COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 3.4.2002
SEC(2002) 376

COMMISSION STAFF WORKING PAPER

SUBGROUP ON FISHERY AND ENVIRONMENT (SGFEN)

SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

INCIDENTAL CATCHES OF SMALL CETACEANS

Brussels, 10- 14 December 2001

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

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report summarises current information concerning the bycatch of small cetaceans in European fisheries, and makes some preliminary suggestions both for improving information on this subject and for addressing means of minimising such bycatches.

The occurrence of cetacean species of concern is listed and methods that are used to estimate their abundance are described in sections 2.1 and 2.2. Methods of estimating bycatch rates and methods used to extrapolate to total bycatches for an entire fishery is also described in section 2.2.

Current abundance estimates for all relevant species, as well as estimates of bycatch and estimates of fishing effort in relevant fisheries are described for the Baltic (2.3), North and Norwegian Seas (2.4), Atlantic (2.5) and Mediterranean (2.6) areas. Where mitigation measures have been attempted in these areas they are described in the appropriate sections too.

The methods that have been used to set limits to bycatch are described in Section 3. These include ‘rules of thumb’ proposed by the IWC and more stringent methods that have been derived in the USA under the Marine Mammal Protection Act. The deliberations of ASCOBANS on this subject are also briefly discussed.

For three species, namely the harbour porpoise, the striped dolphin and the common dolphin, there are estimates of both bycatch rate and abundance for some areas. These have been tabulated in section 4, and the bycatch rate compared numerically to the abundance estimates. In several cases bycatch rates exceed likely sustainable levels as described in section 3. It is noted however that in all cases there is insufficient information on population structure, and that in all cases bycatch estimates must be treated as minima, because several important fisheries have not been assessed for cetacean bycatch.

The subgroup agreed that it is currently impossible to attribute levels of risk to specific fisheries, but it was able to tabulate many fisheries where bycatch is know or suspected to occur, and to further tabulate those fisheries where rigorous estimates of cetacean bycatch are available (section 5)

Methods of bycatch reduction were discussed (section 6) including time and area fishery closures, effort reduction, gear modifications and acoustic alarms. There was insufficient time to examine any of these in much detail.

Methods of small cetacean bycatch reduction currently in place around the world were summarised (section 7). These include the Danish use of pingers in certain gillnet fisheries in the North Sea, the Take Reduction Team procedures implemented under the Marine Mammal Protection Act in the USA, and the specific fishery management plans adopted in New Zealand to protect Hector’s dolphin.

The Subgroup had insufficient time to elaborate on methods of establishing appropriate monitoring schemes (section 8), but agreed that these needed to be based on the use of independent observers and noted the existence of a report produced at the behest of ASCOBANS, which addresses this issue.

The subgroup decided to defer discussion of potential management frameworks to a later meeting.

The subgroup elaborated on future research and monitoring needs (Section 10), highlighting the lack of abundance surveys in many areas, and some of the problems inherent in estimating cetacean bycatch. Improvements in data collection were suggested to address some of these problems. Bycatch mitigation methods were also addressed and the group stressed among other things, the need to ensure that 'solutions' are effective once implemented in the real world. Several specific fisheries were highlighted as being in need of immediate further investigation, including gillnet fisheries in the Baltic, pelagic trawl fisheries in the Atlantic, Norwegian set gillnet fisheries and driftnets in the Mediterranean.

The subgroup agreed that a further meeting would be needed in May 2002 to complete its business.

1 INTRODUCTION

At its 11th meeting in November 2000, STECF was asked to address the issue of incidental catches of marine mammals with particular attention to small cetaceans; it was also asked to organise and develop terms of reference for a dedicated meeting of its Subgroup on Fishery and Environment (SGFEN) addressing the issue only on small cetaceans (SEC (2001)177). STECF emphasised that the issue of incidental catches of small cetaceans is one of the aspects of the broader problem of interference between marine mammals and fisheries. Due to sensitivity of the issue, STECF pointed out the need for making use of only robust scientific data and information and avoiding to make reference to suppositions. STECF identified a number of fisheries concerned by the problem, including, *inter alia*, drift nets and fixed-nets, purse-seiners, pelagic trawlers and long line fisheries. STECF recognised that the opportunistic predation on fishing gear by small cetaceans could be one of the reasons for the occurrence of unintentional bycatch. STECF also highlighted that another aspect of the problem, quite often neglected or not considered, concerns the damages caused by marine mammals to fishing gears.

The STECF Subgroup on Fishery and Environment (SGFEN) met at the Demot Building in Brussels from 10 to 14 December 2001.

The Chairman of the subgroup, Mr Simon Northridge, opened the session at 14.00.

The Secretariat of STECF welcomed the participants wishing them success in their deliberations.

The terms of reference for the meeting were surveyed and briefly discussed to arrange the details of the meeting. The session was managed through alternation of plenary and working groups meetings.

1.1 LIST OF PARTICIPANTS

The complete address of the participants is listed in **Appendix I**.

1.2 *TERMS OF REFERENCE*

SGFEN was asked to address the following issues:

1. Review and update existing data and information on small cetacean bycatch rates by fleet, season and geographic area (2.3.2; 2.4.2; 2.5.2);

2. Review and update information on small cetacean population abundance estimates and dynamics per species and geographic area. Give whenever possible trends in historic population sizes (2.3.1, 2.4.1, 2.5.1);

3. Assess the risks posed by fisheries to small cetacean populations (2.2.3; 2.4.3; 2.5.3; 5);

4. Prepare a list of fisheries (metiers) ranked according to the risk or threat to small cetaceans (5);

5. Review and update estimates of a maximum allowable level of anthropogenic mortality by cetacean species and advise on maximum bycatch rates by species and area; (3; 4)

6. Advise on possible approaches to reduce the impact of fishing; (6)

7. Review and summarise information on implementation of actions already taken at national and international level to monitor and survey cetacean bycatches and to enforce the use of mitigation devices; (7)

8. Conceive and design an observer sampling scheme suitable to monitoring cetacean by catches. An account of the human resources needed, on a permanent or seasonal basis, by "metier" should be addressed. (8)

9. Identify possible management frameworks, suitable to the European Community decision-making structure, to tackle the issue of cetacean bycatches; (8)

10. Indicate future research and monitoring needs for a greater knowledge of cetacean populations and the development of bycatch mitigation devices and practices; (10)

2 CURRENT SCIENTIFIC INFORMATION

2.1 *OCCURRENCE OF SMALL CETACEANS IN EU AND NEARBY WATERS*

Small cetaceans are defined in this report as all toothed whales (odontocetes) except the largest, the sperm whale *Physeter macrocephalus*. The following small cetacean species occur in EU waters. Several of these species (marked with an asterisk) are very rare or vagrant to EU waters and are not considered further in this report.

Sowerby's beaked whale	*Mesoplodon bidens*	
Blainville's beaked whale	*Mesoplodon densirostris*	*
Gervais' beaked whale	*Mesoplodon europaeus*	*
Gray's beaked whale	*Mesoplodon grayi*	*
True's beaked whale	*Mesoplodon mirus*	*
Cuvier's beaked whale	*Ziphius cavirostris*	
Northern bottlenose whale	*Hyperoodon ampullatus*	
Pygmy sperm whale	*Kogia breviceps*	*
Dwarf sperm whale	*Kogia simus*	*
White whale	*Delphinapterus leucas*	*
Narwal	*Monodon monoceros*	*
Harbour porpoise	*Phocoena phocoena*	
Rough-toothed dolphin	*Steno bredanensis*	*
White-beaked dolphin	*Lagenorhynchus albirostris*	
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	
Risso's dolphin	*Grampus griseus*	
Bottlenose dolphin	*Tursiops truncatus*	
Atlantic spotted dolphin	*Stenella frontalis*	*
Spinner dolphin	*Stenella longirostris*	*
Striped dolphin	*Stenella coeruleoalba*	
(Short-beaked) common dolphin	*Delphinus delphis*	
Fraser's dolphin	*Lagenodelphis hosei*	*
Melon-headed whale	*Pepenocephala electra*	*
False killer whale	*Pseudorca crassidens*	
Killer whale	*Orcinus orca*	
Long-finned pilot whale	*Globicephala melas*	
Short-finned pilot whale	*Globicephala macrorhychus*	

The report presents tables and text that relate to Areas, sub-areas and divisions that are already in use, or are proposed by the International Council for the Exploration of the Sea (ICES) or the General Fisheries Commission for the Mediterranean (GFCM) (Figures 2.1 and 2.2).

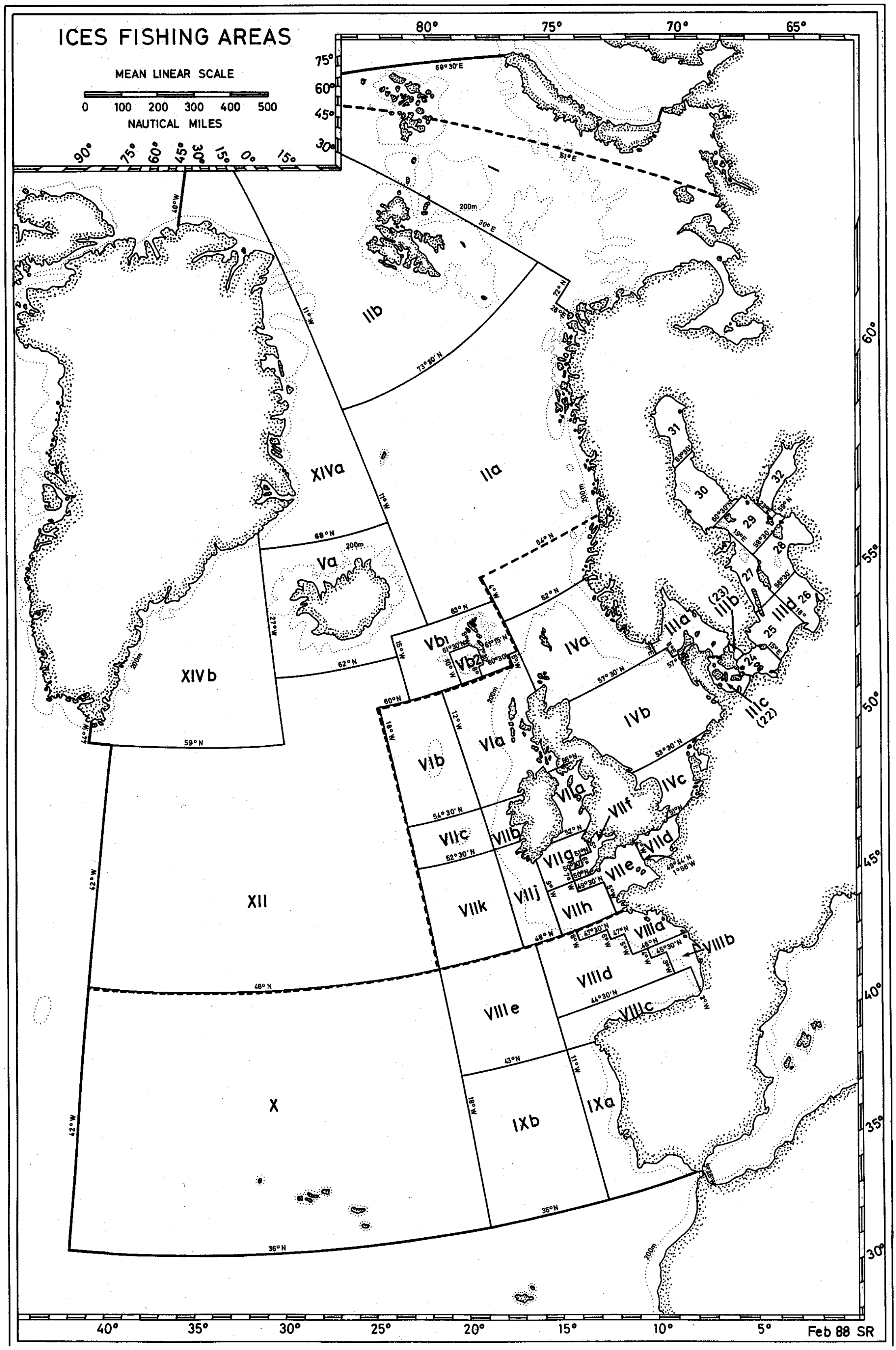

Figure 2.1 Map of the ICES Area with Areas, sub-Areas and sub-divisions.

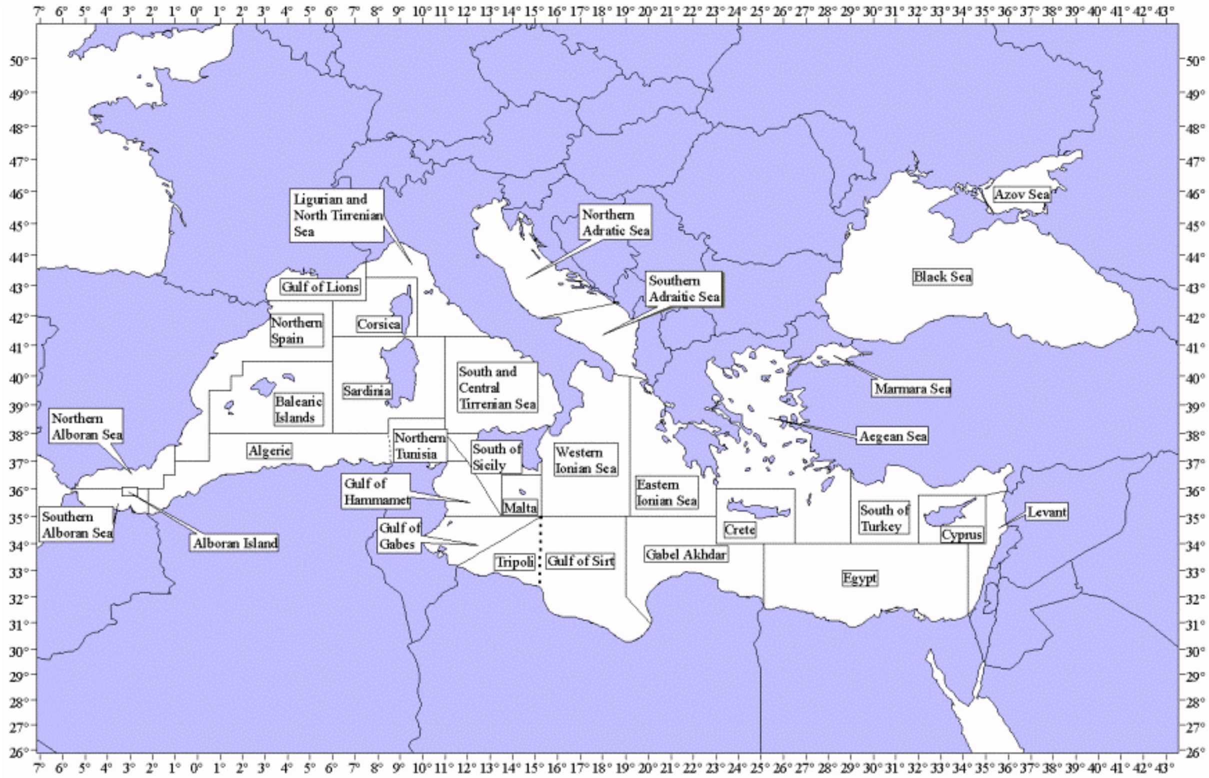

Figure 2.2 Map of Mediterranean with GFCM boundaries

2.2 *METHODS*

2.2.1 *Abundance estimation methods*

The group reviewed methods that have been used to estimate the abundance of cetaceans. It was noted that the estimation of cetacean abundance in a specified survey region is not equivalent to an estimate of population size, as biological populations may extend over wider areas, or conversely be contained within a sub area of the survey region. Abundance estimates may usually be considered to be snapshots of animal density and abundance over a short period of time. With highly mobile species such as cetaceans the actual density or abundance of animals within a survey region may vary considerably either seasonally or inter-annually if those animals range outside the survey area. For animals with seasonal migrations, an estimate of abundance in one part of the range should not be used as an indication of abundance throughout the year. Mark-recapture techniques can provide estimates of numbers over a longer time period (see below)

The most widely used method of estimating cetacean abundance is by line transect, and this is generally considered the most reliable (Buckland *et al.* 1993a). Ideally there are 2 independent teams of observers on the same platform (ship) one of which counts cetacean surfacings (cues) and estimate the distance and bearing of all such sightings in relation to the vessel's direction of travel so that the g(0) (probability of sighting the target on the trackline) and any responsive movements can be accounted for. The second team scans ahead of the vessel with binoculars to estimate the proportion of animals the main team is missing. Environmental parameters are also recorded, and the density of sightings is modelled according to a sighting rate function that declines from the trackline with distance from the ship. Survey blocks are allocated according to expected density and tracklines within blocks are placed randomly. Line transect methodology has been the subject of considerable statistical refinement and is generally held to be the most reliable means of estimating cetacean abundance.

Strip transect methodology assumes that all animals within a strip can be counted and therefore avoids the problems associated with estimating distance in line transect methodology. Strip transects have been used less regularly for estimating cetacean abundance but can be useful in some circumstances, notably in aerial surveys, though they are usually regarded as being less accurate than line transects.

In both strip and line transect surveys it is important to ensure that the area to be surveyed is chosen with due regard to the likely range of the animals concerned (i.e. at an appropriate spatial scale), is adequately stratified and that tracklines are randomised so that no part of the survey area is more likely to be surveyed than any other area.

Photo-identification studies have been used to provide capture-recapture estimates of abundance. Such studies only work where individual animals can be readily identified from fluke or fin markings, and work best for groups of such animals where there is a high probability of finding and identifying a substantial proportion of the group.

Acoustic methods are being developed to estimate cetacean abundance too. Towed hydrophones with automatic cetacean click of whistle detection software have been used to identify individual cetaceans and to track the movements of individuals. In theory such methods could also be used for line transect estimation, as bearing and distance from the trackline can be computed, but there are a number of practical and theoretical problems that remain to be resolved. Similarly hydrophones could be used to detect individual cetaceans using whistle or click signatures in a way that is analogous to photo-id capture recapture methods.

Sightings surveys on platforms of opportunity can also be used to detect trends in cetacean density in space and time. Photo-id and acoustic studies may also be used to investigate seasonal or other movements of animals that may help inform the design of abundance estimates and may also be useful in designing mitigation strategies.

There have been a number of abundance estimates in EU waters that are detailed in relevant sections below. However in order to give an idea of the distribution of small cetaceans, Table 2.1 indicates occurrence of regularly occurring species in EU waters by standard fisheries areas (either ICES or GFCM) and where there is at least a partial abundance estimate. It is rare for abundance estimates to be based on these fisheries areas; details of the sampling area checked for each abundance estimate are included in the relevant section below.

Table 2.1 Occurrence of the commoner small cetaceans in EU waters, divided by ICES/GFCM fishery area (see Figures 2.1 and 2.2).

Y = partial or whole abundance estimate available for area (see sections below); N = resident or regularly present, no abundance estimates; - = vagrant or absent. If a species is vagrant or absent from all of the areas in one of the following sub-tables, it is not included in that sub-table.

ICES Area	IIa	IIIa,b,c	IIId S 25,26	IIId rest	IVa	IVb	IVc	Va
Sowerby's beaked whale	N	-	-	-	N	-	-	N
Northern bottlenose whale	N	-	-	-	-	-	-	N
Harbour porpoise	Y	Y	Y	N	Y	Y	Y	N
White-beaked dolphin	N	Y	-	-	Y	Y	Y	N
Atlantic white-sided dolphin	Y	-	-	-	Y	Y	-	N
Risso's dolphin	-	-	-	-	N	N	-	-
Bottlenose dolphin	-	-	-	-	Y	-	-	-
Common dolphin	N	-	-	-	N	N	-	N
Killer whale	Y	Y	-	-	Y	Y	-	N
Long-finned pilot whale	Y	N	-	-	Y	-	-	Y

ICES Area	Vb	VIa	VIb	VIIa	VIIb	VIIc	VIId	VIIe
Sowerby's beaked whale	N	N	N	-	-	-	-	-
Cuvier's beaked whale	-	-	-	-	-	N	-	-
Northern bottlenose whale	N	N	N	-	-	-	-	-
Harbour porpoise	N	Y	Y	N	Y	Y	-	-
White-beaked dolphin	Y	N	-	-	N	N	-	-
Atlantic white-sided dolphin	Y	Y	Y	-	N	N	-	-
Risso's dolphin	N	N	N	N	N	N	-	-
Bottlenose dolphin	-	Y	N	Y	Y	N	-	Y
Striped dolphin	-	N	N	-	-	-	-	-
Common dolphin	N	Y	Y	N	Y	Y	-	Y
False killer whale	-	-	-	-	-	N	-	-
Killer whale	N	N	N	-	N	N	-	-
Long-finned pilot whale	Y	Y	Y	N	N	N	-	N

ICES Area	VIIf	VIIg	VIIh	VIIj	VIIk	VIIIa	VIIIb	VIIIc
Cuvier's beaked whale	-	-	-	N	N	N	N	N
Harbour porpoise	Y	Y	Y	Y	N	N	N	N
Atlantic white-sided dolphin	-	N	-	N	N	N	N	-
Risso's dolphin	-	N	N	N	N	N	N	N
Bottlenose dolphin	Y	Y	N	N	N	Y	N	N
Striped dolphin	-	-	N	Y	Y	Y	N	N
Common dolphin	Y	Y	Y	Y	Y	Y	N	N
False killer whale	-	-	-	N	N	-	-	N
Killer whale	-	N	N	N	N	-	-	N
Long-finned pilot whale	N	N	N	Y	Y	N	N	Y
Short-finned pilot whale	-	-	N	-	-	-	-	-

ICES Area	VIIId	VIIIe	IXa	IXb	X	Mad	Can

Cuvier’s beaked whale	-	-	-	N	N	N	N
Pygmy sperm whale	N	N	N	-	-	-	N
Harbour porpoise	-	-	N	-	-	-	-
Atlantic white-sided dolphin	N	-	-	-	-	-	-
Risso’s dolphin	N	N	N	N	N	N	N
Bottlenose dolphin	N	N	Y	N	N	N	N
Atlantic spotted dolphin	-	-	-	-	N	N	N
Striped dolphin	Y	Y	N	N	N	N	N
Common dolphin	Y	Y	N	N	N	N	N
False killer whale	N	N	N	N	N	N	N
Killer whale	N	N	N	N	N	N	N
Long-finned pilot whale	Y	Y	N	Y	Y	-	-
Short-finned pilot whale	-	-	-	-	-	N	N

GFCM Area	SAS/A	NAS	Alg	BI	NS	GoL	LNTS	Cor
Cuvier’s beaked whale	N	N	N	N	N	N	N	N
Risso’s dolphin	N	N	N	N	N	N	N	N
Bottlenose dolphin	N	N	N	N	N	N	N	N
Striped dolphin	Y	Y	Y	Y	Y	Y	Y	Y
Common dolphin	Y	Y	N	N	N	N	N	N
Short-finned pilot whale	N	N	N	N	N	N	N	N

GFCM Area	Sar	SCTS	NT	SoS	GoH	GoG	Malta	Trip
Cuvier’s beaked whale	N	N	N	N	N	N	N	N
Risso’s dolphin	N	N	N	N	N	N	N	N
Bottlenose dolphin	N	N	N	N	N	N	N	N
Striped dolphin	N	N	N	N	N	N	N	N
Common dolphin	N	N	N	N	N	N	N	N
Short-finned pilot whale	N	N	N	N	N	N	N	N

GFCM Area	GoS	GA	WIS	EIS	SAS	NAS	Crete	Aeg
Cuvier’s beaked whale	N	N	N	N	N	-	N	N
Harbour porpoise	-	-	-	-	-	-	-	N
Risso’s dolphin	N	N	N	N	N	N	N	N
Bottlenose dolphin	N	N	N	N	N	N	N	N
Striped dolphin	N	N	N	N	N	N	N	N
Common dolphin	N	N	N	Y	N	N	N	N
Short-finned pilot whale	N	N	N	N	N	-	N	N

GFCM Area	Egypt	SoT	Cypr	Leva
Cuvier’s beaked whale	N	N	N	N
Risso’s dolphin	N	N	N	N
Bottlenose dolphin	N	N	N	N
Striped dolphin	N	N	N	N
Common dolphin	N	N	N	N
Short-finned pilot whale	N	N	N	N

2.2.2 Bycatch estimation methods

There are several methods that 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 group agreed that methods that rely on fishermen providing information on bycatch rates are intrinsically unreliable and likely to be biased. Logbook and reporting schemes that have been tried in several countries around the world where independent observer schemes have also been in place show that the returns by fishermen may be an order of magnitude or more smaller than bycatch estimates derived from the parallel observer schemes. Nevertheless such schemes may be useful in identifying fisheries or areas where cetacean bycatch might require more detailed monitoring.

Stranded animals likewise, when subjected to an appropriate diagnostic examination to establish cause of death as bycatch, can be used to identify the existence of a bycatch problem in an area. Strandings records cannot be used to estimate the magnitude of any such bycatch in a fishery, except the absolute minimum, because the rate at which bycaught and discarded animals are washed ashore is highly variable and unpredictable.

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. Such measures need to be comparable with some measure of fishing activity that is available for the whole fleet, including the unsampled boats, if the observed estimate of bycatch rate is to be used to extrapolate a total bycatch figure. Observer schemes are only useful for estimating total bycatch where there is an adequate measure of total fleet activity.

The establishment of observer schemes to monitor cetacean bycatch is an obligation for member states under the Habitats Directive.

Power analysis prior to the establishment of the scheme will help to determine what level of precision in the estimation of bycatch rate might be expected from what levels of coverage. A power analysis requires prior information about the expected statistical distribution of bycatches, and this is not always possible, though comparisons with adjacent areas or similar fisheries may provide some first approximations. The level of coverage will always be constrained by the costs of the exercise, and some trade off between cost and expected accuracy is inevitable.

Certain fisheries are more difficult to observe than others, and the problem of small boats in particular was raised. Small boats may be too small to carry an observer with any reasonable level of safety. It was suggested that fishing activities of such fleets might sometimes be observed from another nearby platform, such as a clifftop, or a patrol vessel. Such techniques have been employed to monitor small vessel gillnet fisheries of the U.S. Atlantic and Pacific coasts (ICES 1998). Also, the bycatch rate of a fleet of small boats could be addressed by sampling only the largest boats in the fleet so long as they are fishing in the same manner and area as the smaller ones.

The possibility of remote monitoring by use of on-board video cameras was also raised, and although this has not to the group's knowledge been tried anywhere, it is technically possible.

Observer schemes rely on having appropriate personnel available to do the work, and must also pay due regard to national shipping regulations and to safety and insurance matters.

Finally, it was noted that observer schemes, although recognised as the most accurate means of obtaining bycatch rates, can only ever 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 always escape being 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.

2.2.3 Extrapolation methods and effort data collection

2.2.3.1 Extrapolation methods

Extrapolation factors are required in order to produce an estimate of total bycatch for a fleet that has been sampled by observers. The raising factor used should be one that has a linear relation to bycatch; in other words whatever unit of fishing effort is used, twice as much bycatch should be observable where there are twice as many effort units. The effort units available vary from country to country, and depend on the method of fishery data collection. Units that have been used include the weight of the landed catch, the number of days at sea, the number of fishing operations, and a measure of fishing effort such as, for gillnets, km of netting or km netting x soak time, or for trawls, tow time.

The landed weight of a target fish species is normally an easy statistic to obtain, but has several problems. First, the declared landings need to be accurate, as under-reported landings will bias a bycatch estimate as much as they bias the catch estimate. Secondly, it must be assumed that the number of cetaceans per tonne of fish landed remains constant over the sampling period. As fish catches per unit effort tend to vary in relation to fish stock size (CPUE is not constant) it cannot be assumed that the bycatch rate of a cetacean in relation to fish catch will remain constant over time.

For fisheries where it has been possible to obtain estimates of bycatch per unit catch for one year, it is dangerous to extrapolate other years unless there is some independent way to show that the catch per unit effort has not changed between the two time periods.

For some fisheries where it has been possible to obtain estimates of cetacean bycatch on an annual basis, this may not be a problem when the sampling rate is high enough. Incidental catches can require a significant sampling rate (in the French albacore driftnet study the sampled trips were 30% of the fleet fishing effort). When the sampling effort is weak, the raising factors deduced from landings and fishing effort can be very different. As an example the "Bycatch and discarding in pelagic trawl fisheries" study presents a low sampling rate in the various French fisheries investigated because of to the great number of seasonal targets involved.

Table 2.2 shows that the extrapolation factor can be different according to the raising method chosen when sampling rate is low. It is quite obvious that the bycatch estimates can vary strongly according to the method. When both landings and effort data are available, the raising method to be chosen depends whether the incidental catches are linearly related to fishing effort or whether the presence of cetacean bycatch is more closely related to the abundance of the target species.

Table 2.2 Sampling rates and extrapolation factors by landings or by fishing effort in some French pelagic trawl fisheries.(Morizur *et al*. 1997)

Fishery	Sampled tows	Sampled trips	Sampling rate by		Extrapolation factor by	
			Landings	Fishing effort	Landings	Fishing effort
Hake	52	7	0.42%	0.20%	238	500
Albacore	43	4	2%	1.1%	50	91
Bass	10	2	3.2%	0.07%	31	1428

2.2.3.2 Fishing effort data

'Days at sea' is a standard measure of fishing activity and therefore a proxy for fishing effort in many places. It has the advantage that it is less likely to be misreported than the landings are where fisheries are regulated by catch quotas. A day at sea can represent a very different amount of fishing effort for vessels of different sizes or other categories. If this measure is used it is important that the observer scheme is appropriately stratified to ensure that fishing effort is approximately equal for vessels within each category or stratum before the total bycatch is extrapolated.

For gillnets and trawls, the number of hauls or tows, where these data are collected, is probably a more accurate measure of fishing effort and therefore more closely related to the number of animals expected to be bycaught.

In some gillnet fisheries the catch per net km.hour (net length x soaktime) is the best predictor of bycatch rate across vessel sizes, though this measure is rarely if ever available in the official fleet records. In other gillnet fisheries bycatch is not related to net length or soaktime, and is best expressed in terms of the number of hauls.

Regardless of which measure of fishing effort is to be used, it is critical for the estimation of total bycatch that the fleet effort records are made available. Not infrequently fleet effort data are not made available for researchers to extrapolate total cetacean bycatches, and clearly this is an undesirable situation.

Logbook data, which typically record measures of fishing effort as well as catches, are often not used for assessment purposes but are maintained solely for enforcement, and so the relevant effort data are not available. Again this is clearly an undesirable situation with regard to bycatch estimation. Furthermore, logbook and other records of fishing effort, are typically organised as though the standard method of fishing is the trawl. Thus effort measures are collected in terms of duration of fishing activity and KWhrs rather than number of nets hauled or net lengths.

In most European waters, including the Mediterranean from 2000, logbooks are mandatory for all boats over 10m. If these logbook data were collected adequately and stored for assessment purposes, rather than used simply for enforcement, they could provide a very valuable record of standardised fishing effort for the entire European fleet over 10m.

Those vessels under 10m are more problematic, and as they are often very numerous, especially in the Mediterranean, some measure of fishing effort also needs to be obtained for them. At present some countries do collect effort data for these vessels, but such instances are the exception. Under EC Regulation 15/43 of 2000 a new data collection regime for fisheries will be put in place in 2002. This regime will be revised in 2003/4 when there will be the possibility for Member States of the EU to include data collection measures specifically aimed at environmental concerns.

2.2.4 Independent mitigation trial methods

There have been a number of mitigation trials in European waters to test the efficacy of bycatch reduction techniques. Typically these have followed standard experimental protocols where experimental and standard fishing gears are deployed in the same area at the same time with the standard gear acting as a control.

The subgroup agreed that wherever possible such trials should be done ‘blind’ or ‘double blind’ so that the vessel operator or the vessel operator and the observer are unaware of which gear type they are using. Clearly this is not always practical, as it may be quite obvious which gear type is being used, but it is important to try to minimise the possibility of the skipper or the observer influencing the outcome of the trial by deliberately or unconsciously treating the two gear types differently.

The subgroup also stressed that whenever a new mitigation method had been tested experimentally it also needed to be monitored over a long time period in a real fishery to ensure that the technique or equipment would work in the ‘real world’.

The subgroup also discussed the issue of habituation with respect to pingers. There has been much speculation that porpoises and other small cetaceans might become habituated to pingers and reduced bycatch rates may not be sustained. This is a suggestion that has often been made, but has not been proven anywhere. A recent paper by Cox *et al* (2000) had shown that after repeated exposure to an acoustic pinger in the Bay of Fundy, Canada, harbour porpoises there began to surface closer to the sound source. However, they still remained at some distance from the pingers and there was no suggestion that the efficacy of the devices had been compromised by the apparent threshold shift in the animals’ behaviour.

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

The small cetaceans (mostly harbour porpoises) in this area are considered below in three units. The Baltic Sea corresponds approximately to ICES sub-area IIId. The Belt Sea and western Baltic area include both Mecklenburg and Kiel Bights and corresponds approximately to ICES sub-area IIIb and IIIc. The Kattegat-Skagerrak area corresponds approximately to ICES sub-area IIIa.

2.3.1 Abundance estimates

Estimates of harbour porpoise abundance exist for a number of geographical areas in the North Sea and adjacent waters from the Small Cetacean Abundance in the North Sea (SCANS) Survey conducted in July 1994 (Hammond *et al.* 1995). In the Skagerrak-Kattegat and Great Belt, there was an abundance of 36046 animals (Table 2.3) was estimated from ship-based surveys. In the Little Belt-Kiel Bight aerial surveys resulted in an estimated abundance of 588 porpoises (Hammond *et al.* 1995).

Table 2.3 Abundance estimates for small cetaceans in the Baltic Sea, Belt Seas, Kiel and Mecklenburg Bights, Kattegat and Skagerrak

Species	Year of estimate	ICES Area	Abundance estimate	95% Confidence limits	Method	Reference
Harbour porpoise	1994	IIIa + b	36046	20276 – 64083	Ship-based	Hammond *et al.* 1995
		IIIc	588	(CV 0.48)		
	1995	24+25	599	200 – 3300	Aerial survey, line transect	Hiby and Lovell 1996
		K&M Bights	817	300 – 2400		

The abundance of harbour porpoises in the Baltic Sea was estimated during a line transect aerial survey in July 1995 (Hiby and Lovell 1996). The survey used the same methodology (both in track line design and to generate abundance estimates), aircraft and observers as were used in the SCANS survey. The survey covered a 43000 km^2 area (corresponding to ICES Sub-divisions 24 and 25, but excluding a 22 km wide corridor along the Polish coast) and yielded an estimate of 599 animals. The abundance estimate for the Baltic Sea was based on sightings of only three groups, each containing a single animal. Although, the 15 hours of tracklines surveyed gave enough coverage of the survey area to allow for the calculation of an abundance estimate, this was inevitably accompanied by a large confidence interval. The same crew also covered the Kiel and Mecklenburg Bight area in July 1995 and the resultant estimate was 817 animals (Hiby and Lovell 1996). A ship-based line transect survey of Polish coastal waters in 2001 saw only one harbour porpoise, thus rejecting the idea that these waters hold a large population of harbour porpoises (Per Berggren, pers. comm.). Abundance estimates for other species are not available for this region.

Two populations of harbour porpoise are considered to live in the area: one in the Baltic proper and one in the eastern part of the Skagerrak, Kattegat, Belt Sea, Kiel Bight and Mecklenburg Bight to Darss sill in the east.

2.3.2 Bycatch estimates

The bycatch of porpoises in the various fisheries is extremely difficult to quantify. Many fishermen use small boats of less than 10 m length in a diverse range of fisheries (see section 2.3.3.1). Their catches constitute more than 30% of the landings in the Danish part of the Kattegat and western Baltic (Vinther 1999). In most countries, these fishermen have no obligation to report fish catch and effort statistics. In addition, part-time fishermen carry out much of the fishing. There is a high variability in completeness of self-reporting among fishermen (Berggren 1994).

2.3.2.1 *Baltic*

As in other areas, harbour porpoises are believed to be subject to incidental takes in gill net fisheries. Atlantic salmon drift net fisheries were suggested to have taken substantial numbers of harbour porpoises in the past (Ropelewski 1957, Lindroth 1962).

a) Denmark: No bycatches reported in the Danish observer programme (350 km.days of net observed (less than 0.5% of total net days in this fishery)) (Vinther 1999) between 1992 and 1998 or in more recent years (F. Larsen, pers. comm.).

b) Germany: No recent reports of bycatch (K.-H. Kock, pers. comm.).

c) Sweden: Berggren (1994) used reports from fishermen to estimate a minimum catch of about 5 harbour porpoises/year in the early 1990s. Most of these were taken in salmon drift nets or cod gillnets. The scale of the fishery has declined over the past twenty years, so it likely that the harbour porpoise bycatch has declined also. The Swedish turbot fishery has not reported a substantial bycatch (Berggren 1994). A total of six nights were spent at sea by an observer on salmon drift net vessels; no bycatch was recorded by this observer, but one was reported from a non-observed vessel (Harwood et al 1999).

d) Poland: 5 harbour porpoise/year reported from various gill net fisheries (I. Kuklik, pers. comm.)

e) Russia: no bycatch, no one working currently on harbour porpoise (V. Sushin, pers. comm.)

f) Lithuania: no information.

g) Latvia: no reported bycatch since the mid-1970s (V. Pilas, pers comm.)

h) Estonia: no bycatch reported (A. Kruus, pers. comm.)

i) Finland: a bycatch monitoring scheme in place from 1986 – 1999 reported only two entanglements of harbour porpoises, occurring in ICES divisions 29 and 30 (ASCOBANS 2000).

2.3.2.2 Belt Seas and the Bights

a) Denmark: No reported bycatch in the Danish observer programme (193 km.days observed (less than 0.5% of total net days in this fishery)) between 1992 and 1998 (Vinther 1999).

b) Germany: Based on interviews with fishermen, K.-H. Kock (pers. comm.) estimate a catch of about 3 – 5 harbour porpoises per year.

c) Sweden: The fishery in the small Swedish part of these seas is included in the Baltic proper (section 2.3.2.1).

2.3.2.3 Kattegat and Skagerrak

a) Sweden

Studies on bycatches of harbour porpoises in set net fisheries were conducted on the Swedish cod and pollack fisheries in 1996-97 (Harwood et al 1999). A total of 7441 net km.hrs was observed over three seasons of the year in two ICES rectangles on the Skagerrak/Kattegat boundary. A total of 12 porpoises were seen as bycatch, while a further 13 animals were reported as bycatch on unobserved vessels fishing in the same rectangles. Based on these figures, these authors extrapolated a catch of 105 animals per 10000 net km.hrs in the Skagerrak/Kattegat combined. The Swedish fisheries targeting cod and pollack decreased by 59 % between 1997 and 2000 due to the reduction in the stock size of cod. The overall effort in Swedish set net fisheries decreased by 45 % during this period (data from the Swedish National Board of Fisheries).

b) Denmark

Vinther (1999) observed 329 net km.days between 1995 and 1998 on Danish set net fisheries in the Kattegat and Skagerrak. A total of five porpoises was observed as bycatch in one ICES rectangle; four of these were caught in the lumpfish fishery. This equates to 15 animals bycaught per 1000 net km.days.

2.3.3 Fishing effort statistics

2.3.3.1 Baltic

Fisheries that are known to take porpoises occasionally (or even regularly) are various kinds of set-net fisheries using different mesh sizes. These fisheries target salmon and other salmonids, such as sea trout, cod, turbot, other flatfish (Pleuronectiformes) and herring in spring. Gear types used are usually species-specific in larger vessels but often multi-species in small vessels. Nets targeting different species have different heights, as 4 m in cod, 1 – 1.5 m in most flatfish fisheries and 0.3 – 0.5 m in sole fisheries, and different hanging ratios (Vinther 1999).

a) Sweden

Fishing in Swedish waters using gill nets is mostly for cod and turbot, with drift nets used for salmon (Table 2.4).

Table 2.4 Swedish fishing effort in gill nets in the Baltic Sea (km net.days) (Swedish National Board of Fisheries)

	1997	1998	1999	2000
Total	173404	176241	189947	203004

2.3.3.2 Belt Seas and the Bights

No information available.

2.3.3.3 Kattegat and Skagerrak

a) Sweden

Fishing in Swedish waters using gill nets is mostly for cod and turbot, with drift nets used for salmon (Table 2.5).

Table 2.5 Swedish fishing effort with gill nets in the Skagerrak and Kattegat (km net.days) (Swedish National Board of Fisheries)

	1996	1997	1998	1999	2000
Pollack	73	29	28	6	2
Driftnet	0	1	0	3	1
Trammel net	637	3470	4298	5066	3268
Dogfish	165	162	71	34	83
Crab	826	583	979	564	1403
Salmon driftnet	8	0	0	0	0
Mackerel	228	175	85	68	133
Turbot	585	1151	884	99	1263
Herring	68	73	166	36	130
Flounder	1753	2790	1592	744	1100
Cod	2446	2827	2707	1245	1169
Sole	2768	5071	3152	1333	636
Salmonid setnets	13	11	1	0	4
Total	9573	16342	13963	9198	9192

2.3.4 Mitigation measures

No mitigation measures to reduce small cetacean bycatch have been introduced in this area.

A mitigation experiment with Dukane NetMark 1000 pingers was conducted in the bottom set gillnet fishery for cod in the Swedish Skagerrak Sea in March–April 1997 (Carlström *et al.* in review). The aim of the experiment was to evaluate (i) the effectiveness of pingers in reducing bycatch of harbour porpoises, and (ii) possible effects on the catches of the target species in the fishery. The design of the study was based on a statistical power analysis of the results from observer programmes conducted 1995–1996 in the same area, fishery and time of year. The results of the experiment were inconclusive as no harbour porpoises were caught in any string during the experiment. This could not be explained by a reduction in fishing effort per set relative to the observer programme period, a difference in total catch of fish for consumption or a shift in the spatial distribution of the sets between the observer programmes and the pinger experiment. The catches of cod, pollack and other fish species were not affected by the sound of pingers in the active strings.

2.4 North and Norwegian Seas

This section covers the North Sea and Norwegian Seas, but does not include the Skagerrak (see section 2.3) or the English Channel (see section 2.5).

2.4.1 Abundance estimates

There has been one main quantitative survey of small cetaceans in parts of these waters – the EU funded SCANS survey in 1994 (Hammond *et al*. 1995). This survey covered the whole North Sea, the English Channel and the Celtic shelf. In addition, some smaller areas have been surveyed or inshore semi-resident bottlenose dolphin population/group sizes estimated. Further out into the Atlantic, the NASS surveys have estimated the abundance of parts of the long-finned pilot whale distribution. The results of these surveys are summarised in Table 2.6.

Table 2.6 Abundance estimates of the most common small cetacean species in the North Sea.

Species	Year of estimate	ICES Area or sea area	Abundance estimate	95% Confidence limits	Method	Reference
Harbour porpoise	1988-89 1994	IVa, IVb, IIa(S) IVa IVb + c	61335 98564 169888	(CV 0.29) 66679 – 145697 124121 – 232530	Ship-based line transect	Hammond *et al*. 1995
Bottlenose dolphin	1998	Moray Firth (southwestern IVa)	129	110 – 174	Photographic mark-recapture	Wilson *et al*. 1999
White-beaked and Atlantic white-sided dolphins	1994	IVa IVb	1685 9242	690 – 4113 5344 – 15981	Ship-based line transect	Hammond *et al*. 1995
Killer whale	1989	IIa, IVa,b	7057	3400 - 14400	Ship-based line transect	Øien 1993

2.4.2 Bycatch estimates

2.4.2.1 Driftnet fisheries

a) UK

The UK has several small drift net fisheries. Observations have been made on two of these (with relatively low proportionate effort) and no bycatch has been observed.

b) Norway

Bycatch of harbour porpoises in a Norwegian drift net fishery for salmon was examined in 1988. A financial reward was offered to fishermen to return porpoises to port for post mortem examinations. Catch rates were among the highest ever recorded for a marine mammal in a net fishery, at around 0.65 – 1.47 porpoises/km.hour of fishing effort (Bjørge and Øien 1995). This fishery was closed after the 1998 fishing season, mainly for reasons of salmon conservation.

2.4.2.2 Set net fisheries

a) Norway

In Norwegian fisheries there is no programme yet established to monitor bycatches of cetaceans and an estimate of bycatches based on monitored fishing effort cannot be provided. However, there are a number of harbour porpoises taken per year in coastal gill net fisheries (carcasses are periodically collected for biological studies). This bycatch may be substantial. The scale of bycatches of cetaceans (or other marine mammals) in the Norwegian offshore gill net fisheries are unknown.

b) Denmark

Vinther (1999) estimated the bycatch rate of porpoises for the years 1992-98 in Danish bottom-set net fisheries. These bycatch rates were extrapolated using target species landings for each year from 1990 to 2000 in order to provide a total estimated bycatch by this fleet. Annual estimates (Table 2.7) varied between 5000 and 8000 porpoises over this period. The annual estimates appear to show a decreasing trend in bycatch over recent years. However this could be an artefact caused by the use of landings to extrapolate the observed data. Such an extrapolation relies on the catch per unit effort of the target species remaining constant. If, as is likely due to the decreasing cod stock in the North sea, catch per unit effort has decreased, it may be that fishermen are expending more effort (as measured in net soak time) to obtain their catch. If bycatch is more closely related to soak time, then it may be that bycatch has not decreased by the same amount.

Table 2.7 Bycatch in Danish North Sea bottom set net fisheries by year (in litt. Danish Fisheries Minister to Commissioner Fischler (ASCOBANS AC8/Doc. 18)).

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fishery	Quarter											
Hake	1 - 4	437	775	1233	1211	718	704	244	118	144	357	251
Turbot	1 - 4	2800	3092	2683	2739	2790	2418	1899	1196	771	534	657
Plaice	1 - 4	339	1489	1803	1544	2258	1790	1873	1660	829	616	638
Cod – smooth bottom fishery	1 + 3	1145	1026	1116	1405	1385	1669	1872	1801	1969	1571	839
	2 + 4	311	264	293	269	343	368	474	498	471	298	226
Cod – wreck fishery	1+2+4	119	99	101	99	112	125	157	159	156	121	74
	3	134	187	317	534	532	662	668	658	761	448	286
Sole	1 - 4	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1 - 4	5285	6933	7547	7803	8138	7737	7187	6090	5103	3945	2971

c) Germany

No bycatch of small cetaceans has been observed in this fishery (Kock 1997). A project will be launched in 2002 to investigate possible bycatches of a 17m vessel fishing off Denmark, Germany and the Netherlands over a period of 12 months (Kock, pers. comm.).

d) Netherlands

No information was available to this meeting

e) Belgium

There is no observer scheme and no reported bycatch of cetaceans by Belgian vessels

f) United Kingdom

For the United Kingdom, cetacean bycatch data exists for fisheries for cod, sole, skate and turbot in the North Sea (Table 2.8). Only harbour porpoises have been recorded caught in these fisheries. Porpoise bycatch was assessed for the period 1995-99. The bycatch halved during this period as fishing effort (measured in days at sea) has declined. Bycatch estimates were based on observed bycatches per day at sea within metier, on the assumption that mean effort per day at sea among sampled vessels was an unbiased estimate of mean effort per day at sea for the entire metier.

Table 2.8 Estimates of harbour porpoise bycatch in the North Sea (Northridge, this meeting). These estimates are for cod, sole, skate and turbot set net fisheries and are derived from individual estimates for each of the fisheries in each area.

Year	North Sea	95 % confidence interval
1995	818	674 – 1233
1996	624	500 – 959
1997	627	513 – 957

1998	490	383 – 769
1999	436	351 – 684

2.4.2.3 Pelagic trawl fisheries

Very limited information exists for the pelagic trawl fisheries of the North and Norwegian Seas. Couperus (1997) describes the incidental catch of cetaceans in Dutch pelagic trawls in the North Sea and the Channel between 1992 and 1994. This included 3 white-beaked dolphins, 5 common dolphins, 5 pilot whales and 22 other unidentified dolphins. The number of hauls monitored is not mentioned. Pierce *et al*. (2001) observed 73 days at sea in the UK pelagic fishery (including the North Sea and areas west of UK) with no recorded bycatch in 69 hauls.

2.4.3 Fishing effort statistics

Complete fishing effort statistics for the North and Norwegian Seas were not available to this meeting. The information that was available was in different units making comparison and extrapolation difficult, if not impossible.

2.4.3.1 Set net fishery

a) Norway

No information available

b) Denmark

Information on effort in the Danish North Sea bottom set net fishery is available for the period 1990 – 2000, divided by six target species. Number of trips, days at sea, trip length, total landings etc. are all available. The first two statistics are summarised in Table 2.9.

Table 2.9 Effort data for Danish North Sea bottom set net fishery (in litt. Danish Fisheries Minister to Commissioner Fischler (ASCOBANS AC8/Doc. 18)).

Fishery	Average 1990 - 2000		1999		2000	
	No. trips	Effort (days at sea)	No. trips	Effort (days at sea)	No. trips	Effort (days at sea)
Hake	396	1054	214	697	172	540
Turbot	340	1569	149	580	237	701
Plaice	2132	4692	1,173	2,598	1,021	2,331
Cod	3992	10405	4,158	11,121	3,534	8,342
Sole	1660	3693	1,531	3,178	1,592	2,910

c) Germany

Set net fisheries in Germany are conducted on a limited scale only. A fishery targeting sole is carried out off the Wadden Sea coast of Schleswig-Holstein by 3 –4 vessels from April to September. The size of these vessels does not exceed 14 m. Effective fishing height of their nets does not exceed 30 – 50 cm. One 17m German fishing vessel is fishing with set nets throughout the year off the Dutch-German-Danish coast.

d) Netherlands

Couperus (1997) states that there were approximately 4 vessels using gillnets in the Netherlands in the mid 1990s. No further information was available to this meeting.

e) Belgium

Only three vessels are active in the Belgian set net fishery, mainly targeting sole and cod. They mostly operate in the southern North Sea (ICES sub-area IVc). The average engine power of these vessels is 523 hp with an average length overall and tonnage of respectively 16 m and 54 tonnes. Effort data are given in Table 2.10 and comprise days at sea and average net length.

Table 2.10 Effort data for Belgian bottom set net fishery (M. Welvaert, Belgian fishery administration)

Fishery	1999	2000	2001			
	Effort (days at sea)	Effort (days at sea)	Effort (days at sea)	Average net length (km)	Average soak time (hrs)	Effort (net km.hrs)
All species	262	236	449	5	24	53880

f) UK

Information on the UK set net and driftnet fishery from 1995 to 2000 is given in Tables 2.11 and 2.12. Effort over this period has declined generally.

Table 2.11 UK set nets and driftnets effort (days at sea by all vessels) by area and year (Northridge, this meeting).

ICES Area	1995	1996	1997	1998	1999	2000
IIa	37	0	15	7	18	17
IVa	632	1162	2596	1549	2401	1370
IVb	8523	7528	8108	8226	5457	4723
IVc	11448	10685	10129	7821	6802	5643

Table 2.12 Estimates of fishing effort (days at sea) by various UK fleet fishery categories in the North Sea (Northridge, this meeting).

North Sea (ICES IV)	1995	1996	1997	1998	1999	2000
cod wreck nets	2775	2672	2378	1725	1991	1417
cod	8791	9127	7300	8711	4713	3609
skate	1675	750	1019	470	489	838
sole	3989	2456	3229	2298	3315	1912
turbot	0	0	14	11	17	30
dogfish	107	85	67	18	1	0
anglerfish	16	64	203	274	95	104
Other	3251	4222	6623	4090	4039	3825
Total North Sea	20603	19375	20833	17596	14660	11735

2.4.3.2 Other fisheries

No other effort information was assembled at this meeting

2.4.4 Mitigation measures

Porpoise bycatches in Danish fisheries have been monitored using observer programmes since 1992.

The Danish Institute for Fisheries Research conducted an experiment, funded under the EU programme BYCARE, in 1997 to investigate whether acoustic alarms could reduce the unintentional bycatch of harbour porpoises in the Danish bottom set gill net fishery for cod in the North Sea (Larsen 1999). The experiment was designed as a double-blind experiment with a control group consisting of nets with inactive pingers. All 14 vessels that participated had an observer from DIFRES on board during the experiment, which was conducted in the period 30 August to 10 October 1997. The double-blind aspect meant that neither the crew nor the observer on board knew which of the pingers were active and which were dummies. The pingers used were prototype PICE pingers developed by Loughborough University, England. Pingers were attached to the nets so that no net was more than c. 70 m from a pinger.

The participating vessels had a total of 168 days at sea during the experiment, fishing 590 stations varying in size from 4 nets to 240 nets. The total effort was 6523 nets with active pingers, 5680 nets with dummy pingers and 3395 nets without pingers. During the experiment a total of 24 porpoises were caught, including 1 animal caught in nets with active pingers, 13 caught in nets with dummy pingers and 10 caught in nets without pingers.

The frequency of bycatch of porpoises was 0.00015 animals/net in nets with active pingers, 0.00229 animals/net in nets with dummy pingers and 0.00295 animals/net in nets without pingers. The difference in frequency of bycatch between nets with active pingers and nets with dummy pingers was statistically highly significant ($p<0.001$). There was no significant difference in bycatch frequency between nets with dummy pingers and nets without pingers ($p=0.699$).

In 1998, the Danish government adopted an action plan to reduce bycatches of porpoises (Ministry of Environment and Energy, 1998) and in 2000 a requirement to use acoustic alarms (pingers) was included in the fisheries regulations. The regulation requires the use of pingers in all Danish bottom set gillnet fishing in the North Sea in the period August-October when net fleets up to 300 m are used. In practice this will only apply to wreck gillnet fishing. The reason for selecting this fishery and period was that particularly high rates of bycatches were observed here.

An observer program was established in 2000 to monitor bycatch of porpoises by vessels using pingers during wreck fishing. In 2000, 99 hauls were observed. Pingers were used on 87 of these hauls with no bycatch of porpoises recorded. In the remaining 12 hauls pingers were not used, resulting in bycatch of two porpoises. In 2001 a slightly lower number of hauls with pingers was observed, again with no bycatch of porpoises.

2.5 ATLANTIC

This section covers all waters from the Canary Islands to the Faroes, including the English Channel and the Irish Sea.

2.5.1 Abundance estimates

The SCANS survey of the North Sea in 1994 extended to cover the Celtic Shelf south of Ireland and west of England (Hammond *et al*. 1995). Estimates of the abundance of harbour porpoise, common dolphin and white-beaked/Atlantic wide-sided dolphin (combined) were made (Table 2.13). The NASS surveys covered large areas offshore in the northern part of the area in the mid to late 1980s (Buckland *et al*. 1993), and Goujon *et al*. (1993) surveyed an area to the west of the Celtic shelf. In addition, some smaller areas have been surveyed (e.g. O'Cadhla *et al*. 2001) or inshore semi-resident bottlenose dolphin population/group sizes estimated (e.g. Ingram 2000).

Table 2.13 Abundance estimates of small cetaceans in the Atlantic region

Species	Year of estimate	ICES Area or sea area	Abundance estimate	95% Confidence limits	Method	Reference
Harbour porpoise	1994	VIIf+g+h+j	36280	12828 - 102604	Ship-based line transect	Hammond *et al*. 1995
Bottlenose dolphin	1993 1993 1993 1990s 1991/3 1994-95 1991 1999 1995	Brittany Mont St Michel Arachon Sado Estuary Cornwall Dorset Cardigan Bay Shannon Estuary Dingle Bay	30 60 6 35-40 15 5 120+ 113 +/- 16 12	na na na na na na na na na	Photographic identification or direct observation	ICES 1996 Ingram 2000
White-beaked and Atlantic white-sided dolphins	1994	VIIf+g+h+j	833	159-4360	Ship-based line transect	Hammond *et al*. 1995
Atlantic white-sided dolphin	2000	parts of VI a&b, VII b/c, VIIj&k	5490	1134 - 10015	Ship-based line transect	O'Cadhla *et al*. 2001
Common dolphin	1994 2000	VIIf+g+h+j parts of VI a&b, VII b/c, VIIj&k	75449 4496	22900 – 284900 2414 - 9320	Ship-based line transect	Hammond *et al*. 1995;

Long-finned pilot whale	1987 1989 1981–84 1987-89 1987-89	V (parts of) VI V (parts of) NW Spain / W France / SW Ireland VIII (E. of 15°W) VIII (W of 15°W)	29198 5392 80867 9739 12235 128080	 3924 - 38148 45241 - 362640	Ship-based line transect	Buckland *et al*. 1993 Sanpera and Jover 1987 Buckland *et al*. 1993.
Striped dolphin	1993	NW Spain / W France / SW Ireland	73843	36113 - 150990	Ship-based line transect	Goujon *et al*. 1993
Common dolphin	1993	NW Spain / W France / SW Ireland	61888	35461 - 108010	Ship-based line transect	Goujon *et al*. 1993

2.5.2 Bycatch estimates

2.5.2.1 Driftnet fisheries

a) Canary Islands/ Madeira

No information available.

b) Portugal - Azores

No information available.

c) Portugal – mainland

No bycatch estimates are available for the Portuguese fisheries.

d) Spain

There is no driftnet fishery off Spain following a ban introduced in 1993.

e) France

Goujon *et al*. (1993) surveyed the French driftnet fishery for tuna in the northeast Atlantic from June – September in 1992 and 1993 (Table 2.14). Thirty-one vessels took part in the fishery, and observers accompanied 18 of these, amounting to 27% of the total fishing trips. It was not possible to be sure of species involved in some of the bycatch.

Table 2.14 Bycatch estimates for the French driftnet fishery for tuna in the northeast Atlantic from June – September in 1992 and 1993 (Goujon *et al*. 1993).

Bycaught species	Year	Bycatch estimate	Confidence interval
Common dolphin	1992	410	325 - 495
Common dolphin	1993	419	266 - 572
Striped dolphin	1992	1193	946 - 1440
Striped dolphin	1993	1152	732 – 1572
Common, striped and bottlenose dolphins, long-finned pilot whale	1992	1722	1365-2079
Common, striped and bottlenose dolphins, long-finned pilot whale	1993	1754	1115-2393

f) UK

SMRU (1995) surveyed the UK albacore driftnet fishery in ICES Areas VIII and VII h, j and k (Table 2.15). Effort in this fishery has dropped from 416 days in 1995 to 32 days in 2000. Common and striped dolphins were the main bycaught species, but the ratio between these in the bycatch probably varies between years.

Table 2.15 Bycatch estimates for UK albacore driftnet fishery in June – September 1995 in Areas VIII and VIIjkh (SMRU 1995)

Bycaught species	Bycatch estimates	Confidence intervals	Year
Common dolphin	61	16-106	1995
Striped dolphin	104	38-169	1995

g) Ireland

The bycatch in the Irish albacore fleet is presented in Table 2.16.

Table 2.16 Mean catch per haul for all cetaceans, common and striped dolphins in 1996 and 1998 in the Irish albacore fleet. Confidence intervals were calculated as the mean ± $t_{0.05}$*SE (Harwood et al. 1999).

Species	1996		1998	
	Mean catch/haul	95% confidence interval range	Mean catch/haul	95% confidence interval range
All cetaceans	2.05	1.60 – 2.49	1.5	0.68 – 2.32
Common dolphins	1.32	0.92 – 1.72	0.72	0 – 1.46
Striped dolphins	0.51	0.33 – 0.69	0.78	0.20 – 1.36

Extrapolation to a fleet is always difficult, particularly with regard to obtaining effort data on actual trips and hauls. However, since only seven boats operated in 1996, effort can be estimated, using local knowledge, as all the boats operated from the same ports over the same time period with similar number of trips. Using local knowledge, it is estimated that there were a total of 261 hauls in 1996 (48% of these hauls were observed). To validate this assumption, it is possible to raise the calculated weight of fish caught to the official landings. In 1996, this means that 43.3% of the total effort (as a function of tonnage) was observed (Harwood et al. 1999).

Total bycatch in the Irish fishery for this year can then be estimated by applying the observed bycatch rate per haul to the total number of hauls made during the season. For example, taking the value of 2.05 cetaceans/haul as the mean number caught, it can be estimated that 535 cetaceans (95% CI 418 – 651) were incidentally caught by this fleet in this year. This comprises 345 common dolphins (95% CI 240 – 449) and 134 (95% CI 87 – 180) striped dolphins, the remainder comprising smaller numbers of the less frequently caught cetacean species (Harwood et al. 1999).

In 1998, 18 boats operated in the fishery. Allowing for a similar effort in 1996, it can be estimated that 819 hauls occurred. Using 1.5 cetaceans/haul as the mean number caught in this year, brings the estimated total cetacean entanglement to 1,229 (95% CI 555 – 1,902). The corresponding values for common dolphins are 592 (95% CI 0 – 1,197) and for striped dolphins 637 (95% CI 162 – 1,112). However, if the more robust 1996 data are used, assuming fishing area the same, the bycatch rates are higher (Table 2.17).

Table 2.17 Observed and extrapolated bycatch in the Irish albacore driftnet fishery in 1996 and 1998 (Harwood et al. 1999).

Species	Observed		Extrapolated	
	1996	Released alive	1996	1998*
Common dolphin	170	9	356	2,522
Striped dolphin	65	1	136	964
Pilot whale	4	1	8	59
Bottlenose dolphin	3		6	45
Risso's dolphin	1		2	15
White-sided dolphin	1		2	15
Unidentified dolphin	9	1	19	134

* using bycatch data from 1996

2.5.2.2

2.5.2.3 Set net fisheries

a) Canary Islands/ Madeira

No information available

b) Portugal - Azores

No information available

c) Portugal - mainland

No bycatch estimates are available for the Portuguese fisheries. Cetaceans are known to be regularly caught by the artisanal fleet using gillnets set close to the coast. The common dolphin is the species most commonly affect by gillnets, although harbour porpoises can also be caught, especially in the northern region.

Most of the bycatches still remain unreported, but it is thought that almost one half of the reported strandings (120-150 per year) involves bycaught animals.

d) Spain

The only estimates of bycatch in gillnet fisheries of Spain derive from port interviews with fishermen in Galicia (Pierce and Santos 1989). The fisheries were classified into inshore and offshore and "dolphins", bottlenose dolphin and long-finned pilot whales were noted as being bycaught.

An observers programme carried out by the Institute of Fisheries Research of the Basque Country (AZTI) started in 1996 covering Basque gillnet boats in ICES areas VIIIa,b,c, and d. During the period 1996-2000, 36 hauls were monitored in this fishery. No incidental catches of cetaceans were reported. An EC-funded observers programme (PEM93/5) carried out by the IEO during 1994 in ICES areas VI, VII, VIIIa, b, c and IXa did not report any bycatch in 55 gillnet hauls.

e) France

For France, there is little reported bycatch of cetaceans in set net fisheries (Swarbrick *et al*. 1994). Sole and cod are the main target species in VIId while anglerfish and sole are the main target species of these fisheries in VIIe. In VIId, observations of 21 km of net, set at a depth of 30m were made during hauls in 1995-96. No bycaught cetaceans were seen. In VIIe area, more than 410 km of set nets were observed during 117 days at sea in several fisheries with a major part of observations from anglerfish netting (379 km). The observers reported no cetacean bycatch (Morizur *et al*. 1996). However, interviews with fishermen indicate that sporadic bycatch of harbour porpoise occurs in the middle of western Channel (around rectangle 27E5) and that the annual bycatch is around one harbour porpoise per boat. Swarbrick *et al*. (1994) reported one harbour porpoise caught in a trammel net in area VIIe. This area is relatively distant from the coast and is not accessible to most of the netters. Only the biggest boats can fish in this area during summer, usually with trips of around 4 days. No more than 30 netters are involved in the offshore part of this fishery.

Some gill netting experiments were carried out on hake and sole in 1995 (project gill net AIR2CT93 1122). 18 x 1.5 km = 27 km of hake nets observed and 40 km of sole nets with no cetacean bycatch recorded (Brabant et al. 1994).

f) UK

For the United Kingdom, cetacean bycatch data exists for the hake gill net fishery in the Celtic Sea, and for fisheries in seas to the west of Scotland for dogfish, crayfish and skate. Harbour porpoises and common dolphins have been caught in these fisheries. This bycatch was assessed for the period 1995-99. To the west of Scotland, the estimated numbers of harbour porpoises in the bycatch varied annually between 209 and 22 (Table 2.18). The recent decline in bycatch to the west of Scotland has been due to the collapse of the crayfish tangle net fishery. The total recorded effort (days at sea) in all set net fisheries west of Scotland has declined from 1256 to 697 days between 1995 and 2000, with the crayfish component going from 882 to 53.

Table 2.18 Estimates of harbour porpoise bycatch to the west of Scotland (Northridge, this meeting). These estimates are for all set net fisheries and are derived from individual estimates for each of the fisheries in each area.

Year	Extrapolated numbers bycaught	95 % confidence interval
1995	165	82 – 365
1996	156	74 – 349
1997	209	95 – 475
1998	45	34 – 83
1999	22	14 – 39

Tregenza *et al*. (1997) report on 328 days at sea by observers of the Celtic Sea hake set net fishery from Ireland and England. The fishery works throughout the year on vessels greater than 15m in length. Over a 12-month period in 1992-93, 25 harbour porpoises were counted in the bycatch of 1034 km nets. Sixteen of the harbour porpoises were caught in February-March. Bycatch of harbour porpoises was estimated for the year 1993/1994 around 740 with 95 % confidence interval 383-1097 (Tregenza *et al*. 1997). For the same period, four common dolphin were seen with 2870 km of net hauled and the yearly raised bycatch was estimated at 200 (95 % CI 4-500) (Tregenza and Collet 1998).

g) Ireland

The Irish hake fishing fleet operated in ICES area VIIg, h, j and k and the bycatch rate for the Irish boats was 12.6 porpoises per 100 days at sea, giving a total estimated porpoise bycatch of 1487 porpoises (SE 475, 95% CI 566 – 2428) (Tregenza *et al*. 1997). This figure must be interpreted with caution because it does not allow for differences in trip length by boats of different size and because the average net length reported in the official statistics is less than the average length carried by the boats observed.

The estimated total annual bycatch of UK and Irish fleets combined is 2,200 porpoises (95% CI 900 – 3500) (Tregenza *et al*. 1997).

2.5.2.4 Pelagic and large vertical opening (VHVO) trawl fisheries

a) Canary Islands/ Madeira

No information available.

b) Portugal - Azores

No pelagic trawling in Portugal.

c) Portugal - mainland

No pelagic trawling in Portugal.

d) Spain

The only estimates of bycatch in 'trawl' fisheries of Spain derive from port interviews with fishermen in Galicia (Pierce and Santos 1989). It is not clear from these authors as to what sort of trawl was in use in Galicia at the time, however given the range of species caught ("dolphins", bottlenose dolphin and long-finned pilot whales) it seems likely that a pelagic trawl or similar was in use. Nearly all noted were caught in "offshore" fisheries, but the location of "offshore" was not specified (but included the Great Sole Bank to the south of Ireland).

The observers programme carried out by the Institute of Fisheries Research of the Basque Country (AZTI) 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, 417 hauls, spread over 192 fishing days on 32 trips were observed in this fishery. A total of 24 small dolphins were caught in Areas VIIIa,b and d.

The Spanish Institute of Oceanography (IEO) carried out an observer programme in 1997 that covered two VHVO pair trawlers working in ICES areas VIIIc and IXa. Only one incidental catch was reported (involving three animals) in the pair trawl working in area IXa. Sampling effort for this gear and area was 12 hauls, 10 fishing days, 7 trips.

e) France

The French pelagic trawl fisheries in the western English Channel and the Bay of Biscay were observed in 1995 (Morizur *et al*. 1999) (Table 2.19). A total of 9 cetaceans were recorded as bycaught, but it should be noted that generally rather low proportions of these fisheries were observed.

Table 2.19 Bycatch estimates in the French pelagic trawl fisheries in the Bay of Biscay (ICES Areas VIIIa, b, c, d, VIIe, h and j) and western English Channel (ICES Area VIIe) in 1994-95 (Morizur *et al*. 1999).

Bycaught species	Fishery target	Area	Effort (h)	Sampled effort (%)	Bycatch	Rate (per 100 hours)
Common dolphin	Hake	VIIIa, b	338	0.3	4	1.18
Common dolphin	Tuna	VIIIb, c, d	265	1.6	3	1.13
Bottlenose dolphin	Tuna	VIIIb, c, d	265	1.6	1	0.34
Common dolphin	Sea bass	VIIe, VIIIb	73	1.37	1	1.37
Cetaceans	Anchovy	VIIIb, c	15	< 0.1	0	
Cetaceans	Black sea-bream	VIIe	9	0.1	0	
Cetaceans	Sardine	VIIIa	3	0.1	0	
Cetaceans	Horse mackerel	VIIIa	19	1.6	0	

f) UK

Morizur *et al*. (1999) report on observations made on the western Channel/Celtic shelf fleets. The sardine fishery was observed in October-November and the mackerel fishery from November to March. No cetacean bycatch was observed in the 76 days spent at sea (48 sampled tows). However fish pumps are used in the fishery and the cod end is emptied out-board, thus any bycaught marine mammals may have gone unobserved during the night. Further observations will be required to ensure full knowledge of the bycatch of these fisheries.

Pierce *et al*. (2001) observed 73 days at sea including some to the west of Ireland in the UK pelagic fishery for herring and mackerel with no recorded bycatch in 69 hauls.

g) Ireland

No cetacean bycatch was observed in the Irish pelagic fishery for herring in the Celtic Sea (Berrow *et al*. 1998). Bycatch in the Irish experimental pair pelagic trawl fishery for albacore was observed in 1999 off western Ireland and the southern Bay of Biscay (BIM 2000). A total of 313 hauls over 160 days was observed. A total of 145 cetaceans of four species of cetacean were caught (Table 2.20), more than 2/3 of these were taken in just ten hauls, with one haul accounting for 30 animals. Ninety percent of hauls had no cetacean bycatch.

Table 2.20 Bycatch in Irish experimental pair trawls off western Ireland and in Bay of Biscay in 1999 (BIM 2000).

Species	Number caught
Common dolphin	127
Striped dolphin	8
Atlantic white-sided dolphin	2
Long-finned pilot whale	8

h) Netherlands

Couperus (1997, 1997a) describes the incidental catch of cetaceans in Dutch pelagic trawls as found from an independent observer programme that covered about 5% of the annual effort of this fishery between 1992-94. In parallel with this independent observer scheme, a self-reporting scheme was set up that covered the same fishery during the last two years of the study. With the addition of some further records from 1989-1991 and 1995-1996, 76 bycatch incidents were recorded involving a minimum of 320 individual dolphins. Forty-one of these incidents (172 individuals) occurred in one year (1994). Approximately 90% of the incidents occurred in the late winter/early spring in the mackerel and horse mackerel fisheries that, at this time of year, both operate south-west of Ireland. Couperus noted that the stomach contents of the bycaught dolphins (mostly Atlantic white-sided) contained mackerel whereas the target species of the trawl fishery was scad (horse mackerel). During the period of peak cetacean bycatch of SW Ireland these two fish are found in association. Atlantic white-sided dolphins were the main bycaught species (83% of identified individuals), with long-finned pilot whales, short-beaked common dolphin and bottlenose dolphin being caught in this area. Elsewhere (mostly in western North Sea and the western English Channel) very few white-sided dolphins were caught and short-beaked common dolphin, long-finned pilot whale and white-beaked dolphin were present in the bycatch. About 40% of dolphins were not identified to species level.

2.5.2.5 Other fisheries

a) Portugal - Azores

Silva *et al*. (in press) observed bycatch in the pole and line tuna fishery off the Azores that targets five tuna species bigeye, skipjack,, albacore, yellowfin and bluefin. The first two of these constitute the main targets of the fishery, accounting for 95% of total landings in weight. A total of 617 fishing trips were monitored during the 3 years study, with a total of 6554 fishing events recorded (Table 2.21). Since there are no data on the number of fishing events, the total tuna landings per trip was used to as a measure of the fishing effort of the whole fleet to estimate the capture rates of cetaceans (Table 2.22). All the animals caught (hooked) were released alive (by cutting the fishing line) although it was impossible to know if they survived the interaction or if the lesions caused death after release.

Table 2.21 Number of fishing vessels, observer coverage and total tuna catch (tonnes) per month from 1998 to 2000 in the Azores fishery. (Silva *et al*. in press)

	1998			1999			2000		
Month	No. fishing vessels	% observer coverage	Total catch (tonne)	No. fishing vessels	% observer coverage	Total catch (tonne)	No. fishing vessels	% observer coverage	Total catch (tonne)
April	0	0	0	11	64	180.4	0	0	0
May	21	43	516.6	21	62	703.7	27	44	223.6
June	20	50	1921.2	23	52	516.5	28	43	414.4
July	22	50	1439.9	17	82	237.6	28	46	190.9
August	21	62	873	19	63	403.2	15	87	202.8
September	20	55	511.7	19	63	272.2	13	62	246.7
October	16	56	138.2	6	50	20	10	50	233.4

Table 2.22 Bycatch estimates for Azores (Silva *et al*. in press). Note that all of these animals were released alive after capture

Bycaught species	Fishery target	Gear	Season	Years	Bycatch estimates	95% confidence interval
Common, striped and bottlenose dolphins	Tuna	Pole-and-line	May to October	1998 1999 2000	38 55 16	16.91 – 59.06 19.55 – 89.55 11.74 – 20.19

b) Portugal - mainland

No bycatch estimates are available for the Portuguese fisheries. Cetaceans are caught regularly in the beach purse seine fishery operating near Aveiro (north of Portugal). This fishery operates during summer and catches 2 –3 pairs of mother-calf harbour porpoise per year.

c) Spain

An observer programme, carried out by the Institute of Fisheries Research of the Basque Country (AZTI), started in 1996 and has continued until the present covering the Basque bottom trawl and longline boats in ICES areas VIIIa,b,c, and d. During the period 1996-2000, 1508 hauls were monitored in the bottom trawl fishery, and 111 in the longline fishery. No incidental catches of cetaceans were reported in these gears.

An observers 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. 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. 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.

2.5.3 Fishing Effort Statistics

2.5.3.1 Pelagic and other similar wide-opening trawl fisheries

a) Canary Islands and Madeira

No information available

b) Portugal - Azores

No information available

c) Portugal – mainland

Portugal had 8 boats using pelagic trawls in 1991 (Sequeira and Ferreira 1994).

d) Spain

Spanish fleets are prohibited from using pelagic trawls by national regulation. However in 1993 a new Spanish gear with a very high vertical opening (VHVO also called Naberan trawl) appeared in the Bay of Biscay. This gear is used by pairs and in 1992 it was used by 22 Spanish Basque boats working in pairs and targeting hake (STECF 1996). In 1997, there were 27 pairs working with VHVO in ICES area VIIIa,b. These vessels fished for 4856 days spread over 932 trips (IEO 2001). In area IXa, 102 boats were recorded in 2000 using purse seines in the south of Spain.

e) France

France has 258 boats fishing with pelagic trawling (mainly in pairs) which are around 15-20 metres long. One hundred boats work full time with pelagic gear and 150 vessels are working part-time with pelagic gear (Table 2.23). These vessels target hake, whiting, sea bass, albacore and pelagic species. Most of the fishing takes place in the Bay of Biscay and some of the boats enter the Western Channel for the winter sea bass season. According to Ifremer, fishing effort in 1997 for pair trawling was 94,000 hours in area VIII and 17,000 hours in area VII.. For single trawling it was 2600 and 8700 tow hours respectively.

Table 2.23 Effort data for French pelagic trawl fleets in 1992 in English Channel (ICES Areas VIId, e) (Morizur *et al*. 1997).

Species	Season	No. of boats	Tow duration (hours)	No. of tows / day	Area
Sea bass	February - March	50-60	6	4	VIIe
Black sea-bream	Winter (& all year)	14	3	3 (night time)	
Industrial fishing	All year	1			VIId-IVc

f) UK

No information available

g) Ireland

No information available

2.5.3.2 Set net fisheries

a) Canary Islands and Madeira

No information available

b) Portugal - Azores

No information available

c) Portugal - mainland

In Portugal, gillnetting is done mainly by numerous small scale boats which operate mainly in inshore waters. There were 4844 netters registered in 1991 (Sequeira and Ferreira 1994). At the same time Fahy (1993) reported 3329 set netters registered in Portugal in the early 1990s.

d) Spain

In Spain, 43 boats were recorded fishing in areas VIIIa,b in 2000 and targeting demersal species. Netting activity in area VIIIc in 2000 is unknown. In 1993, 16 boats were fishing on hake, and 50 on anglerfish. A higher number of small netters (300 boats in 1990-93) worked in inshore waters in areas VIIIc and IXa. In 1998, 535 boats from Galicia were recorded working offshore in the ICES areas VIIIc and IXa and a greater number of Galician small boats (1068 netters) were fishing with set nets in inshore waters. (Pierce *et al*. 2001). These figures are summarised in Table 2.24.

Table 2.24 Spanish set net effort

Area	Gear	Target species	Month	Year	Boats	Effort	Source
VIIIa,b	set nets			2000	43	2494 fishing days; 221 trips	IEO 2001
VIIIc	set nets	hake	1-12	1990-93	16	2000t hake	Fahy 1993
VIIIc	set nets	anglerfish	1-12	1990-93	50		Fahy 1993
VIIIc,IXa	set nets	hake	1-12	1990-93	300	600 t hake	Fahy 1993
Galicia offshore	set nets			1998	535	120767 trips	Pierce *et al*. 2001
VIIIc, IXa (Galicia inshore)	set nets			1998	1068	247298 trips	Pierce *et al*. 2001

e) France

In France set nets are used in the Bay of Biscay to target sole, hake, anglerfish and rays. All French metiers and effort statistics were reported in detail in the most recent review of these fisheries (Pouvreau and Morizur 1995). Sole is the main target and in 1994, 600 boats were fishing part time or all year round. The quantity of nets hauled by a boat is suspected to have increased by 15 % per year during the 1986-97 period in the sole fishery (Morizur and Carn 2000). Other target species include hake, but the number of boats involved has decreased recently due to overexploitation of this resource. All species combined, the number of boats is around 800 (Table 2.25).

Table 2.25 Effort data for French bottom set net fisheries in 1994 (Pouvreau and Morizur 1995).

Species	Area	Season	No. of boats	Maximum net length (km) hauled per boat per day	Typical soak time (hours)	Maximum effort per hauling day
Spider crab	VIIe	Feb-July	150 (25 spec.)	5	120	600 km hours
Sole	VIId –e	Feb-Sept	250	15	18	270 km hours
Anglerfish, rays, turbot, brill	VIIe	All year	150	15	72	1080 km hours
Hake	VIIe –f	All year	20	8	9	72 km hours
Cod	VIId	Nov-Apr	190	10	24	240 km hours
Pollack	VIIe	All year	20	5	15	75 km hours
Sole	VIIIa,b	All year	600	15-20	24	480 km hours
Hake	VIIIa,b	All year	200 (58)	10	12	120 km hours
Anglerfish + turbot + benthic sp	VIIIa,b	All year	200	15	72	1080 km hours
Whiting	VIIIa,b	Nov - May	100	10	12	120 km hours
Total all species	VIIIa,b	All year	800 (?)			15 km days

In the western part of the Channel (VIIe), set nets are used only during neap tides to avoid strong currents. In the anglerfish fishery the yearly quantity of hauled nets is around 1000 km per boat working full-time. Due to long immersion times in this fishery (often exceeding one day), a 'day at sea' is either a shooting day, or a shooting and hauling day, or hauling only.

The same boats target hake and pollack. Separate fleets fish the other target species.

f) UK

UK registered vessels target a wide variety of species using gill nets in Atlantic and Channel waters (Table 2.26). It is difficult to define specific fisheries, as recorded landings typically include many species. There is an offshore set net fishery operated by large vessels that freeze their catch on board, and which typically operates along the shelf edge and on offshore banks. There is a large fishery for cod, flatfish, cuttlefish and other species in coastal waters of the Channel in VIId, and significant fishing effort in the Celtic Sea by English vessels targeting hake and other gadids, monkfish and crustaceans. The overall effort figures (days at sea by ICES division) conceal many inter-annual changes in fishing patterns among the various vessel categories and net types.

A sampling programme in VIa has enabled estimates of fishing effort by notional fisheries in this region. Crayfish and dogfish landings and effort have declined considerably over a six-year period (Table 2.27).

Table 2.26 UK set nets and driftnets effort (days at sea by all vessels) by area and year (Northridge, this meeting)

ICES Area	1995	1996	1997	1998	1999	2000
Vb	40	54	56	41	94	145
VIa	1643	1322	1822	1781	937	561
VIb	2020	2547	1408	1898	1623	2233
VIIa	1225	787	587	413	1702	2657
VIIb	230	152	194	245	67	96
VIIc	886	891	948	1071	712	520
VIId	21877	18086	21493	23318	18463	13914
VIIe	8443	8318	9100	8657	7202	7241
VIIf	3854	3287	3671	2062	2905	3267
VIIg	1678	1727	2436	1739	3510	3862
VIIh	1469	912	1093	954	12	672
VIIj	3006	2587	2568	3459	2467	1899
VIIk	1841	2270	2507	2646	1948	1117
VIII	11	111	32	37	0	0
XII	0	34	0	12	59	43

Table 2.27 Estimates of fishing effort (days at sea) by various UK fleet fishery categories in the ICES division VIa (Northridge, this meeting)

West coast (VIa)	1995	1996	1997	1998	1999	2000
crayfish	882	858	1193	106	17	53
dogfish	282	258	278	2	6	0
skate	53	34	47	49	3	9
cod	23	10	3	7	13	12
herring	16	0	0	0	0	0
anglerfish	1	1	9	1	28	29
Other	387	161	293	1616	870	458
TOTAL ICES VIa	1643	1322	1822	1781	937	561

g) Ireland

No information available

2.5.3.3 Drift nets

a) Canary Islands and Madeira

No information available

b) Portugal - Azores

No information available

c) Portugal - mainland

No information available

d) Spain

There is no drift net fishery in Spain.

e) France

Thirty four boats, each with 2.5 km, are licensed for the year 2001 in the French Albacore driftnet fishery which takes place between June and October in ICES areas VII,VIII (Morizur, pers. comm.)

f) UK

UK driftnet and set net effort are combined in Table 2.26.

g) Ireland

The number of boats in the Irish driftnet fisheries has risen from 7 vessels in 1996 to 18 in 1998 and has stayed relatively stable since then. The number of hauls has risen also (Table 2.28).

Table 2.28 Effort data (number of hauls) in Irish driftnet fishery (all species) (Harwood et al. 1999 and Rogan. pers. obs.)

1996	1998	2000
261	819	estimated to be equal to 1998

2.5.3.4 Other fisheries

a) Canary Islands and Madeira

No information available

b) Portugal - Azores

No information available

c) Portugal - mainland

Some information is available for bottom trawls and seine nets in Portugal (Table 2.29)

Table 2.29 Trawl effort in Portuguese fisheries in ICES area IX, and in seine net fisheries.

Area	Gear	Target species	Year	Boats	Effort (fishing hours)	Source
IXa,b	bottom trawl	mackerel	2000		69850	ICES 2001
IXa,b	bottom trawl	hake	2000		77435	ICES 2001
IXa,b	bottom trawl	hake	1994		151798	ICES 2001
	seine nets		1991	179		Sequeira and Ferreira 1994

e) Spain

Some information on Spanish trawl and purse seine fisheries in the Atlantic is available (Table 2.30).

Table 2.30 Spanish trawl and purse seine information.

Area	Gear	Year	Boats	Effort	Source
VIIIc	bottom trawl	2000	721	12377 fishing days; 8189 trips	IEO 2001
VIIIa,b	bottom trawl	2000	24	2451 fishing days; 412 trips	IEO 2001
IXa	bottom trawl	2000	88	14855 fishing days; 8598 trips	IEO 2001
VIIIc	pair trawl	2000	37 pairs	3378 fishing days; 3133 trips	IEO 2001
VIIIa,b	pair trawl	1998	27 pairs	6338 fishing days; 980 trips	IEO 2001
IXa	pair trawl	2000	18 pairs	2917 fishing days; 2917 trips	IEO 2001
IXa_south	bottom trawl	2000	255	30 000 fishing days	IEO 2001
IXa_south	purse seine	2000	102	10405 fishing days	IEO 2001
IXa_south/ inshore	artisanal	2000	386	27430 fishing days	IEO 2001
Offshore Galicia	trawls	1998	243	51669 trips	Pierce *et al*. 2001
VIIIc, IXa (inshore Galicia)	trawls	1998	250	59367 trips	Pierce *et al*. 2001

e) France

No information available

f) UK

No information available

g) Ireland

No information available

2.5.4 Mitigation measures

2.5.4.1 Gear modification and acoustic devices

Independent observers monitored 160 days of fishing activity in a UK bottom-set fishery for hake in the Celtic Sea in 2000, covering the hauling of 418 strings of gillnets, or over 30,000 net km hours of fishing effort. Approximately 40% of this fishing effort involved strings of nets equipped with pingers (Dukane). One porpoise was observed entangled in these nets. The remaining 60% of observed fishing effort, which included both floatrope and traditional nets were associated with 18 entangled porpoises. The bycatch rate in the pingered nets were 92% lower than in the unpingered nets, supporting the conclusions of several other experiments that these pingers are effective in significantly reducing porpoise bycatch (SMRU *et al*. 2000).

Mitigation alternatives were tested by IFREMER in 1991 for the French tuna driftnet by increasing the immersion depth of the drift nets. The technique involves lowering the headline of the net 2-4 metres below the surface to allow the cetaceans to escape over the top of it. Immersion at 2 m did not entirely solve the bycatch problem (Antoine and Danel 1992); there was a decrease in numbers of dolphins caught but the difference was not statistically significant. When nets were submerged to 4m, there was no further cetacean bycatch, but the catch of the target species fell also and fishermen found the technique logistically difficult also due the large number of buoys and ropes required.

Other countries (e.g. Ireland) have tested ‘dolphin doors’. These are large gaps left between strings of nets to provide passing places. This concept was originally devised to be used in conjunction with passive reflector enhancement of the mesh zones (as proposed at the 1992 SFIA Hull meeting with net fishermen). The concept was first used experimentally in the UK by Cornish fishermen who reported a reduction in blue shark bycatch and dolphins. However, these were private tests made with nets set for albacore tuna that were not equipped with acoustic reflectors. The practice was then copied for a short time by other UK boats. The dolphin door concept was later tested in Ireland, again without acoustic reflectors, but these were not judged successful (R. McCormic, Dublin pers. comm.).

In 1991, the EU Fisheries Council took a decision to limit the length of surface gillnets to 2.5km, and in 1998 declared its intention of banning drift nets, using a phasing-out approach, with a total ban after January 1 2002 (Council Regulation 1239/98). This includes the albacore tuna fishery to the south and west of Ireland and the Bay of Biscay.

2.5.4.2 Behavioural studies

In a study between 1994 and 1997. De Haan *et al*. (1998), with EU funding under the CETASEL programme, studied dolphin interactions with a truncated pelagic trawl (to avoid both catch and bycatch) fished at 80m depth. Tracking data suggested that the animals spent time swimming close to, and probably inside, the mouth of the trawl. The risk of cetacean capture was increased when the fishing vessel changed course, or started to haul. The geometry of the net changes at these times and the large mesh apertures near to the mouth of the trawl close (these otherwise are accessible entry/exit routes for dolphins). This study also demonstrated that deck floodlights on the vessel attracted dolphins at night.

2.5.5 Other relevant interactions

There are some deliberate takes of bottlenose, striped and common dolphins for use as bait and/or to reduce competition in the Spanish Basque country (Fernandez-Contreras *et al*. 2001). The magnitude of these catches is unknown.

2.6 MEDITERRANEAN

2.6.1 Abundance estimates

Abundance estimates are available for some small cetaceans occurring in the Mediterranean (Table 2.31).

Table 2.31 Abundance estimates for Mediterranean cetaceans. See text for comment on sources and areas to which the estimates apply.

Species	Area	Number	95% Confidence interval	Year	Method	Source
Common dolphin	Alboran Sea	14736	6923 - 31366	1992	Ship-based line transect	Forcada and Hammond 1998
Striped dolphin	Western Mediterranean Corso-Ligurian basin	117880 217806 25614	68379 – 214800 15377 - 42685	1991 1991-1992 1992	Ship-based line transect	Forcada *et al*. 1994 Forcada and Hammond 1998 Forcada *et al*. 1995

The International Whaling Commission in 1994 reported some further abundance estimates, but these estimates appear to be little more than informed guesses. These estimates are not used elsewhere in this document.

All abundance estimates provided by Forcada and Hammond (1998) were obtained in the western Mediterranean basin in 1991-92 after a large-scale striped dolphin die-off; thus these figures may be lower than at other times.

Research is currently under way in the Marine Mammal Sanctuary of the Corse-Provencal-Ligurian Basin and off Tunisia using a variety of techniques, including visual and acoustic, that will provide further abundance estimates in future. Several studies have been carried out or are currently running in several areas of the Mediterranean (Spain, France, Italy, Croatia, Greece and Tunisia) to better define some local population/groups of various cetacean species by individual photo-identification.

2.6.1.1 Population sub-divisions

As noted above, there are few abundance estimates for the Mediterranean and a lack of scientific evidence of any separate populations of small cetaceans. Studies on both of these are currently under way in several laboratories, but it is at present difficult to attribute geographical limits to the distribution of each species (or any sub-population). Abundance estimates from the southern and eastern parts of the Mediterranean are completely lacking.

Based on studies elsewhere, local sub-populations/groups might be found with the Mediterranean bottlenose dolphin distribution (particularly in some coastal areas). Divisions have also been found among the oceanic species in the Mediterranean. The extent of any interchange (whether regular migration or not) between the Atlantic and Mediterranean is unknown for any species.

2.6.2 Bycatch estimates

Bycatch data exists only for some Mediterranean areas and fisheries (Table 2.32).

Table 2.32 Cetacean bycatch estimates – Mediterranean Sea

Species	Fishery target	Gear	Area	Season	Bycatch estimate	95% confidence interval	Year	Reference
Striped and common dolphin	Swordfish	Driftnet	Eastern Gibraltar Straits	July-August	366	268 - 464	1993	Silvani *et al*. 1999
Striped and common dolphin	Swordfish	Driftnet	Eastern Gibraltar Straits)	July-August	286	283 - 340	1994	Silvani *et al*. 1999
Bottlenose dolphin	Several	Artisanal & trawler	Balearic islands	Whole year	30	Not provided	1991	Silvani *et al*. 1992
Striped dolphin	Blue fin tuna	Thonaille (driftnet)	Gulf of Lyon, Liguro-Provençal area	March-October	326	180 - 472	2000	Imbert 2001b

These estimates are summarised by species in the following section. In addition to this, evidence from strandings and other sources indicates that further, so far unquantified, bycatch occurs in the Mediterranean (Table 2.33).

Table 2.33 Strandings of small cetaceans in Italy, Spain, France, Greece and Tunisia with indications of bycatch. The gear likely to be implicated is indicated.

Species	Fishery target	Gear	Area	Season	Minimu mannual bycatch	Years	Reference
Bottlenose dolphin	?	Gill net	Greek waters	All year	9	1991-2001	NCMR PCRI Unpublished data
Striped dolphin	?	Gill net	Greek waters	All year	5	1991-2001	NCMR PCRI Unpublished data
Common dolphin	?	Gill net	Greek waters	All year	1.6	1991-2001	NCMR PCRI Unpublished data
Risso's dolphin	?	Gill net	Greek waters	All year	1.6	1991-2001	NCMR PCRI Unpublished data
Harbour porpoise	?	Gill net	North Aegean	All year	0.3	1991-2001	NCMR PCRI Unpublished data
Undef.	Undef.	Undef.	Greek waters	All year	9.4	1991-2001	NCMR PCRI Unpublished data
Bottlenose dolphin	Sardine	Purse seine	Gulf of Gabes	Autumn	1	1991	Bradai (2000)
Striped dolphin	Undef.	Trammels	Eastern coasts of Tunisia	Summer	1	1991	Bradai (2000)
Bottlenose dolphin	Undef.	gillnets	Italian coast	All year	6	1986-1996	CSC (1987-2000)
Common dolphin	Undef.	gillnets	Italian coast	All year	0.3	1986-1996	CSC (1987-2000)
Striped dolphin	Swordfish	Driftnet	Pelagic waters	Summer	16	1986-1996	CSC (1987-2000)
Risso's dolphin	?	Driftnet	Italian waters	Summer	1	1986-1996	CSC (1987-2000)
Long-finned pilot whale	Swordfish.	Driftnet	Ligurian sea	Summer	1.2	1986-1996	CSC (1987-2000)
Cuvier's beaked whale	Swordfish.	Driftnet	Ligurian sea	Summer	1	1986-1996	CSC (1987-2000)
Undef.	Undef.	Undef.	Italian coast	All year	9	1986-1996	CSC (1987-2000)

2.6.2.1 Common dolphin

Silvani *et al*. (1999) estimated bycatch of striped dolphin and common dolphin together using independent on-board observers in the swordfish drift net fishery in the Gibraltar area. Ten observers monitored 94 fishing operations. This represented about 3% of all hauls in 1993 and 10.2% of those in 1994. In total 366 were recorded in 1993 and 289 in 1994; the proportion of the common dolphin was 45% in 1993 and 50% in 1994.

Observers on board of Italian drift-net vessels in 1990-91 reported no common dolphins bycatch (Di Natale 1992), neither did observers on board French drift-net vessels in 2000 (Imbert *et al*. 2001a,b).

2.6.2.2 Striped dolphin

Observers on board Italian drift-net vessels in 1990-91 reported several striped dolphins in the bycatch: 6 in 1990 (raised to 1149 for the entire fishing activity) and 7 in 1991 (raised to 1363 for the whole fishing activity) (Di Natale 1992). A total of 100 hauls were monitored by 12 independent observers, however the total number of hauls was estimated at over 5000 for the two years combined, so observer coverage was only 0.2% of the fishery. The catch rate was quite different in two major areas: the Ligurian Sea (0.455 specimens/haul in 1990 and 0.125 specimens/haul in 1991) and the Central Mediterranean Sea (0.0523 specimens/haul in 1990 and 0.087 specimens/haul in 1991). No more recent data are available for this fishery, but the Italian driftnet fishery in the Ligurian Sea has been banned since 1992.

Thirty-one observers on board the French thonaille drift net fishing vessels in 2000 recorded a total of 72 hauls, representing about 7.6% of the total number of hauls made by the fleet (Imbert *et al*. 2001a,b). Nineteen striped dolphin were bycaught (raised to 326+/-146 for the whole activity), with a catch rate of 0.34 specimens/haul.

Silvani *et al*. (1999) estimated bycatch of striped dolphin and common dolphin together using independent on-board observers in the swordfish drift net fishery in the Gibraltar area. Ten observers monitored 94 fishing operations. This represented about 3% of all hauls in 1993 and 10.2% of those in 1994. In total 366 were recorded in 1993 and 289 in 1994; the proportion of the common dolphin was 45% in 1993 and 50% in 1994.

The small pelagic purse-seine fishery off the SE Spanish Mediterranean coast had a bycatch of 300 dolphins (both species combined) in 1994 (Silvani *et al*. 1999).

Bycatch of striped dolphin are also occasionally reported in the tuna purse-seine fishery (Magnaghi & Podestà 1987), in drifting long-lines (Duguy *et al*. 1983), in gill nets (Di Natale 1989) and in the harpoon fishery (Di Natale 1992), but without providing a catch rate.

2.6.2.3 Bottlenose dolphin

No catch rates are available. Silvani *et al*. (1992) provides a total estimate of 30 bottlenose dolphins caught by artisanal gear and trawlers in the Balearic area in 1991. Bycatch occasionally occurs in the gill net fishery (Di Natale 1989), drift nets (Di Natale 1992), drifting long lines (Di Natale 1992), bottom trawlers (Di Natale 1989; Northridge & Di Natale 1991) and by the harpoon fishery (Di Natale 1992).

2.6.2.4 Risso's dolphin

No catch rates are available. Bycatch occasionally occurs in the gill net fishery (Di Natale 1989), driftnets (Di Natale 1992), drifting long lines (Di Natale 1992) and by the harpoon fishery (Di Natale 1992).

2.6.2.5 Long-finned pilot whale

Bycatch occasionally occurs in the drift-nets fishery (Di Natale 1992), where the catch rate, in the period 1990-91 was 0.001 specimen/haul. Sporadic incidental catches are also reported in the drifting long-line fishery, but no catch rate is available.

2.6.2.6 Cuvier's beaked whale

No catch rates are available. Bycatch occasionally occurs in the gill net fishery (Di Natale 1989), driftnets (Di Natale 1992), drifting long lines (Di Natale 1992) and by the harpoon fishery (Di Natale 1992).

2.6.2.7 Other cetacean species

No catch rates area available for other cetacean species in the Mediterranean Sea. Incidental catches of false killer whale (in drifting long-lines, Di Natale & Mangano 1983), killer whale (in a tuna trap, Di Natale and Mangano 1993) are reported in the literature.

2.6.2.8 General comments

Additional data provided by the EC Project MED 93/011 (12 to 15 specimens of "dolphins" caught per vessel/year by the Sicilian driftnet and gill-net fleets) were not considered useful to the meeting.

A Spanish-Italian observer programme (EU funded) was carried out in 1995 and 1996 (191 and 171 hauls observed respectively) on board bottom trawl boats. No incidental catches of cetaceans were reported.

2.6.3 Fishing effort statistics

It is difficult to collect fishing effort statistics for the Mediterranean fleets concerned. One of the major gaps is due to the lack of available statistics for each fishery and particularly for the most recent years. This is mostly due to multipurpose licences existing in several countries (including the EC ones) and to the very poor information available in other eastern and southern Mediterranean countries.

2.6.3.1 Drift-nets

One of the most studied fleet segments is that of the large-scale drift-nets, including all the gear types (spadara, thonaille, etc.), where the current total Mediterranean fleet amounts to at least 700 vessels (Table 2.34) The fishing effort is measured usually in fishing days (one haul per day). The fishing effort for the each spadara drift-netting vessel was between 44 and 32 days in 1991. The most recent data (Imbert *et al*. 2001b) report an average of 21 (limits 2 – 37) days per boat per year for the thonaille in 2000.

Table 2.34 Drift net fishery effort data available to the working group

Country	Number of vessels	Effort	Year	Source

Italy	333	*	1998	EC Project 98/0034
Italy	130		2000	SCRS/ICCAT 2001
France	75	*	1999	EC Project 97/029
France, excluding Corsica	46	21 fishing days per vessel/year (=hauls)	2000	Imbert *et al*. (2001a)
Algeria, Greece, Monaco and Albania	20			SCRS/ICCAT 2001
Morocco	>400			SCRS/ICCAT 2001
Turkey	110			SCRS/ICCAT 2001

* several sets of efforts data are included in the report for various areas and fleet.

2.6.3.2 Gill nets

No recent data are available about the very large number of artisanal vessels using gillnets all around the Mediterranean coast. In areas where this fishery is licensed, gillnets are commonly included in multipurpose or multigear licences. It is likely that the total number of vessels or small boats using these nets is between 50000 and 60000 (Table 2.35). The data about the fishing effort (net length, fishing days, etc.) are scarce and related to very small fisheries. The variety of gillnets gear is quite large and includes bottom nets, midwater nets, surface nets and surrounding nets, that could be used seasonally or according to the tradition in the area. Historical data are reported by Northridge *et al.* (1991), Northridge & Di Natale (1991) and Di Natale & Notarbartolo (1994).

Table 2.35 Artisanal fishery data available to the working group; note that this includes several metier including gill nets

Country	Number of vessels	Year	Source
Spain	2977	2000	EC Project 00/21
France	1359	2000	EC Project 00/21
Greece	18080	2001	EC Project 00/019
Italy	13450		Multipurpose, EC Project 95/C/76/12
Tunisia	9480		Bradai 2001

2.6.3.3 Bottom Trawl nets

Bottom-trawling is the most important fishery in the Mediterranean from a production point of view. Despite this, effort data are not available for most Mediterranean countries. A substantial improvement for the statistics is expected from the FAO funded COPEMED and ADRIAMED projects, but no data were available to the workshop (Table 2.36). Some data exist for most of the EC fleets operating in the Mediterranean.

Usually, the number of fishing days per vessel is between 200 and 240, but this varies from area to area and from fishery to fishery. The fishing efforts parameters commonly used (Kw, GT) are not considered useful to asses the impact on the cetacean bycatch; the number of hauls or the fishing time would be more useful.

Table 2.36 Bottom trawl fishery data available to the working group.

Country	Number of vessels	Year	Source
Spain	1329	2000	EC Project 00/21
France	155	2000	EC Project 00/21
Greece	346	2001	EC Project 00/019
Tunisia	342		Bradai 2001

2.6.3.4 Pelagic Trawl nets

This fishing activity is not well known in the Mediterranean and the statistics are poor, particularly from the effort point of view. According to the information submitted at this workshop, the French Mediterranean pelagic trawl fleet usually carries out an average of about 300 hauls/boat/year.

2.6.3.5 Tuna purse seine

There has long been a specialist purse seine fleet targeting tuna. However, important changes have happened in the last 10 years, due to the increase of the economic value of tuna and the growth in cage fattening. Several vessels, originally using the purse seine only for small pelagic fishery, are now involved in the tuna purse seine in some periods. Deterioration in the statistics on catches has also occurred (SCRS-ICCAT). Data about most of the European fleet are reported by the EC study BFTMED (Table 2.37).

Table 2.37 Tuna purse seine fishery effort data available to the working group.

Country	Number of vessels	Effort	Year	Source
Spain	7	*	1999	EC Project 97/029
France	28	150 fishing days per vessel	1999	EC Project 97/029
Italy	48	*	1999	EC Project 97/029
Greece	6	*	1999	EC Project 97/029
Tunisia	68			Bradai 2001

* several sets of efforts data are included in the report for various areas and fleet.

2.6.3.6 Purse seine

This category includes several gear types used for various target species of small pelagic fishes. Statistical data are poor, and data on the fishing effort are available only for some fleets, mostly from EU countries (Table 2.38).

Table 2.38 Purse seine fishery data available to the working group.

Country	Number of vessels	Year	Source
Greece	328	2001	EC Project 00/019
Italy	300	2000	EC Project 00/21
Spain	408	2000	EC Project 00/21
Tunisia	347		Bradai 2001

2.6.3.7 Tuna traps

A few traditional tuna traps still exist in the Mediterranean; 5 in Italy, 2 in Spain, 2 in Croatia, 2 in Libya, 2 in Tunisia, 1 in Morocco. They usually operate from May to July, sometimes expanding the period from April to August. The number of tuna trap and the total number of fishing operations should vary from year to year. This fishery is being studied by the IFREMER-Sete.

2.6.3.8 Drifting long lines

Large vessels or small artisanal boats use this gear all around the Mediterranean Sea. There is a range of target species (bluefin tuna, swordfish, albacore) and a wide variety of technical characteristics. The statistics are quite scarce, either because this gear is often included in the multipurpose licence or simple because no statistics are available, particularly for the non-Mediterranean vessels engaged in the tuna and swordfish fishery operating in the Mediterranean waters, sometimes flying flags of convenience. The data about most of the European fleet are reported by the EC study BFTMED and by the SWOMED (Table 2.39).

Table 2.39 Drifting long-line fishery data available to the working group.

Country	Number of vessels	Effort	Year	Source
Spain	396	*	1999	EC Project 97/029
Greece, S.Aegean Sea	56	1467550 hooks 2125 fishing days	2001	Tuna fishing - EC Project 00/44
Greece, E. Ionian Sea	32	1096500 hooks 657 fishing days	2001	Tuna fishing - EC Project 00/44
Greece	119	*	1999	Tuna fishing, EC Project 97/029
Greece	333		2001	EC Project 00/019
Italy	557		1998	EC Project 98/0034
Italy	206	*	1999	Tuna fishing, EC Project 97/029

* Several sets of efforts data are included in the report for various areas and fleet.

2.6.3.9 Bottom long lines

This gear is used by a very large number of artisanal vessels off all Mediterranean coasts and is often licensed as part of a multipurpose licence. There is a large variety of target species, fishing techniques and gear characteristics that vary with location and season. Few statistical data are available and only cover a few localised fisheries (Table 2.40).

Table 2.40 Bottom long-line fishery data available to the working group.

Country	Number of vessels	Year	Source
Spain	377	2000	EC Project 00/21

2.6.3.10 Harpoon

The only harpoon fishery for large species existing in the Mediterranean concerns the traditional fleet in the Strait of Messina. Fourteen vessels still use this method, in a fishing season from April to August. The total number of fishing days per vessel ranges from 35 to 60.

2.6.4 Mitigation measures

A review of known studies is provided below.

A mechanical wave activated bell system was tested in the Italian swordfish Spadara fishery in 1993 but the results were judged inconclusive for reasons of low dolphin bycatch in the limited observation time. Three dolphins were caught in the control nets and one in the net fitted with bells. However calm weather conditions at the time of the latter capture may have silenced the bell (STECF 1995).

Imbert *et al*. (2001b) tested pingers (*AQUAmark200*) as dolphin deterrents to reduce bycatch in tuna drift nets off France. The only observed bycaught species was striped dolphin. The preliminary results, from August to September 2001 during the peak dolphin bycatch season showed an 80-85% reduction in bycatch when compared to unmodified nets fished nearby and to the previous year's bycatch in the period from June to September. The 2001 tests employed four boats equipped with 40 pingers per boat. The pingers were spaced at 200m intervals along the nets. This project is expected to be extended, with French government support, to continue on a larger scale during 2002 to provide a comprehensive statistical analysis for the complete fishing fleet of approximately 48 boats.

2.6.5 Other relevant interactions

There are some deliberate takes of small cetaceans for use as bait and/or to reduce competition in, at least, the Balearic Islands (bottlenose dolphins) and southeastern Spain (bottlenose and common dolphins). The magnitude of these catches is unknown.

Di Natale (1992) reports single specimens of common dolphin deliberately killed by harpoon.

Other known pinger usage in the Mediterranean concerns attempts to separate dolphins from fishing gear where the interactions may involve loss of catch and damage to gear but do not normally involve the incidental catch of the cetacean. Such interactions appear driven by predation and these have sufficient economic consequences for the fishermen that many are encouraged to use illegal harassment methods e.g. explosives, poison bait, needles placed inside fish and shooting.

A small scale trial was carried out in Mallorca during 2001 utilised pingers (*AQUAmark100*) in the trammel net fishery for cuttlefish and for red mullet. Twenty pingers were attached to nets spaced at 150m intervals. The average length of net set per boat in both fisheries was 3 km. The results were judged inconclusive (Manel Gazo pers. comm.).

Trials in Sicily examined predation and damage caused by dolphins to small scale artisanal trammel and gillnets in two different areas (Goodson et al. 2001). The gear designs, landed weights of fish and the species involved were recorded. The primary study was based in the Egadi islands and a secondary site at Catania was also monitored. Pingers (prototype *AQUAMark100*) were deployed in the second year of the study with only a single pinger attached per net. The results showed that dolphin damage to the nets with pingers was effectively eliminated and the landed catch weights also increased when pingers were attached. Significant CPUE benefits were obtained for both types of fishing gear at both geographic locations and also by season, (47% in total for trammel and gillnets fished at Favignana and a maximum of 133% in the Catania 'Menaidi' gillnet fishery). Seasonal peaks in the damaging interactions to unmodified gear were noted, with most damage occuring during the spring and least during the summer. This small-scale study indicated that the pingers could reduce damaging interactions with dolphins in these fisheries and that these effects were not reduced after one year.

A squid jigging fishery with lights off Sicily suffers multi-species predation, including from Risso's dolphin. A preliminary study started in 2001 based on a single fisherman using a single pinger (*AQUAmark100*). No analysis of findings has yet occurred (Di Natale pers. comm.).

A refined version of the Japanese Iki Island 'steel tube' deterrent is being trialled off Tunisia. This manually activated device is used in both the purse seine fishery (with lights) and with trammel nets. The oil or water-filled tube is struck at intervals with a hammer. It is claimed to have an effective range of about 1 km (but the effect may wear off with time and with habituation the effect may reverse and eventually act to attract dolphins (Rais, this meeting).

3 REVIEW METHODS USED TO SET UP BYCATCH LIMITS

The relative merits of current approaches to setting bycatch limits were discussed. In 1995 the Scientific Committee of the International Whaling Commission (IWC), following the precautionary principle, agreed that bycatch should in no case exceed one-half of the maximum growth rate of a small cetacean population, and it was noted that the maximum net production rate of the harbour porpoise could be lower than 4% per year. Given the uncertainty in both bycatch and abundance estimates, a figure of 1% of the abundance estimate was adopted by the Scientific Committee as a reasonable and precautionary level beyond which to be concerned about the sustainability of bycatch.

A second approach is that adopted by the US under the Marine Mammal Protection Act (MMPA). A primary goal of the MMPA is to prevent any marine mammal stock from being reduced below its optimum sustainable population level, and to restore stocks that have been reduced below that level (Wade and Angliss, 1997). The MMPA requires that all U.S. marine mammal stocks are subjected to a stock assessment report annually, and that each stock assessment report should take into account several items, including:

1) a description of the stock, including its geographic range;

2) a minimum population estimate, a maximum net productivity rate, and a description of current trend, including a description of the information upon which these are based;

3) an estimate of the annual human-caused mortality and serious injury of the stock and for a strategic stock, other factors that may be causing decline or impeding recovery of the stock, including effects on habitat and prey,

4) a description of the commercial fisheries that interact with the level of incidental mortality and serious injury by each fishery on an annual basis;

5) a statement categorising the stock as strategic or not and why; and

6) an estimate of the potential biological removal level (PBR) for the stock, describing the information to calculate it.

A take limit, or Potential Biological Removal (PBR) is calculated on a stock-by-stock basis for each marine mammal stock in US waters. The PBR is defined as “the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population”. PBR is calculated as the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate (0.5 R_{max}); and a recovery factor (F_r).

N_{min} is defined in the MMPA as an estimate of the number of animals in a stock (based on the best scientific information on abundance, incorporating precision and variability). N_{min} is calculated such that a stock of unknown status would achieve, and be maintained at, an optimal sustainable population with 95% probability. This has been calculated to be the lower limit of a 60% 2-tailed confidence interval. The minimum population estimate of the stock should be considered unknown if 8 years have transpired since the last abundance survey of a stock, unless compelling evidence indicates that a stock has not declined since the last census.

One-half of R_{max} is defined as “one-half of the maximum theoretical or estimated net productivity rate of the stock at a small population size" where the term "net productivity rate" means the annual per capita rate of increase in a stock resulting from additions due to reproduction, minus losses due to natural mortality. Default values are used in the absence of stock-specific measurements (e.g. 0.12 for pinnipeds and sea otters, 0.04 for cetaceans).

The recovery factor (F_r) is a value between 0.1 and 1.0. This factor is incorporated to ensure that the time necessary for populations listed as endangered, threatened or depleted to recover is not significantly increased. The use of $F_r < 1$ allocates a proportion of expected net production towards population growth and compensates for uncertainties that might prevent population recovery, such as biases in N_{min} and R_{max} or errors in the determination of stock structure. Simulation trials run for species considered endangered demonstrate that the default F_r should be 0.1, and that the default F_r for depleted or threatened stocks or unknown should be 0.5. Populations that are not known to be decreasing can have higher F_r levels. Similarly, the recovery factor can be adjusted to accommodate additional information and allow for management discretion in some instances. For example, if human-caused mortalities include more than 50% females, then the recovery factor should be decreased to compensate for the greater impact this mortality has on the population.

The aim of ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) is “to restore and/or maintain biological or management stocks of small cetaceans at the level they would reach when there is the lowest anthropogenic influence”. The interim objective is “…. to restore populations to, or maintain them at, 80% or more of carrying capacity (K)”. In the case of the harbour porpoise, a joint IWC-ASCOBANS working group used a PBR-type approach to evaluate the maximum potential annual removal rate from a porpoise population of unknown status that would be consistent with achieving a minimum population size of 80% of K with 95% probability, over an infinite time horizon (Anon 2000). This rate was estimated at 1.7%

of the population size, and this figure was adopted by ASCOBANS in 2000 as an interim maximum annual removal rate for this species (ASCOBANS 2000a)

Having considered the options, the group considered the ASCOBANS approach and conservation objectives useful and in the interim, adopted 1.7% as a maximum allowable removal rate for the harbour porpoise. The group was not able to run a PBR type model to calculate an equivalent rate for the other species of concern, for example, common and striped dolphins, but agreed, again as an interim measure and given the lack of any clear alternative, that a PBR-type model would be a useful way forward for these other species. The group agreed to examine this approach further at a later meeting.

4 BYCATCH LIMITS BY RELEVANT SPECIES AND AREA

Given that in some areas there are both abundance estimations and bycatch estimations in at least some fisheries, the sub-group considered it useful to compare both. These are summarised on a species-by-species basis in Table 4.1. It is important to note that the abundance estimations are NOT population estimates, and in most cases the species' range probably extends beyond the survey area, although stock structure is usually not known. Similarly, there are no bycatch estimates from ALL fisheries operating in a given area, so bycatch estimates are underestimates.

Table 4.1 Species, fisheries and areas for which bycatch rates can be related to animal abundance

Harbour porpoise (*Phocoena phocoena*)

Areas and fisheries	Bycatch estimate	Abundance estimate	%	Comment
Celtic Sea Irish hake 14-22m vessels UK hake 15+ m vessels	2,200 [1] (95% CI 900-3500) UK & Ireland 1994/1995	36,000 [2] (cv = 0.57)	6.2%	Serious concern. Although fishing effort decreased in both the Irish and English fleets, this does not take into account bycatch in other set nets or in other fisheries in the same area. This fishery has been subjected to an experimental pinger trial, which successfully reduced harbour porpoise bycatch by 92%.
Skagerrak & Kattegat	114 Skagerrak[3]	4,785 [3]	2.4 %	[3] The abundance estimate is calculated using density estimates calculated during the SCANS survey for a larger area and scaled down to the Swedish EEZ area
Cod and pollock gillnet	50 Kattegat [3]	4,009 [3]	1.2 %	
North Sea	8,138 Danish (1994) [4]	268,800 [5] ( )	3.0%	Bycatch in the Danish fishery was high at the time of the SCANS survey (1994) but in recent years, with a decrease in fishing effort, bycatch has decreased. Pingers have been made obligatory in the Danish cod wreck fishery.
Danish gillnets for cod, turbot, hake	2,971 Danish [4] ( )		1.3%	The figure of 1.3% includes current estimates of Danish and UK bycatch for all Danish and most UK gillnet fisheries. In the absence of a more recent abundance estimate and no information for the Norwegian, Dutch, Belgian, German and other UK fleets, this figure is an underestimate.
UK gillnets for cod, skate, sole, turbot	436 UK [6] (95% CI 351-884)			

[1] Tregenza et al., 1997, [2] Hammond et al., 1995, [3] Berggren and Carlstrom, 1999; [4] Danish fisheries; Vinther this meeting, [5] ICES 1996,

[6]UK turbot, skate, cod, sole; Northridge this meeting

TABLE 4.1 (Continued)

Common dolphin (*Delphinus delphis*)

Areas	Bycatch estimate	Abundance estimate	%	Comment
Celtic Sea & Western waters				The drift net fishery targeting albacore tuna extended from the Bay of Biscay to the waters west of Ireland between May and September. The fisheries operated in slightly different areas and the abundance estimates are not contiguous in all cases. However, it is likely that all the fisheries are impacting the same population. Pelagic trawl fisheries operating in the same area also have a common dolphin bycatch (Morizur et al, 1999), the scale of which is not clear.
Irish tuna driftnet	356[8]- 835[9]			
UK tuna driftnet	61[10]			
UK & Irish hake gillnet	200	101,205 [7]	0.6-1.1	
Bay of Biscay	410 [11]- 419 [12]	61,888 [13]	0.67	The drfit net fishery has been banned with effect from 1.1.2002. Other fisheries, however, such as the French and Dutch pelagic trawl fisheries, catch common dolphins in this area (e.g. Morizur *et al*., 1999), and although the observed effort is low, it is likely that these fisheries have a high take of common dolphins, probably in the 1000s. The bycatch estimates are therefore negatively biased.
French tuna driftnet				
Alboran Sea				Bycatch estimate made in 1993 & 1994 in swordfish drift net fishery, since then Spanish driftnetting has been banned but Moroccan effort increased from 200 to 400 vessels.
Spanish swordfish driftnet fishery	165 [14] - 145 [14]	14,736 [15]	1.2	

[7] Harwood et al., 1999; [8] Irish drift net bycatch 1996, [9] Irish drift net bycatch Rogan this meeting; [10] Anon., 1996 UK drift net fishery, [11, 12] French drift net bycatch 1992, 1993; [13] Project MICA; [14] Silvani et al., 1999; [15] Forcada, J. and Hammond, P. 1998

TABLE 4.1 (Continued)

Striped dolphins (*Stenella coeruleoalba*)

Areas	Bycatch estimate	Abundance estimate	%	Comment
Celtic Sea & Western waters				
Irish tuna driftnet	136[8] - 528[9]	66,825 [7]	0.27 - 0.79	The drift net fishery targeting albacore tuna extends from the Bay of Biscay to the waters west of Ireland between May – September. The fisheries operate in slightly different areas and the abundance estimates are not contiguous in all cases.
UK tuna driftnet	44[10]			
Bay of Biscay				
French tuna driftnet	1193[11]-152[12]	73,843 [13]	1.6 - 1.56	Striped dolphins have a southern distribution and the locations of bycatch reflect the fishing distribution. However, it is likely that all fishing fleets are impacting on the same population and the combined removals are likely to be in excess of 2% at current fishing levels.
Alboran Sea				
Spanish swordfish fishery	145[14]- 201[14]	14,736 [15]	1.2	Bycatch estimate made in 1993 & 1994, since then effort by Spanish fishing effort has been prohibited but Moroccan effort has increased significantly
Corsican/Ligurian Sea				
French tuna driftnet	326±146 [17]	25,614 (95% CI 15,377 42,685)[18]	1.3	Bycatch from the French tuna drift net fishery calculated in 2000. Experimental trials using pingers reduced bycatch rate from 0.34 to 0.091 animals/haul
Italian swordfish driftnet	160 (1990) [19] - 51 (1991) [19]		0.62 0.19	Bycatch estimate from the Italian driftnet fishery in 1990 and 1991, scaled to the Ligurian sea area. This swordfish fishery has been banned in this area since 1992.
Western Mediterranean				
Italian swordfish driftnet	14 (1990) [19] - 15 (1991) [19]	117,880 (1991)[20] 217,806 (1992)	0.006	Abundance estimates were derived after the striped dolphin die off in the Mediterranean in 1990. % of estimate calculated on the most recent estimate.

[17]Imbert *et al*. 2001; [18]Forcada *et al*., 1995; [19] DiNatale, 1992, [20]Forcada *et al*., 1997,

5 LEVELS OF RISK ATTRIBUTABLE TO RELEVANT FISHERIES

The group was tasked with ranking fisheries according to their risk to small cetaceans, but felt that there were insufficient data and time in the present meeting to progress this task very far. Instead it was agreed that two types of table would be created, the first to list those *fisheries* for which bycatch estimates and local abundance estimates are available, with an indication of the current management measures that are being proposed for these fisheries.

The group wished to stress that the inclusion of fisheries within this first table was NOT intended to highlight these fisheries as being more problematic than others – rather the table highlights those fisheries in which research has been done that may enable some assessment of the level of impact to be made.

The second table type lists fisheries where there is a measured bycatch but no estimate of animal abundance, and those fisheries where some bycatch is known or may reasonably be expected, but for which no adequate sampling has been done. There was no time in the present meeting to rank these fisheries in terms of their potential risk to cetaceans, but three areas have been highlighted in Section 10 below. A third table was also drawn up to include those fisheries in the Mediterranean where there is know to be conflict with dolphins (such as net damage and fish depredation) and which may lead to deliberate killing of the dolphins involved.

Table 5.1 Fisheries with bycatch estimates and local cetacean abundance estimates.

Areas and fisheries	Take rates as % of animal abundance	Mitigation action being taken
Skagerrak & Kattegat		
Swedish cod and pollock gillnet	1.2 - 2.4 (Porpoise)	None
North Sea		
Danish gillnets for cod, turbot, hake, plaice	>3.0% in 1994 >1.3% in 2000 (Porpoise)**	Pingers deployed in several fisheries Aug-Oct
UK gillnets for cod, skate, sole, turbot		None
Celtic Sea & Western NE Atlantic		
Irish hake 14 -22m vessels	>6% in 1994 (Porpoise)**	None; but pingers tested successfully
UK hake 15+ m vessels		
Irish tuna driftnet	0.27-0.79 (Striped)	*
UK tuna driftnet	> 0.6-1.1 (Common)	*
Bay of Biscay		
French tuna driftnet	> 0.67 (Common) 1.6 (Striped)	*
Alboran Sea		
Spanish swordfish driftnet fishery	1.2 (Striped) 1.2 (Common)	Fishery closed 1992 (but continuing non EU flagged vessels)
Western Mediterranean		
Italian swordfish driftnet fishery	0.006-0.079 (Striped)	*
Corsica/Ligurian Sea		
Italian swordfish driftnet	0.17-0.5 (Striped)	Fishery closed 1992
French tuna driftnet	1.0 (Striped)	* Pingers successfully tested experimentally 2001

- These fisheries are scheduled for closure in 2002 according to EC regulation 1239/98

- ** Effort in these fisheries has changed substantially since 1994. Declining effort in the North Sea at least, coupled with pinger use, has probably reduced porpoise bycatch considerably since 1994, but given the fact that bycatch estimates are incomplete, bycatch totals probably still exceed 1.7%

.

Table 5.2 (a)

Summary of **reports** of small cetacean bycatch in fisheries in waters around **northwestern Europe** for which insufficient information exists either on stock size or bycatch levels or both for an adequate assessment to be made. Also included under (b) is a list of similar fisheries that have yet to have their small cetacean bycatch reported. The sub-group wishes to **stress** that these reports differ in reliability and time frame and are therefore not always comparable. The absence of fisheries from this table should NOT be taken as evidence of the absence of bycatch in any such fishery. Generally bottom trawl fisheries are found to take small cetaceans as bycatch very infrequently or animals are taken dead as discards from other fisheries.

Gear type	Location	Target species	Nation	Bycatch species and estimate, source
Gill and tangle nets	Skagerrak & Kattegat,	Cod, turbot, sole, plaice and lumpfish	Denmark	Harbour porpoise, no. unknown (Vinther, 1999)
	Eastern North Sea	Cod, sole, other flatfish	Germany	Harbour porpoise. No. unknown, will be studied in 2002
	Baltic	Herring, cod, flounder, turbot, salmon	Baltic nations	Harbour porpoise, 133 in 1987-2000 reported in Kiel - Mecklenburg Bights (Kock, pers. comm.). Harbour porpoise, 44 in 10 years (1990-present) from Poland (interviews) (Kuklik, pers. comm.)
Gill nets and tangle nets	West of Scotland	Crayfish and dogfish	UK (Scotland)	Harbour porpoise 16 to 22 annually 1995-1999 Northridge and Hammond 1999.
Drift nets	Baltic	Salmon	Baltic nations	Harbour porpoise, no. unknown, Annual min. estimate 2 – 3 animals/year in Swedish fisheries in early 1990's
Pelagic trawls	Skagerrak	Herring	Denmark	Pilot whales, no. unknown
	Bay of Biscay	Hake	France	Common dolphin (1994-95) (Morizur *et al*. 1997; 1999), decrease in fishing effort due to low stock size
	Bay of Biscay Celtic Sea	Albacore	France, Ireland , UK	Common, White-sided dolphin (1992-93 in Morizur et al. 1997,1999) (1998-99 in EU contract n. 98/010)
	Western Channel, Bay of Biscay	Sea Bass	France	Common dolphin (1994-95) (Morizur *et al*. 1997; 1999)
	West of Ireland, Celtic Sea, Channel,	Mackerel, horse mackerel	UK, France, Ireland, Netherlands	Common, white-sided dolphins (1992-93) (Kuiken et al. 1994, Berrow and Rogan, 1997), Couperus, 1997
	Bay of Biscay	Hake, mackerel, horse mackerel	Spain	'Dolphins' 24 in 417 hauls, 1996-2000. (Gorka Sancho, pers. comm.)

Table 5.2b Other similar fisheries whose bycatch is as yet unmeasured

Gear type	Location	Target species	Nation	Information
Gill and tangle nets	North Sea	Saithe, other species	Norway	Harbour porpoise likely by analogy
	Southern North Sea		Netherlands	Opportunistic reports
	Southern North Sea and Channel		Belgium	Occasional – self-reporting and strandings
	Western Channel	Flatfish, mixed sp.	France	Occasional – self-reporting
	Eastern Channel	Flatfish, spider crabs and others	France	No recent records; harbour porpoise population now very depleted
	Eastern Channel	Cod, cuttlefish, plaice, sole	UK	No recent records; harbour porpoise population now very depleted
	Celtic Sea	Hake, flatfish, & others	France, Spain	Occasional – self-reporting and investigation of strandings
	Bay of Biscay	Numerous species	France and Spain	None observed in small Spanish study; 1994: 54 sets observed, 1998-2000: 36 sets observed. Increased frequency of harbour porpoise strandings with net marks, but may reflect increased activity to investigate strandings
	Continental shelf edge	various	UK, Spain and others	
	Portuguese coastal waters	various	Portugal	Harbour porpoise, common dolphin, no. unknown
	Atlantic margin off Ireland, Celtic Sea	Hake, *Lophius*, others	Ireland, and others	Occasional – self reporting and strandings
Drift net	Southern and western North Sea	Salmon and other species	UK (England)	Studies undertaken, no bycatch seen, but insufficient sampling to draw conclusions
Drift net	West Ireland, Celtic Sea	Salmon	Ireland	Occasional – self reporting and strandings
Pound nets	Kattegat, Baltic	Various	Denmark, Germany and others	Catches rare or entangled cetaceans usually released alive, mostly self-reporting
Bottom and beam trawls	All waters	Many	All coastal nations	Considered generally very low – some opportunistically reported accounts involving several species (Fertl and Leatherwood 1997)
Pelagic trawls	Atlantic margin off Ireland	Mixed species, mackerel, horse mackerel, blue whiting	Ireland	Evidence of bycatch from strandings, self reporting
Long-lines	All waters	Several spp.	All nations	A few opportunistic accounts, species unknown ?
Beach purse seine	Portuguese coastal waters (northern region)	Small pelagic fish	Portugal	Harbour porpoise, common dolphin, no. unknown

5.3 (a) Summary of reports of cetacean bycatches in fisheries in **Mediterranean waters,** where there is an indication of bycatch rate (a), where cetaceans are known to be subject to bycatch (b) and where other gear conflicts suggest the possibility of associated mortalities (c). The sub-group stresses that these reports differ in reliability and time frame and are therefore not always comparable. The absence of fisheries from this table should not be taken as evidence of the absence of bycatch in any such fishery.

a) Fisheries where bycatch rates are available, as well as the list of species in the bycatch

Gear Type	Location	Target species	Country	Bycatch species
Drift nets ("spadara" and other types)	Mediterranean	*Xiphias gladius, Thunnus alalunga*	Morocco, Turkey, France, Italy, a few vessels are also present in Albania, Algeria, Greece, Monaco	*Stenella coeruleoalba* (0.455 n/haul, Ligurian Sea, 1990; 0.125 n/haul, Ligurian Sea 1991; 0.052 n/haul, Central Mediterranean 1990; 0.087 n/haul , Central Mediterranean 1991 Di Natale et al., 1999*); Ziphius cavirostris* (0.028 n/haul) (Di Natale et al., 1992); (201 n/year in the Alboran Sea 1993; 145 n/year in the Alboran Sea, 1994) (Silvani et al. 1999), Ligurian Sea 1990-91)(Di Natale et al., 1992), *Globicephala melas* (0.028 n/haul, Ligurian Sea 1990-91) (Di Natale et al., 1992*), Delphinus delphis* (165 n/year in the Alboran Sea 1993; 144 n/year in the Alboran Sea, 1994) (Silvani et al., 1999*), Grampus griseus, Physeter macrocephalus, Balaenoptera physalus, Balaenoptera acutorostrata* (Di Natale et al., 1992, 1993)
Drift nets ("thonaille")	Mediterranean	*Thunnus thynnus*	France, Monaco	*Stenella coeruleoalba* (0.34 n/haul in 2000 in the Ligurian-Provencal Basin) (Imbert et al. 2001a) (0.091 n/haul in 2001 in the Ligurian-Provencal Basin, obtained by experimental nets equipped with acoustic devices) (Imbert et al. 2001b)

b) Fisheries where bycatch rates are not available, but where cetaceans have been recorded as bycatch. For some of the gears, the frequency or the severity of gear interactions with cetaceans could also potentially create harassment or deliberate killing.

Gear Type	Location	Target species	Country	Bycatch species
Bottom set gillnets	Mediterranean	*Mullus* spp., *Sepia* spp. Sparidae, *Scorpaena* spp. other demersal species	Many coastal areas	*Ziphius cavirostris* (Di Natale, 1989), *Delphinus delphis* (Duguy et al. 1983), *Stenella coeruleoalba* (Di Natale & Notarbartolo, 1994; Bradai, 2000), *Grampus griseus,Tursiops truncatus, Physeter macrocephalus* (Di Natale & Notarbartolo di Sciara, 1994). A very high level of gear-interaction is reported and there are several strandings with evidence of fishery interaction (Northridge et al., 1991, Northridge & Di Natale, 1991, Di Natale & Notarbartolo di Sciara, 1994, Centro Studi Cetacei, 1987-2000; Lauriano et al., 2001).
Bottom set gillnets	Mediterranean	*Palinurus elephas, Merluccius merluccius*	Many coastal areas	*Tursiops truncatus is the species most reported to have interactions, even if no specific catches have been reported so far* (CORISA, 1992).
Middle-water set gillnets	Mediterranean	*Boops boops, Oblada melanura, Trachurus* sp., *Spicara* spp.	Many coastal areas	*Tursiops truncatus is the species mostly reported to have interactions, even if no specific catches have been reported so far (Goodson et al., 2001).*
Drift nets	Mediterranean	*Sarda sarda, Auxis*	Italy	*Tursiops truncatus, Grampus griseus* (Di Natale &

		rochei, other small tuna species.		Notarbartolo di Sciara, 1994)..
Purse seine	Mediterranean	*Sardina pilchardus, Engraulis enchrasiculus,* other small pelagic species	all	*Tursiops truncatus* (Bradai, 2000), but only very occasional catches. A lot of interactions are already reported (Northridge & Di Natale, 1991)
Tuna purse seine	Mediterranean	*Thunnus thynnus*	Spain, France, Italy, Greece, Tunisia, Turkey, Croatia, Algeria, Morocco	*Stenella coeruleoalba* (Magnaghi & Podesta, 1987, Podestà & Magnaghi, 1989). Interactions are reported to very rarely occur.
Tuna traps	Mediterranean	*Thunnus thynnus*	Spain, Italy, Tunisia, Libya, Morocco, Croatia	*Tursiops truncatus* (Di Natale, 1992), 1 *Balaenoptera acutorostrata* (Bradai, 2000), 1 *Orcinus orca* (Di Natale & Mangano, 1983). Interactions are sporadic.
Bottom trawl	Mediterranean	A large range of demersal species	All areas	*Tursiops truncatus* (Silvani et al., 1992). A very high number of interactions is reported.
Harpoons	Mediterranean	*Xiphias gladius, Thunnus thynnus, Tetrapturus belone*	Italy	*Stenella coeruleoalba, Grampus griseus, Physeter macrocephalus, Ziphius cavirostris, Delphinus delphis* (Di Natale, 1992). The species reported were deliberately harpooned by the fishermen in the 80s, but no other cases have been recently reported.
Drifting long lines	Mediterranean	*Xiphias gladius, Thunnus thynnus*	Spain, Italy, Greece, Albania, Turkey, Cyprus, Lebanon, Egypt, Libya, Tunisia, Algeria, Morocco, Malta	*Stenella coeruleoalba* (Duguy et al. 1983), *Grampus griseus* (Di Natale & Mangano, 1983), *Tursiops truncatus* (Di Natale, 1992), *Pseudorca crassidens* (Di Natale & Mangano, 1993), *Globicephala melas* (Di Natale et al., 1993), *Ziphius cavirostris* (Di Natale et al., 1993), *Physeter macrocephalus* (Di Natale et al., 1993) *Balaenoptera physalus* (Di Natale & Mangano, 1993). Most of the cases are related to specimens found often alive with the longline around the body and not hooked. There is a certain level of interaction with this gear, but the total number of specimens caught per year is very low**.**
Drifting long lines	Mediterranean	*Thunnus alalunga* and other small tunas	Spain, Italy, Greece, Albania,	*Stenella coeruleoalba, Tursiops truncatus* (Di Natale et al., 1992). Frequent interactions are already reported.

c) Fisheries where bycatch rates are not available, but where the number of interference between cetaceans and fishery could potentially create harassment or deliberate killing or where there is a potential risk.

Gear Type	Location	Target species	Country	Bycatch species
Pelagic trawl	Mediterranean	demersal species	France, Italy	No data are available, but interactions and possible bycatch of few specimens are suspected.
Drift nets	Mediterranean	*Scomber* spp., *Boops boops,* and other small pelagic species	Many coastal areas	*Stenella coeruleoalba, Tursiops* truncatus are the species reported to often interact with this fishing gear (Goodson et al.,, 2001). No cetacean bycatch is reported so far.
Encircling gillnets	Mediterranean	*Boops boops, Oblada melanura, Belone belone, Spicara spp.* other small and medium size pelagic species	Spain, Italy, Greece	*Tursiops truncatus* is the species mostly reported by the fishermen to have interactions, but no data are available so far (Goodson et al., 2001).
Bottom long lines	Mediterranean	*Merluccius merluccius,* Sparidae spp., *Lepidopus caudatus*	Spain, Italy, Greece, Albania,	No data are available, but the fishermen reported sporadic interactions
Rod and reel	Mediterranean	*Thunnus thynnus*	Spain, France, Italy	No data are available, but the fishermen reported sporadic interactions.
Hand-line	Mediterranean	*Thunnus thynnus*	Spain, Italy, Greece	The fishermen have reported a few interactions.
Jigging line	Mediterranean	*Todarodes sagittatus, Illex* sp.	Spain, Italy, Greece	Very frequent interactions are reported.

6 METHODS OF SMALL CETACEAN BYCATCH REDUCTION

6.1 TIME/AREA CLOSURES

The subgroup briefly discussed time/area closures as a means of reducing small cetacean bycatch. It was noted that to be efficient, time/areas selected for closure should have a higher bycatch rate than neighbouring periods/areas. If they don't have a higher bycatch rate, the time/area closures are likely to lead merely to a displacement of effort and no reduction in overall bycatch.

Northridge reported that no suitable candidates for time/area closures had been identified in the case of porpoise bycatches in the UK/Irish hake fishery in the Celtic Sea (Northridge *et al* 2000). In the Danish North Sea bottom set gill net fishery a potential candidate could be the wreck net fishery for cod in the period August-October, where particularly high bycatch rates of harbour porpoises, compared to the rest of the year, have been observed. This elevated bycatch rate is the reason for the Danish wreck net fishery in this period having been selected for mandatory use of acoustic alarms (see section 9.1).

6.2 GEAR MODIFICATIONS

6.2.1 Selection devices

The subgroup was aware of only one experiment testing mechanical selection devices to reduce bycatch of small cetaceans. In the EU-funded project CETASEL (De Haan et al., 1998) the concept of a 'dolphin excluder' for pelagic trawls was tested on captive animals. The concept included a "comb" of ropes, stretched diagonally from the floor of the trawl to enlarged openings in the roof of the trawl. The function of this "comb" would be to prevent a dolphin from swimming too far into the trawls, and to guide it up and out through these openings. However, in the trials conducted in Kolmarden Dolphinarium the dolphins swam through the "comb" barrier, even when this was enhanced with passive acoustic reflectors. This behaviour was unexpected, since captive dolphins are known to avoid passing through narrow passages, *e.g.* gates between pools, and since the test animals were naïve to this kind of rope panels. Although it is not possible to extrapolate directly from captive studies to the possible response of wild dolphins, these results were sufficiently discouraging for the project to recommend against this approach, although this is only one of many possible approaches to exclusion devices

6.2.2 Alternative gear

The subgroup noted that some types of fishing gear (e.g. longlines, baited traps a.o.) have no or very low bycatches of small cetaceans, and encourages further development and testing of such fishing gear, as long as any environmental impacts of alternative gears are also investigated. It should also be noted in this context that there are numerous reports from around the world of predation on long-lines by odontocetes, including killer whales, false killer whales and sperm whales, which cause severe economic loss and encourage retaliatory action by fishermen (Ashford et al 1996).

6.3 ACOUSTIC ALARMS

6.3.1 Passive acoustic devices

Passive acoustic devices include modifications to fishing gear that will increase the probability of detection of the gear by an echolocating animal and are predicated on the assumption that the animal is caught because it did not seek to avoid the hazardous mesh zone of gillnet fishing gear either because it did not detect the mesh zone or because it incorrectly classified it as non-dangerous.

Passive acoustic reflectors that have been tested are small rigid plastic devices with a resonant air cavity, which are attached to the mesh zone of a fishing net at discrete intervals (3-6 m) in order to make the net more detectable to the cetacean. Acoustic reflectors should be optimised to return strong echoes directly back towards an approaching cetacean at the high frequencies used by these echolocating animals. They may be regarded as an acoustic analogy of "cats eyes" reflecting a vehicle's headlights at night. To work efficiently these devices must have a significant acoustic cross-section greater than ~3 wavelengths. The echoes must be returned towards the animal from any reasonable approach direction. (Goodson *et al.,* 1994; Goodson, 1997). Practical tests, tracking bottlenose dolphin behaviour in Scotland, showed that detection normally occurred at ranges greater than 50 m and occasionally at distances of 170 m. Side scan sonar trials which examined short sections of drift nets and bottom set gillnets equipped with passive reflectors are reported by the Sea Fish Industry Authority (Swarbrick, 1992; Swarbrick et al. 1994) and the technique has been further examined in South Africa.

The Natal Sharks Board has deployed passive reflectors of the type tested in the UK on the beach protection shark nets and Peddemors (pers comm) reports that they were very effective for 10 months of the year in reducing small cetacean bycatch. During the remaining period the protection shark nets are normally withdrawn (Dudley & Gribble, 1999) as the "sardine run" encourages large numbers of pelagic dolphins (*D. delphinus*) into the high risk areas. Passive reflectors have reduced the bycatch of bottlenose dolphins in KwaZulu-Natal at the experimental sites (Peddemors, 2001).

Nets made from material intended to have an increased acoustic reflectivity were tested in an experiment conducted by the Danish Institute for Fisheries Research in the North Sea bottom set gillnet fishery for cod in autumn 2000. The purpose of the experiment was to test if such nets could reduce the bycatch rate of harbour porpoises compared to conventional nets. In the experimental nets, iron oxide was used as filler in the net material to increase the acoustic reflectivity, and thereby increase the chances of detection by an echolocating animal. In addition to the iron oxide filler, the experimental nets differed from the control group by colour and stiffness. The experiment was terminated after c. 20 days at sea because of reduced catches of the target species in the experimental nets, and indications that this reduction was caused by the stiffness of these nets. However, no porpoises were caught in the experimental nets compared to 8 animals caught in the control nets. Preliminary results of subsequent measurements of target strength using an artificial porpoise click generator revealed no significant difference between experimental nets and conventional nets (F. Larsen, pers. com.).

The subgroup noted that these results were not unexpected when the physical acoustics of the gillnet construction are examined. The net fibres being typically 0.5 mm to 0.8 mm diameter are significantly smaller than the 10 mm wavelength of a 140 kHz harbour porpoise sonar signal. Such sub-wavelength dimensions 'Rayleigh-scatter' incident acoustic energy and will not produce a specular echo. This means in practical terms that a simple density increase in the material of the net fibre cannot be translated into a significant increase in the echo strength of this target (Goodson *et al.,* 1994a).

6.3.2 Active acoustic devices

Active acoustic deterrents or pingers have relatively low acoustic source levels (typically less than 150 dB re 1 μPa at 1m) and are classed as ADDs. These devices are designed mainly for use in static net fisheries. It is important to make the distinction between these low power devices and the much higher power acoustic systems (with source levels >185 dB re 1 μPa at 1m) that are used to protect aquaculture sites from pinniped predation. The latter are classed as AHDs (Acoustic Harassment Devices) and are not discussed here.

Goodson provided the sub-group with a review of pinger development. Active pingers were first shown to successfully reduce cetacean bycatch in Canada, primarily as a means to reduce baleen whale entrapment in coastal set nets and traps. This first generation of electronic devices operated at 2.5 kHz and were applied experimentally to gillnets in a small Bay of Fundy test where they appeared to minimise harbour porpoise bycatch. Similar pingers continue to be used in the Makah salmon fishery off the Seattle coast, USA, and in Australia on beach protection shark nets.

A second generation of pinger was introduced by the USA after successful trials in the Gulf of Maine (Kraus *et al.*, 1997). This design operated at 10 kHz and the success in reducing porpoise bycatch led to the US NMFS regulations, which specify a harbour porpoise bycatch reduction pinger (300 ms pulses of a 10 kHz tonal pulse repeated at 4 second intervals with a minimum source level of 132 dB re 1 μPa). This U.S. technical specification was arrived at empirically but the statistical results of a series of observer-based studies confirm that they appear to work quite effectively.

Tests with captive porpoises in Holland and in Denmark have revealed that more aversive acoustic signals exist than sinusoidal tone pulses. Wide band pulses with a dynamically changing spectrum (frequency sweep) were shown to be significantly more aversive than single tones (EPIC project DGXIV 97/006). These features were incorporated into a third generation pinger employing digital signal synthesis (programmable microcontroller) developed by Loughborough University in the UK (Newborough *et al.,* 2000). Prototype “PICE-97” devices were trialled successfully in the commercial Danish North Sea fishery during autumn of 1997 (Larsen, 1999). The device emits a variety of wide band frequency sweep type signals with randomised inter-pulse intervals. Goodson reported that significant engineering improvements, especially to battery life were implemented during the EPIC project and that the current licensee manufacturing these devices markets them as AQUAmark100. Individual identification codes are also transmitted by these devices together with battery status information to aid management in a commercial fishery.

A variant, recently introduced for experimental use, is known as the AQUAMark200. This uses the same technology to transmit wide-band transmission patterns similar to the AQUAmark100 but with the energy distribution in the pulse intended to deter dolphins. These devices have been deployed during 2001 in the preliminary French Tuna drift net study of Imbert (2001) with a significant reduction in cetacean bycatch. AQUAmark100 prototype devices were tested with good effect in the ADEPT study of dolphin predation on artisanal trammel and gillnets in Sicily. These wideband pingers have also been deployed experimentally in the Balearic Islands (Gazo) and in Greece in artisanal fisheries to try to deter dolphin predation.

A newly announced deterrent device, according to information supplied by the Cuckoo company in Holland, appears to transmit similar micro-computer generated wide band signals as the PICE/Aquamark devices. So far this prototype system has only been tested by a few individual fishermen in Greece (2001, Cyclades and Patmos) with some encouraging indication that they can deter dolphins from causing damage to trammel nets.

A full discussion of the technical aspects of the various pingers on the market was deferred until a later meeting, but it was noted that there are currently at least three manufacturers selling such devices which meet regulations (US or Danish) set after thorough testing in commercial fisheries.

It was noted during the discussion that in some cases the use of pingers has been reported to lead to an increase in the catch of target species, and that if this is a repeatable result, it would help to make the use of pingers for reduction of bycatch more acceptable to the fishermen involved. There have been no indications of decreased fish catches due to the use of pingers in any of the European fisheries studied so far.

Concern was expressed that widespread use of pingers could lead to small cetaceans being excluded from habitat critical for the viability of the populations. This would be of particular concern in cases where the cetaceans are specifically exploiting the same areas exploited by the fishermen. The subgroup noted that more research into this question is needed to determine the long-term effects at the population level of widespread use of pingers. Concern was also expressed that pingers lost in the sea would continue to emit signals for a considerable period and thus unnecessarily add to the areas that small cetaceans were excluded from utilizing. The subgroup noted, however, that it is technically feasible for some pinger types to be programmed to stop transmitting after a pre-set period of submergence.

The subgroup agreed that pingers should not be introduced indiscriminately, but in a responsible manner and only following well designed trials showing that they work as intended on the species in question. Introduction of pingers should be accompanied by information to the affected fishermen concerning the proper use of the pingers, including information on potential positive or negative side effects.

‘Clangers’

A refined copy of the Japanese Iki Island “steel tube” deterrent is experimentally used in Tunisia. This manually activated device is used both in the purse seine fishery (with lights) and with trammel nets principally to deter dolphin depredations. The oil or water filled tube is operated by being struck at intervals with a hammer. The deterrent is claimed to have an effective range of about 1 km, but the effect may wear off with time, and with habituation the effect can reverse and eventually act to attract dolphins.

Fireworks

Waterproof fireworks are often used in artisanal fisheries to mitigate the dolphin’s predation on several fishing gears where the interactions with dolphins are particularly intense. The method is used to keep the dolphins away from the gear, due to the strong disturbance caused by the small explosions. According to fishermen, dolphins will become partially habituated within a period of three months, making it necessary to increase the number of fireworks used per night. Some data collected in the Mediterranean show that the number of fireworks used per night by a single vessel might approach 50, in case of high presence of dolphins. No scientific monitoring has been conducted so far to assess the impact of this practice either on cetaceans or on the environment.

6.3.3 *Other acoustic methods.*

Interactive pingers are devices where the deterrent sounds are triggered by the sonar clicks of the approaching porpoises. This concept addresses frequently voiced concerns in connection with the use of pingers:

- it reduces “noise pollution” by only transmitting when needed;
- it delays desensitisation/habituation.

Tests of this concept, extending the trials carried out within the EPIC project (DG IV 97/0006), were conducted in 2001 by the Fjord&Belt Centre (FBC), Denmark, in cooperation with Kolmården, Sweden, using two captive adult harbour porpoises at the FBC. The project was funded by the Nordic Council of Ministers. Aquatech Subsea Ltd provided a computer controlled test version of an interactive pinger unit. The deterrent sounds triggered by the porpoises, were the same eight broadband, multi-harmonic sounds as transmitted by an AQUAmark100. From studies within the EPIC project, porpoises are now known to forage some of the time by means of a so called “bottom grubbing” behaviour, in a vertical orientation, and with their sonar directed into the seabed. In order to trigger the interactive pinger, they need to be enticed to aim their sonar beam towards the device. Artificial, porpoise-like sonar click trains, transmitted according to a random schedule of 5-30 second intervals, had this desired effect.

The results can be summarized as follows:

- The porpoises were deterred by the unusually strong “echo” returning from the transducer.
- Displacement effects were similar to those created by beacon mode pingers.
- The porpoises were more reluctant to approach the transducer after this was de-activated, as compared with their behaviour during beacon mode pinger trials.
- Randomly inserted periods when the trigger function was deactivated (a battery saving test) did not reduce this deterrent effect.

During 2002, trials with this test unit are planned to be carried out in the waters around the island of Fyn, Denmark. The displacement of wild porpoises will be tracked by means of theodolites, and all the associated acoustic activity will be recorded.

6.4 *FISHING EFFORT REDUCTION*

The subgroup briefly discussed reducing fishing effort as a means to reducing bycatch of small cetaceans. All other things being equal, it is expected that a reduction in fishing effort will lead to a reduction in bycatch. The scale of the reduction will depend on the relationship between bycatch and effort, which is not necessarily linear.

Apart from total fishery closures (see 7.4 below), the subgroup was not aware of any cases where fishing effort had been reduced specifically to reduce bycatch of small cetaceans, but noted that effort reductions introduced for other reasons could also benefit small cetaceans.

7 METHODS OF SMALL CETACEAN BYCATCH REDUCTION CURRENTLY IN PLACE

7.1 DENMARK

Porpoise bycatches in Danish fisheries have been monitored using observer programmes since 1992. In 1998 the Danish government adopted an action plan to reduce bycatches of porpoises (Ministry of Environment and Energy, 1998) and in 2000 a requirement to use acoustic alarms (pingers) was included in the fisheries regulations. The regulation requires the use of pingers in all Danish bottom set gillnet fishing in the North Sea in the period August-October when net fleets up to 300 m are used. In practice this will only apply to wreck gillnet fishing. The reason for selecting this fishery and period was that particularly high rates of bycatches were observed here.

An observer program was established in 2000 to monitor bycatch of porpoises by vessels using pingers during wreck fishing. In 2000 a total of 99 hauls were observed. Pingers were used on 87 of these hauls with no bycatch of porpoises recorded. In the remaining 12 hauls pingers were not used, resulting in bycatch of two porpoises. In 2001 a slightly lower number of hauls with pingers was observed, again with no bycatch of porpoises.

7.2 USA

Under the US Marine Mammal Protection Act, all cetacean stocks are reviewed annually and known bycatches are compared with population numbers according to the PBR (Section 3, above). Where bycatch rates exceed PBR, Take Reduction Teams, consisting of representatives from all stakeholders and scientists, are established in order to devise fishery management plans to reduce cetacean bycatch to below PBR levels. Four such TRTs have developed plans to minimise small cetacean bycatch.

The Atlantic offshore Cetacean Take Reduction Team developed such a plan in 1996, but having reviewed the plan, the National Marine Fisheries Service refused authorisation for the pelagic pair trawl fishery for albacore. The NMFS also terminated the driftnet fishery for swordfish, because of high cetacean bycatch rates, and in the driftnet case at least, to assist in swordfish stock conservation.

The Mid-Atlantic and Gulf of Maine harbour porpoise TRTs have devised a series of management measures comprising large-scale time and area prohibitions on the use of gillnets unless the nets are equipped with pingers designed to NMFS specifications. These teams have been working together as the same population of harbour porpoises is impacted in the two areas though mainly at different times of the year.

The Pacific Offshore TRT has also implemented a plan for the use of pingers, and the lowering of float-lines below the surface, for offshore driftnet fisheries for large pelagic fish off California.

In the latter three cases TRT plans have seen a reduction in bycatch to below PBR levels, whereas in the Atlantic Offshore region, prescriptive management action by NMFS meant that the take reduction plan was not needed as cetacean bycatch was reduced below PBR by closing two of the fisheries concerned.

7.3 New Zealand

Protection of small cetaceans in New Zealand has been mainly focused on the issue of set gillnet bycatch of Hector's dolphin (*Cephalorhynchus hectori*). This species has a very localised and restricted range in a few remaining places in New Zealand and populations have declined considerably in recent decades. Protection is being attempted by banning the use of gillnets in an area around the Banks Peninsula on the south Island, while recent management measures also prohibit all amateur and commercial gill net fishing within four nautical miles of the west coast of the North Island, from Maunganui Bluff (north of Dargaville) to Pariokariwa Point (north of New Plymouth), encompassing some 400 km of coastline.

A comprehensive observer programme will be implemented on all trawlers and vessels using Danish seines fishing in the area closed to set netting to ensure that bycatch in these fisheries is minimal.

7.4 Driftnet bans

Following widespread public and governmental concerns at a global level during the early 1990s, the United Nations unanimously agreed a moratorium on large scale high seas driftnet fishing in 1992 (Resolution 44/225). The European Community decided to limit the length of nets used in the European fishery for tuna to 2.5km (Council Regulation 345/92). Subsequently several states either banned the use of driftnets or limited the maximum length of driftnets to 2.5 km. Italy banned the use of driftnets in the Ligurian Sea, where especially high cetacean bycatch rates had been observed, in order to minimise cetacean bycatch, and Spain banned the use of driftnets in 1994. More recently, EU Council regulation 1239/98 has phased out the use of driftnets for certain species of large pelagic fish throughout the EU as a result of concerns over bycatch.

8 Design of a monitoring scheme

The sub-group did not have sufficient time at this meeting to consider this topic in any detail. It was noted that a report addressing this subject had been prepared and presented to ACOBANS in 1996 (Northridge 1996). The main points derived from this report are presented in Appendix 2.

9 Potential management framework

The sub-group was asked to identify possible management frameworks, suitable to the European Community decision-making structure, to tackle the issue of cetacean bycatches. The sub-group considered this to be a task that would require some time, and was unable to address the issue in the current meeting. Further discussion of this topic was deferred to another meeting.

10 Future research and monitoring needs:

On the basis of the foregoing discussion, the sub-group isolated key issues and gaps in knowledge that it considered most important. The sub-group did not discuss management needs in relation to agenda items where discussion had been deferred to a later meeting, such as a potential management framework.

10.1 ABUNDANCE ESTIMATES

There is a clear need for further cetacean abundance surveys to be conducted throughout most European waters. Furthermore, it is necessary to ensure that the resulting abundance estimates are updated at regular intervals or for some means of determining trends in abundance to be established.

Perhaps the most critical area in European waters is the Baltic Sea where recent studies suggest a porpoise population collapse. The sub-group agreed that the ASCOBANS recovery plan for Baltic harbour porpoises was to be welcomed. The sub-group was aware of joint sightings and acoustic surveys conducted during the summer of 2001, and agreed that these represented a useful way forward towards obtaining current estimates of porpoise abundance and distribution in the Baltic. Acoustic techniques will require further development before they can be used to yield abundance estimates but if this can be done acoustic surveys may provide a more cost effective means of monitoring trends in abundance especially in areas with low density .

The Sub-group welcomed similar synoptic surveys, such as the NATO backed Solmar project, which integrate survey methodologies, and recognised that such approaches are likely to represent the most cost-effective means of improving information on cetacean abundance and distribution. In particular, the sub-group proposed that developments in acoustic monitoring methodology should be encouraged.

The sub-group also recognised that population structure of cetacean species in Europe is very poorly understood. This has implications both for population abundance survey design and for bycatch management. The sub-group agreed that it is important to pursue investigations into population structure, and specifically in the context of bycatch studies, to develop methods of assigning individual animals to populations.

The sub-group noted that, although all European waters need further survey work some areas were more important than others in view of known or suspected high bycatch rates and unknown population sizes. The sub-group identified Atlantic waters that were not covered by SCANS, and the eastern and southern Mediterranean as areas of particular concern.

10.2 BYCATCH ESTIMATION

The sub-group recognised that there is a problem in estimating bycatch in areas of low cetacean abundance, and also a potential problem in estimating bycatch rates in fisheries dominated by very small boats. These issues need to be examined in more detail, and methods for monitoring small boat fisheries need to be established and promoted.

The sub-group stressed that when bycatch surveys are conducted there should be adequate coverage to provide a statistically robust estimate of total bycatch, and to this end whenever possible a power analysis should be conducted prior to sampling to estimate the levels of sampling required.

The sub-group recognised that throughout Europe there have been numerous studies of fish discards, and that such studies would normally record any marine mammal bycatch. Even the absence of marine mammal bycatch in such studies is of interest, and the sub-group suggested that some co-ordination of the results of such studies would greatly help in elucidating marine mammal bycatch throughout EU fisheries.

The sub-group also recognised that there are new opportunities for data collection under the new Commission Regulation on fisheries data collection, and suggested that improved coverage of cetacean bycatch could be encouraged through this means.

The sub-group noted that there is a lack of any national legislation that would help to get cetacean bycatch observers accepted by vessel owners and skippers. National legislation or regulations to assist in ensuring observer placement would be an advantage.

The sub-group recognised that the issue of cryptic bycatch needs further investigation. Bycatch may be hidden in a number of ways, including for example, animals becoming drowned in nets but then floating free before the nets are retrieved. Such sources of additional mortality are often recognised but have yet to be quantified anywhere.

The sub-group agreed that there needs to be some clarification of the means by which observed bycatch rates are extrapolated to an entire fleet. There needs to be some clearer examination of the consequences of using different raising factors (eg total landed weight, days at sea, hours towed etc) in estimating total bycatch.

The sub-group stressed that under current procedures, EU logbooks are collected almost entirely for the purpose of enforcement of fishery regulations, but that logbooks may contain data that are critically important in estimating fishing effort for a fleet, and therefore in estimating cetacean bycatch. The sub-group agreed that the new EC regulations should help in ensuring that fleet effort data are available for management purposes, but stressed that consideration needs to be given to ensure that appropriate measures of fishing effort (not just ‘hours towed’) are collected and made available to enable bycatch estimation.

10.3 MITIGATING CETACEAN BYCATCH

The sub-group recognised that there are a large number of fisheries that are potentially concerned with cetacean bycatch. Whereas such fisheries represent an important economic activity, cetacean bycatch mitigation methods must be encouraged and/or more benign methods of fishing sought as alternatives. The sub-group notes that in addition to set net and drift net fisheries, some pelagic trawl fisheries are also believed to be responsible for significant cetacean mortality. In the case of driftnet fisheries, experimental fisheries could be considered in order to find some general solution to the bycatch problem, bearing in mind that in some fisheries (such as the thonaille in the Mediterranean) encouraging results have been obtained in the bycatch mitigation trials that are in progress.

The sub-group agreed that, prior to adoption on a fishery wide basis, experimental tests of particular mitigation methods should be carefully monitored for a significant period in the commercial fishery, in order to identify problems or side-effects that would be difficult to address once a specific measure had been adopted. The sub-group, citing American experience, observe that once regulations defining mitigation methods are introduced the incentive to support further technical development is impaired. It is therefore important to plan to re-evaluate mitigation methods to ensure that they remain effective and to support the continued search for alternative or improved mitigation methodologies which will be needed in the future if habituation or some other effect render techniques less effective with time.

The sub-group noted that the reduction of cetacean bycatch is among the objectives of the Action Plan for the conservation of cetaceans adopted by the Mediterranean countries within the framework of the Barcelona convention. Some initiatives have already been undertaken for the mitigation of cetacean bycatch. The Tunisian authorities have taken a decision to forbid the use in Tunisian waters of drift nets longer than 2.5 km. This decision, in addition to its obvious impact on the reduction of bycatch, is intended to help in avoiding the transfer to Tunisian fishermen of European long driftnets following the EC ban on using them, and the sub-group welcomed the initiative by the Tunisian authorities in a precautionary context.

The sub-group also noted the growing use of protected areas as a tool for the conservation of cetaceans. Most recently an agreement establishing the International Sanctuary for the protection of the cetaceans has been signed in 2001 by the governments of France and Italy, and the principality of Monaco. Considering the importance of that area for cetacean populations, the Mediterranean countries (Parties to the Barcelona Convention) have decided recently to include the Sanctuary in the SPAMI List (Specially Protected Areas of Mediterranean Importance). By including it in the SPAMI List, the parties recognise the particular importance of the area and commit themselves not to undertake any activity likely to harass protected species (including cetaceans) or endanger their conservation status. The sub-group noted this commitment and stressed the importance of including a consideration of bycatch in the management of human activities within the Sanctuary.

The sub-group suggested that in fisheries where a potential problem has been identified, the Commission and member states should press for mitigation action to be implemented as soon as possible. In the case of the driftnet fisheries too little had been done too late.

The sub-group recognised that pingers have been shown to be effective in a number of European and other trials, and recognised these devices as a useful tool in the mitigation armoury. One big advantage is that they can be put into operation with little starting delay, thus implementing an immediate mitigation action, even if it is to be only a temporary one while longer term methods are being developed. However, the sub-group also stressed that more work needs to be done to examine the population-level effects of cetacean exclusion from specific habitats that might result from wide scale pinger deployment.

The sub-group also suggested that in many cases, the best method of mitigation might in fact be a switch to an alternative gear or fishing method, and that the development of more benign alternatives should be encouraged. Notwithstanding this, the sub-group also stressed the importance of ensuring that if the EC or member states were to promote the use of alternative fishing gears or methods, that such gears and methods should be intensively assessed in order to ensure that they do not introduce further unacceptable environmental hazards.

The sub-group recognised that, especially in the Mediterranean, there are many instances where dolphins interact with fishing gear by damaging nets or taking fish. Such interactions are often associated with retaliatory actions by fishermen that can lead to dolphin mortalities. The sub-group agreed that such situations require further investigation and that mitigation of such interactions would likely reduce ‘retaliatory’ mortalities.

10.4 SPECIFIC FISHERIES IN NEED OF FURTHER INVESTIGATION

Although the sub-group recognised that, in general, all of those fisheries listed in Tables 5.2(b) and 5.3(b) require further detailed investigation in order to assess the nature and extent of any cetacean bycatch problem, several fisheries stood out as being of particular concern for one reason or another:

The sub-group endorsed the approach taken by ASCOBANS to try to address the critical state of the porpoise population in the Baltic, especially in with respect to gillnet fisheries.

The pelagic and pair trawl fisheries of the Western Channel and Bay of Biscay are known to be responsible for a problematic number of cetacean mortalities, but it is still unclear which are the most significant fisheries in this respect and how and where cetacean bycatches occur. All the seasonal pelagic and pair trawl fisheries in this area require more detailed examination, and bycatch mitigation trials should start in some of the more critical fisheries as soon as cooperation with fishermen is obtained.

Norwegian gillnet fisheries in the northern North Sea have yet to be assessed for porpoise bycatch, and this is considered to be a priority area because of the large scale kills of porpoises in other fisheries in the North Sea.

Finally, the deployment of long driftnets in the Mediterranean by vessels flagged in non-EU member states requires urgent assessment in collaboration with the relevant regional fisheries bodies. At the very least some accurate measurement of the current scale of these fisheries needs to be established.

11 BIBLIOGRAPHY

Anonymous. 2000. Report of the IWC-ASCOBANS Working Group on Harbour Porpoises. Journal of. Cetacean Research and Management **2**:297-305.

Antoine, L. and Danel, P. 1992. Captures comparées de deux types de filets dérivants en 1991: premiers résultats. Rec.doc. Sci. ICCAT, vol XXXIX (1), 1992 : 241-246.

ASCOBANS, 2000. Fourth annual compilation of national reports. ASCOBANS Secretariat, Bonn.

ASCOBANS, 2000a. Proceedings of the Third Meeting of Parties. Bristol, United Kingdom, 26-28th July 2000. ASCOBANS Secretariat, Bonn. 110pp. (Annex 9c)

Ashford, J.R., Rubilar, P.S. and Martin, A.R. 1996. Interactions between cetaceans and longline fishery operations around South Georgia. *Mar. Mammal Sci.* 12(3):452-7.

Berggren P, 1994: By-catches of the harbour porpoise (*Phocoena phocoena*) in the Swedish Skagerrak, Kattegat and Baltic waters, 1973-93. Report of the International Whaling Commission. Special Issue 15: 211-6.

Berrow, S. D., M. O'Neill, and D. Brogan. 1998. Discarding practices and marine mammal by-catch in the Celtic Sea herring fishery. Biology and Environment: Proceedings of the Royal Irish Academy **98B**:1-8.

Berrow, S. and Rogan, E. 1997. Cetaceans stranded on the Irish coast, 1901-1995. Mammal review, 27(1):51-76

BIM 2000. Diversification Trials with alternative tuna fishing techniques including the use of remote sensing technology. Final report of EU Contract 98/010, Bord Iascaigh Mhara, Dun Laoghaire.

Bjorge, A. and Øien, N. 1995. Harbour porpoise in Norwegian waters. Report of the International Whaling Commission Special Issue 16: 89-98.

Brabant J.C., Fontaine, B., George, J.P., Jacqueline, F., Mortreux S. and Sacchi, J. 1994. Selectivity of gill nets in the North Sea, English Channel and Bay of Biscay\~; Periodic Report no. 1, EU AIR 2 -CT93-1122 (SC), nov 1993-nov 1994. Rapport Ifremer DITI/NPA no. 0 94.044., 34 p + appendix.

Bradai 2001. Le Golfe de Gabes: Ecosistème/Biodiversitè. UNEP RAC/SPA: 1-14.

Buckland, S.T., Bloch, D., Cattanach, K.L., Gunnlaugsson, Th., Hoydal, K., Lens, S. and Sigurjónsson, J. 1993. Distribution and abundance of long-finned pilot whales in the North Atlantic, estimated from NASS-87 and NASS-89 data. Report of the International Whaling Commission Special Issue 14: 33-49.

Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. 1993a. Distance Sampling: Estimating abundance of biological populations. Chapman & Hall, London. 446pp.

Carlström, J., Berggren P., Felicia D. and Börjesson, P. (in review). A field experiment of acoustic alarms (pingers) to reduce harbour porpoise bycatch in bottom set gillnets. ICES Journal of Marine Science.

Centro Studi Cetacei. 1987. Cetacei spiaggiati lungo le coste italiana. I. Rendiconto 1986 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 128 (3-4): 305-313.

Centro Studi Cetacei. 1988. Cetacei spiaggiati lungo le coste italiana. II. Rendiconto 1987 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 129 (4): 411-432.

Centro Studi Cetacei. 1989. Cetacei spiaggiati lungo le coste italiana. III. Rendiconto 1988 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 130 (21): 269-287.

Centro Studi Cetacei. 1990. Cetacei spiaggiati lungo le coste italiana. IV. Rendiconto 1989 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 131 (27): 413-432.

Centro Studi Cetacei. 1991. Cetacei spiaggiati lungo le coste italiana. V. Rendiconto 1990 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 132 (25):337-355

Centro Studi Cetacei. 1992. Cetacei spiaggiati lungo le coste italiana. VI. Rendiconto 1991 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 133 (19):261-291

Centro Studi Cetacei. 1993. Cetacei spiaggiati lungo le coste italiana. VII. Rendiconto 1992 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 134 (II):285-298:

Centro Studi Cetacei. 1994. Cetacei spiaggiati lungo le coste italiana. VIII. Rendiconto 1993 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 134 (II): 437-450

Centro Studi Cetacei. 1994. Cetacei spiaggiati lungo le coste italiana. IX. Rendiconto 1994 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 135 (II):451-462:

Centro Studi Cetacei. 1995. Cetacei spiaggiati lungo le coste italiana. X. Rendiconto 1995 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 136 (II):205-216

Centro Studi Cetacei. 1996. Cetacei spiaggiati lungo le coste italiana. XI. Rendiconto 1996 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 137 (I-II):135-147 .

Centro Studi Cetacei. 1998. Cetacei spiaggiati lungo le coste italiana. XII. Rendiconto 1998 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 139 (II):213-226

Centro Studi Cetacei. 2000. Cetacei spiaggiati lungo le coste italiana. XIII. Rendiconto 1999 (Mammalia). Atti Socita Italiane di Scienze Naturali. Museo Civieo di Storia Naturali Milano, 141 (I):145-158 .

Couperus, A.S. 1997. Interactions between Dutch midwater trawl and Atlantic white-sided dolphins (*Lagenorynchus acutus*) southwest of Ireland. Journal of Northwest atlantic Fisheries Science 22:209-218.

Couperus, A.S. 1997a. By-catch of marine mammals and discards in pelagic fisheries (MAMDIS) – CFP 94/018. Report to the European Comission: 1-21.

Cox, T.M.C., Read, A.J., Solow, A.J., and Tregenza, N. 2000. Will harbour porpoises habituate to pingers? Journal of Cetacean Research and Management 3:81-86

De Haan, D., Dremière P.Y., Woodward B., Kastelein R.A., Amundin M., Hansen K., 1998. Prevention of the bu-catch of cetaceans in pelagic trawls by technical means , CETACEL. Final report , Contract AIR III-CT94-2423, 1994-1997, 204 p.

Di Natale, A. 1989. Marine mammals interactions with fisheries activities: the Mediterranean case. Presented at the first International Conference on marine Mammals, Riccione, 30 August – 2nd September 1989

Di Natale A., 1992. Impacts of large pelagic fishery on cetaceans in the Italian seas. Boll.Musei Ist.Biol., Univ. Genova (56-57): 100-112

Di Natale A. and Mangano A. 1983. Killer whales, *Orcinus orca* (Linneus) and false killer whale, *Pseudorca crassidens* (Owen), in the Italian seas. Rapp. Comm. Int. Mer Medit. 28: 181-182.

Di Natale A., Labanchi L., Mangano A., Maurizi A., Montaldo L., Montebello O., Navarra E., Pederzoli A., Pinca S., Placenti V., Schimmenti G., Sieni E., Torchia E. and Valastro M.. 1993 – Gli attrezzi pelagici derivanti utilizzati per la cattura del pescespada (Xiphias gladius) adulto: valutazione comparata della funzionalità della capacità di cattura, dell'impatto globale e della economia dei sistemi e della riconversione. Report to: Ministero della Marina Mercantile. 300pp

Di Natale A. and Notarbartolo di Sciara G. 1994. A review of the passive fishing nets and trap fisheries in the Mediterranean Sea and the cetacean by-catch. Report of the International Whaling Commission Special Issue 15: 189-202.

Dudley, SFJ and Gribble NA 1999. Management of shark control programmes. pp819-859 in Shotton, R. (ed.) Case studies of the management of elasmobranch fisheries. FAO Fisheries Technical paper. No. 378, part 2. Rome, FAO. pp. 480-920.

Duguy R., Besson J., Casinos A., Di Natale A., Filella S., Raduan A., Raga J. and Viale D. 1983. L'impact des activities humaines sur les cétacés de la Méditerranée occidentale. Rapp. Comm. Int. Mer Médit., 28(5): 219-222.

Fahy E., 1993. Inventory of enmeshing gears in European waters. Commission of the European Communities, Directorate General for Fisheries, DG XIV/87/94.

Fernandez-Contreras, M.M., Cantos, G., Coll, M and Aguilar, A., 2001. Interactions between fishing activities and cetaceans in the Northern Atlantic coast of Spain. Abstract. Presented to the European Cetacean Society 15th Annual Conference, Rome, May 2001.

Fertl, D., and S. Leatherwood. 1997. Cetacean interactions with trawls: a preliminary review. J. Northw. Atl. Fish. Sci. **22**:219-248.

Forcada, J., Aguilar, A., Hammond, P.S., Pastor, X. and Aguilar, R. 1994. Distribution and numbers of striped dolphins in the western Mediterranean Sea after the 1990 epizootic outbreak. Marine Mammal Science 10: 137-150.

Forcada, J. and Hammond, P.S. 1998. Geographical variation in abundance of striped and common dolphins of the western Mediterranean. Journal of Sea Research 39: 313-325.

Forcada, J., Notarbartolo di Sciari, G. and Fabbri, F. 1995. Abundance of fin whales and striped dolphins summering in the Corso-Ligurian basin. Mammalia 59: 127-140.

Goodson, A.D. (1997) Developing deterrent devices designed to reduce the mortality of small cetaceans in commercial fishing nets. J.Mar.Fresh.Behav.Physiol. v29:pp211-236

Goodson, A.D., Datta, S., Dremiere, P.-Y. and di Natale, A. 2001. EC contract DGXIV 98/019 – Project ADEPTs.

Goodson, A.D., Klinowska, M, Bloom, PRS (1994) Enhancing the acoustic detectability of fishing nets. *In:* Report of the International Whaling Commission.(Special Edition 15).pp585-595.

Goodson, A.D., Mayo, R.H., Klinowska, M, Bloom, PRS (1994a) Field resting passive acoustic devices designed to reduce the entanglement of small cetaceans in fishing gear. *In*: "Gillnets and Cetacean", Report.of the International.Whaling Commission.(Special Edition 15).pp597-605.

Goodson, A.D. and Mayo, R.H. (1995). Interactions between free-ranging bottlenose dolphins and passive acoustic gillnet deterrents. *In*: Sensory systems of aquatic mammals. Pub De Spil, Woerden, NL.

Goujon, M., Antoine, L., Collet, A., and Fifas, S. 1993. Approche de l'impact écologique de la pêcherie thonière au filet maillant dérivant en Atlantique nord-est. Rapport IFREMER – RI.DRV-93.034: 47p.

Hammond, P.S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A., Heide-Jørgensen, M.P., Heimlich-Boran, S., Hiby, A.R. and Øien, N. 1995. Distribution and abundance of the harbour porpoise and other small cetaceans in the North Sea and adjacent waters. LIFE 92–2/UK/027.

Harwood, J., Andersen, L.W., Berggren, P., Carlström, J., Kinze, C.C., McGlade, J., Metuzals, K., Larsen, F., Lockyer, C.H., Northridge, S., Rogan, E., Walton, M., Vinther, M., 1999. Assessment and reduction of the by-catch of small cetaceans (BY-CARE). Final report to the European Commission on FAIR-CT05-0523.

Hiby, L. and Lovell, P. 1996. Baltic/North Sea aerial surveys – final report. (Unpublished). 11pp.

ICES, 1996. Report of the study group on seals and small cetaceans in European Seas. ICES CM 1996/N:1

ICES, 1998. Report of the working group on marine mammal population dynamics and trophic interactions. ICES CM 1998/G:6

ICES, 2001. Report of theWorking Group on the Assessment of Southern Shelf Demersal Stocks ICES CM 2001/ACFM:05

IEO 2001 Datos y Resúmenes. Instituto Español de Oceanografía 14: 122 pp.

Imbert, G. 2001. Impact de la Thonaille sur les petits cetaces du sanctuaire des mammiferes en Mediterranee. 9e Conference International sur les cetaces Mediterranee de la RIMMO. Juan-les Pins 17-19 nov. 2000: 59-65.

Imbert, G., Gaertner, J.-C. and Laubier, L. 2001a. Thonaille méditerranéenne. Suivi en mer de la campagne 2000. Univ. Aix Marseille II. CNRS Centre d'océanologie de Marseille Rep PACA n°3340. 90p.

Imbert, G., Gaertner, J.-C. and Laubier, L. 2001b. Prevention a l'aide de repulsifs acoustiques des captures de dauphins par les thonailles. 10e Conference International sur les cetaces Mediterranee de la RIMMO. Juan-les Pins 16-18 nov. 2001 (Abstract)

Ingram, S. 2000. The ecology and conservation of bottlenose dolphins in the Shannon estuary. PhD thesis, University College, Cork.

Kock, K.-H. 1997. The by-catch of small cetaceans in the German fisheries in the North Sea and the Baltic in 1996 – preliminary results. Paper SC/49/SM21 (International Whaling Commission)

Kraus, S. D., A. J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson, and J. Williamson. 1997. Acoustic alarms reduce porpoise mortality. Nature **388**:525-526.

Kuiken, T., V. R. Simpson, C. R. Allchin, P. M. Bennett, G. A. Codd, E. A. Harris, G. J. Howes, S. Kennedy, J. K. Kirkwood, R. J. Law, N. R. Merrett, and S. Phillips. 1994. Mass Mortality of Common Dolphins (Delphinus-Delphis) in South- West England Due to Incidental Capture in Fishing Gear. Veterinary Record **134**:81-89.

Larsen, F. 1999. The effect of acoustic alarms on the by-catch of harbour porpoises in the Danish North set gill net fishery: a preliminary analysis. Paper SC/51/SM41 submitted to the 51st IWC meeting, Grenada.

Lauriano, G, Di Muccio, S. Cardinali, A. and Notarbatolo di Sciara, G., 2001. Interactions between bottlenose dolphins and small scale fisheries in the Asinara Island national Park (northeastern Sardinia). Paper presented to the ICRAM Workshop on nteractions between dolphins and fisheries in the Mediterranean: Evaluation of Mitigation Alternatives Roma, 4-5 May 2001. ICRAM/AHD/INFO 21.

Lindroth, A. 1962. Baltic salmon fluctuations 2: porpoise and salmon. Report of the Institute of Freshwater Research, Drottningholm 44: 105-112

Lockyer, C., Desportes, G., Amundin, M. & Goodson, D. 2001. EPIC -Elimination of Harbour Porpoise Incidental Catches. Report to the EU on project no DG XIV 97/0006.

Ministry of Environment and Energy. 1998. Action plan for reducing incidental bycatches of Harbour Porpoises. Ministry of Environment and Energy, Forest and Nature Agency, Nature and Wildlife Section, (J.nr. SN 1996-402-0035). Copenhagen, Denmark.

Magnaghi, L., Podestà, M., (1987) An accidental catch of 8 striped dolphins, Stenella coeruleoalba (Meyen, 1983) in the Ligurian Sea. (Cetacea Delphinidae). Atti Soc. Ital. Sci. Nat. Mus. Civ. Stor. Nat. Milano, 128 (3-4) 235-239.

Morizur, Y, Berrow, S.D., Tregenza, N.J.C., Couperus, A.S. and Pouvreau, S. 1999. Incidental catches of marine-mammals in pelagic trawl fisheries of the northeast Atlantic. Fisheries Research 41: 297- 307.

Morizur Y. and Carn, N. 2000. Contribution à l'évaluation et à l'évolution des puissances de pêche des fileyeurs français. Report IFREMER/DRV-RH, novembre 2000, Study DGXIV-c-1/97/033, 85 pp.

Morizur Y., Pouvreau, S. and Guenole, A. 1996. Les rejets dans la pêche artisanale française de Manche occidentale. Editions Ifremer, France, 127 p.

Morizur, Y., Tregenza, N., Heessen, H., Berrow, S. and Pouvreau, S. 1997. By-catch and discarding in pelagic trawl fisheries. Final report, Contract EC DGXIV–C-1, Study Bioeco/93/017, 122 p + appendix

Newborough, D. Goodson, A.D. and Woodward, B (2000). "A beacon mode deterrent to reduce cetacean bycatch in fisheries". Underwater Technology v23(3) 2000.

Northridge, S.P., 1996. A review of marine mammal bycatch observer schemes with recommendations for best practice. Joint Nature Conservation Committee Report No. 219.

Northridge S. and Di Natale A. 1991. The environmental effects of fisheries in the Mediterranean. Report to the EC Directorate General Environment, Nuclear Safety and Civil Protection: 1-44.

Northridge, S.P., Di Natale, A., Kinze, C.C., Lankester, K., Ortiz de Zarate, V., and Sequeira, M., 1991. Gillnet fisheries in the European Community and their impacts on the marine environment. Report to the European Commission's Directorate General Environment Nuclear Safety and Civil Protection.

Northridge, S.P., and P.S. Hammond, 1999. Estimation of porpoise mortality in UK gill and tangle net fisheries in the North Sea and west of Scotland. Paper presented to the Scientific Committee of the International Whaling Commission, Grenada, May 1999. SC/51/SM42.

Northridge, S., Tregenza, N., Rogan, E., and Hammond, P. 2000. Spatial aspects of porpoise bycatch in UK and Irish Celtic Shelf gillnet fisheries. Paper presented to the Scientific Committee of the International Whaling Commission, Adelaide, June 2000, SC/52/SM31

O'Cadhla, O., Burt, M.L., Borges, A.L. and Rogan, E. 2001. Summer distribution and abundance of cetaceans in western Irish waters and the Rockall Trough. Paper O:15 submitted to the 53rd meeting of the International Whaling Commission, London.

Øien, N. 1993. Abundance of killer whales (*Orcinus orca*) in waters off Norway. Working paper for the NAMMCO Working Group on Killer and Northern Bottlenose Whales, Reykjavik 24-25 November 1993.

Peddemors, VM. 2001. A review of cetacean interactions with fisheries and management thereof in South Africa. Paper presented to the Scientific Committee of the International Whaling Commission, June 2000, SC/53/E17.

Pierce, G., Santos, B., Eggleton, J., Kelly, E., Whomersley, P. Young, I., Newton, A., Robb, A., Tregenza, N., Palenzuela, J.T., Pardo, P.C., Tranchero, P.O., Alfaya, C.L., López, A., Figueiredo, P.C., Barreiro, A., Cedeira, J.A.M, Fontaíña, V.T. and Otero, M.G. 2001. Pelagic fisheries in Scotland (UK) and Galicia (Spain): observer studies to collect fishery data and monitor by-catches of small cetaceans. Draft final report of EU study project 2000/27.

Pierce, G. J. and Santos, B. 1989. Impact of fisheries on small cetaceans in coastal waters of Northwest Spain and Scotland. Final report study No 97/089.

Podesta, M. and Magnaghi, L. 1989. Unusual numbers of cetacean bycatches in the Ligurian Sea. In Proceedings of the Third Annual Conference of the European Cetacean Society, La Rochelle, France, 24-26 February 1989.

Pouvreau S. and Morizur, Y. 1995. Les métiers du filet fixe en France (Régions 1, 2 et 3). Rapport Ifremer-RH-Brest–Direction des pêches, juin 1995 , 48 pp .

Ropelewski, A. 1957. The common porpoise (*Phocaena phocaena* L.) as a by-catch in Polish Baltic fisheries. Prace Morskiego Instytutu Rybackiego 9: 427-437. (in Polish)

Sequiera, M. and Ferreira, C. 1994. Coastal fisheries and cetacean mortality in Portugal. Report of the International Whaling Commission Special Issue 15: 165-181.

Silva, M.A., Feio, R., Prieto, R., Gonçalves, J.M. and Santos, R.S. (in press). Marine Mammal Science

Silvani, L., Raich, J. and Aguilar, A. 1992. Bottle-nosed dolphins, *Tursiops truncatus*, interacting with local fisheries in the Balearic Islands, Spain. European Research on Cetaceans: 32-33.

Silvani, L., Gazo, M. and Aguilar, A. 1999. Spanish driftnet fishing and incidental catches in the western Mediterranean. Biological Conservation 90: 79 - 85

SMRU 1995. Cetacean bycatch in the UK tuna driftnet fishery in 1995. Contract Report to the Ministry of Agriculture Fisheries and Food. November 1995. Sea Mammal Research Unit, Cambridge.

SMRU, UCC, CFPO and ISWFO. 2001. Reduction of porpoise bycatch in bottom set gillnet fisheries. Report to the European Commission, Study Contract 97/095.

STECF 1995 Second report of the Scientific, Technical and Economic Committee for Fisheries, 6 November 1995. DG XIV SEC (95) 2160, 48pp.

STECF 1996. 4th Report of the Scientific, Technical and Economic Committee for Fisheries , Brussels 11-14 November 1996. DGXIV-SEC(97) 70., 32 p.

Swarbrick, J. (ed) (1992). Initial trials to increase the acostic detectability of drift nets used in the Albacore tuna fishery. Sea Fish Industry Authority Report No.408, SFIA (Hull) UK.

Swarbrick, J., Sacchi, J., Massart, G., MacMullen, P. and Goodson, A.D. 1994. Investigation of the selectivity of static nets and an assessment of by-catch, effort and discards – ICES Areas VIIe and VIIf. Final Report to the European Community DG XIV/C-e. . Sea Fish Industry Authority (Hull) / IFREMER Plousané

Tregenza, N. J. C., Berrow, S.D., Hammond, P.S. and Leaper, R. 1997. Harbour porpoise (*Phocoena phocoena* L.) by-catch in set gillnets in the Celtic Sea. ICES Journal of Marine Science 54: 896 - 904.

Tregenza, N. and Collet, A. 1998. Common dolphin *Delphinus delphis* bycatch in pelagic trawl and other fisheries in the northeast Atlantic. Report of the International Whaling Commission 48: 453 - 459.

Vinther, M., 1999. Bycatches of harbour porpoises (*Phocoena phocoena* L.) in Danish set-net fisheries. Journal of Cetacean Research and Management 1: 123 – 135.

Wade, P. and Angliss, R.P., 1997. Guidelines for Assessing Marine Mammal Stocks: report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12 Feb 1997

Wilson, B., Hammond, P.S., and Thompson, P.M. 1999. Estimating size and assessing trends in a coastal bottlenose dolphin population. Ecological Applications 9: 288–300.

12 APPENDIX 1

LIST OF PARTECIPANTS WITH COMPLETE ADDRESSES

Name & Address	Telephone	Fax	Email
Mats Amundin Research & Education Kolmardens Djurpark 61892 Kolmarden Sweden	+46 1124 9018 +46 7054 70427 (mobile)	+46 1124 9065	mats.amundin@kolmarden.com
Antonio Di Natale Aquastudio Via Trapani 6 98121 Messina Italy	+39 090 34 64 08	+39 090 36 4560	adinatale@acquario.ge.it aquauno@box1.tin.it
Dave Goodson Loughborough University Underwater Acoustic Group Department of Electronic and Electrical Engineering Ashby Road Loughborough LE11 3TU United Kingdom	+44 1509 227076	+44 1509 227014	a.d.goodson@lboro.ac.uk
Guy Imbert Centre d'Océanologie de Marseille (Université de la Méditerranée – CNRS) Station Marine d'Endoume Rue Batterie-des-Lions 13007 Marseille France	+33 491 04 16 01 +33 442 78 76 36 (home)	+33 442 78 76 36 (home)	guyimbert@wanadoo.fr
Karl-Hermann Kock Bundesforschungsanstalt für Fischerei Institut für Seefischerei, Palmaille 9 22767 Hamburg Germany	+49 40 38 905 104	+49 40 38 905 263	kock.ish@bfa-fisch.de
Iwona Kuklik Hel Marine Station University of Gdansk P.O. Box 37, Morska 2 84-150 Hel Poland	+48 58 6750 836	+48 58 6750 420	oceik@univ.gda.pl
Mary Labropoulou NCMR Greece Agios Fosmas Hellinikon 16604 Athens Greece	+30 1 9822 557	+30 1 9811 713	mlabro@ncmr.gr

Finn Larsen Danish Institute for Fisheries Research, Department of Marine Fisheries Charlottenlund Castle DK-2920 Charlottenlund Denmark	+45 33 96 33 00 (switch) +45 33 96 34 68 (direct)	+45 33 96 33 33	fl@dfu.min.dk
Giancarlo Lauriano Istituto Centrale per la Ricerca Scientifica e tecnologia Applicata al Mare (ICRAM) Via di Casalotti 300 00166 Roma Italy	+39 06 6157 0409	+39 06 6155 0581	lauriano@tin.it
Santiago Lens Instituto Espanol de Oceanografia Centro Oceanografico de Vigo Apdo 1552 36280 Vigo Spain	+34 986 492 111	+34 986 492 351	santiago.lens@vi.ieo.es
Ulf Lindahl Kristineberg Marine Research Station 450 34 Fiskebäckskil Sweden	+46 523 22 527	+46 523 18502	u.lindahl@kmf.gu.se
Mette Mauritzen Institute of Marine Research P.O. Box 1870 Nordnes N-5817 Bergen, Norway	+47 55 23 8608	+47 55 23 8617	mette.mauritzen@imr.no
Yvon Morizur IFREMER Centre de Brest BP70 29280 Plouzané France	+33 298 224 481	+33 298 224 653	yvon.morizur@ifremer.fr
Simon Northridge Sea Mammal Research Unit Gatty Marine Laboratory University of St Andrews St Andrews, Fife KY16 8LB Scotland	+44 1334 462654	+44 1334 462632	simon.northridge@st-andrews.ac.uk
Hans Polet Sea Fisheries Department Ankerstraat 1 8400 Oostende Belgium	+32 593 42253	+32 593 30629	hans.polet@dvz.be

Chedly Rais Mediterranean Action Plan of UNEP –RAC/SPA Boulevard de l’Environnement BP 1080 Tunis cedex Tunisia	+216 1 795760	+216 1 797349	car-asp@rac-spa.org.tn
Emer Rogan Zoology Department University College Lee Maltings, Prospect Row Cork Ireland	+353 21 4904 197	+353 21 4277 922	e.rogan@ucc.ie
Marina Sequeira Instituto da Conservação da Natureza (ICN) Rua Ferreira Lapa, 38- 5ºD 1150-169 Lisboa Portugal	+351 21.316 05 20	+351 21.352 04 74	marinasequeira7@yahoo.com sequeiram@icn.pt
Mark L Tasker Joint Nature Conservation Committee, Dunnet House 7 Thistle Place Aberdeen, AB10 1UZ Scotland	+44 1224 655701 +44 7971 078441 (mobile)	+44 1224 621488	mark.tasker@jncc.gov.uk

European Commission

Biagi, Franco (STECF Secretariat) Directorate General for Fisheries Conservation Policies Rue Joseph II, 99 B-1000 Bruxelles Belgium	0032.2.2994104	0032.2.2994802	Franco.Biagi@cec.eu.int
Jose Rizo Martin Environment Directorate General Avenue de Beaulieu 5 B-1160 Brussels Belgium	0032.2.2950106		Jose.Rizo-Martin@cec.eu.int

13 APPENDIX 2

EXECUTIVE SUMMARY FROM A REVIEW OF MARINE MAMMAL OBSERVER SCHEMES WITH RECOMMENDATIONS FOR BEST PRACTICE -(NORTHRIDGE, 1996)

This report was commissioned by the Joint Nature Conservation Committee at the request of the ASCOBANS Advisory Committee to provide advice on how best to establish schemes to monitor bycatches of marine mammals in fishing operations.

Fishery observer schemes are the preferred means of monitoring bycatch, not just of marine mammals, but of all species.

Fishery observer schemes have proliferated over the past two decades as the most reliable means of obtaining data on fishery catch composition; so too has the number of observer schemes recording marine mammal bycatch.

Observer schemes are seen to be expensive, so the combining of objectives within an observer programme, to facilitate marine mammal bycatch monitoring along with more general fishery management objectives, is clearly a sensible approach.

Marine mammal bycatch observer schemes need to be accompanied by marine mammal population assessments in order to be able to determine bycatch as a proportion of population size.

Alternatives to observer schemes include port interviews, collection or counting of marine mammal carcasses when they are brought to port, or logbook schemes which rely on fishermen themselves reporting bycatches.

All of these methods are found to be unreliable as methods of estimating total catches. Nevertheless, interviews and questionnaires can provide limited information on the seasonality or relative scale of bycatch, and salvage schemes enable biological data to be collected.

Independent observer schemes to monitor fish or marine mammal discards or bycatch are the best means of obtaining reliable bycatch estimates, and often marine mammal bycatch monitoring schemes are integrated within a fish discard or bycatch programme.

In Europe several discard programmes have been established. Generally, a low level of coverage means that these schemes are designed to provide indicative statistics on discards rather than precise estimates. One scheme in the Danish gillnet fishery has been expanded to examine marine mammal bycatch in detail.

Dedicated marine mammal observer schemes have also been established in several European countries. Globally, most marine mammal observer programmes have been set up as an extension of existing fishery observer programmes.

Co-operation with the fishing industry is identified as a key factor contributing to the success of most observer schemes. The importance of explaining the problem to the fishing industry and addressing the issue of bycatch in a positive and constructive manner are stressed.

Practical considerations in establishing a scheme include safety at sea, insurance, sampling problems associated with the dispersed nature of some fleets, reimbursement of skippers for expenses, confidentiality of commercially sensitive information, and feedback and discussion of the results with the industry.

The level of coverage in a fishery will generally be constrained by the available resources. Notwithstanding this issue, the general aim should be to sample a fishery at a level sufficient to provide a reliable estimate of total bycatch.

In general this will entail producing a total bycatch estimate with a sufficiently low coefficient of variation (CV). It is not possible to specify an exact sampling level which will produce a target CV before the scheme has been established, but rather a scheme can be tuned to produce the desired level of accuracy after it has been established.

Observer schemes generally need to be stratified, by season, by area or by sub-fishery. Sampling can be optimised within strata to maximise the accuracy of the total bycatch estimate for a given level of sampling. Alternatively sampling may be proportional within strata.

Extrapolating observed bycatch rates to bycatches for the entire fleet relies upon a suitable indicator of effort for the entire fleet. If existing measures of effort are found to be inadequate, bycatch estimates may have to be extrapolated based on landings rather than effort statistics. For this reason it is important that observer schemes collect landings data on observed trips.

It is also important to understand any possible inherent biases in fleet effort or landings statistics.

Observer schemes are expensive, with costs estimated to run from around US$100 to US$1000 per day at sea. Insurance, transport, observer payments and data management are all significant costs. These factors need to be accounted for during the planning stage. It is generally agreed that the observers themselves should be trained technicians rather than volunteers.

The data to be collected by an observer scheme will depend on the objectives of that scheme. The establishment of an observer scheme provides the possibility of addressing a range of bycatch-related issues, but care must be taken to ensure that redundant data are not collected and that the data management potential is not swamped by unnecessary data collection.

Other issues which might be addressed in a bycatch observer scheme include biological aspects of the bycaught species, mechanical aspects of the capture, fishery management issues, and socio-economic aspects of the fishery. Incorporating such objectives may assist in integrating a bycatch observer scheme into a broader-based fishery management programme, thereby bringing additional resources to the scheme.

14 APPENDIX 3

FISH SPECIES MENTIONED IN THE TEXT

Dogfish	*Scyliorhinus canicula*
Blue shark	*Prioance glauca*
Skate	*Raja batis*
Herring	*Clupea harengus*
Sardine	*Sardina pilchardus*
Anchovy	*Engraulis encrassicolus*
Salmon	*Salmo salar*
(Sea) trout	*Salmo trutta*
Anglerfish (Monkfish)	*Lophius piscatorius & L.budegassa*
Cod	*Gadus morhua*
Whiting	*Merlangius merlangus*
Pollack	*Pollachius pollachius*
Hake	*Merluccius merluccius*
Lumpfish	*Cyclopterus lumpus*
(Sea) bass	*Dicentrarchus labrax*
Horse mackerel/ Scad	*Trachurus trachurus*
Red mullet	*Mullus surmuletus*
Black sea-bream	*Spondyliosoma cantharus*
Mackerel	*Scomber scombrus*
Bluefin tuna	*Thunnus thynnus*
Albacore (tuna)	*Thunnus alalunga*
Yellowfin tuna	*Thunnus albacares*
Bigeye tuna	*Thunnus obesus*
Skipjack tuna	*Katsuwonus pelamis*
Swordfish	*Xiphius gladius*
Brill	*Scophthalmus rhombus*
Turbot	*Psetta maxima*
Plaice	*Pleuronectes platessa*
Flounder	*Platichthys flesus*
Sole	*Solea solea*
Crab	*Cancer pagurus*
Spider crab	*Maja squinado*
Crayfish	*Palinurus elephas, P. vulgaris*
Cuttlefish	*Sepia* sp.

15 APPENDIX 4

ACRONYMS USED IN THE TEXT

ASCOBANS	Agreement on the conservation of Small Cetaceans Of the Baltic And North Seas
AZTI	Institute of Fisheries Research of the Basque Country (Spain)
BIM	Bord Iascaigh Mhara (Ireland)
COPEMED	The COPEMED (FAO) project started in 1996 to provide advice and technical support in the establishment of networks to facilitate co-ordination in support of fisheries management in the Mediterranean (first stage: Western and Central Mediterranean). Morocco, Algeria, Tunisia, Libya, Malta, Italy, France and Spain are participating in the Project. COPEMED will last for 5 years.
CPUE	Catch Per Unit Effort
CSC	Centro Studi Cetacei (Italy)
DIFRES	Danish Institute of Fisheries Reseach
EU	European Union
FBC	Fjord and Belt Centre (Denmark)
GFCM	General Fisheries Council for the Mediterranean
ICCAT	International Commission for the Conservation of Atlantic Tuna
ICES	International Council for the Exploration of the Sea
IEO	Instituto Espanol de Oceanografia
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
NASS	North Atlantic Sightings Survey
NCMR PCRI	National Centre for Marine Research, Pelagos Cetacean Research Institute
SCANS	Small Cetacean Abundance in the North Sea
SCRS	Standing Committee on Research and Statistics (ICCAT)
SFIA	Sea Fish Industry Authority (UK)
SGFEN	Subgroup on Fisheries and Environment (STECF)
SMRU	Sea Mammal Research Unit (UK)
SPAMI	Specially Protcted Areas of Mediterranean Importance
STECF	Scientific, Technical and Economic Committee for Fisheries
UK	United Kingdom
VHVO	Very High Vertical Opening (net)