementation of appropriate management plans within protected areas to improve the status of harbour porpoises and/or their critical resources (e.g. prey stocks), without allowing such limited measures to serve as substitutes for the other broader-scale conservation initiatives recommended elsewhere in this recovery plan.
Recommendation 15	Develop a comprehensive public awareness campaign
Recommendation 16	Strive for close consultation and cooperation between ASCOBANS and other relevant regional and international bodies

The Jastarnia Plan recognises that fishermen need to be closely involved in decision making, and that the Baltic Sea should not be considered as one entity and that different areas may need different bycatch mitigation approaches at different times of year. The lack of knowledge about porpoise distribution, abundance, movement and habitat use is a major obstacle to the reduction of porpoise bycatch (ASCOBANS 2009d). Hopefully the SAMBAH project will provide some useful data on these issues (see section 2.1.1).

6.1.2.2 Conservation Plan for Harbour Porpoises in the North Sea

The ASCOBANS Conservation Plan for Harbour Porpoises in the North Sea was developed following a call by the 5th International Conference for the Protection of the North Sea. Its objectives were defined by the 5th North Sea Conference and reflect Article 1 of the Habitats Directive. They also take into consideration the ASCOBANS aim of restoring and maintaining populations at at least 80% of their carrying capacity (ASCOBANS 2009e).

“This Plan aims to restore and/or maintain North Sea harbour porpoises at a favourable conservation status, whereby

• population dynamics data suggest that harbour porpoises are maintaining themselves at a level enabling their long-term survival as a viable component of the marine ecosystem;

• the range of harbour porpoises is neither reduced, nor is it likely to be reduced in the foreseeable future;

• habitat of favourable quality is and will be available to maintain harbour porpoises on a long term basis;
and

• the distribution and abundance of harbour porpoises in the North Sea are returned to historic coverage and levels wherever biologically feasible.” (ASCOBANS 2009e)

The Conservation Plan highlights bycatch as a threat to harbour porpoises and gives it a ‘high’ prioritisation for action. It aims to ensure that existing regulations relating to bycatch mitigation are being properly implemented and that data on their efficacy should be collected. This should be done via an observer scheme and a review of existing schemes as well as the development and trialing of mitigation methods and devices (ASCOBANS 2009e).

Another recommendation of the Conservation Plan is that a certification scheme should be considered, whereby fish caught using methods which avoid harbour porpoise bycatch should have a higher commercial value (ASCOBANS 2009e).

The Conservation Plan also highlights the difficulties in monitoring small vessels and recreational fisheries and recommends that research be done into reducing bycatch in these areas (ASCOBANS 2009e).

6.2 Existing EU legislation

6.2.1 Common Fisheries Policy

The European Commission is currently reviewing the Common Fisheries Policy (CFP). This review will lead to a new policy from 2012 (Lutchman *et al.,* 2009). It is hoped that the new policy will not only focus on fisheries but will look at the marine environment as a whole.

The Coastal and Marine Union (EUCC) asserts that it is essential for the new CFP to pay more attention to the bycatch of air-breathing animals (mammals, turtles, seabirds). It stresses that small cetaceans in particular are under threat (EUCC Marine Team, 2009).

The EUCC wants the CFP to make funding available for research into more selective fishing equipment which is less disturbing to habitats. Effort should also be increased in researching and developing ways to stop bycatch. Pingers, alternative gear and methods should all be considered. Data collection and monitoring should also play a key part in the process (EUCC Marine Team, 2009).

6.2.2 The Habitats Directive

All EU Member States are requested under the Habitats Directive (92/42/EEC) to monitor habitats and species considered to be of Community interest (see "The Net Effect?"). Member States are to report to the European Commission every six years on the implementation of the Directive.

The first report covered the period 2001-2006 and showed that few Member States are investing the necessary resources needed to monitor habitats and species in their territories and many of the reports submitted lacked detail. Many Member States lack information on the marine environment in particular. 57% of the marine species assessments and 40% of the marine habitats assessments were classed as 'unknown'. In the Baltic, the status of all four mammal species was 'bad'. The reports also showed that the status of coastal habitats is particularly poor (CEC 2009a).

The Habitats Directive has been criticised for not having precise standards which has led to a failure to evaluate the scale of bycatch in the north-east Atlantic (ICES 2008c).

The ICES Study Group for Bycatch of Protected Species (SGBYC) notes that the Habitats Directive requires bycatch monitoring to be carried out but does not specify how much monitoring should be done (ICES 2008d).

Haelters and Camphuysen (2009) report an infringement of the Habitats Directive by Belgium. The Belgian authorities had issued licences for the recreational use of gillnets which are known to incidentally catch porpoises thereby failing to comply with two Articles in the Habitats Directive which require member states to protect species listed in Annex IV (a) and to monitor incidental capture. The European Commission, however, dropped the case against Belgium after new Flemish legislation was passed to strengthen the protection of species such as porpoise. As yet, no specific protection measures for porpoises have been put into place (ASCOBANS 2010a).

6.2.3 Council Regulation (EC) No 812/2004

"The Net Effect?" refers to a proposed EU regulation on incidental catches of cetaceans (Ross and Isaac 2004). This regulation was ratified on 26 April 2004 as Council Regulation (EC) 812/2004 "laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88.98" (CEC 2004). It acknowledges the Common Fisheries Policy and the Habitats Directive, but states that "the scientific information available and the techniques developed to reduce incidental capture and killing of cetaceans in fisheries justify additional measures being taken to further the conservation of small cetaceans in a consistent and cooperative manner at Community level," (CEC 2004).

Various compromises were made before the Regulation was ratified meaning that certain details in the original proposal were not carried out. With regard to the mandatory use of acoustic deterrent devices (pingers), vessels under 12m in length do not have to use pingers (the proposal covered all vessels). Fisheries using pingers do not have to take part in the on-board observer scheme. Dates were set for when individual fisheries had to start using pingers (European Parliament, 2009).

ICES states that the introduction of acoustic deterrent devices under Regulation 812/2004 has not taken into consideration many important factors including control and enforcement, economic impacts, technical issues, biological impacts, monitoring and legislative issues (ICES 2008a). A monitoring and support system needs to be established to ensure that mitigation devices like pingers are working properly (ASCOBANS 2010h).

The ICES Study Group for Bycatch of Protected Species (SGBYC) has found that enforcement agencies are finding it hard to enforce the regulations because of difficulties in testing whether pingers are working or whether fisherman have attached them to the nets. The Regulation requires monitoring of vessels and the effect of pingers on bycatch but the majority of EU Member States have been unable to carry out the necessary monitoring due to lack of resources (ICES 2008d).

The proposal asked for observers to be placed on all vessels, but under the Regulation, vessels under 15m are not required to take part in the on-board observer scheme (European Parliament, 2009). Northridge *et al.* (2007) point out that UK tangle net and gill net fisheries in the southwest of Britain (sub-area VIIefghj) are not monitored under Regulation 812/2004 even though this area has a high rate of cetacean stranding and that many of these strandings are thought to be a result of bycatch. ICES (2010a) calls for monitoring technologies and techniques to be investigated for fleets of smaller fishing vessels.

The Regulation also gave deadlines for the phasing-out of driftnets from EU fisheries and, since 1st January 2008, driftnets have been banned (European Parliament, 2009).

Regulation 812/2004 has been criticised for failing to fulfill it's aims. The ASCOBANS Conservation Plan for Harbour Porpoises in the North Sea states that Regulation 812/2004 is not 'fully serving its purpose in certain areas/fisheries' (ASCOBANS 2009e). ICES has pointed out that the introduction of the Regulation has caused resentment in some fisheries. In the Baltic it has failed to address the fisheries where harbour porpoise bycatch is a particular problem (ICES 2008a). For example, the majority of fishing boats with set nets in Puck Bay and Pomeranian Bay in Poland are not required to use pingers or to have observers on board because they are smaller than the lengths stipulated in the Regulation for these two mitigation methods. However, these vessels are known to be responsible for some harbour porpoise bycatch (ICES 2009). ICES (2010c) recommends that mitigation methods should be applied to all static net fisheries in the whole of ICES sub-division 24 (in the Baltic Sea).

In 2009, a follow-up document was released relating to Council Regulation 812/2004 which stated that "although most Member States have reported low or no incidental catches in EU waters, scientific evidence from at-sea monitoring schemes or from post-mortem analysis of stranded animals continue to show existing conflicts between cetaceans and fisheries" (European Parliament, 2009). The UK and other Member States have told the European Commission that the areas specified for monitoring by the Regulation are not necessarily the correct ones as consistently no bycatch has been recorded (DEFRA 2009a). ICES also acknowledges that the Regulation "was not targeted particularly well at the fisheries that have the highest risk of cetacean bycatch" (ICES 2010c).

The European Commission "recognises that some Member States have made considerable efforts to correctly implement (EC) Regulation 812/2004 but ... some Member States are lagging behind". It also highlights the need for Member States to monitor bycatch of cetaceans under the Habitats Directive (European Parliament, 2009).

The European Cetacean Society (ECS 2008) adopted a resolution at it's Annual General Meeting in 2008 which reviewed Council Regulation 812/2004 for the Baltic Sea and proposed that the European Commission should:

- make the introduction of pingers mandatory in ALL gillnet or entangling net fisheries of high risk to cetaceans regardless of vessel size
- find an alternative to gillnets as quickly as possible by testing and introducing other types of fishing gear
- have a mandatory and effective marine mammal bycatch monitoring programme

- include vessels below 15m in the mandatory observer programme and, if it is not feasible for human observers to be provided, then electronic surveillance should be conducted. Comprehensive reporting of bycatch by fishermen should be encouraged.

Regulation 812 has been criticised for being a “top-down” approach. Fishermen should be encouraged to find their own solutions to the problem of bycatch, though individual fishermen may not realise how serious the problem of bycatch is if they are not personally catching what they see as many cetaceans and they are not aware of the overall removal rates (ASCOBANS 2009c). The 2010 ASCOBANS/ECS Cetacean Bycatch Mitigation Workshop suggest that the Regulation should be revised so that it does not prescribe what measures need to be taken but rather sets targets for each area and then allows fishers to find solutions that are relevant to their specific situation (ASCOBANS 2010h).

The ICES SGBYC notes that Member States do not seem to be working together to tackle the issue of bycatch. In some cases, sampling is directed at fisheries suspected to have low bycatch rates and little or no sampling is directed at others that may have higher bycatch rates (ICES 2008d). They recommend that monitoring programmes need to be flexible so that Member States do not end up overly monitoring fisheries with low bycatch levels and neglecting fisheries with high rates of bycatch (ICES 2010a).

The ICES SGBYC also criticises the Regulation for not specifying which types of nets are to be monitored by observers. Gillnets and tangle nets are listed as the setnets which need to be observed, but does not mention trammelnets. ICES recommends accurate, practical and clear definitions of gear types should be included in the Regulation. Also that there should be a review of which fisheries are covered by the Regulation. ICES suggests the inclusion of demersal trawl fisheries (ICES 2008d, ICES 2010c).

ICES (2010a) calls for a standard reporting format to be implemented for all Member States.

6.3 Enforcement of legislation

The development of technical mitigation methods and the passing of legislation does not guarantee that fisheries will adopt the recommended measures or comply with the law. Enforcement can be difficult due to a lack of resources for the management agencies. The relationship between fishers and management agencies needs to be considered when looking at enforcement possibilities. The success of enforcement can also be effected by the type of gear the fishery is using and other specifics of the individual fishery (Campbell and Cornwell 2008).

7. Assessment and monitoring of fisheries and bycatch

Further study into interactions between cetaceans and fisheries in the north-east Atlantic is needed. Solutions need to be aimed at individual fisheries taking into account the species being targeted, the species of cetaceans that are being bycaught, the type of gear being used, the size of the vessel, the location and season of the fishing and even the time of day, as there is some evidence that more bycatch takes place during night-time fishing (NECESSITY 2008).

ICES (2010c) recommends that improvements should be made to the way that fishing effort data is collected. Vessels under 10m, set net and recreational fisheries require particular attention if mitigation methods are to be targeted at the necessary fisheries and/or areas.

The ICES Working Group on Marine Mammal Ecology (WGMME) has recommended to the EU that observers be placed on vessels involved in the gillnet fisheries of the North Sea to get more accurate data on bycatch in the region independently from EU Regulation 812/2004. The WGMME offers detailed recommendations on how to monitor cetacean populations (ICES 2008c).

In Sweden, pilot studies have been undertaken to evaluate the use of video surveillance rather than observers on board smaller vessels. Using four cameras and a multiple screen, most of the fishermen's activities can be monitored. At a cost of 350 Euros per boat per day, it is about a third of the cost of having an observer on board. However, it is estimated that to get reliable bycatch estimates on the East coast/Baltic set net fisheries using this system would cost 16 million Euros (ASCOBANS 2009c).

As well as monitoring bycatch onboard fishing vessels, the analysis of stranded animals should be taken into consideration when bycatch statistics are being compiled. Between 1990 and 2006, 415 cetceans which stranded along the coasts of Cornwall in the southwest of the UK were necropsied. Of these, 253 (61%) were determined to have died as a result of bycatch (Leeney *et al.,* 2008).

The Cetacean Bycatch Evidence Evaluation Project (Cetacean BEEP) believes that much valuable information is lost because many stranded animals are not necropsied. They therefore aim to diagnose bycatch in cetaceans found on beaches using a standardised protocol to record external signs on stranded animals. The project is being developed in Cornwall, UK, with the aim of being used internationally in the future (Cetacean BEEP 2007).

In Cornwall in 2008 only 2 stranded cetaceans were diagnosed as bycaught after post-mortem. However, observations of stranded animals which were not necropsied suggested that about 8% of stranded cetaceans had died as a result of bycatch (Loveridge and Loveridge 2008).

Though it is not mandatory, some EU Member States collect information on the bycatch of protected species when observers are on board vessels as part of the Data Collection Framework of the Common Fisheries Policy. The ICES SGBYC looked at some of the information collated and found that cetacean bycatch was present in several demersal trawl fisheries as well as the gillnet and pelagic trawl fisheries. They recommend that national discard sampling schemes should be assessed to see how much they are recording bycatch of cetaceans and other species (ICES 2009). ICES also recommends that the Data Collection Regulation (DCR) be used to record and report cetacean bycatch (and discard). This would be particularly useful in fisheries which are thought to have low levels of bycatch as it would highlight any problem areas or fisheries which are not being monitored under Regulation 812/2004 (ICES 2010c).

The ICES SGBYC has reviewed the issues involved in different bycatch monitoring methods and observer programmes (ICES 2009).

In the UK, DEFRA (Department for Environment, Food and Rural Affairs) first published the UK Small Cetacean Bycatch Response Strategy in 2003. It was due to be reviewed on 2010 (DEFRA 2009a).

In the USA, the National Marine Fisheries Service (NMFS) is required to establish “take reduction teams” (TRTs) to develop measures to reduce bycatch of specific marine mammal stocks. In order to do this the NMFS has to establish which stocks or populations are at risk and therefore require a TRT. The TRT should then develop a “take reduction plan” (TRP). In 2008, the US Government Accountability Office (GAO) reviewed this process (GAO 2008).

In theory, the TRTs work to strict deadlines and with involvement from the fishing industry, conservation organisations, the scientific community and State and Federal resource management agencies. The GAO review of 2008 found a number of problems, many of which come down to lack of funding. For the TRPs to work properly, the NMFS needs good data and the audit showed that the NMFS was often relying on incomplete, outdated or imprecise data on population size and/or mortality. This can lead to TRPs not being developed for stocks that need them and even to TRPs being developed for stocks that are not at risk. Deadlines for the TRPs are often not met (GAO 2008, NOAA 2010a).

How to assess the effectiveness of TRPs also needs to be considered. If bycatch continues after a TRP has been implemented, it is important to determine whether the plan was flawed or whether there was a lack of compliance (GAO 2008).

8. Conclusions and recommendations

It is encouraging that the issue of cetacean bycatch in the north-east Atlantic is being addressed by legislation and conservation plans. Different stakeholders are now working towards reducing bycatch by introducing various mitigation methods. However, much of the work being done takes a very top down approach. Conservation groups, scientists and politicians are all trying to find solutions which will be imposed on fisheries.

Individual fisheries need to be encouraged to find their own solutions and to get actively involved in bycatch reduction programmes. Many individual fishermen may not realise the scale of the bycatch problem if they do not personally catch many cetaceans. Therefore statistics need to be regularly and accurately collected so that fishermen can see what the extent of the problem is. If they are not experiencing much bycatch, perhaps they can offer advice to others who do find they are catching dolphins and porpoises in their gear.

If there are economic benefits for reducing bycatch then, these need to be calculated accurately and presented to fishermen. However, it is important to remember that economic factors are not the only ones to be considered when working to reduce bycatch within fisheries. Campbell and Cornwell (2008) point out that social and cultural factors are also important and that research into these could help in our understanding of how fishermen respond to bycatch reduction technology and management plans. Understanding fisheries' attitudes to cetaceans and cetacean bycatch is key. NGOs and government agencies need to bear in mind that cetaceans are not necessarily valued in the same way by all stakeholders.

The ASCOBANS/ECS Cetacean Bycatch Mitigation Workshop held in March 2010 recommended that Parties to ASCOBANS should "fund cooperative projects that bring together fishers, gear technologists and cetacean scientists to work on finding solutions for by-catch mitigation" (ASCOBANS 2010h). This approach needs to take place in consultation with RACs and other relevant fisheries meetings. Cultural differences between different countries in the ASCOBANS region need to be taken into consideration and it should not be assumed that all fishing communities will have a similar reaction to the issue of cetacean bycatch.

Networks of volunteers who patrol coasts and can provide detailed information on stranded cetaceans can add their findings to those from observers onboard fishing vessels to make bycatch statistics more accurate.

The EU, ICES, ASCOBANS and the CFP can work together to offer advice to fisheries which are working to reduce their bycatch. These organisations may benefit from working with the NMFS in the USA to exchange ideas and methods used by “take reduction teams” (TRTs) there.

Every country that fishes in north-east Atlantic waters needs to be held responsible for its own fisheries. At the moment, some countries are putting far more money and effort into the issue than others. Countries which have bycatch reduction programmes in place need to share their data with other countries who are yet to put their full effort into the issue. ICES (2010a) suggests that if Member States work more closely together then bycatch monitoring and observer schemes could be more efficient. For example, when one Member State lands fish in the port of another Member State, then there is the opportunity for sharing monitoring responsibilities. ICES recommends developing guidelines to help Member States work together.

Countries that fish in the ASCOBANS agreement area but which are not yet party to the agreement should be encouraged to join. As cetaceans are free-moving creatures, then their conservation and welfare needs have to be managed by all range state countries and not just a select few.

TRTs in the USA use education and outreach programmes to help reduce bycatch. This is something that could be considered to cover the north-east Atlantic. The Atlantic Trawl Gear Take Reduction Team (ATGTRT) education and outreach plan aims to bring together various groups, such as regional fishery management councils, states, industry, environmental organisations, and academia. These different groups are encouraged to share information relevant to reducing marine mammal bycatch in various Atlantic trawl fisheries. (ATGTRT 2008).

Effective methods of communication need to be researched. The ATGTRT recommends using a website to provide updates on the results of gear research, status of stocks, bycatch of marine mammals in various fisheries, meeting summaries and presentations. Maps showing cetacean “hotspots” and factsheets about bycatch and relevant legal requirements as well as species identification placards could all be distributed to fishermen (ATGTRT 2008).

The ASCOBANS/ECS Cetacean Bycatch Mitigation Workshop suggested that Parties to ASCOBANS should “create incentives for the development of environmentally friendly, sustainable, fishing methods” (ASCOBANS 2010h). Ideas considered at the workshop included eco-labelling, allowing higher quotas for responsible fisheries or allowing fishing to take place in MPAs on condition that environmentally friendly gear was used. These proposals are worth investigating further to establish whether they would encourage fishermen operating in the north-east Atlantic to change their fishing methods. Other stakeholders would have to be consulted to determine whether such methods would be acceptable or workable. Fishing in MPAs as a reward for using environmentally friendly gear might not, for example, be deemed appropriate at this time.

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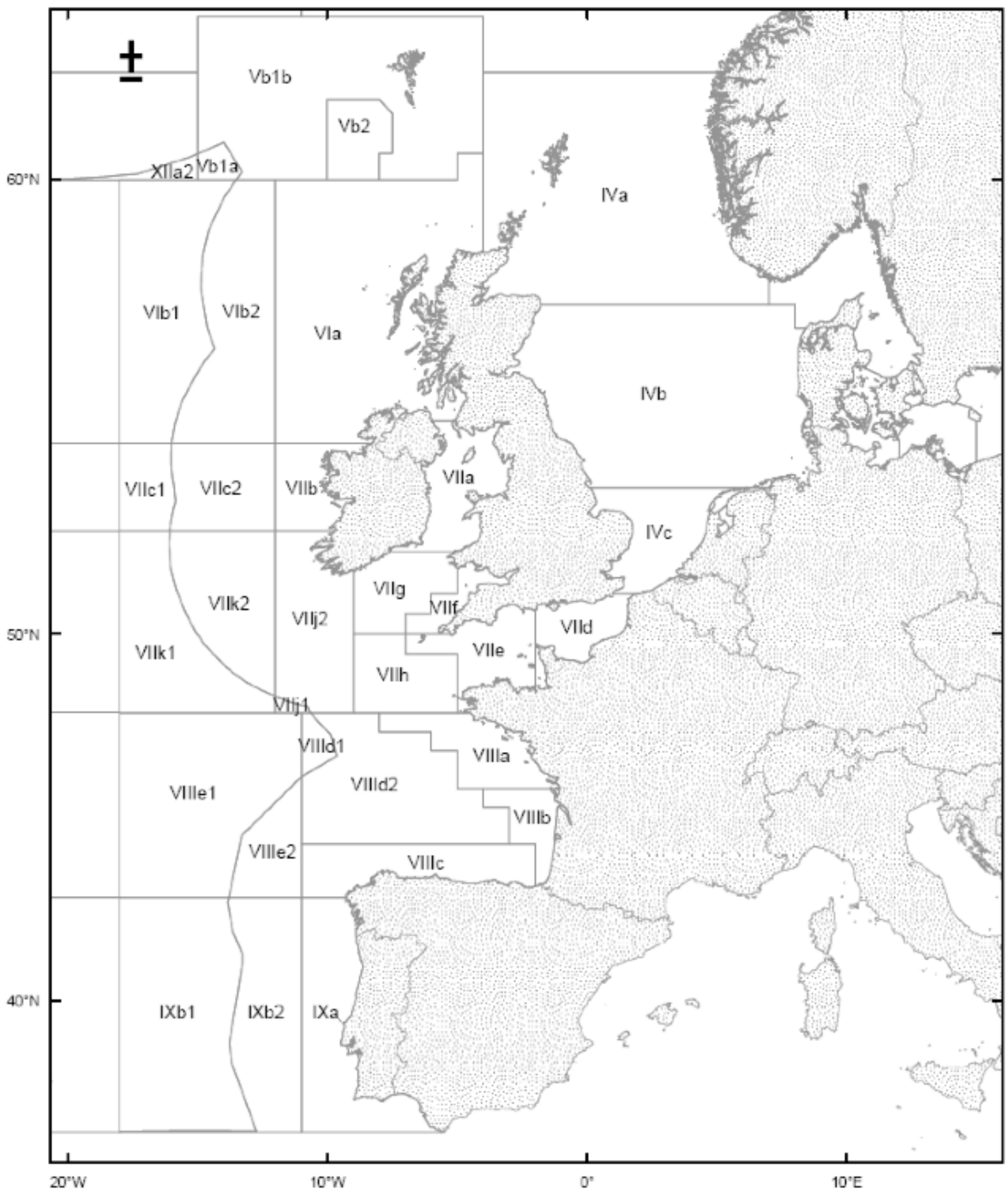
Annex 1 – Acronyms

ACCOBAMS	The Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area
ASCOBANS	The Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
ATGTRT	The Atlantic Trawl Gear Take Reduction Team
BRT	Bycatch Reduction Technology
BSAP	Baltic Sea Action Plan
CEC	Commission of the European Communities
CFP	Common Fisheries Policy
DCF	Data Collection Framework
DCR	Data Collection Regulation
DEFRA	Department for Environment, Food and Rural Affairs
ECS	The European Cetacean Society
EU	European Union
EUCC	The Coastal and Marine Union
GAO	United States Government Accountability Office
HELCOM	Helsinki Commission (Baltic Marine Environment Protection Commission)
HPTRP	Harbour Porpoise Take Reduction Plan
HPTRT	Harbour Porpoise Take Reduction Team
ICES	International Council for the Exploration of the Sea
IFAW	International Fund for Animal Welfare
IUCN	The International Union for Conservation of Nature

IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
MCSS	Monitoring, Control and Surveillance System
MoP	Meeting of the Parties
MPA	Marine Protected Area
NECESSITY	NEphrops and CEtacean Species Selection Information and TechnologY
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OSPAR	The Convention for the Protection of the Marine Environment of the north-east Atlantic (the 'OSPAR' Convention)
PBR	Potential Biological Removal
RAC	Regional Advisory Council
RSPCA	The Royal Society for the Prevention of Cruelty to Animals
RSW	Refrigerated Seawater
SAMBAH	Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise
SCANS	Small Cetacean Abundance in the North Sea
SGBYC	ICES Study Group for Bycatch of Protected Species
SMRU	Sea Mammal Research Unit
TRP	Take Reduction Plan
TRT	Take Reduction Team
WDCS	The Whale and Dolphin Conservation Society
WGMME	ICES Working Group on Marine Mammal Ecology
ZMRG	Zero Mortality Rate Goal

Annex 2 - ICES Statistical Divisions

(taken from Northridge *et al.* 2007)



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