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MITIGATION OF INCIDENTAL CATCHES OF CETACEANS IN EU WATERS

STUDY

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DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT B: STRUCTURAL AND COHESION POLICIES

FISHERIES

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STUDY

This document was requested by the European Parliament's Committee on Fisheries.

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Abstract:

This study provides a description of the status of the populations and the incidental catches of a number of cetacean species in EU waters and assesses the regulatory framework adopted in the EU for the mitigation of incidental catches of cetaceans in EU waters. It focuses primarily on provisions under Council Regulation (EC) No. 812/2004 and also Council Directive 92/43/EEC (Habitats Directive).

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LIST OF ABBREVIATIONS

ACCOBAMS	Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area
ACFA	The Advisory Committee on Fisheries and Aquaculture (EU)
ACOM	Advisory Committee (ICES)
ADD	Acoustic Deterrent Device
ADGPROT	Advice Drafting Group on protected species (ICES)
AHD	Acoustic Harassment Device
ASCOBANS	The Agreement on the Conservation of Small Cetaceans in the Baltic and North Sea
BAP	Biodiversity Plan (UK)
$BASO_4$	Barium Suplhate
BIM	Bord Iascaigh Mhara (Ire)
CCTV	Closed circuit Television
CCW	Countryside Council for Wales (UK)
CI	Confidence Intervals
CITES	the Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species
CODA	Cetacean Offshore Distribution and Abundance
cSACs	Candidate Special Areas of Conservation
CV	Coefficienct of Variation
DAM	Dynamic Area Management
DCF	Data Collection Framework
DDD	Dolphin Dissuasive Device (an ADD)
DGFISH	Directorate General for Fisheries
DIFRES	Danish Institute for Fisheries Research
ECJ	European Court of Justice
EEA	European Environment Agency
EIA	Environmental Impact Assessements
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FCS	Favourable Conservation Status
Fe_20_3	Iron Oxide
F_R	Recovery Factor
GAMs	Generalised Additive Models
GLMs	Generalised Linear Models
HVO	High Vertical Opening Trawl
IATTC	Inter-American Tropical Tuna Commission
ICES	International Council For The Exploration of the Seas
IFREMER	L'Institut Francais de Recherche pour l'Exploitation de la Mer
IMP	Institute Maritime de Prevention
IUCN	International Union for Conservation of Nature

IUU	Illegal, Unreported and Unregulated Fisheries
IWC	International Whaling Commission
$LiSOCl_2$	Lithium-thionyl chloride
MMPA	Marine Mammal Protection Act (USA)
MNPL	Maximum Net Productivity Level
NAMMCO	The North Atlantic Marine Mammal Commission
NASS	North Atlantic Sighting Survey
NEAq	New England Aquarium (USA)
NGO	Non-Governmental Organisation
NMFS	National Marine Fisheries Service (USA)
NOAA	The National Oceanic and Atmospheric Administration (USA)
NRC	National Reseach Council (USA)
PAS	Passive Alerting System
PBR	Potential Biological Removal
PCBs	Polychlorinated biphenyls
PICE	Porpoise Incidental Catch Eliminator (an ADD)
PODs	Porpoise Echolocation Detectors
PRA	Paperwork Reduction Act (USA)
PVA	Population Viability Analysis
RAC	Regional Advisory Council
RIVO	Animal Sciences Group, Wageningen University and Research Centre
SACs	Special Areas of Conservation
SAPs	Species Action Plans (UK)
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Sites of Community Interest
SE	Standard Error
SEPA	Swedish Protection Agency (Swe)
SFIA	Sea Fish Industry Authority (UK)
SFS	Species Protection Regulations (Swe)
SGBYC	ICES Study Group on the Bycatch of Protected Species
SGPOT	ICES Study Group on the Development of Pots for Commercial Fisheries and Survey Purposes
SMRU	Sea Mammal Research Unit (UK)
SO_2	Sulphur Dioxide
STECF	Scientific, Technical and Ecnomic Committee for Fisheries
TS	Target Strength
USTAN	University of St Andrews (UK)
WGMME	ICES Working Group on Marine Mammal Ecology
WWF	World Wide Fund for Nature

GLOSSARY

ACCOBAMS: The Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area. This agreement was concluded in 1996 and entered into force in 2001.There are currently 29 signatories and contracting parties to the agreement. ACCOBAMS is a cooperative tool for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its purpose is to reduce threats to cetaceans in Mediterranean and Black Sea waters and improve knowledge of these animals.

ASCOBANS: The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas. The agreement was concluded in 1991 and entered into force in 1994.There are currently 10 parties to the agreement. In February 2008, an extension of the agreement area came into force which changed the name to "Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas". The aim of the Agreement is to promote close cooperation amongst Parties with a view to achieving and maintaining a favourable conservation status for small cetaceans.

Auditory Brainstem Response: (ABR), also known as brainstem evoked response (BSER) is an electrical signal evoked from the brainstem of a human or other mammal by the presentation of a sound such as a click.

Baitings: The tapered section of the top panel of a trawl net directly behind the mouth of the trawl.

Barcelona Convention: Convention for the Protection of The Mediterranean Sea against Pollution was signed 16 February 1976, in force 12 February 1978 (revised in Barcelona, Spain, on 10 June 1995 as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean). It is a regional convention to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. This includes, but is not limited to, dumping, run-off and discharges.

Bayesian probability: is one of the most popular interpretations of the concept of probability. The Bayesian interpretation of probability can be seen as an extension of logic that enables reasoning with uncertain statements.

CETASEL: Cetacean Selectivity: An EC funded project that ran between 1994 and 1997 and investigated technical means of reducing small cetacean bycatch in pelagic trawls.

CODA: Cetacean Offshore Distribution and Abundance. An EU funded project to estimate abundance of common dolphin and other cetacean species in offshore European Atlantic waters and to provide information for a management framework to assess the impact of bycatch and recommend safe bycatch limits for common dolphin.

Codend: Terminal part of a trawl where catch collects.

CV: Coefficient of Variation. The Coefficient of Variation is a statistical term described as a normalised measure of dispersion of a probability distribution. CV is defined as the ratio of the standard deviation (σ) to the mean (μ).

Dyneema™: is a Ultra-High Molecular Weight Polyethylene (UHMwPE) product used for netting in the construction of trawls.

FCS: Favourable Conservation Status: The Conservation Status of a natural habitat is defined in Article 1(e) of the Habitats Directive (92/43/EEC) as the Conservation Status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. The conservation status of a natural habitat will be taken as 'favourable' when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.

Flaking Machine: This machine is used to stow gillnets as they are hauled aboard. The machine moves on rails above the net storage pounds and hauls the nets into the pounds as it separates the headline and footrope of the net.

Gillnet: means gear made up of a single piece of net and held vertically in the water by floats and weights. It catches living aquatic resources by enmeshing.

Hanging ratio: The ratio of the length of rope to which netting is attached, compared with the length of the fully extended netting in the direction in which it is hung.

MNPL: Maximum Net Productivity Level: The population level at which the productivity curve is maximum. It is considered to be greater than 50% of the carrying capacity or pre-exploitation abundance of the population.

Markov chain Monte Carlo: (MCMC) methods (which include random walk Monte Carlo methods), are a class of algorithms for sampling from probability distributions based on constructing a Markov chain that has the desired distribution as its equilibrium distribution. The state of the chain after a large number of steps is then used as a sample from the desired distribution. The quality of the sample improves as a function of the number of steps

NASS: North Atlantic Sighting Survey. NASS is a periodic shipboard cetacean survey organised by the North Atlantic Marine Mammal Commission (NAMMCO) that has taken place over the North Atlantic Summer during 1987, 1989, 1995 and 2001.

NAMMCO: North Atlantic Marine Mammal Convention is an international body for cooperation on the conservation, management and study of marine mammals in the North Atlantic. NAMMCO was established in 1992 and is made up of Norway, Iceland, Greenland and the Faroe Islands

NECESSITY: Nephrops and Cetacean Species Selection Information and Technology was an EC funded project that ran from 2004 to 2007 to develop alternative gear modifications and fishing tactics, in collaboration with the fishing industry, to reduce bycatch in *Nephrops* and pelagic fisheries, without reducing the catch of target species significantly.

PETRACET: Pelagic Trawl and Cetaceans is an EC funded project to establish the scale of cetacean bycatch through coordination of observer effort in pelagic trawl fisheries in the Celtic Seas and Bay of Biscay region.

SCANS I: Small Cetacean Abundance in the North Sea and adjacent waters survey, SCANS-I, was conducted in July 1994 and generated the first large-scale abundance estimates for the harbour porpoise, white-beaked dolphin and minke whale throughout the North Sea, Kattegat, Skagerrak and Celtic Sea. Abundance estimates were calculated for Harbour porpoise, minke whale and white-beaked dolphin.

SCANS II: Small Cetacean Abundance in the North Sea and adjacent waters SCANS-II, aimed to estimate small cetacean abundance in European waters, allowing the assessment and management of bycatch through the development of improved methods for monitoring, and a robust management framework. Abundance estimates were calculated for harbour porpoise, minke whale, white-beaked dolphin white- sided dolphin and Common dolphin.

Setnet: a general term for any simple net when it is held in fishing trim by anchors, sinkers and/or stakes. It includes trammel nets, tangle nets and gill nets.

Sharks Teeth: Joining of large mesh size section of netting into a smaller mesh size in a trawl net, creating a 'Sharks teeth' effect.

Stretched Mesh: The distance between the centres of the two opposite knots in the same mesh when fully stretched in the 'normal' direction.

Tangle net: means a large-meshed loosely hung single panel set net which catches fish by entanglement.

Trammel Net: means gear made up of two or more pieces of net hung jointly in parallel on a single headline and held vertically in the water by floats and weights.

Two alternative forced choice: a psychophysical method for eliciting responses from a person about his or her experiences of a stimulus.

EXECUTIVE SUMMARY

Background

In European fisheries, cetacean bycatch has been reported for a number of years and despite many regulatory attempts the scale of the problem remains relatively poorly understood, although there is now unequivocal evidence that in some fisheries bycatch is at a level to be of extreme concern. For instance in the Baltic Sea, the population of harbour porpoises is at such a low level that even the bycatch of a single animal is cause for concern.

Globally there are a number of regulatory frameworks designed to reduce or minimize cetacean bycatch. Most of these frameworks are adopted in the context of the FAO's Code of Conduct for Responsible Fisheries (FAO 1995). Article 7 of the Code states that "*States should take appropriate measures to minimize catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species".* Many of the current regulations merely set maximum levels of bycatch based on a level deemed acceptable for sustaining the population, while others are more specific by prescribing the use of mitigation measures such as closed areas or seasons, or, in the most extreme cases prohibiting fishing methods in particular fisheries.

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 continues to demonstrate conflicts between fisheries and cetacean conservation. Information on cetacean populations is fragmented and population *status* remains unclear.

Aim

This study provides a description of the status of the populations and the incidental catches of a number of cetacean species in EU waters and assesses the regulatory framework adopted in the EU for the mitigation of incidental catches of cetaceans in EU waters. It focuses primarily on provisions under Council Regulation (EC) No. 812/2004 and also Council Directive 92/43/EEC (Habitats Directive).

Relevance

The stated aim of regulation 812/2004 is "*to prevent the accidental capture of cetaceans such as dolphins and harbour porpoises in fishing gear, as this is threatening the conservation of these species*". It was intended to achieve this objective through restricting the use of driftnets by limiting the length of driftnets in the Baltic to and phasing them out completely by January 2007 and establishing the mandatory use of acoustic devices ('pingers') on gillnets throughout EC waters to warn off cetaceans. In addition a monitoring programme has been introduced to increase the knowledge of the cetacean bycatch levels. It has been further stated that while bycatch mitigation and monitoring obligations already existed under the provisions of the 1992 Habitats (Directive 92/43/EEC), their implementation has been insufficient and uneven across Member States and hence the need for further measures under regulation 812/2004. This regulation therefore was designed to provide a better definition of these obligations and stipulate priorities to ensure equity in their application across Member States.

In assessing whether this remains a relevant objective it is first useful to review recognized methods for estimating absolute abundance of cetaceans which include conventional distance sampling (design-based estimates); model-based estimates, partially applying distance sampling; and mark-recapture models. All methods provide managers with a point abundance estimate, with its two confidence limits (usually significant at 95%) and Coefficient of Variation as required under 812/2004. All of these methods have limitations, however, and it is clear that the information on cetacean absolute abundance in EU waters, including those in the Mediterranean Sea, is extremely heterogeneous and unsatisfactory, from a management perspective. Absolute estimates that might be useful to inform management actions, and relating to areas of reasonable size in terms of coverage of the range of such highly mobile species – exist for harbour porpoise, common dolphins, bottlenose dolphins, white-beaked dolphins and minke whales in the North Sea, the Baltic Sea and parts of the north-eastern Atlantic but for nowhere else. Based on this data, IUCN have concluded that none of the global populations of the species considered here is regarded as especially at risk, although regional populations of some of these species notably harbour porpoises and common dolphins are considered as threatened. For the Mediterranean and the Black Sea it is apparent that estimates of cetacean abundance are inadequate making any assessment of population or bycatch impossible for these regions. Therefore as a first step it is recommended that a basin wide survey for cetacean abundance in this region is long overdue and should be funded.

There are a number of alternative means of assessing the status of cetacean populations including sightings surveys, acoustic monitoring, strandings data. None of these are perfect and caution is urged in using strandings data in particular. There is much ongoing work focused on trying to make best use of platform of opportunity data and acoustic means for detecting trends in the relative abundance, but at present, and in contrast to the situation for dedicated abundance surveys, there is still no widely agreed set of tools to address this objective, and little pan European effort to co-ordinate the development of such tools. This makes this information of limited use currently.

There are several methods that have been used to estimate cetacean bycatch rates in the past. Essentially these can be divided into indirect measures such as the use of strandings, interview methods, logbooks or other formal reporting mechanisms, and direct independent observations, which may include observers or remote monitoring through the use of video cameras (electronic monitoring). It is generally thought that those involving independent direct monitoring are the most desirable, and that other methods are less reliable.

From the data on bycatch collected through direct independent observations under regulation 812/2004, a total of 135 cetaceans consisting of 81 common dolphins (*Dephinus delphis)*, 32 harbour porpoises (*Phocoena phocoena*), 9 bottlenose dolphins (*Tursiops truncatus*), 7 striped dolphins (*Stenella coeruleoalba*), 5 long finned pilot whales (*Globicephala melas*) and 1 Atlantic white-sided dolphin (*Lagenorhynchus acutus*) have been observed as bycatch. The variety of formats in which data on bycatch have been collected, though, make it difficult to comment on the consistency of the data collected under 812/2004. Generally bycatch is estimated as being low in most fisheries observed, although it is difficult to extrapolate to fleet level.

It has also been found that comparing data collected as part of observer schemes carried out under 812/2004 with other historic observer schemes is not straight forward as various methods have been employed to aggregate data and data have been aggregated at different levels. In addition data gaps exist in the information compiled under 812/2004 and the bycatch estimates are not comprehensive across all Member States. Some comparisons have nevertheless been attempted and show bycatch continuing in certain fisheries e.g. common dolphin byctach in the pelagic trawl fishery for bass in the English Channel and Bay of Biscay and harbour porpoise and common dolphin bycatch in set net fisheries in the Celtic and North Seas. At the very least by combining these datasets an indication of fisheries with bycatch can be drawn.

Although outside the scope of the present study, significant bycatch levels have also been reported for cetaceans and other species by EU Member and non EU Member States in several fisheries in the Mediterranean and Black Seas. Notable bycatch events recorded include, 237 striped and common dolphins observed in the Moroccan (IUU) driftnet fishery with an estimated total bycatch of 3647 animals and a bycatch of 68 and 46 harbour porpoises in Turkish fisheries and Romanian set gillnet fisheries in the Black Sea respectively. Small bycatch incidents have also been by Italy reported for bottlenose dolphins in fisheries in the Black Sea and the Mediterranean. While not covered by 812/2004, of grave concern are the heavy bycatches of loggerhead turtles reported in a range of fisheries in the Mediterranean.

Besides accidental capture in fishing gears, cetacean populations living in European waters regularly face a number of other human threats, which have the potential to directly and/or indirectly increase their mortality. These are: collisions, noise, physical disturbance, depletion of prey and habitat degradation, including the presence of noxious manmade pollutants in the marine food web. Quantitative estimations of mortality induced by these threats are, however, extremely difficult.

Several criteria for defining permissible thresholds or sustainable take levels of cetaceans are currently in use. These include criteria that have been proposed by the IWC, by ASCOBANS, and a method used in the USA Potential Biological Removal (PBR). These methods and their uses are discussed.

Estimates for PBR take limits at 1%, 1.7% and 2% have been generated for a range of species using the SCANS II data. Unfortunately as current bycatch estimates are too patchy to allow any comparisons between total bycatch estimates and these potential take limits. There are also difficulties in using this method, however, in that the establishment of take limits using a PBR including monitoring, data interpretation, enforcement and framing legislation. There are also problems where populations are trans-boundary and wide-ranging as it is impossible to determine the proportion of that population on each side of the border. In Europe this would be particularly problematical because there is a large overlap between nations and possibly even between fisheries.

More sophisticated modeling approaches are also possible in order to estimate the effects of bycatch on cetacean populations and these are discussed. Integrated population dynamics model for assessing the state and dynamics of a small cetacean population subject to bycatch have been developed under the SCANS II and CODA projects. This method has potential but it is important to recognize that bycatch limits estimated by this modeling approach are entirely dependent on the stated conservation objective, which is not sufficiently identified under either the Habitats Directive or regulation 812/2004. Existing bycatch estimates are fragmentary and do not cover all the fisheries that are likely to impact any of the species of concern. Nevertheless estimates from the fisheries that have been monitored would indicate that total bycatch of both porpoises and common dolphins should be a matter for concern for Member states and suggest better coverage of fisheries affecting them is required if the impact of bycatch on their conservation status is to be understood.

Based on the available assessments of populations and bycatch it is recommended that better co-ordination is required among Member States at a scientific level in agreeing on cetacean population status, conservation goals and bycatch limits: this is an area in which the Commission should take a lead, although there is much work to be done to elaborate how for example, appropriate bycatch limits might be set. In any reform of 812/2004, however, it is clear that a different approach to setting management objectives should be considered.

Effectiveness

With respect to regulation 812/2004 a full assessment has been carried out. Generally it can be concluded that there has not been sufficient sampling in the right fisheries or areas to enable sound management decisions to be made with respect to cetacean bycatch. Currently there appears to be an over emphasis on mitigation measures by the EU where such reliable measures only partially exists. This has resulted in poor compliance amongst Member States with Article 2 and there is clearly a general reluctance by fishermen to use the devices currently available due to practical and economic reasons that have been well documented. Critically regulation 812/2004 has been in place for 6 years, yet it is not possible to make any reliable assessment on its impact on the status of cetacean populations, nor on incidental catch rates.

A number of issues still remain over the format of data being collected by Member States leading to difficulties in analysing the data collected, level of monitoring including a lack of funding in some cases, reporting format and the recording of bycatch of other species including seals, seabirds and turtles. ICES have made a number of recommendations to this affect. These recommendations have helped to highlight some of the problems with the regulation although it is noted that the EU have taken board a number of them both from ICES and the 2009 workshop. This is seen as positive and should be acknowledged. Nonetheless better co-ordination is required among Member States at a scientific level in agreeing on cetacean population status, conservation goals and bycatch limits: this is an area in which the Commission should take a lead, although there is much work to be done to elaborate how for example, appropriate bycatch limits might be set.

Regarding reporting under the regulation, excluding one Member State which has stated that her fishing fleets are not within the scope of the regulation, all others have provided at least one annual report. Eleven Member States have provided observer data in at least one annual report and eight have provided observer data for at least two years. The quality and content of these reports, however, remains inconsistent, making analysis difficult. The observations made so far under Regulation 812 are a patchwork of relevant and irrelevant monitoring. It is recommended that greater flexibility and co-ordination is required in allocating monitoring effort, but the onus should be with member states to demonstrate low impact (results based monitoring) with a high degree of certainty. Lower certainty should be translated into more precautionary management measures.

Another criticism of 812/2004 is that the monitoring targets specified in the regulation are over optimistic. Further a precise bycatch estimate with a CV of 0.3 as prescribed has not been very effective in managing cetacean bycatch in Europe, and this target could well be rethought. A more general approach, such that Member States would be required to demonstrate their fisheries were not exceeding some agreed level of cetacean bycatch would be a more appropriate way of ensuring sufficient sampling to address the management question without overburdening Member States with excessive monitoring requirements.

Acoustic Deterrent Devices are required in certain fisheries under 812/2004. ADDs provide the most simple and effective solution for bycatch reduction although they have only been proven to work in reducing harbour porpoise bycatch in set net fisheries. Numerous trials have shown that pingers of several types can reduce porpoise bycatch by around 90%. ADDs can however be unreliable, expensive particularly where many are required (e.g. for set net fisheries), require periodic maintenance to check and replace batteries and can interfere with net setting and hauling. A combination of these factors has meant uptake by fishermen has remained sporadic in spite of legal requirements. There is still ambivalence towards ADDs from NGOs due to perceived habitat exclusion and environmental noise effects. The seriousness of these effects is unproven. Habituation has also been cited as a reason that ADDs don't work although again there is little evidence that this is an issue. It is recommended that bycatch mitigation should be an integral part of the fisheries management system – that is in determining effort or quota allocation or technical measures among fleets.

No alternative mitigation measures to ADDs currently exist that are fully proven although results from trials with treated and stiff gillnets in South America, Denmark and Canada may be cause for optimism. Such chemically enhanced nets can be expensive however because they are not routinely produced and need to be specially sourced and constructed in the Far East. Other measures such as time and area closures can reduce the incidental mortality of cetaceans where catch events are predictable and relatively restricted in time and space but such circumstances in practice are rare making their use limited.

Excluder devices have been tested extensively in pelagic trawl fisheries although fish losses through have been shown to be sizeable in many trials. They can also be difficult to install, maintain and handle (grids) in large pelagic trawls, and mixed results have been obtained in trials carried out to date. Overall it is concluded that acoustic deterrence, though in several ways not ideal, is the only technical measure that is known to work in reducing cetacean bycatch in EU fisheries. It is preferable to the imposition of closed areas or times, yet the tools available are less than adequate. It is strongly recommended, though that the development of more robust and operationally manageable devices should be a priority. Alternative measures should also be sought through coordinated research.

Under Council Directive 92/43/EEC, Article 12.4 requires Member States to establish a system to monitor the incidental capture and killing of animal species, such as cetaceans, listed under Annex IV of the Directive. Member States are also required to establish Special Areas of Conservation (SACs) to enable relevant natural habitat types and species habitats to be maintained or restored at a favourable conservation status. Analysis of the EU database that contains all information supplied reveals that Member States reported on the status of 31 species of cetacean in EU waters under Article 17 of the Habitats Directive. Ideally this would be a useful tool with which to examine the status of the different European cetacean species, but in reality the information provided by Member States reporting under Article 17 is confused and contradictory. The standard format of the reports produced by Member States includes an evaluation of threats and pressures faced by marine mammal species. Pressures were identified as known adverse factors currently affecting the status of the species while identified threats were the more ephemeral/potential future impacts on the population. Little guidance was provided, however, on this and treatment between Member States may not have been uniform, judging from the information reported. Many inconsistencies were observed in the database; sufficient that any analysis would be likely to give spurious results.

It is concluded that in contrast to the Habitats Directive, specific objectives and targets in relation to cetacean bycatch monitoring are clearly defined in Council Regulation 812/2004. Although monitoring targets, data formats and other issues are subjects of ongoing debate, the regulation has, according to the conclusions of SGBYC 2010, succeeded in providing a "much more comprehensive picture of cetacean bycatch in European fisheries". From a policy perspective, duplication of requirements under these laws does not make sense. Furthermore, both laws are large in their scope so it would not be practical to combine them in their entirety into a single law. There is very little evidence of any linkage among member states activities between addressing obligations under the Habitats Directive and actions undertaken in fulfillment of regulation 812/2004. The Habitats Directive is focused on areas based management, yet in most cases this is unlikely to be an effective means of addressing conservation issues for cetaceans, most of which range over very large areas and are subject to wide-ranging bycatch. The obligation to monitor incidental catch under the habitats directive is widely ignored in favour of establishing ‘protected areas’ that are unlikely to be able to address conservation goals. It may make sense to remove the requirement to monitor bycatch under the Habitats Directive and to restrict bycatch related requirements to provisions under 812/2004.

Efficiency / Cost Effectiveness

Observation schemes are often cited as being costly. Seven Member States provided information on costs associated with carrying out observer coverage related to requirements under 812/2004 and the total estimated cost for observations carried out to date in relation to 812/2004 is roughly €6 million for a reported bycatch of 135 cetaeans. The cost per animal does not however reflect the total value of these schemes. Many marine mammal bycatch monitoring trips are integrated with other observer scheme duties (including obligations under the Data Collection Framework, and observations of trips without bycatch are also valuable to establish likely maximum bycatch rates, which maybe negligible but which certification schemes, for example, may wish to have confirmed. Further it is recommended that quantifying bycatch needs to be done by independent monitoring either using observers or electronically (e.g. video surveillance), but to ensure value for money and rational ecosystem management, it should be an integrated element of a wider ecosystem and fisheries monitoring of all non-target species.

The other element of 812/2004 with respect to cost effectiveness is the cost for fishermen to use Acoustic Deterrent Devices. Currently the annual costs of deploying ADDs vary considerably in relation to the technology employed in the devices and the rate of loss in specific fisheries. The costs are not considered to be insignificant for gillnet fisheries and these costs combined with poor reliability and negative impacts on fishing operations have discouraged uptake of ADDs and compliance with the regulations. Several countries have, however, instigated grant aid schemes or provided fishermen with pingers free of charge. This has helped but is not uniform across Member States.

1. INTRODUCTION

Global fishery bycatch of marine mammals has been estimated in the hundreds of thousands of individuals per year. Probably of most concern has been the reported large number of cetacean species, within the EU particularly harbour porpoises (*Phocoena phocoena*) and common dolphins (*Delphinus delphis*), that die in fisheries around the world. This bycatch has been documented for several decades; nonetheless, progress at quantifying the scale of the problem globally has remained slow and an understanding of the causes of bycatch is still limited in many cases. While bycatch in set and drifting gillnets and purse seines remain of principal concern, incidental mortality in trawl nets, longlines and some artisanal fishing methods such as beach seines are also problematic in many parts of the world. Of the 80 species of cetaceans, a group that includes whales, dolphins and porpoises, Northridge (1991) noted that "most marine mammals, with the exception of the rarer ocean beaked whales, have been recorded at some time or other caught in some type of fishing gear".

There are a variety of mitigation devices and gear modifications that have either been tested or are currently undergoing further experimentation. Several of these have been proven to work and some have been adopted. But because they are often sporadic in nature, cetacean interactions are notoriously difficult to observe and therefore remain poorly understood. Mitigation measures are thus usually designed based on conjecture rather than on a detailed knowledge of the behavior of the animal in and around the fishing gear.

In European fisheries, cetacean bycatch has been monitored and reported for a number of years and despite many regulatory attempts the scale of the problem can still only be estimated, although there is now unequivocal evidence that in some fisheries bycatch is at a level to be of extreme concern. For instance in the Baltic Sea, the population of harbour porpoises is at such a low level that even the bycatch of a single animal is cause for concern.

Globally there are a number of regulatory frameworks designed to reduce or minimize cetacean bycatch. Already enshrined in principle under article 119 of UNCLOS, bycatch reduction is also called for under the FAO's Code of Conduct for Responsible Fisheries (FAO 1995). Article 7 of the Code states that "*States should take appropriate measures to minimize catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species".* Many of the current regulations merely set maximum levels of bycatch based on a level deemed acceptable for sustaining the population, while others are more specific by prescribing the use of mitigation measures such as closed areas or seasons, or, in the most extreme cases prohibiting fishing methods in particular fisheries.

This study assesses the regulatory framework adopted in the EU for the mitigation of incidental catches of cetaceans in EU waters. It focuses primarily on provisions under Council Regulation (EC) No. 812/2004 and also Council Directive 92/43/EEC (Habitats Directive) and attempts to assess the relevance, effectiveness and cost-effectiveness in dealing with the issue of cetacean bycatch.

Council Regulation 812/2004 lays down measures concerning incidental catches of cetaceans in EC fisheries. The stated aim of regulation is "*to prevent the accidental capture of cetaceans such as dolphins and harbour porpoises in fishing gear, as this is threatening the conservation of these species*". It specifies: fisheries where the use of acoustic deterrent devices (ADDs) is mandatory; technical specifications and conditions of use of the devices; and fisheries where at sea observer schemes are required.

Under Council Directive 92/43/EEC, Article 12.4 requires Member States to establish a system to monitor the incidental capture and killing of animal species, such as cetaceans, listed under Annex IV of the Directive. Member States are also required to establish Special Areas of Conservation (SACs) to enable relevant natural habitat types and species habitats to be maintained or restored at a favourable conservation status.

This study focuses primarily on harbour porpoises, bottlenose dolphins (*Tursiops truncatus*) as well as short-beaked common dolphins and, where appropriate, information on other species such as minke whales (*Balaenoptera acutorostrata*) and Atlantic white-sided dolphins (*Lagenorhynchus acutus)* is also provided.

The study is split into three sections as follows:

- Task 1 provides a description of the status and the incidental and accidental catches of the above mentioned species in EU waters.
- Task 2 provides a detailed assessment of the outcome of Regulation (CE) 812/2004
- Task 3 provides an assessment of the outcome of Directive 92/43/EEC on the above mentioned species in EU waters.

Key sub-tasks under each of these tasks are outlined as headings under each section of the report. Associated tables are presented in separate Annexes.

Under Task 1 recent estimates of abundance and population related issues for relevant cetaceans in EU waters are reviewed and bycatch estimates are compiled from a number of sources including the International Council for the Exploration of The Sea (ICES) Study Group on Bycatch of Protected Species (SGBYC) and the ICES Working Group on Marine Mammal Ecology (WGMME).

Under Task 2 recommendations in relation to 812/2004 from several groups reporting to ICES, Member State reports submitted in fulfillment of the regulation, the cost and targets of observer schemes, ADDs and other mitigation methods, as well as the impact of the regulation on relevant cetacean populations are analysed in order to assess the outcome of the regulation.

Under Task 3 reports from Member States submitted under the Habitats Directive are summarized. Although not available at a species specific level, compiled information on Designated Marine SACs and Sites of Community Importance (SCIs), which may include provisions for relevant cetacean species, where available, are described. In addition a variety of means used by Member States to transpose the directive into national law are outlined. The duplication of requirements under the two regulations is identified and a potential method of streamlining legislation in order to improve the results of the separate monitoring programmes is discussed.

The final section of the reports contains a series of conclusions and recommendations from the analysis completed of the main requirements under 812/2004 and 92/43/EEC. These recommendations are put forward as means to improve the current regulations but should be considered in addition to the multiple recommendations made by ICES and others.

2. ASSESSMENT OF THE STATE OF CETACEAN POPULATIONS AND THE INCIDENTAL CATCHES OF CETACEANS IN EU WATERS

This chapter details the best available information on the current status of cetacean populations within EU waters covered by Regulation 812/2004 and Council Directive 92/43/EEC (Habitats Directive). It also summarizes the level of incidental and accidental bycatch of these species based on information from a number of sources. It describes the current methodologies used to make these assessments and also to quantify bycatch levels in respect of current population estimates. While this data is extremely patchy, both in relation to population estimates and bycatch rates, it is reasonable to conclude that in a number of EU fisheries bycatch levels are of a sufficient scale to warrant concern and the continuing need for regulatory measures.

2.1. Current estimates of abundance for cetaceans in EU waters

KEY FINDINGS

- Recognized methods for estimating absolute abundance of cetaceans include conventional distance sampling (design-based estimates); model-based estimates, partially applying distance sampling; and mark-recapture models. All methods provide managers with a point abundance estimate, with its two confidence limits (usually significant at 95%) and Coefficient of Variation. All methods have limitations.
- The information on cetacean absolute abundance in EU waters is extremely heterogeneous and unsatisfactory from a management perspective despite the best efforts of researchers. Absolute estimates that might be useful to inform management actions, and relating to areas of reasonable size in terms of coverage of the range of such highly mobile species – exist for the North Sea, the Baltic Sea and parts of the north-eastern Atlantic but not for the Mediterranean nor the Black Sea. This remains an obstacle in assessing the true impact of regulatory measures in reducing cetacean bycatch.

2.1.1. Available methods

In order to reliably assess the impact of accidental catches of cetaceans or of any other measurable anthropogenic mortality at the population level, robust information on spatial and temporal pattern of their absolute abundance is required (STEFC 2002; Buckland *et al.* 2004; Evans & Hammond 2004; Anon 2006). In addition details on the population structure of each species of interest is also needed. Methods estimating relative abundance or density are valuable (e.g. encounter rates), in terms of providing relative indications on short-term changes (e.g. outlining local trends over time), but they cannot be used, for example, to put impacts (e.g. human-induced mortality) into a population context.

Recognised methods for estimating absolute abundance of cetaceans are currently accepted as:

- conventional distance sampling (design-based estimates);
- model-based estimates, partially applying distance sampling; and
- mark-recapture models.

All methods provide managers with a point abundance estimate, with its two confidence limits (usually significant at 95%) and a Coefficient of Variation (CV). Line transects surveys use dedicated platforms that allow representative coverage of large areas from which abundance estimates can be made. Mark-recapture models also allow population dynamics analyses, including estimation of survival and reproductive rates. However, these are applicable only to those species where individual recognition is possible (e.g. bottlenose dolphins and humpback whales (*Megaptera novaeangliae*). Finally model-based estimation, by mixing concepts characterising the distance sampling (detection function estimate) and GLMs and/or GAMs (spatial modelling of groups), also allow the use of data collected through non-systematic survey.

In **Conventional Distance Sampling** surveys (line-transect surveys) for cetaceans, observers perform a standardized survey along a series of transects, searching for animals or groups of animals. For each *detection*, the distance and angle (relative to a transect) to the "detection" are recorded. The basic concept is that the perpendicular distance to each detected object can be used to estimate the effective width of the strip that has been searched. Density is then estimated as: $\hat{D} = \frac{n\bar{s}}{2eswL}$ where n is the number of separate detections of animals (or groups), $\bar{s}$ is mean group size, L is the total length of transect searched, and 'esw' (on two sides of the vessel) is the estimated effective strip width. Since the probability of detecting objects decreases with distance from the transect line, the key to distance sampling analyses is to fit a detection function to the observed perpendicular distances of all the detections, and use that to estimate the proportion of missed objects and the effective strip width. The method is the standard means of estimating cetacean abundance has been developed and used extensively by, among other organisations, the Inter-American Tropical Tuna Commission (IATTC), the US National Marine Fisheries Service (NMFS) and the International Whaling Commission (IWC).

For **model-based abundance** estimation, five steps are usually followed: (a) a detection function is estimated from the distance data and any covariates (such as weather) that could affect detection probability; (b) the number of groups in each segment is estimated through the Horvitz-Thompson estimator; (c) the abundance of groups is modelled as a function of spatial and environmental covariates; (d) the groups sizes is modelled as a function of detection probabilities and covariates; and (e) "step c" and "step d" are combined and extrapolated to the whole study area for obtaining the final abundance of animals. The beauty of this method is that can be applied to data collected through both systematic and non-systematic line-transects.

The principle relationship underlying all **mark-recapture models** is as follows: if in a given population a sample (n_1) of individuals is marked (photo-identified) and the population is re-sampled after a period that allows complete mixing, then the ratio of the number of marked individuals (m_2) to the size of the second sample (n_2) should be equal to the ratio of the total number of marked animals in the total population size (N). Thus, $\frac{m_2}{n_2} = \frac{n_1}{N}$.

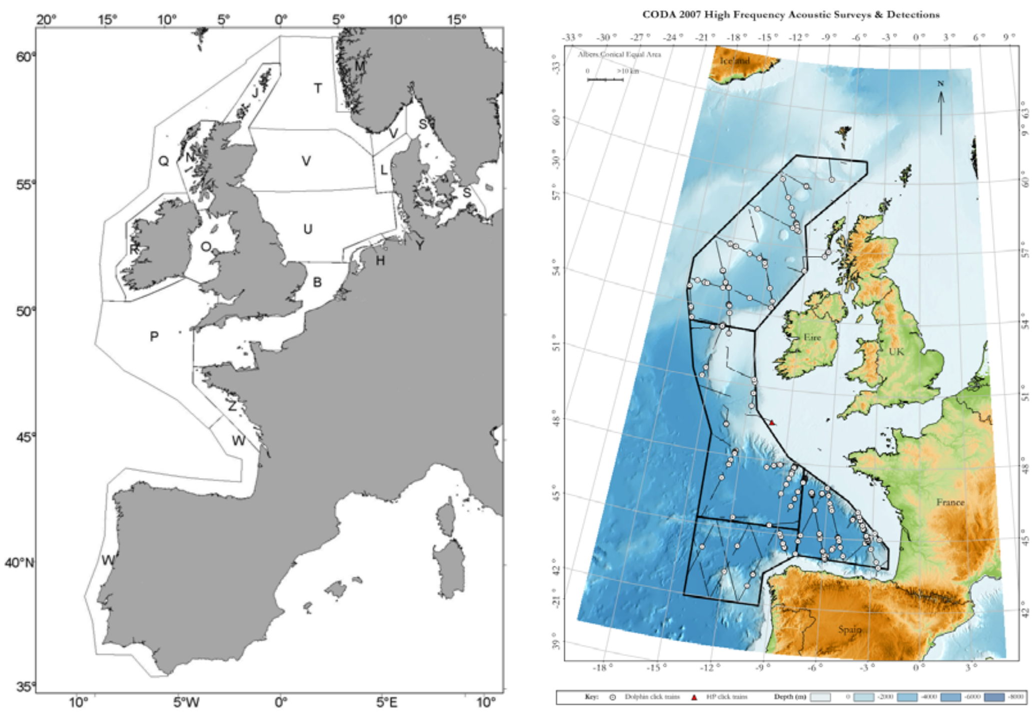
Rearranging this equation gives the two-sample Lincoln-Petersen estimator: $\hat{N} = \frac{n_1 n_2}{m_2}$

The Lincoln-Petersen estimator is basic. When studies allow for multiple sampling occasions, a number of more complex estimators can be applied and models for open populations can also be applied.

2.1.2. Available data

The information on cetacean absolute abundance in EU waters, including those in the Mediterranean Sea, is extremely heterogeneous and unsatisfactory, from a management perspective. Absolute estimates that might be useful to inform management actions, and relating to areas of reasonable size in terms of coverage of the range of such highly mobile species – exist for the North Sea, the Baltic Sea and parts of the north-eastern Atlantic (See Annex I). These estimates are the results of large-scale surveys (SCANS-I, SCANS-II, CODA, NASS), which applied conventional "distance sampling" techniques. Figure 1 shows the SCANS II and CODA survey areas. Additional information on *relative* abundance is available for several local areas; however, these relative indices cannot be used when it comes to assessing the impact of anthropogenic activities in the population context. Concerning the Mediterranean and Black Sea EU waters, the situation is even more inadequate (See Annex I). Only a few older estimates exist on a large-scale for the western Mediterranean. Additional conventional distance sampling, model based and mark-recapture estimates exist for local populations or sub-regional areas, but nothing exists at the basins' level. Under the aegis of ACCOBAMS a plan for a wide-basin survey in Mediterranean and Black Sea - the "*ACCOBAMS Survey Initiative*" - has been prepared, but the funding is still lacking. In fact, given the need of covering also non-EU waters (cetaceans do not acknowledge borders) traditional grants from the EU - such as, for example, LIFE funding that was used for SCANS-I & -II - seem to be inapplicable. Other EU grants - such as, for example, those devoted to the application of the Barcelona Convention or to multilateral fishing agreements – seem to be unachievable.

Map 1. The SCANS II Survey Area 2005 (left) & CODA survey Area 2006 (right)



Source: SCANS II, 2008 & Anon., 2009

2.1.3. IUCN status of relevant species

KEY FINDINGS

- Although none of the global populations of the species considered here is regarded by the IUCN as especially at risk, regional populations of some of these species, notably harbour porpoises and common dolphins are considered as threatened.

The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world.

The overall aim of the Red List is to convey the urgency and scale of conservation problems to the public and policy makers, and to motivate the global community to try to reduce species extinctions. IUCN categories are not a substitute for abundance estimates or trends in population abundance that might be used in a management context to determine whether known bycatch levels are likely to drive population numbers down in an unsustainable way. The categories are 'broad brush' statements on overall levels of concern.

There are **nine** categories in the IUCN Red List system: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient, and Not Evaluated. Classification into the categories for species threatened with extinction (Vulnerable, Endangered, and Critically Endangered) is through a set of five quantitative criteria that form the basis of the system. These criteria are based on biological factors related to extinction risk and include: rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation.

The status of all species within the scope of this study on the IUCN list is 'Least concern'. A taxon is "Least Concern" when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category. Justification for this status and conservation actions for each of these species relevant to the present study include:

2.1.3.1. Harbour porpoise

The harbour porpoise is known to be harvested in two areas and regional declines are described, it is widespread and abundant. In some of the major habitats for harbour porpoises (the shelf waters of the USA and Europe) conservation measures are implemented. The species is listed in Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora).

In the North Sea incidental takes have been determined to be above the advised maximum level of removals. The European Union adopted a regulation aimed at reducing the incidental catch of small cetaceans in fisheries in European Union waters. The regulation includes measures restricting Baltic Sea drift net fisheries, providing for mandatory use of acoustic deterrent devices (pingers) in some EU gillnet fisheries in the North and Baltic Seas, and the use of onboard observers on vessels of over 15 m in length. A review of the progress of implementing resolution is scheduled for 2007.

2.1.3.2. Common Dolphins

Despite ongoing threats to local populations, common dolphins are widespread and very abundant (with a total population in excess of four million), and no threats are believed to be resulting in a major global population decline.

The species is listed in Appendix I of CITES. The Mediterranean population is listed in Appendices I and II of CMS (Convention on Migratory Species). The current ban on driftnet fishing in the Mediterranean should be implemented and enforced as a matter of priority.

2.1.3.3. Bottlenose dolphins

Although there are many threats operating on local populations, bottlenose dolphins are widespread and abundant, and no threats are believed to be resulting in a major global population decline.

The species is listed in Appendix II of CITES. The bottlenose dolphin has been afforded special protected status under Annex II of the European Union's Habitats Directive. Commercial hunting of Black Sea cetaceans including bottlenose dolphins was banned in 1966 in the former USSR, Bulgaria and Romania, and in 1983 in Turkey.

2.1.3.4. Minke Whale

There is no estimate of total global population size, but estimates from parts of the range in the Northern Hemisphere (totalling in excess of 100,000 individuals) show that the minke whale is above the thresholds for a threatened category. While declines have been detected or inferred in some areas, there is no indication that the global population has declined to an extent that would qualify for a threatened category.

Minke whales, including *B. acutorostrata*, are included in Appendix I of CITES, with the exception of the population from Greenland which is included in Appendix II. This implies prohibition of commercial international trade in products, but such prohibition does not apply to Iceland, Norway or Japan, who hold reservations on the species.

2.2. Incidental and accidental catches of relevant cetacean species

KEY FINDINGS

- Generally bycatch is estimated as being low in many fisheries observed, although it is difficult to extrapolate to fleet level. Significant bycatch levels, however, have been reported in several fisheries.
- A total of 135 cetaceans consisting of 81 common dolphins (*Dephinus delphis*), 32 harbour porpoises (*Phocoena phocoena), 9 bottlenose dolphins (Tursiops truncatus), 7 striped* dolphins (*Stenella coeruleoalba*), 5 long finned pilot whales (*Globicephala melas*) and 1 Atlantic white-sided dolphin (*Lagenorhynchus acutus*) have been observed as bycatch in data collected under regulation 812/2004.
- The variety of formats in which data on bycatch have been collected, though, make it difficult to comment on the consistency of the data collected under 812/2004.
- Comparing data collected as part of observer schemes carried out under 812/2004 with other observer schemes is not straight forward as various methods have been employed to aggregate data and data have been aggregated at different levels. In addition data gaps exist in the information compiled under 812/2004 and the bycatch estimates are not comprehensive across all Member States. Some comparisons have nevertheless been attempted and show bycatch continuing in certain fisheries e.g. pelagic trawl fishery for bass.
- Other bycatch data not required under 812/2004 were available for fisheries in the Mediterranean. Notable bycatch events recorded include, 237 striped and common dolphins observed in the Moroccan (IUU) driftnet fishery with an estimated total bycatch of 3647 animals and a bycatch of 68 and 46 harbour porpoises in Turkish fisheries and Romanian set gillnet fisheries in the Black Sea respectively. Small bycatch incidents have also been by Italy reported for bottlenose dolphins in fisheries in the Black Sea and the Mediterranean.
- While not covered by 812/2004, of grave concern are the heavy bycatches of loggerhead turtles reported in a range of fisheries in the Mediterranean.

2.2.1. Information obtained under 812/2004 observer schemes

Data on bycatch incidences from observer programmes carried out as part of monitoring programmes undertaken in relation to 812/2004 are outlined in Annexe II taken from SGBYC 2010 (ICES, 2010). A total of 135 cetaceans consisting of 81 common dolphins (*Dephinus delphis*), 32 harbour porpoises (*Phocoena phocoena*), 9 bottlenose dolphins (*Tursiops truncatus*), 7 striped dolphins (*Stenella coeruleoalba*), 5 long finned pilot whales (*Globicephala melas*) and 1 Atlantic white-sided dolphin (*Lagenorhynchus acutus*) have been observed as bycatch in data collected under regulation 812/2004.

These data have been reorganised in Annex IIa and b to highlight bycatch estimates. The data are sorted by cetacean species, host country of relevant fishing fleets, information on gear type at the maximum level of available detail and a description of the species targeted by these fleets which provides some information on the characteristics of fishing gears. In order to provide some clarity regarding blank values, the data were organised as follows. Annex IIa presents bycatch estimates which have been provided by Member States. Annex IIb presents extrapolated bycatch estimates where no bycatch estimate value has been provided but where observed days, corresponding fleet effort and a positive or blank value for no cetacean specimens are provided for a given strata. It should be reemphasised that these bycatch estimates have not been provided directly by Member States and the quality of these estimates is unknown.

Some 53 cetacean bycatch estimates have been provided by Member States from 2005 – 2008 (Annex IIa). Nineteen of these estimates were positive values where cetacean bycatch occurred while the remaining 34 estimates were zero values indicating zero bycatch. A further 13 positive bycatch incidents occurred from a total of 72 extrapolated bycatch estimates (Annex IIb).

A further 50 records have been compiled in Annex II where the number of days observed and corresponding bycatch for a given strata are provided but no corresponding total fishing effort for that strata is provided which means that bycatch estimates have not been provided nor is it possible to extrapolate bycatch estimates from the available data. These data include 1 record of a single bottlenose dolphin bycatch, 6 records of harbour porpoise bycatches, 4 records of common dolphin bycatches and 1 record of 22 common dolphins caught in the UK midwater trawl fishery for bass in 2008.

A table of estimated accidental/ incidental cetacean bycatch by Member State's fishing fleets operating in areas where 812/2004 compiled at fishery level was compiled at SGBYC 2008 (ICES, 2009) (Table 1). This type of table which summarizes bycatch data at fishery level is useful in terms of obtaining a snap shot of where bycatch problems may or may not be occurring.

Notable fishery level bycatch estimates from Table 1 and Annex IIa include:

- 807 common dolphins and 1194 harbour porpoises in the UK set gillnet fishery for the combined years of 2005 and 2006;
- total bycatch of 500 harbour porpoises and 226 common dolphins were estimated in the French set gillnet fishery and midwater pair trawl fishery for bass (*Dicentrarchus labrax)* respectively in 2007;
- 355 harbour porpoises were estimated as bycatch in the Irish set gillnet fishery for hake *(Merluccius merluccius)* and cod (*Gadus morhua)* in the Celtic Sea in 2006.

Table 1. Summary of estimated accidental/incidental cetacean bycatch by Member State's fishing fleets operating in areas where the Regulation applies

Country	Year	Gear	*Phocoena phocoena*	*Delphinus Delphis*	*Globicephala melas*	*Lagenorhynchus acutus*	Coverage %
Netherlands	2004/2005	Pelagic Trawl					11.8
Netherlands	2006	Pelagic Trawl					12.7
Ireland	2005	Pair Pelagic Trawl		0			15.4
Ireland	2006	Pair Pelagic Trawl		0			5.6
Ireland	2005-2007	Gillnet	355				2.0
Estonia	2006	Pelagic Trawl					0.8
Poland	2006	Pelagic Trawl					0.5
Poland	2006	Gillnet					0.2
Finland	2006	Pelagic Trawl					9.0
Sweden	2006	Pelagic Trawl					3.9
Italy	2006	Demersal/pelagic trawl					4.4
Germany	2005	Pelagic Trawl					13.2
Denmark	2005	Pelagic Trawl					5.2
Denmark	2005	Gillnet					1.0
Denmark	2006	Pelagic Trawl					5.2
Denmark	2006	Gillnet					0.5
UK	2005&2006	Pair Pelagic Trawl		196			
UK	2005&2006	Gillnets	911	195			
UK	2005&2006	Tangle nets	283	612			
UK	2005&2006	Other pelagic trawls					
France	2006	Pair Pelagic Trawl					1.8

Source: SGBYC 2008 (ICES, 2009a)

2.2.2. Other information relevant to 812/2004

A project called PETRACET was carried out in response to a call by the European Commission (DG Fish) to address a lack of co-ordination in monitoring of cetacean bycatch by EU Member States. The project aimed to monitor approximately 5% of annual fishing effort among the main French, Irish, UK, Danish and Dutch pelagic trawl fisheries operating in the Celtic Sea and the Bay of Biscay region. Sampling was carried out by independent observers between December 2003 and May 2005. Some 952 valid hauls were observed with an associated bycatch of 93 cetaceans in 21 fishing operations. Common dolphins were the most prevalent bycatch species with 89 animals reported as bycatch. Three striped dolphins and one Risso's dolphin (*Grampus griseus)* were also reported. The highest bycatch occurred in the bass pair trawl fishery in the Bay of Biscay with 75 dolphins (common, striped and Risso's dolphin) reported in 13 hauls; 8 of these in a relatively small area off the Brittany coast. Total bycatch of common dolphins for all pelagic trawl fisheries operating in the area ranged from 620 up to 1930 animals depending on the method used to extrapolate observed bycatch to fleet level (MacAlister Elliot & Partners, 2006). The UK bass trawl fishery was not included in this study but the fishery was monitored intensely from 2000 with total estimates of bycatch of 40 to 400 common dolphins per year (Northridge *et al*., 2005).

An extensive study on harbour porpoise bycatch in set gillnets in the Celtic Sea was carried out between 1992 and 1994. Total estimates of bycatch for 1993 was 740 (S.E 182, 95% C.I. 383 – 1097) for UK vessels over 15m and 1497 (S.E. 475, 95% C.I. 566 – 2428) for Irish vessels between 14 – 22m with a combined annual estimate of approximately 2200 animals (Tregenza *et al*., 1997a).

A study on common dolphin bycatch in set gillnets in the Celtic Sea was carried out concurrently to the previous study. Total estimates of bycatch for 1993 was 54 (95% C.I. 18 - 162) for UK vessels over 15m and 180 (95% C.I. 60 - 540) for Irish vessels over 15m with a combined annual estimate of 234 (95% C.I. 78 – 702) animals (Tregenza *et al*., 1997b).

2.2.3. Comparison of data collected under 812/2004 and other programmes

Comparing data collected as part of observer schemes carried out under 812/2004 with other observer schemes is not straight forward as various methods have been employed to aggregate data and data have been aggregated at different levels. In addition data gaps exist in the information compiled under 812/2004 and the bycatch estimates are not comprehensive across all Member States. Some comparisons are nevertheless, where possible, attempted:

Bycatch of common dolphins in the French bass pelagic trawl fishery was highlighted as potentially problematic in the PETRACET study with 75 dolphins (71 common, 3 striped and 1 Risso's dolphin) observed as bycatch from 2003 to 2005. Data collected under 812/2004 have demonstrated that dolphin bycatch continues to exist in this fishery with total estimates of 226 and 300 animals caught between December and March in 2007 and 2008 respectively. In addition under 812/2004, the UK reported a total combined estimated bycatch of 196 common dolphins in midwater pair trawl fisheries for the years 2005 and 2006. This includes the bass fishery. This estimate is consistent with earlier estimates from a UK monitoring programme of 40 to 400 animals per year from 2000 onwards (Northridge *et al*., 2005).

A total estimate of 807 common dolphins reported as bycatch in the UK gillnet fishery for the combined years 2005 and 2006 is considerably higher than the total estimate of 54 animals obtained in 1993. This difference may be due to the fact that only one fishery (the gillnet fishery for hake) was monitored in 1993, whereas a wider regime of métiers is now sampled. Coupled with total bycatch estimates of 100 in French and 23 in Spanish set gillnet fisheries in 2008, this confirms that bycatch of common dolphins occurs in set gillnet fisheries carried out by most if not all EU Member States in the Atlantic region.

As part of scientific studies monitoring the practicalities and effects of deploying ADDs in Celtic Sea gillnet fisheries, a total estimated bycatch of 355 harbour porpoises was reported by Ireland in 2006. This estimate was considerably lower than a total estimate of 1497 animals obtained for 1993. This decrease could be attributed to a major decrease in fishing effort with approximately 10 times more fishing trips carried out by Irish gillnet vessels in the Celtic Sea in 1993 than 2006 (Cosgrove and Browne, 2007a). In contrast relatively high bycatch estimates of harbour porpoise in set gillnets recorded by the UK and France in areas where ADDs are not currently required under 812/2004, demonstrate that harbour porpoise bycatch is still an issue and is widespread. It reinforces the view that mitigation measures should remain to protect harbour porpoises.

2.2.4 Other bycatch data not required under 812/2004

Bycatch information was also available for species and countries not required under 812/2004. Italy has provided data on loggerhead turtles in reports under 812/2004. A total of 65 loggerhead turtles were observed as bycatch in Italian pair pelagic trawl fisheries in area GSA 17 in the Mediterranean in 2006 and 2008. A total estimated bycatch of 427 animals was provided by Italy for this fishery in 2008. Denmark also reported 1 harbour seal as bycatch in set gillnet fisheries in 2008.

Information on bycatch of cetacean and non cetacean species by Member states and non Member States in the Mediterranean was compiled by SGBYC in 2008 as outlined in Table 2 below (ICES 2009a). These data were extracted from a variety of sources (journal articles, published and unpublished reports) (Brotons *et al*. 2007, Casale *et al*., 2004, Fortuna, 2008 and Tudela *et al*. 2005). The data were not considered to be exhaustive, but represented the best information available. Some 237 striped and common dolphins were also observed in the Moroccan (IUU) driftnet fishery with an estimated total bycatch of 3647. Harbour porpoises have been observed as a bycatch in Turkish fisheries (68) and Romanian set gillnet fisheries (46) in the Black Sea. Small bycatch incidents have also been reported for bottlenose dolphins in fisheries in the Black Sea and the Mediterranean. Major bycatches of loggerhead turtles have been observed in Italian Bottom trawl and pair pelagic trawl fisheries, and Spanish surface longline fisheries. While outside the scope of 812/2004 this issue remains of grave concern.

Table 2. Mediterranean Sea: Summary of recent protected species bycatch data and estimates of total bycatch

Country	Region	Gear/Fishery	Year	Coverage %	Species	Observed	Estimate (CV)
Italy	Mediterranean	Bottom Trawl	1999/2000	0.004	Bottlenose dolphin	0	
					Loggerhead turtle	62	4273 (CI: 2186-8546)
Italy	Mediterranean	Pair midwater/pelagic trawl	1999/2000	0.011	Bottlenose dolphin	0	
					Loggerhead turtle	0	
Italy	Mediterranean	Pair midwater/pelagic trawl	Jul 2006–Nov 2008	2.3	Bottlenose dolphin	2 dead, 1 released	34 (NA)
					Loggerhead turtle	78 (released alive) + 2 (dead)	1284 bycaught (NA) 34 dead (NA)
Morocco	Mediterranean	IUU driftnets	Dec 2002–Sept 2003	0.6	Striped and common dolphins	237	3647 (95% CI 537) - 50% Sc & 50% Dd
					Loggerhead turtle	46	
Spain	Mediterranean	Trammelnet	2001–2003	NA	Bottlenose dolphin	2	
Spain	Mediterranean	Surface longlines		NA	Loggerhead turtle	588	
Romania (EU)	Black Sea	Turbot gillnets	2002–2006	NA	Harbour porpoise	46	NA
					Common dolphin	3	NA
					Bottlenose dolphin	2	NA
Turkey	Black Sea		1999, 2002, 2003	NA	Harbour porpoise	68	
					Common dolphin	0	
					Bottlenose dolphin	1	

Source: SGBYC 2008 (ICES, 2009a)

2.3. Information on Population status provided from reporting under the Habitats Directive

KEY FINDINGS

- Analysis of an EU database that contains all information supplied by Member States under Article 17 reveals that Member States reported on the status of 31 species of cetacean in EU waters. Ideally this would be a useful tool with which to examine the status of the different European cetacean species, but in reality the information provided by Member States reporting under Article 17 is confused and contradictory.
- The standard format of the reports produced by Member States includes an evaluation of threats and pressures faced by marine mammal species. Pressures were identified as known adverse factors currently affecting the status of the species while identified threats were the more ephemeral/potential future impacts on the population. Little guidance was provided, however, on this and treatment between Member States may not have been uniform, judging from the information reported. Many inconsistencies were observed in the database; sufficient that any analysis would be likely to give spurious results.
- ICES SGBYC recommended that this draft database could not be used for a reliable analysis of the main threats or pressures on marine mammals in European waters. Should such an analysis be required, it seems likely that a first step should be to issue some consistent guidance on completion of the reports by Member States that have been used in compiling the database.
- It is clear that a more coordinated and perhaps regional approach to the assessment of cetacean conservation status is required under this Directive if a reliable and useful indicator is to be established in future otherwise the information provided will continue to be of limited value.

Article 17 of the Habitats Directive 92/43/EEC requires that every 6 years Member States prepare reports to be sent to the European Commission on the implementation of the Directive. The Article 17 reports for the period 2001-2006 for the first time includes assessments on the conservation status of the habitat types and species of Community interest. In theory these reports should detail the conservation status of all cetacean species in Europe. Member States reports have been summarized and tabulated in a publicly available database held by the European Environment Agency at:
http://www.eea.europa.eu/data-and-maps/data/article-17-database-habitats-directive-92-43-eec

Initial analysis of this database revealed that Member States reported on the status of 31 species of cetacean in EU waters under Article 17 of the Habitats Directive. Ideally this would be a useful tool with which to examine the status of the different European cetacean species, but in reality the information provided by Member States reporting under Article 17 is confused and contradictory. The overall conservation status reported by Member States is summarized in section 4 but one example that serves to illustrate the general point that the information is confused and contradictory is given below.

The harbour porpoise is distributed throughout northern and western European waters, from Portugal to Norway. It is especially abundant in the North Sea and adjacent waters, with over 300,000 individuals estimated as being present here in two major EU funded surveys (SCANS and SCAN II) a decade apart. The conservation status of porpoises in the North Sea is recorded as "unfavourable bad", "unfavourable inadequate", "unknown" and "favourable" by various Member States in this region. Clearly different Member States have used different criteria to assess the same population and have come up with widely different interpretations, rendering these assessments of little use.

It is clear that a more coordinated and perhaps regional approach to the assessment of cetacean conservation status is required under this Directive if a reliable and useful indicator is to be established otherwise the information provided will continue to be of limited value. This is further discussed in section 4.

2.4. Alternative means of assessing the status of cetacean populations

KEY FINDINGS

- There are number of alternative means of assessing the status of cetacean populations including sightings surveys, acoustic monitoring, strandings data. None of these are perfect and caution is urged in using strandings data in particular.
- There is much ongoing work focused on trying to make best use of platform of opportunity data and acoustic means for detecting trends in the relative abundance, but at present, and in contrast to the situation for dedicated abundance surveys, there is still no widely agreed set of tools to address this objective, and little pan European effort to co-ordinate the development of such tools.

The status of wild animal populations in general is usually measured in terms of their abundance, but numerous other interpretations are possible. These might include disease prevalence, mortality rates, growth rates, animal condition, age at sexual maturity or reproductive output. Any of these metrics could be used to make some assessment of population 'status'. However, none is particularly easy to quantify (for most there are considerable problems in obtaining unbiased samples) and none can *directly* address the potential impact of incidental catches. For this, an assessment of the changes in numbers of animals is required in order to quantify 'status', though often this is inferred from a trend (e.g. sharply declining suggests poor status). We therefore consider below only those methods that might be used to quantify animal abundance or trends in animal abundance.

Abundance can be quantified either in absolute terms (which is always necessary for determining bycatch limits) or in relative terms from one time period to another, which may inform on trends in population size. A common method applied to assess the status of cetacean populations is to therefore estimate absolute abundance and subsequently to monitor spatial and temporal trends in that abundance. In Europe this has been done at roughly a decadal interval by the two SCANS surveys for the North Sea and adjacent waters. Large scale shifts in harbour porpoise density were noted, but no significant change in absolute abundance was reported over the decade by the SCANS II project (Anon 2007). There is, however, no overall strategy for dealing with the assessment of cetacean abundance at the European level, or for examining trends in abundance, and these tasks are largely down to Member States or to scientists to try to source funding to address the issue. Instead there is a patchwork of non-overlapping data sets with a few that deal with trends in the abundance of local populations, notably of semi-resident or resident populations of bottlenose dolphins in small areas.

Berggren et al (2007) have reviewed the methods used to monitor spatial and temporal trends in cetacean abundance as part of the SCANS II project, and our review draws heavily upon their assessment.

The primary methods of quantifying cetacean abundance are through sightings surveys. The methods are described above in section 2.1 and include standard distance sampling, model based abundance estimates and mark recapture (or photo-id) studies. These methods can be used to generate estimates of population size at intervals so that trends in abundance can be estimated and this can be used to infer population status. Other or alternative methods are typically intended to examine trends in relative abundance rather than estimate absolute abundance. These include:

- *Incidental sightings* (collected from platforms of opportunity such as ferries or yachts) have been used where data are collated from a variety of sources to infer trends in sightings rates.
- *Fixed surveys* from land or from a fixed position in the sea have also been attempted.
- *Acoustic methods* are used to determine relative abundance between areas or between time periods. These might involve towed hydrophones to cover a certain area, or static click detectors to monitor trends at specific location.
- Other surveys, for example *fish sampling surveys* may be used to collect sightings or acoustic data in a more systematic way than is possible from incidental sightings.
- Records of *stranded animals* have occasionally been proposed as another way to monitor abundance. We briefly summarize the advantages and disadvantages of these alternative methods.

Incidental sightings (from 'platforms of opportunity') are a cheap way of collecting data, and can provide information on the species present in an area, and they might be able to say something about relative abundance from one area to another or from one time period to another. Long-term data sets can be compiled and data can be collected throughout the year rather than as a snapshot at one time period, which is typical of dedicated sightings surveys. Unfortunately there are usually many confounding issues that preclude reliable assessments of trends in these data. Different observers and differing sighting methods (including the vessel type, speed and height of observation) can all have dramatic effects on the probability of detecting an animal. Unless observers and vessels are thoroughly mixed through time and across the area of interest it is very likely that biases will be introduced that preclude the possibility of detecting trends. Nevertheless new statistical tools are under development to try to address some of these issues (Thomas, 2009), and particularly where a lot of observations are available from a restricted group of individuals or vessel types, it may be possible to detect significant signals within the general noise associated with these types of data.

Sightings or acoustic detections from fixed points, including for example cliff-top observations, have been suggested as a means of monitoring population status, but they rely upon the small area that is sampled being representative of the entire population. Small changes in distribution could easily mask population level trends or be taken to imply trends that do not exist at the population level. This method is used for some species that have a regular migration route that takes them close to land, but no such obliging population of cetaceans is known in European waters.

Acoustic monitoring relies upon the fact that odontocete cetacean's echolocate much of the time and these echolocation clicks can be detected and stored or logged using suitable equipment. Acoustic monitoring can be used in dedicated surveys (as it was in SCANS II and CODA), but can also be deployed from small vessels and platforms of opportunity and is therefore potentially a fairly cheap way to monitor relative encounter rates of echolocating cetaceans. It has the advantage over visual methods that the 'observer' – a hydrophone and electronic filters – is consistent, but results can vary depending on the boat, so some overlap between different vessels covering the same area at the same time is needed if the data are to be calibrated, or the surveys must be conducted from the same vessel. Methods are still being developed to try to use acoustic detections to estimate animal abundance, but in the meantime use of acoustic means to infer trends in abundance could be a useful tool, though this remains unproven.

A more rigorous platform of opportunity survey may be possible using vessels that cover a large area routinely. **Monitoring in conjunction with other surveys** has often been mooted as a potential way of overcoming some of the problems of heterogeneity associated with incidental sightings collected from a wide variety of platforms. Regular fish research surveys for example may provide such an opportunity, but have rarely been used consistently or over a wide enough or long enough time period to enable them to be used for detecting trends in cetaceans, and there is still a risk that changes in personnel and vessel characteristics may confound the ability to detect trends (though Bravington *et al* 1999 did analyse some such data series and were hopeful that such data could be used to determine trends).

Occasionally people have tried to use **strandings data** to infer something about trends in abundance. However, as with static monitoring, trends in strandings can be greatly influenced by changes in distribution. Other factors such as changes in mortality rates, weather and changes in reporting efficiency can also seriously affect any interpretation of strandings data and generally speaking they should not be used to determine trends in abundance, though on occasion they may help provide additional evidence of some such trend.

For all of these alternative methods one must remember that trends in abundance only make sense if they are related to a geographical area that is large enough to be meaningful in terms of the population biology of the animals concerned. In reality biological populations are not neatly defined, and marine mammals are often managed as 'stocks', or populations that are designated for management convenience. Care must therefore be taken to ensure that 'trends' in abundance really reflect the dynamics of changes in survival and production rather than simple shifts in distribution within a stock boundary.

We have focused here on methods to detect trends in abundance as indices of population status. In reality such methods will usually only detect large scale changes in abundance. Smaller changes of a few percent will not be noticed unless the population is very well studied, and usually that means that most individuals can be recognised.

Other less direct methods are also available, that rely upon population models to try to determine current population trajectories. Population Viability Analysis (PVA: Beissinger and McCullough 2002) for example, is one tool used to determine likely population trajectories, but this requires a rather different set of data, including at least one abundance estimate. For a PVA type model information on survivorship and reproductive rates are also required. These data are difficult to obtain for cetaceans, though for well studied populations this has proved possible.

Long-term monitoring programmes, including dedicated abundance surveys, are an essential part of any management procedure for cetacean (or other wildlife), not an optional extra. It is obviously fundamental that these programmes are carefully planned and methods applied to collect and analyse data are as consistent as possible, despite their implementations over time. There is much ongoing work focused on trying to make best use of platform of opportunity data and acoustic means for detecting trends in the relative abundance, but at present, and in contrast to the situation for dedicated abundance surveys, there is still no widely agreed set of tools to address this objective, and little pan European effort to co-ordinate the development of such tools.

2.5. Available measures to quantify cetacean bycatch

KEY FINDINGS

- There are several methods that have been used to estimate cetacean bycatch rates in the past including indirect measures such as the use of strandings, interview methods, the use of logbooks or other formal reporting mechanisms, and direct independent observations, which may include observers or remote monitoring through the use of video cameras (electronic monitoring). It is generally thought that those involving independent direct monitoring are the most desirable, and that other methods are less reliable.
- Observer programmes have been the sole measure used to quantify bycatch as part of 812/2004 but given the costs of such programmes other direct monitoring techniques should be considered in the future, particularly remote monitoring using CCTV, which is well suited to monitoring rare events such as cetacean bycatch.

There are several methods that have been used to estimate cetacean bycatch rates in the past and these have been reviewed by Northridge (1996) and Northridge and Fortuna (2008). Essentially these can be divided into 5 categories. There are indirect measures such as:

- the use of strandings;
- interview methods;
- the use of logbooks or other formal reporting mechanisms.

There are direct independent observations, which may include:

- observers;
- remote monitoring through the use of video cameras (electronic monitoring).

It is generally thought that those involving independent direct monitoring are the most desirable, and that other methods are less reliable (IWC 1997).

Strandings records can only be used to estimate the absolute minimum level of bycatch in a fishery because the rate at which bycaught and discarded animals are washed ashore is highly variable and unpredictable. Care must be taken not to over-interpret data from stranded animals, and protocols for establishing the real cause of death must be put in place. Stranded animals diagnosed as having died in fishing nets may alert managers to the presence of a potential issue, but should not be used to try to guess the scale of such bycatches.

Interviews are widely used in areas where there is insufficient infrastructure to support a more objective means of measuring bycatch. Interviewing fishermen can be conducted either formally (with a series of specific questions) or informally, to gain an impression of the scale of bycatch or damage to fisheries in a region. Interviews are best conducted by people who are experienced in this method of data collection and who can be accepted as being independent and without any pre-conceptions. Interviews can be a relatively inexpensive way to obtain some initial information. They rely on fishermen telling the truth, which in part means they must be able to remember accurately. Experimental work in Canada has shown that fishermen are not always very good at recalling the number of animals they caught (Lien et al 1994), which reflects a general feature of human beings in relation to numerical recall. If there is a perceived threat to their livelihoods then it is very unlikely that the results of interview surveys would be a reliable means of estimating bycatch levels. Interviews might provide useful qualitative data on such issues as species presence, seasonality of bycatch, relative vulnerability to different gear types and perhaps the general frequency of events. Cultural and legal factors are likely to influence the results of such surveys.

Fishing logbooks are required in many countries, and in several of these the reporting of marine mammal bycatch is compulsory. Yet several studies have shown that logbook records greatly under-estimate the true bycatch. This is largely because fishermen usually have a great amount of information to file on logbook forms and issues such as bycatch are seen as of marginal value. There may also be a perception that reporting marine mammal bycatch might lead to confrontation with managers or environmental groups. Marine mammal bycatch is generally a rare enough event that failure to report is unlikely to get challenged.

Direct Independent Observation includes the use of observers. Independent observation schemes usually rely on placing trained technicians or **observers** on board a representative sample of the fishing fleet to monitor and record fishing activity and bycatch rates. Bycatch is usually recorded as the number of animals and number of events per fishing operation, but may also be expressed per trip or per day at sea. Such measures need to be comparable with some measure of fishing activity that is available for the whole fleet, including the unsampled boats, if the observed estimate of bycatch rate is to be used to extrapolate a total bycatch figure. Observer schemes are only useful for estimating total bycatch where there is an adequate measure of total fleet activity. Observer schemes are currently the most reliable and well understood means of measuring bycatch, and observers can be deployed successfully on most fleets including small boats, provided safety concerns can be addressed.

The main weakness of observer schemes is that they are relatively expensive, though this can sometimes be overstated because additional benefits can accrue from observer schemes, including fishery–science liaison and the collection of fishery and fish biology data. Observer schemes are only helpful where they are likely to be able to provide sufficient coverage of a fleet to answer the specific management question being posed. Such a question might be 'is the total incidental catch in this fishery less than a certain number of animals'? This is a more useful way of posing the more general question 'how many animals are being killed in this fishery'. If the actual number is small (as is often the case) then it is not possible to say before implementing an observer programme how many observers or observer days are required to estimate the total number with any level of precision. If the actual number is very low, one can calculate how many days will be required to be sure that the rate does not exceed a certain level (see section 3.5), which is a more useful approach. This is a problem within 812/2004 as there are no specific objectives and level of coverage required to comply with the regulation are currently unrealistic.

The advent of cheap and high resolution video cameras, coupled with very cheap and large data storage devices, has led to the development of **video monitoring systems**, sometimes referred to as **electronic monitoring**. These have been deployed successfully in several fisheries around the world, including at least three in the EU. Pilot studies in Denmark and Sweden have shown that they can be used on small boats and they can be used to monitor bycatch of protected species (ICES 2010). The costs are less than those of an observer scheme, but at present a human operator still needs to review all the footage to check for the identity of animals that are caught. It is of course crucial that enough cameras are deployed on each boat to ensure any bycatch including animals that might fall out of nets as they are raised form the water can be identified. It is likely that such systems will become more widespread given they are well-suited to monitoring rare events such as cetacean bycatch, provided industry acceptance can be obtained.

2.6. Inherent risk of the accidental catches with other human activities affecting the size, distribution or state of health of the populations

KEY FINDINGS

- Besides accidental capture in fishing gears, cetacean populations living in European waters regularly face a number of other human threats, which have the potential to directly and/or indirectly increase their mortality. These are: collisions, noise, physical disturbance, depletion of prey and habitat degradation, including the presence of noxious manmade pollutants in the marine food web. Quantitative estimations of mortality induced by these threats are, however, extremely difficult. Accidental capture in fishing gear remains the greatest source of anthropogenic mortality in EU waters.

Besides accidental capture in fishing gears, cetacean populations living in European waters regularly face a number of other human threats, which have the potential to directly and/or indirectly increase their mortality. These are: collisions, noise, physical disturbance, depletion of prey and habitat degradation, including the presence of noxious manmade pollutants in the marine food web. Quantitative estimations of mortality induced by these threats are extremely difficult. The most difficult threats to analyse are those that diminish the fitness of individuals such as, for example, habitat alteration and chemical pollution.

Collisions between ships and whales, both odontocetes and mysticetes, are nowadays regularly reported from all the world's oceans. The fatal strike rate may not usually threaten the species at the population level, however, in some cases it may represent one of the major causes of human induced mortality and pose serious threats to the survival of a species as, for example, in the case of the North Atlantic right whale, (*Eubalaena glacialis)* (Knowlton and Kraus 2001; Kraus *et al*., 2005; Knowlton and Brown, 2007). To date, there is evidence of ship collisions with several species of large whales and small cetaceans (Laist *et al.* 2001, Jensen and Silber, 2003, Van Waerebeek *et al*. 2006). The fin whale (*Balaenoptera physalus*) is most commonly recorded as being hit by ships worldwide (Panigada *et al*., 2006). The reported levels of marine traffic, the forecasted increase in the commercial marine traffic, coupled with suggest the urgent need for proper mitigation measures to reduce this threat, although the impact on smaller cetacean species such as harbour porpoises or common dolphins is probably minimal.

At present, **noise** is a ubiquitous form of marine pollution, especially in areas of heavy maritime traffic and developed coasts. Intense underwater noise is generated by airguns widely used for geophysical explorations for the oil and gas industry as well as for academic and administrative purposes, by high power sonar, (either military or civil), by ship traffic, by shoreline and offshore construction works, and by a series of other commercial, military and industrial sources. The knowledge that man-made noise can affect marine mammals and the need for a regulatory system to mitigate such effects has increased over the past few years, mainly within the context of military sonar and seismic surveys. Marine mammals rely heavily on sound to communicate, to coordinate their movements, to navigate, to exploit and investigate the environment, to find prey and to avoid obstacles, predators, and other hazards.

It is generally accepted that received levels greater than 120 dB re 1 µPa may produce behavioural change (Richardson *et al*. 1995; Moore *et al.* 2002) and received levels greater than 150 dB can lead to effects ranging from severe behavioural disruption to physical damage, including death in some circumstances. These numbers are still debatable, but represent current best estimates. Noise pollution can cause marine mammals to abandon their habitat and/or alter their behaviour by direct disturbance or by masking their acoustic signals over large areas (Payne & Webb, 1971; Hildebrand, 2004, 2005); the impact can have a stronger effect on coastal dolphins, that are expose to higher disturbance of coastal maritime traffic in summer, in coincidence with the presence of calves; higher levels could directly affect their hearing capabilities by producing either temporary or permanent hearing losses (NRC 2000; NRC 2003; Gordon *et al*., 2004). All these effects may be critical for the survival of marine mammals. Some high energy sound sources can even trigger mortality events, as recently evidenced by several dramatic and well documented atypical mass strandings of beaked whales (e.g. Greece 1996, Bahamas 2000, Canary Islands 2002 as reported by Simmonds and Lopez-Jurado, 1991; D'Amico et al, 1998; Frantzis, 1998; Evans and England, 2001; Evans and Miller, 2004; Fernández, 2006). Although atypical mass strandings represent the most dramatic class of incidents related to acute sound exposure, at least for certain marine mammal species the effects of repeated non lethal exposures and of increased noise levels are generally unknown but may potentially have significant long term effects. Furthermore, the biology of "disturbance" and the effect of noise on the fecundity of marine mammals and their prey species are not well understood. Fundamental research on marine mammal acoustics, on their habitats and habits, as well as on their prey, is thus needed to address this very complex issue.

Overlap between cetacean prey species and fishery target species does not imply direct competition (Briand, 2004). However, it is reasonable to infer competitive effects when key prey become scarce and remain subject to heavy fishing pressure (Trites et al., 1997). **Excessive fishing pressure** and the resulting worldwide decline in fish stocks and loss of marine biodiversity is a growing concern worldwide (e.g. Pauly *et al*., 1998, 2002; Worm *et al*., 2006). Recent reports by the European Environment Agency concede that more fishing has been allowed than is recommended by scientific advice and that this is due to the lobbying influence of the fishing industry (EEA, 2003, 2004). The principle that predator density depends *inter alia*, or primarily, on the availability of their prey is a key principle in ecology. The effect this has on cetacean populations, however, remains largely unknown.

Toxic contamination is a major concern because of the potential effects on reproduction and health. Chemical compounds, as secondary effects, seem to compromise the immune response of an organism to fight new or existing diseases. Compounds, such as PCBs, have been associated with reproductive disorders and immune-system suppression in cetaceans (Lahvis *et al*. 1995; Schwacke *et al.*, 2002; Hall *et al*., 2006). For example, the extreme severity of the *morbillivirus* outbreaks, which dramatically impacted the Mediterranean population of striped dolphin (*Stenella coeruleoalba*) during the 90s, is believed to be a consequence of anthropogenic pollution (Aguilar & Borrel 1994).

2.7. Estimation of the permissible threshold of accidental catches

KEY FINDINGS

- Several criteria for defining permissible thresholds or sustainable take levels of cetaceans are currently in use. These include criteria that have been proposed by the IWC, by ASCOBANS, and a limit used in the USA, the Potential Biological Removal (PBR).
- Estimates for take limits at 1%, 1.7% and 2% and at the PBR level have been generated for a range of species using the SCANS II data. Unfortunately current bycatch estimates are too patchy to allow any comparisons between these potential take limits and any total population level removals.
- Existing estimates of bycatch for the fragmentary set of fisheries that have been monitored would indicate that total bycatch of both porpoises and common dolphins should be a matter for concern for Member States and suggest better coverage of fisheries affecting them is required.
- More sophisticated modeling approaches are also possible in order to estimate the effects of bycatch on cetacean populations. Integrated population dynamics model for assessing the state and dynamics of a small cetacean population subject to bycatch have been developed under the SCANS II and CODA projects. This method has potential but it is important to recognize that bycatch limits estimated by this modeling approach are entirely dependent on the stated conservation objective, which is not sufficiently identified under either the Habitats Directive or Regulation 812/2004.
- Existing bycatch estimates are fragmentary and do not cover all the fisheries that are likely to impact any of the species of concern. Nevertheless estimates from the fisheries that have been monitored would indicate that total bycatch of both porpoises and common dolphins should be a matter for concern for Member states and suggest better coverage of fisheries affecting them is required if the impact of bycatch on their conservation status is to be understood.

Several criteria for defining permissible thresholds or sustainable take levels of cetaceans are currently in use. These include criteria that have been proposed by the International Whaling Commission (IWC), by The Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS), and a method used in the USA Potential Biological Removal (PBR).

The Scientific Committee of the IWC reviewed the conservation status of harbour porpoises in 1995 (Anon, 1996). During these deliberations the Committee agreed that, in the absence of any detailed information on stock status, an estimated annual bycatch of 1% of the estimated population size would indicate that further research should be undertaken immediately to clarify the status of the stocks and that an estimated annual bycatch of 2% may cause the population to decline and requires immediate action to reduce bycatch. On this basis, the IWC's Scientific Committee expressed concern for the conservation status for any small cetacean populations with estimated bycatch greater than *2% of a best estimate of abundance*.

At the third Meeting of ASCOBANS, it was decided that bycatch levels of small cetaceans of less than 1.7% of the best population estimates should be the targets for all Parties to the Convention. ASCOBANS Parties later agreed that a take of 1% of the population size should be used as an "intermediate precautionary objective". The 1.7% limit was based on the results of a joint IWC/ASCOBANS working group that addressed the sustainable take limits for harbour porpoises (Anon, 2000), though ASCOBANS also applies the same take limit criteria to all small cetaceans. In 2006, at the Fifth Meeting of Parties, ASCOBANS reiterated that a precautionary objective entails reducing bycatch to less than 1% of the best available abundance estimate.

Based on ASCOBANS recommendations, Government ministers of North Sea riparian states decided under the Bergen Declaration (2002) that an unacceptable bycatch limit for harbour porpoises was 1.7% of the best estimate of population size. They also agreed on a precautionary objective to reduce the bycatch of all marine mammals to less than 1% of the best available population estimate. Under the Goteborg Declaration in 2006, Government Ministers of North Sea riparian states also agreed that "Special attention should also be given to the development of fishing gear and fishing methods that will help reduce bycatches of marine mammals to less than 1% of the best population estimate."

In the United States the National Marine Fisheries Service (NMFS) under the provisions of the Marine Mammal Protection Act (MMPA), uses an index of Potential Biological Removal (PBR) to determine the limits of sustainable takes. The PBR procedure was designed to calculate the maximum number of animals, not including natural mortalities, which can be removed from a marine mammal stock, while still allowing that stock to reach or maintain its optimum sustainable population level (Wade, 1998). It is designed to prevent populations from declining below their Maximum Net Productivity Level (MNPL), which is thought to be between 50–80% of carrying capacity (K) (Taylor and DeMaster, 1993). The PBR operates on a single current estimate of absolute abundance. It is calculated as follows:

$PBR = N_{min} \times ½ R_{max} \times F_R$
where N_{min} = 'minimum' estimated total population size at time t,
R_{max} = maximum population growth rate/potential rate of increase and
F_R = a recovery factor.

Population simulations have demonstrated (Wade, 1998) that the goal of preventing populations from declining below their MNPL can be achieved with a high probability by defining Nmin as the 20th percentile of a log-normal distribution based on an estimate of the number of animals in a stock (which is equivalent to the lower limit of a 60% 2-tailed confidence interval):

$N_{min} = N/\exp(0.842 * (\ln(1+CV(N)^2))^{1/2})$

Where N is the abundance estimate and CV(N) is the coefficient of variation of the abundance estimate.

The MMPA defines the recovery factor, F_R, as being between 0.1 and 1.0. The intent here is to ensure the recovery of populations to their Optimum Sustainable Population levels (i.e. above the level of maximum net productivity), and to ensure that the time necessary for populations listed as endangered, threatened, and depleted to recover is not significantly increased. The use of F_R less than 1.0 allocates a proportion of expected net production towards population growth and compensates for uncertainties that might prevent population recovery, such as biases in the estimation of N_{min} and R_{max} or errors in the determination of stock structure. Population simulation studies demonstrate that the default F_R for stocks of endangered species should be 0.1, and that the default F_R for depleted and threatened stocks and stocks of unknown status should be 0.5. The default status is considered as unknown. R_{max} is defined as the maximal growth rate in the absence of density effects, namely at low population sizes. It is therefore not an easy parameter to estimate, but is often assumed to be around 0.4, consistent with other similar sized mammals that breed slowly.

We have derived take limits for each of five species based on the PBR and percentage rates described above as shown in Table 3. We have used abundance estimates and their CVs shown in Annex I and derived from the SCANS II and CODA surveys as the most reliable estimates for these species. In each case the Recovery Factor (F_R) is set at the default value of 0.5 in the PBR calculations, on the assumption that current population status is unknown. (For populations known to be above their respective levels of Maximum Net Productivity F_R would be set at 1.0, doubling the PBR). The value of R_{max} is taken to be 0.04 per year, which is a widely assumed default value for small cetaceans. Unfortunately as current bycatch estimates are too patchy and would make any comparisons between total bycatch estimates and these potential take limits misleading. Nonetheless this analysis gives an indication of the level of bycatch that such a measure would give.

Table 3 PBR applied to a range of species at different levels

Species	Abundance	CV	PBR	1.0 %	1.7 %	2.0 %	Source / Survey area
Harbour porpoises	341,366	0.14	3004	3414	5803	6827	SCANS II
Common dolphins	180,075	0.27	1409	1801	3061	3602	CODA & SCANS II
Bottlenose dolphins	1,970	0.45	13	20	33	39	SCANS II
Bottlenose dolphins	19,295	0.25	154	193	328	386	CODA
White-beaked dolphins	10,800	0.83	56	108	184	216	SCANS II
Minke whales	8,445	0.24	68	84	144	169	SCANS II

Source: ICES, 2008a

A take limit, using a measure such as PBR, could be understood to imply the establishment by fishery managers of bycatch 'quotas' for individual protected species for specific fisheries or even by vessel within a fleet. The establishment of such a system would open up a wide range of problems for monitoring, data interpretation, enforcement and legislation. It would also be necessary to consider whether single annual limits or multi-annual limits should be set.

Another interpretation could be of 'notional' take limits or guidelines allocated to individual fisheries in order to determine (a) how much monitoring might be required for each fishery and (b) to set bycatch reduction targets (without necessarily implying 'quotas') for individual fisheries. This means that the limit, instead of being a mechanism to close the fisheries once numbers are reached, is more a performance standard for stakeholders and fishermen to work together to achieve. The essential problem is that in European fisheries bycatch of species that are protected at a European level are taken at varying rates by more than one fishery and usually by vessels of several EU Member States. Common dolphins, for example, are taken in pelagic trawls, gillnets and tangle nets (*inter alia*), and by vessels registered in France, Ireland, the UK, the Netherlands, Spain and Portugal. If such bycatch is to be reduced, it is important to develop some allocation measures that will enable managers to determine the extent to which bycatch in any of these national fisheries involved needs to be reduced. Expecting all fisheries from all nations to reduce bycatch rates by a fixed proportion or to a fixed limit could well be an impractical, unfair and unproductive means to reducing the overall level of bycatch to below a sustainable level.

The U.S. guidelines recommend that when a Marine Mammal stock is migratory the overall take limit can be allocated in proportion to the time that population spends in each nation's waters. Where a population is trans-boundary and wide-ranging the PBR is based on the number found in US waters not on the whole biological population. Where two nations, such as the US and Canada, share a marine mammal population (such as harbour porpoises) but there is no clear idea of the proportion of that population on each side of the border, uncertainty remains over how best to resolve the situation, and it becomes a political problem as to how the PBR should be divided (Wade and Angliss, 1997).

The situation is even more difficult in Europe because there is much more overlap between nations and possibly even between fisheries (for example the common dolphin bycatch in trawls and in set nets) but there are several ways in which the total bycatch limit or PBR for a protected species stock might be allocated among fisheries. These could include allocation by the landed weight of catch for each fishery, by landed value of catch, by the number of boats involved, by the number of fishermen involved or by the amounts of fishing effort as measured by some standard metric. Any such method, however, might overlook social or economic aspects of the group of fisheries involved that might be considered to be more important than for example landed catch value.

More sophisticated modeling approaches are also possible in order to estimate the effects of bycatch on cetacean populations. Under the SCANS II and CODA projects, Winship, Berggren and Hammond (2006) and Winship and Hammond (2009) have developed an integrated population dynamics model for assessing the state and dynamics of a small cetacean population subject to bycatch. In brief, the population model is an age-structured model of the female component of a small cetacean population. The model can be fitted to a range of data on the population (e.g., abundance), life history (e.g., pregnancy rate, sexual maturity at age, age structure of natural mortality) and bycatch (e.g., age structure of bycatch mortality). The numbers of animals bycaught can be treated as known input to the model or bycatch can be estimated by fitting the model to data on bycatch rate per unit fishing effort with total fishing effort as input. The model is flexible and allows for a range of scenarios with respect to population dynamics (e.g., density-independent or density-dependent dynamics) and population structure (e.g., multiple subpopulations with dispersal among them). The model is fitted in a Bayesian statistical framework using a Markov chain Monte Carlo method.

Unlike the PBR method, however, it cannot be readily used to generate an estimate of sustainable bycatch by a manager using four easily understood parameters, but requires a program to be parameterised and run and the output interpreted, much as a fish stock assessment would do. It is important to recognise that bycatch limits estimated by this modelling approach are entirely dependent on the stated conservation objective, on the tunings that are used to achieve it under different interpretations, and on the data that are used to initiate the procedure. A range of possible bycatch limits for porpoises (SCANS II) common dolphins (CODA) were elaborated, under various scenarios, but the authors warn that in the absence of clear conservation objectives any such numbers should only be used to illustrate the problems inherent in establishing bycatch limits.

Existing bycatch estimates are fragmentary and do not cover all the fisheries that are likely to impact any of the species of concern. Nevertheless estimates from the fisheries that have been monitored would indicate that total bycatch of both porpoises and common dolphins should be a matter for concern for member states and suggest better coverage of fisheries affecting them is required if the impact of bycatch on their conservation status is to be understood.

3. ASSESSMENT OF THE OUTCOME OF REGULATION (EC) 812/2004

This chapter discusses the effectiveness of the different components of Regulation 812/2004 and also whether results achieved, have been obtained at reasonable cost. Overall this analysis has shown that there has not been sufficient sampling in the right fisheries or areas to enable sound management decisions to be made with respect to cetacean bycatch. The stated objective for monitoring bycatch is to obtain a bycatch estimate with a CV (coefficient of variation) of less than 30% (0.3) but it is apparent that very few Member States have managed to achieve estimates of bycatch with a CV anywhere near to this level. Especially in cases for which a very low bycatch rate is recorded, this target result impossible unless almost the entire fleet is monitored. In addition currently there appears to be an over emphasis on a single mitigation measures (i.e. Acoustic Deterrent Devices) by the EU which has been proven to be only partially effective. This has resulted in poor compliance amongst Member States with Article 2 and there is clearly a general reluctance by fishermen to use the devices currently available due to practical and economic reasons that are documented below. Moreover, in the EU Mediterranean countries the provision to monitor only pelagic trawlers does not make much sense, given existing knowledge on bycatch of cetaceans suggests this is most likely to be caused by entangling nets. Rather than simply extending the scope of 812/2004, an opportunity now exists to review and assess all information available in relation to the outcome of 812/2004 to develop an adaptive and responsive management framework, as recommended by ICES SGBYC so that mitigation measures are applied in the appropriate fisheries as and when bycatch problems are identified. Despite these obvious deficiencies the regulation has, according to the conclusions of SGBYC 2010, succeeded in providing a "much more comprehensive picture of cetacean bycatch in European fisheries" and highlights the need for a regulatory measures to remain in place.

These specific issues are discussed in detail in the following sections.

3.1. Advice and recommendations produced by ICES on the outcome of 812/2004

KEY FINDINGS

- A number of issues still remain over the format of data being collected by Member States leading to difficulties in analyzing the data collected, level of monitoring including a lack of funding in some cases, reporting format and the recording of bycatch of other species including seals, seabirds, turtles and elasmobranches. ICES have made a number of recommendations to this affect.
- The recommendations made by ICES have helped to highlight some of the problems with the regulation although it is noted that the EU have taken board a number of them both from ICES and the 2009 Commission workshop. This is seen as positive and should be acknowledged.

Recommendations in relation to the outcome of 812/2004 are available in Annex 4 and Annex 5 of the 2008 and 2009 SGBYC reports (ICES, 2008a, ICES 2009a) respectively, draft conclusions from SGBYC 2010 (ICES, 2010), the 2008 and 2009 WGMME reports (ICES, 2008b, 2009b), and minutes of a meeting of the Advice Drafting Group on protected species (ADGPROT) held in May 2009 (ICES, 2009c). Excluding duplications and recommendations irrelevant to the outcome of 812/2004 a list of 23 recommendations is outlined and summarized in Annex III. This table outlines the source, subject, detail and target of relevant recommendations.

In addition it should be noted that the Commission has formally acknowledged the difficulties inherent to the implementation of the 812/2004 and has made a commitment improve the situation, although has stopped short of seeking to produce a new regulation. A workshop to address this subject was carried out in Brussels, 24-25 March 2009. The workshop aimed to collect information and to set a basis for reflection and define a follow-up of 812/2004. Participants included national administrations, Regional Advisory Councils (RACs) and The Advisory Committee on Fisheries and Aquaculture (ACFA) representatives, scientists and the two relevant Commission services for this subject. The Commission subsequently issued a communication to the European Parliament and the Council on the implementation of 812/204 (COM (2009) 368 final (CEC, 2009), which contained a number of recommendations on how the regulation could be improved.

The ICES and EU recommendations are summarized below. In order to simplify the process of comparing advice, these points are categorized into 5 main issues, Basic data, Data analysis, Monitoring, Report format and Revision of 812/2004.

3.1.1. Basic Data

Both SGBYC and WGMME have identified a number of problems with the data collected under 812/2004, making it difficult to make a detailed assessment of the representativeness of bycatch levels. Data deficiencies exist in a number of areas, most critically in the reporting of fishing effort. Although a number of different types of effort data are required under 812/2004, "days at sea" has predominantly been provided by Member States and used by SGBYC to compile data. A requirement for all Member States to provide data in "days at sea" would simplify and improve efficiency of data compilation and analysis. Also it is apparent that not all Member States have had access to or been able to provide National fleet effort data. There is in fact a paucity of reporting on total fleet effort, representing the entire activity of a given fleet and in many cases it is unclear if fleet effort data compiled to date represent total or partial fleet effort. Consequently, onboard observations of bycatch cannot be extrapolated up to fleet level. Fleet effort data gaps, however, could easily be filled by SGBYC and therefore Member States should be encouraged to review and update data gaps in previous submissions.

Geographic resolution of data is also currently provided in different formats by Member States i.e. at ICES area, sub-area or sometimes at even a finer scale of resolution by ICES Statistical rectangle. Similarly the temporal scale of data provided is also variable, sometimes by month or by quarter. Again this makes analysis difficult. The main conclusion from this is that there is a need for a standard report format.

3.1.2. Data analysis

For a variety of reasons as outlined in this description of recommendations, it has not been possible for SGBYC to compile best estimates for cetacean bycatch for all fisheries that have been monitored. Therefore a sub group, established during SGBYC 2010, has looked at data analysis and examined the data received to date to determine representativeness and assess possibilities of coordinating transnational monitoring. This work is ongoing but data gaps need to be filled.

WGMME (ICES 2008b) specifically recommended that best estimates of total bycatch should be produced for common dolphins and harbour porpoises for all fisheries in ICES Areas VII and VIII.

3.1.3. Monitoring

The level of observer coverage by many Member States remains sporadic at best. Some Member States have managed to implement monitoring schemes according to 812/2004 but others have not. It is clear funding has been an issue in some countries such as Germany and Ireland where no additional funds to develop monitoring of cetacean bycatch have been allocated, and observations have been limited to other scientific and technical work. ICES also identified that the level of data precision required in the regulation is ambitious and sometimes impossible to achieve for rare events such as cetacean bycatch. ICES therefore recommended that funding should be made available by national governments to establish formal monitoring programmes where these have not been established. Member States should also attempt to widen current monitoring schemes, including observations carried out under the Data Collection Framework (DCF) and to integrate observations on incidental catches of cetaceans between countries.

SGBYC also recommended that monitoring of 12-15m vessels currently excluded from the regulation should be considered given evidence of bycatch in certain fisheries and targeted by these fleets.

Due to a generally poor level of uptake of ADDs, harbour porpoise bycatch continues to occur in areas where these devices are required. Although not required, some monitoring is carried out in these areas but more comprehensive monitoring should be considered until issues in relation to the implantation of ADDs are resolved. SGBYC further recommended that Member States should be encouraged to consider using other monitoring technologies such as CCTV, particularly for small vessels taking account the difficulties in sampling such vessels.

Finally in order to standardize monitoring by observers from Member States, SGBYC recommended a workshop to address technical aspects of bycatch monitoring be held. This workshop has been arranged for July 2010 and will be co-hosted by ICES and The North Atlantic Marine Mammal Commission (NAMMCO).

3.1.4. Report Format

A standard format for reporting under 812/2004 is required as stated. This was recommended by ICES ACOM as an urgent action on the basis of the analysis carried out by SGBYC. A draft format was proposed by SGBYC and this was subsequently amended by The EU’s Scientific, Technical and Economic Committee for Fisheries (STECF) and circulated to Member States for comment in September 2009. It is understood that this format is close to being agreed by Member States and should be in place for Member States to adopt for 2010 reports.

3.1.5. Revision of 812/2004

Regarding possible revisions to 812/2004, SGBYC and WGMME have separately made a number of recommendations as summarized below.

SGBYC recommended that the Commission should establish some review of the fleets that are currently being sampled under 812/2004 to establish which fleets/fisheries should continued to be monitored and fleets/fisheries that should be monitored but currently are not included. In this respect WGMME specifically referred to fisheries in the North Sea. In addition SGBYC recommended that a review of how the targets for monitoring levels should be set, as these are currently overly ambitious in some cases. This suggestion was made in response to the difficulty in obtaining bycatch estimates with a target CV of below 0.3 due to rare bycatch events. The EU has subsequently concluded that it was necessary to identify measurable objectives for maximum acceptable bycatch levels for different cetacean populations.

With respect to mitigation measures, in 2008 SGBYC carried out a review of methods and technologies that have been used to minimise bycatch of species of interest, including methods that have failed. Based on this review, SGBYC recommended that any further mitigation plans for minimizing cetacean or other protected species bycatch should be introduced only after careful consideration of all of the factors listed under the bycatch mitigation framework detailed by SGBYC. SGBYC also recommended that a regional approach would help to establish better-targeted observer programmes as well as targeting the use of pingers where the risk of bycatch is the highest. This recommendation was made in response to the regulation seemingly failing to be effective in reducing porpoise bycatch in the Baltic. The EU have signalled, following the workshop held in 2009, that special attention will be given to harbour porpoise populations and bycatch in the Baltic and also in the Black Sea

SGBYC also pointed out that within the current regulation what constitutes a "pilot project" is poorly defined resulting in a number of different interpretations by Member Sates. The regulation should be simplified in this regard and perhaps should simply delete reference to pilot projects and merely define levels of observer coverage required.

Finally although not required under 812/2004 several Member States do report on bycatch of seals, turtles, seabirds and/or elasmobranches in National reports. WGMME recommended that this should be carried out routinely as part of 812/2004 but also as part of DCF observations. It is understood that the EU have taken this on board, at least in respect of 812/2004 and have included reference to the recording of these species in the standard report format.

In conclusion these recommendations help to highlight some of the problems with the regulation although it is noted that the EU have taken onboard a number of them both from ICES and the 2009 workshop. This is seen as positive although more work is needed to make the regulation fully functional and workable.

3.2. Effects of the regulation on the state of populations and incidental / accidental catches

KEY FINDINGS

- Regulation 812/2004 has been in place for 6 years, yet it is not possible to make any reliable assessment on its impact on the status of cetacean populations, nor on incidental catch rates.
- A limited number of vessels are using ADDs in Ireland, UK and Denmark. It is likely that the use of pingers by these vessels has reduced the total number of incidental deaths of harbour over the past few years.
- Even if an abundance survey of cetaceans had been conducted in 2009 it is very doubtful that it would have had the statistical power to detect any change based on the likely level of reduced incidental catch that might have resulted from regulation 812/2004, even if it had been fully implemented.

Regulation 812/2004 has been in place for 6 years, yet it is not possible to make any reliable assessment on its impact on the status of cetacean populations, nor on incidental catch rates. Incidental catch rates would have been affected by two management measures that result from 812/2004 and associated legislation. The first relates to the requirements to use pingers as specified in Article II and Annex I of the Regulation. National reports on the implementation of regulation 812/2004, and the reports of the ICES SGBYC, make it clear, however, that these requirements have been poorly implemented for the reasons that are discussed in some detail in Section 3.6 below.

Nevertheless, some vessels have been using pingers, notably in Ireland, UK and Denmark. There are no official records of the numbers of boats that are carrying pingers at present, but our own sources suggest that this amounts to at least five vessels in the UK over the past two years, as well as at least four vessels in Ireland and at least eight in Denmark. It is likely that the use of pingers by these vessels has reduced the total number of incidental deaths of harbour porpoises over the past few years.

EU cetacean population assessments have only been carried out at about 10 year intervals, most recently in 2005, so it is not possible to make any determination of the effects of Regulation 812/2004 on this basis. However, even if another abundance survey had been conducted in 2009 it is very doubtful that it would have had the statistical power to detect any change based on the likely level of reduced incidental catch that might have resulted from regulation 812/2004, even if it had been fully implemented. Indeed such surveys will likely only ever detect very large scale changes (Taylor et al 2006) and the conservation benefits of reducing bycatch rates will mostly be asserted through population modelling.

An exception may relate to the Baltic Sea. Here regulation 812/2004 (Preambular Paragraph 8) calls for an amendment of Council Regulation (EC) No 88/98 of 18 December 1997 laying down technical measures for the conservation of fishery resources in the waters of the Baltic Sea. Subsequently, Article 9 of Council Regulation (EC) No 2187/2005 banned the carriage of driftnets in the Baltic Sea (only) from 2008. If, as has been assumed, drift nets in the Baltic were an impediment to the recovery of the critically endangered Baltic Sea population of harbour porpoises, then some recovery might be noticed in the medium term if porpoises begin to re-establish themselves in areas of the Baltic where they have not been recorded in recent years.

3.3. Summary of the yearly reports submitted under 812/2004

KEY FINDINGS

- Excluding one, all relevant EU member states have provided at least one annual report. Eleven Member States have provided observer data in at least one annual report and eight have provided observer data for at least two years. The quality and content of these reports, however, remains inconsistent, making analysis difficult.
- To some extent this has been addressed recently by the provision of a new reporting format by the EU.

A summary of information provided in yearly reports by twenty two Member States is provided in Annex IV. Excluding one Member State, all have provided at least one annual report. The Maltese authorities sent a letter to the Commission in 2009 explaining that Regulation (EC) 812/2004 does not apply to their fleets, because no pelagic trawlers (single or pair) were registered in Malta in 2007 and 2008 (ICES 2010). Eleven Member States have provided observer data in at least one annual report and eight have provided observer data for at least two years.

Regarding the fleets which did not provide any observer data, Belgium, Bulgaria, Cyprus, Greece all provided a single annual report stating that their fleets did not carry out any fishing operations which fall under the scope of Annex I (ADDs) and III (Onboard observers) under Regulation 812/2004. Lithuania provided a report to cover years 2006 and 2007 which stated that no fishing operations were carried out where the use of ADDs were required as outlined in Annex I of 812/2004. Detailed fleet effort data were provided for 2006 but no onboard observations were made. Lithuania provided a further report to cover 2008 which noted a reduction in set gillnet fishing effort to 3 vessels in 2008. No onboard observer data were provided for setnets or pelagic trawls but some information on interviews with skippers regarding cetacean bycatch was provided. Slovenia provided a letter stating that two vessels fell under the scope of the regulation, that observer coverage was carried out at a level of approximately 5% and no bycatch of cetaceans was observed but no data were provided.

No onboard observer programmes were carried out by Spain or Portugal under the conditions established in 812/2004 in the first two years of the regulation, although the existence of information from other sources was mentioned in the Spanish 2009 report. Spain provided some onboard observer data from a pilot observer programme for set gillnets combined with some observations carried out under the DCF on gillnets and High Vertical Opening Trawls (HVO) trawls in 2008, in the 2010 SGBYC report. Portugal noted in their report to SGBYC 2010 that no Portuguese fisheries fall under the scope of Annex I of 812/2004 (pingers) and that no bycatch observation programme had been carried out under Articles IV and V due to "administrative and financial reasons".

Germany provided reports for 2005 and 2006 which included some observation data. The reports were provided in German, were not translated, and the data were not compiled in the SGBYC 2008 report. Although no report was submitted by Germany for the 2007 period, some observer data collected under the Data Collection Framework (DCF) were made available at SGBYC. Again these data were not compiled in the SGBYC 2009 report. Some data were provided on onboard observations carried out under DCF at SGBYC 2010 but corresponding fleet effort data were not provided.

It was difficult to categorize and summarize pilot projects because of different interpretations by Member States of several types of pilot projects outlined in 812/2004. An attempt was made, however, to include information in Table 3.3 on pilot studies carried out in relation to monitoring carried out on <15m vessels and in relation to pingers and this is included in the table in Annex IV. This provides a general indication of the level of ancillary research being carried out in relation to 812/2004 with more information available on this work in SGBYC reports.

Some 12 Member States, Denmark, Estonia, Finland, France, Ireland, Italy, Latvia, Netherlands, Poland, Spain, Sweden and the UK have submitted reports with onboard observer data. All but one have provided some cetacean bycatch estimates.

A detailed breakdown of the data submitted in National Reports by Member State and Year is outlined in Annex II. All countries have provided information on fishing gear corresponding to a minimum of Level 3 and some to Level 4 in Appendix IV of Commission Decision 2008/949/EC, in relation to the definition of fisheries in Annex III of 812/2004. Effort and observer data have predominantly been grouped data together for several different target species corresponding to each defined gear type. Temporal data have been predominantly been provided in a mixed seasonal format with several or all months in a given year associated with each strata. Fishing area data have mainly been provided at ICES Division level e.g. IIId but also at ICES Sub-area level e.g. Area III particularly in the case of pelagic trawl operations. GFCM Geographic Sub-Areas were indicated for the Mediterranean.

Onboard Observer information has been made available from a number of different sources including dedicated observer programmes carried out in relation to 812/2004, the DCF and various other scientific and technical trials. No detailed analyses of the extent of data provided in relation to the requirements of 812/2004 or the representativeness of the data provided to date have been carried out.

Observed and Fishing effort data have been provided in a variety of formats as required under 812/2004 but Days at Sea has been the predominant metric utilised. Fishing effort data have mostly been provided by Member States whenever Onboard Observer data have been submitted.

3.4. Cost to Member States of implementing the regulation in terms of monitoring and observer schemes

KEY FINDINGS

- The total number of observer days carried out to date by all Member States in relation to 812/2004 is 9,530. Based on the average cost per day across Member States, roughly €6million has been spent on observer coverage for a reported bycatch of 135 cetaceans. However, the cost per animal does not reflect the total value of these schemes. Many marine mammal bycatch monitoring trips are integrated with other observer scheme duties (including obligations under the DCF), and observations of trips without bycatch are also valuable to establish likely maximum bycatch rates, which maybe negligible but which certification schemes, for example, may wish to have confirmed.

A request was made by the project team to SGBYC members to provide information on the total annual cost and number of observer days carried out by each Member State to meet monitoring requirements under 812/2004. Eight Member States provided information in a variety of formats with some countries including and others excluding costs of observer coverage carried out by other programmes such as DCF or other scientific and technical work. It was not possible to segregate costs by different observer programmes based on the information provided. It was possible, however, to examine the average cost per day of observer coverage in each Member State and the total estimated cost of all observer coverage, regardless of which programme it was carried out under, in relation to 812/2004.

Under the assumption that Observer costs were similar within each country regardless of which programme they fell under, the average cost per day obtained from Member States was multiplied by the total number of observer days carried out to provide a total estimated cost of observer coverage by Member State carried out to date in relation to requirements under 812/2004 (Table 4). The average cost by incidental/accidental catch unit can be calculated from the figures provided if required.

Contributions from Member States on observer costs are outlined in Table 4. Denmark provided costs based on a 5-year observer plan from 2005-2009 to meet the requirements of 812/2004. Costs per day were broken down into Observer costs of €907 and fisher compensation of €53, totalling €960 per day. Denmark has carried out a total of 429 days to date at an estimated cost of €412,000 with a total bycatch of 2 animals reported.

France provided an approximate total cost of €2.15 million to carry out monitoring and pilot studies under 812/2004 over a period of 2 years with 1700 days planned each year. This equates to an average cost per day of €657. This observer plan did not take account of observer coverage carried out in the English Channel, however, which was carried out under other schemes. The total number of observer days carried out by France to date in relation to 812/2004 is 4399. Assuming that observer days carried out under the different schemes costs the same amount, this equates to a total cost of €2.78 million for observer coverage carried out in relation to 812/2004. A total bycatch of 76 animals has been reported to date.

Ireland provided costs based on a planned dedicated independent observer programme to satisfy the requirements of 812/2004 which was put out to tender in February 2010 and is due to commence in summer 2010. An estimated 190 days observer coverage will be carried out to meet the pilot monitoring requirements under 812/2004 in addition to targeted sampling of the albacore tuna pelagic trawl fishery where cetacean bycatch is known to occur. The total estimated cost to carry out 190 days is €50,000 equating to €263 per day. Ireland has carried out 387 days observer coverage in relation to 812/2004 to date under DCF, scientific and technical programmes. The total estimated cost of this coverage is approximately €102,000 based on the figures provided above. Some 16 animals have been reported as bycatch to date.

The Netherlands provided costs of €163,060 to carry out 185 days of observations at sea under 812/2004 providing an average cost per day of €875. A total of 657 observer days have been carried out by the Netherlands as compiled by SGBYC, however, suggesting that the majority of observer coverage in fact is carried out under DCF or other programmes. The total cost of observer coverage in relation to 812/2004 to date is approximately €575,000 and 4 animals have been reported as bycatch to date.

The Basque Country in Spain provided planned costs for one year of monitoring equating to a total of €83,000 for 217 days monitoring which provided a daily observer cost of €382. Information for the Basque Country and Spain are combined in national reports under 812/2004 so it was assumed that observer costs were the same for Spain. A total of 61 days observer coverage has actually been carried out by Spain and the Basque Country to date in relation to 812/2004 at an estimated total cost of €23,000. Two animals have been reported as bycatch to date.

Sweden provided a breakdown of observer costs over a three-year period from 2006 to 2008. Average cost per observer day ranged from €3,745 per day in 2006, to €1,587 in 2007 to €1,052 per day in 2008. The total average cost was €1858 per day. Sweden carried out a total of 325 observer days to date under 812/2004 at an estimated total cost of €604,000 and no bycatch has been observed.

The United Kingdom provided a detailed breakdown of costs over a three-year period. A total budget of €690,000 has been made available to carry out 1500 days observer work. The figures provided were slightly complicated in that some of these days were covered by DCF work and also by the fact that more days observations were generally carried out by the contracted party than actually agreed. These factors tended to balance each other out, however, with an end result of an annual budget of €230,000 for 500 days observations. This provides an average cost per observer day of €460. The total number of observer days carried out by the UK to date in relation to 812/2004 is 780 according to Table 3. Some gaps in the data compiled for the UK are known to exist however and this figure should be higher, as much of the UK sampling effort is directed either at "Pilot Studies" under 812/2004 or to address monitoring obligations under the Habitats Directive. Based on the figure of 780 days a total of €359,000 has been spent to date on observer coverage and a total of 32 animals have been reported as bycatch to date.

Italy provided costs of €469,000 to carry out 767 days of observations at sea under 812/2004 between 2006 and 2008, providing an average cost per day of €611. The total cost of observer coverage in relation to 812/2004 to date is approximately €818,000, including the ongoing monitoring programme 2009-2010 (additional €349,000). Three animals have been reported as bycatch to date.

The average cost per observer day ranged from a speculative €263 per day in Ireland (this observer programme has yet to be carried out) to a relatively high €1,858 in Sweden. Using the considerably lower average cost per day in Sweden in 2008 of €1,052, the average cost per observer day across Member States was €651.

Information on the estimated cost of an observer day on the east coast of the US was also obtained in order to permit these figures to be compared with those of a well-established observer programme outside the EU. The current estimate is $1,200, equating roughly to €900 which covers all overhead costs such as insurance, training and equipment (Pers. comm. Marjorie Rossman, NMFS).

The total number of observer days carried out to date by all Member States in relation to 812/2004 is 9,530 (Table 4). Based on the average cost per day across Member States, roughly €6million has been spent on observer coverage for a reported bycatch of 135 cetaceans. However, the cost per animal does not reflect the total value of these schemes. Many marine mammal bycatch monitoring trips are integrated with other observer scheme duties (including obligations under the DCF, and observations of trips without bycatch are also valuable to establish likely maximum bycatch rates, which maybe negligible but which certification schemes, for example, may wish to have confirmed.

Table 4. Summary information on Observer Costs in relation to 812/2004

	Provided observer figures					Coverage achieved		
	Total			Average		Total		
Country	Years	Days	Cost (€000)	Days/year	Cost/ day (€)	Days achieved	Cost (€000)	Bycatch No of animals
Denmark	5	1131	1088	226	960	429	412	2
France	2	3400	2150	1700	632	4399	2782	76
Ireland	1	190	50	190	263	387	102	16
Italy	3	800	469	256	586	767	450	3
Netherlands	1	185	163	185	875	657	575	4
Spain	1	217	83	217	382	61	23	2
Sweden	3	226	420	75	1858	325	604	0
UK	3	1500	690	500	460	780	359	32

Source: Author

3.5. Impact of the coefficient of variation on the cost and effectiveness of the scheme

KEY FINDINGS

- The monitoring target of a precise bycatch estimate with a CV of 0.3 has not been very effective in managing cetacean bycatch in Europe, and this target could well be rethought.
- A more general approach whereby Member States would be required to demonstrate their fisheries were not exceeding some agreed level of cetacean bycatch would be a more appropriate way of ensuring sufficient sampling to address the management question without overburdening Member States with excessive monitoring requirements.

Under Regulation 812/2004, the stated objective for monitoring bycatch is to obtain a bycatch estimate with a CV (coefficient of variation) of less than 30% (0.3). The CV is a standardized measure of the precision of the estimate, so that for data sets with widely different means (or point estimates of bycatch) there is a way to compare precision between data sets or surveys. Generally speaking a CV of 0.3 would be considered to be a reasonably precise estimate of bycatch, and one that could usefully be compared with an estimate of mammal abundance.

When bycatch or a marine mammal species is reasonably frequent – that is perhaps at least once every hundred fishing operations for example, obtaining a bycatch estimate with a CV of 0.3 is feasible. However, when bycatch events are relatively low, a great deal of observation becomes necessary to obtain a precise estimate. In the extreme, and where no bycatch is observed, it is not possible to compute a value for the CV – it is undefined. Sampling follows a law of diminishing returns with respect to obtaining a CV of a given value. More sampling leads to ever decreasing marginal improvements in the CV of the estimate, and a CV of 0.3 can often be an extremely expensive target. Whereas precision of an estimate of this sort is desirable, it may not always be necessary.

It is clear even from a cursory review of the National Reports under Regulation 812 that very few Member States have managed to achieve estimates of bycatch with a CV anywhere near to 0.3. In the majority of cases, the fisheries listed in Annex III have yielded no bycatch observations under pilot monitoring schemes of 5% (or 10% in some cases). As long as no cetacean bycatches are recorded, a CV cannot be computed, so Member States are left in a quandary, unclear how to proceed. One Member State decided that no observations mean that no further monitoring is required. Others have continued to monitor at the pilot levels. It is therefore undoubtedly true that a large proportion of the resources devoted to addressing the monitoring aspects of Regulation 812/2004 have been allocated to fisheries with such low bycatch rates that obtaining bycatch estimates with CVs of 0.3 is either impossible or will be extremely expensive. In fact the national reports do not indicate that any member state has even tried to calculate sampling levels that would achieve a bycatch estimate with a CV of 0.3.

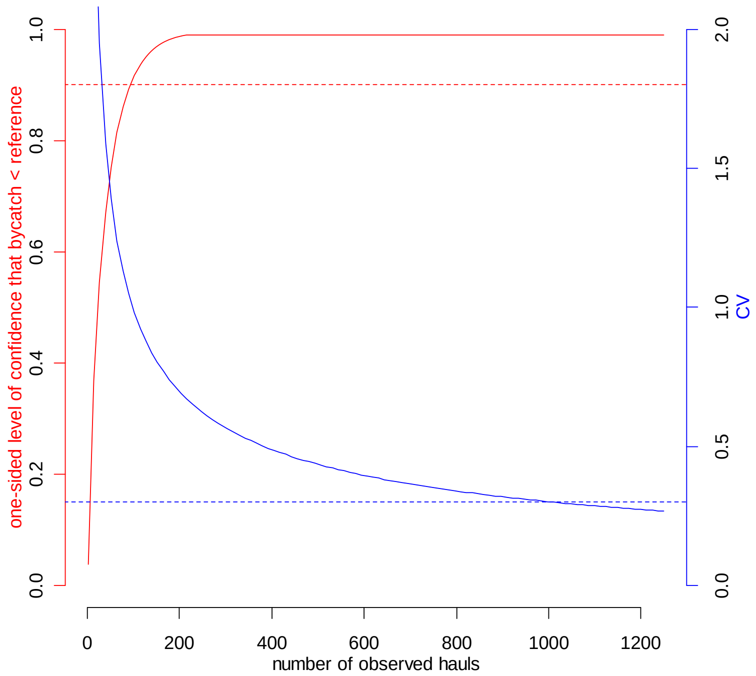
A precise estimate of bycatch, however, is not always the most practical objective. Other objectives may be more useful. This point is most easily demonstrated by example.

If a certain fishery has an actual bycatch level of just 10 animals per year, from a population of several hundred thousand, but this bycatch level is presently unknown, one might conceivably estimate the bycatch after many hundreds or thousands of observations at (e.g.) 8, with a very large CV, such that 90% confidence limits around the estimate were from 1 to 50. This is not a very precise estimate, but it suggests that one can be 90% confident that the total mortality is less than 50 animals per year. It is very unlikely that 50 animals per year from a population of several hundred thousand would be a major conservation issue. A rational approach would be to say that no more monitoring is needed to ensure there is not a conservation problem. In this case sufficient sampling has already been achieved. But under Regulation 812/2004, further sampling might be needed to improve the precision of the estimate. This would be a waste of human and financial resources because sampling is already sufficient to say that there is not a conservation problem.

An alternative approach to monitoring levels was therefore proposed by Northridge and Thomas (2003). Under this approach of 'sufficient sampling', it is necessary to determine in the first instance a trigger level of bycatch up to which managers are not concerned about the population level impacts. This might for example be 1% of the best estimate of abundance. Monitoring levels would then be established such that sampling would be limited to a level sufficient to be (e.g.) 90% sure that the total bycatch level is indeed less than the trigger level of 1% of the abundance estimate.

An example is shown in Figure 1 below.

Figure 1. An example of the consequences of different management questions on the amounts of monitoring required



Source: Northridge and Thomas, 2003

In this example a typical fishery is envisaged (based loosely on the gillnet fishery in the southwest of England) in which there are 25,000 fishing operations per year, and 1 in 100 operations results in a porpoise being caught incidentally, so that the true (but as yet unknown) annual bycatch rate is 250 animals. At the same time, it is decided that it is only necessary to know whether or not the bycatch is less than 1000 animals.

In this example only about 100 hauls would need to be monitored to be 90% sure that the true bycatch is less than 1000 animals. This is shown by the rightward-rising (red) curve, which is the 90% upper confidence limit on the estimate of bycatch in this fishery for 0 to 1200 monitored observations. After observing just 100 operations one can be 90% sure that the true bycatch is less than 1000 under this scenario. Increased monitoring simply increases ones confidence that this is the case, and 100 observations are sufficient to answer the management question.

Conversely, the rightward falling curve (blue) shows the precision of the estimate. The target CV of 0.3 is not achieved until about 1000 operations have been observed. In this instance therefore trying to target a CV of 0.3 requires ten times as many observations as targeting a level of monitoring that is sufficient to answer the management question – "are there fewer than 1000 animals being killed per year?" The precision required in this scenario is unnecessary.

The above example may be a little disingenuous, because the size of the fishery, sampling level and true bycatch rate have all been set to levels which (though realistic) conveniently show that "sufficient sampling" is more efficient than sampling for a target level of precision. In some situations the reverse may be true. If the true bycatch rate is very close to the 'trigger' level, it may be necessary to do a great deal more sampling to see whether or not the upper confidence limit is below that trigger level. In such instances it may be very much easier to stick to a target of a CV of 0.3. However, from a management perspective, this may not be any more useful. A relatively precise estimate of 1000 animals per year with 90% confidence limits of between 900 and 1100 animals per year still leaves the manager in a quandary. A more precise estimate might be called for. Alternatively, conservation action might be called for to reduce the level of bycatch.

Clearly the monitoring target of a precise bycatch estimate with a CV of 0.3 has not been very effective in managing cetacean bycatch in Europe, and this target could well be rethought. A more general approach, such that Member States would be required to demonstrate their fisheries were not exceeding some agreed level of cetacean bycatch would be a more appropriate way of ensuring sufficient sampling to address the management question without overburdening Member States with excessive monitoring requirements. The central problem to adopting this approach would be to allocate trigger levels (reference levels) of bycatch by species to each fleet and to each Member State.

Determining reference limit or trigger levels of bycatch that might represent a possible conservation threat cannot be done at a national level, because individual Member States' fleets operate in one another's waters, and cetacean populations are distributed among and between Member States' waters and are highly mobile. It would therefore be necessary for some international body, perhaps ICES, or STECF or ACFA to establish such limits on a regional basis. Ideally this would involve co-operation with neighbouring states such as Norway in the North Atlantic and Morocco, Turkey and others in the Mediterranean and Black Seas.

With some idea of what might constitute a conservation threat at a population level, it should then be up to member states to show whether or not they can be sure their fleets represent no significant conservation threat. If they cannot be sure (in other words if the upper 90% confidence level on their bycatch estimate exceeds their reference limit), then they should either improve the monitoring scheme to obtain a better estimate or if the point estimate of bycatch is close enough to the reference limit (for example above half of it), they should also take conservation action by limiting fishing effort, mandating the use of mitigation devices such as pingers, or implementing other measures and so demonstrate through continued monitoring that bycatch rates are sure to have been reduced below the reference limit.

Such an approach pre-supposes a number of technical issues that might be explored elsewhere, but also requires a degree of European co-ordination and commitment to addressing this issue that has so far been lacking. A commitment to monitor and address the potential environmental impacts of fishing should be a part of any ecosystem-based approach to management, and such an approach should be included in any revision of the Common Fisheries Plan.

3.6. Acoustic deterrent devices (ADDs/pingers)

KEY FINDINGS

- The existing technical measure contained in 812/2004 i.e. the use of ADDs will reduce but not eliminate bycatch. Expectations for mitigation measures must be realistic and should aim to reduce bycatch to levels that are very unlikely to represent a conservation threat.
- Currently ADDs provide the most simple and effective solution although so far they are only proven for a reduction of harbour porpoise bycatch in set net fisheries. Numerous trials have shown that pingers of several types can reduce porpoise bycatch by around 90%.
- ADDs are expensive, where many are required (e.g. for set net fisheries), require periodic maintenance to check and replace batteries, can interfere with net setting and hauling and can be unreliable. A combination of these factors has resulted in sporadic uptake by fishermen in spite of legal requirements. There is quite a negative perception about these devices amongst fishermen around Europe, which remains a problem. Further technical work is required to make these devices more robust and easier to check that they are functioning correctly.

Active acoustic deterrents or 'pingers' are small self-contained battery operated devices that emit regular or randomized acoustic signals, at a range of frequencies, and typically loud enough to alert or deter animals from the immediate vicinity of fishing gear. These devices are distinct from much higher-powered systems that are used to protect aquaculture sites from seal predation, classified as Acoustic Harassment Devices (AHDs). AHDs emit sounds of such high intensity they cause pain or harm to animals' hearing and are not seen as a solution to bycatch reduction, given the potential harmful effects.

Active pingers were first tested in Canada, primarily as a means to reduce entrapment of baleen whales in coastal gillnets and fish traps. These first devices, operated at 2.5 kHz, were subsequently tested on gillnets in the Bay of Fundy and appeared to reduce harbour porpoise bycatch. Similar pingers were also deployed in the Makah salmon fishery off the Washington coast and in Australia on beach protection nets with reasonable results (CEC 2002a).

More complex devices were developed after experiments with gillnets in the Gulf of Maine (Kraus *et al.* 1997). A design operating at 10 kHz was found to be effective at reducing porpoise bycatch and ultimately formed the basis for legislation under National Marine Fisheries Service (NMFS) regulations. In the regulations the specifications for porpoise pingers were defined as 300ms pulses of 10 kHz tonal pulses repeated at 4-second intervals with a minimum source level of 132dB re 1 μPa.

A third generation pinger was developed in the late 1990s by Loughborough University in the UK on the basis of tests with captive porpoises in Holland and Denmark. These "PICE-97" devices were trialed successfully in the Danish cod fishery during the autumn of 1997, with a significant reduction in harbour porpoise bycatch observed (Larsen 1999). The new pingers emitted a variety of wide band frequency sweep type signals with randomized inter-pulse intervals, rather than simple single tonal pulses.

From these devices, six recognized manufacturers of ADD's have emerged although other "cruder" devices exist. Two of these devices are made in the US, one in the UK, one in Italy, one in Spain and one in the Netherlands. The technical specifications, relative effectiveness, reliability, cost, impact, safety and control and enforcement issues associated with their use are discussed in the following sections.

3.6.1. Technical Specifications

Detailed technical specifications of ADDs were available from a number of sources. Annex V outlines sound source characteristics including signal type e.g. single or multiple/sweep signals, signal duration and interval, a number of source level measurements and a description of the frequency spectrum. This information was provided for a relatively exhaustive list of commercially available and prototype ADDs some of which were being developed for use in pelagic trawls and is reported in Anon., 2007.

Cosgrove *et al*., 2006, outlined a broader a range of characteristics in terms of physical and practical, power and signal characteristics in relation to four models of commercially available gillnet ADDs which were tested by Bord Iascaigh Mhara (BIM) in Ireland. The Sea Fish Industry Authority (SFIA) in the UK produced a similar table in relation to the same ADD models (Caslake and Lart, 2005). Table 5 below shows these models and in addition provides the characteristics of the Italian DDD device, and the Spanish Marexi V2.2 devices which have also been extensively field-tested. Figure 2 shows these six devices.

Table 5. Specifications of most commonly used commercial ADD devices

Manufacturer	Airmar	Aquatec	Fumunda	Savewave	STM-Products	Marexi
Website	www.airmar.com	www.netPinger.net	www.fumunda.com	www.savewave.net	www.stm-products.com	**www.marexi.com**
Model	Gill net pinger	AQUAmark 100	FMDP-2000	Dolphin Saver - High Impact System	DDD02F	V2.2
Mitigation use	bycatch	bycatch	bycatch	depredation	bycatch	bycatch
Dimensions: L x dia (mm)	156 x 53	164 x 58	152 x 46	202 x 67 x 42	210 x 61	129 x 45
Weight in air (g)	408	410	230	400	905	315
Max. depth	275	200	200	200	200	±500
Attachment details	3-way holes each end	2 holes each end	3-way holes each end	2 holes each end	1 hole at end	1 hole at each end
Spacing along nets (m) (max recommended)	100	200	100	200	200	200
Signal human audible	Yes	No	Yes	No	Yes	Yes
Housing Material	Plastic Alloy	Urethane	Co-polymer	HIPS Styrosun	Urethane	Polymer
Battery type and Number	1D-Cell Alkaline	1 D-Cell Alkaline	1 lithium	1 Sealed 9v unit	NiMh Rechargeable	1 D-Cell Alkaline
Approx. battery life (months)	> 12	16 - 24	15	< 3	90 hours	9500 hours
Battery replaceable	Yes	No	Yes	No	Yes	Yes
Battery disposal	by operator	20% discount on replacements	by operator	20% discount on replacements	NA	NA
Wet switch	No	Yes	Yes	Yes	Yes	Yes
Tonal/Wide band	Tonal	Wide band / tonal	Tonal	Wide band	Random	
Source Level (dB re 1μPa @ 1m)	132 +/- 4dB	140	132 +/- 4dB	155	160-174	132 +/- 4dB
Frequency (kHz)	10	20-160	10	5-160	1-250	10+/- 2kHz
Pulse duration (ms)	300	200-300	300	200-900	100ms – 7s	300
Inter-pulse period(s)	4	4-30	4	4-30	Random	4±0.2s

Source: Caslake and Lart, 2005 & Cosgrove et al., 2006

Figure 2. Six commercially available Acoustic Deterrent Devices

Source: Cosgrove et al., 2006 & Morizur et al., 2009
(From left to right: Savewave ; Airmar; Aquamark; Fumunda; DDD; Marexi)

3.6.2. Spacing

KEY FINDINGS

- Research has demonstrated a higher effective spacing for specific ADD models than currently permitted under 812/2004. The advantages of using a higher spacing and therefore fewer ADDs include reductions in pollution from lost or damaged pingers, noise pollution and associated potential porpoise habitat exclusion, and lower cost and less handling for fishermen.

A number of studies have been carried out on maximum effective spacing of ADDs on gillnets in terms of cetacean bycatch reduction. The advantages of using a higher spacing and therefore fewer ADDs include reductions in pollution from lost or damaged pingers, noise pollution and associated potential porpoise habitat exclusion, lower cost and less handling for fishermen. The most successful trial carried out to date took place in the Danish North Sea hake gillnet fishery in 2006. The trial was carried out using Aquatec Aquamark 100 pingers deployed on nets with a hanging ratio of 0.23 made from 0.57mm mono twine, with mesh size 140mm, height 40.05 meshes and a length of 2000m. A sample station was defined as a fleet of nets, 45 to 135 nets, set at approximately the same time, either without or with pingers attached at a spacing of 455m or 585m. A total of 108 stations were included in the study; 41 control stations, 24 stations at 455m and 43 stations at 585m. A 100% reduction in porpoise bycatch rates was observed in nets with 455m spacing and a 78% reduction in bycatch in nets with 585m spacing. Bycatch observed in these spacing groups was significantly different than bycatch observed in the control nets. No significant difference was observed between the two pinger spacing groups however (Larsen and Krog, 2007). On the basis of this trial the Danish authorities were granted a derogation for their vessels to use a spacing of 400m, compared to the 200m spacing required in the regulation.

BIM carried out a pinger spacing trial in the Celtic Sea hake and cod gillnet fisheries in 2006 using Aquamark and Fumunda pingers. Monofilament gillnets of 0.6mm diameter, with 120mm mesh size and 45 to 60 meshes net height for hake (*Merluccius merluccius)*, and 160mm mesh size and 30 meshes in height used for cod. Fully rigged strings of gillnets varied from 18 to 24 individual sheets of approximately 200m in length with an average total length per string/station of 4.19 km. A total of 152 stations/samples were observed; 22 of 200m spacing, 27 of 600m spacing and 96 controls (no pingers attached). A total of 7 harbour porpoises were observed as bycatch in control deployments and no bycatch was observed in any nets with Aquamark pingers spaced at 200 or 600m. No significant difference occurred between spacings of 200m and 600m but neither was any significant difference found between these treatments and control treatments due to the relatively low number of bycaught animals (Cosgrove and Browne, 2007a).

IFREMER also carried out a pinger spacing experiment in 2008 using DDD02, Aquamark 100 and Marexi pingers in a French trammel net fishery in the Iroise Sea in the Bay of Biscay. The nets were made up of three panels of 270 and 700mm stretched mesh with a buoyant headrope and weighted foot rope. Marexi pingers were spaced 200m apart, Aquamark 100 pingers 400m apart and DDD02 pingers were spaced at varying distances ranging from 1600m to 4300m. A total of 158 fishing operations, 37 with pingers and 121 without were observed with a bycatch of 2 harbour porpoises in the former and 3 in the latter. No statistical test was applied to the data and no significant results were obtained (Morizur *et al*., 2009a).

3.6.3. Effectiveness for different species

KEY FINDINGS

- The effectiveness of ADDs deployed on bottom set gillnets is well established for harbour porpoises.
- The effect of ADDs on other species such as common dolphins is less clear. Significant reductions in bycatch of common dolphins in a pelagic trawl fishery using ADDs have been observed even though the same devices failed to elicit any evasive behaviour in direct playback experiments
- It is clear that acoustic signals should be tested on each odontocete species for which they are intended to reduce bycatch

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

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

The AquaTech 363 interactive deterrent system (see Annex V for technical specification), which was developed by BIM in Ireland in conjunction with Aquatec Subsea Ltd for use in pelagic trawls, emits acoustic signals in response to echolocations from common dolphins in the vicinity of the device. The system was designed to discern dolphin sounds from other underwater noises associated with pelagic trawlers and their fishing gear. The potential advantages of the system include prevention of animal habituation to a continuous signal, reduction of environmental noise pollution and a reduction in power requirements. Extensive research involving direct playback experiments with dolphins has been carried out to find an effective deterrent signal to be incorporated into the device

(Leeney, *et al*., 2007; Berrow *et al*., 2009) including recent trials using recordings of killer whale vocalisations but no consistently effective deterrent signal has been identified.

Also under an EU funded project called NECESSITY, IFREMER in France carried out major research and development of an ADD called a CETASAVER (Annex V) for common dolphins in pelagic trawls. They have also tested various models of commercially available ADDs such as the DDD02F in direct playback experiments and although some positive results were obtained no acoustic signal has been identified which has a strong deterrent effect on common dolphins in all geographic areas at all times of year (Anon., 2007).

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

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

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

3.6.4. Collateral Effects

KEY FINDINGS

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

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

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

In terms of habituation, Cox *et al*., 2001, found a 50% reduction in pinger deterrent effect within 4 days of constant pinger operation. Carlstrom *et al*., 2009, found an element of habituation at one of the experimental sites. The authors concluded that long term habituation was more likely to happen (i) close to shore, where porpoise density was lower and animals may have passed through the sound of several pingers on their way in or, (ii) close to the pingers. The results of this study also suggested that intermittent exposure to pinger sound may cause habituation if the exposure is repeated over time. The analysis by Palka et al., 2008, of US data collected over more than a decade, however, showed no evidence for temporal trends in the bycatch rates, suggesting that any habituation by harbour porpoises to pinger sounds had not been sufficient to limit the effectiveness of the pingers.

Other collateral effects such as the dinner bell effect are less well known with cetaceans but more common with pinnipeds (Mate and Harvey, 1987). Noise pollution is referred to as a collateral effect in publications such as Kastelein *et al*., 2007, and online forums such as :
http://oceanlink.island.net/ocean_matters/noise.html,
http://www.smartgear.org/smartgear_winners/smartgear_winner_2007/smartgear_winner_2007special/ but no other detailed studies have been carried out directly on noise pollution effects of pingers.

3.6.5. Reliability

KEY FINDINGS

- Summarized information on pinger reliability based on extensive testing carried out in Ireland, UK, Denmark and France demonstrates the failure of ADD's, in general, to withstand harsh working conditions in North Atlantic gillnet fisheries and this remains a problem.

BIM carried out extensive testing of commercially available gillnet ADDs in the Celtic Sea in 2005. Fifteen ADD units from the manufacturers Airmar, Fumunda, Aquamark and SaveWave were tested along with a number of attachment modifications that differed from the manufacturer's specifications. The devices were tested on standard bottom set gillnets targeting cod and hake; (5-6m height and 120-160mm mesh size) and bottom set tangle nets targeting turbot (*Scophthalmus maximus*); mesh size (1.75m height and 270mm mesh size). The devices were deployed for approximately 200 haul/deployment cycles. All pingers suffered heavy collisions on steel bars, gunwales and deck machinery during fishing operations and none of the types tested were found to be 100% reliable at the end of the trial periods.

One Airmar out of fourteen (7%) tested was found to be non-functional (not pinging) at the end of Trial 2. It is not clear why, but again the positive contacts on all of the batteries were compressed to some degree and this may have been a factor. Six out of thirteen (46%) Aquamarks were found to be non-functional at the end of Trial 2. It was not possible to carry out an internal inspection of the Aquamarks because they are sealed units. External examinations, however, revealed extensive marking and scarring to the wet switch at the ends of the pingers, as well as numerous bubbles in the resin on the body of the pinger unit. Two out of thirteen Fumunda's (15%) were non-functional and were found to rattle internally behind the battery spring so they may have been damaged because of impact during fishing operations. Only two out of twelve (17%) Savewaves were found to be still functional at the end of Trial 2. It was noted during the course of the trials that this device was particularly prone to damage. These units were cracked through key structural points of the housing and were subsequently deemed beyond further operational use (Cosgrove *et al*., 2006). However, the two Savewave pingers that were still functioning had been at sea for approximately 5 months at that stage thereby surpassing their specified battery life of 3 months.

Trials were also carried out in the UK on the same pinger models but over a longer period of time of approximately 15 months. Of 53 Fumunda pingers used during the course of the trial, 44 of the pingers were still operative when tested with a new battery, 2 had taken on water and no longer operated and 7 were missing. Of 50 Airmar pingers, 18 of the units first deployed returned satisfactory signals, 23 returned no signal of which 14 worked when tested with a new battery. The remaining 9 did not return a signal due to electronic failure and a further 9 pingers were unaccounted for. Over the course of the endurance trials 25 AQUAmark pingers were deployed. Of the 22 pingers tested at the end of this trial 9 remained operative, 13 were inoperative with one loss and 2 unaccounted for. The feedback received from the manufacture of these pingers was that some of the pingers were inoperative due to cracks in the resin allowing water to seep into the electronics and the manufacturer reported making a number of design changes intended to improve the performance of these pingers (Caslake and Lart, 2006).

Short term handling trials were carried out for the same four models of ADDs by the Danish Institute for Fisheries Research (DIFRES) in Denmark. The trials were primarily focused on handling issues with each pinger tested during a separate trip lasting 3 – 5 days. The vessel fished for cod and anglerfish (*Lophius piscatorius)* in the North Sea using gillnets with mesh sizes of 160 and 270mm. Airmar, Aquatech and Fumunda models were tested on the 270mm mesh nets (0.57mm monofilament; 10.5 vertical meshes; 2000 knots horizontally), whereas SaveWave were tested on the 160mm mesh nets (5 x 0.2mm multi-mono twine; 22.5 vertical meshes; 1000 knots horizontally). All of 19 Airmars and 16 Aquamark 100s functioned normally at the end of the trial, but two of 20 Savewaves and 9 of 20 Fumundas had ceased to function by the end of the trial (Larsen, 2006).

IFREMER in France assessed the reliability of Aquamark 100, Marexi V2.2, and DDD02 ADDs. Although no indication of the number of models which continued to function at the end of the trial was provided, comments on the physical durability of these devices were made; the plastic casing of Aquamarks were prone to cracking, the wet contact of the Marexi was overly sensitive in that pingers continued to function out of water and the DDD02 was found to have high power requirements (Morizur *et al*., 2009).

3.6.6. Battery life

KEY FINDINGS

- In general the battery life of commercially available pingers does, when they work properly, meet manufacturer specifications.

Details of approximate battery life reported by the manufacturers of a number of commercially available pinger models are outlined in Table 5. These can be compared against the results from independent testing carried out by a number of institutes. SFIA in the UK carried out bench tests to assess the battery duration associated with the Fumunda and Aquatec pingers. The results showed the estimated battery life (continuous pinging) for these pingers to be approximately 19 and 40 months, respectively compared to 15 and 24 months reported by the manufacturers.

DIFRES in Denmark tested the battery life for four pinger models Airmar Gill Net Pinger, Aquatec AquaMark100, Fumunda FMDP2000 and SaveWave Saver. Two specimens of each of the four pinger models were placed in a water tank in May 2004 and checked on a monthly basis using an ultrasound detector. The two Fumunda FMDP2000 pingers stopped emitting deterrent sounds after between 5 and 6 months, the two SaveWave Savers stopped after between 10 and 11 months, whereas the Airmar Gill Net Pingers and the Aquatec AquaMark100 pingers were still emitting deterrent sounds in April 2006 after 23 months of continuous pinging. During discussions at a workshop on pingers convened by DIFRES in April 2006 (Larsen, 2006), it was observed that the large difference in battery life between the two studies for the Fumunda pinger was due to them being two different versions. The one tested by DIFRES was the older version which had a power management system and was not very good at conserving power. The version tested by SFIA had a more efficient power management system (Larsen, 2006).

3.6.7. Annual Cost

KEY FINDINGS

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

Cosgrove et al., 2006 estimated the projected costs associated with fitting out 20km of fishing gear (considered typical for Irish and UK vessels > 15m) with four of the commercially available ADDs. Fumunda FMDP-2000 were the most expensive at the outset due to a smaller spacing of 100m and the unit cost of €67. Airmar were the cheapest to purchase at €46 per unit, so the total initial fit out cost is not prohibitive despite the lower maximum spacing of 100m. Aquamark 100 were the most expensive unit to purchase at €104, but this price was offset by their maximum spacing of 200m. Savewave Dolpin Saver-High Impact System was the cheapest pinger to fit on the gear initially with a relatively inexpensive unit cost of €60 and a smaller number of pingers required due to a higher maximum spacing of 200m. These costs are summarized in Table 6.

Table 6. Initial Outlay Costs for different pinger types (based on 20km of gillnets)

	Airmar	Aquamark	Fumunda	Savewave
No. pingers required	200	100	200	100
Unit cost (€)	46	100	67	60
Total Outlay	€9200	€10400	€13400	€6000

Source: Cosgrove et al., 2006

Cosgrove *et al*, 2006 further assessed the average annual cost of Airmar, Aquamark 100, Fumunda FMDP-2000 and Savewave Dolpin Saver-High Impact System ADDs. Average costs of deployment of pingers on 20km of bottom set gillnet gear over a 5 year period were calculated, taking into account battery life, if the battery was user replaceable, the number of pingers required in terms of acceptable spacing, and cost of units and batteries. Average annual costs were estimated at €400 for the Airmar, €480 for the Fumunda, €3,328 for the Aquamark and €18,240 for the Savewave. In response to the study, the manufacturers of the Aquamark pointed out that the batch unit cost of their devices was lower than the cost used in the study which would have reduced the figure provided above. Also, gear loss which would reduce the benefit of battery replacement, thereby reducing cost of the Aquamark and the Savewave and increasing the cost of the Airmar and Fumunda, was not accounted for in the analysis.

SFIA carried out a similar study based on non specified pinger costs for 200m (non battery replaceable) and 100m (battery replaceable) spaced pingers deployed on strings of 400 or 1200 nets over a period of 4 years, taking into account spacings, cost per pinger, annual net loss rate of 14%, annual pinger failure rate of 10% and the costs of replacing units or batteries (Caslake and Lart, 2005). Comparing costs from this and the BIM study, the average annual cost for a vessel using 20km of gear was approximately €3,000 for 200m and 100m spaced pingers.

IFREMER also carried out a recent analysis of costs for the Aquamark 100, Marexi V2.2, and DDD02 ADDs which included relatively high turnover rates of replacement pingers ranging from 150% for the Aquamark to 300% for the Marexi (Morizur *et al.*, 2009). These high turnover rates which were considerably higher than the other studies e.g. SFIA (combined turnover rate of 24%), resulted in very high estimated costs, equating to an average annual cost for a vessel using 20km of gear of €20,625 for DDDs, €46,500 for Aquamark 100s and €84,000 for Marexi ADDs.

Table 7 below summarizes the estimated annual replacement costs from these three studies by device.

Table 7. Annual Replacement Costs for different pinger types

Pinger Type	Non Specified	Aquamark	Airmar	Fumunda	Savewave	DDD	Marexi
Ireland[1]		€3,328	€400	€480	€18,240	Na	Na
UK[2]	€3000	Na	Na	Na	Na	Na	Na
France[3]		€46,000	Na	Na	Na	€20,625	€84,000

Source: Author

[1] Based on average costs for 20km of gillnets averaged over a 5 year period and observed loss rates
[2] Based on average cost of deploying ~ 20km of gillnets over a period of 4 years with an annual net loss rate of 14% and failure rate of 10%
[3] Based on average costs for 20km of gillnet and a replacement rate of 150%-300% annually

3.6.8. Safety

KEY FINDINGS

- Several Member States have raised legitimate concerns regarding the safety of ADDs including chemical leakage from batteries and entanglement in gear. Most of these can be overcome, however, through improved design, better quality control at supplier level and also through small changes to operational practice on board vessels.

Trials using Aquamark 200 ADDs were carried out in France in 2005 by the Institute Maritime de Prevention (IMP) on the impact of ADDs on the safety and working conditions onboard gillnet vessels in the Bay of Biscay in 2005. A number of safety issues were highlighted by this study. In particular relatively heavy pingers (Aquamark 200 is 410 grammes) transported at relatively high speeds around the vessel created risks of injury to crew during fishing operations especially during shooting and stowing of nets with the flaking machine. Some pingers smashed into pieces when they impacted heavily on the vessels with obvious safety concerns for fishermen in close proximity. Although not used in the trial, the report also refers to one type of pinger which uses lithium batteries (Le Berre, 2005).

"*This type of battery has the property of reacting violently with water, liberating extremely flammable gas. It also releases hydrogen as well as some lithium oxide and lithium hydroxide particles. This mixture in the presence of oxygen could combust during battery* *replacement and therefore poses a major risk to the person carrying out battery replacement*" (Le Berre, 2005)".

Similar problems were encountered with lithium batteries during pinger trials carried out by BIM in Ireland. Failure of the outer casing caused the lithium-thionyl chloride (Li-$SOCL_2$) batteries to be exposed to sea water. Water seeping into compromised housings seemed to cause batteries to short circuit, leading to pingers exploding which would explain the ruptured state of damaged pingers. The majority of damaged pingers were also accompanied by corrosion of the nylon covers and ropes used to mount the pingers which was caused by an acidic substance, probably hydrochloric acid, seeping from the batteries. In addition, on several occasions during hauling, gas was observed emanating from pingers likely to have been sulphur dioxide (SO_2). One observer experienced some respiratory difficulties after inhaling some gas while inspecting a damaged pinger. BIM suggested that if it was absolutely necessary to use this type of battery the manufacturers should consider using moulded or sealed pingers so that the likelihood of batteries coming into contact with seawater would be greatly reduced (Cosgrove and Browne, 2007a).

BIM also referred to safety issues which arose due to crew members being obliged to climb to a height to reach and clear the net flaking machine[1] which was frequently jammed with pingers as they passed through the machine (Cosgrove *et al*., 2006). SFIA have also raised safety concerns with regard to deploying pingers at regular intervals along nets. In the context of carrying out trials using louder DDD devices at much greater spacings, SFIA suggested that "*the underlying problem is that pingers in their present form need to be attached at regular intervals along the tiers of nets. In attaching the pingers directly to the nets, there will always be issues concerning entanglement and health and safety of the crew*" (Caslake and Lart, 2006).

In trials carried out by The Sea Mammal Research Unit (SMRU), some operational issues, mainly associated with shooting the pingers have also been reported. During initial trials of the much louder DDDs, one crew member had to throw pingers and floats over the side/stern of the vessel as the gear was deployed. Skippers involved in the trial suggested that some form of self-shooting system should be developed which would be safer and would permit the crew to concentrate on their normal duties. Current ongoing trials by the SMRU using the DDDs involve deploying pingers only at each end of a string or fleet of nets. While this approach is acoustically "wasteful" as each pinger ensonifies an area beyond the ends of the net in addition to the nets themselves, it overcomes the safety issue of deploying pingers partway along the net (ICES, 2010).

3.6.9. Impact on fishing operations

KEY FINDINGS

- Based on assessments carried out in Ireland, UK, France, Sweden and Denmark it has been shown that ADDs do create some handling difficulties for fishermen. In particular issues with devices becoming entangled in nets and also preventing specialized flaking machines from removing twists in gears have been observed. A number of potential solutions to help reduce the impacts of ADDs have been suggested that largely eliminate these problems.

[1] This machine is used to stow gillnets as they are hauled aboard. The machine moves on rails above the net storage pounds and hauls the nets into the pounds as it separates the headline and footrope of the net

BIM carried out a detailed assessment of the impact of pingers on fishing operations with key problems identified as follows: In tangle nets 34% of pingers regardless of model type became tangled in the gear during hauling. Net flaking machines which are used to store nets onboard gillnet and tangle net vessels were frequently blocked up and tangling of the gear slowed up operations considerably. Three out of four of the pingers tested were negatively buoyant and this would naturally cause the headrope in tangle nets to sink (Cosgrove *et al*., 2006).

SFIA also described the impact of individual pingers on gillnet fishing operations. Fumunda's were relatively easy to attach to the headline and no problems occurred with this model 'button holing' (falling through meshes). The pinger caused little to no problems with handling and comfortably navigated the hauler and net flaking machine due to the design which was similar to a net float although some problems occurred with battery life during this trial. Some problems, though, were encountered with Airmar and Aquamark 100 pingers when passing through the net flaking machine and also the size of the devices was a safety concern. Savewave pingers were not considered to be an appropriate shape for the UK gillnet fishery as they frequently became entangled in the gear and didn't pass easily through the hauler or the net flaking machine (Caslake and Lart, 2006).

A study on the impact of ADDs on gillnets and tangle nets using Aquamark 200 pingers was also carried out in France. Major entangling of pingers occurred as nets were hauled aboard, and cleared nets again became entangled when the heap of net on the net clearing table became too large. This caused fishing operations to slow down considerably. (Le Berre, 2005).

The Swedish Fisheries Board conducted trials on the impact of using Aquamark 100 and Fumunda pingers in the Swedish Baltic gill net fishery. Trials were carried out on 4 vessels (three 12m and one 20m) fishing with gill nets up to 260mm mesh size. The 12m vessels used AQUAmark100 pingers for over 3 years and the 20m vessel used Fumunda pingers for two weeks. All pingers were mounted between nets, AQUAmark pingers with flanking floats and Fumunda without. The vessels deployed 10 - 20km of gill nets each and with shooting speeds of 4 - 6.5 knots through net tubes. No major problems were encountered during these trials with pingers although the Aquamark 100 was considered too heavy and a safety risk for the 20 m vessel so the Fumunda's were used instead. One type of net cleaner used in the western Baltic and the Sound was not suitable for nets with pingers however (Larsen, 2006).

A table on problems and potential solutions in relation to ADDs and fishing practices was produced at a workshop hosted by DIFRES in April 2006 (Table 8) and best summarizes the issues.

Table 8. Problems and potential solutions in relation to ADDs and fishing practices

PROBLEMS		POTENTIAL SOLUTIONS
Pingers impacting on crew		1. Improve safety awareness 2. Lighter and fewer pingers on gear
Damage to pingers	caused by collisions	3. Improve manufacturing quality / durability of pingers 4. Attach floats tightly on both sides of pingers
	caused by tension	5. Avoid tension on pingers by choice of attachment methods
Pingers entangling nets	Gillnets	6. Attach pingers on joins of nets 7. Attach floats tightly on both sides of pingers 8. Attach pingers as tight to the headline as possible 9. Overbraid and shrink-wrap is promising work in progress 10. "Carsten"-design may be an alternative, but beware of looseness
	Tangle nets (exacerbates all entangling problems)	11. As for gillnets 12. Optimise buoyancy
Pingers prevent flaking machine removing twists from nets		13. Not resolved, but lighter and fewer pingers on gear will reduce problem 14. Consider if re-design of flaking machine could reduce the problem
Monitoring pinger function		15. Primary requirement is confidence in pingers 16. Warranty for pingers 17. On board control of pinger function by dedicated person

Source: (Larsen, 2006)

A number of potential solutions to help reduce the impact of ADDs on fishing operations and improve the durability of ADDs have been presented and new ADDs are being developed to address the issues which have been raised: http://fishtekmarine.com/acousticPinger.php.

3.6.10. Monitoring of Pinger Functionality

KEY FINDINGS

- Monitoring devices have been designed and built to test whether pingers are functioning properly, but legal and technical barriers to being able to enforce any legal pinger requirement still exist.

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

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

3.7. Alternative methods to reduce the incidental/accidental bycatch of cetaceans

KEY FINDINGS

- No alternative technical mitigation measures to ADDs currently exist that are fully proven although the results from trials with stiff gillnets in Denmark and Canada may be cause for optimism. Such chemically enhanced nets are currently expensive because they are not routinely produced and need to be specially sourced and constructed in the Far East.
- Fish losses through excluder devices or net barriers have been shown to be sizeable in some trials. Exclusion devices can also be difficult to install, maintain and handle in large pelagic trawls, and trials have so far been only partially successful.
- Time and area closures can reduce the incidental mortality of cetaceans where catch events are predictable and relatively restricted in time and space but such circumstances in practice are rare making their use limited.

In addition to Acoustic Deterrent Devices, a number of other methods to reduce incidental/accidental catches of cetaceans in gillnet and pelagic trawl fisheries have been tested in Europe and worldwide. These can be categorized as:

- Passive Acoustic Devices including Passive Alerting Systems (PAS)
- Acoustically Dense Netting Materials
- Excluder Devices and other gear modifications
- Other methods e.g. operational and time/area closures
- Alternative gears

3.7.1. Passive Acoustic Devices

Passive acoustic devices include modifications to fishing gears that will increase the probability of detection of the gear by an echo-locating animal. Several tests have been carried out with passive acoustic reflectors, which are small rigid plastic devices with a resonant air cavity that are attached to the mesh zone of gillnets at intervals to make the gear more acoustically detectable by marine mammals such as dolphins and whales. In simplistic terms, they are designed to act as acoustic “cats’ eyes” for marine mammal species. To work effectively, these devices must have a significant cross section greater than approximately three wavelengths and must be omnidirectional (Goodson 1997; Goodson et al. 1994). Practical tests have been carried out in the United Kingdom with bottlenose and common dolphins and also separately in the Albacore tuna (*Thunnus alalunga)* drift net fishery, now closed under EU regulations. No significant results, however, were reported from these devices. The Natal Shark Board in South Africa also deployed passive reflectors of the type tested in the United Kingdom on beach protection shark nets and reported that they were effective for a short period in reducing small cetacean bycatch (CEC, 2002a). A more recent "passive porpoise deterrent" device, developed by the Aquatec Group in the United Kingdom and a prize winner in the WWF Smart Gear competition in 2007, combines acoustic reflectors with a small number of active acoustic devices. The reflectors are fitted on a gillnet every 5 m, and when an echo-locating porpoise emits a click, the reflectors transmit back a stronger echo, making the reflectors appear to the porpoise to be much larger objects than they actually are (WWF 2007). This device has yet to be field tested but if it does work it will be a simple and cost-effective solution.

An alerting device called a Passive Alerting System, (PAS-pinger) was tested in the Danish North Sea gillnet fishery in 1996 in a blind, controlled experiment (Kindt-Larsen *et al.*, 2007). The hypothesis behind this concept is that bycatch of harbour porpoises in gillnets happens because the porpoises are not paying sufficient attention to their surroundings. The PAS pinger was designed to attract the attention of animals to the net by emitting signals mimicking a porpoise click, as previous studies had shown that such signals could increase the echolocation activity of porpoises (Tregenza, *pers. comm.*). However, the experiment showed no decrease in bycatch rate when using the PAS-pinger. Research is ongoing to determine the cause of this failure to reduce bycatch, including tests of the relative behavioural responses to different alerting signals.

Other, less technologically advanced "acoustic-based" methods have been used to deter cetaceans from fishing gears. In Japan and Tunisia, oil- or waterfilled steel tubes, manually struck at intervals with a hammer, have been used in purse-seine fisheries with limited success in minimizing depredation of nets (CEC 2002b). This deterrent is claimed to have an effective range of 1 km, but dolphins appear to habituate quickly to the sound so that the method ends up becoming an attractant rather than a deterrent. There are also a number of reports of waterproof fireworks being used in artisanal fisheries, particularly in the Mediterranean (CEC 2002b). This method is used to keep cetaceans away from fishing gear, using disturbance caused by the explosions. Ethically and legally such a practice is highly questionable and should be strongly discouraged.

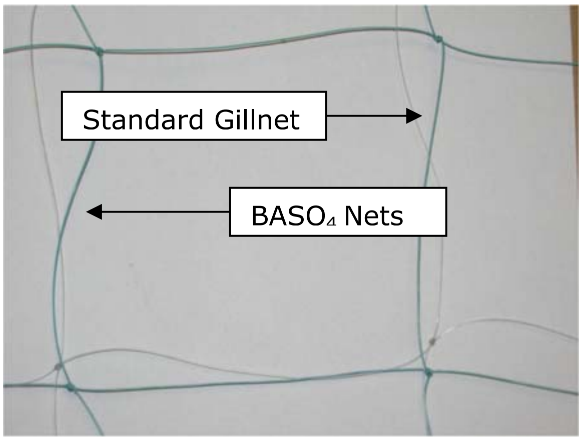
In summary it seems none of the Passive Acoustic Devices tested have shown any great promise as alternatives to ADD's and the most potential seems to be for use in conjunction with pingers.

3.7.2. Acoustic Netting Materials

Another passive acoustic approach is the use of net materials with increased acoustic reflectivity. The acoustic properties of set nets can be modified to increase their detectability to cetaceans so that animals may perceive the net as an impenetrable barrier. Modifications include chemically enhancing net fibres, increasing the density of net fibres with air-filled plastic tubing, braided wire or plastic coating or the addition of extra floats or bead chains spaced along the net (Au & Jones 1991; Koschinski & Culik 1997;

Cox & Read 2004). Figure 3 below shows an acoustically reflected net overlaid with a normal gillnet.

Figure 3. A net impregnated $BASO_4$ overlaid with a standard monofilament gillnet



Source: Northridge and Sanderson, 2003

In 2000, DIFRES in Denmark conducted experiments in the North Sea with modified bottom set gillnets made from nylon impregnated with iron oxide. The results showed a significant reduction in harbour porpoise bycatch in the iron oxide nets compared to conventional nets, but also a significant reduction in catches of cod, the main target species. Subsequent investigations revealed that the difference in acoustic target strength was not significantly different between net types and that differences in catch rates for cod and for porpoises between net types were due to increased stiffness in the iron oxide nets (Larsen *et al*, 2007). Further tests were carried out in Eastern Canada in reducing the bycatch of harbour porpoise with barium sulphate ($BASO_4$) gillnets (Trippel et al. 2003). However, doubts were expressed as to whether this was because of the nets' acoustic reflectivity, increased stiffness, or greater visibility over conventional gillnets (Werner et al. 2006).

Following this, a series of experiments with captive porpoises were conducted by the Danish National Institute of Aquatic Resources in collaboration with the Fjord&Belt Centre and University of Aarhus to determine how well porpoises can detect normal nylon gillnets and whether they can detect any differences between normal nylon nets and barium suplhate ($BaSO_4$) and iron oxide (Fe_2O_3) impregnated nets. Both a behavioural experiment using a "Two alternative forced choice" paradigm as well as Auditory Brainstem Response measurements were used. Preliminary results suggested that the animals were not necessarily as good at detecting nets as expected based on theoretical predictions. The consortium also carried out measurements of target strength of $BaSO_4$ and Fe_2O_3 nets under different conditions. These net types were found not to differ much from standard nylon nets, but differences in the ability to trap air bubbles on the nets may create differences in target strength during the initial deployment phase. However, this effect disappears after a few hours of submergence.

Northridge & Sanderson (2003) compared a set of polyamide (nylon) nets impregnated with barium sulphate and standard monofilament tangle nets. Incidental catch rates of both porpoises and seals were higher in the barium sulphate nets (mean of 0.05 porpoises/haul and 0.06 seals/haul) than in the standard nets (0.02 porpoises/haul and 0.03 seals/haul). This difference is only significant for porpoises at the 10% level and only at the 20% level for seals. The finding that incidental catch rates were higher in barium sulphate nets for both seals and porpoises suggested that there may be a common reason aside from the acoustic properties of the chemically enhanced nets.

Further trials of barium sulphate nets were undertaken by Cox & Read (2004) in the Bay of Fundy/Grand Manan demersal set net fishery for Atlantic cod, Pollack (*Pollachius pollachius*) and white hake (*Urophycis tenuis*). Porpoise Echolocation Detectors (POD's) were attached to 9 experimental and 14 control nets to record echolocation activity near nets. No harbour porpoises were caught in nets equipped with PODs and neither echolocation rate nor echolocation occurrence differed between the two types of net. The authors concluded that the mechanism by which the experimental nets reduced incidental catch in previous studies is unrelated to the acoustic properties of the nets.

Mooney et al. (2004) simulated dolphin-like echolocation signals to test the target strength (TS) of acoustically enhanced, barium sulphate filled nets compared with standard nylon nets. Results indicated that barium sulphate nets should be detected at a greater range by bottlenose dolphins and harbour porpoises when the net is approached from angles between 0° and 40° (the angle of the net was varied from normal incidence to angles of 10°, 20°, 30° and 40°) but not from other angles.

All of these trials raised questions about the use of acoustic netting materials. More recent work reported by Trippel et al (2009) evaluating the efficacy of barium sulphate ($BaSO_4$) modified gillnets has, however, produced interesting results. This work was carried out to reduce Franciscana dolphin (*Pontoporia blainvillei)* bycatch in an area a few kilometres of the Argentine coast in the Bahia Samborombon, near to San Clemente del Tuyu. Field testing occurred from January to February, 2008 and November to March, 2009. Monofilament nylon gillnets containing $BaSO_4$ (6% by weight) were deployed with a stretched mesh size of 110 mm and twine thickness of 0.6 mm. Standard nylon nets from the same manufacturer using new mesh provided appropriate controls. Based on observer data, in the first year, a total of four and seven dolphins were caught in 55 sets of $BaSO_4$ and 57 sets of standard nylon gillnets, respectively and in the second year, 11 and 19 dolphins were caught in 198 sets of $BaSO_4$ and 211 sets of standard gillnets, respectively. Commercial fish catch rates were very similar among the two net types (ICES, 2010).

A new experiment conducted by Pablo Bordino has recently started at the same study site in Argentina. This trial is part of the international "Stiffnet" project led by Tim Werner of the New England Aquarium (NEAq). Bycatch rates of Franciscana dolphins in two modified gillnets are being compared to standard nets used in the fishery. The first modified net type is impregnated with $BaSO_4$ and the second is a chemically stiffened net. The trial began in October 2009 and should be completed in February 2010 (Mackay pers. Comm.) A second trial under the "Stiffnet" project using the same modified nets began in Brazil in January 2010. This trial is being conducted by Eduardo Sechi and Franciscana dolphin bycatch rates in the three nets will be compared in both a bottom set and surface set gillnet fishery (ICES 2010).

3.7.3. Excluder Devices and Other Gear Modifications

Cetacean bycatch mitigation work with excluder devices has been carried out with pelagic trawls with limited success. The University of St. Andrews (USTAN) has conducted sea trials with several modified gears tested for the pelagic trawl fishery for bass in the English Channel (Anon. 2007). A solid steel grid (70 kg) at the front of the extension piece of the trawl was initially tested but proved to be too heavy. A tubular steel grid proved much easier to handle in both small and large vessels and again achieved some positive results;

an underwater video system allowed several dolphins to be observed escaping from the device (Figure 3). A flexible grid was also tested at sea in the same fishery but became easily distorted, resulting in unacceptable fish losses. Various escape hatches have also been tested in combination with the grids. The overall effect of introducing a grid and escape hatch has been to change the behaviour of some of the dolphins within the net as they try to escape. Whereas almost all animals will swim the length of a trawl net to the codend when there is no impediment in the net, once a grid is placed in the net dolphins appear to detect its presence many tens of metres in front of it and will try to escape much further forward, often drowning in the process. Only about a quarter of animals actually approached a grid and then used the escape panel to exit the net. Additional escape holes placed further forwards in the net were suggested but were not tested as USTAN subsequently abandoned this research to concentrate on acoustic solutions.

Figure 4. Steel exclusion grid with 1.7m escape hatch and 22mm netting cover

Source: SMRU, 2004

An EU-funded project entitled CETASEL aimed to test the effects of a series of ropes hung within the pelagic trawl net to determine if such ropes would prevent the entry of dolphins farther into the net. Following extensive experiments with captive animals, sea trials were also conducted with the excluder panel in April 1997 in waters off the South Ireland and in the Bay of Biscay. In the experiments carried out, ropes were placed in two parallel rows, 2.5 m apart, and seven escape holes were placed in the top sheet of the trawl with openings of 25 × 8 m. The results, however, were inconclusive due to a lack of interactions with cetaceans, but the panel appeared technically feasible (De Haan et al. 1998).

Other netting exclusion devices have been deployed in Mauritania, northwest Africa, by Dutch freezer trawlers and proved effective in eliminating large organisms such as hammerhead sharks (*Sphyrna mokarran*) and manta rays (*Manta birostris*) but not cetacean species (Zeeberg et al. 2006). The modification tested comprised a filter grid positioned in the aft section of a pelagic trawl connected to an escape tunnel. The filter grid sloped downward at an angle of 20 degrees, which forced larger non-target species such as sharks and manta rays downward to a tunnel entrance. A cetacean exit window was also positioned in front of the filter grid, although this did not seem to be effective. This work has been followed up by RIVO in the Netherlands as part of the EU-funded studied entitled NECESSITY. Extensive testing of two cetacean barriers (rope and tunnel barrier) in the front part of a pelagic trawl was carried out in 2005 but was largely inconclusive, with losses of marketable fish catch being a limiting factor. Similar rope exclusion panels tested by USTAN in the bass fishery, and placed at the point in the trawl where the large meshes of the fore part of the net join into smaller meshes leading to the codend of the trawl, gave negative results and proved impossible to handle without entangling the gear. These panels also resulted in no target fish catch. A 20-cm mesh Dyneema™ panel at the same place was found to be more manageable but increased drag greatly and reduced fish catch by 90%. Three other excluder device modifications were evaluated for their efficacy by IFREMER during tests undertaken in 2004 and 2005 (Anon. 2007). These designs were as follows:

- A 300-mm (bar length) square mesh tilted panel, fitted in the baitings of the trawl developed by a French net maker and tested by IFREMER
- A vertical barrier of 300 mm (bar length) square mesh placed in the body of the pelagic trawl (in the part constructed in 100-mm half mesh)
- A semi-rigid oval grid fitted in the extension piece of pelagic trawl

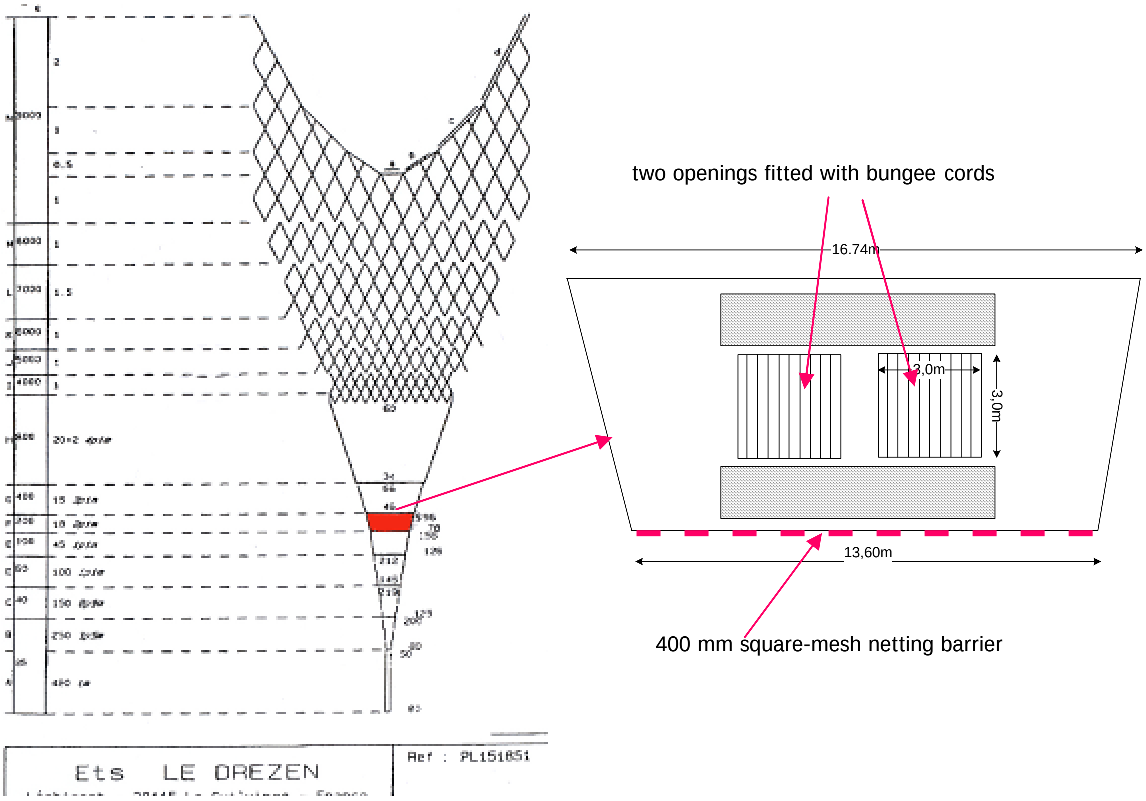
Mixed results were obtained. The tilted and vertical barriers were susceptible to blockages with large catches and resulted in unacceptable losses of marketable catches. The device performed relatively well in fishing operations but blockages occurred when large catches of bass were encountered. To solve this problem, it was suggested bar spacing should be increased to 300 mm and the bars should be cylindrical instead of rectangular but this was never tested.

Figure 5. A vertical net barrier and a flexible semi-oval grid as tested by IFREMER

Source: Anon., 2007

Further experiments were carried out by IFREMER in 2006 with two escapement devices. Escapement device 1 consisted of a 400 mm square-mesh barrier set at the section of the 200mm meshes (14 m x 8 m). In front of this barrier, two 3 m x 3 m openings fitted with bungee cords spaced 35 cm apart provided a potential escape route for cetaceans. These openings were covered so as to limit fish escapement on a number of occasions. This device seemed ineffective in spite of the large (uncovered) escapement openings. The device may have been positioned too far back in the codend (at the section of 200 mm meshes), given that most of the dolphins observed in front of the barrier seemed to be exhausted. Escapement of bass was also observed although this could have been limited by covering the escapement openings. It was decided therefore as a priority, to make a larger sized barrier, consisting of 800 mm square-meshes that would be positioned at the joining between the 800 mm meshes and the 4 m meshes "shark teeth" section with the aim of enabling dolphin escapement through the large size meshes further forward in the trawl. The results from trials with this device were inconclusive and at best this type of device would only give 20-30% reductions in cetacean bycatch with losses of marketable catch likely. IFREMER subsequently abandoned this research to concentrate on acoustic solutions (Anon, 2007).

Figure 6. Position and Details of IFREMER Square-Mesh Escapement Device



Source: Anon., 2007

It has also been suggested that marine mammal bycatch occurs in trawls during hauling. One way to avoid this might be to close the codend acoustically prior to hauling. This has been proved operationally possible (Pennec and Woerther, 1993) but has yet to be tested on a commercial fishing vessel.

Several modifications to set nets have also been tested. Trials in demersal set net fisheries in Yorkshire, England compared two sets of tangle netting, one of which was a monofilament nylon net and the other a three strand multi-filament net. Results indicated no significant difference in the catch rate of harbour porpoises between the two net types. Five porpoises were caught in 90 hauls using multi-filament net and five porpoises were caught in 87 hauls using monofilament net (Northridge & Sanderson 2003). A second set of trials compared monofilament nets with different twine diameters; 0.4 mm ('thin') and 0.6 mm ('thick'). The thin twined net also had a smaller mesh size (90 mm stretched mesh). There was a significant difference in the incidental catch of both seals (grey seals, *Halichoerus grypus* and common seals, *Phoca vitulina)* and harbour porpoises between the two net types ($P < 0.01$). In 142 hauls with thin twine, one porpoise and one seal were caught (0.007 porpoises/haul and 0.007 seals/haul) and in 142 with thick twine, 8 porpoises and 10 seals were caught (0.06 porpoises/haul and 0.07 seals/haul). After all nets had soaked for roughly 1000 hours, there were 39 large holes in the thick twined nets and 58 in the thin twined nets. Some, if not all, of the holes in the thin twined nets may have been caused by animals becoming entangled and breaking free or falling out of the net (Northridge & Sanderson, 2003).

Trials have also been carried out in New England due to compliance and monitoring issues related to the use of pinger device. Evidence from observer records indicated that gillnets with a hanging ratio of 0.33 had higher bycatch than more rigid gillnets with a ratio of

0.50. As a result, there was interest in conducting research trials that evaluated the effect of different gillnet hanging ratios on the bycatch of harbour porpoise (Rossman. Pers. comm.). From February through April 2009, an experiment was conducted in an offshore area to the southeast of the Cape Cod South PRA. This is an area with documented high bycatch rates of harbour porpoise. The experiment was conducted in two phases. Phase 1 used a randomized design to assign net panels constructed with the two different hanging ratios to a string of gillnets. Phase 2 utilized gillnet strings where each panel in the string had the same hanging ratio. Phase 2 was implemented quickly in the study due to unexpectedly high bycatch of marine mammals during Phase 1 of the study (randomly designed nets). The preliminary results are inconclusive. Over the duration of the study more animals were bycaught in nets where hanging ratio = 0.30 (n=7) compared to nets with a hanging ratio = 0.50 (n=5). However, more trials need to be conducted in order to conduct a statistical analysis on the experimental data (ICES, 2010).

3.7.4. Other Methods

Other bycatch mitigation solutions include operational changes to fishing practices or involve time/area closures to avoid "hotspots" of conflicts between fishing and non-target catch. Time and area closures, however, are only effective if the spatial or temporal frame is large enough to encompass a suitably high proportion of bycatch events. It is therefore necessary to know spatial and temporal (seasonal) distribution of bycatch events and for bycatch to be not just a transient or random occurrence, unless the closures are in real-time. Spatial and temporal closures of fisheries have been effective in certain circumstances; for instance, the Banks Peninsula Marine Mammal Sanctuary that was created in 1988 to protect Hector's Dolphins (*Cephalorhynchus hectori*) from gillnets in New Zealand (Read et al. 2006). The National Oceanic and Atmospheric Administration (NOAA) system of real-time closures referred to as dynamic area management (DAM) zones, which temporarily restrict the use of lobster pots and anchored gillnets on an expedited basis to protect right whales, has also proved to be successful. In this system, a DAM zone is triggered by a single reliable report from a qualified individual of three or more right whales within an area (75 nm^2) such that right whale density is equal to or greater than 0.04 right whales/nm^2. There are examples, though, where such closures have not worked. For example, Zollet (2005) reported that higher bycatch rates of harbor porpoise in 1994 in the New England multispecies gillnet fishery resulted from a poorly designed area closure network instigated by NFMS.

Operational changes to fishing practices have also been considered. It was reported that bycatch of cetaceans in pelagic trawl fisheries occurs mostly at night or at dawn and dusk by Morizur et al. (1999). While this is not the case in all fisheries, this information could be used in promulgating mitigation strategies. There have been several other suggestions that haulback procedure, offal-discarding practices, deck lighting arrangements, and the use of certain sonar equipment may all contribute to increasing cetacean bycatch probability. These ideas, however, have yet to be tested rigorously and while of limited value at this juncture may form the basis for developing "Codes of Best Practice" for vessels operating in high risk fisheries in the future.

3.7.5. Alternative Gears

The need to develop alternative fishing gear in the gillnet fisheries in the Baltic has increased in recent years due to the high bycatch of birds and mammals and also growing seal and fisheries conflict. A potential alternative fishing gear for cod being considered to gillnets in the Baltic is the use of pots or traps. Studies in a number of countries including Sweden, Norway, Canada, Faroe Islands and Iceland are reported by the ICES Study Group on the Development of Fish Pots for Commercial Fisheries and Survey Purposes (SGPOT) (ICES, 2009e). In Germany a series of small scale feasibility studies were conducted to find out whether cod pots could fully or partly replace gillnets and this was reported by SGBYC in 2009. Two cruises on a research vessel in August and October 2008 were carried out to compare catches of cod with (Norwegian Type) pots set pelagic and on the bottom with catches of gillnets fished nearby. The results for the trials were very disappointing because only one cod was caught in 11 pots. The 50 gillnets showed a mean catch of 12 kg/day of cod and 74 kg/day of flounder. Subsequently commercial fishermen have also been equipped with a limited number of cod pots. Catch rates have been more encouraging and closer to catch rates in gillnets although further work is required before it is felt likely fishermen will adopt this method of fishing. Costs for switching to alternative gears also remain a major dis-incentive for fishermen (ICES, 2009d).

3.7.6. Comparison with ADDs

Table 9 summarizes the effectiveness, ease of use, impacts on target species catch, cost and collateral effects of a range of alternative gears. Most of these are still under development or have proven ineffective for a variety of reasons. Even the simplest solution of time/area closures requires a specific set of rarely found circumstances to be even partially effective. The encouraging results from the trials with treated and stiff gillnets in South America may be a cause for optimism as an alternative but these results are only preliminary and from an artisanal fishery with an endemic south American dolphin species, and which would not be representative of European gillnet fisheries. This therefore is at the moment a “work in progress” and the results should be closely monitored. Fishery closures and changes in operational practices have merit but ultimately can displace bycatch problems and may have other unforeseen consequences.

Table 9. Summary of Alternative Measures in terms of Effectiveness, ease of use, impacts on catches of target species, cost and collateral effects

Gear Type	PADs/PAS	Stiff Nets	Excluder Devices	Area/Seasonal/Fishery Closures	Operational Changes	Alternative Gears
Effectiveness	None proven effective	Not proven	Only an option for pelagic trawl fisheries. Best indications of 20% reduction in bycatch but generally unproven	Effective if well defined and the spatial and temporal distribution of bycatch events well known. If bycatch is transient or random then closures need to be real-time.	Unproven	Only effective if in certain fisheries and in certain areas e.g. cod off the Newfoundland coast
Ease Of Use/Reliability	Easy to use and generally reliable	Not enough work to be able to assess	Can be difficult to install in large pelagic trawls and have been shown to increase drag of the gear. Devices such as large grids can be difficult to handle on board smaller vessels	Simple	Simple	Depends on vessel layout
Impact on Target Species Catch	None	Previous work in 2000 high losses in catches in target species	Previous work has shown losses of target species can be high.	Can be high if vessels are excluded from areas of high catches or the fishery is closed completely.	Untested but some such measures are likely to have an impact on target species catches	Most experiments have shown reduced catch rates with alternative gears
Cost	Cheap	More expensive than standard gillnets	Depending on the trawl can be expensive	Cheap although monitoring costs can be high	No real cost	Expensive
Collateral Effects	None anticipated	None anticipated	None anticipated although Bottlenose dolphins have been shown to actively follow trawls and feed within the mouth opening.	None	None	None anticipated

Source: Author

4. ASSESSMENT OF THE OUTCOME OF DIRECTIVE 92/43/EEC

KEY FINDINGS

- The Habitats Directive – in common with all EU Directives, sets out objectives, which Member States are then expected to address through the implementation of national legislation. Under Article 17, every six years Member States are required to report on the implementation of measures taken under the Directive and in particular should report on the conservation measures referred to in Article 6 and the main results of the surveillance referred to in Article 11. But there is no explicit requirement to report on Article 12, which requires member states to monitor incidental catches. Article 3 of the Directive also calls for the establishment of special areas of conservation to be established to protect all listed species including, among the cetaceans, harbour porpoises and bottlenose dolphins.
- From a policy perspective, the Habitats Directive provides broad objectives, but without specific requirements Article 12 of the Directive (which requires monitoring to ensure that incidental capture and killing does not have a significant negative impact on the species concerned) had not been implemented by any member state by 2004. Regulation 812/2004 can therefore be seen as a means to enforce Article 12 and to generate reports on monitoring activities that should be conducted under Article 12 of the Habitats Directive
- By 2006 no member state had established an SAC for either of the two listed cetacean species. Common dolphins (and other potentially vulnerable cetacean species) are not listed in Annex II of the Directive. But the establishment of SACs for harbour porpoises and bottlenose dolphins are unlikely to help in minimising bycatch, as bycatch is usually widespread and unpredictable with regard to area.
- Some Regulatory action is needed to ensure other marine species listed in Annex IV of the Directive are also subject to monitoring as required under Article 12.
- The Habitats Directive is focused on areas based management, yet in most cases this is unlikely to be an effective means of addressing conservation issues for cetaceans, most of which range over very large areas and are subject to wide-ranging bycatch. The obligation to monitor incidental catch under the habitats directive (Article 12.4) is widely ignored in favour of establishing 'protected area' that are unlikely to be able to address conservation goals.

Information on the transposition of Directive 92/43/EEC by Member States is available from The Report from the Commission on the implementation of the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, Part II Summaries of EU Member State, 2003. The most up to date compiled information on created Special Areas of Conservation (SACs) was available from the National Summaries and Checklists for reports submitted for the 2001 - 2006 period in relation to Article 17 of the Directive. All of this information was available from the EUROPA, European Commission, Environment, Nature & Biodiversity web site on Article 17 Habitats Directive reporting at: http://ec.europa.eu/environment/nature/knowledge/rep_habitats/docs/memberstates_summary_en.pdf

From this information it was found that no Marine SACs were created by any Member States during the 2001 – 2006 period but progress was made during this period on designating SACs and Sites of Community Interest (SCIs). Information on designated SCIs

and SACs by Member State Marine Region was available from a report on the State and Designation of Sites of Community Importance and Special Areas of Conservation for the period 2001-2006 by the European Topic Centre on Biological Diversity available at:
http://eea.eionet.europa.eu/Public/irc/eionet-circle/habitats-art17report/library?l=/papers_technical/designation_scissacspdf/_EN_1.0_&a=d

Designated Sites of Community Importance outlined in this report included: Sites officially proposed by the Member State, but not yet included in a biogeographical Community list (pSCIs), Sites included in a biogeographical Community list approved by a Commission decision (SCIs), SCIs already classified by the Member State as Special Areas of Conservation (SACs).

No compiled information on the designation of SACs specifically in relation to cetacean species was located. Some information was available from various sources on ongoing developments by individual Member States in relation to SACs. The quality of information available varied considerably by Member State, however, and in the interests of providing consistent information, sources of information used in this section of the report were restricted to centrally compiled information as found on the European Commission web site.

No information was available on the transposition of the Directive from several Member States. Information was available, however, on the overall conservation status of cetaceans and designation of SCIs and SACs in these Member State Regions, and these data are included in the summary Tables in Annex VI and Annex VII along with the other Member States reported below.

4.1. Comments on the Implementation of the Habitats Directive

Reviews of the Habitats Directive in relation to bycatch and issues related to the protection of species were available from SGBYC reports (ICES, 2008a, ICES 2009a). In 2009 the SG dealt with a request to examine Member State reports and the draft EU database compiled from reports in fulfilment of Article 17 of Directive 92/43/EEC (the Habitats Directive) (see also Section 2.3 above).

The standard format of the reports produced by Member States included an evaluation of threats and pressures faced by marine mammal species. Pressures were identified as known adverse factors currently affecting the status of the species while identified threats were the more ephemeral/potential future impacts on the population. Little guidance was provided however on this and treatment between Member States may not have been uniform. Relevant possible categories of "threats/pressures" from fisheries for marine mammals were Drift-net fishing, Trawl fishing, Fixed location fishing, Leisure fishing, Professional fishing and Fish and shellfish aquaculture.

Overlaps existed between these categories (e.g. most fisheries could be either professional or leisure and one of the first three categories). Little guidance on how to use these categories was provided and potential threats from other gear types were not addressed.

Many inconsistencies were observed in the database; sufficient that any analysis would be likely to give spurious results. There appeared to be no difference between the pressure and threat reports. No pressures or threats to marine mammals from fisheries were reported from Germany, Finland, Estonia, Latvia or Lithuania. Other Member States had reported only pressures from Leisure fishing or Professional fishing, with no further specification of type of fishery.

These inconsistencies lead SGBYC to recommend that this draft database could not be used for a reliable analysis of the main threats or pressures on marine mammals in European waters. Should such an analysis be required, it seems likely that a first step should be to issue some consistent guidance on completion of the reports by Member States that have been used in compiling the database.

In terms of common issues and synergies, monitoring of bycatch of cetaceans and other species listed under Annexe IV of the Directive is required under 812/2004 and the Habitats Directive. The Habitats Directive does not stipulate how much monitoring should be carried out, however, and the absence of targets combined with poorly defined bycatch data collection formats has resulted in small amounts of poor quality data.

In contrast, specific objectives and targets in relation to cetacean bycatch monitoring are clearly defined in Council Regulation 812/2004. Although monitoring targets, data formats and other issues are subjects of ongoing debate, the regulation has, according to the conclusions of SGBYC 2010, succeeded in providing a "much more comprehensive picture of cetacean bycatch in European fisheries". Section 2.2.1 of this report and in particular Annex II which summarizes bycatch estimates by species and fishery demonstrates the relatively high quality, if not yet entirely comprehensive, information which has been collected under the regulation to date.

The Habitats Directive has clearly failed to stimulate the monitoring of incidental mortality that is required under Article 12. Regulation 812/2004 addresses this inadequacy on the part of member states to fulfil their obligations, but does so in a prescriptive way that does not necessarily promote either best value or best understanding of the conservation threats to cetaceans. A more co-ordinated approach between member states that addressed the common conservation status of these highly migratory species and the common threats posed by European (and neighbouring) fishing fleets would be desirable.

From a policy perspective monitoring of incidental mortality is required under Article 12 of the Habitats Directive for all species listed in Annex IV. Regulation 812/2004 solely addresses cetacean bycatch although several other marine species on Annex IV also occur as bycatch in fisheries. A broader regulation in terms of species which ensures that the obligations of Article 12 are addressed (though perhaps with less specific detail on the levels of sampling – see section 3.5 above) would make sense. The European Commission has taken tentative steps towards including species other than cetaceans "e.g. Seabirds, turtles etc." in 812/2004 (ACFA, 2010). Although additional challenges will undoubtedly be raised, extending the scope of the regulation to include bycatch observations of all Habitats Directive Annexe IV species may be the most practical way of systematically obtaining useful information on bycatch of species other than cetaceans in commercial fisheries.

As discussed in section 2.6, bycatch is probably the greatest conservation threat to cetaceans, and as discussed under section 3.7, area based measures are not normally a useful way of mitigating fishery bycatch for cetaceans. The Habitats Directive's focus on the establishment of Special Areas of Conservation unfortunately directs conservation efforts away from Article 12, where Member States, "in the light of the information gathered" (from bycatch monitoring schemes), are obliged to undertake "further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned".

Nevertheless, transposition of the Habitats Directive into national law shows little advancement on obligations held on Article 12.

4.2. Country Reports

4.2.1. Belgium

The law of 20 January 1999 concerning the Protection of the Marine Environment under the jurisdiction of Belgium (MB 12/03/1999) (MMM law) transposes the Habitats Directive. Another Law of 22 April 1999 concerning the exclusive economical zone of Belgium in the North Sea (MB 10/07/1999) (EEZ-law) is also relevant. There are several legal instruments implementing the MMM law: the "Arrêté Royal" of 20 December 2000 establishing rules on environmental impact assessment; the "Arrêté Royal" of 20 December 2000 establishing procedures for granting permits and authorisations for some activities in the marine environment; the "Arrêté Royal" of 21 December 2001 concerning the protection of species (including all relevant Annex IV species) in the marine environment; and the "Arrêté Royal" of 12 March 2000 concerning procedures for dumping certain substances and materials in the North Sea.

All incidental capture or killing of relevant Annex IV species has to be notified. Fishermen are also asked to land any marine mammal bycatch to facilitate scientific study.

Harbour porpoises and bottlenose dolphins were present off the Belgian coast in the Marine Atlantic (MATL) Region. The overall conservation status for both species was unfavourable. One designated SCI was reported in the Belgian MATL.

4.2.2. Denmark

Local and regional authorities take decisions on most matters relating to Natura 2000 and associated land use. In 1998, an Order was introduced laying down guidelines for local and regional authorities on the implementation of legislation linked to Natura 2000. For sea areas, powers are vested in the Danish government.

Articles 6(3) and 6(4) of the Directive have been implemented by §4 and §6 of Order No. 782 on the Demarcation and Administration of International Nature Conservation Areas. The 23 Order states that all proposals for plans covered by Danish planning legislation must include an assessment of the consequences the proposed plan will have for species and habitat types in Natura 2000 areas. If the consequences are assessed as negative in relation to species or habitats the plan cannot be realised. Similarly, all authorisations etc. granted for most land use activities must include a statement, based on an appropriate assessment, that they do not deteriorate or disturb Natura 2000 sites.

In Denmark, the protection of species has been implemented or is being implemented through a number of provisions pursuant to the Nature Protection Act. Under Danish law, a large number of habitat types are protected from any changes to their condition. The provisions of Articles 12(1)(d) of the Directive have recently been specified in new Orders (Ministry of the Environment Orders 624, 636 and 637) under which no permits may be granted that may lead to the destruction or damage to breeding or resting grounds/habitats of strictly protected species.

The provisions of Article 12(1)(a)-(c) already related to most species and were implemented in the Order on the Conservation of Species adopted in pursuance of the Nature Protection Act. Amendments will be made to this Order to ensure that the protection of all Annex IV species is transposed into Danish law. In the case of mammals this will require amendments to Orders adopted on the basis of the Management of Wild Animals Act.

There were no systematic control systems in place that would monitor the number of Annex IV species killed accidentally. However, the Danish authorities have drawn up an action plan to reduce the incidental capture of harbour porpoises.

Harbour porpoises were present off the Danish coast in both the Marine Atlantic (MATL) and Marine Baltic (MABL) regions. The overall conservation status for this species was unfavourable bad in both regions. Thirteen and sixty seven SCIs were designated in the Danish MATL and MBAL respectively.

4.2.3. France

Decree no. 95-631 of 5 May 1995 laid down a legal procedure to be followed in relation to the process of proposing sites under the Habitats Directive, leading to the submitting, by the Ministry of Environment, of the national list of sites eligible to be proposed as SCIs. The Decree formalised the procedure and specified the roles of the different bodies in conducting the scientific inventory, assessing the sites and establishing the national list. This Decree was followed by a succession of Ministerial Circulars sent to Prefects implementing the provisions of the Decree.

In terms of management measures, the Natura 2000 contracts are formally established in Article L 414-3 of the Environment Code. A Circular was issued by the Ministry of Environment on 26 February 1999 requesting département Prefects to begin work on preparing the management plans. Consultations were launched in 1999 by the Prefects for 300 management plans. Article L 414-2 of the Environment Code provides a legal framework for management plans. Articles R 214-23 to R 214-27 of the Environment Code lays down the arrangements for developing and implementing management plans (inserted by Decree no. 2001-1216 of 20 December 2001 adopted under the Ordinance of 11 April 2001).

In terms of protection of sites (eg avoiding deterioration, assessment) (Article 6(2)), Article L 414-1-V lays down that "suitable preventive measures are also to be taken on Natura 2000 sites to avoid deterioration of these natural habitats and disturbances that may significantly affect these species. These measures are to take into account economic, social and cultural requirements as well as regional and local particularities, and are to be adapted to the specific threats on the natural habitats and species concerned.

The measures are to be adopted under Natura 2000 contracts, or under existing systems of protection of natural areas, particularly national parks, nature reserves, biotope protection orders and listed sites (sites classés). These statutory, regulatory and contract-based systems in force lay down general protection requirements for natural areas. Thus, these requirements can be implemented on Natura 2000 sites, if the latter are situated in one or more of the specific categories of protected area concerned.

Legislation is in place concerning environmental impact assessments (EIAs), which are required for proposed schemes that may cause damage to the environment (Article L 122-1 of the Environment Code). These measures were supplemented, in order to transpose Article 6, paragraph 3 of the Habitats Directive, by Articles L 414-4 and 5 of the Environment Code and Articles R 214-34 to R 214-39 of the Rural Code. This regulatory item was adopted following the ECJ's ruling against France issued on 6 April 2000.

Statutory protection is based on Articles L 411.1 and 2 of the Environment Code. Ministerial Orders, applicable nationally, are adopted per species group banning activities listed in the Directive.

Conservation measures adopted for the most threatened species listed in Annex IV are aimed at curbing limiting factors, most notably, habitat loss. In some cases, national restoration plans are established per species for a given time period (usually five years). No general monitoring system has been put in place for incidental capture and killing of animals in view of the numerous causes involved.

Common and bottlenose dolphins were present in both the French Marine Mediterranean (MMED) and MATL while minke whales and harbour porpoise were present only in the latter. The overall conservation status was unknown for minke whales, unknown and unfavourable bad for common dolphins in the MATL and MMED respectively, unknown for harbour porpoise, and unknown for bottlenose dolphins in both French regions. Seventy nine and forty two SCIs were designated in the French MATL and MMED regions respectively, while seventeen SACs were designated in the French MATL.

4.2.4. Germany

With respect to protection of sites, plans and projects with a potentially adverse effect on pSCIs, require an environmental impact assessment (FFH Erheblichkeits- and Verträglichkeitsprüfungen) under Article 19 of the Federal nature conservation law. At the Länder level, administrative regulations have, in many cases, been adapted. These regulations contain detailed provisions for the appraisal of plans and projects with potentially adverse impacts on Natura 2000 sites and indications for the necessity of impact assessments to Article 6(3) of the Directive. In some Länder, site-specific and legally binding conservation objectives are used to assess the potential impact of plans and projects as part of environmental appraisal procedures.

In addition to legal provisions, general measures taken in support of habitat and species protection, water quality standards, and hydrological integrity help to avoid the deterioration of sites. Similarly, legal guidance given with regards to forest, water and soil management facilitates the general maintenance of the conservation status.

Provisions for a strict system of species protection are made by the federal nature conservation act (Bundesnaturschutzgesetz), the federal regulation for the protection of wild species (Bundesartenschutzverordnung), and Länder legislation. For those species outside this strict system of protection, the Bundesländer have adopted protection orders (naturschutzrechtliche Schutzvorschriften) and, where appropriate, have put in place species- specific conservation measures.

In accordance with the respective Länder legislation, it is the responsibility of relevant nature conservation authorities at the Länder level to monitor the incidental capture and killing of protected species.

Harbour porpoises were present off the German coast in both MATL and MBAL regions. The overall conservation status of harbour porpoise was unfavourable inadequate and unfavourable bad in the MATL and MBAL respectively. Twenty two and fifty five SCIs were designated in the German MATL and MBAL regions respectively, with one SAC also designated in each region.

4.2.5. Greece

Law 2742/99 on 'Land-use planning and sustainable development and other provisions' establishes the procedure for setting up management bodies in protected areas and specifies their responsibilities and method of functioning. The management bodies are given various powers and responsibilities, including the compilation of management plans and operating regulations, monitoring and assessment of the application of the regulations, control over human activities, the delivery of opinions concerning preliminary planning authorisation and the adoption of environmental conditions for projects and activities.

Under Law 1650/86, the designation of protected areas and the establishment of management bodies require a prior Specific Environmental Study (SES). These studies, supervised by the Environment Ministry, may be carried out by official bodies (Environment Ministry, prefectural authorities, municipalities, etc.) or other bodies (NGOs, etc.), through LIFE- Nature programmes, programming contracts, or from own financial sources. The Studies assist in the preparation of legal texts required for the designation of protected areas, the drawing of management guidelines and the establishment of their management bodies following their examination and formal acceptance by the Ministry of Environment.

No system of legal protection is reported specifically for pSCIs. The main mechanism for the evaluation and authorisation of new projects which may affect pSCIs is the environmental impact assessment (EIA). Law 1650/86 makes EIA compulsory for projects and activities which may bring about changes in the natural characteristics of an area. This prevents deterioration of the natural environment and, if changes do occur, ensures that compensatory measures are taken.

No systematic surveillance or monitoring arrangements are reported at the national level. It is envisaged, however, that systematic monitoring of habitats and species, as well as of the important abiotic parameters which can significantly affect them, will be conducted at local level by management bodies when they are set up.

Laws have been introduced to provide protection for those Annex IV species that were not previously protected. Action plans and specific actions have been devised for many Annex IV species through the LIFE-Nature programmes, and also with government support in the framework of national planning for the environment. Certain species have been given priority for protection actions but this does not include any cetacean species.

No formal system for monitoring of the incidental capture and killing of species of fauna has been introduced. In the case of marine species, the services of the Ports Corps record the numbers of cetaceans that are found dead, the locations at which they are found and the opinions delivered by veterinarians, and they forward the information to the Ministry of Merchant Shipping, the Ministry of the Environment and the relevant non-governmental organisations.

Common dolphins, harbour porpoise and bottlenose dolphins were present in the Greek MMED region and the overall conservation status was unfavourable bad for common and bottlenose dolphins and unfavourable inadequate for harbour porpoise. One hundred and two SCIs were designated in the Greek MMED.

4.2.6. Ireland

It was originally intended to transpose the Habitats Directive into Irish law by way of amendments to the Wildlife Act 1976. It was instead decided to bring the Directive into force under the 'European Communities Act 1972'. The Directive was finally officially transferred into national law through the European Communities (Natural Habitats) Regulations (1997) (SI No.94/1997)). The Directive was further transposed into Irish law through the Wildlife (Amendment) Act 2000. The Wildlife (Amendment) Act 2000 includes provisions to strengthen the protective regime for pSCIs by ensuring that protection will in all cases apply from the time of notification to the Commission of proposed sites.

There are a number of specialised monitoring programmes also either already or soon to be in use throughout Ireland. Specific condition monitoring programmes are in preparation for Bottlenose dolphin.

Strict protection systems at the species level are provided for in Irish law by the European Communities (Natural Habitats) regulations 1997. These regulations augmented the provisions of the Wildlife Act 1976, which already offered extensive legislative protection to species included in the Habitats Directive. The Wildlife (Amendment) Act of 2000 further strengthened the legal protection.

Annex IV animal species present in Ireland are given full protection under Section 23 of the European Communities (Natural Habitats) Regulations 1997 and the Wildlife Acts 1976 and 2000. It is an offence to kill or disturb these species except under licence.

There are currently no provisions for the monitoring of incidental capture and killing of protected species. Ireland intends to further examine systems of monitoring and control of incidental capture and killing of Annex IV(a) species if it is considered in the future that incidental capture and killing could have a significant negative impact.

All four species, minke whales, common dolphins, harbour porpoise and bottlenose dolphins were present in the Irish MATL region and all had a favourable overall conservation status. Eighty SCIs were designated in the Irish MATL.

4.2.7. Italy

The Habitats Directive is transposed in Italy by Presidential Decree No 357 of 8 September 1997. However, Article 6 has created problems. First, some regions and autonomous provinces challenged the stipulations of the Presidential Decree. Also, at the end of 1999 the EC instituted infringement proceedings because Article 6(3) of the Directive was transposed imperfectly.

From 2000, the regions and autonomous provinces started to integrate the Article 6 requirement on the assessment of projects into their regulations and to transpose the prescriptions of PD 357/97 into their project authorisation procedures. The legal basis varies: in some cases, it is EIA legislation (e.g. Lombardy, Apulia), while in others (e.g. Tuscany) the requirement for project assessment is implemented through regulations on nature conservation. The technical board revised the text of PD 357/97, producing a modified version, although due to various delays it has not been approved definitively by the competent body, nor have the changes been confirmed as sufficient by the EC.

Presidential Decree 357 transposes Article 11 of the Habitats Directive and entrusts the State Forestry Board (CFS) with the task of carrying out surveillance activities pursuant to the Decree. Where cases involve problematic decisions, the CFS refers to the Ministry of the Environment as the competent national body.

Presidential Decree No 357/97 (transposing the Habitats Directive) includes the annexes to the Directive in full, and thus protects all the species of Annexes IV and V. In addition, the national law NO 157 of 11 February 1992 protects all mammals listed in Annexe IV. Regional legislation on the protection of wild fauna varies.

There is no national system capable of monitoring incidental captures and killings of all species covered, though some regions and autonomous provinces have taken action to that end.

Common and bottlenose dolphins were present in the Italian MMED region and the overall conservation status was unfavourable bad for the former and unfavourable inadequate for the latter. Three hundred and ninety seven SCIs were designated in the Italian MMED.

4.2.8. The Netherlands

Following a Commission letter of formal notice for failing to adequately transpose Article 6 into Dutch law, the government introduced a bill amending the 1998 Nature Conservation Act (December 2001). The bill has yet to be debated by parliament.

As far as Annex IV species are concerned, the provisions of Article 12(1) and (3) and Article 13 of the Habitats Directive were incorporated in the form of prohibitions in Chapter V of the 1967 Nature Conservation Act. In 2002 the above were replaced by the Flora and Fauna Act (passed in 1997/98, entered into force on 1 April 2002), which implements the species protection components of the Habitats Directives.

In accordance with Article 12 (4) of the Habitats Directive, bycatch (e.g. dolphins and porpoises) resulting from fishing activities are monitored. Research is being conducted to improve catching methods so as to prevent bycatch.

Harbour porpoise were present in the Dutch MATL and the overall conservation status for this species was unfavourable bad. Four SCIs were designated in the Dutch MATL.

4.2.9. Portugal

A legal framework is established by Decree Law No. 140/99 of 24 April 1999, which transposes the Habitats Directive into national law. The Decree provides for the preparation of a sectoral plan designed to establish the scope and framework of measures needed to guarantee the conservation of natural habitats and species, having regard to the environmental assets to be protected and the socio-economic development of the areas included in Natura 2000.

Protection measures were implemented through Decree Law No. 140/99, Article 7. Sites partially or totally coinciding with protected areas are subject to the protection existing for those areas.

Article 8 of Decree Law No. 140/99 lists the activities affecting sites that are subject to a binding opinion from the authority responsible for nature conservation. These include changes of use to marine areas. The Environmental Impact Assessment system has been applied wherever justified by the nature of the projects.

A methodology for monitoring marine sites is to be defined as part of the LIFE Project 'Integrated Management of Coastal and Marine Areas of the Azores'. Generally speaking, surveillance is interpreted as a site-specific activity, rather than as monitoring of the conservation status of habitats or species throughout their range, against established targets.

Although there are numerous projects for improving the conservation of particular species, including increased protection in specific sites, no examples are reported of strict protection systems operating throughout a species' range. For several species in particular sites, including cetaceans, there is a system for reporting the appearance of dead specimens. In general, monitoring systems have not been established throughout a species' range.

Minke whales and harbour porpoise had an overall conservation status of unfavourable inadequate, while common and bottlenose dolphins had an overall conservation status of favourable in the Portuguese MATL region. Minke whales, common and bottlenose dolphins were also present in the Portuguese Marine Macaronesian (MMAC) region where their overall conservation status was unknown. No SCIs or SACs were designated in these Portuguese regions.

4.2.10. Spain

A national legal framework exists (Law 4/1989) for the management of designated protected areas but, at present, there is no national system (methodology or guidelines) specifically for the preparation of management plans and measures in proposed SCIs.

Under Law 4/1989, all protected areas under national and regional legislation are required to have management plans and their corresponding measures. Where these plans exist, they will be modified as necessary if and when they are designated as Natura 2000 sites.

According to Royal Decree 1997/1995, which transposes the Habitats Directive into Spanish law, Article 6(2) comes into force once the final SCI lists have been approved. Several regions report that no specific protection has been introduced for proposed sites, although many have a *de facto* protection as protected areas while other regions have taken steps to apply the protection required by this Article to proposed SCIs.

The existing mechanisms are those established under legislation for EIA procedures and for protected areas. The procedures vary according to the region and sometimes the protected area in question. Most regions report that there is no established mechanism specifically for dealing with activities affecting SCIs, although environmental authorities may take particular account of the Natura 2000 values present in these sites when new activities emerge through the established EIA and protected area procedures.

The Spanish report refers to the State legislation for species protection (Law 4/1989), and to the definition of different categories of threatened species, and the legal requirements in terms of recovery plans, management plans, etc. The strict protection of species and of their places of reproduction is not referred to in the report. Measures to monitor incidental capture and killing are covered in the Annexes of the national report.

All four study species were present in the Spanish MATL with unknown overall conservation status. Porpoise and bottlenose dolphins were present in the Spanish MMAC region with unfavourable inadequate overall conservation status. Porpoise, common and bottlenose dolphins were present in the MMED region where these species all had unknown overall conservation status. No SCIs or SACs have been created in these Spanish regions. Eighteen, eighty one and SCIs were designated in the Spanish MMAC and MATL regions respectively.

4.2.11. Sweden

According to the Swedish report, existing site protection methods are well proven and there is consequently no need to assess them specifically in terms of Natura 2000.

Permits are required for certain activities according to the Environmental Code. These permits can be combined with requirements to protect and prevent activities that can be harmful to Natura 2000 sites. The Natura 2000 EIA required by Chapter 6 of the Environmental Code provides the framework on which planned activities and their consequences for Natura 2000 sites are to be described. A planned guidance document by the Swedish Protection Agency (SEPA) will specify requirements for this process.

The Directive's definitions of FCS for habitats and species have been transposed into the Nature Protection Act (SFS 1998:1252). There is no assessment of the effects of Article 6 on FCS.

The species in Annex IV are protected by hunting legislation, fisheries legislation or species protection legislation under the Environmental Code. All species in Annex IV are covered by the Species Protection Regulation (SFS 1998:179).

Legislation to create a national monitoring system for incidental capture and killing was implemented in 2001 and covers Annex IV species.

Harbour porpoises were present in the Swedish MATL and MBAL regions and the species had an unknown bad overall conservation status in both regions. Two hundred and forty two and eighty nine SCIs were designated in the Swedish MBAL and MATL regions respectively.

4.2.12. United Kingdom

The UK provided information on candidate special areas of conservation (cSACs). For most marine cSACs, management plans have to be developed from scratch. This has been a major new undertaking for the UK. Regulation 33 of the Conservation (Natural Habitats & c.) Regulations 1994 (Regulation 28 in Northern Ireland) states that the statutory conservation agencies have a duty to advise public bodies on conservation objectives operations, which may cause damage or disturbance.

Marine cSACs, unlike their terrestrial counterparts, do not have targeted positive incentive measures that complement existing arrangements. The UK has 23 packages and consultation programmes under Regulation 33, covering 38 sites. In Wales, there are two marine cSACs that already have received Regulation 33 advice and have management plans. Most other marine cSACs have management committees that will draw up management plans.

In England, 13 Regulation 33 packages have been produced and a consultation programme established for 15 sites. Considerable progress has also been made in establishing management schemes at each of the 16 sites in the programme, with management groups being established for all 16 sites, advisory groups established at 12, and consultation schemes produced for 6.

Within Scotland, the marine cSACs that have progressed the furthest in developing management schemes involve 5 sites with LIFE-funded Project Officers. For all 5, draft management schemes have been developed in consultation with the relevant authorities. Drafts of Regulation 33 packages for the LIFE and cross-border sites have been developed in parallel with the management schemes and have been put out for public consultation. For the non- LIFE marine cSACs, the development of the Regulation 33 packages follows on from the completion of the conservation objectives.

In Wales, the development of management plans for marine cSACs is divided into two stages: firstly CCW provides conservation advice to the relevant authorities, and secondly, these authorities have to develop a management plan based on this advice.

In terms of protection of sites, the UK Government and the devolved administrations already treat cSACs as if they were fully designated. cSACs in England have been afforded protection in law by virtue of an amendment to the Conservation (Natural Habitats &c) Regulations 1994, such that candidate sites are legally protected from the date they are submitted to the European Commission.

The Government has issued formal guidance to planning authorities that the environmental effects of any proposed development either in or close to a Natura 2000 site should be subject to the most rigorous examination.

Protected wild animals and plants are listed in schedules 2 and 4 of the Conservation Regulation (Natural Habitats, &c) 1994 in England. Each schedule has specific provisions to guard against particular threats or activities. Regulations 38-41 of the Conservation Regulation (Natural Habitats, &c) 1994 in Great Britain and Regulation 34 of the Conservation Regulation (Natural Habitats, &c) 1995 for Northern Ireland protect animals listed in Annex IV of the Habitats Directive.

Wild animals of Annex IV(a) species in Great Britain and Northern Ireland are also protected under Section 9 of the Wildlife and Countryside Act 1981 for Great Britain and Article 10 of the Wildlife (Northern Ireland) Order 1985, respectively. Protection is given against intentional killing, injuring or taking of wild animals, possession or control of any live or dead wild animal listed on Schedule 5. Additionally, under the Act, structures or places used by protected wild animals are given protection, and animals occupying such structures or places are protected against disturbance.

The status and distribution of some Annex IV species has been assessed in detail as part of the UK Biodiversity Action Plan (BAP). The Species Action Plans (SAPs) for priority UK species identify targets and actions necessary for the conservation and recovery of flora and fauna. These are linked to Habitat Action Plans that perform the equivalent functions for special habitats of high conservation value.

The statutory conservation agencies must monitor the incidental capture or killing of species where it is feasible or relevant. The report does not elaborate on systems of monitoring except for a brief explanation of the monitoring of cetaceans that are stranded on the UK shorelines or caught as bycatch (such as dolphins or harbour porpoises).

Regulation 41 (Regulation 36 for Northern Ireland), supplemented by Section 11 of the Wildlife and Countryside Act 1981 (for Great Britain) and by Article 12 of the Wildlife (Northern Ireland) Order 1985 prohibit the use of indiscriminate means of capture or killing which are capable of causing local disappearance of, or serious disturbance to, populations of the species listed on Annex IV (a).

All four species were present in the UK MATL region and all, with the exception of Common dolphins which had an unknown overall conservation status, have a favourable conservation status. The UK also had common dolphins and bottlenose dolphins present in the MMED region. The latter had an unfavourable inadequate overall conservation status while the former was not reported. Seventy three SACs were designated in the UK MATL.

5. CONCLUSIONS

5.1. Current Estimates of Abundance and incidental catches

- Recognized methods for estimating absolute abundance of cetaceans include conventional distance sampling (design-based estimates); model-based estimates, partially applying distance sampling; and mark-recapture models. All methods provide managers with a point abundance estimate, with its two confidence limits (usually significant at 95%) and Coefficient of Variation. All methods have limitations.
- The information on cetacean absolute abundance in EU waters is extremely heterogeneous and unsatisfactory from a management perspective despite the best efforts of researchers. Absolute estimates that might be useful to inform management actions, and relating to areas of reasonable size in terms of coverage of the range of such highly mobile species – exist for the North Sea, the Baltic Sea and parts of the north-eastern Atlantic but not for the Mediterranean nor the Black Sea. This remains an obstacle in assessing the true impact of regulatory measures in reducing cetacean bycatch.
- Although none of the global populations of the species considered here is regarded by the IUCN as especially at risk, regional populations of some of these species, notably harbour porpoises and common dolphins are considered as threatened.
- Generally bycatch is estimated as being low in many fisheries observed, although it is difficult to extrapolate to fleet level. Significant bycatch levels, however, have been reported in several fisheries.
- A total of 135 cetaceans consisting of 81 common dolphins (*Dephinus delphis*), 32 harbour porpoises (*Phocoena phocoena*), *9 bottlenose dolphins (Tursiops truncatus)*, *7 striped* dolphins (*Stenella coeruleoalba*), 5 long finned pilot whales (Globicephala melas) and 1 Atlantic white-sided dolphin (*Lagenorhynchus acutus*) have been observed as bycatch in data collected under regulation 812/2004.
- The variety of formats in which data on bycatch have been collected, though, make it difficult to comment on the consistency of the data collected under 812/2004.
- Comparing data collected as part of observer schemes carried out under 812/2004 with other observer schemes is not straight forward as various methods have been employed to aggregate data and data have been aggregated at different levels. In addition data gaps exist in the information compiled under 812/2004 and the bycatch estimates are not comprehensive across all Member States. Some comparisons have nevertheless been attempted and show bycatch continuing in certain fisheries e.g. pelagic trawl fishery for bass.
- Other bycatch data not required under 812/2004 were available for fisheries in the Mediterranean. Notable bycatch events recorded include, 237 striped and common dolphins observed in the Moroccan (IUU) driftnet fishery with an estimated total bycatch of 3647 animals and a bycatch of 68 and 46 harbour porpoises in Turkish fisheries and Romanian set gillnet fisheries in the Black Sea respectively. Small bycatch incidents have also been by Italy reported for bottlenose dolphins in fisheries in the Black Sea and the Mediterranean.

- While not covered by 812/2004, of grave concern are the heavy bycatches of loggerhead turtles reported in a range of fisheries in the Mediterranean.
- There are number of alternative means of assessing the status of cetacean populations including sightings surveys, acoustic monitoring, strandings data. None of these are perfect and caution is urged in using strandings data in particular.
- There is much ongoing work focused on trying to make best use of platform of opportunity data and acoustic means for detecting trends in the relative abundance, but at present, and in contrast to the situation for dedicated abundance surveys, there is still no widely agreed set of tools to address this objective, and little pan European effort to co-ordinate the development of such tools.
- There are several methods that have been used to estimate cetacean bycatch rates in the past including indirect measures such as the use of strandings, interview methods, the use of logbooks or other formal reporting mechanisms, and direct independent observations, which may include observers or remote monitoring through the use of video cameras (electronic monitoring). It is generally thought that those involving independent direct monitoring are the most desirable, and that other methods are less reliable.
- Observer programmes have been the sole measure used to quantify bycatch as part of 812/2004 but given the costs of such programmes other direct monitoring techniques should be considered in the future, particularly remote monitoring using CCTV, which is well suited to monitoring rare events such as cetacean bycatch.
- Besides accidental capture in fishing gears, cetacean populations living in European waters regularly face a number of other human threats, which have the potential to directly and/or indirectly increase their mortality. These are: collisions, noise, physical disturbance, depletion of prey and habitat degradation, including the presence of noxious manmade pollutants in the marine food web. Quantitative estimations of mortality induced by these threats are, however, extremely difficult. Accidental capture in fishing gear remains the greatest source of anthropogenic mortality in EU waters.
- Several criteria for defining permissible thresholds or sustainable take levels of cetaceans are currently in use. These include criteria that have been proposed by the IWC, by ASCOBANS, and a limit used in the USA, the Potential Biological Removal (PBR).
- Estimates for take limits at 1%, 1.7% and 2% and at the PBR level have been generated for a range of species using the SCANS II data. Unfortunately current bycatch estimates are too patchy to allow any comparisons between these potential take limits and any total population level removals.
- Existing estimates of bycatch for the fragmentary set of fisheries that have been monitored would indicate that total bycatches of both porpoises and common dolphins should be a matter for concern for Member States and suggest better coverage of fisheries affecting them is required.
- More sophisticated modeling approaches are also possible in order to estimate the effects of bycatch on cetacean populations. Integrated population dynamics model for assessing the state and dynamics of a small cetacean population subject to bycatch have been developed under the SCANS II and CODA projects. This method has potential but it is important to recognize that bycatch limits estimated by this

modeling approach are entirely dependent on the stated conservation objective, which is not sufficiently identified under either the Habitats Directive or Regulation 812/2004.

5.2. Assessment of 812/2004

- A number of issues still remain over the format of data being collected by Member States leading to difficulties in analyzing the data collected, level of monitoring including a lack of funding in some cases, reporting format and the recording of bycatch of other species including seals, seabirds, turtles and elasmobranches. ICES have made a number of recommendations to this affect.
- The recommendations made by ICES have helped to highlight some of the problems with the regulation although it is noted that the EU have taken board a number of them both from ICES and the 2009 Commission workshop. This is seen as positive and should be acknowledged.
- Regulation 812/2004 has been in place for 6 years, yet it is not possible to make any reliable assessment on its impact on the status of cetacean populations, nor on incidental catch rates.
- A limited number of vessels are using ADDs in Ireland, UK and Denmark. It is likely that the use of pingers by these vessels has reduced the total number of incidental deaths of harbour over the past few years.
- Even if an abundance survey of cetaceans had been conducted in 2009 it is very doubtful that it would have had the statistical power to detect any change based on the likely level of reduced incidental catch that might have resulted from regulation 812/2004, even if it had been fully implemented.
- Excluding one, all relevant EU member states have provided at least one annual report. Eleven Member States have provided observer data in at least one annual report and eight have provided observer data for at least two years. The quality and content of these reports, however, remains inconsistent, making analysis difficult.
- To some extent this has been addressed recently by the provision of a new reporting format by the EU.
- The total number of observer days carried out to date by all Member States in relation to 812/2004 is 9,530. Based on the average cost per day across Member States, roughly €6million has been spent on observer coverage for a reported bycatch of 135 cetaceans. However, the cost per animal does not reflect the total value of these schemes. Many marine mammal bycatch monitoring trips are integrated with other observer scheme duties (including obligations under the DCF), and observations of trips without bycatch are also valuable to establish likely maximum bycatch rates, which maybe negligible but which certification schemes, for example, may wish to have confirmed.
- The monitoring target of a precise bycatch estimate with a CV of 0.3 has not been very effective in managing cetacean bycatch in Europe, and this target could well be rethought.
- A more general approach whereby Member States would be required to demonstrate their fisheries were not exceeding some agreed level of cetacean bycatch would be a more appropriate way of ensuring sufficient sampling to address the management

question without overburdening Member States with excessive monitoring requirements.

- The existing technical measure contained in 812/2004 i.e. the use of ADDs will reduce but not eliminate bycatch. Expectations for mitigation measures must be realistic and should aim to reduce bycatch to levels that are very unlikely to represent a conservation threat.
- Currently ADDs provide the most simple and effective solution although so far they are only proven for a reduction of harbour porpoise bycatch in set net fisheries. Numerous trials have shown that pingers of several types can reduce porpoise bycatch by around 90%.
- ADDs are expensive, where many are required (e.g. for set net fisheries), require periodic maintenance to check and replace batteries, can interfere with net setting and hauling and can be unreliable. A combination of these factors has resulted in sporadic uptake by fishermen in spite of legal requirements. There is quite a negative perception about these devices amongst fishermen around Europe, which remains a problem. Further technical work is required to make these devices more robust and easier to check that they are functioning correctly.
- Research has demonstrated a higher effective spacing for specific ADD models than currently permitted under 812/2004 and there are grounds for revising the current provisions to allow the use of specific ADD devices at a greater spacing. The advantages of using a higher spacing and therefore fewer ADDs include reductions in pollution from lost or damaged pingers, noise pollution and associated potential porpoise habitat exclusion, and lower cost and less handling for fishermen.
- The effectiveness of ADDs deployed on bottom set gillnets is well established for harbour porpoises.
- The effect of ADDs on other species such as common dolphins is less clear. Significant reductions in bycatch of common dolphins in a pelagic trawl fishery using ADDs have been observed even though the same devices failed to elicit any evasive behaviour in direct playback experiments.
- It is clear that acoustic signals should be tested on each odontocete species for which they are intended to reduce bycatch.
- The collateral effects of pingers, particularly habituation and habitat exclusion are unproven and it seems reasonable to assume that the proven efficacy of pingers at reducing harbour porpoise bycatch currently outweighs any potential negative collateral effects.
- In general the battery life of commercially available pingers does, when they work properly, meet manufacturer specifications.
- Annual costs of deploying ADDs vary considerably in relation to the technology employed in the devices and the rate of loss in specific fisheries. The costs are not considered to be insignificant for gillnet fisheries and these costs combined with poor reliability and negative impacts on fishing operations have discouraged uptake of ADDs and compliance with the regulations. Several countries have, however, instigated grant aid schemes or provided fishermen with pingers free of charge. This has helped but is not uniform across Member States.
- Several Member States have raised legitimate concerns regarding the safety of ADDs including chemical leakage from batteries and entanglement in gear. Most of

these can be overcome, however, through improved design, better quality control at supplier level and also through small changes to operational practice on board vessels.

- Based on assessments carried out in Ireland, UK, France, Sweden and Denmark it has been shown that ADDs do create some handling difficulties for fishermen. In particular issues with devices becoming entangled in nets and also preventing specialized flaking machines from removing twists in gears have been observed. A number of potential solutions to help reduce the impacts of ADDs have been suggested that largely eliminate these problems.
- No alternative technical mitigation measures to ADDs currently exist that are fully proven although the results from trials with stiff gillnets in Denmark and Canada may be cause for optimism. Such chemically enhanced nets are currently expensive because they are not routinely produced and need to be specially sourced and constructed in the Far East.
- Fish losses through excluder devices or net barriers have been shown to be sizeable in some trials. Exclusion devices can also be difficult to install, maintain and handle in large pelagic trawls, and trials have so far been only partially successful.
- Time and area closures can reduce the incidental mortality of cetaceans where catch events are predictable and relatively restricted in time and space but such circumstances in practice are rare making their use limited.

5.3. Assessment of the Outcome of the Habitats Directive

- Analysis of an EU database that contains all information supplied by Member States under Article 17 reveals that Member States reported on the status of 31 species of cetacean in EU waters. Ideally this would be a useful tool with which to examine the status of the different European cetacean species, but in reality the information provided by Member States reporting under Article 17 is confused and contradictory.
- The standard format of the reports produced by Member States includes an evaluation of threats and pressures faced by marine mammal species. Pressures were identified as known adverse factors currently affecting the status of the species while identified threats were the more ephemeral/potential future impacts on the population. Little guidance was provided, however, on this and treatment between Member States may not have been uniform, judging from the information reported. Many inconsistencies were observed in the database; sufficient that any analysis would be likely to give spurious results.
- ICES SGBYC recommended that this draft database could not be used for a reliable analysis of the main threats or pressures on marine mammals in European waters. Should such an analysis be required, it seems likely that a first step should be to issue some consistent guidance on completion of the reports by Member States that have been used in compiling the database.
- It is clear that a more coordinated and perhaps regional approach to the assessment of cetacean conservation status is required under this Directive if a reliable and useful indicator is to be established in future otherwise the information provided will continue to be of limited value.
- The Habitats Directive – in common with all EU Directives, sets out objectives, which Member States are then expected to address through the implementation of national

legislation. Under Article 17, every six years Member States are required to report on the implementation of measures taken under the Directive and in particular should report on the conservation measures referred to in Article 6 and the main results of the surveillance referred to in Article 11. But there is no explicit requirement to report on Article 12, which requires member states to monitor incidental catches. Article 3 of the Directive also calls for the establishment of special areas of conservation to be established to protect all listed species including, among the cetaceans, harbour porpoises and bottlenose dolphins.

- From a policy perspective, the Habitats Directive provides broad objectives, but without specific requirements Article 12 of the Directive (which requires monitoring to ensure that incidental capture and killing does not have a significant negative impact on the species concerned) had not been implemented by any member state by 2004. Regulation 812/2004 can therefore be seen as a means to enforce Article 12 and to generate reports on monitoring activities that should be conducted under Article 12 of the Habitats Directive
- By 2006 no Member State had established an SAC for either of the two listed cetacean species. Common dolphins (and other potentially vulnerable cetacean species) are not listed in Annex II of the Directive. But the establishment of SACs for harbour porpoises and bottlenose dolphins are unlikely to help in minimising bycatch, as bycatch is usually widespread and unpredictable with regard to area.
- Some regulatory action is needed to ensure other marine species listed in Annex IV of the Directive are also subject to monitoring as required under Article 12.
- The Habitats Directive is focused on areas based management, yet in most cases this is unlikely to be an effective means of addressing conservation issues for cetaceans, most of which range over very large areas and are subject to wide-ranging bycatch. The obligation to monitor incidental catch under the Habitats Directive (Article 12.4) is widely ignored in favour of establishing ‘protected areas’ that are unlikely to be able to address conservation goals.

6. RECOMMENDATIONS

1. Estimates of cetacean abundance are inadequate for the Mediterranean and the Black Sea. This makes bycatch assessment impossible for that region. A basin wide survey for cetacean abundance in this region is long overdue and should be funded.

2. Better co-ordination is required among Member States at a scientific level in agreeing on cetacean population status, conservation goals and bycatch limits: this is an area in which the Commission should take a lead, although there is much work to be done to elaborate how for example, appropriate bycatch limits might be set.

3. The observations made so far under Regulation 812 are a patchwork of relevant and irrelevant monitoring. Greater flexibility and co-ordination is required in allocating monitoring effort, but the onus should be with member states to demonstrate low impact (results based monitoring) with a high degree of certainty. Lower certainty should be translated into more precautionary management measures.

4. Bycatch mitigation should be an integral part of the fisheries management system – that is in determining effort or quota allocation or technical measures among fleets.

5. Quantifying bycatch needs to be done by independent monitoring either using observers or electronically (e.g. video surveillance), but to ensure value for money and rational ecosystem management, it should be an integrated element of a wider ecosystem and fisheries monitoring of all non-target species

6. Better co-operation or EU level supervision of bycatch monitoring, bycatch assessment and development of bycatch mitigation strategies is required

7. Acoustic deterrence, though in several ways not ideal, is the only technical measure that is known to work in reducing cetacean bycatch in EU fisheries. It is preferable to the imposition of closed areas or times, yet the tools available are less than adequate. Development of more robust and operationally manageable devices should be a priority. Alternative measures should also be sought through co-ordinated research.

8. There needs to be stronger linkage among Member States activities between addressing obligations under the Habitats Directive and actions undertaken in fulfilment of regulation 812/2004.

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ANNEX I. ABUNDANCE ESTIMATES FOR CETACEAN SPECIES WITHIN EUROPEAN WATERS

NORTH, CELTIC & BALTIC SEAS	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Habour porpoise (*Phocoena phocoena*)									
	IIIa, b, c; IVa, b, c; VI a; VII d, e, g, j, h	~1,040,00	In- & Off-shore	1994	341,366	0.14	260,000-449,000	Conventional Distance Sampling	Hammond *et al*. 2002
	VIIe,g,j,h	201,490	In- & Off-shore	1994	36,280	0.57	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	43,744	In-shore	1994	16,939	0.18	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa, , VIa	102,277	In- & Off-shore	1994	37,144	0.25	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa	109,026	In- & Off-shore	1994	31,419	0.49	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa, IVb	118,985	In- & Off-shore	1994	92,340	0.25	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	113,741	Off-shore	1994	38,616	0.34	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	45,515	In- & Off-shore	1994	4,211	0.29	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa,c	49,485	In- & Off-shore	1994	36,046	0.34	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIc	8,170	In- & Off-shore	1994	5,262	0.25	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa	31,059	In- & Off-shore	1994	24,335	0.34	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb	18,176	In- & Off-shore	1994	11,870	0.47	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb	12,612	In- & Off-shore	1994	5,666	0.27	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb	5,810	In- & Off-shore	1994	588	0.48	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb	7,278	In- & Off-shore	1994	5,912	0.27	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb	NA	In- & Off-shore	1995	4,288	NA	1,500-7,800	Conventional Distance Sampling	Siebert *et al*. 2006
	IIIc	NA	In-shore	1995	980	NA	360-2,880	Conventional Distance Sampling	Siebert *et al*. 2006

NORTH, CELTIC & BALTIC SEAS	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Habour porpoise (*Phocoena phocoena*)									
	IIId	NA	In- & Off-shore	1995	601	NA	233-2,684	Conventional Distance Sampling	Siebert *et al*. 2006
	IVb	NA	In- & Off-shore	1996	7,356	NA	5,040-12,600	Conventional Distance Sampling	Siebert *et al*. 2006
	IIIc	NA	In-shore	1996	1,830	NA	960-3,840	Conventional Distance Sampling	Siebert *et al*. 2006
	IXa,VIIIa,b,c,d; VIIa,b,c,d,e,g,h,j,k; VIa; IVa,b,c; IIa, IIIa,b,c	1,011,000	In- & Off-shore	2005	344,400	0.14	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IVb,c	NA	In- & Off-shore	2005	80,000	0.34	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IIIa,b,c	NA	In- & Off-shore	2005	21,400	0.42	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	VIIg,h,j,k	NA	In- & Off-shore	2005	58,400	0.43	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IIIa	NA	In- & Off-shore	2005	38,900	0.30	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IIa	NA	In- & Off-shore	2005	25,300	0.46	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	VIIc,b,a	NA	In- & Off-shore	2005	7,800	1.12	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IXa; VIIIc,d	NA	In- & Off-shore	2005	2,900	0.65	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	VIIe,d; IVc	NA	In- & Off-shore	2005	40,900	0.38	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IVb,c	NA	In- & Off-shore	2005	3,900	0.45	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IVa	NA	In- & Off-shore	2005	10,300	0.36	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IIIa	NA	In- & Off-shore	2005	11,600	0.56	NA	Conventional Distance Sampling	Hammond&Macleod 2006

NORTH, CELTIC & BALTIC SEAS	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Habour porpoise (*Phocoena phocoena*)									
	IVa	NA	In- & Off-shore	2005	3,900	0.31	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IVa	NA	In- & Off-shore	2005	12,100	0.39	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	VIIa	NA	In- & Off-shore	2005	15,200	0.34	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	VIIb,g,j	NA	In- & Off-shore	2005	10,700	0.28	NA	Conventional Distance Sampling	Hammond&Macleod 2006
	IVb	NA	In- & Off-shore	2005	1,500	0.13	NA	Conventional Distance Sampling	Hammond&Macleod 2006
Bottlenose dolphin (*Tursiops truncatus*)									
	IVa	~1,000	In-shore	1992	129	0.12	110-174	Mar-Recapture (closed pop)	Wilson *et al*. 1999
	IIIa; IVa,b,c; VIb,d,e,g,j; VIIa,e,d; VIIIa,b	1,011,000	In- & Off-shore	2005	1,970	0.45	712-5,460	Conventional Distance Sampling	Hammond & Macleod 2006
Shortbeaked common dolphin (*Delphinus delphis*)									
	IIIa, b, c; IVa, b, c; VI a; VII d, e, g, j, h	~1,040,00	In- & Off-shore	1994	75,450	0.67	23,000-149,000	Conventional Distance Sampling	Hammond *et al*. 2002
	VIIe	4,129	In- & Off-shore	2004, 2005	3,005	0.39	1,425-6,544	Conventional Distance Sampling	de Boer *et al*. 2008
	IIIa; IVa,b,c; VIb,d,e,g,j; VIIa,e,d; VIIIa,b	1,011,000	In- & Off-shore	2005	32,800	0.82	8,060-133,000	Conventional Distance Sampling	Hammond & Macleod 2006
Striped dolphin (Stenella coerulealba)									
	IIIa; IVa,b,c; VIb,d,e,g,j; VIIa,e,d; VIIIa,b	1,011,000	In- & Off-shore	2005	157	1.30	22-1,100	Conventional Distance Sampling	Hammond&Macleod 2006

NORTH, CELTIC & BALTIC SEAS	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Whitebeaked dolphin (Lagenorhynchus albirostris)									
	IIIa, b, c; IVa, b, c; VI a; VII d, e, g, j, h	~1,040,00	In- & Off-shore	1994	7,856	0.30	4,000-13,000	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	43,744	In In-shore	1994	2,351	0.52	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa, , VIa	102,277	In- & Off-shore	1994	1,157	0.56	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa	109,026	In- & Off-shore	1994	115	1.09	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa, IVb	118,985	In- & Off-shore	1994	1,790	0.42	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	113,741	Off-shore	1994	2,443	0.54	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa; IVa,b,c; VIb,d,e,g,j; VIIa,e,d; VIIIa,b	1,011,000	In- & Off-shore	2005	10,800	0.83	2,590-44,600	Conventional Distance Sampling	Hammond & Macleod 2006
Minke whale (Balaenoptera acutorostrata)									
	IIIa, b, c; IVa, b, c; VI a; VII d, e, g, j, h	~1,040,00	In- & Off-shore	1994	8,445	0.24	5,000-13,500	Conventional Distance Sampling	Hammond *et al*. 2002
	VIIe,g,j,h	201,490	In- & Off-shore	1994	1,195	0.49	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVb,c	43,744	In-shore	1994	1,073	0.42	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa, , VIa	102,277	In- & Off-shore	1994	2,920	0.40	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IVa	109,026	In- & Off-shore	1994	853	0.37	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa, IVb	118,985	In- & Off-shore	1994	1,354	0.36	NA	Conventional Distance Sampling	Hammond *et al*. 2002

NORTH, CELTIC & BALTIC SEAS	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Minke whale (Balaenoptera acutorostrata)									
	IVb,c	113,741	Off-shore	1994	1,001	0.70	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIIa,c	49,485	In- & Off-shore	1994	49	0.87	NA	Conventional Distance Sampling	Hammond *et al*. 2002
	IIa, IVa, Va, Vb1,b2, VIa,b	NA	Off-shore	2001	4,078	0.41	1,775-9,476	Conventional Distance Sampling	Gunnlaugsson *et al.* 2003
	IXa,VIIIa,b,c,d; VIIa,b,c,d,e,g,h, j,k; VIa; IVa,b,c; IIa, IIIa,b,c	1,011,000	In- & Off-shore	2005	16,600	0.43	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	IIIa	NA	In- & Off-shore	2005	4,400	0.7	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	VIIc,b,a; IVa	NA	In- & Off-shore	2005	1,900	0.7	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	IVb,c	NA	In- & Off-shore	2005	3,500	1.9	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	IIa; IVa	NA	In- & Off-shore	2005	1,700	0.45	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	VIIg,h,j,k	NA	In- & Off-shore	2005	1,700	0.33	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	VIIe,d; IVc	NA	In- & Off-shore	2005	1,200	0.96	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	IVa	NA	In- & Off-shore	2005	800	1.02	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	VIIa	NA	In- & Off-shore	2005	1,100	0.89	NA	Conventional Distance Sampling	Hammond & Macleod 2006
	VIIb,g,j; VIa	NA	In- & Off-shore	2005	2,200	0.84	NA	Conventional Distance Sampling	Hammond & Macleod 2006

NORTH – EASTERN ATLANTIC	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Fin whale (Balaenoptera physalus)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	7,624	0.21	5,028-11,563	Mark-Recapture Distance Sampling	Anonymous 2009
					9,019	0.11	7,265-11,197	Model Based Distance Sampling	Anonymous 2009
Sei whale (Balaenoptera boerealis)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	366	0.33	176-762	Mark-Recapture Distance Sampling	Anonymous 2009
								Model Based Distance Sampling	Anonymous 2009
Sperm whale (Physeter macrocephalus)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	2,091	0.34	1,007-4,057	Mark-Recapture Distance Sampling	Anonymous 2009
					2,077	0.20	1,404-3,073	Model Based Distance Sampling	Anonymous 2009
Minke whale (Balaenoptera acutorostrata)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	6,765	0.99	1,239-36,925	Conventional Distance Sampling	Anonymous 2009
Bottlenose dolphin (*Tursiops truncatus*)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore		19,295	0.25	11,842 – 31,440	Conventional Distance Sampling	Anonymous 2009
Striped dolphin *(Stenella coeruleoalba)*									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	61,364	0.93	12,323-305,568	Mark-Recapture Distance Sampling	Anonymous 2009
					67,414	0.38	32,543-139,653	Model Based Distance Sampling	Anonymous 2009

NORTH –EASTERN ATLANTIC	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Common dolphin (*Delphinus delphis*)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	118,264	0.38	56,915-246,740	Mark-Recapture Distance Sampling	Anonymous 2009
					116,709	0.34	61,397-221,849	Model Based Distance Sampling	Anonymous 2009
Long-finned pilot whale (*Globicephala melas*)									
	VIa,b VIIc,k,j VIIIc,d,e IXa,b	967,538	Off-shore	2007	25,201	0.33	13,251-47,550	MRDS	Anonymous 2009
					25,338	0.35	12,912-49,725	Model Based Distance Sampling	Anonymous 2009
WESTERN MEDITERRANEAN SEA	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Bottlenose dolphin (*Tursiops truncatus*)									
Alboran sea (Spain)	GSA 1	11,821	in- & off-shore	2000-3	584	0.28	278 – 744	Distance sampling and GAMs	Cañadas & Hammond 2006
Almeria (Spain)	GSA 1	4,232	In- & off-shore	2001-3	279	0.28	146 – 461	Distance sampling and GAMs	Cañadas & Hammond 2006
Asinara island National Park (Italy)	GSA 11	480	Inshore	2001	22	0.26	22 – 27	Mark-recapture (closed pop)	Mackelworth *et al*. 2002
Central Spanish Mediterranean sea	GSA 6	32,270	in- & off-shore	2001 - 03	1,333	0.31	739 – 2,407	Conventional Distance Sampling	Gomez de Segura *et al.* 2006
Balearic Islands and Catalonia (Spain)	GSA 5 & 6	86,000	in- & off-shore	2002	7,654	0.47	1,608 - 15,766	Conventional Distance Sampling	Forcada *et al.* 2004
Valencia (Spain)	GSA 6	32,270	in- & off-shore	2001-3	1,333	0.31	739 - 2,407	Conventional Distance Sampling	Gomez de Segura *et al.* 2006
Striped dolphin *(Stenella coeruleoalba)*									
Western Mediterranean (Tyrrhenian Sea excluded)	GSA 1 to 9, GSA 11	889,400	in- & off-shore	1991	117,880	0.22	68,379 - 214,800	Conventional Distance Sampling	Forcada *et al* 1994
Corso-Ligurian basin	GSA 8, 9, 11	58,269	in- & off-shore	1992	25,614	0.25	15,377 - 42,658	Conventional Distance Sampling	Forcada *et al* 1995
Pelagos Sanctuary (Corso-Ligurian basin)	GSA 8, 9, 11	58,000	in- & off-shore	2008	13,232	0.36	6,640-26,368	Conventional Distance Sampling	Lauriano et al in press

WESTERN MEDITERRANEAN SEA	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Striped dolphin *(Stenella coeruleoalba)*									
Balearic Sea (1)	GSA 5, 6	64,733	in- & off-shore	1991-92	5,826	0.36	2,193 - 15,476	Conventional Distance Sampling	Forcada & Hammond 1998
Provencal basin (2)	GSA 6 to 8, 11	133,800	in- & off-shore	1991-92	30,774	0.36	17,433 - 54,323	Conventional Distance Sampling	Forcada & Hammond 1998
Ligurian Sea (3)	GSA 8, 9	46,677	in- & off-shore	1991-92	14,003	0.35	6,305 - 31,101	Conventional Distance Sampling	Forcada & Hammond 1998
Liguro-Provencal basin (2+3)	GSA 6 to 9, 11	177,517	in- & off-shore	1991-92	42,604	0.26	24,962 - 72,716	Conventional Distance Sampling	Forcada & Hammond 1998
North-western Mediterranean (1+2+3)	GSA 5 to 9, 11	240,490	in- & off-shore	1991-92	48,098	0.24	29,388 - 78,721	Conventional Distance Sampling	Forcada & Hammond 1998
Alboran Sea (4)	GSA 1 to 4	88,640	in- & off-shore	1991-92	17,728	0.33	9,507 - 33,059	Conventional Distance Sampling	Forcada & Hammond 1998
Central Spanish Mediterranean sea	GSA 6	32,270	in- & off-shore	2001 - 03	15,778	0.19	10,940 – 22,756	Conventional Distance Sampling	Gomez de Segura et al 2006
South Balearic area (5)	GSA 4 to 6, 11	235,125	in- & off-shore	1991-92	18,810	0.34	8,825 - 35,940	Conventional Distance Sampling	Forcada & Hammond 1998
South-western Mediterranean (4+5)	GSA 1 to 6, 11	333,025	in- & off-shore	1991-92	39,963	0.38	18,206 - 87,721	Conventional Distance Sampling	Forcada & Hammond 1998
Aeolian Islands (Italy)	GSA 10	13,200	in- & off-shore	2002 - 03	4,030	0.30	2,239 – 7,253	Conventional Distance Sampling	Fortuna et al 2007
Common dolphin (*Delphinus delphis*)									
Alboran Sea	GSA 1 to 4	92,100	in- & off-shore	1991-92	14,736	0.40	6,923 – 31,366	Conventional Distance Sampling	Forcada & Hammond 1998
Alboran Sea	GSA 1	19,189	in- & off-shore	1992-2004	19,428	0.11	15,277 – 22,804	Distance sampling and GAMs	Cañadas & Hammond 2008
Risso's dolphin (*Grampus griseus*)									
Central Spanish Mediterranean sea	GSA 6	32,270	in- & off-shore	2001 - 03	493	0.61	162 – 1,498	Conventional Distance Sampling	Gomez de Segura *et al* 2006
Long-finned pilot whale (*Globicephala melas*)									
Strait of Gibraltar	IXb	NA	in-shore	2005	83*	0.11	71-107	Mark-Recapture, only well-marked animals (36% of the total)	Verborgh *et al* 2009
Fin whale *(Balaenoptera physalus)*									
Western Mediterranean	GSA 5, 6, 8, 9, 11	-	in- & off-shore	1991	3,583	0.27	2,130-6,027	Conventional Distance Sampling	Forcada *et al.* 1996

WESTERN MEDITERRANEAN SEA	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Fin whale *(Balaenoptera physalus)*									
Corso-Ligurian waters	GSA 8, 9, 11	58,269	in- & off-shore	1992	901	0.22	591 - 1,374	Conventional Distance Sampling	Forcada *et al.* 1995
EASTERN MEDITERRANEAN SEA	Fishing area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Sperm whale *(Physeter macrocephalus)*									
Ionian sea (Italy & Greece)	GSA 19, 20	271,000	in- & off-shore	2003	62	0.11	25 - 165	Conventional Distance Sampling	Lewis *et al*. 2007
Bottlenose dolphin (*Tursiops truncatus*)									
Tunisian waters	GSA 13, 14	~ 750	inshore	2001 & 2003	3,977	0.34	1,982 - 7,584	Conventional Distance Sampling	Ben Naceur *et al.* 2004
North-eastern Adriatic sea (Slovenia, Croatia)	GSA 17	1,000	inshore	2005	68	0.18	62-81	Mark-recapture (closed pop)	Genov *et al*. 2008
North-eastern Adriatic sea (Kvarnerić, Croatia)	GSA 17	1,000	inshore	1997	113	0.06	107-121	Mark-recapture (closed pop)	Fortuna *et al.* 2000
North-eastern Adriatic sea (Kvarnerić, Croatia)	GSA 17	2,000	inshore	2001-2	128	0.12	106 – 158	Mark-recapture (open pop)	Wiemann *et al.* 2003
Amvrakikos Gulf (Greece)	GSA 20	400	inshore	2005	148	-	132–180	Mark-recapture (closed pop)	Bearzi *et al.* 2008
TURKISH STRAIT SYSTEM	GFCM area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Bottlenose dolphin (*Tursiops truncatus*)									
Turkish Strait	GSA 28	~ 100	inshore	1997	485	-	203 – 1,197	Conventional Distance Sampling	Dede (1999), cited after IWC (2004)
Turkish Strait	GSA 28	~ 100	inshore	1998	468	-	184 – 1,186	Conventional Distance Sampling	Dede (1999), cited after IWC (2004)
Common dolphin (*Delphinus delphis*)									
Turkish Strait	GSA 28	~ 100	inshore	1997	773	-	292 – 2,059	Conventional Distance Sampling	Dede (1999), cited after IWC (2004)
Turkish Strait	GSA 28	~ 100	inshore	1998	994	-	390 – 2,531	Conventional Distance Sampling	Dede (1999), cited after IWC (2004)

BLACK SEA	GFCM area code	Study area (km^2)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Bottlenose dolphin (*Tursiops truncatus*)									
Kerch Strait	GSA 29	890	Inshore	2001	76	-	30 – 192	Conventional Distance Sampling	Birkun *et al.* 2002
Kerch Strait	GSA 29	890	Inshore	2002	88	-	31 – 243	Conventional Distance Sampling	Birkun *et al.* 2003
Kerch Strait	GSA 29	862	Inshore	2003	127	-	67 – 238	Conventional Distance Sampling	Birkun *et al.* 2004
NE shelf area of the Black sea	GSA 29	7,960	Inshore	2002	823	-	329 – 2,057	Conventional Distance Sampling	Birkun *et al.* 2003
Northern and NE shelf area of the Black sea	GSA 29	31,780	Inshore	2002	4,193	-	2,527 – 6,956	Conventional Distance Sampling	Birkun *et al.* 2004
Harbour porpoise (*Phocoena phocoena*)									
Azov sea	GSA 30	40,280	Inshore	2001	2,922	-	1,333 – 6,403	Conventional Distance Sampling	Birkun *et al.* 2002
Southern Azov sea	GSA 30	7,560	Inshore	2001	936	-	436 – 2,009	Conventional Distance Sampling	Birkun *et al.* 2002

Source : Author

ANNEX II. TABLE OF ALL SGBYC BYCATCH DATA 2005 – 2008

(OBSERVED EFFORT DAYS OBSERVED >0)

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
DK	>15	Pelagic Trawls		MAC,HER SPR	Yes	2007	1196	44	IIIa	1-12	5	4		0		0
DK	>15	Pelagic Trawls		MAC,HER SPR	Yes	2007	2105	142	IVb	1-12	5	7		0		0
DK	>15	Pelagic Trawls		MAC,HER SPR	Yes	2007	1277	87		1-12	5	7		0		0
DK	<15	Nets	GNS	COD, PLE, HKE		2008	37	37	IIIa	9-12			Phoca vitulina	1	camera	
DK	<15	Nets	GNS	COD, PLE, HKE		2008	37	37	IIIa	9-12			Harbour Porpoise	1	camera	
DK	>15	Pelagic Trawls		MAC,HER SPR	Yes	2008	649	73	IIIbcd	1-2	5	11		0		
DK	>15	Pelagic Trawls		MAC,HER SPR	Yes	2008	358	9	IIIa	1-2	5	3		0		
EE	>15	Pelagic Trawls	OTM/ PTM	HER, SPR		2006	1009	8	III d	1-12	5		0		pilot	
EE		Nets	GNS	COD, FLE, WHG	Yes	2008		13	IIIb,c,d	1-12				0		
FL	>15	Pelagic Trawls	OTM/ PTM	HER, SPR		2006	275	25	III d	7-12	5		0		pilot	
FL		Pelagic Trawls		SPR		2007	560	1	III d south	1-12	5	5		0		0
FL		Pelagic Trawls		HER, SPR		2007	810	42	III d North	6-9	5	5		0		0
FR	<15	Nets	GNS	SOLE, BASS, HKE		2006	28800	30		1-12			0	0	pilot	0
FR	>15	Nets	GNS	SOLE, BASS, HAKE		2006	10640	61		1-12			0	0	pilot	0
FR	>15	Pelagic Trawls	OTM/ PTM	BASS, SCAD, MAC, HER, PIL		2006	8390	276		1-12			Common dolphin	4	pilot	57
FR		Nets	GNS	SOLE		2007	10668	154		1-12	5	1	Harbour Porpoise	1		100
FR		Nets	GNS	SOLE, ANF, POL,		2007	27552	213		1-12	1	1	Harbour Porpoise	8	pilot	500

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
				MUT												
FR		Pelagic Trawls	OTM	MAC, JAX, PIL, SPR, HER		2007	280	2		1-12	5	0		0	pilot	0
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2007	4605	341		4-11	5	7	Long-finned Pilot whale	1		13
FR		Pelagic Trawls	PTM	BASS		2007	1745	170		1-3, 12	10	10	Common Dolphin	13		226
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2007	4605	341		4-11	5	7	Common Dolphin	1		13
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2007	4605	341		4-11	5	7	Bottlenose Dolphin	4		54
FR		Pelagic Trawls	PTM	MAC,JAX, PIL,SPR, HER		2007	740	30		4-11	5	4		0	pilot	0
FR		Pelagic Trawls	PTM	MAC,JAX, PIL,SPR, HER		2007	1480	34		4-11	5	5		0		0
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2007	4605	341		4-11	5	7	Striped Dolphin	3		40
FR		Nets	GNS	SOLE, ANF, POL, MUT		2008	13120	265		1-12	1	2	Harbour Porpoise	2	2	100
FR		Nets	GNS	SOLE, ANF, POL, MUT		2008	13120	265		1-12	1	2	Striped Dolphin	1	2	50
FR		Nets	GNS	SOLE, ANF, POL, MUT		2008	13120	265		1-12	1	2	Common Dolphin	2	2	100
FR		Nets	GNS	Sole		2008	10668	210		1-12	5	2	Harbour Porpoise	5	1	250
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2008	7079	238		4-11	5	3.4	Common Dolphin	5	1	120

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
FR		Pelagic Trawls	PTM	Bass		2008	3017	196		1-3, 12	10	9.3	Common Dolphin	19	1	300
FR		Pelagic Trawls	PTM	ANC,PIL	Yes	2008	6000	194		1-12	5	3	Striped Dolphin	2	1	70
FR		Pelagic Trawls	PTM	ANC,PIL	Yes	2008	6000	194		1-12	5	3	Bottlenose Dolphin	1	1	35
FR		Pelagic Trawls	PTM	ALB, MAC, SBX, JAX, BASS		2008	7079	238		4-11	5	3.4	Long-finned Pilot whale	4	1	90
IE	<15	Nets	GNS	COD,HKE, TUR, CRW	No	2005	83	15	VIIg	7-9	0		Harbour Porpoise	1		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2005	160	15	VIIg	1-3	0		Harbour Porpoise	2		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2005	260	48	VIIg	4-6	0		Harbour Porpoise	2		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2005	399	1	VIa	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2005	7	7	VIIk	7-9	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2005	48	14	VIIj	7-9	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2005	518	12	VIIb	1-3	10			0		
IE	<15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	172	3	VIIg	1-3	0			0		
IE	<15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	216	3	VIIg	4-6	0			0		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	76	14	VIIg	10-12	0		Common Dolphin	2		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	87	31	VIIg	7-9	0		Common Dolphin	1		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	87	31	VIIg	7-9	0		Harbour Porpoise	1		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	76	14	VIIg	10-12	0		Harbour Porpoise	2		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2006	76	14	VIIg	10-12	0		Striped Dolphin	1		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2006	58	16	VIIa	10 -12	10		Common Dolphin	4		

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2006	560	24	VIa	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2006	11	11	VIIj	7-9	10			0		
IE	>15	Nets	GNS	COD,HKE, TUR, CRW	No	2007	163	10	VIIg	4-6	0			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	14	11	VIa	4-6	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	321	11	VIIj	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	270	10	VIIb	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	117	2	VIIj	10 -12	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	39	1	VIIa	10 -12	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	587	3	VIa	10 -12	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2007	4	7	VIIg	4-6	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	372	2	VIa	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	10	10	VIIb	7-9	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	22	4	VIa	7-9	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	172	3	VIIj	7-9	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	115	4	VIIc	1-3	10			0		
IE	>15	Pelagic		MAC,HER,	Yes	2008	3	1	VIIa	1-3	10			0		

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
		Trawls		WHB,JAX, ALB												
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	144	12	VIIg	10 -12	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	579	13	VIa	10 -12	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	297	2	VIIb	1-3	10			0		
IE	>15	Pelagic Trawls		MAC,HER, WHB,JAX, ALB	Yes	2008	67	8	VIa	4-6	10			0		
IT	>15	Pelagic Trawls	PTM	ANC(~ 70%), PIL (20%)	Yes	2006	22636	243	GSA 17	1-7, 9-12	CV <30%		Logger-head Turtle	26		
IT	>15	Pelagic Trawls	PTM	ANC(~ 70%), PIL (20%)	Yes	2007	7961	199	GSA 17	1-7, 9-12	CV <30%	2	cetaceans	0		0
IT	>15	Pelagic Trawls	PTM	ANC(~ 70%), PIL (20%)	Yes	2008	10861	409	GSA 17	1-7, 9-12	CV <30%	3	Logger-head Turtle	39		427
IT	>15	Pelagic Trawls	PTM	ANC(~ 70%), PIL (20%)	Yes	2008	10861	409	GSA 17	1-7, 9-12	CV <30%	3	Bottlenose dolphins	3		24
LV	>15	Nets	GNS	COD		2006		222	III d	1-12	5		0		pilot	
LV	>15	Pelagic Trawls	OTM/ PTM	HER,SPR		2006		641	III d	1-12	5		0		pilot	
NL	>15	Pelagic Trawls		JAX,WHB		2004/ 2005	834	98		1-3, 12	10		Common dolphin	3	pilot	
NL	>15	Pelagic Trawls		JAX,WHB		2006	685	87		1-3, 12	10		Whitesided dolphin	1	pilot	
NL		Pelagic Trawls				2007	89	10	IVb	4-11	5	11		0		0
NL		Pelagic Trawls				2007	146	41	IIa	4-11	5	28		0		0
NL		Pelagic Trawls				2007	383	67	IVa	5-11	5	17		0		0
NL		Pelagic Trawls				2007	0	1	VIb	4-11	5	0		0		0
NL		Pelagic Trawls				2007	270	34	VIa	4-11	5	13		0		0
NL		Pelagic				2007	99	5	VIIb	4-11	5	5		0		0

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
		Trawls														
NL	>15	Pelagic Trawls		JAX,WHB		2007	13	5	VIIe	1-3, 12	10	38		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	3	2	VIIh	1-3, 12	10	67		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	29	3	VIb	1-3, 12	10	10		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	81	11	VIId	1-3, 12	10	14		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	46	8	VIIb	1-3, 12	10	17		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	153	13	VIa	1-3, 12	10	9		0		0
NL	>15	Pelagic Trawls		JAX,WHB		2007	78	4	VIIj	1-3, 12	10	5		0		0
NL	<15	Nets	GNS	COD,TUR	No	2008	1781	48	IVc	1-6	0	0.03		0	2,7	
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	241	21	VIA	4-11	5	0.09		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	2	1	VB	4-11	5	0.5		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	104	18	VIIJ	4-11	5	0.17		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	8	1	VIIE	1-3, 12	10	0.13		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	110	9	VIID	4-11	5	0.08		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	140	54	IIa	4-11	5	0.39		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	32	4	IVC	4-11	5	0.13		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	79	1	VIIE	4-11	5	0.01		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	2	7	VIIID	4-11	5	3.5		0		

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	59	12	VIIIA	4-11	5	0.2		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	115	4	VIIJ	1-3, 12	10	0.03		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	98	3	VIA	1-3, 12	10	0.03	Harbour Porpoise	1		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	99	24	VIIB	1-3, 12	10	0.24		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER,	Yes	2008	200	30	VIIC	1-3, 12	10	0.15		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER,	Yes	2008	90	19	VIID	1-3, 12	10	0.21		0		
NL	>15	Pelagic Trawls	OTM	JAX,MAC, WHB,HER, ARG	Yes	2008	91	12	IVA	4-11	5	0.13		0		
POL	>15	Nets	GNS	COD,FLE	yes	2006	2857	6	IIId	9-12	5		0		pilot	0
POL	>15	Pelagic Trawls		HER,SPR	yes	2006	4130	19	IIId	9-12	5		0		pilot	
POL	>15	Nets	GNS	COD,FLE	yes	2007	2288	7	IIId	1-12	5	0				0
POL	>15	Pelagic Trawls		HER,SPR	yes	2007	6165	140	IIId	1-12	5	2		0		0
POL	>15	Nets	GNS	COD,FLE	yes	2008	540	32	IIId	1-6	5	5.83		0		
POL	>15	Pelagic Trawls		HER,SPR	yes	2008	1289	76	IIId	1-6	5	5.93		0		
ES	>15	Nets	GNS	Various		2008	581	25	VIIIa,b	10-12		6	Common Dolphin	1	pilot	23
ES	>15	Pelagic Trawls	OTM	HKE		2008		36	VIIIa,b,d	1-7,9-12			Common Dolphin	1		
SWE		Pelagic Trawls		HER,SPR		2006	188	13	IIIa	9-12	5			0		
SWE		Pelagic Trawls		HER,SPR		2006	826	20	IIId	9-12	5			0		
SWE		Pelagic Trawls		HER,SPR		2006	33	3	IVa	9-12	5			0		
SWE	>15	Nets	GNS	COD,FLE		2007	141	24	IIId	1-12	5	9			11	0
SWE		Pelagic Trawls		HER,SPR		2007	2761	140	IIId	1-12	5	5		0		0
SWE		Pelagic Trawls		HER,SPR		2007	399	18	IIIa	1-12	5	8		0		0

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
SWE		Pelagic Trawls		HER,SPR		2007	68	2	IVa	1-12	5	4		0		0
SWE	>15	Nets	GNS	COD,FLE		2008	239	71	IIId	1-12	5			0	7	
SWE		Pelagic Trawls		HER,SPR		2008	32	3	IVa	1-12	5			0		
SWE		Pelagic Trawls		HER,SPR		2008	2579	30	IIId	1-12	5			0		
SWE		Pelagic Trawls		HER,SPR		2008	196	1	IIIa	1-12	5			0		
UK	>15	Pelagic Trawls		MAC		2007	777	76	IVa	1-12	5	10		0	1	0
UK	>15	Pelagic Trawls		MAC,HER, WHB,JAX PIL,SPR, BASS,ALB		2007	449	84	VIa	12,1-3	10	16		0	1	0
UK	>15	Pelagic Trawls		MAC,HER, WHB,JAX PIL,SPR, BASS,ALB		2007	40	3	VIId	4-11	5	8		0	1	
UK	>15	Pelagic Trawls		MAC,HER, WHB,JAX PIL,SPR, BASS,ALB		2007	124	19	VIIe	4-11	5	15		0	1	
UK	>15	Pelagic Trawls		MAC,HER, WHB,JAX PIL,SPR, BASS,ALB		2007	269	26	VIa	4-11	5	10		0	1	
UK	>15	Pelagic Trawls		MAC,HER, WHB,JAX PIL,SPR, BASS,ALB		2007	184	7	VIIc	12,1-3	10	4		0	1	0
UK		Nets	GNS	TUR		2008		14	VIIG				Harbour Porpoise	1	11	
UK		Nets	GNS	SCR		2008		5	VIIF						11	
UK		Nets	GNS	TUR		2008		21	VIIE						11	
UK		Nets	GNS	HKE		2008		38	VIIG				Common dolphin	1	11	
UK		Nets	GNS	ANF		2008		5	VIIG						11	
UK		Nets	GNS	POL		2008		8	VIIG						11	
UK		Nets	GNS	POL		2008		6	VIIH						11	
UK		Nets	GNS	HKE		2008		16	VIIJ				Harbour Porpoise	1	11	

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
UK		Nets	GNS	POL		2008		9	VIIE						11	
UK		Nets	GNS	MUT		2008		7	VIIF						11	
UK		Nets	GNS	COD		2008		2	VIIE						11	
UK		Nets	GNS	BASS		2008		2	IVC						11	
UK		Nets	GNS	SOLE		2008		24	VIIA						11	
UK		Nets	GNS	SRX		2008		2	VIIA						11	
UK		Nets	GNS	BASS		2008		2	VIIA						11	
UK		Nets	GNS	FLE		2008		2	VIIA						11	
UK		Nets	GNS	PLE		2008		6	VIIA						11	
UK		Nets	GNS	SRX		2008		5	VIID						11	
UK		Nets	GNS	SOLE		2008		15	VIID				Harbour Porpoise	1	11	
UK		Nets	GNS	SRX		2008		4	VIIE						11	
UK		Nets	GNS	HKE		2008		52	VIIF				Harbour Porpoise	1	11	
UK		Nets	GNS	BLL		2008		7	VIIE						11	
UK		Nets	GNS	SRX		2008		4	VIIF						11	
UK		Nets	GNS	SOLE		2008		19	VIIE						11	
UK		Nets	GNS	HKE		2008		15	VIIE						11	
UK		Nets	GNS	MIX		2008		5	VIIF						11	
UK		Nets	GNS	POL		2008		8	VIIF						11	
UK		Nets	GNS	ANF		2008		4	VIIF						11	
UK		Nets	GNS	BASS		2008		1	VIIE						11	
UK		Nets	GNS	HKE		2008		52	VIIF				Common dolphin	1	11	
UK		Nets	GNS	LBE		2008		8	VIIE						11	
UK		Nets	GNS	SCR		2008		4	VIIE						11	
UK		Nets	GNS	MUT		2008		1	VIIE						11	
UK		Nets	GNS	SRX		2008		7	VIIE						11	
UK		Nets	GNS	POL		2008		14	VIIE				Bottlenose dolphin	1	11	
UK		Nets	GNS	POL		2008		14	VIIE				Harbour Porpoise	1	11	

Country	Vessel size range (m)	Gear Type Level 3	Gear Type Level 4	Target Species	Required under 812/2004	Year	Fleet Effort Days	Obs Effort Days	Fishing Area	Season	Target Cov.	Cov. (%)	Species	No. without pingers	Type of Pilot study	Prov. Bycatch Est
UK		Nets	GNS	PLE		2008		2	VIIE						11	
UK		Nets	GNS	ANF		2008		55	VIIE				Common dolphin	1	11	
UK		Nets	GNS	ANF		2008		55	VIIE				Harbour Porpoise	1	11	
UK		Nets	GNS	LBE		2008		21	VIIF						11	
UK	<15	Nets	GNS	COD		2008		2	IVC						11	
UK	<15	Nets	GND	BASS		2008		2	IVB						11	
UK	<15	Nets	GND	BASS		2008		5	VIID						11	
UK	<15	Nets	GND	SRX		2008		1	VIIA						11	
UK	<15	Nets	GND	SOLE		2008		4	IVC						11	
UK		Pelagic trawls	PTM	BASS		2008		10	VIIE				Common dolphin	22	9	

Source: ICES, 2010

KEY FOR TARGET SPECIES

ANC – Anchovy
ALB – Albacore Tuna
ARG- Argentine
WHB- Blue Whiting
HER – Herring
JAX – Horse Mackerel
MAC – Mackerel
PIL – Pilchard/Sardine
SPR – Sprat

COD – COD
FLE – Flounder
HKE – Hake
MIX – Mixed Fish
ANF – Anglerfish
PLE - Plaice
SRX - Rays
MUT – Red Mullet
SBX – Sea Bream

TUR - Turbot
POL – White Pollack
CRW - Crawfish
LBE - Lobster
SCR – Spider Crab

ANNEX IIA. PROVIDED BYCATCH ESTIMATES UNDER 812/2004

Species	Country	Gear Type Level 4	Target Species	Fishing Area	Season	2006	2007	2008
None	Denmark	Pelagic Trawls	MAC, HER, SPR	IIIa	1-12		0	
None	Denmark	Pelagic Trawls	MAC, HER, SPR	IIIbcd	1-12		0	
None	Denmark	Pelagic Trawls	MAC, HER, SPR	IVb	1-12		0	
None	Finland	Pelagic Trawls	HER, SPR	III d North	6-9		0	
None	Finland	Pelagic Trawls	SPR	III d south	1-12		0	
None	France	Midwater Otter trawl	MAC, JAX,PIL,SPR,HER	VI, VII & VIII	1-12		0	
None	France	Midwater Otter trawl	MAC, JAX,PIL,SPR,HER	VI, VII & VIII	4-11		0	
None	France	Set gillnet	SOLE, BASS, HAK	IVc, VII bdehgj, VIIIabce	1-12	0		
None	Italy	Midwater pair trawl	ANC (~70%), PIL (~20%)	GSA 17	1-7, 9-12		0	
None	Netherlands	Pelagic Trawls		IIa	4-11		0	
None	Netherlands	Pelagic Trawls		IVa	5-11		0	
None	Netherlands	Pelagic Trawls		IVb	4-11		0	
None	Netherlands	Pelagic Trawls		VIa	4-11		0	
None	Netherlands	Pelagic Trawls		VIb	4-11		0	
None	Netherlands	Pelagic Trawls		VIIb	4-11		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIa	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIb	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIIb	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIId	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIIe	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIIh	1-3, 12		0	
None	Netherlands	Pelagic Trawls	JAX,WHB	VIIj	1-3, 12		0	
None	Poland	Pelagic Trawls	HER, SPR	IIId	1-12		0	
None	Poland	Set gillnet	COD, Flatfish	IIId	1-12		0	
None	Poland	Set gillnet	COD, Flatfish	IIId	9-12	0		
None	Sweden	Pelagic Trawls	HER, SPR	IIIa	1-12		0	
None	Sweden	Pelagic Trawls	HER, SPR	IIId	1-12		0	
None	Sweden	Pelagic Trawls	HER, SPR	IVa	1-12		0	

Species	Country	Gear Type Level 4	Target Species	Fishing Area	Season	2006	2007	2008
None	Sweden	Set gillnet	COD, Flatfish	IIId	1-12		0	
None	United Kingdom	Pelagic Trawls	MAC, HER, WHB, JAX, PIL, SPR, BASS, ANC	VIa	12,1-3		0	
None	United Kingdom	Pelagic Trawls	MAC, HER, WHB, JAX, PIL, SPR, BASS, ANC	VIIc	12,1-3		0	
None	United Kingdom	Pelagic Trawls	MAC	IVa	1-12		0	
Caretta caretta	Italy	Midwater pair trawl	ANC (~70%), PIL (20%)	GSA 17	1-7, 9-12			427
Delphinus delphis	France	Midwater Otter trawl	BASS, JAX, MAC, HER,PIL	IVc, VII bdehgj, VIIIabce	1-12	57		
Delphinus delphis	France	Midwater pair trawl	BASS	VI, VII & VIII	1-3, 12		226	300
Delphinus delphis	France	Midwater pair trawl	ALB, MAC, SBX, JAX, BASS	VI, VII &VIII	4-11		13	120
Delphinus delphis	France	Set gillnet	SOLE, ANF, POL, MUT	VIa, VIIa,b, VIII-a, b, c, IXa	1-12			100
Delphinus delphis	Spain	Set gillnet	MIX	VIIIa,b	10-12			23
Globicephala melas	France	Midwater pair trawl	ALB, MAC, SBX, JAX, BASS	VI, VII &VIII	4-11		13	90
Phocoena phocoena	France	Set gillnet	SOLE	VIa, VIIa,b, VIII abc, IXa	1-12		100	250
Phocoena phocoena	France	Set gillnet	SOLE, ANF, POL, MUT	VIa, VIIa,b, VIII-a, b, c, IXa	1-12		500	100
Stenella coerulealba	France	Midwater Otter trawl	ANC, PIL	Mediterranean	1-12			70
Stenella coerulealba	France	Midwater pair trawl	ALB, MAC, SBX, JAX, BASS	VI, VII &VIII	4-11		40	
Stenella coerulealba	France	Set gillnet	SOLE, ANF, POL, MUT	VIa, VIIa,b, VIII-a, b, c, IXa	1-12			50
Tursiops truncatus	France	Midwater Otter trawl	ANC, PIL	Mediterranean	1-12			35
Tursiops truncatus	France	Midwater pair trawl	ALB, MAC, SBX, JAX, BASS	VI, VII &VIII	4-11		54	
Tursiops truncatus	Italy	Midwater pair trawl	ANC (~70%), PIL (20%)	GSA 17	1-7, 9-12			24

Source: Author (Based on Annex II)

ANNEX IIB. EXTRAPOLATED BYCATCH ESTIMATES FROM DATA PROVIDED UNDER 812/2004

Species	Country	Gear Type Level 4	Target Species	Fishing Area	Season	2004/2005	2005	2006	2007	2008
None	Denmark	Pelagic Trawls	MAC, HER, SPR	IIIa	1-2					0
None	Denmark	Pelagic Trawls	MAC, HER, SPR	IIIbcd	1-2					0
None	Estonia	Midwater Otter trawl	HER, SPR	III d	1-12			0		
None	Finland	Midwater Otter trawl	HER, SPR	III d	7-12			0		
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIa	10 -12				0	0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIa	1-3		0	0		0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIa	4-6				0	0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIa	7-9					0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIA	10 -12				0	
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIA	1-3					0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIb	1-3		0		0	0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIb	7-9					0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIc	1-3					0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIG	10 -12					0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIG	4-6				0	
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIj	10 -12				0	
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIj	1-3				0	
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIj	7-9		0	0		0
None	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIk	7-9		0			
None	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	1-3			0		
None	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	4-6			0	0	
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIIb	1-3, 12					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIIc	1-3, 12					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIId	1-3, 12					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIIe	1-3, 12					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIIj	1-3, 12					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	IIa	4-11					0

Species	Country	Gear Type Level 4	Target Species	Fishing Area	Season	2004/2005	2005	2006	2007	2008
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	IVa	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	IVC	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VB	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIa	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIId	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIIe	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIIIA	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIIID	4-11					0
None	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER, ARG	VIIj	4-11					0
None	Netherlands	Set gillnet	COD, TUR	IVC	1-6					0
None	Poland	Pelagic Trawls	HER, SPR	IIId	1-6					0
None	Poland	Pelagic Trawls	HER, SPR	IIId	9-12			0		
None	Poland	Set gillnet	COD, Flatfish	IIId	1-6					0
None	Sweden	Pelagic Trawls	HER SPR	IIIa	1-12					0
None	Sweden	Pelagic Trawls	HER, SPR	IIIa	9-12			0		
None	Sweden	Pelagic Trawls	HER, SPR	IIId	1-12					0
None	Sweden	Pelagic Trawls	HER, SPR	IIId	9-12			0		
None	Sweden	Pelagic Trawls	HER, SPR	IVa	1-12					0
None	Sweden	Pelagic Trawls	HER, SPR	IVa	9-12			0		
None	Sweden	Set gillnet	COD, Flatfish	IIId	1-12					0
None	United Kingdom	Pelagic Trawls	HER, WHB, JAX, MAC, PIL, SPR, ANC	VIa	4-11				0	
None	United Kingdom	Pelagic Trawls	HER, WHB, JAX, MAC, PIL, SPR, ANC	VIId	4-11				0	
None	United Kingdom	Pelagic Trawls	HER, WHB, JAX, MAC, PIL, SPR, ANC	VIIe	4-11				0	
Caretta caretta	Italy	Midwater pair trawl	ANC (~70%), PIL (20%)	GSA 17	1-7, 9-12			2422		
Delphinus delphis	Ireland	Pelagic Trawls	MAC, HER, WHB, JAX, ALB	VIIA	10 -12			15		
Delphinus delphis	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	10-12			11		
Delphinus delphis	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	7-9			3		
Delphinus delphis	Netherlands	Pelagic Trawls	JAX, WHB	VI, VII & VIII	1-3, 12	26				

Species	Country	Gear Type Level 4	Target Species	Fishing Area	Season	2004/2005	2005	2006	2007	2008
Lagenorhynchus acutus	Netherlands	Pelagic Trawls	JAX, WHB	VI, VII & VIII	1-3, 12			8		
Phoca vitulina	Denmark	Set gillnet	COD, PLE, HKE	IIIa	9-12					1
Phocoena phocoena	Denmark	Set gillnet	COD, PLE, HKE	IIIa	9-12					1
Phocoena phocoena	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	10-12			11		
Phocoena phocoena	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	1-3		21			
Phocoena phocoena	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	4-6		11			
Phocoena phocoena	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	7-9		6	3		
Phocoena phocoena	Netherlands	Midwater Otter trawl	JAX, MAC, WHB, HER	VIa	1-3, 12					33
Stenella coerulealba	Ireland	Set gillnet	COD, HKE, TUR, CRW	VIIG	10-12			5		

Source: Author (Based on Annex II)

ANNEX III Summary of advice and recommendations

Index	Source	Category	Subject	Recommendation	Target	ADGPROT Recommendation
1	SGBYC 2008	Basic data	Fishing effort	Some common measures of fishing effort should be included in 812/2004 Reports where possible - to enable calibration of fleet effort between nations.	EC, MS	
2	SGBYC 2008	Basic data	Fleet effort	The administrations of MS must give access to appropriate logbook and effort data to the research institutes charged with responsibility for the data reporting requirements under Regulation 812/2004.	MS	
3	SGBYC 2008	Basic data	Geographic resolution	812/2004 Reports should in future present data in a more homogenous geographical scale. ICES sub-divisional level may be more appropriate, while in some particular cases a larger or smaller scale might be appropriate.	EC, MS	
4	SGBYC 2008	Basic data	Representative sampling	Future National reports should contain clear indications of whether sampling programmes are considered to be representative and therefore qualify for further assessment of bycatch estimates.	MS	
5	SGBYC 2008	Data analysis	Representative sampling	SGBYC should explore how representative existing sampling strategies are before taking any further the issue of co-ordinated (trans-national) monitoring,	SGBYC	
6	WGMME 2008	Data analysis	Bycatch Estimates	SGBYC should compile the best current estimates for common dolphin and harbour porpoise bycatch in Areas VII and VIII for all fisheries that have been monitored to provide overall bycatch estimates for this region.	SGBYC	
7	SGBYC 2008	Monitoring	Funding	Funding should be made available by national governments to establish formal monitoring programmes where these have not already been established, so that National obligations under Regulation 812/2004 can be fully met.	MS	
8	SGBYC 2009	Monitoring	Observer workshop	A workshop should be convened in collaboration with NAMMCO, and involving other relevant regional IGOS, to address technical aspects of bycatch monitoring.	ACOM, EC, GFCM, NAMMCO	Awaiting letter from NAMMCO

Index	Source	Category	Subject	Recommendation	Target	ADGPROT Recommendation
9	SGBYC 2009	Monitoring	Representative sampling	Incentives and reprisals should be used to ensure that observers are not prevented from sampling representative parts of the fleets' activities.	MS	No action recommended
10	SGBYC 2009	Monitoring	Vessel Comparison	Observed vessels within bycatch monitoring or discard schemes should be compared with the rest of the fleet with respect to vessel length, effort by month and by area, and species composition and landed weight of the catch to ensure that sampling is unbiased.	SGBYC	SGBYC internal
11	SGBYC 2010	Monitoring	Flexible approach	In order to take account of issues such as monitoring small populations with rare bycatch incidences, a more flexible approach to monitoring should be adopted which includes a set of tools and guidelines for MS to decide how best to target monitoring.	EC	
12	SGBYC 2010	Monitoring	Vessels under 15m	Monitoring of vessels under 15m should be progressed taking account of difficulties inherent in sampling small vessels and new technologes which can help to address this issue. This should also be discussed at the joint NAMMCO/ICES workshop	ACOM, EC, GFCM, NAMMCO	
13	SGBYC 2009	Report format	Pilot Proects	Pilot projects should be included in National Reports. A table in the standard report format proposed by SGBYC was modified to facilitate this.	EC, MS	Included in advice
14	SGBYC 2009	Report format	Standard Format	National Reports compiled under Regulation 812/2004 should be submitted in a standard format. At least a summary should be provided in English.	EC, MS	Included in advice
15	SGBYC 2010	Report format	Standard Format	The EU should complete revision and issue a requirement to report using a standard format, including a requirement to report effort in Days at Sea, as quickly as possible.	EC	
16	SGBYC 2008	Revision of 812/2004	Fleet review	The Commission should establish some review of the fleets that are currently being sampled under Regulation 812/2004	EC	
17	SGBYC 2008	Revision of 812/2004	Mitigation plans	Any further mitigation plans for minimising cetacean or other protected species bycatches should be introduced only after careful consideration of all of the factors listed under the bycatch mitigation framework.	EC	

Index	Source	Category	Subject	Recommendation	Target	ADGPROT Recommendation
18	SGBYC 2009	Revision of 812/2004	Fishing gear	Any revision of Regulation 812/2004 should include an agreed international description of fishing gear categories suitable for bycatch monitoring in an Annex.	EC, SGBYC, STECF, WGFTFB	Draft letter for Secretariat to send to DG Mare
19	SGBYC 2009	Revision of 812/2004	Monitoring targets	Any revision of regulation 812/2004 should include a review of how the targets for monitoring levels should be set.	EC, STECF	Draft letter for Secretariat to send to DG Mare
20	SGBYC 2009	Revision of 812/2004	Regional approach	Any revision of Regulation 812/2004, should apply a more regional approach which will evaluate specificity of different sea regions and fishing fleets.	EC, STECF	Draft letter for Secretariat to send to DG Mare
21	SGBYC 2010	Revision of 812/2004	Pilot Proects	Pilot projects are poorly defined in the regulation resulting in number of different interpretations by each MS. The regulation should simplified in this regard and merely define appropriate levels of observer coverage	EC	
22	WGMME 2008	Revision of 812/2004	North Sea monitoring	Observer monitoring should be extended to the North Sea in order to obtain more recent estimates of bycatch of porpoises and other marine mammals in this region.	EC	
23	WGMME 2008	Revision of 812/2004	Seal bycatch	Bycatches of seals and other protected species should be reported by observer programmes established under the 812/2004 regulation as well as those conducted under Data Collection Regulations for discard sampling.	EC	

Source: ICES SGBYC & WGMME (ICES 2008A, 2008B, 2009A, 2009B, 2010)

ANNEX IV. SUMMARY OF MEMBER STATE REPORTS SUBMITTED IN FULFILMENT OF 812/2004

		Report					Pilot Studies	
Nation	Year	(Y/N)	Data Years	Format	Language	Bycatch estimates	<15m	Pingers (Y/N)
Belgium	2008	Y		National	English	N	N	**N**
Belgium	2009	N		-	-	N	-	**-**
Bulgaria	2008	Y		National	English	N	-	**-**
Bulgaria	2009	N		-	-	N	-	**-**
Cyprus	2008	Y		National	English	N	N	**N**
Cyprus	2009	N		-	-	N	-	**-**
Denmark	2008	Y		National	English	N	N	**Y**
Denmark	2009	Y	2007	National	Native	Y	N	**N**
Estonia	2008	Y	2006	National	English	Y	N	**N**
Estonia	2009	Y	2007	National	English	Y	N	**N**
Finland	2008	Y	2006	National	Native	Y	N	**N**
Finland	2009	Y	2007	National	Native	Y	Y	**N**
France	2008	Y	2006	National	Native	Y	Y	**N**
France	2009	Y	2007	National	Native	Y	Y	**N**
Germany	2008	Y		National	Native	N	N	**N**
Germany	2009	N		-	-	N	-	**-**
Greece	2008	Y		National	English	N	N	**N**
Greece	2009	N		-	-	N	-	**-**
Ireland	2008	Y	2005/2006	National	English	Y	N	**Y**
Ireland	2009	Y	2007	National	English	Y	N	**Y**
Italy	2008	Y	2006	National	Native	Y	N	**N**
Italy	2009	Y	2007	National	English	Y	N	**N**
Latvia	2008	Y	2006	National	English	N	N	**N**
Latvia	2009	N		-	-	N	-	**-**
Lithuania	2008	N		-	-	N	-	**-**
Lithuania	2009	Y		National	English	N	N	**N**
Malta	2008	N			-	N	-	**-**
Malta	2009	N		-	-	N	-	**-**
Netherlands	2008	Y	2004/2005/2006	National	English	Y	N	**N**
Netherlands	2009	Y	2007	SGBYC	English	Y	N	**N**
Poland	2008	Y	2006	National	English	Y	N	**N**
Poland	2009	Y	2007	National	English	Y	N	**N**
Portugal	2008	Y		National	Native	N	N	**N**
Portugal	2009	N		-	-	N	-	**-**
Romania	2008	Y		National	English	N	-	**-**
Romania	2009	N		-	-	N	-	**-**
Slovenia	2008	Y		National	-	N	N	**N**
Slovenia	2009	N		-	-	N	-	**-**
Spain	2008	Y		National	Native	N	N	**N**
Spain	2009	Y		National	Native	N	N	**N**
Sweden	2008	Y	2006	National	English	Y	N	**Y**
Sweden	2009	Y		SGBYC	English	Y	N	**N**
UK (UK)	2008	Y	2005/2006**	National	English	Y	Y	**N**
UK (UK)	**2009**	**Y**	**2007**	**ACOM**	**English**	**Y**	**N**	**Y**

ANNEX V. COMPARISON OF TECHNICAL SPECIFICATIONS OF AVAILABLE PINGERS

Sound source and manufacturer	Signal type	Signal duration (ms)	Signal interval(s)	SLpulse (dB re 1 µPa @ 1 m)	SLcycle (dB re 1 µPa@1 m)	SPL @ 6 m (dB re 1 µPa)	Frequency spectrum and peak levels at 1 m (dB re 1 µPa)
DRS-8 transmitter by Ocean Engineering Enterprise	600 Hz tonal 'known effect' reference sound	300	4	172	161	177	
DRS-8 transmitter by Ocean Engineering Enterprise	3 kHz tonal 'known effect' reference sound	300	4	202	-	-	
Fumunda FMDP 2000 by Fumunda Marine Products, USA	Tonal signal 9.6 kHz	297	3.2	141	131	138	Harmonic energy up to 73 kHz, 3rd and 5th harmonic -10 dB. 0.02-0.1 kHz -60 dB.
Airmar gillnet pinger by AIRMAR Technology Corporation, USA	Tonal signal 9.8 kHz	309	3.5	134	124	125	Harmonic energy up to 50 kHz -30 dB. 0.02-0.1 kHz -30 to -60 dB.
AQUAmark 100 by Aquatec Subsea Ltd, UK	Tonal and sweep signals	Random Avg 304 Min 213 Max 358	Random Avg. 12.2 Min. 4.2 Max 22.6	148 (SD 3.7) (n=16)	Avg 133 Min 142 Max 130	143 (SD 1.6) (n=16)	Tonal levels +7 dB with peaks at 64.4 kHz (136 dB) and 128 kHz (100 dB). Sweep signals peaked between 44-54 kHz & 60-80 kHz, LF peaks at 0.75 (-34 dB) & 1.6 kHz (-50 dB).
AQUA mark 200* by Aquatec Subsea Ltd, UK	Tonal and sweep signals	Random Avg 282 Min 272 Max 293	Random Avg 12.1 Min 3.7 Max 21.1	134 (SD 1.26) (n=16)	Avg 118 Min 123 Max 120	130 (SD 1.5) (n=16)	Tonal peaks at 21 & 42 kHz (126-130 dB) and 63-104 kHz (-5 to-15 dB). Sweep signals peaked between 10-14 kHz & 48-53 kHz. LF peaks at 0.7 kHz (-15 dB).
SaveWave endurance by SaveWave BV, The Netherlands	Sweep signal	Random Avg. 295 Min. 196 Max. 393	Random Avg 14.5 Min 8.2 Max 21.1	134 (SD 0.41) (n=14)	Avg 117 Min 117 Max 117	132 (SD0.7) (n=12)	Sweep 5.3 –110 kHz. Peaks between 7-95 kHz 112-116 dB. LF contribution 0.5-3 kHz -40 dB. Pulse duration proportional to time intervals.

SaveWave white high impact by SaveWave BV, The Netherlands	Sweep signal	Random Avg. 529 Min. 197 Max. 852	Random Avg. 11.39 Min. 2.65 Max. 18.24	140 (SD 0.58) (n=17)	Avg 126 Min 131 Max 125	141 (SD0.43) (n=17)	Sweep 5–95 kHz 115 dB. Peaks between 7.5-54 kHz +12 dB. LF contribution 0.75-2.4 kHz -20/-35 dB.
SaveWave black high impact by SaveWave BV, The Netherlands	Sweep signal	Random Avg. 318 Min. 229 Max. 427	Random Avg 14.6 Min 8.8 Max 23.0	143 (SD 0.67) (n=13)	Avg 127 Min 127 Max 126	143 (SD1.0) (n=12)	Sweep 33 –97 kHz 108 dB, Peaks between 50-95 kHz (+10 dB). LF contribution 6 to 9 kHz -40 dB.
	Resonance frequency (kHz)	Type of signal	Frequency band (kHz)	Repetition rate (s)	Duration (s)	SLpeak dB re 1 µPa@ 1 m/Vrms	SLpulse dB re 1 µPa@ 1 m
AquaTech 363 interactive	35 - 90	Various sweep signals	<160	Random <15s apart	300ms	175	167
DDD 02	130	Start sequence	5-250	1200	30	174 (130 kHz)	165-170 (F?)
		FM		Min Max Avg 100	Min 0.5 Max 7 avg		
		clicktrains	?		0.1		
DDD 02F	130	Start sequence				174 (130 kHz)	165-170 (F?)
		FM	5-250	Min Max Avg 30	Min 0.5 Max 9 avg		
		clicktrains	?		0.1		
		clicktrain	90		0.1	?	

Source: Anon, 2007

ANNEX VI. SUMMARY OF NUMBER AND AREA OF MARINE SITES OF COMMUNITY IMPORTANCE (SIC) DESIGNATED BY MEMBER STATES

Member State	Member State	Number of marine sites (2001-2006)	Marine area (km2) (2001-2006)	Number of marine sites (Nov 2009)	Marine area (km^2) (Nov 2009)	Number of marine sites (Dec 2009)	Marine area (km^2) (Dec 2009)
AT	Austria						
BE	Belgium	2	198	1	181	2	198
BG	Bulgaria	14	592			14	592
CY	Cyprus	5	50	5	50	5	50
CZ	Czech Republic						
DE	Germany	53	19768	77	20192	53	19768
DK	Denmark	125	16145	80	7599	125	16145
EE	Estonia	46	3752	33	3450	46	3752
EL	Greece	114	6344	102	6133	114	6344
ES	Spain	97	7926	149	4277	97	7926
FI	Finland	98	5460	98	5460	98	5460
FR	France	132	25709	121	5596	132	25709
HU	Hungary						
IE	Ireland	97	6014	80	3386	97	6014
IT	Italy	162	2254	397	2298	162	2254
LT	Latvia	2	171	1	171	2	171
LU	Luxembourg						
LV	Lithuania	6	562	6	1185	6	562
MT	Malta	1	8	1	8	1	8
NL	Netherlands	14	10857	4	4099	14	10857
PL	Poland	6	3600	2	2753	6	3600
PT	Portugal	25	775			25	775
RO	Romania	6	1353			6	1353
SE	Sweden	334	7512	331	5847	334	7512
SI	Slovenia	3				3	0
SK	Slovakia						
UK	United Kingdom	49	12409			49	12409
EU	**European Union**	**1391**	**131459**	**1488**	**72685**	**1391**	**131459**

Source:

2001-2006: Habitats directive Article 17 report (2001-2006) compiled by the European Topic Centre on Biological Diversity for the European Commission (DG Environment).

November 2009: The Natura 2000 Barometer: commentary on progress in the implementation of both the Habitats and the Birds Directives in all 27 countries up to November 2009.

December 2009: The Natura 2000 Barometer update December 2009.

ANNEX VII. CONSERVATION STATUS OF SELECTED CETACEAN SPECIES IN EU WATERS AS OF JULY 2008

Member State	Species	Marine Atlantic	Marine Baltic	Marine Macaronesian	Marine Mediterranean
Belgium	Phocoena phocoena	Unfavourable bad			
Denmark	Phocoena phocoena	Unfavourable inadequate	Unfavourable inadequate		
France	Phocoena phocoena	Unknown			
Germany	Phocoena phocoena	Unfavourable inadequate	Unfavourable bad		
Greece	Phocoena phocoena				Unfavourable inadequate
Ireland	Phocoena phocoena	Favourable			
Latvia	Phocoena phocoena		Unfavourable bad		
Netherlands	Phocoena phocoena	Unfavourable bad			
Poland	Phocoena phocoena		Unfavourable bad		
Portugal	Phocoena phocoena	Unfavourable inadequate			
Spain	Phocoena phocoena	Unknown			Unknown
Sweden	Phocoena phocoena	Unfavourable bad	Unfavourable bad		
United Kingdom	Phocoena phocoena	Favourable			
Belgium	Tursiops truncatus	Unfavourable bad			
Cyprus	Tursiops truncatus				Unknown
France	Tursiops truncatus	Unknown			Unknown
Greece	Tursiops truncatus				Unfavourable bad
Ireland	Tursiops truncatus	Favourable			
Italy	Tursiops truncatus				Unknown
Malta	Tursiops truncatus				Unknown
Portugal	Tursiops truncatus	Unknown		Unknown	
Slovenia	Tursiops truncatus				Unfavourable inadequate

Spain	Tursiops truncatus	Unknown		Unfavourable inadequate	Unknown
United Kingdom	Tursiops truncatus	Favourable			Unfavourable inadequate
France	Delphinus delphis	Unknown			Unfavourable bad
Greece	Delphinus delphis				Unfavourable bad
Ireland	Delphinus delphis	Favourable			
Italy	Delphinus delphis				Unfavourable bad
Malta	Delphinus delphis				Unknown
Portugal	Delphinus delphis	Unknown		Unknown	
Spain	Delphinus delphis	Unknown		Unfavourable inadequate	Unknown
United Kingdom	Delphinus delphis	Unknown			Not reported
France	Balaenoptera acutorostrata	Unknown			
Ireland	Balaenoptera acutorostrata	Favourable			
Portugal	Balaenoptera acutorostrata	Unfavourable inadequate		Unknown	
Spain	Balaenoptera acutorostrata	Unknown		Favourable	
United Kingdom	Balaenoptera acutorostrata	Favourable			

Source: National checklist of species and their overall conservation status submitted to the European Commission by each Member State as required under Article 17 of the Habitats Directive

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