INTERNATIONAL WORKSHOP ON CETACEAN BYCATCH WITHIN THE ACCOBAMS AREA

Organized by ACCOBAMS and GFCM

Rome (FAO HQs), Italy, 17-18 September 2008

1. INTRODUCTORY ITEMS

The International Workshop on Cetacean by-catch within the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) area was held at the FAO HQs, Rome (Italy), on 17th and 18th of September 2008. The meeting was attended by official representatives and experts from 14 contracting countries (Algeria, Albania, Bulgaria, Croatia, Cyprus, France, Italy, Lebanon, Malta, Romania, Slovenia, Spain, Tunisia and Ukraine), four from non contracting countries (Egypt, Montenegro, Turkey and European Commission), as well as by representatives from the General Fisheries Council of the Mediterranean (GFCM) Secretariat and the Pelagos Sanctuary Secretariat. Six NGOs were also represented. The list of participants is given in Annex 1.

The Terms of Reference of the workshop included:

- Gathering national overviews on the current status of by-catch and critical review of historical data in all ACCOBAMS Countries;
- The adoption by the ACCOBAMS scientific community of standard protocol on data collection and its submission to representatives of the ACCOBAMS Parties;
- The discussion on the implementation of the ByCBAMS framework within the ACCOBAMS area.

Introductory remarks and background information

The ACCOBAMS Executive Secretary, Dr Marie-Christine Grillo-Compulsione, Dr Matthew Camilleri, from the GFCM Secretariat, and Dr Giuseppe Notarbartolo di Sciara, chair of the ACCOBAMS SC, welcomed all participants. The Fishery and Aquaculture General Directorate of the Italian Ministry of Agriculture, Food and Forestry (MiPAAF) policies was thanked for the valuable financial support, given for this and other related activities.

The ACCOBAMS Executive Secretary and the Chair of the ACCOBAMS Scientific Committee explained the course of all activities related to the issue of cetacean-fishery interactions carried out by ACCOBAMS in cooperation with GFCM. At the 2nd MoP ACCOBAMS Parties approved Resolution 2.21 aiming to the "*Assessment and mitigation of the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS area*". Its main objectives were the following:

- To collect historical data about cetacean by-catch in the project area;
- To provide assistance to national authorities at their request to enable independent observers to sample fishing vessels;
- To collect data about current cetacean by-catch in the project area;
- To test the most appropriate mitigation measures;
- To help Countries undertaking information campaigns directed at fishermen with a special focus on

the handling procedures in case of incidental catch of cetaceans.

A draft project proposal (ByCBAMS) was presented and welcomed by Parties. The project included actions on: 1) technical aspects of data standardisation, 2) training of observers, 3) data collection through both rapid assessments (questionnaires) and direct observations, and 4) public awareness campaigns.

Besides with this Resolution ACCOBAMS Parties also instructed the Secretariat to establish and/or reinforce its relations with the relevant regional fishery Intergovernmental and Non-Governmental Organisations. In particular, the General Fisheries Commission for the Mediterranean (GFCM), Black Sea Commission, European Commission, and the MEDISAMAK. As follow up, a considerable amount of work has been done through the cooperation between ACCOBAMS and the GFCM. This work included:

- two workshops (in Tunisia and Italy),
- a questionnaire for rapid assessment of the knowledge on by-catch and depredation in the relevant area (see in Annex 2 for a summary of the information gathered), and
- the institution of a GFCM transversal Working Group on the issue of by-catch of cetaceans and other endangered marine species under the coordination of the Sub-Committee on Marine Environment and Ecosystems (SCMEE) and the Sub-Committee on Stock Assessment (SCSA).

The implementation of the Resolution 2.21, so far, has been largely based on the financial support made available by ACCOBAMS through its "*Supplementary Conservation Funds*" – specifically, three projects were funded on relevant issues: 1) "*Project for the assessment of the extent of present cetacean by-catch and stranding in the Romanian Black Sea area*" in Romania; 2) "*Study of dolphin/fishing net interactions at the level of traditional fisheries in Kerkennah and Kelibia: assessment of damage and economic loss*" in Tunisia; 3) "*Pilot project for use of acoustic devices*" in Morocco - and by MiPAAF.

Additional efforts has been made by ACCOBAMS Parties at the national level. For example, the Spanish Ministry of Agriculture, Fisheries and Food of has funded a project on bycatch issues that is within the scope of the ByCBAMS activities. On the other hand, at the end of 2006 the Italian Ministry of Agriculture, Food and Forestry Policies decided to fund four actions contained in the ByCBAMS framework. All actions were coordinated by the ACCOBAMS, through cooperation with ISPRA (ex-ICRAM) and Consorzio Mediterraneo. This project, which fulfil some of the Italian commitments toward the Habitat Directive (Article 12, paragraph 4), the EC Regulation 812/2004, and the ratification Laws of ACCOBAMS (Law 27/05) and PELAGOS Sanctuary (Law 391/01), had three main objectives and outputs:

- the elaboration of a standard protocol/guidelines for data collection on interactions between fisheries and cetaceans within the ACCOBAMS area;
- the assessment of the historical and present status of such interactions within Italian waters;
- data collection in the Tyrrhenian and Ligurian Sea, and
- the creation of an international network of experts on these issues through a synergy between

ACCOBAMS and GFCM.

Mr Matthew Camilleri highlighted the GFCM general interest on the issue of incidental catches of species of protected species and species of conservation concern, in line with its policy toward sustainable fisheries.

Appointment of Chair, moderators and rapporteur

Dr Simon Northridge was appointed ad chair and Giuseppe Nortarbatolo di Sciara, Matthew Camilleri and Mr Chedly Rais were appointed as moderators of different sessions Caterina Fortuna was appointed as rapporteur.

2. NATIONAL AND SUB-REGIONAL OVERVIEWS ON THE CURRENT STATUS OF CETACEAN-FISHERIES CONFLICTS, INCLUDING BY CATCH AND DEPREDATION, AND CRITICAL REVIEW OF HISTORICAL DATA

Giuseppe Nortarbartolo di Sciara and Simon Northridge moderated three sessions dedicated to the national and sub-regional overviews. Official representatives were asked to present all information available to them on the nature and extend of cetacean-fisheries interactions at national level. To help them with this task a template was prepared by the ACCOBAMS experts (Annex 3).

A total of 18 countries (Algeria, Albania, Bulgaria, Croatia, Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Romania, Slovenia, Spain, Syria, Tunisia and Ukraine) submitted their national reports. Official representatives of 15 countries had the chance to introduce their reports at the meeting. Besides experts from Algeria, France, Italy, Spain, Tunisia and Turkey presented additional information on bycatch, depredation and historical records of cetacean meat consumption. A list of all contirbutes is given in Annex 4.

All material presented and prepared for this meeting is available online at the following web page: http://www.accobams.org/2006.php/pages/show/313.

From these presentations it was possible to draw some general conclusions and highlight few issues. These are summarised in the following paragraphs.

Quantitative estimates of cetacean bycatch are lacking in much of the ACCOBAMS area, yet bycatches are widely reported anecdotally or through more or less systematic strandings surveys or interviews with fishermen in some countries. Anecdotal accounts of bycatch were reported from most countries, except from Egypt. In many cases it was unclear the temporal dimension of those events.

Fishing fleet present in Mediterranean and Black Seas were highly different in all possible terms: fleet size, boat size and engine powers, fishing gears and fishing practices (metiers).

Monitoring programmes involving at sea observations of fishing activity were reported in Spain, France, Italy, Slovenia and the Ukraine. Such programmes have only recently been implemented and few estimates of total bycatch were available. In four cases out of five the catalyst for implementing these programmes has been the Regulation (CE) 812/2004, laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98, which is mandatory only for European countries of the Mediterranean and Black Seas.

Some long-term study such as, for example, the one carried out by the University of Genova (Italy) to assess interactions between species of conservation concern and swordfish longline fishery in the western Ligurian Sea could help producing estimates for that artisanal fishery.

Evidence from strandings reveals that bycatches occur in some countries including Albania, Algeria, Bulgaria, Montenegro, Romania, Turkey. However, experts were aware that similar data exist for any other country were stranding networks are operating with different levels of effort and organisation. There were, for example, Croatia, France, Greece, Israel, Italy, Spain and Tunisia. Direct contacts with fishermen have also yielded observations and minimum estimates in several countries including Bulgaria, Romania, Turkey, Ukraine, Israel and Algeria.

Fishermen in several countries, including Algeria, Bulgaria, Cyprus, France, Italy, Montenegro, Morocco, Spain, Syria and Tunisia, clearly considered depredation a serious issue. Again, this did not appended in Egypt. In many cases, scientists documented these cases of depredation, but not proper quantitative studies were available.

Overall there is a paucity of detailed information throughout the region, but anecdotal accounts including records from fishermen and evidence from strandings suggests that both bycatch and depredation are widespread throughout the region. In same area there was some indication for competition for the same resources; however, conclusive studies did not exists yet.

The primary species involved in depredation is the bottlenose dolphin (especially, in gillnets, trammel nets, purse-seines and trawls fisheries), though common dolphins (in purse-seine fisheries) and killer whales (in tuna longline fisheries), at least, were also reported.

In the Black Sea the harbour porpoise was the most frequently recorded cetacean among incidentally caught animals; while in the Mediterranean Sea, common and striped dolphins, as well as some bottlenose dolphins were reported as the most affected.

Worrying reports were made by the representative of Montenegro on some records of stranded animals that have been shot or victims of explosives, presumably during fishery interactions. Some case was known also in Croatia and Italy. Besides, reports from Morocco, Spain and Italy were made on illegal driftnetting causing bycatch, but given the nature of this fisheries estimates were not possible.

In the Black Sea several hotspots for cetacean bycatch were identified in Bulgaria, Georgia, Russia, Turkey and Ukraine. Harbour porpoises were the most commonly caught, especially in turbot (large mesh) and other large mesh (spiny dogfish, sturgeons) set nets with very long soaking time (from 1 week up to a month). Formerly, in this area, cetaceans were also caught in trawls for small pelagic fish. Common dolphins and bottlenose dolphins were also taken. Data presented showed that harbour porpoises were caught 30-40 times more than other species; recently this proportion has decreased around 15 times. In this area too was reported an extended use of illegal fishing gears or illegal fishing practices.

No major depredation issue was reported for the Black Sea, even though occasional interactions with bottlenose dolphins are known. However, the representative from Bulgaria highlighted that bottlenose dolphins blamed by fishermen for severe depredation.

The GFCM Secretariat informed the participants about its effort to strengthen cooperation in the Black Sea. In fact, a document related to Black Sea fisheries affairs and including a draft project framework was prepared in 2007 and presented during the 32nd Session of the GFCM in 2008. This document was well received by the Commission, in particular by Bulgaria, Romania and Turkey, and it was agreed to take the initiative further.

The participants of the ACCOBAMS/GFCM workshop welcomed this information and strongly supported the implementation of such a project in the Black Sea.

Given time limitations, it was not possible to present the results of the Italian experts workshops on cetacean by-catch and depredation, held in Rome on the 10th-11th of September 2007. However it was agreed that this final report would contain also the main conclusion from that workshop, for the benefit of all participants. The following paragraphs summarised its main conclusions.

The workshop was co-organised by ISPRA experts (former Central Institute of Marine Research of Rome) and the ACCOBAMS Secretariat, within the framework of the ByCBAMS activities. Its main objectives were:

- to draw up an overview on the interactions between fisheries and cetaceans in Italian waters;
- to draft a proposal for a by-catch monitoring plan in Italian waters; and
- to comment on the draft protocol for data collection prepared by the experts designated by ACCOBAMS.

The main conclusions and recommendations of the Workshop were the following:

- Past research programmes and present opportunistic data collected in Italy seem to highlight a general low level of bycatch events; however, large pelagic driftnets (in terms of length, mesh size, and larger target species) and new mitigation measures applied against depredation (such as anti-predator nets for aquaculture facilities) proved to have a high impact. Nevertheless, it has to be emphasised that the feeling of a presumed low level of impact could be biased by the fact that proper data on bycatch, as well as data on cetacean population abundances, is lacking.

- Potentially highly impacting illegal fishing operations were still ongoing at the time of this workshop, but the nature of such activity did not allow estimating proper bycatch rates. These operations were illegal in term of both deployed fishing gears (often nets cumulatively longer than 2.5 km) and target species (species, such as swordfish, tunas, and some species of sharks, contained in Annex VIII of Regulation (EC) 894/97 and following modifications). In terms of use of driftnets, it is interesting to note that Article 9 of the Regulation (EC) 812/2004, stating "*from 1 January 2008, it shall be prohibited to keep on board, or use for fishing, driftnets*" it only applies to waters of the Baltic Sea, the Belts and the Sound. There are not restrictions, apart those listed above on net length and target species, applying to other European waters, including the European Mediterranean Sea.
- At the present, in Italy there was only one independent observer scheme on pelagic trawlers, in compliance to Regulation (EC) 812/2004.

Mr Camilleri gave a presentation of the GFCM Task 1 database, implemented according to Resolution GFCM/31/2007/1. Given the fact that GFCM is aiming to manage fisheries through effort control by Operational Units ("an Operational Unit is the group of fishing vessels practising the same type of fishing operation, targeting the same species or group of species and having a similar economic structure"), the development of a GFCM database (GFCM Task 1) where Members can input data on operational units in a standardized way, is clearly a priority. This database has also the option for uploading information on bycatch; however this option has not been developed yet.

3. BRIEF OVERVIEW ON THE OUTCOME OF THE GFCM WORKSHOP ON BYCATCH AND INCIDENTAL CATCHES (15-16 SEPTEMBER)

Mr Bradai, chair of the GFCM SCEEM summarised the outcomes of the previous GFCM Workshop on bycatch of species pf conservation concern (FAO Hqs, 15-16 September 2008).

The first meeting of the SCMEE/SCSA Transversal Working Group on bycatch/incidental catches was held at the FAO HQs, Rome (Italy), on 15 and 16 September 2008. Twenty-nine experts attended the meeting from six GFCM Members, namely Bulgaria, Croatia, France, Italy, Spain and Tunisia, as well as from GFCM partners, NGOs (ACCOBAMS, WWF, CIRSPE, Black Sea Council for Marine Mammals etc.) and the GFCM Secretariat.

The most relevant conclusions of the Working Group for cetaceans are summarised in the following paragraphs:

- Although the information presented on by-catch events of different taxa (elasmobranches, marine turtles and cetaceans) was interesting and valuable, the lack of standardisation in data collection and analysis makes it difficult to translate it into management advice. Extrapolation of non-standardised by-catch rates is not only dangerous, but also wrong and detrimental for management. The scenario was worsened by the fact that the available information was not homogenously spread in geographic terms.

~ In general, reliable data on population structure and abundance of by-caught species are of fundamental importance, not only to understand the real status of species and populations, but also to evaluate mitigation measures. The Working Group strongly encouraged more studies on population dynamics (population size, structure and demographics) on species of conservation concern (also in terms of fishery management), aiming to both clarify the status of the populations and evaluate the efficiency and the cost effectiveness of mitigation measures.

~ Interviews and types of survey other than direct observations, even though may not be used for quantitative assessments, can be extremely valuable as warnings of the existence of a problem, especially in case of artisanal fisheries/small scale fisheries, where no other data could be collected.

~ For species of conservation concern, if a serious threat for a given species or population is suspected, mitigation measures should be applied promptly, without waiting for more information on their population size and structure.

The most relevant recommendations of the Working Group to the SCEEM are summarised as follow:

~ To collaborate and promote, together with other relevant IGOs/NGOs, coordinated studies on population dynamics of species of conservation concern, such as marine turtles, mammals, birds.

~ To launch pilot projects on by-catch in specific metiers, taking into account not only technological measures for mitigation, but also the social aspects connected with that metier (especially in artisanal fisheries).

~ Implementation of more testing studies on promising technical and operational changes in fishing practices (e.g. circle hooks, TEDs, deep hooks, etc;)

In terms of future SCEEM work plan, Working Group recommended to follow-up on these activities:

~ Drafting a protocol for data collection on by-catch of species of conservation concern, merging the draft protocols prepared for ACCOBAMS and MedLem;

~ Evaluate existing data on by-catch, and identifying critical areas that could be object of local fishery management measures.

4. DISCUSSION OF THE DRAFT STANDARD PROTOCOLS FOR DATA COLLECTION PREPARED FOR THE ACCOBAMS AREA BY SIMON NORTHRIDGE

Dr Simon Northridge (University of St Andrews, UK), in cooperation with Dr Caterina Fortuna (ISPRA, Italy), developed a set of operational guidelines, under the aegis of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS), to help facilitate improved data collection in order to assess the extent of operational interactions between fisheries and cetaceans in the Mediterranean and Black Seas. However, despite the target *taxon*, it is believed that the basic principles will be the same in many other areas, and also for other species that are of conservation concern. Wherever there is a need to determine how frequently a particular non-target species is being caught in fishing operations, or how frequently fishery catch is being damaged, it is likely that the same procedures – primarily independent observations of fishing activity - will be required.

The protocol is not intended to be the final word, nor a complete compendium of methods, but is rather intended as a set of adaptable guidelines to assist in the establishment of monitoring schemes where none has previously been established. It is likely that these guidelines will need to be extended and adapted to particular local circumstances, as bycatch and depredation monitoring schemes are deployed more widely in the Mediterranean and Black Seas.

The protocol has been reviewed by several experts in the field and discussed to a series of workshops and meetings. These have included an Italian National Workshop on cetacean bycatch (Rome, Italy, 10-11 September 2007), the ACCOBAMS Scientific Committee (Castel Gandolfo, Italy 17-19 April 2008), a General Fisheries Council of the Mediterranean (GFCM) Scientific Advisory Committee transversal Working Group on by catch/incidental catches (Rome, Italy, 15-16 September 2008) and a joint GFCM/ACCOBAMS International Workshop on cetacean bycatch within the ACCOBAMS area (Rome, Italy, 17-18 September 2008). The final version of this document, revised after the latter meeting taking into account all comments received, can be found in Annex 5.

5. DISCUSSION ON THE IMPLEMENTATION OF THE BYCBAMS FRAMEWORK: POTENTIAL FUTURE COORDINATED EFFORTS

A considerable effort has been put in starting the assessment of the extent of the bycatch problem within the Agreement area, in accordance to the vision and objectives of ACCOBAMS Resolution 2.21. Some discussion was engaged on the future work that has to be carried out nationally and at the ACCOBAMS level, with particular emphasis on those actions of the ByCBAMS project (*Project for assessing the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS Area*) that are still to begin or were only partially initiated at a local level. These actions are:

- National Workshops in all ACCOBAMS riparian Countries;
- Data Collection
    - Data collection should be carried out applying those standard procedures that are proposed in the "*Protocol for data collection on bycatch and depredation in the ACCOBAMS*

Region", in accordance with local financial and logistic capacity;

- Elaboration of a technical manual on handling cetaceans incidentally caught in fishing gears
- Elaboration and dissemination of awareness raising material

It was also stressed the importance of good coordination between actions carried out at the international level and national projects. Coordination does not mean control over the others' ideas and the others' funding, but rather the enhancement of effectiveness of each single project through:

- facilitation of exchange of ideas,
- use of standard protocols and
- sharing of results in real time.

Such coordination is not only desirable, but also necessary for optimisations of the available human and financial resources, which are scarce.

The Workshop was closed at 17:00 on the 18th of September 2008.

ANNEX 1

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ANNEX 2

SUMMARY OF INTERACTIONS BETWEEN CETACEAN AND FISHERIES WITHIN THE ACCOBAMS AREA

In this annex are summarised the results of the rapid assessment of cetacean-fishery interactions within the ACCOBAMS/GFCM area.

Definitions

Bycatch: incidental catches.

Depredation: fish removal from gears by cetaceans.

Competition: exploitation of the same resources by both cetaceans species and fisheries.

Positive interaction: any cooperative behaviour between cetaceans and fishermen during fishing/hunting.

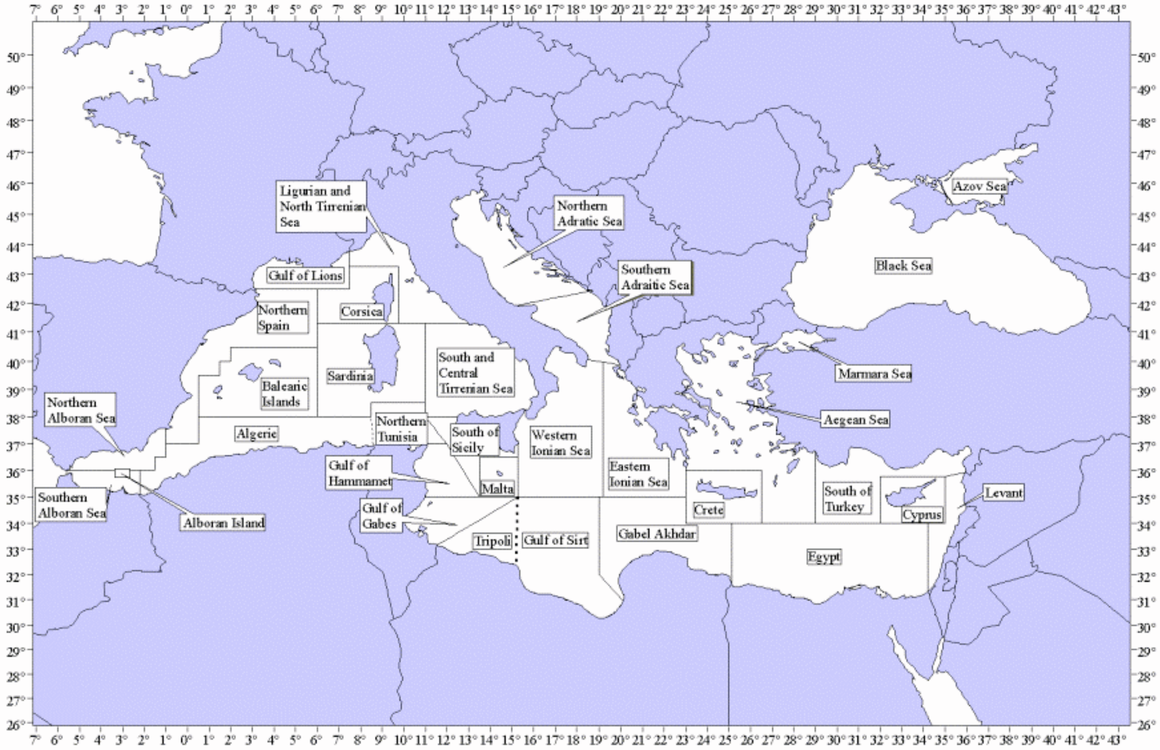
Species involved (species code)	Bycatch	Depredation	Competition for resources	Positive interaction	When	Gear type (code)	GFCM GSA Concerned (& Country)
Fin whale (*Balaenoptera physalus*)	X				Past	LLD	19 (Italy)
	X				Past	GND	10 (Italy)
			X		Past	TBB	10 (Italy)
Minke whale (*Balaenoptera acutorostrata*)	X				Present	GN	27 (Israel)
	X				Past	GND	10 (Italy)
Sperm whale (Pm)	X				Past & Present	GND	1 (Spain), 10-19 (Italy), 25 (Greece)
	X				Past	LLD	10-19 (Italy)
	X				Past	HARP	10 (Italy)
	X				Past	GTR	10 (Italy)
Long-finned pilot whale (Gm)	X	X	X		Past	LLD	9–21 (Italy)
	X				Past	GND	9–21 (Italy)
	X				Past	LHP	10 (Italy)
		X			Present	LX	19 (Italy)
Cuvier's beaked whale (Zc)	X				Present	LL	1, 5, 6 (Spain)
	X				Past & Present	GND	1, 5, 6 (Spain), 10 (Italy)
	X				Past	LLD	10 (Italy)
Killer whale (Oo)		X	X		Present	LHP	0 (Morocco, Spain)
		X	X		Past & Present	LHM	0 (Morocco, Spain)
	X	X	X		Present	FIX	00 (Morocco, Spain), 10 (Italy)
False killer whale (Pc)	X				Past	GND	10 (Italy)
		X			Past	LHP	10 (Italy)
Risso's dolphin (Gg)	X				Present	LL	1, 5, 6 (Spain), 22 (Greece), 10 (Italy)
		X	X		Past	LX	10, 19 (Italy)
	X	X			Past & Present	LLD	9, 10, 15, 18, 21 (Italy & International waters)
	X				Past & Present	GND	9, 10 (Italy), 22 (Greece)
	X				Past & Present	GTR	10, 18 (Italy)

Bottlenose dolphin (Tt)	**X**	**X**	**X**		Past & Present	**TBB**	1, 5 (Spain), 20 (Greece), 10, 13, 14, 15, 16 (Italy & International waters), 27 (Israel)
	X				Past & Present	**GND**	9, 10, 18, 19 (Italy), 22 (Greece)
	X	**X**	**X**		Present	**GTN**	29 (Romania)
	X	**X**	**X**		Past & Present	**GTR**	5 (Spain), 8 (France), 9, 10, 11, 15, 16, 18, 19 (Italy & International waters)
	X	**X**	**X**	**X**	Past & Present	**GN**	8 (France), 10 (Italy), 17 (Montenegro), 20, 22 (Greece), 27 (Israel)
	X	**X**	**X**		Past & Present	**GNS**	9, 10, 11, 15, 16, 18, 19 (Italy & International waters), 20 (Greece)
	X	**X**	**X**		Past & Present	**NK**	1, 5, 6 (Spain), 20, 22 (Greece),
	X	**X**			Past & Present	**LLD**	9, 10, 11, 13, 15, 16, 18, 19, 21 (Italy & International waters)
	X				Past	**HARP**	10 (Italy)
	X	**X**	**X**		Past & Present	**PS**	10, 15, 16, 18, 19 (Italy & International waters)
		X			Present	**PS1**	9 (Italy)
	X	**X**	**X**		Past & Present	**LX**	10, 16, 19 (Italy)
Short-beaked common dolphin (Dd)			**X**		Past & Present	**PS1**	10 (Italy)
	X		**X**		Past & Present	**PS2**	20 (Greece)
	X				Past & Present	**GN**	22(Greece)
	X				Past & Present	**GND**	00, 0, 1(Morocco & Spain), 4, 5 (International waters).
	X	**X**	**X**		Present	**GTN**	29 (Romania)
	X	**X**			Past	**LLD**	9, 10, 11, 18, 19 (Italy and international waters)
	X				Past & Present	**NK**	1 (Spain)
Striped dolphin (Sc)	**X**				Present	**RG**	7 (France)
	X		**X**		Past & Present	**GND**	00, 0, 1 (Spain), 4, 5, 9, 10, 11, 18, 19 (Italy and international waters), 22 (Greece)
	X				Present	**GN**	17 (Montenegro), 27 (Israel)
	X				Past & Present	**LLD**	10 (Italy and international waters)
		X	**X**		Past & Present	**LX**	10, 19 (Italy and international waters)
	X				Past	**HARP**	10 (Italy and international waters)
	X				Present	**NK**	1, 6 (Spain), 20, 22 (Greece)
Harbour porpoise (Pp)	**X**				Present	**NK**	00 (Spain), 22 (Greece)
	X	**X**	**X**		Present	**GTN**	29 (Romania)
Rough-toothed dolphin (Sb)	**X**				Present	**GN**	27 (Israel)
		X			Present	**LLD**	21 (International waters)
Unidentified delphinid species	**X**				Present	**NK**	20, 22 (Greece)

FAO FISHING GEAR CATEGORIES

SURROUNDING NETS		*TRAPS*	
With purse lines	PS	Traps (not specified)	FIX
One-boat operated purse seines	PS1	*HOOKS AND LINES*	
Two-boat operated purse seines	PS2	Handlines and pole-lines (hand operated)	LHP
TRAWLS		Handlines and pole-lines (mechanised)	LHM
Bottom trawls	TBB	Drifting longlines	LLD
Mid water pair trawls	PTM	Longlines (not specified)	LL
GILLNETS AND ENTANGLING GEAR		Hooks and lines (not specified)	LX
Set gillnets (anchored)	GNS	*GRAPPLING AND WOUNDING*	
Driftnets	GND	Harpoons	HAR
Trammel nets	GTR	*RECREATIONAL FISHING GEAR*	RG
Combined gillnet-trammel nets	GTN	*GEAR NOT KNOWN OR NOT SPECIFIED*	NK
Gillnets and entangling gillnets (not specified)	GEN	*SHARK CONTROL NETS*	NSC
Gillnets (not specified)	GN		

NOTE: For more details, explanations and figures, please check at the FAO official web page:
http://www.fao.org/figis/servlet/static?dom=root&xml=tech/gears_search.xml



FAO and GFCM CODES for SUB-REGIONAL AREAS

FAO Sub-area	*GFCM Geographical sub-areas*
Western Mediterranean	00. Contiguous Atlantic 0. Gibraltar Strait 5. Balearic Islands 6. Northern Spain 4. Algeria 1. Northern Alboran Sea 2. Alboran Island 3. Southern Alboran Sea 7. Gulf of Lions 8. Corsica Island 11. Sardinia 10. South and Central Tyrrhenian Sea 9. Ligurian and North Tyrrhenian Sea 12. Northern Tunisia
Central Mediterranean	17. Northern Adriatic Sea 18. Southern Adriatic Sea 19. Western Ionian Sea 20. Eastern Ionian Sea 15. Malta Island 16. South of Sicily 13. Gulf of Hammamet 14. Gulf of Gabes 14bis. Tripoli 21. Gulf of Sirt (Libya) 21bis. Gabel Akhdar
Eastern Mediterranean	22. Aegean Sea 23. Crete Island 25. Cyprus Island 24. North Levant (South of Turkey) 27. Levant 26. South Levant (Egypt)
Black Sea	28. Marmara Sea 29. Black Sea 30. Azov Sea

ANNEX 3

FORMAT FOR THE SUBMISSION OF NATIONAL OVERVIEWS ON THE CURRENT STATUS OF CETACEAN-FISHERIES CONFLICTS INCLUDING BYCATCH AND DEPREDATION WITH A CRITICAL REVIEW OF ANY HISTORICAL DATA

1. Overview of relevant fisheries[1], for example

    - Inshore trammel and gillnet fisheries (include details on, for example, mesh size, total length, area of deployment, etc.)
    - Driftnet fisheries (include details on, for example, mesh size, total length, area of deployment, etc.)
    - Lampara
    - Longline (include details on, for example, hook size, total number of hooks, area of deployment, etc.)

    Please, for common names and explanatory figures see the FAO website: http://www.fao.org/fi/website/FISearch.do?dom=geartype.

    Including a geographical overview of the extent of such fisheries (approximate number of fishing units in each sector in appropriate geographical zones. Please, together with the name of the location, indicate also the GFCM Sub-Area codes).

2. Overview of the nature and extent of any known conflicts including a summary of any anecdotal information on bycatch and/or depredation – both recent and historical.

    a. Species of cetacean involved

    b. Fishery involved and nature of interaction

    - Note particularly any reliable quantitative information regarding such conflicts, for example estimates of fish losses, number of vessels impacted, frequency of bycatch in a given fishery / area.

3. Summary of any cetacean-fishery interactions studies that have been done in the past or are currently underway, including bibliographic details.

4. Summary of areas and fisheries where no information on such conflicts is known.

5. Existing direct observers monitoring programmes or studies

6. Summary of any cetacean abundance studies that have been done in the past or are currently underway, including bibliographic details.

7. Existing relevant legislation.

8. Contact detail of the compiler.

[1] "Relevant" in this context means having potentials to cause bycatch or being subjected to depredation.

ANNEX 4

LIST OF CONTRIBUTIONS

BIRKUN, A. 2008. Cetacean-Fisheries conflicts in the Black Sea Region. Working paper prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

BRADAI, M.N. 2008. Overview on the outcome of the GFCM Workshop on Bycatch (15–16 September 2008). PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

FORTUNA, C.M. 2008. Conclusions from the National Workshop “Overview on the historical and present knowledge on cetacean fisheries interactions in Italy: status, problems and solutions” (Rome, 10th-11th September 2007). PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

FORTUNA, C.M., FILIDEI, E. jr, VALLINI, C., DI MUCCIO, S., TARULLI, E., MAZZOLA, A. 2008. Cetacean Bycatch Estimates in Italian Pelagic Pair Trawls Fishery. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

GARIBALDI, F., BAVA, S., CANESE, S., COSTA, M.R., FANCIULLI, G., CATTANEO VIETTI, R. 2008. The hunt for "*musciame*" in the Ligurian Sea. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

GARIBALDI, F., ORSI RELINI, L., Calandri, G. 2008. Interactions between protected species and swordfish longline fishery in the Western Ligurian Sea. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

NORTHRIDGE, S., FORTUNA, C.M. 2008. Draft Protocols for data collection on bycatch and depredation in the ACCOBAMS Region (version 9). Working paper prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

ÖZTÜRK, B., TONAY, A.M. 2008. Turbot fisheries and its impact on dolphin by- catch in the Black Sea. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

PELUSI, P., REPETTO, N. 2008. Cetacean interactions with fishing in Tyrrhenian and Ligurian Sea. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

RAIS, C. 2008. Project for assessing the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS Area. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

SACCHI, J. 2008. International Workshop on cetacean bycatch within the ACCOBAMS area. Working document Recent studies on incidental catches of cetaceans by French fisheries. PowerPoint presentation prepared for the International Workshop on cetacean bycatch within the ACCOBAMS, Rome (FAO HQs), Italy, 17-18 September 2008.

ANNEX 4

PROTOCOL FOR DATA COLLECTION ON BYCATCH AND DEPREDATION IN THE ACCOBAMS REGION

Protocol for data collection on bycatch and depredation in the ACCOBAMS Region

A Standardised Methodology for Use in the Collection of
Data on Cetacean Bycatch and Depredation of Nets
(with application for other species of conservation concern)

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October 2008

Table of Contents

Preface

This protocol was developed as a set of operational guidelines, under the aegis of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS), to help facilitate improved data collection in order to assess the extent of operational interactions between fisheries and cetaceans in the Mediterranean and Black Seas. In fact we believe the basic principles will be the same in many other areas, and also for other species that are of conservation concern besides cetaceans. Wherever there is a need to determine how frequently a particular non-target species is being caught in fishing operations, or how frequently fishery catch is being damaged, it is likely that the same procedures – primarily independent observations of fishing activity, will be required.

The protocol is not intended to be the final word, nor a complete compendium of methods, but is rather intended as a set of adaptable guidelines to assist in the establishment of monitoring schemes where none has previously been established. It is likely that these guidelines will need to be extended and adapted to particular local circumstances, as bycatch and depredation monitoring schemes are deployed more widely in the Mediterranean and Black Seas.

The protocol, reviewed by several experts in the field that were known to us, has since been presented to a series of workshops and meetings. These have included an Italian National Workshop on cetacean bycatch (Rome, Italy, 10-11 September 2007), the ACCOBAMS Scientific Committee (Castel Gandolfo, Italy 17-19 April 2008), a General Fisheries Council of the Mediterranean (GFCM) Scientific Advisory Committee transversal Working Group on by catch/incidental catches (Rome, Italy, 15-16 September 2008) and a joint GFCM/ACCOBAMS International Workshop on cetacean bycatch within the ACCOBAMS area (Rome, Italy, 17-18 September 2008). The present version has benefited greatly from many comments and suggestions from a wide variety of experts from all of these forums, to all of whom we are grateful. Nevertheless any omissions or errors are entirely our fault.

Executive Summary

Background:

Several legal and institutional drivers underlie the need to develop monitoring schemes to assess levels of interaction between cetaceans and fisheries in the ACCOBAMS area. Parties to ACCOBAMS have endorsed a research framework directed towards the 'assessment and mitigation of the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS area'[1]. The present report aims to meet one of the fundamental goals of the research framework, to establish an agreed protocol for data collection on cetacean bycatch and depredation.

There is an urgent conservation requirement to quantify the numbers of animals being killed in fisheries annually and to make a comparison with estimates of population size.

More objective measures of the economic significance of fishery losses to dolphin depredation are also needed in the ACCOBAMS area.

Fishery interactions with other species of conservation concern, including some sharks, seabirds and sea turtles also require monitoring under a variety of international agreements, national legislative instruments and International Plans of Action including those formulated by the Food and Agriculture Organisations of the United Nations. This protocol may also be useful in developing monitoring schemes for such species.

Overview of available Methods

There are several methods to assess the impact of a specified level of bycatch at the population level, and most rely on some measure of the intrinsic population growth rate as well as the annual bycatch total and the population size.

Methods of quantifying bycatch or damage range from the indirect (counting stranded animals) to the more direct measures of running logbook or questionnaire surveys, but biases are likely in all of these methods and the ensuing risk of misinterpretation is high. Although these indirect measures can provide useful insights into the problem, and can also be done relatively cheaply, their main utility is in stimulating more rigorous direct monitoring.

Independent observations of fishery operations are the most reliable means of quantifying bycatch of or damage to fisheries by cetaceans and cannot be replaced by indirect measures. However, given the potential financial costs of such programmes, indirect and direct means should be integrated to optimise available resources.

In many cases it may be advisable to stratify fisheries, perhaps by season, or by geographical area, or by some gear or fish-target related parameter such as mesh size. Unfortunately it is not always possible to specify such sampling strata in

[1] Resolution 2.21 of the 2nd Meeting of Parties, Spain 2004.

advance and before some detailed knowledge of the fleets, their activities and the incidence of cetacean interaction has been obtained.

In the first instance observer monitoring should be spread as evenly as is practicable across the entire fleet and in proportion to fishing effort, unless there is prior knowledge of where interactions are likely to be greatest. In such cases it may make more sense to focus most sampling in some key areas. Again specialist statistical advice should be sought on this point.

<u>Addressing how much monitoring is needed</u>
The amount of monitoring needed will depend on the resources available and the degree of precision that is required in order to produce a meaningful or useful result.

The size of the monitoring scheme will depend fundamentally on the size of the fishery. It is therefore imperative to understand the fleet structure, its modes of operation and levels of fishing effort by fishing category.

Determining the amounts of annual or seasonal fishing effort by gear and by vessel type may prove difficult where official statistics aggregate fishing methods or where relevant effort data or not collected in sufficient detail.

Some form of initial survey of ports, in person or by telephone, may be needed to better quantify the number of boats involved in specific fisheries and the nature and scale of their involvement.

In general the scale of a monitoring programme is a trade-off between operational costs and the level of precision of the final estimate of bycatch (or fishery damage).

In planning bycatch monitoring schemes it is simplest (especially in the absence of prior information) to assume in the first instance that bycatch events can be treated as though they follow a binomial distribution.

On this assumption, and where bycatch rates are thought to be generally low, it is possible to specify likely levels of precision of a bycatch estimate based on the projected proportion of fishing effort that will be sampled.

Greatest relative gains in precision are made with increased levels of monitoring at low levels of coverage. As the level of coverage is increased the law of diminishing returns dictates that a relatively lower improvement in precision is obtained.

Where there is an urgent conservation need to determine whether a level of bycatch is above some predetermined sustainable limit, and where there is already some idea of the likely bycatch rate, it is possible to determine levels of sampling required to determine with a given level of certainty whether or not that limit is being exceeded. Specialist statistical advice will be needed for such an approach.

Practical aspects of implementing a monitoring scheme:

Observers need to be well acquainted with fishery procedures and be prepared and be able to work in typical fishery conditions.

It is important to maintain or establish good relations with the fishing industry and ensure that the collection of any sensitive data does not compromise further relations with the industry.

Reluctance of skippers to take observers, lack of space on board boats, and vessel safety are all reasons why monitoring opportunities may be limited. Although ideally trips should be made randomly across an entire fleet, practical and pragmatic constraints often limit the sampling pool that observers are able to monitor. Nevertheless, representative coverage should always be an important aim.

Safety training is essential and a safety policy should ensure that emergency procedures are in place before the deployment of any sea-going personnel. Likewise adequate insurance is critical.

Costs can be high, but can be defrayed to some extent by collaborating with any other ongoing or putative data collection schemes involving on-board sampling (such as discard surveys or other on-board stock assessment-related surveys).

Where other data collection schemes are used to collect cetacean bycatch (or damage) data, it is important to ensure that observers' duties with respect to the various aims of the different schemes are actually compatible and do not compromise data collection in any respect.

The structure of data collection forms should be decided locally, as the significance of different data items or parameters may vary from place to place. At a minimum, however, details of the vessel, its area and timing of operation, and details of each fishing operation such as fishing duration and catch and bycatch species should be recorded. An example is given in the main text.

Advantages and disadvantages of paper *versus* electronic media for collecting data are discussed. Paper is more durable and reliable in the field. Laptop computers may enable automatic data checking as data are collected.

Implementation of a reliable database management system is fundamental to being able to make use of data collected by on board observe schemes. A typical data schema is described.

Estimating totals:

In order to analyse observations of a sample of vessels to estimate the levels of bycatch or depredation for the entire fleet, some way of estimating the amount of fishing activity by the entire fleet is required. Ideally such data will be available through a fishery effort monitoring scheme, but such schemes are often lacking and estimates of fishing effort for the fleet will need to be made by comparing whatever measures are officially available (such as tonnes landed, boat days at sea

or simply number of boats per region) with the same measures for the observed sample, and thus raise the observed rates to those of the entire fleet.

A simple ratio estimate can be used to raise the observed number of bycaught animals (or measure of fishery damage) to the entire fleet. Estimates of precision are more difficult, but typically log-normal confidence intervals are calculated and a procedure for this is described. Again statistical advice should be sought.

Any estimates of bycatch or of economic losses should be considered in a wider context that includes information on such factors as the population size and the perceived conservation limits or the profitability of specific fishery sectors.

Towards a bycatch management framework:

Data on bycatch rates and cetacean abundance should be thoroughly evaluated with the aim of setting bycatch limits. Such limits should be set by policy makers with due consideration for public concerns. Policy makers should also agree upon an ACCOBAMS management framework on cetacean bycatch to ensure bycatch limits are not being exceeded. This framework should include, at least, the following steps:

- **Definition of conservation objectives by policy makers**
- **Definition of a criterion for assessing bycatch sustainability (indicating also limits for uncertainty measures) by policy makers (informed by scientists)**
- **Data collection through independent observers schemes by scientists**
- **Data collection of abundance by scientists**
- **In-depth assessment (as a process for data validation) by scientists**
- **Implementation and evaluation of needed mitigation measures by policy makers (informed by scientists, technicians and industry)**

1. Introduction

Interactions between cetaceans on the one hand and fisheries on the other are widespread, and the cause of much concern in the ACCOBAMS region. Unfortunately at present there is a lack of detailed and robust information on the nature and scale of these problems throughout the Mediterranean and Black seas and adjacent Atlantic area. This Methodology has been put together in order to facilitate improved data collection in the region as a whole, specifically in order to address the need for better information that is mandated by several international agreements, including ACCOBAMS.

1.1 Legal and Institutional Framework for Data Collection

There are several agreements, conventions, resolutions and legal requirements that may oblige national governments to implement monitoring schemes to address cetacean bycatch. Normally, such international initiatives are implemented nationally through Laws, Decrees or any other form of legally binding regulation. Schemes to monitor other types of interaction (e.g. depredation or ecological competition) are more likely to be driven by political needs to address local concerns of the fishing industry than by international agreements.

In the ACCOBAMS region several legal frameworks and international bodies provide drivers for monitoring cetacean interactions with fishing gear. These include the Bern and Bonn Conventions, their Annexes and related Agreements (ASCOBANS and ACCOBAMS), the General Fisheries Council for the Mediterranean, the International Convention for the Conservation of Atlantic Tuna (ICCAT), the International Whaling Commission and, within the countries of the European Union, the Habitats Directive and Regulation 812/2004 on cetacean bycatch. Annex 1 provides a summary of the how these instruments and bodies relate to this issue.

The present document is one result of the strong commitment by Parties to the ACCOBAMS demonstrated through the endorsement of several related actions and activities, and including the preparation of this standard procedure for data collection (Annex 1).

1.2 The Purpose of Monitoring: An Overview of Conservation Issues.

Bycatch of cetaceans is one of the main sources of anthropogenic mortality worldwide, and for some populations represents a significant conservation threat (see for example Read et al 2006; Bjorge et al 1994; Reeves et al 2003). There is a need therefore to quantify this potential threat by estimating the number of animals that are killed annually in specific regions or fisheries and, by making a comparison with estimates of the number of live individuals in the same population, to assess whether the scale of deaths is likely to pose a conservation threat (See Annex 2). Although the present guidelines only deal with the quantification of the level of interaction, independent measures of population status – such as trends in abundance or trends in density - should also be used to determine whether or not the estimated levels of mortality due to bycatch might be affecting the population size. Such measures are currently being developed under the aegis of ACCOBAMS in the form of wide-scale sightings surveys, while trends in abundance or density of some species have also been monitored for some delimited areas by smaller scale sightings programmes (See Annex 3).

Monitoring fisheries also enables some assessment of the impact of cetacean depredation of fishing gear. Dolphins are widely blamed for removing fish from fishing gear and damaging nets in the Mediterranean, yet for this issue to be taken seriously, some measure of the extent and scale of the problem needs to be made, and some objective assessment of the economic significance of such losses is also required. Methods for making such assessments are less well developed than those for bycatch assessment, but essentially include quantifying the economic cost of the losses and making an assessment of the economic and social significance of these costs. **Such conflicts between dolphins and fishermen can also lead to additional anthropogenic mortalities where fishermen resort to illegal lethal action to prevent gear damage or fish loss**.

1.3 Assessing the Potential Conservation Threat

The accidental mortality of cetaceans in fishing operations often evokes an emotional response in the media and the public more generally. However, it must be recognised that such events are the unintended consequences of a socially and economically important activity. As such it is necessary to balance the conservation impact of the bycatch with the benefits that the fishery represents. Deciding what level of bycatch or other anthropogenic mortality might constitute a potential conservation threat is not straightforward. In most instances it is useful to compare the best available estimates of total annual mortality with the best available estimates of animal abundance.

In some situations, however, the absolute number of animals dying, rather than the number of such mortalities in relation to the population abundance, is important. On occasion, public sentiment may over-ride the theoretical constraints of conservation policy, and in these cases arbitrary numbers of dead animals may become politically if not biologically significant.

There are several other approaches to determining whether or not an estimated bycatch rate is sustainable. These are summarised below in Annex 2, but **essentially mostly rely on an estimate of abundance and an estimate of bycatch**. Some will also require information on potential rates of population growth.

The significance of any depredatory interactions is primarily economic, and can be assessed by quantifying the economic loss due to depredation, and assessing the impact on profitability of a fishery.

2. Methods

2.1 Overview of Methods

Monitoring schemes are designed to **quantify bycatch (or damage) on a fishery-by-fishery basis** and **rely on sampling the 'population' of boats in a manner that will provide a statistically robust estimate, sometimes to a predetermined level of precision**. Sampling can be undertaken in a number of ways. Simplest, but of dubious validity, is the questionnaire or interview. The most rigorous and reliable method is to use fishery-independent on-board observations. (See Box 1)

BOX 1: Overview of methods used to quantify bycatch, and damage

- Strandings and other indirect measures
  - The presence of dead animals on beaches or elsewhere may help determine the fact that some bycatch is occurring in a region, but as a quantitative measure such observations cannot be of much use because the number of dead animals that wash onto beaches is usually only indirectly related to the number of animals that are bycaught in any given region. Care must be taken not to over-interpret data from stranded animals, and protocols for establishing cause of death must be followed.
- Interviews
  - Interviewing fishermen can be conducted either formally (with a series of specific questions) or informally, to gain an impression of the scale of bycatch or damage to fisheries in a region. Interviews are best conducted by people who are experienced in this method of data collection and who can be accepted as being independent and without any pre-conceptions. Interviews can be a relatively inexpensive way to obtain some initial information. However, it has been shown that fishermen, like all humans, are not good at remembering specific details, such as numbers, over any length of time (Lien et al 1994). Furthermore, there may be strong incentives in some areas for the scale of bycatch to be misrepresented. The possibility of economic compensation for damage may also lead to inflated reports of depredation or net damage.
- Logbooks
  - Logbooks schemes have been tried in a number of areas, and have been shown not to work well in some, because fishermen often have too many forms to complete on a daily basis. When logbook data on bycatches have been compared with independent observations in the same area, the former have been shown to under-represent actual bycatch levels (see review in Northridge 1998). In one or two areas, researchers claim to have good collaboration with fishermen, and accurate reporting, particularly with respect to reports of net damage.
- On-board observer
  - Independent observations made by trained observers are ***the most reliable and useful means of collecting data***. They can be expensive, but costs can sometimes be defrayed by co-ordinating observations to meet several objectives at once, for example to provide data that may be useful for fish stock assessment or fishery effort quantification or validation.
- Remote independent monitoring
  - In some situations it is possible to minimise independent observer costs by monitoring fishing operations remotely. This might be done by camera, for example, or by observing fishing operations from another boat, or even from the shore in some circumstances. This approach has only rarely been tried and is likely only to be useful in certain specific circumstances.

The amount of monitoring, in whatever form it takes, will ultimately be determined by the financial and human resources available to address the task. However, **it is always helpful to know on the one hand how useful and reliable the results of a given amount of monitoring might be, or on the other, what amount of monitoring will be needed to produce a useful and reliable result**.

Central to determining how much monitoring is required is **a detailed understanding of how much fishing activity is occurring in the region of interest, by gear type or by fishing metier**. This information not only determines the absolute level of sampling required to achieve a useful result, but also helps to inform a strategy for appropriate stratification of the sampling – that is dividing sampling into different strata for the purposes of estimating bycatch (or depredation).

Determining the fleet structure, modes of operation and levels of fishing effort is usually the first step in implementing a monitoring programme. Deciding on and designing the monitoring programme should follow on from this first stage. This will include many practical considerations. Finally, the analysis of any survey data to estimate the level of bycatch or depredation by an entire fleet cannot be conducted without data on the overall amounts of fishing effort (fishing activity) by the fleets concerned. So, more generally speaking, it is very important in any such fishery monitoring programme **to understand as much as possible about the structure and function of the fishing fleet concerned**, and also to understand how the available information or data on fleet activities are collected.

2.2 Understanding fleet structure and activity

An essential objective during the planning phase is to quantify the amount of fishing activity for each of the gear types that are of interest.

The basic structure of any nation's fishing fleet is normally available through reports or statistical accounts collated by fishery departments. Data such as the number of boats are usually available, though in some cases small boats may not be fully represented in the official statistics. What is usually more difficult to ascertain are indications of what gear types are used by how many boats, or the amounts of fishing effort (for example number of boat-fishing days, or number of fishing operations), and a break down of the fleet by size and amounts of gear used.

Marine mammals interact with some specific gear types more than others, and **it is therefore important to understand what gear types are being used, where, when and by how many boats, before any monitoring is planned**. But such detailed information is often hard to come by. This is particularly true of vessels, which are able to use several different gear types ('polyvalent'). Such activity makes it more difficult to determine the relative importance of different gear types, unless a proper "effort recording system" is in place.

Determining levels of fishing effort for specific gear types is important in order to be able to plan sampling, whether by interview or by on board monitoring.

Often research work will be required by combing through existing statistics backed up by directly asking people with a detailed local knowledge (such as harbour masters or fishery officials) of their local fleet disposition. Where official information or other data are very limited, some form of rapid appraisal might be appropriate to estimate the nature and scale of the fishing fleet.

It is also useful at an early stage to be aware of any **natural 'strata'** that occur within a fleet. For example, among a fleet of gillnet boats, some may be substantially larger and fish further offshore than the majority. These may need to be treated separately during sampling and for estimation of fleet level totals.

Initially it is operationally easier to assume a minimal number of strata but expand these as data are collected and a better understanding of the operational details of the fisheries and their bycatch become available. However, an early aim should be to understand the variety of the fleet that is to be monitored, in terms of vessel size, gear characteristics, and area and season of operation.

Observations should ideally be made at random within each stratum, and between strata in proportion to overall fishing effort. Totally random sampling is clearly impractical, as the basic management unit for observations is a fishing trip, which may include several or many fishing operations. Instead care should be taken to move observers among boats to the extent that is practicable, trying to sample as wide a range of vessels (in terms of size, fishing area and fishing tactics if appropriate).

In summary, the **essential requirement** for establishing a monitoring scheme is to determine **how much fishing effort there is in the area of interest**, as **only then can a sensible decision about how much monitoring might be required**. A first step is therefore to find and catalogue fishing effort data. This will be used both in planning an observer programme and in obtaining a final estimate for the whole fleet. **A more detailed understanding of fishing activities and patterns will assist in stratifying sampling.**

2.3 Assessing how much monitoring is required

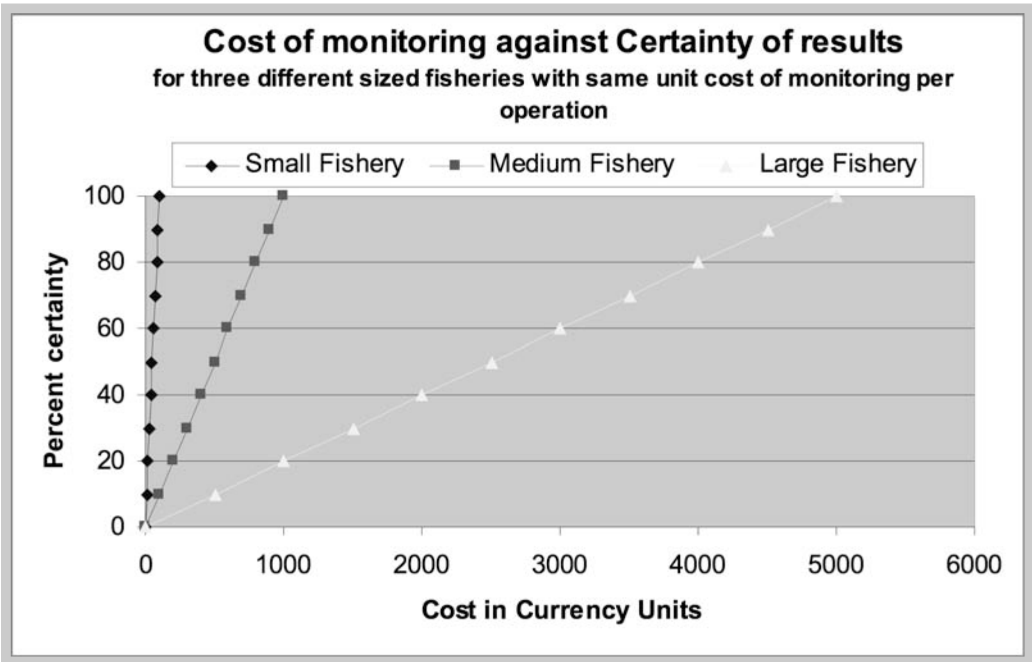
The amount of monitoring that might be needed in a given area will depend on several factors. In some limited cases, the levels of monitoring may be established within a legal framework (such as the EU 812/2004 regulation, in which the level of monitoring needs to be adequate to achieve a bycatch estimate with a CV of 0.3 or less for the most commonly caught cetacean species). In other cases there will be a balance between costs and information gain that needs to be assessed.

In general it is more difficult to estimate bycatch rates with a given level of precision than it is to estimate damage rates, because significant rates of bycatch are possible at relatively low levels of occurrence, while significant levels of damage are almost by definition likely to occur when such events are relatively frequent. The rest of this section therefore mainly addresses the issue of bycatch monitoring.

In principle, **the aim of monitoring is to produce an estimate of bycatch with some calculable level of precision**. It is important however to have clear goals in monitoring: for example, what precision of estimate is required or what bycatch limit does the fishery need to be assessed against. This information will help decide how much sampling is required, and this will be constrained by the available budget. Every observation made will increase the level of precision of the estimate, but will cost a fixed amount. With each increasing observation, the cost increases and so does the precision of the estimate.

The extreme situations are **"zero cost - zero precision"** (no information) and **"certainty"** with (usually) a relatively high cost of 100% level of observation. **An optimal level of sampling is therefore a trade-off, between the two extremes**. But the larger the fishery, the greater is the gap between the two extremes and the higher is the cost of the operation for the same level of precision. This is illustrated crudely in Figure 1. The relationship between increasing cost and increasing precision, however, is not linear, and in reality, precision increases rapidly at lower levels of sampling, but increases less rapidly as sampling approaches 100%.

Figure 1: Relationship between cost, fishery size and precision of estimate



It is necessary to consider some of the **statistical properties of bycatch events** before proceeding much further. In some cases, cetaceans are almost always caught alone, as individuals. In other cases, the more gregarious cetaceans are usually caught in groups. If cetaceans are usually caught singly, then the process of estimating the total number caught, calculating the precision of that estimate and also determining an appropriate level of sampling is relatively simple. The process can be assumed to be binomial – that is, each fishing operation either catches a cetacean or it does not, and each bycaught cetacean is independent from all others.

When more than one cetacean is usually caught in a bycatch event, there is an additional level of uncertainty, especially where the number of cetaceans in a bycaught group can vary considerably.

When planning a monitoring programme it is therefore simplest to try to determine what proportion of fishing operations results in a cetacean bycatch. This ignores, in the first instance, the fact that a bycatch event may involve many animals. This can be addressed later if it is found that bycatch events involve more then one individual at the time.

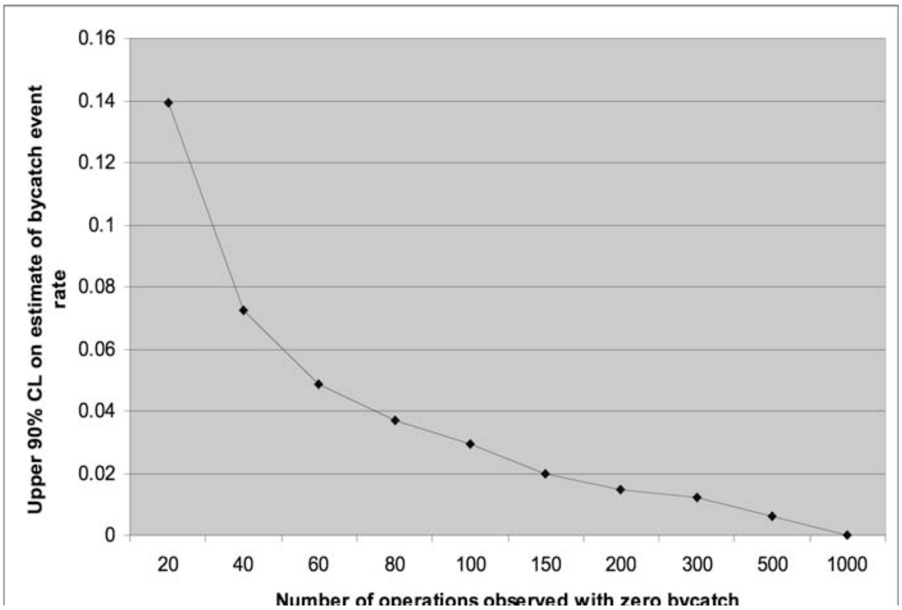
Once we have reduced the problem to a binomial one - that is, we wish to find out what proportion of all fishing operations result in a cetacean bycatch event- determining levels of precision becomes fairly easy. This is best illustrated by example.

Suppose a fishery exists in which 1000 fishing operations occur every year. All of these fishing operations involve the same gear type in the same area in the same season. If we monitor just one observation, without finding any bycatch, we can be 100% sure that the true bycatch rate is less than 1.0 bycatch events per operation in this fishery. But we cannot be very sure it is less than, for example, 0.5 events per operation. As we observe more and more operations with no bycatch our confidence that the true rate is less than (e.g.) 0.5 increases.

Another way to look at the same thing would be to say that the upper 90% confidence limit (UCL) on our estimate of the true bycatch rate will decline as the number of observed operations with no bycatch increases. Graphically, this can be presented as in Figure 2 below.

With no bycatches events observed, the best estimate of the bycatch events per operation is zero for the entire fleet. The 90% UCL for this estimate of zero declines as more sampling is achieved. It can be seen from the above that there is in fact an initial rapid decline in the UCL of a zero bycatch estimate, which is the same as saying a rapid increase in certainty that bycatch is not greater than zero, in the early stages of sampling. By increasing sampling from 20 observations among 1000 (2%) to 40 such observations (4%), the UCL on the zero bycatch event per operation estimate declines from 0.14 to 0.07. By the time 10% of operations are being sampled, the rate of increase in certainty has declined, and the law of diminishing returns has become evident.

Figure 2. Decreasing 90% UCL on bycatch rate estimate with increased observations[2]



In situations where there is no prior information on the likely bycatch rate, and where a low actual bycatch rate is a reasonable assumption, this procedure can be used to determine the level of certainty that will arise for a given planned level of observation. Typically in such situations, the aim is to be 'sure' that the true rate of bycatch events is in fact low, and again **typically monitoring somewhere between about 2% and 7% of annual fishing effort would be useful**. Increasing sampling levels above about the 10% level will do little to increase certainty, while less than 1% may leave an unacceptably large degree of uncertainty.

There are, however, a couple of other possible sampling objectives. It may be that there is already a suspicion that bycatch rates are high in some fishery, and that it is important to determine whether they are really above or below some specified level. In such instances the same approach can be used to determine how much sampling is required to be (for example) 90% sure that the true rate is less than some critical level (see Northridge and Thomas, 2003, for examples).

Another approach may be to target the *precision* of an estimate. In such cases it is necessary to have some prior idea of what the true bycatch rate is likely to be, and then one can calculate how much sampling is required to obtain an estimate with a target CV (coefficient of variation) or a target upper confidence limit. Within the European Union, Council Regulation 812/2004 requires member states to monitor certain fisheries with the aim of obtaining bycatch estimates (for the most commonly by-caught cetacean species) with a CV of 0.3. The same target is adopted in the USA.

[2] The Confidence Intervals on estimates of binomially distributed parameters can be calculated in a number of ways. This graph was produced using the 'Binomdist' function in Microsoft Excel© and the 'goal seeking' tool therein. The less-than-perfectly-smooth curve is due to imprecision in the goal-seeking iterative procedure used. It is also possible to calculate the CIs exactly by analytical methods.

This is because, if they are to be useful in a management context, all bycatch estimates need to be compared with an abundance estimate for the species or population concerned. It is the ratio of the bycatch estimate to the abundance estimate that is most useful. A reasonable abundance estimate for a cetacean typically has a CV of about 0.3 and it therefore makes sense to try to have an equally precise (or imprecise) estimate of bycatch. This is a way to optimise scarce resources, as there is little point in having a very precise estimate of bycatch if the estimate of abundance is very imprecise.

In general, the amount of sampling required depends on what the exact aims of the sampling programme are. This is discussed further by Northridge and Thomas (2003) with respect to bycatch. Obtaining useful results with respect to levels of damage is usually easier, because whenever it is considered a problem, damage events (depredation or gear damage) will be fairly frequently recorded. As such, reliable estimates of the total rate may be quicker to determine.

Clearly, as stated previously, **sampling cannot be planned unless there is relevant information on the nature and scale of the fisheries concerned**.

2.4 Practical considerations

There are a number of practical considerations when planning a monitoring programme. These include personnel, relations with the industry, constraints, safety and insurance, and linkages to other programmes.

2.4.1 Personnel

Ideally observers should have considerable sea-going experience on fishing vessels, and also have appropriate training so that they are able to make adequate records, identify species of concern, understand and record details of fishing activity, and be able to convey things they have seen clearly and concisely. Often observers will need to liaise directly with skippers to ensure they have a berth on a vessel, and they therefore need to have the self-confidence and understanding of the industry that will enable them to do so. Fishing vessels are often cramped, dirty and uncomfortable. Many do not ride seas comfortably, and an observer programme manager needs to be confident that observers will not suffer sea sickness and will be able to function independently in what can be a harsh environment.

2.4.2 Industry Relations

It is important that the industry, which means skippers, crew and also their representatives onshore, **understand and are sympathetic to the aims of the programme**. Sometimes there may be a legal requirement to take observes, but this can in fact make observer programme management more difficult if relations between observers and crew are strained as a result. Programme managers have a duty of care for their employees and cannot expect to send observers to sea for any length of time with a hostile crew. It is much more helpful if all parties are clear on what the potential advantages of such a programme might be. **Where there is**

already suspicion of a bycatch problem, it is important that the scale of the problem can be accurately assessed and remedial measures sought where necessary, before ignorance of the facts leads to pressure for drastic action to be taken. **Where there is no problem with bycatch**, then it is useful to be able to demonstrate this fact to a potentially sceptical public. **Where depredation is an issue**, it is important to be able to provide fishery authorities with accurate information on the nature and scale of such problems. Overall, by taking observers, skippers and crew will increase public and fishery authority awareness of a range of possible problems that they might face. **Often**, however, **skippers and crew have no problem with the idea of people monitoring their legal activities**. Some thought needs to be given to the **storage of data that might be considered sensitive** (such as fishing locations and amount of fish caught) in some cases. Whether or not, or the extent to which, data can be held in confidence is also an issue that needs consideration at the outset. In many countries (including EU ones) data collected through publicly funded research may have to be made available if requested, unless there are good reasons why not. The laws may vary from country to country, but this will need to be considered from the outset. The forced disclosure of sensitive information can have a potentially disastrous effect on any collaborative relationship between researchers and the fishing industry.

2.4.3 Constraints

There are numerous constraints to the operation of a successful observer programme. **Industry reluctance** to assist is one such constraint, but the careful development of relations with the industry (See 2.4.2 above) can help overcome this. Sometimes there is **not sufficient space on a vessel** to take an observer, for example there may be a limited number of sleeping spaces available. However, this can also be put forward as a reason for not taking an observer when it is not in fact true, and observer managers need to be aware of this. Occasionally **a boat may be in a poor state of repair**, and then sending an observer to sea may not be a safe or wise thing to do. Ultimately each observer should have the ability and the right to assess the safety of a boat and refuse to embark on a journey if safety standards are clearly unsatisfactory. . Occasionally there may also be valid safety concerns on the part of a vessel owner or skipper of a small vessel where an additional person on board may present a safety issue.

Ideally, trips on fishing boats would be arranged randomly across the entire fleet, but **realistically this is not often feasible**, and observers tend to work with some boats more than others as relations with skippers and crews develop. **It is important however to try to ensure that a representative sample of boats is observed and that spatial and temporal coverage is broadly representative of the fleet's activity**.

Cost is another major constraint, which is why planning is essential at the outset to ensure an adequate sample is possible, and to ensure that some analysis has been made of likelihood of meeting objectives with the financial resources available. Costs may also be defrayed to some extent if marine mammal bycatch observations can be linked with other programmes (see 2.4.5 below)

2.4.4 Safety and Insurance

Observers should be aware of what the **existing safety regulations** are for fishing vessels in their country, and should know how to assess these for any boat they visit. Employers also need to address safety issues by **ensuring that adequate safety training and equipment are given** and that risk assessments or safety policies are drafted as appropriate. A safety policy will need to be implemented and this may include, among other things, some 'reporting-in scheme', whereby observers inform the programme manager that they are about to leave port with a particular boat, and report back in when they return. Insurance is also generally required to ensure that any injuries sustained can be dealt with, and any liabilities due to observer negligence can also be met.

2.4.5 Linkages to other Programmes

Observer programmes in general are increasingly used to obtain data on a wide variety of fishery related topics, including the assessment of discard rates and collection of biological data on fish. **Cost sharing** with such programmes may be possible, or bycatch observers may be able to collect certain other data to improve the value for money of the bycatch monitoring programme. **Care should be taken that the different duties given to observers to not conflict**. For example, adequate monitoring of cetacean bycatch requires observers to watch the gear being retrieved from the water as for some gears, such as gillnets, cetaceans often drop out of the net into the water before the net reaches the boat (Bravington and Bisack 1996). If an observer is busy measuring fish as the net is being retrieved such 'dropouts' will be missed. In general, collaboration with an existing research programme is likely to produce synergistic effects with benefits to both areas of research.

2.4.6 Data Forms

The exact nature of the data forms should be decided locally, and may include data that are relevant to other programmes to help justify the expense of running an observer programme. Nevertheless, certain key fields will almost certainly always be required, and these are listed below in logical tabular form. Depending on whether bycatch of depredation is the main focus of the monitoring programme, certain features of the data collection may vary, for example, if bycatch only is being recorded, then the number of damaged fish may not be significant, and recording the number of fish by species may also not be necessary.

Key Data Fields Likely to be Required

Observer name and Trip Code
Skipper name (and contact details for future trips and for feedback)
Boat details (name, registration, size, capacity, type, affiliation etc)
Trip details
- Port
- Date
- Fishing Area
- Landed catch (species, weight)
- Number of days spent at sea
- No of fishing operations (hauls, tows, sets)
- Stratum / substrata (includes fishing method)

Operation details
- Location
- Timing
- Gear details (includes measures of effort)
- Bycatch or not

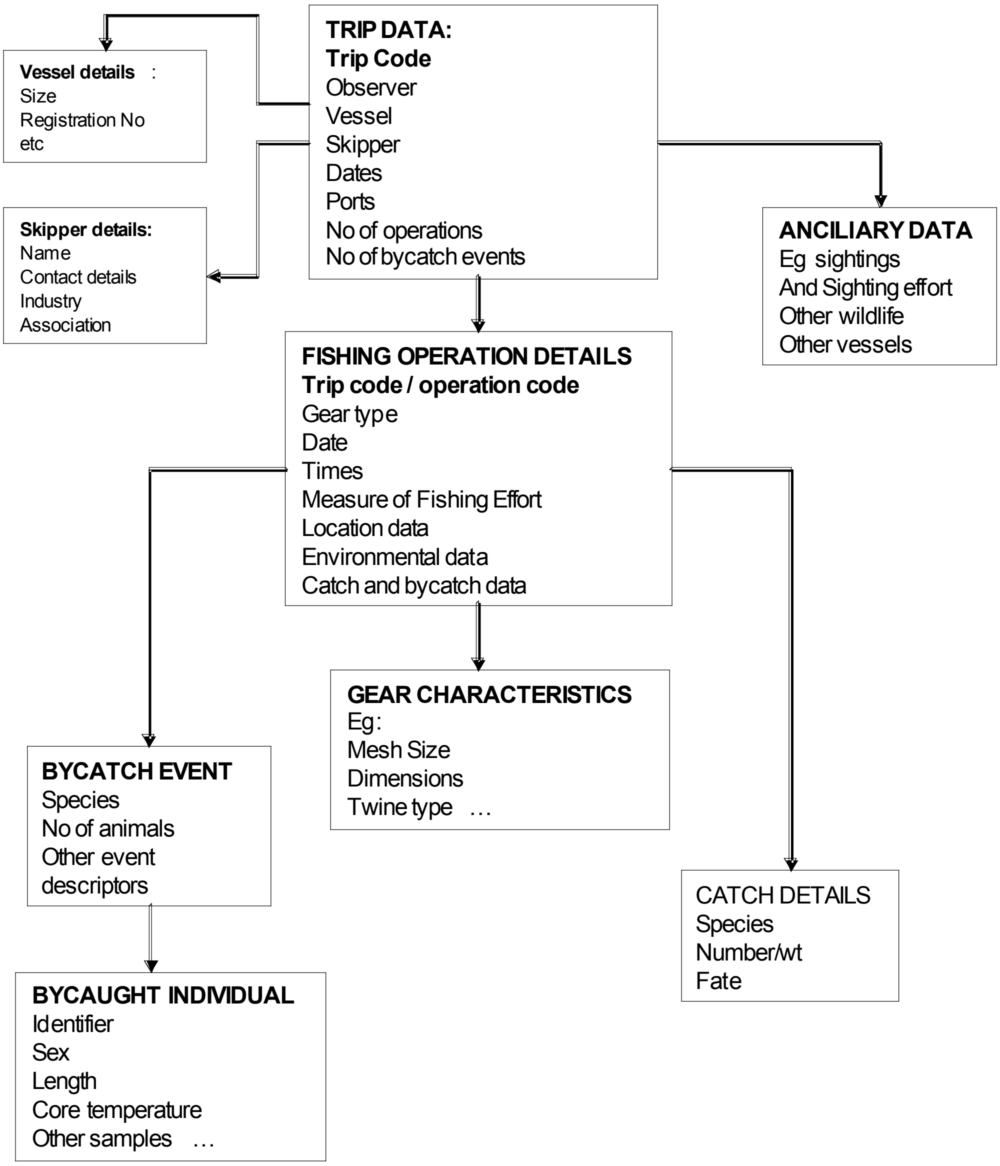
Catch details by fishing operation
- Fish species: number or weight
- Bycatches: species, number, sex, length
- Damaged fish, numbers by species
- Number of new net holes, lost hooks etc

Important bycatch details
- Samples from marine mammals e.g. stomach contents, teeth for aging etc

Sightings
- Dedicated or incidental sightings of marine mammals

Data may be collected on paper or electronically, but paper is usually more durable and more flexible in that observers are able to write extended notes as they wish, and these often provide clues to resolve apparent inconsistencies in any subsequent database that is constructed for analysis. Paper has the advantage that it can be easily transcribed, and is resilient to getting wet. Electronic data collection on the other hand, has the potential advantage that errors may be picked up as the observer enters the data on board a vessel if adequate resources are given to data entry forms and error checking routines.

Potential Data Schema for Monitoring (Bycatch) Data



2.4.5 Database Management.

Data accumulate quickly in observer programmes, and if any detailed analysis is to be possible it is important to ensure that adequate resources are provided to manage data in a timely manner. A database manager should design the database to enable rapid querying and detailed analysis. In most instances the purpose of the database will be to enable exploratory data analysis, so the structure should be kept as simple as possible. Data redundancy ('denormalised data') can often be a good idea for trapping data entry errors and allowing simple and rapid queries to be run. Data of this type lend themselves easily to a relational structure. An example is given above.

3. Getting from the observations to a total bycatch figure.

Once observations from a fleet have been collated, it is possible to determine an observed bycatch rate (which may be zero) – or damage rate in terms of lost fish or number of holes. It is important that the units used in this determination are appropriate to the situation. Observers will have monitored on a haul-by-haul basis (each operation is observed), and so the most fundamental unit of measurement is likely to be the number of animals (or incidents, or lost fish or net holes etc) per operation. From this measure, we need to be able to obtain an estimate for the entire fleet.

3.1 Fishing Effort

Ideally, in order to be able to raise any set of observations to a fleet total, **the number of fishing operations conducted by each category of vessel should be available from the entire fleet**. This is unlikely to be easy to obtain, so some less accurate measure of fishing effort such as the number of days or months fished by specific vessel types for each region or area should be obtained.

When observations have been made, **it is possible to estimate total bycatches for the fleet from the officially recorded measures of effort (number of boats, days at sea, etc) to an estimate of the number of operations made by the entire fleet based on the observed mean number hauls per day or per boat per year**. Although this may sound straightforward, the task of estimating fleet effort is usually very involved and will require a good understanding of how the official statistics are collected and how they can be transformed into a more useable measure of total fishing effort. Although some mean value of a fleet population sample (i.e. those boats that were observed) on its own is often used to generate an estimate of fishing effort for the entire fleet, ideally the sample variance would also be used to provide additional levels of certainty associated with any estimate of total fleet effort.

3.2 Levels of uncertainty/confidence

Simple ratio estimates can then be used to raise the observed bycatches in order to estimate bycatches for the entire fleet. Treating uncertainty in these estimates is not quite so straightforward. **Confidence intervals can be calculated by bootstrap methods or by using a variety of other methods**. A **log-normal confidence interval** is probably most often used, and one method is described for this in Annex 4. Additional or specialist statistical advice may be needed here.

3.2.1 Stratification

Simple ratio estimates can be applied to the entire fishery as a single stratum, but this assumes that there is no a priori reason why any one observed operation is more or less likely than any operation in the entire fleet to encounter an incident of bycatch or fishery damage. Or, to put it another way, none of the *un*observed operations should belong to another 'category' of fishery in which such events are more or less likely than in the observed operations. Often this is an article of faith – **as one can never be sure that there is not some fishing method or gear variant that is uncommonly used and which has a higher bycatch rate or damage rate than the more normal variety**. Observer programme managers should always be aware of this possibility, and where it is suspected sampling should be targeted at such boats.

If there is clear reason to believe that the entire fleet could be divided into two or more strata in which there are fundamentally different bycatch rates, then the observations and the fleet effort data need to be stratified accordingly. The simplest and most easily explained example would relate to seasonal differences in bycatch rates. If a cetacean species is much more common in a fishing area during one part of the year than in another, then any bycatch rates should be much higher during that part of the year. It would therefore make sense to ensure that the observations were divided into a 'low season' and a 'high season' and fishing effort treated in the same way, so that bycatch estimates can be made for these two strata independently. Obviously observations are then required from both such strata.

Other strata might become obvious depending on different types of gear used, or different areas fished. Observer programme managers need to assess these possibilities continuously and be prepared to redesign sampling strategies accordingly to ensure as even coverage as is practicable in each stratum.

Typically, observer effort should be deployed in proportion to fishing effort in the entire fleet. Thus, if half of all fishing effort is in one season, and half in another, then half of the observations should, initially at least, be made in each season.

However, depending on the programme objectives, disproportionate sampling may be sensible if for example one fishery stratum has a higher bycatch rate and by focusing more observer effort in that stratum a more precise estimate of overall bycatch can be achieved. **Statistical advice should be sought to optimise observer programmes** in this way.

In general, it is very important to ensure that sampling and subsequent estimation procedures are carried out in appropriate strata, which will require a detailed knowledge of the fishery or fisheries involved and serious consideration of the best way to stratify them.

3.2.2 Interpretation

Estimates of bycatch or of fishery damage should therefore be generated with some estimate of precision, usually in the form of a CV or a confidence interval. This should determine how useful the programme has been or is being in addressing policy questions. For example, if it is critical that bycatch of a certain cetacean species is below 500, yet the 95% confidence interval of the estimated total is 100-2000, the monitoring programme has not been very successful in addressing the policy question, and more sampling will be needed. Conversely, if a sustainable take is deemed to be in the thousands, yet the bycatch estimate has an upper confidence limit of only 800 then it is likely that the monitoring scheme has been more than sufficient. Results need to be interpreted in relation to conservation objectives in the case of bycatch and in relation to some equivalent measure of what might represent a significant loss to a fishery where the subject of study is depredation or gear damage.

4. Discussion

The preceding sections have described **a pragmatic approach to investigating the scale of cetacean bycatch**. The same principles could be applied to **other non target species of conservation concern**. However, **the approach still assumes that sufficient funds are available to carry out on-board monitoring**, and **that bycatch events are frequent enough that such a scheme would provide useful information from a feasible level of sampling**. Not infrequently neither of these assumptions will be correct. In such cases alternative approaches may be useful. Where there are insufficient funds then some of the methods described in Box 1 could be attempted, such as looking at stranded animals for evidence of bycatch, and interviewing fishermen to gain some idea of bycatch frequency. **Such attempts may help to gain funding for a proper monitoring programme, and might point to the likely scale of a bycatch, but are unlikely to be of use in a management context**.

Where a relatively small group of cetaceans interacts with a relatively large fishery, it may not be practicable or desirable to obtain estimates of the bycatch rate. If a very low bycatch rate with a high population-level impact is suspected, then other approaches may be necessary. These might include **behavioural studies** of the animals concerned to demonstrate some level of interaction with a fishery of concern, **photographic assessments of net scars on live animals**, and an **examination of spatial and temporal habitat use** by the group of animals concerned, **with a view to defining protected areas**. **Pre-emptive mitigation measures could also be applied to a fishery to try to minimise bycatch probability**. However, **such an approach would require a policy framework that would allow such an overt intervention**.

Whatever approach is taken to addressing bycatches of cetaceans, some policy framework is required if management actions are to be devised and implemented. **Normally, once a bycatch estimate has been obtained for a specific cetacean population, that estimate should be compared with the relevant cetacean abundance estimate, and a thorough assessment of the conservation implications should be undertaken**. Such an assessment would include setting bycatch limits, which, when exceeded, should stimulate management actions. Examples of bycatch limits and procedures to calculate those limits are given in Annex 2. All such procedures require input from public policy makers who must establish the overall conservation goals.

To assist in this process, steps should be taken towards the development of **a management framework for cetacean bycatch in the ACCOBAMS area**. This framework should include at least the following steps:

1. The **overall conservation objectives need to be defined and agreed by policy makers**.
2. The **definition of a criterion or a formula for assessing bycatch sustainability**. This should explicitly incorporate uncertainty and provide a means of dealing with such uncertainty to ensure policy objectives can be met.
3. The **implementation of independent observers schemes for data collection and assessments of bycatch**.
4. The **implementation of regional and sub-regional programmes for the assessment of cetacean abundance**.
5. The establishment of a **programme for regular assessments of bycatch rates, abundance estimates and conservation status of the relevant species, to include processes for data validation**. Such assessments should be carried out at a **biologically meaningful sub-regional level**, and at **regular intervals**, to enable policy makers to re-evaluate bycatch limits and management measures. **The needs for bycatch monitoring and abundance estimation should be balanced against one another to ensure an optimal allocation of resources**.
6. **Establishment of an adaptive process for the evaluation and implementation of mitigation measures**, which must include **scientific, technical and economic** input, as well as input from the **fishing sector** and **public policy makers**.

Annex 1: Institutional Drivers for Monitoring within the ACCOBAMS area

- The ***Convention on Migratory Species of Wild Animals*** (Bonn 1979) and the Agreements concluded under its auspices (such as ASCOBANS and ACCOBAMS), the ***Convention on the Conservation of European Wildlife and Natural Habitats*** (Bern 1979) and the ***Convention on Biological Diversity*** and its Annexes (Rio de Janeiro 1992) all require signatory states to monitor the conservation status of biodiversity to determine whether or not human activities can cause unsustainable morality rates, including those caused by fisheries.

- The ***Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS, Monaco 1996)***: Among the other things, Article II 3b states that Parties shall address: […] b) assessment and management of human-cetacean interactions; […]. Article 2 Annex 2 of the Agreement requires Parties to "*collect and analyse data on direct and indirect interactions between humans and cetaceans in relation to, inter alia, fishing …*". During the first Meeting of Parties (February 2002), the Contracting Parties to ACCOBAMS adopted Resolution 1.9 (International Implementation Priorities for 2002-2006) in which they identified one priority, among others, to address the problem of cetacean bycatch, urged Parties and specialised International Organisations to cooperate in this respect, and also called on the Scientific Committee to further develop appropriate actions. During the second Meeting of Parties (November 2004) a number of relevant Resolutions were adopted, particularly Resolution 2.21 "Assessment and mitigation of the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS area" and Resolution 2.12 "Guidelines for the use of acoustic deterrent devices". In Resolution 2.21 Parties agreed to a special action programme aimed at mitigating cetacean bycatches in the ACCOBAMS area "with the following objectives: 1) To collect historical data on cetacean by-catch in the project area; 2) To provide assistance to national authorities at their request to enable independent observers to board fishing vessels; [3)] To collect data about present cetacean by-catch in the project area; [4)] To test the most appropriate mitigation measures; [5)] To help Countries undertaking information campaigns for fishermen with special focus on the handling procedures in case of incidental catch of cetaceans". Concerning mitigation measures, by adopting Resolution 2.12, Parties agreed to adopt the annexed document "Guidelines for technical measures to minimize cetacean-fishery conflicts in the Mediterranean and Black Seas" (Northridge *et al.* 2004) and agreed, among the other things, to "link any use of pingers with an observer scheme designed to monitor their effectiveness over time". At the last meeting of the Parties, held in Dubrovnik (Croatia) in October 2007, Resolution 3.12 ("By-catch, competitive interactions and acoustic devices") was approved. Its operative paragraphs read as follow: "1. Encourages Parties to join the ByCBAMS project by: [a)] collecting data on the present cetacean by-catch in the project area, [b)] establishing, where necessary, official schemes for independent observers on fishing boats; raising the awareness of fishermen about the need to mitigate the impact of fishing on cetacean populations; and [c)] enhancing the capacity of fishermen to properly handle and release alive cetaceans caught incidentally in their fishing gear; 2. Invites the Scientific Committee to analyse, on the basis of the available knowledge, the utility of acoustic devices in cetacean–fishery interactions, the report to be finalized and made available on the web site of ACCOBAMS before the end of 2008; 3. Instructs the Secretariat to prepare, in close collaboration with the Scientific Committee and relevant organizations, technical specifications and conditions for the use of acoustic deterrent devices in the Agreement area, which should be submitted to the Fourth Meeting of the Parties of ACCOBAMS; 4. Also invites the Secretariat and the Scientific Committee to collaborate with relevant organizations and bodies to consider further the relations between prey depletion and increasing interactions between cetaceans and fishing activities, proposing remedial solutions where possible.

- The ***Agreement on the creation of a Mediterranean Sanctuary for marine mammals*** (Rome 1999; also known as Pelagos Sanctuary) concern the portions of the Italian, Monegasque and French waters of the Ligurian and north Tyrrhenian seas and Gulf of Lion. Parties are obliged to co-operate with the intent of periodically assessing the marine mammal population status, the causes of mortality, and the factors affecting with their habitat and their biological functions, such as feeding and reproductive activities (Article 5).

- The ***General Fisheries Commission for the Mediterranean*** (GFCM) has recommended monitoring of bycatch of protected species and sharks and has convened several workshops on this issue (Workshop on Ecosystem Approach to Fisheries in 2005, Workshop on Interaction between Cetacean and Fishing Activities in 2006). The assessment of the extent of bycatch is mainly conducted within the Sub-Committee on Marine Environment and Ecosystems (SCMEE). The Commission in 2007 endorsed the following activities of the Scientific Advisory Committee: 1) the updating of the ByCBAMS project[3] with the available knowledge of the cetacean population status and the assessment of the impact of different types of pingers on cetacean and fish species; 2) the extension of the work on cetaceans-fisheries interactions to other protected/threatened species (e.g. turtles and sharks).

- The International Commission for the Conservation of Atlantic Tunas (ICCAT) has established the Subcommittee on Ecosystems within its Scientific Committee, which has also the task of monitoring and improving information on interactions with non-ICCAT target species, with emphasis on those species of interest to the Commission and for which no Species Group has been established (including cetaceans, turtles and birds). The Subcommittee on Ecosystems has expressed concern that bycatches in tuna fisheries should be monitored adequately.

- IWC. The International Whaling Commission has adopted several resolutions calling for the implementation and improvement of bycatch monitoring

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[3] This is an ACCOBAMS framework to assess cetacean bycatch levels within the ACCOBAMS area, which coincides with the GFCM area.

schemes since 1981. A working group on “estimation of bycatch and other human-induced mortality” was established in order to review available methods used to provide estimates of large cetacean bycatch, in the context of the Revised Management Procedure, based on fisheries data and observer programmes.

- European Union: European Union member States are required by the Regulation 2004/812 on cetacean bycatch and by the Habitats Directive to monitor fisheries in order to assess levels of incidental catch. Regulation 812/2004 spells out which fisheries should be monitored and how this should be done, whereas the obligation is more general under the Habitats Directive. Mediterranean EU member states at the present include Spain, France, Italy, Greece, Slovenia Malta and Cyprus).

Annex 2: Criteria for assessment of bycatch sustainability

Several rules of thumb are commonly cited to describe the limits of acceptable bycatch in the literature:

- While considering the conservation status of harbour porpoises, the Scientific Committee of the ***International Whaling Commission*** agreed in 1995 (IWC 1996) that it should be a matter of concern if bycatches and or directed catches exceeded half of the estimated maximum growth rate of a population. It was noted that the maximum net production rate of the harbour porpoise could be less than 4% per year. Pending the opportunity to thoroughly evaluate this issue, the IWC Scientific Committee agreed that a figure of 1% of the estimated abundance of a population represented a reasonable and precautionary level beyond which "to be concerned about the sustainability of anthropogenic removals" (IWC 1996).

- ***ASCOBANS***, at its Second Meeting of Parties in 1997, noted that the IWC had endorsed the idea that an estimated annual bycatch of 1% of estimated population size indicates that further research should be undertaken immediately to clarify the status of the stocks and that an estimated annual bycatch of 2% may cause the population to decline and requires immediate action to reduce by-catch. ASCOBANS then defined an "unacceptable interaction" as being, in the short term, a total anthropogenic removal above 2% of the best available estimate of abundance within an appropriate management region; however if available evidence suggests that a population is severely reduced, then "unacceptable interaction" may involve anthropogenic removal of much less than 2%. (ASCOBANS 1997) These 1% and 2% levels are widely cited.

- The ***North Sea Conference of Ministers***, at the 2006 meeting, agreed to reduce by-catches of all marine mammals to less than 1% of the best population estimate. (Declaration of the North Sea Ministerial Meeting On The Environmental Impact Of Shipping And Fisheries Göteborg, Sweden May 2006)

More rigorous approaches are also available:

- In the **USA** a more rigorous approach has been taken, as is described by Wade (1998). He puts forward the concept of a Potential Biological Removal that has been incorporated into the US Marine Mammal Protection Act (MMPA, 1972, amended in 1994). The estimated PBR is the annual number of animals that may be removed from a stock due to human activities (for example, fisheries bycatch or collisions) according to a predefined management goal, which under the MMPA, should allow the stock to reach or maintain its Optimum Sustainable Population (OSP) level over a 100 years timeframe. The basic formula for calculating the PBR is set out as:

$$PBR = N \tfrac{1}{2} R_{MAX} F_R$$

where: N is the population size, R_{MAX} is the maximum theoretical net productivity rate of the stock at a small population size (assumed to be 0.04 for cetaceans), and F_R is an arbitrary recovery factor. Wade describes a simulation modelling approach where base models of cetacean population dynamics were used to tune the PBR equation is under a wide range of assumptions to ensure it would meet the objectives of the MMPA. These simulations suggested that if N was taken to be $N_{MIN,}$ the 20th percentile of the sampling distribution of the abundance estimate and F_R is chosen as 0.5 for a population of unknown status relative to its OSP then there is a >95% chance that takes of below the PBR will allow the population to reach or maintain its OSP over a 100 year time frame. Wade pointed out that similar simulation models could also be used to test the PBR against other management goals including that of ASCOBANS to maintain cetacean populations at or above 80% of carrying capacity.

- This approach was adopted by the joint **IWC-ASCOBANS Working Group** on Harbour Porpoises (IWC 2000 297-305), where a base model to describe harbour porpoise population dynamics was specified and then simulation trials were run to determine what annual removal levels would ensure that the ASCOBANS management objectives could be met over an infinite time horizon (as no time scale is specified in the ASCOBANS objectives) and assuming no uncertainty in any parameter. The results indicated that the maximum annual by-catch that would achieve the ASCOBANS interim objective of restoring or maintaining populations at or above 80% of carrying capacity, over an *infinite* time horizon, assuming no uncertainty in any parameter, is 1.7% of the population size in that year. This advice was subsequently endorsed by IWC at its 51st meeting. If uncertainty is considered, such as measurement error in estimating population size, maximum annual by-catch must be less that 1.7% to ensure a high probability of meeting the ASCOBANS objective.
  Subsequently the 3rd Session of the **Meeting of Parties of ASCOBANS** (Bristol, UK 2000), ASCOBANS re-defined "unacceptable interactions" as being, in the short term, a total anthropogenic removal above 1.7% of the best available estimate of abundance.

- The **Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention")** has agreed an Ecological Quality Objective for the North Sea (EcoQO) that the annual by-catch of harbour porpoises should be reduced also to levels below 1.7% of the best population estimate, in line with ASCOBANS definition.

Such an approach implies several elements, including a) a fair knowledge of the population structure, b) a regular monitoring of populations and mortality rates and c) a recovery plan and d) a calculated or assumed value for R_{MAX}.
Few of these elements are yet available for any cetacean population in the ACCOBAMS region.

Annex 3: Monitoring impacts on populations

Monitoring rates of human-induced mortality implies the additional need for monitoring of spatial and temporal patterns in cetacean abundance. It is of no use to have accurate bycatch rate estimates for an area without being able to relate them to the size of the population using the same area. So far, the most widely recognised method to estimate absolute cetacean abundance is ***line transect sampling*** (a distance sampling method), especially to cover large areas (STEFC 2002, Buckland *et al.* 2004). In some case-specific situations and with some particular species ***mark-recapture techniques*** are preferred (STEFC 2002).

Line transects surveys use dedicated platforms that allow representative coverage of large areas from which abundance estimates can be made. Mark-recapture methods are applied to species where individuals are individually recognisable and employ photo-identification techniques (e.g. for bottlenose dolphins, fin and sperm whales). In addition, a recently developed analytical technique that mixes concepts characterising distance sampling (detection function estimate) and GLMs and/or GAMs (spatial modelling of groups), is highly recommended to estimate abundance from data collected through non-systematic survey.

Distance sampling

In line-transect surveys for cetaceans, observers perform a standardised survey along a series of transects, searching for animals or groups of animals. For each detection the distance and the angle (relative to the transect) to the "object" is recorded. The basic concept is that the perpendicular distance to each detected object can be used to estimate the effective width of the strip that has been searched. Density is then estimated as:

$$\hat{D} = \frac{n\bar{s}}{2eswL}$$

where n is the number of separate detections of animals (or groups), $\bar{s}$ is mean group size, L is the total length of transect searched, and 2 *esw* is the estimated effective strip width. Since the probability to detect objects decreases with distance from the transect. The key to distance sampling analyses is to fit a detection function to the observed perpendicular distances, and use it to estimate the proportion of missed objects and the effective strip width.

Free software: DISTANCE
www.ruwpa.st-and.ac.uk/distance

Mark-recapture

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

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

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

Free software MARK:
www.phidot.org/software/mark
Free software CAPTURE: www.mbr-pwrc.usgs.gov/software.html#a

Distance sampling methods estimate the ***average number of animals*** in a specified area at the time of the survey. In contrast, capture-recapture methods estimate the ***number of individual animals*** using the study area over the duration of the study.

Thus, while distance sampling methods typically require a representative sample of the area surveyed, capture-recapture methods require a representative sample of individual animals using the area. Line transect surveys also requires a minimum reasonable coverage of the area (for example, SCANS and SCANS II projects had a maximum of 3% coverage in each block of the study area) that should allow a certain number of encounters to obtain reasonable CVs (<30-50%).

In both methods there are a number of critical assumptions relating to detectability, responsiveness and to other sources of heterogeneity which have been examined in detail over at least 25 years of analytical research focused on the estimation of cetacean abundance.

In order to be successful, in any case, surveys need to be carefully planned, including the right choice of the survey transect design, research platform and observers. The analytical part is also particularly important and need to be performed in a properly manner. Advice from expert in cetacean abundance analyses should always be sought.

Some **basic** reference material:

- Amstrup, S.C., McDonald, T.L, Manly, B.F.J. 2005. Handbook of Capture-Recapture Analysis. Princenton University Press, New Jersey and Oxford.
- Buckland, S.T., Anderson, D.R., Burnham, K., Laake, J.L., Borchers, D.L., Thomas, L. 2001. Introduction to Distance sampling. Oxford University Press.
- Garner, G.W., Armstrup, S.C., Laake, J.L., Manly, B.F.J., McDonald, L.L., Robertson, D.G. 1999. Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.
- Hammond, P.S., Mizroch, S.A., Donovan, G.P. 1990. Individual recognition of cetaceans: Use of photo-identification and other techniques to estimate population parameters. *Report of the International Whaling Commission* (Special Issue 12).
- Thompson, W.L., White, G., Gowan, C. 1998. Monitoring vertebrate populations. Academic Press. USA.

Line transect and photo-identification methods have been employed in a number of relatively small areas throughout the ACCOBAMS region to obtain estimates of cetacean abundance within those areas (see Table 1 below), while a Mediterranean basin wide survey is currently being planned. Such estimates will enable a comparison with any future estimates of bycatch.

Table 1- Abundance estimates within the ACCOBAMS area

WESTERN MEDITERRANEAN	GFCM area code	Study area (km²)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Striped dolphins (*Stenella coeruleoalba*)									
Western Mediterranean (Tyrrhenian Sea excluded)	1 to 9, 11	889,400	in- & off-shore	1991	117,880	0.22	68,379 - 214,800	Distance sampling	Forcada *et al* 1994
Corso-Ligurian basin	8, 9, 11	58,269	in- & off-shore	1992	25,614	0.25	15,377 - 42,658	Distance sampling	Forcada *et al* 1995
Balearic Sea (1)	5, 6	64,733	in- & off-shore	1991-92	5,826	0.36	2,193 - 15,476	Distance sampling	Forcada & Hammond 1998
Provencal basin (2)	6 to 8, 11	133,800	in- & off-shore	1991-92	30,774	0.36	17,433 - 54,323	Distance sampling	Forcada & Hammond 1998
Ligurian Sea (3)	8, 9	46,677	in- & off-shore	1991-92	14,003	0.35	6,305 - 31,101	Distance sampling	Forcada & Hammond 1998
Liguro-Provencal basin (2+3)	6 to 9, 11	177,517	in- & off-shore	1991-92	42,604	0.26	24,962 - 72,716	Distance sampling	Forcada & Hammond 1998
North-western Mediterranean (1+2+3)	5 to 9, 11	240,490	in- & off-shore	1991-92	48,098	0.24	29,388 - 78,721	Distance sampling	Forcada & Hammond 1998
Alboran Sea (4)	1 to 4	88,640	in- & off-shore	1991-92	17,728	0.33	9,507 - 33,059	Distance sampling	Forcada & Hammond 1998
Central Spanish Mediterranean sea	6	32,270	in- & off-shore	2001 - 03	15,778	0.19	10,940 – 22,756	Distance sampling	Gomez de Segura et al 2006
South Balearic area (5)	4 to 6, 11	235,125	in- & off-shore	1991-92	18,810	0.34	8,825 - 35,940	Distance sampling	Forcada & Hammond 1998
South-western Mediterranean (4+5)	1 to 6, 11	333,025	in- & off-shore	1991-92	39,963	0.38	18,206 - 87,721	Distance sampling	Forcada & Hammond 1998
Aeolian Islands (Italy)	10	13,200	in- & off-shore	2002 - 03	4,030	0.30	2,239 – 7,253	Distance sampling	Fortuna et al 2007
Common dolphin (*Delphinus delphis*)									
Alboran Sea	1 to 4	92,100	in- & off-shore	1991-92	14,736	0.40	6,923 – 31,366	Distance sampling	Forcada & Hammond 1998
Alboran Sea	1	19,189	in- & off-shore	1992-2004	19,428	0.11	15,277 – 22,804	Distance sampling and GAMs	Cañadas & Hammond 2008
Risso's dolphin (*Grampus griseus*)									
Central Spanish Mediterranean sea	6	32,270	in- & off-shore	2001 - 03	493	0.61	162 – 1,498	Distance sampling	Gomez de Segura et al. 2006

Table 1 (continued) - Abundance estimates within the ACCOBAMS area

WESTERN MEDITERRANEAN	GFCM area code	Study area (km²)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Fin whale (*Balaenoptera physalus*)									
Western Mediterranean	5, 6, 8, 9, 11	-	in- & off-shore	1991	3,583	0.27	2,130-6,027	Distance sampling	Forcada *et al.* 1996
Corso-Ligurian waters	8, 9, 11	58,269	in- & off-shore	1992	901	0.22	591 - 1,374	Distance sampling	Forcada *et al.* 1995
Bottlenose dolphin (*Tursiops truncatus*)									
Alboran sea (Spain)	1	11,821	in- & off-shore	2000-3	584	0.28	278 – 744	Distance sampling and GAMs	Cañadas & Hammond 2006
Almeria (Spain)	1	4,232	in- & off-shore	2001-3	279	0.28	146 – 461	Distance sampling and GAMs	Cañadas & Hammond 2006
Asinara island National Park (Italy)	11	480	Inshore	2001	22	0.26	22 – 27	Mark-recapture (closed pop)	Mackelworth *et al*. 2002
Central Spanish Mediterranean sea	6	32,270	in- & off-shore	2001 - 03	1,333	0.31	739 – 2,407	Distance sampling	Gomez de Segura et al. 2006
Balearic Islands and Catalonia (Spain)	5, 6	86,000	in- & off-shore	2002	7,654	0.47	1,608 - 15,766	Distance sampling	Forcada *et al.* 2004
Valencia (Spain)	6	32,270	in- & off-shore	2001-3	1,333	0.31	739 - 2,407	Distance sampling (aerial survey)	Gomez de Segura *et al.* 2006
EASTERN MEDITERRANEAN	**GFCM area code**	**Study area (km²)**	**Sampled area**	**Years**	**N**	**CV**	**95% CI**	**Estimation method**	**Source**
Sperm whale (*Physeter macrocephalus*)									
Ionian sea (Italy & Greece)	19, 20	271,000	in- & off-shore	2003	62	0.11	25 - 165	Distance sampling	Lewis *et al*. 2007
Bottlenose dolphin (*Tursiops truncatus*)									
Tunisian waters	13, 14	~ 750	inshore	2001 & 2003	3,977	0.34	1,982 - 7,584	Distance sampling	Ben Naceur *et al*. 2004
North-eastern Adriatic sea (Kvarnerić, Croatia)	17	1,000	inshore	1997	113	0.06	107-121	Mark-recapture (closed pop)	Fortuna *et al.* 2000
North-eastern Adriatic sea (Kvarnerić, Croatia)	17	2,000	inshore	2001-2	128	0.12	106 – 158	Mark-recapture (open pop)	Wiemann *et al.* 2003
Amvrakikos Gulf (Greece)	20	400	inshore	2005	148	-	132–180	Mark-recapture (closed pop)	Bearzi *et al.* 2005

Table 1 (continued) - Abundance estimates within the ACCOBAMS area

TURKISH STRAIT SYSTEM	GFCM area code	Study area (km²)	Sampled area	Years	N	CV	95% CI	Estimation method	Source
Bottlenose dolphin (*Tursiops truncatus*)									
Turkish Strait	28	~ 100	inshore	1997	485	-	203 – 1,197	Distance sampling	Dede (1999), cited after IWC (2004)
Turkish Strait	28	~ 100	inshore	1998	468	-	184 – 1,186	Distance sampling	Dede (1999), cited after IWC (2004)
Common dolphin (*Delphinus delphis*)									
Turkish Strait	28	~ 100	inshore	1997	773	-	292 – 2,059	Distance sampling	Dede (1999), cited after IWC (2004)
Turkish Strait	28	~ 100	inshore	1998	994	-	390 – 2,531	Distance sampling	Dede (1999), cited after IWC (2004)
BLACK SEA	**GFCM area code**	**Study area (km²)**	**Sampled area**	**Years**	**N**	**CV**	**95% CI**	**Estimation method**	**Source**
Bottlenose dolphin (*Tursiops truncatus*)									
Kerch Strait	29	890	Inshore	2001	76	-	30 – 192	Distance sampling	Birkun et al (2002)
Kerch Strait	29	890	Inshore	2002	88	-	31 – 243	Distance sampling	Birkun et al (2003)
Kerch Strait	29	862	Inshore	2003	127	-	67 – 238	Distance sampling	Birkun et al (2004)
NE shelf area of the Black sea	29	7,960	Inshore	2002	823	-	329 – 2,057	Distance sampling	Birkun et al (2003)
Northern and NE shelf area of the Black sea	29	31,780	Inshore	2002	4,193	-	2,527 – 6,956	Distance sampling	Birkun et al (2004)
Harbour porpoise (*Phocoena phocoena*)									
Azov sea	30	40,280	Inshore	2001	2,922	-	1,333 – 6,403	Distance sampling	Birkun et al (2002)
Southern Azov sea	30	7,560	Inshore	2001	936	-	436 – 2,009	Distance sampling	Birkun et al (2002)

Annex 4: Estimation of total bycatch

Estimating annual totals of cetacean bycatch with lognormal confidence intervals, from Northridge and Hammond (1999)[4].

Where:

H is the number of hauls or operations observed in a given year,

U is the number of unobserved hauls or operations in the same year,

t_h is the number of animals taken (bycaught) in the h^{th} haul, and

T is the overall bycatch rate (as animals per haul or animals per operation).

Then an estimate of the population average number of animals taken per haul in a given year is the average bycatch per observed haul in that year

$$\hat{T} = \frac{\sum t_h}{H}, \qquad \text{(Equation 1)}$$

the sample variance of the t_h is

$$V_1 = \frac{1}{H}\sum \left(t_h - \hat{T}\right)^2$$

and an estimate of the variance of $\hat{T}$ due to sampling error is:

$$V_2 = \frac{V_1}{H},$$

with standard error

$$V_1 = \frac{1}{H}\sum \left(t_h - \hat{T}\right)^2$$

$$SE_T = \sqrt{V_2} = \sqrt{\frac{V_1}{H}}.$$

The estimate of the total bycatch in a given year is

$$\hat{K} = \sum t_h + U.\hat{T}, \qquad \text{(Equation 2)}$$

with estimated standard error $SE_K = U.SE_T$ and coefficient of variation $CV = U.SE_T / \hat{K}$.

The lognormal 95% confidence interval can then be calculated as

$$\sum t_h + U \exp\left[\mu \pm 1.96\sqrt{\sigma^2}\right]$$

where $\mu = \frac{1}{2}\ln\left[\frac{\hat{T}^2}{1 + CV^2}\right]$ and $\sigma = \ln\left(1 + CV^2\right)$

[4] This elaboration is due to Dr. Mark Bravington, CSIRO Mathematical and Information Sciences, Australia (personal communication).

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