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REPORT OF THE SECOND MEETING OF THE SUBGROUP ON FISHERY AND ENVIRONMENT (SGFEN) OF THE SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

INCIDENTAL CATCHES OF SMALL CETACEANS

Brussels, 11-14 June 2002

This report has not yet been approved by the Scientific, Technical and Economic Committee for Fisheries (STECF) and it does not necessarily reflect its views.

Executive summary

The subgroup was tasked to update information on cetacean bycatch in European fisheries, and to provide advice on how best to address such bycatch at a European level.

A table of fisheries known or suspected to take cetaceans was prepared, though it was noted that the categorisation of such fisheries was to some extent arbitrary. Some cetacean bycatch has been reported in most of the major fishing gears used in Europe, though gill nets and pelagic trawls appear to contribute most records. EU fleets operating outside EU waters also catch cetaceans but were not considered in any detail.

The subgroup considered several candidate measures for minimising cetacean bycatch. Effort reduction would reduce bycatch linearly with the degree of effort reduction unless such reduction can be targeted at sectors with the highest cetacean bycatch rates. Fishery closures, spatial or temporal, would only work if areas or times of particularly high bycatch rate could be established. The subgroup was not aware of any suitable candidate areas or times. Likewise, protected areas were held to be ineffective on their own in achieving bycatch reduction targets. Exclusion devices and acoustic deterrent devices are currently being trailed in pelagic trawl fisheries, but such approaches will require further development work if they are to be effective. Acoustic deterrent devices have been widely tested and implemented in several gillnet fisheries around the world where they have been successful in reducing bycatches of harbour porpoises, common dolphins and striped dolphins. Alternative netting materials for gillnets were also discussed.

The subgroup reviewed currently available acoustic deterrent devices and some proposals were put forward for appropriate technical specifications for such devices. Concerns were also raised that there has been insufficient research into measuring any possible negative impact such devices might have at a population level on the animals that they are designed to deter.

The subgroup updated the information given in its previous report (CEC 2002) on population assessment, bycatch monitoring and bycatch mitigation, including management measures currently in place. This included a discussion of the ASCOBANS Baltic Porpoise Recovery Plan, and some limited new information on fishing effort in several areas including the Channel and Biscay, on bycatch monitoring, and some revised estimates of bycatch for the North Sea and Kattegat. Some recently published accounts of bycatch mitigation trials in the Mediterranean were also included.

The subgroup considered how best to implement a bycatch monitoring scheme, and reiterated its view that independent observations of fishing activities were essential to provide adequate bycatch estimates. The practical difficulties of implementing such schemes were discussed. The appropriate level of observer coverage will depend on the desired level of precision in the estimate of bycatch, and upon the statistical properties of bycatch events within a particular fishery. Some preliminary information is therefore required before monitoring levels can be specified. The subgroup was able to identify several fisheries where priority should be given to the establishment of monitoring schemes.

The subgroup considered that an appropriate management scheme should be established in the EU to address cetacean bycatch. Such a scheme should be preceded by the adoption of overall management goals. Such goals are driven by societal values rather than scientific ones, but the subgroup suggested an overall goal of restoring or maintaining cetacean populations at or above 80% of their notional environmental carrying capacity, in the long term, would be an appropriate such goal in a European context.

The subgroup considered that within an overall management framework there must be a monitoring and surveillance programme to identify fishery métiers, or times and areas, where cetacean bycatch is a problem, and to provide quantitative estimates of the levels of bycatch for each species/'stock'. Timely population assessments are also required within this framework. There must be a recognised means of determining unacceptable bycatch levels, and an institutional framework for devising bycatch reduction plans where these are necessary. Beyond this, there needs to be a means of implementing any bycatch reduction plan, including methods of enforcement, and of continued monitoring and feedback to ensure the overall objectives are met.

The subgroup concluded with a series of recommendations, headed by the recommendation that a by catch management framework should be established at an EU level at the earliest opportunity. In the meanwhile, recommendations included a series of specific recommendations aimed at reducing harbour porpoise bycatch in the Baltic, at gillnet fisheries in the North Sea, at gillnet fisheries on the Celtic Shelf, and at pelagic trawl fisheries in the Biscay and Channel region. Further by catch quantification and cetacean population estimation were all also recommended.

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1. Introduction

1.1 Terms of Reference

In its terms of reference, supplied by the Commission, the subgroup was asked to:

1) Prepare a new table(s) to include all fisheries where by-catch of small cetaceans is known or suspected to occur, including those fisheries for which such information has not yet been documented.

2) Advise on possible approaches to reduce the impact of fishing. Particular attention should be given both to information useful to set fishing practice restrictions (gear, area and time) and to further technical details on the acoustic properties and installation of acoustic devices.

3) Update the information on enforcement and effectiveness of actions already taken at regional, national and international levels, to monitor and survey cetacean bycatches and to enforce the use of mitigation practices.

4) Conceive and design an observer sampling scheme suitable for monitoring cetacean bycatches. Account of human resources, on a permanent and seasonal basis, by métier, should be addressed.

5) Identify possible management frameworks, suitable to the European Community decision making structure, to tackle the issue of cetacean bycatches;

1.2 Participants

The participants are listed below and contact details are given in Appendix 1.

STECF Members

Antonio di Natale

Invited experts
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Dave Goodson
Guy Imbert
Mary Labropoulou
Finn Larsen
Santiago Lens
Giancarlo Lauriano
Yvon Morizur
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Emer Rogan
Marina Sequeira
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STECF Secretariat (EC Commission)
Franco Biagi
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Jean Weissenberger

2. Table of fisheries where bycatches are known or suspected to occur

The subgroup was asked to provide a table of all fisheries where bycatch is known or suspected in European waters. This request pre-supposes that fishing activities can indeed be split into easily defined units or fisheries, which the subgroup found was not necessarily the case.

In the context of cetacean bycatch, it was suggested that in most cases there is a lack of adequate information with which to divide fishery categories into suitable métiers, and in such cases several métiers might be considered together under the banner of a single gear type or single target species. In some cases specific information on cetacean bycatch rates might make it possible to distinguish between elements of such fishery categories. In Table 1 fisheries have been segregated to the lowest possible level where bycatch is known to occur regularly. Where the situation with respect to bycatch is unclear, several métiers have been lumped together as a potential 'fishery group' for monitoring.

The subgroup did not consider in any detail European fleets working outside EU waters. According to information provided during the meeting, and to the note included by STECF in its analysis of fish stocks of Community interest, particular attention should be given to the pelagic trawl fishery and the bottom trawl fishery prosecuted by EU fleets in Mauritanian waters. This area is particularly important and vulnerable, as reflected by the existence of the Parc Nationale du Banc d'Arguin, and the presence of a colony of the endangered Mediterranean monk seal (*Monachus monachus*). Other areas of the African coast may also be vulnerable and are subject to heavy fishing by European fleets, and the subgroup was aware of very little bycatch reporting or monitoring. Clearly adequate monitoring of and bycatch reporting from these fleets should be established as soon as possible.

Tables of fisheries known or suspected to catch cetaceans:

Table 1. Atlantic waters (ICES Region)

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
Pelagic trawling	Denmark, Sweden, Norway, UK, Germany	June-September	Kattegat, Skagerrak, North Sea	*Clupea harengus*	*Globicephala melaena* Other small cetaceans	Known Suspected	Opportunistic record. Bycatch likely low.
Pelagic trawling	Denmark, UK, Sweden, Norway	October-December	Kattegat, Skagerrak, North Sea	*Scomber scombrus*	Small cetaceans	Suspected	Bycatch likely low.
Pelagic pair trawling	France	Non-seasonal	Bay of Biscay	*Merluccius merluccius*	*Delphinus delphis*	Known	Morizur *et al*. 1996
Pelagic pair trawling	France, Ireland, UK	Summer	Bay of Biscay /Celtic sea	*Thunnus alalunga*	*D. delphis, Stenella coeruleoalba, Lagenorhynchus acutus,* *L. albirostris,* *G. melaena*	Known	Morizur *et al* 1996
Pelagic pair trawling	France, UK	December-May	Western Channel	*Dicentrarchus labrax*	*D. delphis*	Known	Morizur *et al* 1996

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
Pelagic pair trawling	France	November - March	Biscay	*D. labrax*	*D. delphis*	Known	Morizur *et al* 1996
Pelagic pair trawling	France	January – March; June-November	Biscay	*Engraulis encrasicholus, Sardina pilchardus, Trachurus trachurus*	Small cetaceans	Suspected	
Pelagic trawling	France, UK, Ireland, Netherlands, Denmark	October- Dec; Jan - March	West of Ireland, Celtic Sea Channel	*Micromesistius poutassou,* *S. scombrus,* *T. trachurus*	*D. delphis,* *L. acutus*	Known from some métiers, but not recorded in all studies	Morizur *et al* 1996
Trawling – high aperture demersal pair	Spain	Non-seasonal	Biscay	*M. merluccius, T. trachurus*	Small cetaceans	Known	CEC 2002
Purse seines	UK	July-September; October-December	Northern North Sea	*C. harengus,* *S. scombrus*	Small cetaceans	Very few records	Now an occasional fishery only
Purse seines	Spain and Portugal	-	Biscay, western coast of Portugal	*S. pilchardus* (small pelagics)	*D. delphis*, other small cetaceans?	Suspected	

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
Beach seines	Portugal	Summer	Northern region of Portugal	Small pelagics	*P. phocoena* *D. delphis*	Known	Sequeira 1996
Driftnet	Baltic nations	Summer	Baltic	*Salmo salar*	*P. phocoena*	Known	Opportunistic records – Berggren 1994
Driftnet	UK (England)	May- August	North Sea	Salmonids	*P. phocoena*	Known to occur	Recorded, but no bycatch estimate
Driftnet	UK	Summer	Channel, Irish Sea, inshore waters	*D. labrax*	*P. phocoena*?	Suspected	By analogy
Driftnet	Ireland	Summer	West of Ireland and Celtic Sea	Salmonids	Small cetaceans	Known to occur	Recorded, but no bycatch estimate
Driftnet	UK	Winter	Thames estuary	*C. harengus*	*P. phocoena*	Possible	Not recorded, but limited sampling.
Driftnet	UK	?	Irish Sea / SW England	*C. harengus*	*P. phocoena*	Known to occur	Recorded, but no bycatch estimates made
Driftnet	Ireland, UK, France	Summer	Biscay/Irish Sea	*T. alalunga*	*D. delphis,* *S. coeruleoalba*	Known	Goujon et al, 1993 Fishery terminated by EC regulation in 2002
Fixed nets (gill & tangle)	Denmark, Sweden, Norway	All year	Skagerrak and Kattegat	*Gadus morhua, Pollachius pollachius,* flatfishes*, Lophius piscatorius*	*P. phocoena*	Known	Bjornesson 2002, ICES 2002.

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
Fixed nets (gill & tangle)	Germany	All year	Eastern North Sea	*G. morhua*, flatfishes	*P. phocoena*	Known to occur	To be studied in 2002
Fixed (gill & tangle) or drift nets	Baltic nations	All	Baltic	*C. harengus,* *G morhua,* *S. salar*, flatfishes.	*P. phocoena*		Recorded in Germany, Poland and Sweden
Fixed nets (gill & tangle)	Scotland	Mainly summer	West of Scotland	*Scyliorhynus canicula, Raja spp. Palinurus vulgaris.*	*P. phocoena*	Known	Northridge and Hammond 1999; CEC 2002
Fixed nets	Norway	All year	North Sea	*P. virens* and other species	*P. phocoena*	Suspected by analogy	
Fixed nets	UK	All year	North Sea	*G. morhua*, flatfish, *Raja spp.,* *Scophthalmus maximus*	*P. phocoena*	Known	Northridge and Hammond 1999, CEC 2002.
Fixed Nets	Denmark	All year	North Sea	*G. morhua,* *S. maximus, Solea solea,* *M. merluccius,*	*P. phocoena*	Known	Vinther 1999, Vinther and Larsen 2002.

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
				Pleuronectes platessa.			
Fixed nets	Germany	All year	North Sea	*Gadus morhua, S. solea,* mixed spp	*P. phocoena*	Known	Opportunistic reports
Fixed nets	Netherlands	All year	North Sea	Flatfish	*P. phocoena*	Some known	Opportunistic reports
Fixed nets	Belgium	All year	North Sea & Channel	Flatfish	*P. phocoena*	Some known	Opportunistic reports
Fixed Nets	France, UK	All year	Channel	Flatfish, *G. morhua, Maia squinado Lophius spp., Sepia officinalis*	*P. phocoena*	Some known	Opportunistic reports, except monkfish fishery where 410km net observed without bycatch in Celtic Sea and Channel (Morizur pers. comm.)
Fixed nets	France, Spain	All year	Celtic sea	*M. merluccius, Lophius spp.*	*P. phocoena*, dolphin spp.	Suspected, by analogy	410km net observed without bycatch, Celtic Sea and Channel (Morizur pers. comm.)
Fixed nets	Ireland, UK	All year	Celtic Sea	*M. merluccius*, other gadids	*P. phocoena*	Known	Tregenza *et al* 1997
Fixed nets	Ireland	All year	Irish waters	Various species (*Lophius spp.*)	*P. phocoena*	Suspected, by analogy	
Fixed nets	UK	All year	Irish Sea	Gadids, crabs	*P. phocoena*	Some known	Opportunistic and autopsied

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
							stranded animals
Fixed nets	UK, Spain, France, Ireland	All year	Continental shelf edge	*Lophius spp., M. merluccius* and others	*P. phocoena*	Suspected	
Fixed nets	France and Spain	All year	Biscay & coastal Atlantic France and Spain	*S. solea, M. merluccius, Lophius spp*.	Small cetaceans	Some known	Opportunistic records; none recorded in 54 Spanish sets observed in 1994, or 36 Spanish sets 1998-2000
Fixed nets	Portugal	All year	Portuguese coastal waters	Mixed species	*P. phocoena,* *D. delphis*	Known	Opportunistic records
Fish traps (pound nets)	Denmark, Germany	Summer	Kattegat and Baltic	*Salmonids,* *G. morhua,* *C. harengus,* *T trachurus, Cycolpterus lumpus*	*P. phocoena*	Known	Occasional records, mainly released alive.
Fish trap (pound nets)	UK	Summer	North Sea	Salmonids	*P. phocoena*	Known	Occasional records
Pots	All nations	All year	Atlantic	Crustaceans and cephalopods	*B. acutorostrata*, other cetaceans	Known	Occasional records
Long lines	All nations	All year	Atlantic	Several species	Cetaceans	Known	Occasional records

Gear Type	**Nation**	**Season**	**Location**	**Target Species**	**Bycatch species**	**Known of suspected**	**Monitored/estimated**
Pole and line	Portugal	Summer	Azores	*Thunnus spp*.	*Tursiops truncatus, D. delphis, S. coeruleoalba.*	Known	Silva *et al* 2002. But all those observed were hooked and released alive.
Demersal trawl	All nations	All year	Atlantic/ North Sea / Baltic	Many	*P. phocoena, D. delphis,* other species of cetacean	Known	Occasional records. 1 common dolphin recorded in 57 hauls in one Spanish study
Beam trawls	Netherlands, UK	All year	Southern North Sea, Channel	Flatfish	*P. phocoena*	Known, rarely	Rare opportunistic reports.

Table 2. Mediterranean waters (GFCM region).

Gear Type	Nation	Season	Location	Target species	Bycatch species	Known or suspected	Monitored/ Estimated
Drift nets ("spadara" and other types) (mesh size 18 to 42 cm)	Morocco, Turkey, France, Italy, a few vessels are also present in Albania, Algeria, Greece, Monaco	April-August	Mediterranean	*Xiphias gladius, T. alalunga*	*S. coeruleoalba, Ziphius cavirostris* (*Globicephala spp., D. delphis, Grampus griseus, Physeter macrocephalus, Balaenoptera physalus, B. acutorostrata*	Known	Monitored and extrapolated: Di Natale *et al*., 1999; Di Natale *et al*., 1992; Silvani *et al*. 1999; Di Natale *et al*. 1993
Drift nets ("Thonaille") (mesh size 18 to 24 cm)	France, Monaco	May-September	Mediterranean	*T. thynnus*	*S. coeruleoalba*	Known	Monitored and extrapolated: Imbert *et al*. 2001, 2002
Drift nets (mesh size 8 to 16 cm)	Italy	Spring-Autumn	Mediterranean	*Sarda sarda, Auxis rochei,* other small tuna species.	*T. truncatus, Grampus griseus*	Known	Estimated total: Di Natale & Notarbartolo di Sciara, 1994
Drift nets (mesh size 4 to 7 cm)	Many coastal areas	Spring	Mediterranean	*Scomber* spp., *Boops boops,* and other small pelagic species	*S. coeruleoalba, Tursiops truncatus*	Suspected: many interactions with fishing gear	
Bottom set gillnets (including coastal trammels)	Many coastal areas	All	Mediterranean	*Mullus* spp., *Sepia* spp. Sparidae, *Scorpaena* spp. other demersal species	*Ziphius cavirostris*, *D. delphis S. coeruleoalba*, *Grampus griseus,T. truncatus, Physeter macrocephalus*	Known: also high level of gear interaction	Di Natale, 1989; Di Natale & Notarbartolo, 1994; Bradai, 2000; Centro Studi Cetacei, 1987-2000; Lauriano *et al*., 2001.

Gear Type	**Nation**	**Season**	**Location**	**Target species**	**Bycatch species**	**Known or suspected**	**Monitored/ Estimated**
Bottom set gillnets	Many deep coastal areas	All	Mediterranean	*Palinurus elephas, Merluccius merluccius*	*T. truncatus*	Gear interactions known	CORISA, 1992
Middle-water set gillnets	Many coastal areas	All	Mediterranean	*Boops boops, Oblada melanura, Trachurus* sp., *Spicara* spp.	*T..truncatus*	Known	Di Natale pers comm.
Purse seine	All	All	Mediterranean	*Sardina pilchardus, Engraulis enchrasiculus,* other small pelagic species	*T. truncatus*	Known: occasional plus many gear interatciuons	Bradai, 2000
Tuna purse seine	Spain, France, Italy, Greece, Tunisia, Turkey, Croatia, Algeria, Morocco	March-October	Mediterranean	*Thunnus thynnus*	*S. coeruleoalba*.	Known: rare	Magnaghi & Podesta, 1987; Podestà & Magnaghi, 1989
Tuna traps	Spain, Italy, Tunisia, Libya, Morocco, Croatia	April-July	Mediterranean	*Thunnus thynnus*	*T. truncatus B. acutorostrata*, *Orcinus orca*	Known: Interactions are sporadic	Di Natale, 1992; Bradai, 2000; Di Natale & Mangano, 1983

Gear Type	Nation	Season	Location	Target species	Bycatch species	Known or suspected	Monitored/ Estimated
Bottom trawl	All areas	All	Mediterranean	A large range of demersal species	*T. truncatus*. A very high number of interactions is reported	Known.	Silvani et al., 1992
Harpoons	Italy, Turkey	April-August	Mediterranean	*Xiphias gladius, Thunnus thynnus, Tetrapturus belone*	*S. coeruleoalba, Grampus griseus, Physeter macrocephalus, Ziphius cavirostris, D. delphis*.	Known: reports of deliberate harpooning in the 1980s, no recent cases recorded;	Di Natale, 1992
Drifting long lines	Spain, Italy, Greece, Albania, Turkey, Cyprus, Lebanon, Egypt, Libya, Tunisia, Algeria, Morocco, Malta	March-December	Mediterranean	*Xiphias gladius, Thunnus thynnus*	*Stenella coeruleoalba*, *Grampus griseus*, *T. truncatus*, *Pseudorca crassidens*, *Globicephala melas*, *Ziphius cavirostris*, *Physeter macrocephalus*, *Balaenoptera physalus*	Known: probably low level	Duguy *et al*. 1983; Di Natale & Mangano, 1983; Di Natale, 1992 Di Natale *et al*., 1993
Drifting long lines	Spain, Italy, Greece, Albania	Spring-Autumn	Mediterranean	*Thunnus alalunga* and other small tunas	*S. coeruleoalba, T. truncatus*..	Frequent interactions are already reported	Di Natale *et al*., 1992
Pelagic pair trawl	Italy	All	Mediterranean	Pelagic schooling species	*T. truncatus*	Known	Vallini, pers.com
Pelagic trawl	France, Italy	All	Mediterranean	Demersal species	Delphinids	Suspected, by analogy	No

Gear Type	**Nation**	**Season**	**Location**	**Target species**	**Bycatch species**	**Known or suspected**	**Monitored/ Estimated**
Encircling gillnets	Spain, Italy, Greece	Spring-Summer	Mediterranean	*Boops boops, Oblada melanura, Belone belone, Spicara spp.* other small and medium size pelagic species	*Tursiops truncatus*	Suspected	Goodson *et al*., 2001
Bottom long lines	Spain, Italy, Greece, Albania,	All	Mediterranean	*Merluccius merluccius,* Sparidae spp., *Lepidopus caudatus*		Suspected: fishermen report sporadic interactions	
Rod and reel	Spain, France, Italy	Spring-Summer	Mediterranean	*Thunnus thynnus*		Suspected: fishermen report sporadic interactions	
Hand-line	Spain, Italy, Greece	Sping-Summer-Autumn	Mediterranean	*Thunnus thynnus*		Suspected: fishermen have reported a few interactions	
Jigging line	Spain, Italy, Greece	May-September	Mediterranean	*Todarodes sagittatus, Illex* sp.		Suspected: Very frequent interactions are reported by fishermen	

3. Approaches to reducing the impact of fishing

3.1 Effort reductions

In general a reduction in fishing effort should lead to a reduction in bycatch. Reductions in fleet capacity are therefore one way to reduce cetacean bycatch but unless they are targeted in some way they are unlikely to produce more than a proportional reduction in bycatch. In many cases management objectives will demand a much larger reduction in bycatch than is politically or economically acceptable in terms of simple effort reduction. In this case it is desirable to be able to reduce fishing effort in a targeted manner so that a little effort reduction results in a large bycatch reduction. The simplest way to address this is to consider restricting fishing effort within certain times or certain areas with a high bycatch rate.

The subgroup noted, however, that where effort reductions were being implemented across several gear types for other management objectives, reductions of effort in those gears with the highest bycatch rates would achieve a proportionally greater reduction in bycatch than would be achieved by equal reductions across all gear types.

3.2 Time and Area closures

The subgroup was broadly in agreement with the advice from the ICES Advisory Committee on Ecosystems (ACE) on this matter. For closures to be effective they must be directed towards areas or times of relatively high bycatch, and they should also be framed within some management target for bycatch reduction.

It was noted that if an area is closed to a particular gear type, either permanently or seasonally fishermen may either switch to a different and permitted gear type or they may move away from the area and continue fishing with the same gear elsewhere. Only in very special circumstances will there be a total removal of the fishing effort – for example if fishermen are compensated financially to stop fishing.

The environmental effects of either of these consequences need to be considered in any management strategy. For example, the consequences of the switch in gear use need to be fully explored, ideally before the closure is implemented, but at least by monitoring the new gear type. It is possible, for example, that the replacement fishing gear may have an equally high or higher cetacean bycatch rate. Alternatively it may be that the alternative gear has some other undesirable consequence, such as a high bycatch of some other protected species. Clearly a responsible management authority should guard against causing an additional problem, and management actions should be framed within broader conservation considerations.

If the fishery is likely to be displaced by an area closure, then a prior assessment should be made of where the fishery is likely to be displaced to, and what the consequences of such a displacement may be on the intended bycatch reduction.

The subgroup also stressed the need to continue monitoring any closed area or season, assuming fishing of some sort continues inside or outside the closure, in order to assess the effects and ensure that management goals are achieved. Results of this monitoring could be used to improve the effectiveness of the closure by changing it in space or time.

The subgroup also recognised that for closures to work the spatial or temporal aspects of bycatch rate should be predictable. Thus if an area with high bycatch rate is identified, managers must be confident that this is not a transient or a random effect, and that fishery closure in that area will have long term benefits. Continued monitoring is therefore required after the closure is implemented to ensure its efficacy.

It was pointed out that temporal closures do not need to be on a monthly or seasonal scale, but that diurnal patterns of bycatch, if or where they are evident, might be used to control fishing activity on a diurnal basis.

The scale of any candidate closure areas needs to be considered in relation to the distribution and movements of the cetacean species at risk of being bycaught.

The subgroup concluded that for closures to work suitable times or areas need first to be identified, and then (in most cases) the likely effects of the closure need to be modelled by making predictions on how and to where fishing effort will be redirected. The effects of such redirection of effort then need to be considered in relation to the management goal to determine if the closure will be effective. Such considerations would need to consider any possible changes in gear type, relocations of effort or possible changes in cetacean distribution.

After reviewing Table 1, and considering the above points, it was concluded that at present there were no obvious areas in the European Union where fishery closures should be proposed.

3.3 Protected areas and sanctuaries

The subgroup was aware of only one or two area in European seas where an area had been closed to certain fisheries as a means of minimising bycatch. The Italian government banned driftnet fishing in the Ligurian Sea Sanctuary in 1992 to minimise bycatch of cetaceans. The result was that some 22 local boats switched to long-lining, a method of fishing which has been associated in the Mediterranean (and elsewhere) with bycatches of turtles. Vessels from other areas, which had previously fished in the Sanctuary, moved their areas of operation elsewhere, with unknown consequences on the overall bycatch of cetaceans in the Mediterranean.

The Ligurian Sea Sanctuary was established because of the perceived high densities of cetaceans in this area, and because of perceived high bycatch rates. There was no management plan to reduce cetacean bycatch to a predetermined level, and with no such target it was not possible to assess the extent to which Mediterranean cetacean bycatch had in fact been reduced as a result of the banning of driftnets in that region.

In this respect the Ligurian Sea is more like a protected area, as discussed in the ACE report, where an area has been set aside as having intrinsic value, and fisheries and other activities should be controlled to minimise adverse human impacts. The subgroup recognised that the establishment of protected areas may have value in achieving such goals. It however cautioned that management solely within protected areas, such as Special Areas of Conservation (under the EU Habitats Directive), sanctuaries and reserves, is less likely to be as effective in achieving bycatch reduction goals than specifically targeted and adaptable fishery restrictions in times and places that have been identified as having a high bycatch.

The subgroup reviewed some material presented on the establishment of a marine reserve around the German island of Sylt (Sonntag *et al* 1999). This area had been established due to a perceived high level of calving activity in the area. The subgroup considered that management within the reserve area was unlikely to have any significant benefit to North Sea harbour porpoise population in terms of bycatch reduction.

In Greece there is a protected area for monk seals in the Sporades, northern Aegean, with absolutely no fishing allowed in the area. This will have the additional effect of eliminating any cetacean bycatch in this area.

It was noted that reserves are often areas of high productivity and so may also be preferred by fishermen and that this can cause a conflict of interest. It was suggested that monitoring and controlling fisheries might be a better way of achieving management objectives rather than excluding fishing boats from an area.

3.4 Pelagic trawl mitigation

An exclusion device has been tested in the UK bass pair trawl fishery and although more trials are still needed in order to assess its effectiveness in reducing cetacean bycatch the results obtained seemed promising. The modification introduced into the net included a widely spaced rigid grid that would allow dolphins and other larger animals to escape through an outlet built into the sleeve of the trawl. Tests of pingers deployed around the mouth of bass trawls during 2001 proved ineffective.

Further acoustic mitigation trials are planned for the Irish albacore pair trawl fishery starting in July 2002. The CETACEL project (de Haan *et al* 1997) suggested that dolphins might feed in the mouth of the trawl. It was speculated that bycatches might occur as a result of boats changing speed or direction. This could cause a considerable change in the opening of the net, thus reducing the area through which dolphins can escape. It is planned therefore to activate an acoustic alarm in the back of the net to encourage dolphins out of the net before any ship manoeuvre occurs. Two types of wide-band acoustic deterrent devices placed towards the back of the net will also be tested to see if these would reduce dolphin bycatch.

During discussion of the Saver device (see section, 3.5), the subgroup learned that a more robust version of the Saver (mounted in stainless steel) than the standard plastic device has been developed for use in pelagic trawls. Trials are underway on Dutch trawlers working off Mauritania where there is a reported high bycatch of dolphins. Eight Savers were being tested per trawl net.

Although there are currently no proven means of minimising bycatch in pelagic trawl fisheries other than effort reduction, the subgroup agreed that the development of mitigation methods should be encouraged and developed as a more appropriate course of action than closure of seasons / areas. It was noted that an understanding of animal behaviour is of critical importance in development of any such methods. Different approaches to gear modification may have to be considered depending on the fishery concerned, the target species and the behaviour of both the target and the bycaught species.

3.5 Acoustic devices

3.5.1 Available devices

Presentations on the Saver and the AQUAmark acoustic deterrent devices (colloquially known as pingers) were given by representatives of their manufacturers. Both of these device types use digital signal synthesis techniques to create a variety of wide band signals. These were contrasted to the simpler tonal pingers that have been used in the USA. The features of these and other devices are summarised in Table 3.

The SaveWave Dolphin Saver device was designed primarily to prevent damage to Greek set fishing nets, where bottlenose dolphin predation on fish and damage to nets causes problems to fishermen. These problems have reportedly led to the illegal killing of dolphins. There are as yet no published studies on their efficacy in reducing dolphin damage, but the Savers are being field tested in summer 2002.

Savers are sold through the Internet, and current costs are advertised at €42.25 per device for orders of 100 units or more. The small PP3 battery is moulded with the electronics in a replaceable core, and replacement cores are advertised at €35. Under the current configuration the Saver has an operating life of about 350 hours. It was reported that this could be boosted for other applications by lowering the sound pressure level which is set at 155 dB re 1μPa @1m to try to minimise predation damage to nets by dolphins. It was reported that 8500 orders have been received from the Greek market, and that the production capacity could be increased to 15-25,000 units per month after some small technical developments.

The sub-committee noted that Savers have not yet been tested as a means to reduce cetacean bycatch in set-net fisheries, but also noted that the acoustic signals described appear similar to those produced by the AQUAmark, and are also programmable.

The subgroup heard that the AQUAmark 100/200 devices were developed from the earlier PICE range of pingers, including a range of technical improvements and requested management features. The AQUAmark 300 device was developed solely to meet the current US NMFS specification for a pinger, producing 10Khz tones at 4-second intervals.

AQUAmark 100 devices have been used in the Danish North Sea wreck net fishery for cod since 2000, and have been effective in reducing observed harbour porpoise bycatch to zero.

The AQUAmark 200 devices have been used experimentally in the French Thonaille tuna driftnet fishery, successfully reducing striped dolphin bycatch by 87.3% (Imbert *et al.* 2002).

The AQUAmark 100/200 devices were shown to reduce dolphin predation on Sicilian gillnets and trammel nets in 1999/2000 (Goodson *et al*. 2001) and they are currently being tested on trammel nets in Greece with the same aim.

AQUAmark 100/200 devices have an operating life of around 10,000 hours, while the AQUAmark 300 device has a slightly lower operating life due to the short inter-pulse interval specified under US regulations. Around 3000 AQUAmark devices have been supplied for use in the North Sea and Mediterranean so far. Current production capacity is around a few hundred per week, but this can be relatively easily upgraded to several 1000 per month with a new in-house moulding capability. AQUAmark devices cost about €100 each but they have longer expected lifetimes than other devices (Table 3).

The subgroup did not have the same opportunity to review the details of other commercially available acoustic deterrent devices, but some of these are catalogued in Table 3

3.5.2 Future developments and concerns

Amundin presented two papers on interactive pingers – acoustic deterrent devices whose sound is triggered by porpoise clicks (Amundin *et al*. 2002a, b). Porpoises can be stimulated to echolocate towards the devices by the occasional transmission of an artificial porpoise 'feeding buzz'. Open sea trials of the concept are planned for summer 2002.

A paper reviewing the applications and uncertainties surrounding the use of pingers was submitted to the subgroup by the International Fund for Animal Welfare (McLachlan 2002). The subgroup welcomed this attempt to assemble information on the possible disadvantages of pingers, but noted factual and technical errors in several areas. The subgroup could not agree with the overall conclusions of this paper.

3.5.3 Appropriate technical specifications for acoustic deterrent devices (pingers)

The subgroup had a long discussion on the most appropriate specifications for pingers or acoustic deterrent devices. It was again noted that there are differences among the acoustic properties of the devices on the market. There was general agreement that **devices considered suitable for use should have proven aversive abilities within the fishery and for the species giving concern**.

Two of the currently available devices (AQUAmark, Dukane) fitted this definition for bottom-set gill nets and porpoises and therefore could be regarded as suitable standards that any further pinger should equal or exceed in these circumstances. It was noted field trials to demonstrate operational effectiveness were needed in addition to evidence of aversion by the species of concern to the specific acoustic signal of any new device. Controlled experiments were important, but experimental protocols need not necessarily reach double-blind standards. It should not be necessary to conduct full-scale trials with control nets, as these would lead to further cetacean mortality, if a suitable level of aversion to the acoustic signal could be demonstrated in the field.

It was noted that the management framework that would be necessary to implement a bycatch reduction scheme would also have observers (both to determine if the devices were working technically (enforcement) and to determine bycatch levels). It would thus be possible to adjust the use of acoustic deterrents or their technical specifications in the light of future experience.

Table 3. Characteristics of acoustic deterrent devices

Manufacturer	**Airmar Technology Corporation**	**AQUAtec Sub Sea Ltd.**	**Dukane Corporation**	**Fumunda Marine Products**	**SaveWave BV**
Web site URL	www.airmar.com	www.netpinger.net	[www.dukane.com]	www.fumunda.com	www.savewave.net
Models	Gillnet pinger	A) AQUAmark 100 B) AQUAmark 200 C) AQUAmark 300	A) NetMark 1000 B) NetMark 2000	FMDP-2000	Saver
Unit cost (for a 100-unit order)	$55	€100	(Sales discontinued, but still widely in use)	$80	€42.25
Current production potential (per month)	500 in stock, thousands per month "given enough lead time"	"several thousand per month" with the new in-house moulding facility	Zero	"Thousands"	15-25,000 "after some small technical developments"
SIGNAL CHARACTERISTICS					
Signal synthesis	Digital	Digital	Analogue	Digital	Digital
* Tonal/wide band	Tonal	Wide band / tonal	Tonal	Tonal	Wide band
* Source levels (max - min) re 1 µPa@1m	132 +/- 4 dB	145 dB	130-150 dB	132 +/- 4 dB	155 dB

Manufacturer	**Airmar Technology Corporation**	**AQUAtec Sub Sea Ltd.**	**Dukane Corporation**	**Fumunda Marine Products**	**SaveWave BV**
* Fundamental frequency	10 Khz	A, B: 20-160 KHz wide band sweeps C: 10 KHz tonal	10 KHz	10 KHz	30-160 KHz randomised sweeps
High frequency harmonics	Yes	A, B, C Yes	Yes	No	Yes
* Pulse duration (nominal)	300 ms	300 ms	300ms	300ms	100-900 ms randomised
* Inter pulse interval	4 seconds	A, B: 4 -30 seconds randomised; C: 4 seconds	4 seconds	4 seconds	4-26 seconds randomised
Note that for digitally synthesised signals, some signal characteristics can generally be reprogrammed by the manufacturer if necessary for specific applications					
POWER CHARACTERISTICS					
Battery type and number	1 Alkaline “D” cell	1 Alkaline “D” cell	4 Alkaline “AA” cells	1 lithium	Sealed 9v unit
Operating life of battery (continuous use)	> 8700 hours (1 year)	13,000 – 17,000 hours (1.5 - 2 years)	~ 800 hours	~1100 hours (15 months)	350 hours
Wet switch	No	Yes	A- No B- Yes	Yes	Yes
Battery change possible?	Yes	No	Yes	Yes	No

Manufacturer	**Airmar Technology Corporation**	**AQUAtec Sub Sea Ltd.**	**Dukane Corporation**	**Fumunda Marine Products**	**SaveWave BV**
Battery disposal	By operator	20% discount for returned spent units against replacement units	By operator	By Operator	Sealed unit returned for 20% discount on new unit
IMPLEMENTATION CHARACTERISTICS					
Size (length, max diameter, mm)	156 x 53	140 x 56	168 x 55	152 x 46	202 x 67
Weight in air (g)	400	370	400	230	400
Weight in water		120			
Attachment details	3-way holes each end	1 hole at one end	3-way holes each end	3-way holes each end	One hole at each end
* Spacing along nets (max recommended)	100m	200m	100m	100m	200m
Test for failure	Signal is audible	Ultra-sonic testing device	Signal is audible	Signal is audible	Ultra-sonic testing device
Housing material	Plastic alloy	Urethane		co-polymer	
SUCCESSFUL FISHERY TRIALS REPORTED					
A: Bycatch reduction					
Species/fishery:					
Harbour porpoise		Larsen 1999 (A)	Kraus *et al* 1997		

Manufacturer	**Airmar Technology Corporation**	**AQUAtec Sub Sea Ltd.**	**Dukane Corporation**	**Fumunda Marine Products**	**SaveWave BV**
Bottom set nets					
Common dolphins in drift nets		-	Barlow and Cameron 1999		
Striped dolphins in drift nets		Imbert *et al* 2002 (B)	-		
B: Net damage reductions					
Bottlenose dolphins set net fisheries		Goodson *et al* 2001 (A)			

* These characteristics are stipulated by, or are a consequence of, US Federal regulations for devices used in the USA

On the subject of the need to limit the source level (and therefore disturbance) it was noted that aversion needed to be proportionate to risk and not excessive in order to avoid adding extra noise to the environment. Such extra noise might cause needless exclusion of cetaceans from habitat. It was eventually agreed that 155 dB re 1μPa @1m would be a suitable upper limit for signal output from deterrent devices deployed in static gear fisheries. This was chosen on the basis of the specification of devices that were currently available. Trawls, being inherently noisy moving devices, might require greater source levels but the disturbance induced would be transitory. A research "exemption" clause would be sensible in any prospective regulation, particularly if this allowed the technical development of improved devices that might minimise environmental impacts. An experimental switchable acoustic device with a source level of around 165 dB re 1 μPa at 1m is currently being tested with pair-pelagic trawls in Ireland. (Goodson *et al*. 2002).

3.5.4 Use of acoustic deterrent devices in fisheries to limit dolphin depredation

It was noted that Greek waters would shortly experience the greatest application of acoustic deterrent devices in European waters with the arrival of 8500 units. This application was being done by fishermen privately, outside of any management framework, and was being undertaken to reduce damage to nets. Such damage to nets had led to dolphins being shot. Thus indirectly, deployment of devices would help to reduce cetacean mortality.

It was noted that this usage blurred the boundary between use of pingers to improve fishing operations and the use of pingers to reduce bycatch. It was also noted that it was difficult to have any management input to such privately funded deployments.

In summary, it was noted that there could be both positive and negative environmental consequences of any deployment of acoustic deterrent devices and that the balance between these usually needed to be assessed on a case-by-case basis. Several management tools could be used to assess this balance (for instance environmental impact assessment), but in general fisheries managers do not use these tools at present.

3.5 New netting material

Larsen *et al* 2002b examined the effectiveness of gillnets impregnated with iron oxide in reducing porpoise bycatch. No porpoises were caught in these nets compared with eight in control nets. This significant result was attributed to the stiffness of the net, rather than its acoustic reflectivity. Unfortunately, the catch of a main target species, cod, was also significantly reduced, especially in the large fish sizes usually caught by entanglement rather than gilling. In discussion, it was noted that such reductions in cod catch might be beneficial in some fish-stock management circumstances.

3.6 Other gear modifications.

It was noted that statistical modelling of observer-collected bycatch data from gillnet fisheries has shown significant differences in catch rates between nets of different twine diameter (Palka 2000), and between monofilament and multi-monofilament nets (Northridge *et al*. 2001.). In principle, managers could exploit such differences to reduce bycatch. However, in a controlled experiment in which multi-monofilament nets had been tested against monofilament nets no difference in porpoise bycatch rate had been found, in contrast to the observer-scheme analyses (Northridge *et al*. 2001). It is therefore difficult to be sure of inferences made from observational data, and these should not be used to devise management strategies without first being tested.

4. Update of information on monitoring of bycatch and enforcement of mitigation measures

In response to its third term of reference, the subgroup attempted to update information in its previous report on enforcement and effectiveness of actions being taken at regional, national and international levels on monitoring and surveillance of cetacean bycatches and on the implementation of mitigation measures.

Apart from the Danish cod wreck net fishery and the French Thonaille fishery (see below), the subgroup was not aware of any further fisheries where mitigation measures were being implemented in EU waters.

4.1 Baltic Sea, Belt Seas and the Bights, Kattegat and Skagerrak

4.1.1 Byatch monitoring

Bjornesson (2002) reported that there had been two harbour porpoise bycatch records in the Swedish Kattegat during 2001. This represents a six-fold decrease since 1986, in line with the six-fold decrease in gillnet fishing effort in this area over the same period (60.8 million m.hours in 1996 to 10.8 million m.hours in 2000).

Analysis of the distribution of 112 recorded bycatches in the Swedish Kattegat during the 1990s showed no obvious spatial patterns that might be useful in determining potential closed areas.

4.1.2 Mitigation measures

The ASCOBANS Recovery Plan for Baltic Harbour Porpoises (also known as the Jastarnia Plan) was introduced and its background and history noted. The main element needed to enable recovery of the Baltic harbour porpoises is to reduce bycatch in fisheries. The recommended methods to achieve this are :

a) Reduction in fishing effort in driftnet and bottom-set gillnets;

b) Change of fishing methods away from driftnet and bottom-set gillnets towards alternative gear that carries less risk of bycatch;

c) Compile fishing effort data in order to focus the above activities in space and/or time;

d) Implement a pinger programme on a short-term basis. These pingers should be targeted in specific ICES rectangles and in Puck Bay, Poland initially. The plan had been agreed at the recently completed ASCOBANS Advisory Committee meeting along with a prioritised implementation plan. The Advisory Committee had commended both to Parties of the ASCOBANS agreement and will shortly do so to competent fisheries authorities.

Following discussion, the subgroup noted that:

a) There was no reason to believe that pingers would not work on nets in the Baltic.

b) Although Polish waters are presently outside European Union waters, it might be possible to influence decisions about Puck Bay during the accession negotiations of Poland.

c) It was unlikely that any study of mitigation in the Baltic would be able to demonstrate a statistically-powerful result in the short-term, owing to the rarity of harbour porpoises.

d) The decision to exempt the salmon drift net fishery from the EU wide restriction on length (2 km) of such nets was based partly on advice from STECF in February 1995 (SEC (95) 550). This reads: "*Harbour porpoises (Phocoena phocoena) are the only cetacean for which there are records of captures in driftnets in the Baltic. Historically, some were captured by driftnets. However, harbour porpoises are rare at present in the Baltic and mainly occur in the Danish Belts and western Baltic where there is no salmon driftnetting*."

These statements are correct in as far as they go, but the logic of deriving a decision to exempt Baltic driftnets from the EU-wide restriction deserves comment. First, it is widely agreed that incidental mortality in fishing gear (including driftnets) has played a major role in reducing porpoises to a small fraction of their historical abundance in the Baltic Sea, and is now helping prevent their recovery (see e.g. Lindroth 1962, Christensen 1991). Even in 1995 there was a requirement for harbour porpoises to be protected and restored to 'favourable conservation status' under the EU's Habitats Directive (92/43/EEC). Further there is (and was) clear evidence that this is Europe's most critically endangered small cetacean population. Second, the relationship (although not precisely known) of those harbour porpoises occurring in the Baltic to those occurring in nearby waters (i.e. Kiel and Mecklenburg Bights and the Danish Belts) differs at the stock level. This difference had been asserted by 1995, and further genetic evidence has been published since. It appears that either STECF was unaware of the above information or that it chose to ignore it. It seems a little odd that the driftnet fishery for large pelagic fish was eventually banned partially on grounds of its impact on small cetaceans, whereas this fishery that has a proportionately much greater effect on a small cetacean population was not even restricted.

4.2 North Sea

Given this evidence, we **recommend** that the decision to exempt the Baltic driftnet fishery from the length restriction imposed on other such fisheries be reversed and that, in view of the extremely poor state of the Baltic harbour porpoise population, a timetable be established for eventual prohibition.

4.2.1 Population estimates

Although there have been no new estimates of population size in the North Sea, the results of the SCANS project have recently been published in the peer-reviewed literature (Hammond *et al*. 2002). The subgroup noted again that this was the only large-scale survey of cetacean abundance conducted so far by EU member states, and that its results were already rather dated. A second SCANS project is currently being planned.

4.2.2 Bycatch monitoring

Two papers presented recently to the Scientific Committee of the International Whaling Commission were reviewed. The first (Vinther and Larsen 2002) answered some of the comments on extrapolations of bycatch in Danish bottom-set fisheries in the North Sea. These extrapolations had been previously based on a formula related to landings, while the revised figures are based on a formula that includes effort (days at sea). The new method indicates a higher bycatch than that indicated previously. These estimates may be further refined prior to formal publication of the paper.

Table 4. Revised estimates of harbour porpoise bycatch by fishery and season (quarter of year) for Danish bottom set gill net fishing in the North Sea (Vinther and Larsen 2002).

Fishery	Season	1987	1988	1989	1990	1991	1992	1993	1994
Cod, wreck	1,2 and 4	97	99	89	104	102	117	116	123
	3	276	405	383	173	291	386	606	555
Cod, other	1 and 3	1410	1342	1217	919	1076	1307	1603	1578
	2 and 4	236	323	294	401	386	443	428	456
Hake	all	119	160	212	268	405	541	697	493
Turbot	2 and 3	2719	3229	2547	3067	3033	2577	2245	2534
Plaice	all	465	380	231	260	1018	1172	1014	1627
Sole	all	0	0	0	0	0	0	0	0
All	all	5322	5938	4973	5191	6312	6543	6709	7366

Fishery	Season	1995	1996	1997	1998	1999	2000	2001	Mean
Cod, wreck	1,2 and 4	117	121	130	148	126	106	67	111
	3	568	475	587	738	511	570*	405*	462
Cod, other	1 and 3	1546	1472	1514	1943	1705	1420	950	1400
	2 and 4	435	445	538	565	411	413	261	402
Hake	all	381	189	119	142	217	181	158	285
Turbot	2 and 3	2366	1999	1402	1034	737	985	1144	2108
Plaice	all	1325	1292	1018	636	521	475	903	822
Sole	all	0	0	0	0	0	0	0	0
All	all	6737	5991	5308	5206	4227	4149	3887	5591

* Bycatch in this fishery is overestimated, as the effect of the use of pingers has not been taken into account.

Larsen *et al* (2002a) demonstrate a complete elimination of observed bycatch in the Danish North Sea wreck gillnet fishery in the third quarter of the year due to the deployment of pingers. Bycatch estimates above were made without considering the numbers of animals likely to have been saved by the use of pingers. Assuming 100% effectiveness, these would have amounted to 570 animals in 2000 and 405 in 2001. Larsen *et al* (2002a) also noted the unmonitored use of pingers by an unknown number of fishermen using gears other than cod wreck nets in the Danish North Sea set net sector.

Northridge (pers. comm.) reported a further 42 hauls observed in the UK North Sea herring trawl fishery and c.10 in the UK North Sea mackerel trawl fishery, with no cetacean bycatch recorded.

4.3 Atlantic

4.3.1 Population estimates:

McLeod (2002) provides an estimate of Atlantic white-sided dolphins in the Faroese Shetland channel of around 21,000 (10,000-45,000) animals in 1998. Baines *et al.* (2002) reported two estimates of the number of bottlenose dolphins present in the Cardigan Bay area of Wales in 2001, these were 135 (95% CL 85-214) and 213 (95% CL 183-279) animals based on line transects and photo-id capture-recapture assessments respectively.

4.3.2 Bycatch monitoring:

During the early months of 2002 over 130 common dolphins had been reported stranded on the south coast of England, and over 350 on the west coast of France. A high proportion had evidence of mortality due to bycatch in fishing nets.

The subgroup noted that information of Spanish bycatch monitoring compiled in its previous report had been incorrect, and Lens provided information to update the previous report.

Pelagic and large vertical opening (VHVO) trawl fisheries

Spain

The observer programme of the Institute of Fisheries Research of the Basque Country (AZTI) was started in 1996 and has continued until the present covering the Basque VHVO pair trawl fishery in ICES areas VIIIa,b,c, and d. During the period 1996-2000, 661 hauls, spread over 266 fishing days on 72 trips were observed in this fishery. A total of 24 small dolphins were caught in Areas VIIIa,b and d, but none in area VIIIc.

As part of a monitoring programme carried out in 1997, the Spanish Institute of Oceanography (IEO) observed two hauls of a VHVO pair trawler working in ICES area VIIIc. No incidental catches were reported.

The UK has monitored 229 tows in the UK mackerel, bass, pilchard, blue whiting and anchovy fisheries operating in ICES division VII (mainly in the Channel). Lethal dolphin bycatch had been recorded in the bass fishery only, with 53 common dolphins reported taken in 11 tows among 120 monitored in 2001, and 8 common dolphins recorded taken in 2 tows among 66 observed in 2002. Mitigation trials have also been undertaken (see section 3.5).

Other fisheries

Spain

An observer programme carried out by the Spanish Institute of Oceanography (IEO) during 1994 in ICES areas VI, VII, VIIIa, b, c and IXa, funded by the EC (PEM93/5) did not report any bycatch in 1627 bottom trawl hauls, 547 longline hauls or 249 purse seine hauls (Pérez *et al*., 1996). A further observer programme was carried out by IEO in 1997 that covered 439 bottom trawl hauls and 45 bottom pair trawl hauls in ICES areas VIIIc and IXa. Only one incidental catch was reported (involving three animals) in the pair trawl working in area IXa. In 1999 and 2000, IEO monitored a further 1759 bottom trawl hauls and 67 pair trawl hauls. One common dolphin was taken in ICES Area VII (Lens pers. comm.).

During 2001 Spanish observations of 330 trawl tows in the Bay of Biscay, 250 tows of pair trawls and 12 coastal gillnet fishing trips yielded no observations of cetacean bycatch (Lens 2002).

Other countries

An observer programme is currently underway among UK gillnet and tangle net fisheries in the Channel and Celtic Sea.

Fishing Effort Statistics

Morizur (pers. comm.) presented some updated information on French fishing effort during the year 2000 for the Atlantic area. 520 French netting vessels worked for a total of 5000 months during 2000; these boats included 390 dedicated netters and 130 multi-gear vessels. Pelagic trawlers (mainly pair trawlers) consist of 70 full time pelagic boats and 140 mixed (demersal/pelagic) vessels. In the albacore pelagic trawl fishery 65 boats were linked to 149 months of fishing effort. In other pelagic trawl fisheries the effort amounted to 1480 fishing months among 200 boats.

Pelagic and other similar wide-opening trawl fisheries

Spain

Spanish fleets are prohibited from using pelagic trawls by national regulation. A new Spanish gear with a very high vertical opening (VHVO also called Naberan trawl) appeared in the Bay of Biscay in the early 1990s. This gear is used by pair trawlers and in 1992, 22 Spanish Basque boats working in pairs and targeting hake (STECF 1996) used it. Between 1997 and 2000, there were 27 pairs working with VHVO in ICES area VIIIa,b. These vessels fished for 4856 days spread over 932 trips in 2000 (Lens, pers. comm.).

Other fisheries

Spain

Information on Spanish trawl and purse seine fisheries in the Atlantic is given in Table 5. This is a revision of Table 2.30 given in CEC 2002

Table 5. Spanish trawl and purse seine information.

Area	Gear	Year	Boats	Effort	Source
VIIIc	bottom trawl	2000	77	12377 fishing days; 8189 trips	Lens, this meeting
VIIIa,b	bottom trawl	2000	24	2451 fishing days; 412 trips	Lens, this meeting
IXa	bottom trawl	2000	88	14855 fishing days; 8598 trips	Lens, this meeting
VIIIc	pair trawl	2000	37 pairs	3378 fishing days; 3133 trips	Lens, this meeting
VIIIa,b	pair trawl	2000	27 pairs	4856 fishing days; 932 trips	Lens, this meeting
IXa	pair trawl	2000	18 pairs	2917 fishing days; 2917 trips	Lens, this meeting
IXa_south	bottom trawl	2000	255	29876 fishing days	Lens, this meeting
IXa_south	purse seine	2000	102	10405 fishing days	Lens, this meeting
IXa_south/ inshore	Artisanal	2000	386	27430 fishing days	Lens, this meeting
Offshore Galicia	Trawls	1998	243	51669 trips	Pierce *et al*. 2001
VIIIc, IXa (inshore Galicia)	Trawls	1998	250	59367 trips	Pierce *et al*. 2001

4.4 Mediterranean

4.4.1 Mitigation measures

Imbert *et al* (2002) presents the results of bycatch mitigation trials involving 5 boats in the French thonaille fishery. It was noted that unpingered control nets monitored during 2001 showed similar bycatch rates to the nets monitored in 2000. An 87.3% reduction in striped dolphin bycatch was observed among nets equipped with AQUAmark 200 deterrent devices. The results are summarised below.

Table 6: Results of mitigation trials in the Thonaille fishery using the AQUAmark 200 deterrent device (from Imbert *et al* 2002)

Deterrent device	No of hauls (h)	No of dolphins (n)	Bycatch rate n/h
Present	27	2	0.074
Absent	12	7	0.58
$\chi^2 = 12.25$ (1 df) (significant at the 0.5% level); 87.3% reduction in catch rate.			

Caminas and Valeiras (2001) describe bycatch rates of cetaceans in Spanish Mediterranean longline fisheries. Among 291 longline sets observed in 1999, 3 entangled cetaceans were recorded, while 12 cetaceans were also recorded among 507 sets in 2000. Striped dolphins and Risso’s dolphins as well as a single unidentified beaked whale were involved.

Gazo and Aguilar (2002) describe an experimental test of AQUAmark 100 deterrent devices aimed at minimising net damage and fish depredation in Majorca. Significant reductions in damage and an increase in fish catch for those nets in which active pingers were deployed were recorded.

The subgroup noted several relevant ongoing or imminent research programmes in the Mediterranean. A field trial of the Sea Wave Saver device is underway in Paros, Greece, to examine efficacy in relation to net damage caused by bottlenose dolphins. Further studies of the efficacy of AQUAmark devices in reducing dolphin damage to gill and trammel nets are also underway in Corisca, Sardinia and Italy, while regional funding for further such work has also been approved in Sicily as an extension to the ADEPTS programme (Goodson *et al* 2001).

4.4.2 Management measures

The subgroup heard that the French authorities had established an agreement with French Thonaille fishermen in the Mediterranean for the mandatory use of acoustic deterrents in this fishery in order to minimise striped dolphin bycatch. The Naval Authorities monitoring the fishery had adopted a 'zero tolerance' approach, with non-compliance being met with large fines. One contravention had been recorded in 2001.

The subgroup noted information submitted by the ACCOBAMS secretariat in the form of an Action Plan for the Mediterranean area. The subgroup noted that there was little in terms of cetacean population assessment in the Plan. Actions directed towards bycatch-related activities included the proposed establishment of a cetacean bycatch database and the promotion of research into interactions between coastal populations of dolphins and small-scale fisheries. The subgroup suggested that these proposed activities did not coincide with its proposed priorities for bycatch assessment and mitigation by EU member states. The subgroup recognised the importance of International Agreements such as ACCOBAMS in co-ordinating actions to address bycatch, but also noted that neither France nor Italy have ratified ACCOBAMS.

5. The Design of Monitoring Schemes.

The subgroup noted that under the Habitats Directive there is an obligation for member states to establish monitoring schemes to quantify the incidental capture of cetaceans. The subgroup was only aware of any such current schemes in Denmark, the UK and Spain, though plans were also reported to be underway in France.

5.1 Method

Several methods have been used to estimate cetacean bycatch rates in the past. It is generally accepted that the only reliable method involves the use of independent observations of fishing activity. The existence of cetacean strandings schemes in several countries was noted. These schemes have a value in potentially highlighting the existence of a bycatch problem, but the subgroup reiterated its view that such schemes were not adequate to quantify the scale of any cetacean bycatch.

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 may be recorded in terms of the number of animals per day at sea, per fishing activity (tow or net haul), or by some measure of fishing effort such as tow time, net length or net length x soak time. Observer schemes are only useful for estimating total bycatch where there is also an adequate measure of total fleet activity. Furthermore, observer schemes can only provide a minimum estimate of bycatch. Even the most vigilant observer will miss some events. Animals that are trapped in fishing gear underwater, but which then fall from the gear before it is hauled back to the boat, for example, will almost never be counted. Observers must also be able to see the net or other gear as it reaches the boat and the catch and bycatch are removed. During the hours of darkness this ability may be compromised, depending on the lighting conditions, and this can also lead to underestimation.

The subgroup noted that discard-monitoring programmes could sometimes provide data for monitoring bycatch of cetaceans. However, fisheries with significant bycatches of cetaceans are not necessarily covered by discard-monitoring programmes and furthermore such programmes often do not have the observer effort or expertise required to estimate cetacean bycatch reliably.

It was noted that it might yet prove possible to develop appropriate technology to monitor bycatch rates remotely, without the use of observers, for example by the use of video cameras.

The subgroup stressed the need for the observer data to be as representative as possible for the fleet for which the observed estimate of bycatch rate is being extrapolated to (see our last report (reference) for a discussion of extrapolation methods). This is especially relevant with respect to selection of the vessels covered by the observers. It was noted that lack of space was a frequently used reason for not taking observers on board and that this could lead to biases in observer data.

The subgroup discussed the difficulties involved in trying to place observers with vessels where space was limited or where vessel owners or skippers were reluctant to take observers. It was suggested that whenever public funds are used to build new vessels or improve existing ones, the creation of additional bunk space for an observer should be required.

The specific data to be collected will vary between fisheries, but should as a minimum include those necessary for estimation of a bycatch rate, which can be extrapolated to the whole fleet including the unsampled vessels (see IWC 1997 and Northridge 1996 for examples of data to collect). However, the collection of data that will improve the existing knowledge of both the fishery and the cetaceans in question should be encouraged. The subgroup also noted the importance of collecting relevant fishery-related information that can be used to evaluate the validity of the observer data.

5.2 Observer effort required

The observer effort required will depend on the objectives of the monitoring program, e.g. whether it is for estimating total bycatch for management purposes or for keeping an eye on the level of bycatch in a particular fishery. This also means that the effort required to some extent will depend on previous knowledge of the fishery. The minimum required effort will depend also on the particular fishery as well as on the abundance of the cetaceans caught by the fishery.

It is difficult without a good knowledge of the fishery and the cetaceans to determine the appropriate level of sampling. However, the subgroup considered, based on experience from existing and previous monitoring schemes, that an initial sampling level of 5-10% of the total, annual fleet effort is necessary in most fisheries to determine the approximate level of bycatch. A power analysis based on these initial data will then help to determine what level of precision might be expected from what levels of observer coverage. It was suggested that a statistically meaningful level of observer coverage would be one providing a CV (coefficient of variation) of the estimate of total bycatch similar to the CVs of the population size estimate for the cetaceans in question.

5.3 Fisheries to be investigated

Existing monitoring programmes within the EU include dedicated cetacean bycatch monitoring in some fisheries in the UK and monitoring of cetacean bycatch using discard programs in Denmark and Spain. In most other fisheries the necessary data are unavailable even to begin considering the observer effort necessary for monitoring cetacean bycatch.

However, the subgroup considered that in areas where there are known problems of cetacean bycatch, observer schemes should be established that would allow estimation of total bycatch with a CV less than 0.3.

In other areas, and as a preliminary step, observer coverage in fisheries that are thought to have a cetacean bycatch should be initiated at a level somewhere between 5 and 10% of total effort in order to obtain preliminary information on the statistical distribution of observed bycatch and in order to be able to stratify any necessary further sampling in a more reliable manner.

The subgroup did not have adequate information to calculate the required observer coverage levels to achieve a CV of less than 0.3 for any EU fisheries, though this computation should be possible for those few fisheries where cetacean bycatch estimates have already been made. The subgroup was able to identify those broad fishery categories where it thought sampling is most necessary, both in Atlantic and Mediterranean waters (Tables 7 & 8).

Table 7. Atlantic fisheries that require monitoring

Fishery	Countries	Coverage (% effort) required
PRIORITY 1		
Driftnet	Baltic nations	Critical bycatch fishery; coverage as high as is feasible.
Pelagic pair trawling in Biscay Celtic Sea and Channel for hake, bass, anchovy, sardines, horse mackerel, mackerel, albacore	France, Ireland, UK	Minimum of 5-10%, but as high as feasible during December- March when mass strandings of bycaught dolphins occur. Total effort unknown; *see **text below for UK and France***.
Pelagic trawling (single boat) for mackerel, herring, blue whiting etc	France, UK, Ireland, Netherlands, Denmark	Minimum of 5-10%, but as high as feasible during December- March. Total effort unknown. ***See below for UK and France***.
Fixed nets in Atlantic, Irish Sea, Channel waters for various species including hake, monkfish, crabs, flatfish	France, UK, Ireland, Spain, Portugal	5-10%, but total effort unknown. Some sampling already in some sectors of the UK and Irish fleets.
Fishery	**Countries**	**Coverage (% effort) required**
PRIORITY 2		
Pelagic trawling in the North Sea, Baltic, Kattegat and Skagerrak	Denmark, Sweden, Norway, UK, Germany	5-10%, but total effort unknown.
Trawling – high aperture demersal pair	Spain	5-10%, but total effort unknown.
Purse seines	Spain and Portugal	5-10%, but total effort unknown.
Inshore driftnet fisheries for bass, salmon, sardines	UK, Ireland	5-10%, but total effort unknown.
North Sea, Baltic, Skagerrak and Kattegat fixed nets (gill & tangle) for cod, pollock, flatfish, monkfish, skate, saithe, crayfish etc	Denmark, Sweden, Norway, Finland, Germany, UK, Netherlands, Belgium	5-10%, but total effort unknown. Extensive sampling already in Danish fisheries and some in UK fisheries.
Fish traps (pound nets) for salmon, cod, lumpfish	Denmark, Germany, UK	5-10%, but total effort unknown.

Although the subgroup was unable to determine total fishing effort for most of the fisheries listed in Table 7, information was available for UK and French pelagic trawling in the Biscay – Channel area. Both French and UK pelagic trawling in these areas require monitoring for cetacean bycatch, as do vessels from other nations including the Netherlands, Denmark and Ireland. Among French métiers those of most concern are bass in ICES areas VII ad VIII, albacore in areas VII, VIII and IX, because of proven non-negligible cetacean bycatch. Pelagic trawling for anchovy in area VIII should also be monitored because of the relatively high level of fishing effort in this métier. These métiers combined contribute approximately 770 fishing boat-months of effort per year, so that 77 man months would be needed to monitor 10% of the total fishery effort in these métiers. The approximate cost of this monitoring would be around €462,000, assuming a rate of €500 per observer day at sea. A proportionately higher observation rate would be appropriate between December and March.

The UK fleets fishing in this area (mainly ICES Area VII) using pelagic trawls (pair trawling and single boat) fish for mainly for mackerel, horse mackerel, bass, sprats, herring and sardines. Over a five-year period to 2000, UK pelagic trawlers fished for around 1500 days at sea in the area annually. Again, assuming a 10% monitoring rate, 150 observer days at sea would be required annually, at a notional cost of €75,000. Again, an observation rate greater than 10% would be appropriate in the winter months.

Information on fishing effort in this region by Dutch, Danish, Irish and other pelagic trawlers was not available to the subgroup.

Bycatch monitoring in the Mediterranean is made difficult both by a lack of information on fleet activities (distribution and levels of effort), and by the fact that many of the relevant fleets consist of large numbers of small boats, which makes sampling difficult. It is clear that more attention needs to be devoted to determining effort levels in most Mediterranean fisheries and to finding ways of implementing monitoring schemes in large fleets of small boats.

Table 8. Mediterranean fisheries that require monitoring

PRIORITY 1			
Fishery	Country	Coverage	Notes
"Thonaille"	France	10% of fleet	An observer scheme is currently in place. 10% coverage needs 5 observers for 7 months.
Pelagic trawl and pair trawl	Italy, France	10% of the fleet (min. 2 vessels)	Urgent. By-catch is reported to occur. No data are available on fleets and effort.
Bottom set gillnets	Spain, France, Italy, Greece	5-10% of each fishery with problems (min 2 vessels)	Information of effort levels is absent. Many fisheries consist of small boats. Most interactions relate to damage to nets by dolphins and deliberate killings.
PRIORITY 2			
Fishery	Country	Coverage	Notes
Jigging line	Spain, Italy, Corsica, Greece	5-10% of each fishery with problems; Minimum of 2 vessels per fishery through one year	Information of effort levels is absent. Many fisheries consist of small boats. Most interactions relate to damage to nets by dolphins and deliberate killings. Fishing is carried out at night, which presents problems in identifying the species involved.
Purse seine for small pelagic	Spain, France, Italy, Greece	5-10% of the fleet, with area coverage	This fishery is usually carried out at night, and space on board is limited. No effort data are available.
Bottom trawls	Spain, France, Italy, Greece.	5-10% of the fleet, with area coverage	Mostly related to gear damage and potential deliberate killing.

PRIORITY 3			
Fishery	Country	Coverage	Notes
Mid-water set gillnets	Spain, France, Italy, Greece	5-10% of the fleet, with area coverage	No effort data; limited space on board most vessels.
Tuna purse seine	Spain, France, Italy, Greece,	10% of the fleet	Between 25 and 30 observers are estimated to be needed to cover the EC Mediterranean fleets, for a period of about 6 months.
Encircling gillnets	Spain, Italy, Greece	5-10% of the fleet, with area coverage	Information of effort levels is absent. Many fisheries consist of small boats. Most interactions relate to damage to nets by dolphins and deliberate killings.
Surface long-line	Spain, Italy, Greece	5-10% of the fleet	No effort data are available.

In the Mediterranean bycatch by fleets of non-EU countries add to the pressure on cetacean populations. Efforts to promote monitoring by these countries should be encouraged. It would be particularly useful to gain information on drift net bycatches particularly by the larger fleets of Turkey and Morocco.

Information available to the subgroup indicates that a monitoring programme is needed in the trawl fishery (both pelagic and bottom) carried out by the Community's fleets in Mauritanian waters. These waters are important for cetaceans and hold the world's largest rookery of the highly endangered monk seal. One of the most important marine parks in Africa (Parc National du Banc d'Arguin) occurs on this coast.

6. Management framework

6.1 Management objectives

Before a management scheme can be designed, the management goal must be defined. Within the context of cetacean bycatch, the goal is often defined as a mortality limit and is usually set as a proportion of the size of the population, with the ultimate goal of reducing bycatch to zero or close to zero. For management purposes it is therefore important that units of management be defined and alongside this, knowledge of the population size and level of removal be quantified. Managers need to assess the significance of the mortality with respect to its impact on the size and productivity of the affected cetacean population and its relationship with other ecosystem components (such as carrying capacity[1]).

The need for a clear and transparent management plan is important, not only because it develops a framework and timescale to decrease bycatch levels, but it also allows for the identification of critical areas and/or fisheries or species. Further, reasoned responses to fishery-related mass mortalities events can be developed; these are often perceived by the public and media as significant whereas from a population stand point this may not be the case. For example, the entanglement of a single North Atlantic right whale (population approximately 300) or a Baltic Sea harbour porpoise (population <1000) is of much greater concern at a population level than the entanglement of several common dolphins from a population of 200,000.

A number of fora have set management goals or recommended levels of "sustainable" bycatch. The Scientific Committee of the International Whaling Commission (IWC) considered a bycatch level of 1% to be a threshold for concern for harbour porpoise populations. It agreed that bycatches should not exceed 50% of the maximum growth rate of a population (R_{max}). However, given the uncertainty in R_{max} (see below), and uncertainty in estimates of both bycatch and abundance (the ratio of these two estimates will be subject to a wide confidence interval); it was decided that 1% of the estimated abundance was a reasonable and precautionary level beyond which to be concerned about the sustainability of anthropogenic removals (Bjorge and Donovan, 1995).

Other fora (e.g. ICES, ASCOBANS, US federal authorities) have included the maximum potential annual growth rates (R_{max}) in setting limits to bycatch levels. Such limits have been calculated for very few small cetacean species, but for harbour porpoises, for example, this was conservatively estimated at between 4 and 5% (Woodley and Read 1991; Caswell *et al*. 1998). Using the objective of rebuilding populations to 80% of carrying capacity, or maintaining them there, and an R_{max} of 4%, ICES considers an annual bycatch mortality rate of 1.7% of a small cetacean population is the maximum that could safely be sustained. In the USA, a mortality limit is calculated on a stock by stock basis, with the goal of allowing each stock to reach or maintain its optimum sustainable population (defined as a population level between carrying capacity and the population size at maximum net productivity). Under the EU Habitats directive, the requirement is to maintain cetaceans at 'favourable conservation status'.

After some discussion, the subgroup recommended that maintaining stocks at 80% of K, or allowing them to recover to such a level over an infinite time horizon, would be an appropriate goal.

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[1] Ecological carrying capacity (K) is usually defined as the number of individuals that the resources of a habitat can support. In management terms it is the hypothetical population limit with no human impacts.

6.2 Monitoring and Surveillance

Along with the development of a management framework, the subgroup considered it imperative that observer schemes be established, especially in fisheries where there is an existing cause for concern. It noted that the EU fisheries data collection scheme was due for review in 2003 and recommended that at a minimum, marine mammal bycatch be recorded and ideally that coverage within this scheme be extended to obtain cetacean bycatch data at a statistically meaningful level. This topic was also discussed further under Section 5.

6.3 Estimating mortality limits

As mentioned previously, a number of different fora have set or recommended bycatch limits for small cetaceans. The value set by ICES of 1.7% is accepted as the basis for scientific advice until improved estimates of maximum population growth rates are available for the populations of concern, or until different management targets are adopted. Moreover, the maximum rate at which severely depleted populations can rebuild may be lower than 4%, due to demographic considerations, suggesting that bycatch rates substantially below 1.7 % per year could still deter rebuilding of depleted populations of cetaceans. ICES acknowledge that very little is known of the population structure of small cetaceans, but numerous studies suggest that at least some species do have some population sub-structure on geographic scales, for example, between the Mediterranean and NE Atlantic or within the North Sea. Therefore bycatch rates that are below 1.7% on the scale of the entire Northeast Atlantic may be much higher on scales of population substructures.

If the maximum sustainable bycatch rate is estimated to be 1.7% of a population annually, and this estimate is highly uncertain and takes no account of population structure, then within a precautionary approach bycatch rates well below 1.7% annually should be considered ‘significant’ (ICES 2001).

The Scientific Committee of the IWC has agreed that small cetacean bycatch should in no case exceed half of the maximum growth rate of a population. For harbour porpoises at least this Rmax value is unknown but could be lower than 4% per year. The 1% figure that the IWC adopted (“as a reasonable and precautionary level beyond which to be concerned about the sustainability of anthropogenic removals”) with respect to harbour porpoises was to allow for additional uncertainty over estimates of both bycatch and abundance.

In the USA, the management goal under the Marine Mammal Protection Act (MMPA) is to prevent population ‘depletion’. A population is considered depleted if it falls below the maximum net productivity level (MNPL), which is between 50 and 85% of carrying capacity (Wade, 1998). Monitoring populations to look for trends in estimates of abundance is difficult, because of inherent imprecision in surveys (high coefficient of variation (CV)).

Recognising this, and other problems, a management strategy based on calculating a mortality limit was devised (Wade, 1998). This limit is termed the Potential Biological Removal (PBR).

The term 'Potential Biological Removal level' is defined as the maximum number of animals that may be removed by human pressures from a marine mammal stock,whilst still allowing that stock to reach or maintain its optimum sustainable population. Since the goal of the PBR is to allow each stock to reach or maintain a population level above the net productivity level (MNPL), this puts the emphasis on monitoring bycatch levels, as opposed to detecting depletions.

The PBR is calculated as:

$$PBR = N_{min}\ ½\ R_{max}\ F_r$$

where:

N_{min} = minimum population estimate of the stock

½ R_{max} = one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size

F_r = a recovery factor between 0.1 and 1

With perfect knowledge, a mortality limit calculated as the product of N and R_{mnpl} would exactly maintain populations at MNPL. However, given the biases in abundance estimates (e.g. positive biases associated with line-transect methodology – attraction to vessels, over-estimation of group size or negative biases associated with distribution, migration), N_{min} is used. Similarly, ½ R_{max} is a conservative surrogate for N_{mnpl} (at 50% of K). F_r is an additional factor to account for additional uncertainties other than precision of the abundance estimate, for example stock boundaries, mortality estimates (Wade 1998).

The PBR has been subjected to a large number of "robustness" trials and the performance of the system evaluated under a number of different simulations and scenarios, including errors/biases in the abundance or mortality estimates (Taylor 1993). In these trials, a PBR calculated using the 95% lower confidence limit for N_{min} and a F_r of 0.5 resulted in all simulated populations being far above MNPL after 100years.

Wade (1998) further tested the robustness of the model by looking at simulations of the PBR under different management objectives and results from these trials indicated that using the 20th percentile of the abundance estimate for N_{min} would also meet the criteria of keeping populations above MNPL for a period of time.

Therefore, the PBR is flexible enough for use across a number of marine mammal species and management objectives. It requires the management goal to be defined and the mortality limit defined using only regular abundance estimate data and bycatch estimates, but obviously improves if other information is available, e.g. stock structure.

After discussion, the subgroup agreed that a PBR-type approach was very useful and should be adopted, incorporating the management goal of maintaining stocks at 80% of K. However, the subgroup also noted that other models currently being developed might also provide good frameworks, which could be evaluated in the future. In addition, it also noted that data on stock structure and reproductive rate(s) is poor and encouraged research into this in order to further refine the model.

6.4 Assessment

6.4.1 Estimation of population size and structure

It goes without saying that adopting a management framework requires information on the size and structure of the population(s). The subgroup recognises that the most recent abundance estimates for parts of the NE Atlantic and the North Sea were obtained in 1994 and that in some areas, for example, the Mediterranean and waters off Portugal there are no abundance estimates. Within the proposed framework, regular surveys must be carried out and new estimates derived.

In addition to that, research that would better elucidate stock structure within the various species of cetacean is encouraged.

6.4.2 Estimation of bycatch

The establishment of observer schemes to monitor cetacean bycatch in all European fisheries, particularly gillnet and pelagic trawl fisheries is imperative. In addition to this, the collection of effort data must be standardised and collated in a manner that will enable extrapolations to be made for the entire fleet. The subgroup has noted previously those fisheries that should be prioritised for monitoring.

6.5 Bycatch reduction plans

6.5.1 Bycatch reduction plans

If it is decided that there is excessive bycatch in a fishery or of a 'stock' of cetaceans, then bycatch mitigation is necessary. Based on experience from elsewhere in the world (e.g. the USA), it is most convenient to draw up and implement a bycatch reduction plan. If such a plan is to be successful, it is vital that the group devising the plan should be inclusive and should involve stakeholders, particularly fishers or their representatives. This approach has been taken in the USA with their Take Reduction Teams and by ASCOBANS in developing its recovery plan for harbour porpoises in the Baltic Sea.

In EU waters, the group devising the plan could operate on a national level, but it might be more suitable for these groups to be international. They could, for instance, meet within the context of the Regional Advisory Groups proposed recently by the European Commission as part of the reform of the CFP. Clearly, where more than one country is involved, multi-lateral reduction plans should be agreed between all relevant countries.

The basics of any planning should apply to bycatch reduction plans, and these should be detailed enough to define objectives, targets, who should do what and by when, how success will be measured and review arrangements to determine if the plan requires revision. Any necessary training arrangements, such as in the use of pingers, should be built into the plan. Incentives to ensure effective implementation of the plan should be considered. Elsewhere in the world (eastern tropical Pacific) eco-labelling of the fish product (dolphin-friendly tuna) has helped to gain acceptance by fishers. Eco-labelling could therefore be a means of providing incentives for fisheries to adopt and apply bycatch reduction plans if such labelling results in higher prices being paid for fishery products.

6.5.2 Enforcement

The enforcement of bycatch mitigation measures will differ depending on the strategy used. In relation to time/area closures, the current satellite-based system for monitoring large fishing vessels may be sufficient, but would not be suitable for smaller inshore boats. These might be monitored from land or by existing mechanisms to monitor other inshore fishery closures.

If pinger usage was required in a fishery, monitoring could be done in a variety of ways, depending on the region and fishery. Nets could be hauled, to check that pingers are deployed and functioning. Alternatively, hydrophones could be deployed to 'listen' for pingers. With existing technology it is possible to program individually recognisable acoustic codes into the signal of each pinger. If suitable monitoring devices could be developed this might provide a means of checking whether or not pingers were working while on actively fishing nets. A device that could detect whether the pinger was working whilst setting or hauling the gear was also suggested.

Clearly, all regulations for bycatch reduction, particularly pinger implementation needs to be carefully thought through, and regulations are likely to have greatest success if they are adopted or accepted by the fishers being regulated.

6.5.3 Surveillance/monitoring

After the plan has been implemented, it is essential that surveillance be continued. It is recommended that monitoring be at such a level as to ensure that the predicted reduction in bycatch can be confirmed over an extended time period. For example, to date, all research projects that have tested pingers have shown that while pingers significantly reduce bycatch, they do not completely eliminate it. In a 'pingered' fishery, it is important to have sufficient sampling to allow the detection of one dead animal. It is recommended that such a programme be incorporated into any bycatch reduction plan, along with the justification for continued monitoring. Monitoring results can further be used to determine any necessary adjustment of the bycatch reduction plan.

6.5.4 Pinger deployment and maximum pinger density

A number of issues relating to the wide-scale use of pingers were raised. Concern was expressed about the possibility of habitat exclusion if pingers were deployed over wide areas. As pingers are a relatively new deterrent, and have only been mandated in three US fisheries and the Danish wrecknet fishery, there has been little research into the zones of exclusion around fishing nets with the different types of pingers or different species of cetacean. Research into this is needed.

The subgroup considered that widespread use of pingers needed very careful consideration and recommended that bycatch reduction planners and managers should consider possible negative impacts through habitat exclusion when proposing their use. With this in mind, the subgroup recommended that pinger deployments should be limited to a level deemed sufficient to achieve the management goal, rather than applied as a blanket measure.

There was some discussion about the wide-range deployment of pingers or acoustic deterrent devices in areas to prevent damage to fishing nets or fish that have already been entangled, e.g. in the Mediterranean. As with deployment of pingers to prevent bycatch, concern was expressed about the ad-hoc use of pingers, in relation to habitat exclusion and to the possible habituation that might result from the use of pingers as deterrents of net damage. Such habituation might then affect the usefulness of pingers for bycatch reduction. It was considered that either fishers should obliged to declare their use of pingers or that a licensing scheme should be implemented for pinger usage.

6.5.5 A Management Framework Model.

The subgroup **concluded** that in order for the issues discussed above to be properly addressed, a management framework is required at a European level. The subgroup considered that such a framework should include the following points:

1. A Management Objective
2. Surveillance / monitoring schemes
3. Assessment programmes:
    - 3.1. Estimation of population size and structure
    - 3.2. Estimation of by-catch total
4. Establishment of a mortality limit, e.g.
    - 4.1. PBR
    - 4.2. Other modeling work
    - 4.3. Biological studies
5. Development of a By-catch Reduction Plan
6. Implementation Programme for by-catch reduction –
    - 6.1. Targets to be set
    - 6.2. Timeframes to be established
7. Enforcement Strategy
8. By-catch reduction surveillance / monitoring schemes
9. Feedback mechanisms

7. Recommendations

The subgroup agreed the following:

1. General

a) A management framework, such as that described in Section 6 above, needs to be implemented at an EU and other appropriate levels if cetacean bycatch is to be addressed adequately.

b) Any reduction in overall fishing effort is likely to reduce bycatch and therefore be an effective mitigation measure. However, limitation on the use of fishing gear, whether total or partial, could result in redistribution of fishing effort, either into other metiers, or into adjacent areas.

c) Bycatch 'hotspots' are few and might not be persistent over time. We do not recommend spatial closure on a small scale, without accompanying overall effort reduction, as an effective mitigation strategy.

d) Pingers (acoustic deterrents) should be used as a short or medium term mitigation measure, but because effectiveness and effects on distribution are still uncertain, pinger application must be monitored and evaluated.

e) Research that characterises and quantifies noise in the aquatic environment and that assesses the effects of acoustic deterrents on the general behaviour and ecology of cetaceans should be encouraged.

f) Further research into mitigation methods and alternative gears should be encouraged.

2. Baltic Sea

The subgroup endorsed the ASCOBANS Jastarnia Plan for the recovery of the harbour porpoise, and noted that the following specific measures, under that plan, should be implemented as soon as possible in Community waters and at the same time should be promoted for wider implementation within the Baltic.

g) Promote within the Baltic, via the IBSFC, the mandatory use of acoustic deterrent devices in gillnet (both bottom-set and driftnet) fisheries, on a short-term basis (2-3 years), in at least ICES Rectangles 3958, 4059, 4159 and 4160 (and the net fishery for salmon in Puck Bay). The choice of ICES rectangles reflects the fact that 71% of the reported harbour porpoise bycatch in Swedish Baltic waters between 1985 and 1998 occurred there. Moreover 81% of the total Swedish driftnet effort and 53% of the bottom-set gillnet effort in the Baltic in 1977 occurred there. The choice of Puck Bay reflects the fact that during the last decade, over 50% of the total reported bycatch in Poland was from this area, which constitutes 1.1% of Polish Baltic waters. More than 70% of the reported bycatch in this region has been in driftnets.

h) The maximum length of salmon driftnets should be brought in line with the length allowed for other community driftnet fisheries, i.e. 2.5km, and that, in view of the extremely poor state of the Baltic harbour porpoise population, the EU should press for a timetable to be established for eventual prohibition in the Baltic.

i) Measures should be taken by to reduce particularly the fishing effort of driftnet and bottom-set gillnet fisheries.

j) Trials of fish traps, fish pots, and longlines be initiated immediately, with the long-term goal of replacing gillnets in the cod fishery, particularly in areas where porpoises are known or expected to occur more frequently.

k) Serious consideration be given to replacing driftnets with longlines in areas where porpoise bycatch is known or likely to occur.

l) A study to compile data on fishing effort be undertaken to better target mitigation measures listed above.

3. North Sea gillnet fisheries

m) The subgroup endorsed the ICES advice that pinger use should be made mandatory in all cod wreck gillnet fisheries in the months August-October, in line with the Danish regulations, and in other set net fisheries using mesh sizes >=220 mm. These measures, however, should be contingent upon an analysis of existing bycatch and fishing effort data both to assess the likely effects of such actions, in terms of costs, pinger distribution and an estimate of the likely number of porpoises that might be saved.

4. English Channel and Celtic shelf gillnet fisheries

n) The subgroup endorsed the ICES advice that pinger use be made mandatory in the bottom-set gillnet fisheries within the known current range of harbour porpoises in this area. This is likely to approximately cover all shelf waters south of Ireland and west of Britain and France. The eastward limit in the English Channel and southward limit to the west of France require some further research but is likely to extend at least as far as 2^{o}W in the Channel and north of 47^{o}N in the Bay of Biscay. Work remains to be done to establish whether a sufficient reduction in bycatches could be achieved by targeting only boats above a certain size. This would limit pinger use and enforcement to the boats using the most netting, and minimise pinger deployment among some of the hundreds of small vessels working in these waters.

5. Biscay, Celtic Sea and Channel pelagic trawl fisheries

o) The problems regarding cetacean bycatch in the Celtic Sea/Biscay/Channel area need to be addressed urgently. There is as yet insufficient information upon which to base sound management advice. Observer programmes need to be fast-tracked in this area, on vessels from all member states active in the area. Although in general we have recommended that 5-10% of total effort should be monitored in such cases, in this instance we recommend that higher levels of coverage are implemented during December to March when there is most evidence of a bycatch problem in order to find out more quickly the nature and origin of cetacean bycatch mortality in this area.

6. Monitoring programmes

p) Monitoring programs, using independent observers, for information on by-catch of cetaceans should be extended to all fisheries with a potential high risk of by-catch, or those with severe predation interactions (see section 4).

q) There is insufficient information on bycatch in pelagic trawl metiers in general, mostly because of lack of independent observer schemes, to assess the risks to cetacean populations.

r) Further investigations be carried out to determine the effect of gear specification and fishing practice on by-catch, particularly in order to understand which factors induce high bycatch rates and to provide a basis for development of alternative gears.

s) Throughout Europe there is a lack of current information on cetacean population size and status. The subgroup recommends that population surveys should be conducted throughout EU waters and should be repeated at appropriate intervals to detect trends in abundance.

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