ICCAT By-catch Co-ordination Study

Final Report

to the

International Commission for the Conservation of Atlantic Tunas,

Madrid.

Prepared 9 July 2010 by

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Summary

FishWorld Science Ltd was the contractor for a "short-term by-catch coordination study" running from 3 December 2009 until 3 June 2010. This is the final report of the project. By-catch is an important issue for the Atlantic fisheries overseen by ICCAT because of concerns about biodiversity and possible degradation of pelagic ecosystems. More than 300 species have been reported as by-catch at one time or another. This study had 4 work tasks.

Briefly, Task 1 calls for a meta-database of reports and publications providing information about by-catch species from tuna and related fisheries. There are many such publications and a database is needed to help locate useful results for the many species that can occur as by-catch. Task 2 concerns development of a database for unprocessed and aggregated by-catch data for priority species such as marine mammals, turtles, seabirds, and many sharks, rays and teleost fish that are not subjected to stock assessment by ICCAT. Reporting of these data to ICCAT is not yet mandatory though some reporting occurs voluntarily. Task 3 calls for interaction with scientists leading national observer programmes to obtain previously unreported data and to make an inventory of past and current observer programmes. Task 4 involves development of forms and protocols for the collection of more and higher quality by-catch data in future.

The meta-database and the database of tasks 1 and 2 were developed jointly as a single database system using Microsoft Access 2007. Joining them permits better linking of data and metadata, and sharing of common reference information and input and retrieval systems, leading to lower input and maintenance work in future. The primary data tables hold data on publications, projects, grouped results (e.g. from multiple fishing trips reported together), and ungrouped results for individual species. The types of results that can be stored include CPUEs, biological measures, frequency distributions, counts and simple presence/absence, the latter used to keyword species for which no measures were made. This wide range of measures is needed to permit storage of (i) the typically aggregated results found in publications and reports and (ii) observers' data that are typically only aggregated for relatively short time periods and small regions, if at all. A generalised retrieval system was developed for small or large geographic regions that may be referred to by various names, some of them hierarchical, or by co-ordinates. The system depends on rectangular approximations to each named region. A similar system was developed for retrieval of results associated with short and, sometimes, very long periods, e.g. years, of aggregation. Data entry to the database uses specially designed forms and drop-down menus of existing values for the various fields, thus minimising the possibilities for inconsistencies and typing errors. Data tables, including the many reference tables, are fully relational and normalised, meaning, among other advantages, that data only have to be stored once and that there is substantial flexibility for designing retrievals. Two general purpose retrievals are provided, one for publications, the other for by-catch results. The user specifies criteria to retrieve a set of interest, for example the species, the vertebrate group, the geographic region, the time period, keywords, the fishing gear, or the flag of the fishing fleet.

The bibliographic data and selected results from more than 370 publications (ICCAT CVSP series back to 2003, plus journals indexed in ASFA) were loaded onto the By-catch database during the contract period and are available for retrieval. More than 100 new by-catch species were added to the list of by-catch species downloaded from the ICCAT site. These were given 3-letter codes taken from the

FAO coding system if possible. A list of the species remaining without codes was prepared for submission to FAO so that new, unified codes could be drawn up.

Appeals made under Task 3 to national scientists to submit observer data for storage on the database were mostly sent out on 16 March, together with suggestions for developing confidentiality agreements if necessary for release of their data. They yielded only one set, that from a French study of bluefin tuna in the Mediterranean in 2003. It was loaded onto the database. There are several good reasons why ICCAT CPCs (contracting and collaborating parties) find the sharing of observer data difficult: (i) Fishers host observers and can claim ownership rights over the resulting catch data whether the reasons for hosting are mandatory or through good will. (ii) Processing of by-catch data may be slow because it is not legally required, whereas other reporting tasks are, and have priority. (iii) The data may be the subject of research in progress. An inventory of 39 observer projects, the other part of Task 3, was prepared, mostly from ICCAT CVSP papers processed for Task 1.

Several ICCAT CPCs are already monitoring by-catches in detail using observers. The task 4 requirement to develop forms and protocols for collecting by-catch data was conducted independently by firstly reviewing possible objectives for the work, then reviewing by-catch protocols and forms proposed or used by others. Because of the very high diversity of nations, fishing vessels, latitudes, and species caught in the ICCAT region, simplicity, consistency of application, and clear objectives were thought to be key factors for the success of a basic by-catch monitoring protocol applicable to the whole ICCAT region. For this reason, some of the detailed reporting requirements of observer protocols elsewhere were not included in the proposals made here. The proposed objectives for an ICCAT by-catch monitoring protocol are

1. To quantify mortalities of all types of untargeted species paying special attention to those on the IUCN red list, and those with significant ecological roles.
2. To understand and explain the contributing factors.
3. To make scaled-up estimates of total mortalities for each type of fishery.
4. To assess the effectiveness of by-catch mitigation measures recommending improved and new systems when possible.
5. To support research on by-catch species and their ecological roles as resources permit.

Methods for achieving these objectives are discussed and two skeletal forms for observers to use for collecting by-catch data were drafted. The forms could be elaborated for specific fisheries or additional objectives, as several CPCs have already done. It is envisaged that results would be aggregated by geographic grid cells and season or year before transmission to ICCAT, thereby reducing the volumes of data to be processed centrally as well as giving some anonymity to individual fishing companies and nations.

The contractor's proposals were discussed at the 2010 meeting of ICCAT's Sub-committee on Ecosystems (SCECO, 31 May – 4 June), at the end of the contracted period. SCECO decided to recommend a minimal monitoring programme for by-catches. See Annex 6 of this report.

A further ingredient for successful reporting of by-catch data is the correct identification of species. A simple, standard format was developed for species identification with the aim of providing guidance that is usable by observers of all CPCs in ICCAT; the few words on each page could be easily

translated if necessary. Information for preparation of species ID sheets for most by-catch species was collected from sources on the web, notably FAO species guides, and from reference books. Approvals were sought (and usually given) for use of copyrighted materials, though some rights may remain with the creators. A collaboration between ICCAT and FAO was proposed by FAO.

In conclusion, the deliverables from this project are thought to leave ICCAT better able to find the information already published on by-catch, in a good position for implementing a standardised, low-level by-catch monitoring programme across the ICCAT area, and better able to store and retrieve those results flexibly for studies of by-catch mitigating measures and ecological changes linked with fishing.

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Preface

FishWorld Science Ltd was the contractor for a "short-term by-catch coordination study". The contract was signed on 3 November 2009, became effective 30 days later, and finished on 3 June 2010. Interactions between the contractor and ICCAT included a meeting with the chair of SCECO, Haritz Arrizabalaga, and the ICCAT Secretariat in Madrid on 18 Feb 2010 to discuss initial progress and clarify directions. The report of that meeting is attached at Annex 1. An Interim Report of progress was finalised on 29 March 2010. A draft final report, prepared 21 May, was presented and discussed at ICCAT's Sub-committee on Ecosystems (SCECO) held in Madrid from 31 May to 4 June 2010. Section 5 of the agreed minutes of the 2010 meeting summarises the discussion, available from http://www.iccat.int/en/meetingscurrent.htm.

The present version of the final report takes into account comments on the draft submitted to the contractor, plus additional work undertaken in the month following the contract period. It is intended to serve only as the record of work done for the project and no part of it should be read as official policy of ICCAT. In particular, the contractor's independent proposals under task 4 of the project ("Development of specific by-catch data collection forms and protocols") were not all adopted by SCECO 2010 for its recommendations, entitled 'Minimal collection of data on by-catch from fisheries conducted in the ICCAT region'. Those recommendations, parts of which flowed from discussions at SCECO in previous years, are included as Annex 6 of this report.

I am grateful for assistance provided by Pilar Pallares, Carlos Palma, and Laurie Kell of the ICCAT Secretariat, and by Haritz Arrizabalaga, chair of SCECO, and several other scientists whom I will not attempt to list in case I forget someone. Professor Nick Dulvy of Simon Fraser University kindly provided advice on the monitoring of shark species (shown at Annex 4). I also thank my staff for their dependable support: Diz Swift (computing, species ID), Carole Budgen (administration, species ID), and Sophie Cotter (design and production of species identification sheets).

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9 July 2010

Abbreviations

ASFA	Aquatic Sciences and Fisheries Abstracts
CPCs	Contracting Parties and co-operating, non-Contracting Parties to ICCAT
CVSP	ICCAT's Collective Volume of Scientific Papers
ICCAT	International Commission for the Conservation of Atlantic Tunas
ID	Identification
IUCN	International Union for the Conservation of Nature
SCECO	ICCAT's Sub-committee on ecosystems
SCRS	ICCAT's Scientific committee on research and statistics
T2CE	Task II catch and effort reporting under ICCAT procedures

Introduction

Published studies from around the world indicate that fisheries for tuna species can take significant by-catches of non-target species including sharks, dolphins, turtles, sea birds, squid, and non-tuna fish (Bailey *et al.*, 1996, Bratten and Hall, 1996, Romanov, 2000, Huang, 2005, Megalofonou *et al.*, 2005, Olson *et al.*, 2006, Stevens and Wayte, 2008). Some of these species, notably albatrosses, petrels, turtles, and some sharks and rays are listed as vulnerable to extinction, endangered, or critically endangered by the International Union for the Conservation of Nature (IUCN, www.iucnredlist.org) though fishing is not necessarily the main cause of their red-list status.

ICCAT have published a purely qualitative list of recorded by-catch species for major Atlantic and Mediterranean tuna fisheries (www.iccat.int/en/bycatchspp.htm). It includes 12 skates and rays, 46 coastal sharks, 11 pelagic sharks, 105 teleosts, 5 turtles, 37 seabirds, and 26 species of marine mammal. An ecological concern is that ocean fisheries for tuna are removing excessive numbers of top predators causing flattening of the "trophic pyramid" and, perhaps, long-lasting ecological regime changes in ocean systems (Pauly *et al.*, 1998, Jackson *et al.*, 2001, Myers and Worm, 2003, Pauly and Watson, 2005, Lees *et al.*, 2006, Casini *et al.*, 2008). Better knowledge of by-catches is needed so that research and fishery management can be directed towards reducing by-catch and consequential ecological degradation. It is also needed so that political debates about the benefits and risks of tuna fisheries can be based on all the available information on by-catches. As a spin-off, reduction of by-catches may lead to economies for tuna fishers, e.g. the savings of bait brought about by keeping seabirds away from long lines when shooting (Suuronen and Sardà, 2007).

Scientific studies of by-catch require a reasonably uniform and standardised approach to data collection across the ICCAT region and over time. Otherwise, ambiguities arise from varied methods and patchy reporting. The requirement creates substantial challenges for ICCAT. There are 48 Contracting Parties and 4 co-operating, non-Contracting Parties, collectively known as CPCs, speaking many languages and operating many different types of fishery including longlines, purse seines, baitboats, trolling, netting and trapping. The ICCAT area is vast, covering the whole Atlantic Ocean and the Mediterranean Sea. Furthermore, over 300 species may be caught at some time or another by the various fisheries and must be identified taxonomically before they can be noted scientifically. There can also be constraints on the dissemination of by-catch information, e.g. for legal reasons, by agreement in exchange for hosting an observer on a fishing vessel, or because data are the subject of research in progress. Last, but not least, problems of standardisation are significant. For example, should one use numbers, weights, rates per unit of fishing effort or per unit of landed catch? Which extremities define the size of an animal, e.g. a swordfish, a ray, a turtle or an albatross? Different observer groups often have different ideas about such matters.

The four linked tasks of this 6-month project are set out in full at the beginning of each section of this report. See also the report of the meeting on 18 February 2010 (Annex 1) for further information about the contracted work. Briefly, the tasks included

1. Development of a meta-database of reports and publications concerning by-catch (meaning unintended catch and sometimes including species targeted in other fisheries).

2. Development of a database of information on priority species (meaning those for which few or no data are currently submitted to ICCAT, e.g. seabirds, mammals, turtles, rays, some sharks and teleosts).
3. Obtaining relevant national observer data and developing rules for their use, for example, concerning confidentiality.
4. Developing by-catch data collection forms and protocols . . . e.g. adding species ID sheets for observer data collection forms.

Outputs from these tasks were designed as simply and generally as could be achieved so as to assist uptake by different CPCs. This approach is not intended to undermine the importance of specialised research when and where it is possible.

Few by-catch data came forward under Task 3 during the life of the project. Consequently, project resources designated for data processing were under-utilised. They were therefore re-assigned to development of standardised taxonomic guides for use by ICCAT observers at sea. Uniformity of identifications and of species codes seems essential if by-catch data are to be reported unambiguously by all CPCs. That work is reported under Task 4.

Another decision taken by the contractor was to amalgamate the meta-database and the database required under Tasks 1 and 2. The perceived benefits include better linking of data and metadata, easier learning of the system, and less maintenance in future through sharing of reference information and input and retrieval systems. Tasks 1 and 2 have therefore been reported together in the next section.

Tasks 1 and 2: Development of a meta-database and a database

1. Research and document potential sources of by-catch information such as, and not limited to, peer-review publications, reports, working documents, etc. The contractor must prepare a meta-database that identifies the sources, the types of information, the species, the temporal/spatial strata covered, the gears, etc.

2. Development and feed a by-catch database that includes information on catch, catch rates and biological information as detailed as possible (by country, area, gear, year, season, etc.). This task is complementary to Task 1. The contractor must develop a database with available species-specific information. This is a long-term endeavour and it is not expected that in a six-month period the contractor will enter all existing information. However, substantial progress must be made and focus must be on priority species identified by the SCRS Sub-Committee on Ecosystems.

2.1 Introduction:

There is now a large resource of reports and papers that offer scientific information on the various types of Atlantic tuna and shark fisheries overseen by ICCAT. Many reports are filed together as the Collective Volume of Scientific Papers (CVSP) on the ICCAT public web site. They run from 1973 and can be searched with a bibliographic database at http://www.iccat.int/en/pubs_CVSP.htm that allows retrievals by title words, author names, and the names of the principal target species. However, for non-target species, including many fish, sharks, rays, sea birds, turtles, and marine mammals, this facility is quite restrictive. Additionally, numerous publications and grey-literature reports can be found in the Aquatic Sciences and Fisheries Abstracts (ASFA) with which ICCAT collaborates for the dissemination of information. ASFA lists publications on a wide variety of subjects other than tuna fisheries using an extensive set of keywords. As a result, finding specialised publications serving ICCAT's purposes can be time consuming.

In accordance with Task 1, above, a meta-database was developed to open new possibilities for finding reported information on the by-catch species of tuna fisheries.

Additionally, Task 2, above, requires the contractor to develop a database as an archive for by-catch data collected by observers on fishing vessels in the ICCAT region. The "priority species" referred to in the last line of Task 2 include marine mammals, turtles, seabirds, and many species of un-assessed sharks and teleost fish. Reporting of such by-catch species is not yet mandatory for CPCs though the numbers and weights of some non-target species are, nevertheless, being reported as part of the ICCAT "Task II, Catch and Effort" (T2CE) reporting system. [Note: the ICCAT "Task II" is distinguished here from the project "Task 2" by the Roman numeral.] Despite an appeal for new data under Task 3 of this contract (see below), only one small set was received. This suggests that the problems of returning observer data to ICCAT are significant. As mentioned in the Introduction to this report, there can be several good reasons. There may also be insufficient resources to enter, check, retrieve and transmit the required data quickly, and little justification for improving the system while the submission of by-catch data to ICCAT is voluntary.

Some of these problems were discussed at a meeting with the chair of SCECO (Dr. Arrizabalaga) and members of the ICCAT Secretariat on 18 February 2010. See Annex 1 to this report. It was agreed that there is not a need to re-process by-catch data already held in the T2CE system operated by the

Secretariat. In another development, a large data set contributed by a CPC and previously available to the contractor was withdrawn for reasons of confidentiality. This left no unpublished observer data with which to initiate the Task 2 database.

A further point relevant to the design of the Task 2 database is the transmission of data between CPCs and the Secretariat. Observers record the numbers and biological properties of individual fish or animals. Since there would usually be dozens, if not hundreds of by-catch species in each transmission, submitting so many disaggregated data to ICCAT could create an impracticable processing load for the Secretariat. A degree of aggregation prior to transmission seems essential even though some biological information is then lost to ICCAT. At present the T2CE data represent the results from one or more sets aggregated to standard rectangles, usually 5°x5° or 1°x1° squares, by month, season, or year. Presumably, therefore, similar aggregation of by-catch data could also work and be acceptable to ICCAT scientists.

The contractor concluded that amalgamation of the Task 1 meta-database with the Task 2 database provides a reasonable way forward. The Task 1 meta-database is intended to hold by-catch results transcribed from publications and reports. They are frequently in the form of statistics describing by-catch quantities or properties aggregated over regions and periods. As just argued, the Task 2 database would also benefit from a degree of aggregation of submitted data. Furthermore, both databases need bibliographic information, as well as reference tables for species, regions, people, countries, gear groups, and so on. By combining the meta-database with the database, both can share unique sources for this information, thereby improving cross-linking of data, preventing incompatibilities, and reducing inputting and maintenance tasks. With careful design, the two databases can share data input and retrieval forms, thus making for more efficiency and an easier learning curve for new users.

For these reasons, a single “By-catch database” was developed in response to Tasks 1 and 2 of this contract. It was intended to give easy access to by-catch data aggregated at various levels and taken from publications, reports, or from original data sets. Retrievals of publications and reports are in the form of formatted pages giving bibliographic details, abstracts, fishing details, the species referred to, and keywords for the topics studied and the co-variables applied. Retrievals of by-catch results, mostly aggregated in some way, are in the form of data sheets that may be copied and pasted into a spreadsheet program such as MS Excel for further processing. Quantitative processing was not programmed within the database because the large variety of variables recorded and their different precisions prevent meaningful totalling and averaging, etc. by machine. In summary, the By-catch database is envisaged to be valuable as a means of alerting scientists to the many useful pieces of information about by-catch that are scattered around numerous reports, publications, and data sets. Since many of the data were transcribed to put them into the database, they should be checked with original sources before serious use. A ‘health warning’ to this effect is presented on the opening screen of the database.

The following sections set out design ideas for the By-catch database, describe its main components, illustrate what it can do, summarise the many data that have been stored as part of Tasks 1 and 2 and, finally, comment on possible future roles and requirements. The database itself is available electronically and has built-in user instructions in English, French and Spanish that are available by clicking a button on the opening screen. The database is programmed in Microsoft Access as

specified in the contract. The 2007 version was used because of the worthwhile improvements to the interface with the user (e.g. a navigation pane to keep procedures in order, and split screen forms that allow checking of existing data before adding new records). Users with older versions will have to update them before using the database.

2.2 Design of the By-catch database

2.2.1 Tables

The By-catch database holds five principal data tables, denoted here by upper case letters:

- RESULTGROUPS holding header information pertaining to a group of RESULT records, namely a time period and geographic region enclosing the observations, fishing gear, flag and fleet, approximate fishing effort applied, and sources of data. See figure 2.2.1.1. The methods for handling geographic regions and time periods at different scales are discussed in §2.2.2 below.
- PUBLICATIONS holding bibliographic details and keywords for journal articles and grey-literature reports. See figure 2.2.1.2. Keywords are discussed in §2.2.3 below.
- RESULTS holding assorted types of results for named by-catch species, e.g. catch rates, lengths, weights, length frequencies, growth parameters, discard percentages, and almost any other types for which results are available. Results are associated with the geographic region and time period specified in the parent RESULTGROUPS header record. See figure 2.2.1.3. The design of the RESULTS table is discussed in more detail in §2.2.4 below
- PROJECTS holding details of known observer programmes and other projects that have reported by-catch data. See figure 2.2.1.4.
- PERSONS holding names, initials, work location and country of authors, project leaders or anyone else referred to in the database. See figure 2.2.1.5.

Many of the data in these primary tables is in the form of numbers that identify records in subsidiary 'reference' tables where English translations of the record numbers are stored. In this way, fields can be filled from drop-down lists of values read directly from the reference tables, thus preventing non-retrieval of records as a result of typing mistakes or inconsistent spellings, e.g. 'USA' vs. 'United States'. Reference tables are denoted here in upper case letters prefixed with 'ref', e.g. refSPECIES. Fields and data types for two important reference tables are shown in figure 2.2.1.6 and 2.2.1.7.

The table structure is fully relational and normalised. Briefly, this implies that all rows (=records) and columns (=variables or fields) in the database contain different (i.e. independent) information, and no information is present more than once. The advantages of normalisation are significant:

- minimal data entry work,
- any corrections to data need only be made in one place,
- minimal chance of mismatching indices and fields due to human inconsistencies,
- maximum flexibility for retrievals, and
- minimal storage requirements.

The relational links among the tables enable bibliographic and project information to be retrieved jointly with by-catch results, and publications can be found according to the species, gears, regions, time periods, flag, and fleet stored with the associated results. The data retrieval processes are described in more detail below (§2.4).

Figure 2.2.1.1 By-catch database; fields and data types of the RESULTGROUPS table.

RESULTgroups

Field Name	Data Type	Description
ResultGroup#	AutoNumber	Unique record #
RgrpProject#	Number	Refers to record number in PROJECTS table. May be blank
RgrpPub#	Number	Refers to record number in PUBLICATIONS table. May be blank
RgrpGearGroup#	Text	Refers to code letters in refGEARGROUPS table
RgrpRegion	Number	Refers to record # in refREGIONS table
RgrpWlong	Number	W longitude of rectangle enclosing sample location
RgrpElength	Number	W to E length in degrees of rectangle enclosing sample location
RgrpSlat	Number	S latitude of rectangle enclosing sampling location
RgrpNlength	Number	S to N length in degrees of rectangle enclosing sampling location
RgrpStartYear	Number	Start year of period enclosing sampling time
RgrpEndYear	Number	End year of period enclosing sampling time
RgrpNtrips	Number	Number of trips for which result was measured; blank=Not known or not applicable
RgrpNsets	Number	Number of sets for which result was measured; blank=Not known or not applicable
RgrpNdaysAtSea	Number	Number of days at sea for which result was measured; blank=Not known, 0=none
RgrpFlagCode	Text	Refers to code letters in refFLAGS
RgrpFleetID	Text	Refers to code name in refFLEETS
RgrpObservers	Yes/No	Observers used?
RgrpLogbooks	Yes/No	Logbook data used?
RgrpInterviews	Yes/No	Interviews or questionnaires used?
RgrpLandingsData	Yes/No	Landings data used?
RgrpPortSampling	Yes/No	Port sampling, merchant bills used?
RgrpFisheryIndep	Yes/No	Fishery-independent data used?

Figure 2.2.1.2 By-catch database; fields and data types of the PUBLICATIONS table.

PUBLICATIONS

Field Name	Data Type	Description
Pub#	AutoNumber	
1stAuthor#	Number	Refers to PERSONS record#
2ndAuthor#	Number	Refers to PERSONS record#
MoreAuthors	Yes/No	Indicates 'et al'. Tick when > 2 authors
PubYear	Number	Year of publication
PubTitle	Memo	Full printed title
PubSeriesAbbrev	Text	Refers to abbreviation field of PUBLICATIONseries
PubVol&pp	Text	lume, part, and pages in publication
PubAbstract	Memo	Full abstract paste
WebAddress	Hyperlink	URL to location of report text or, if unavailable, email address of contact author
PubProject#	Number	refers to PROJECTS record#
ObserverEffort	Number	Refers to refOBSVReffort record #

Figure 2.2.1.3 By-catch database; fields and data types of the RESULTS table.

RESULTS

Field Name	Data Type	Description
Result#	AutoNumber	Unique record #
ResResultGrp#	Number	Refers to record # in RESULTgroups table
ResYearIncrement	Number	Time increment in years.decimal from RgrpStartYear of header record in RESULTgroups
ResNfish	Number	Number of fish to which measure applies
ResSpecies	Text	Refers to ICCAT species code in refSPECIES
ResGender	Text	M=male, F=female, blank=unknown
ResMeasure	Number	Refers to record # in refMEASURES
ResValue	Number	Value of measure in originally recorded units
ResUnits	Number	Refers to record # in refUNITS
ResAlive	Text	Tick if discarded alive
ResAnimal#	Number	1st RESULTS record # of the same animal (or animals) to allow correlation of variables

Figure 2.2.1.4 By-catch database; fields and data types of the PROJECTS table.

PROJECTS

Field Name	Data Type	Description
Project#	AutoNumber	Unique record #
ProjName	Text	Full official name of project
ProjAbbrev	Text	Usual abbreviated name; OP = observer program
ProjStart	Number	Year of start of project
ProjFinish	Number	ar of end if definitely finished. Must be >= ProjStart
ProjObjectives	Memo	Objectives in free form text
ProjResearch	Yes/No	Tick if known to be a special research project, not routine monitoring
ContactPerson	Number	Reference to PERSONS record #

Figure 2.2.1.5 By-catch database; fields and data types of the PERSONS table.

PERSONS

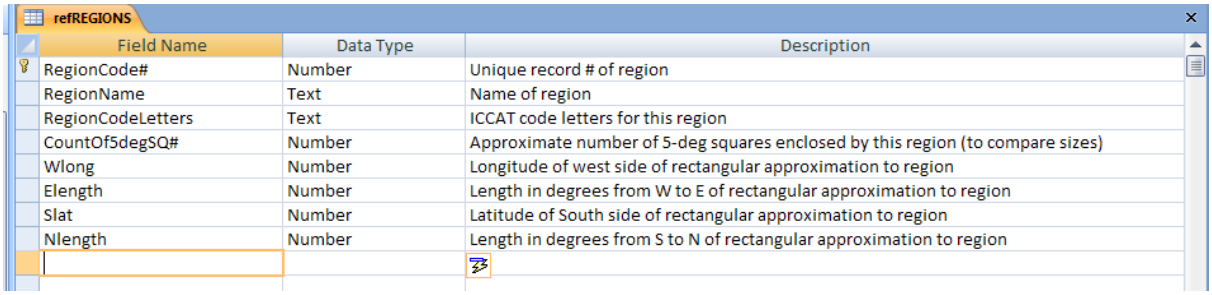
Field Name	Data Type	Description
Person#	AutoNumber	Unique record #
LastName	Text	
Initials	Text	
PersTown	Text	Town where person works
PersCountry	Number	Country where town is

Figure 2.2.1.6 By-catch database; fields and data types of the refSPECIES table.

refSPECIES

Field Name	Data Type	Description
SpeciesCode	Text	3-letter ICCAT code for species
SpGroup	Text	Vertebrate group to which species belongs
SciName	Text	Scientific name (excluding sub-species)
English	Text	Common English name for species
Francais	Text	French name for species
Español	Text	Spanish name for species
REMARKS	Text	Remarks (mostly left from original ICCAT file)
SpeciesID#	Number	Reference number for species (mostly left from original ICCAT file)

Figure 2.2.1.7 By-catch database; fields and data types of the refREGIONS table.



refREGIONS

Field Name	Data Type	Description
RegionCode#	Number	Unique record # of region
RegionName	Text	Name of region
RegionCodeLetters	Text	ICCAT code letters for this region
CountOf5degSQ#	Number	Approximate number of 5-deg squares enclosed by this region (to compare sizes)
Wlong	Number	Longitude of west side of rectangular approximation to region
Elength	Number	Length in degrees from W to E of rectangular approximation to region
Slat	Number	Latitude of South side of rectangular approximation to region
Nlength	Number	Length in degrees from S to N of rectangular approximation to region

2.2.2 Handling geographic regions and time periods at different scales

A particular problem for a database applying to the whole of the ICCAT area is the varying geographic and temporal scales of investigations giving rise to by-catch results. At one extreme, results are reported for precise point co-ordinates in space and time. At the other, results are reported in groups associated generally with large regions such as the 'Atlantic Ocean' or the 'Mediterranean', and with time periods that may be years long. A further complication is that scientists refer to regions and sub-regions, e.g. the Ligurian Sea within the Mediterranean Sea. A straightforward search for results using the keyword 'Mediterranean Sea' would not find those stored for 'Ligurian Sea', nor vice versa.

To get around these problems, a general system for searching for results geographically was implemented in the By-catch database. All results are stored on the By-catch database with an associated geographic rectangle just big enough to contain them (as in ICCAT's T2CE database, see §4.3.1). The rectangle is specified using longitude and latitude degrees. For point results, a small rectangle, say 1°x1°, is used. For grouped results, a larger rectangle, not necessarily a square, is used. For results associated only with a named region, the default rectangle approximating that region is read from the refREGIONS table (figure 2.2.1.7). As an example, the default rectangle approximating the Mediterranean Sea is shown in figure 2.2.2.1. Due to the actual shape of the Mediterranean, it is slightly flawed by including small parts of Biscay and the Black Sea. To improve accuracy, the user may override the default rectangle by specifying other longitudes and latitudes. Of course, inclusion of land is not a problem since no fisheries results are expected from there.

Having stored results in this way, a general search for results geographically can be made by specifying a search rectangle to span the region of interest. Any size or location can be chosen for the search rectangle. There is then a choice of two search methods:

i) Overlapping method: retrieve all results contained within rectangles that enclose or touch the search rectangle.
ii) Enclosing method: retrieve only those results contained within rectangles that are totally within the search rectangle.

Fig. 2.2.2.2 explains these two methods diagrammatically. For a practical example, with method (i), a search rectangle located over the Ligurian Sea would produce results associated with 'Ligurian Sea' or with 'Mediterranean', but not those associated with 'Adriatic Sea' or 'Ionian Sea' because,

although they are part of the Mediterranean, they do not overlap the Ligurian Sea. With method (ii), the same search rectangle would only produce results from within the Ligurian Sea region.

Mention should also be made of a simplification that has been applied to the ICCAT system of locating results using named quarters arranged around 0° N and 0° E. In the By-catch database, longitudes west of the Greenwich Meridian (0° E) are specified as negative numbers, and those east as positive. Similarly, latitudes south of the Equator (0° N) are specified as negative numbers, and those north as positive. This natural mathematical method unifies all global co-ordinates and greatly simplifies programming with geographic structures that may span the equatorial or meridian lines.

The method for dealing with different types of time specification in the By-catch database is a one-dimensional version of the geographic system. Instead of a rectangle, a period is specified in years for a group of results. Depending on how the results are reported in the original source, each result may either be associated with the whole of that period, or it may be assigned a year increment measured from 1 January of the starting year of the period. Suppose for example that the period starts in 1996 and ends in 2000. Results having no year increment specified are associated with the whole of that period, e.g. a mean value for the 5 years. A result having a specified year increment of, say, 1.5 is dated halfway through 1997, i.e. 1996 + 1.5 = 2 July 1997. This system allows time series to be stored if needed. A search period is used to retrieve results for overlapping or enclosed time periods with either the overlapping or enclosing methods. Fig. 2.2.2.3 explains this scheme diagrammatically.

Figure 2.2.2.1 By-catch database: approximating the Mediterranean region with a rectangle, here set at -5° and +35° longitude, 30° and 45° latitude, and shown with curved lines because of the cartographic projection of the map.

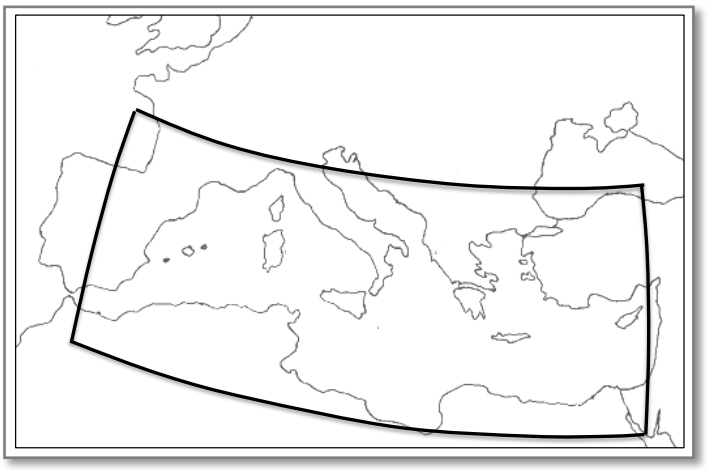


Figure 2.2.2.2 By-catch database: diagram to explain two methods for finding by-catch results geographically. Labelled rectangles enclose results. The search rectangle is dashed. (i) Overlapping search method will find all results in A, B, C and D. (ii) Enclosing search method will only find those in A and B.

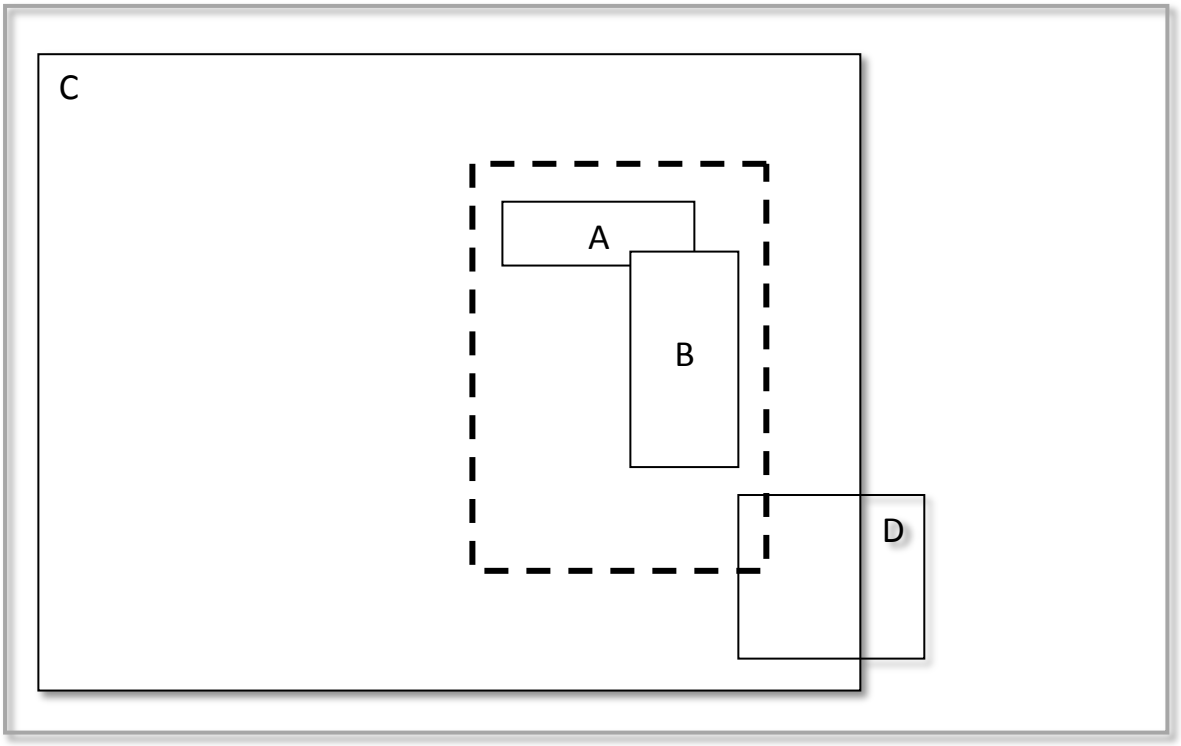
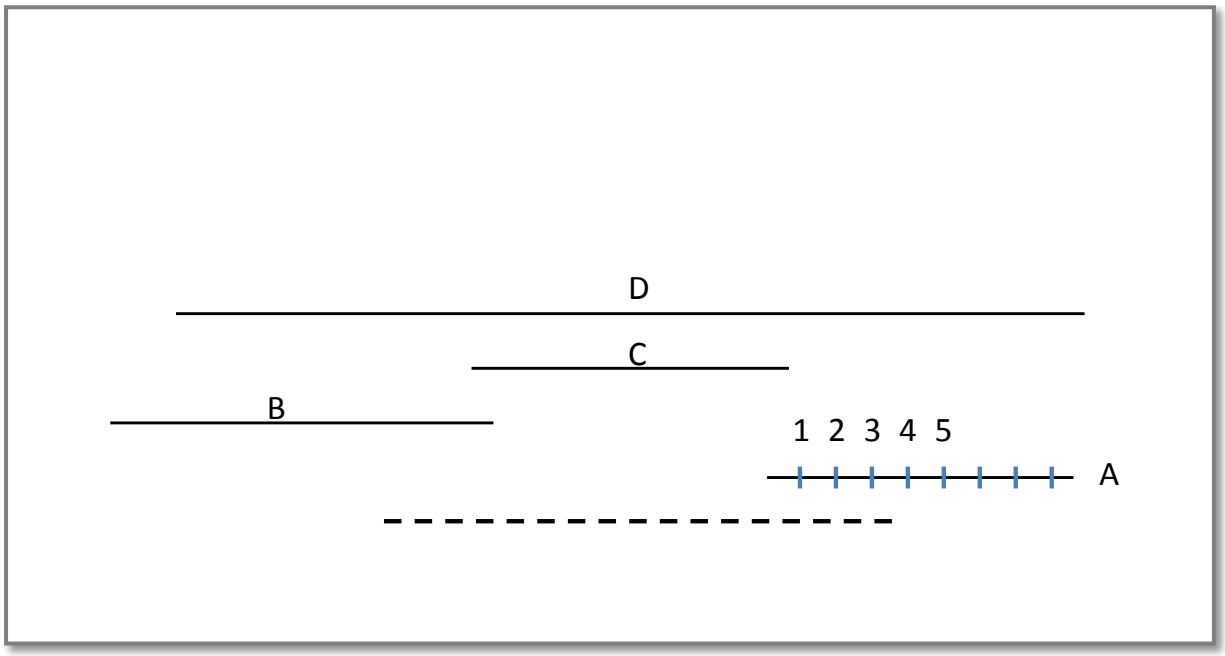


Figure 2.2.2.3 By-catch database: diagram to explain two methods for finding by-catch results for a time period measured from left to right. The search period is dashed. Period A holds a time series of results specified by time increments, 1, 2, 3, etc. (i) Overlapping search method will find results in A1, A2, A3, B, C and D. (ii) Enclosing search method will only find A1, A2, A3 and C.



2.2.3 Keywords for PUBLICATIONS

Retrieval of archived PUBLICATIONS from the By-catch database may use drop-down menus of keywords. They are not those originally assigned by the authors because a list of all of these is extremely long, and a more consistent keyword system can be applied retrospectively from a small set designed to be mutually exclusive in meaning, yet inclusive of all topics. In this way, it is hoped to minimise the number of papers that are archived but seldom found or, conversely, found when not wanted. New keywords must occasionally be added to the standard lists for unforeseen types of research; if necessary, those assigned to previously archived papers should be revised to ensure consistency. Re-assigning keywords is extra work for the archivist if not an author of the paper. Possibly in future, authors could pick their own keywords from a short, standard tick list, particularly for ICCAT CVSP publications.

Two types of keyword have been used for PUBLICATIONS, one describing 'Study topics', the other describing 'Co-variables' as set by researchers. The first group categorises the reported properties of fish, marine organisms, or other topics of study, while the second categorises variables observed or manipulated experimentally for their possible explanatory powers. For example, gender is a biological study topic (sex ratio) when the numbers of males and females occurring in a catch are counted and measured, but it is a manipulated co-variable when a length composition is measured on chosen fixed numbers, say, of 100 males and 100 females separately. Location, season, year, and

variants of fishing gear are other typical co-variables. Users can thus retrieve reports by the research topic, or by the experimental design used. The numbers of keywords were deliberately been kept small so that users may feasibly familiarise themselves with them and find the best ones with minimal delay. They are named in the military style, i.e. main word first, descriptors second, so that related keywords appear together in the alphabetically sorted drop-down menus. The lists of keywords available are shown in figures 2.2.3.1 and 2.2.3.2.

Users will notice that the PUBLICATIONS table stores no keywords specifically for basic qualifiers such as species, regions, and fishing gear. To add these keywords, a PUBLICATION record must be associated with a RESULTGROUPS record where these qualifiers can be stored. This is done with the the form 'addByCatchRESULTS' as described in §2.3 below. In this way, it is not necessary to add such keywords twice, once for the PUBLICATION and once for any RESULTS associated with it.

Figure 2.2.3.1 By-catch database: list of 'Study topics' keywords used for by-catch PUBLICATIONS.

TopicCode	TopicName
B.AGE	Biol: Age compositions
B.BEHAV	Biol: Behaviour
B.CON	Biol: Body condition indices
L.AVG	Biol: Body length/size
B.ECOL	Biol: Ecology
B.EC.BDIV	Biol: Ecology: Biodiversity
B.FOOD.W	Biol: Ecology: Food web/trophic levels
B.EC.HAB	Biol: Ecology: habitat
EC.INDIC	Biol: Ecology: indicators
B.EC.POL	Biol: Ecology: Pollution
B.FEED	Biol: Feeding
GEN.AN	Biol: Genetic analysis
B.LIFE.H	Biol: Life history study
B.PATH	Biol: Pathological study
REP.FEC	Biol: Reproduction: Fecundity
REP.S.GON	Biol: Reproduction: Gonad indices
REP.HIST	Biol: Reproduction: Histology
REP.LARV	Biol: Reproduction: Larval/nursery areas
REP.LIT.N	Biol: Reproduction: Litter size
REP.MAT.ST	Biol: Reproduction: Maturity stage
REP.SEX.RA	Biol: Reproduction: Sex ratio
REP.S.MAT	Biol: Reproduction: Size at maturity
REP.SP.PER	Biol: Reproduction: Spawning
B.SENS	Biol: Sensory study
L.GRO	Biol: Size: growth
L.COMP	Biol: Size: Lengths
L.W.REL	Biol: Size: Length-weight relationship
W.CF	Biol: Size: Weight conversion factors
W.COMP	Biol: Size: Weight: frequency distribution
W.AVG	Biol: Size: Weights
B.SP.ABUN	Biol: Species abundances
B.RISK	Biol: Species extinction risk/threat
SP.ID	Biol: Species identification aids
SP.ID.DET	Biol: Species lists
SP.PROP	Biol: Species proportions by weight or N
SP.ABUN	Biol: Species relative quantities
B.STOM	Biol: Stomach contents
B.SW.DP	Biol: Swimming patterns
DIS.MITIG	Fishing: By-catch: mitigation measures
DIS.MODEL	Fishing: By-catch: modelling
DIS.Q	Fishing: By-catch: quantities
DIS.RATE	Fishing: By-catch: rates
DIS.SURV	Fishing: By-catch: release & survival
C.MODEL	Fishing: Catch: modelling
C.Q	Fishing: Catch: quantities
CPUE.ST	Fishing: Catch: rates, standardized
CPUE	Fishing: Catch: rates, unstandardized
DIS.JUV	Fishing: Discarding of juveniles
F.EC.LAB	Fishing: Eco-labelling
FSHY.INT	Fishing: interactions with gear
FSHY.MGMT	Fishing: management
FSHY.MG.EC	Fishing: Management: Ecosystem-based
F.SPATIAL	Fishing: Spatial distribution of effort
GEOG.DIST	Geogr: distribution of population
GEOG.TAGS	Geogr: migrations by tagging
GEOG.AGE	Geogr: seggregation by age or maturity
GEOG.GEN	Geogr: seggregation by gender
GEOG.SIZE	Geogr: seggregation by size
GEOG.SPN.G	Geogr: spawning/nursery grounds
P.DYN	PopDyn: dynamics modelling
P.INTR.R	PopDyn: intrinsic rate of increase
B.MORT	PopDyn: Mortality rates, M, Z, F
SOC.ECON	Socio-economics:
STATS.DBS	Stats: databases
STATS.OBS	Stats: observer surveys
STATS.SIM	Stats: simulation method

Figure 2.2.3.1 By-catch database: list of 'Co-variable' keywords used for by-catch PUBLICATIONS.

CovarCode	CovarName
BIOL.ABUN	Biological: abundance
BIOL.AGE	Biological: age class
BIOL.ALG	Biological: algal bloom
BIOL.GEND	Biological: Gender/Sex
BIOL.HAB	Biological: Habitat
BIOL.L.CLASS	Biological: Length class
BIOL.LIT	Biological: literature review
FSHY.BAIT	Fishing: Bait type/colour
FSHY.PREV	Fishing: by-catch reduction measures
FSHY.DEP	Fishing: Depth of Fishing
FSHY.E	Fishing: Effort
FSHY.FAD	Fishing: FAD presence/absence
FSHY.FFE	Fishing: Fish Finding Equipment
FSHY.GEAR	Fishing: Gear variant or type
FSHY.GHOST	Fishing: Ghost fishing by lost gear
FSHY.HOOK	Fishing: Hook/leader type
FSHY.LINE	Fishing: Length of line
FSHY.LTSK	Fishing: light sticks present/absent
FSHY.FLAG	Fishing: Nationality of vessel
FSHY.OBPR	Fishing: Observer present/absent
FSHY.SMT	Fishing: Seamount presence/absence
FSHY.SOAK	Fishing: Soak time
FSHY.TGSP	Fishing: Target Species
FSHY.TA.CL	Fishing: Time-Area Closure
FSHY.BOAT	Fishing: Vessel Identity
FSHY.V.SIZ	Fishing: Vessel Size
GEOG.LAT	Geogr: Latitude
GEOG.LOC	Geogr: Location/Region
PHYS.CL	Physical: climate
PHYS.DEP	Physical: Depth of Water
PHYS.ENV	Physical: Environmental factors (various)
PHYS.HYDRO	Physical: Hydrographic
PHYS.LIGHT	Physical: Light
PHYS.POLL	Physical: Pollution
PHYS.REM	Physical: Remote sensing
PHYS.TAG	Physical: tagging technique
PHYS.TEMP	Physical: Temperature
PHYS.WTHR	Physical: Weather/sea state
SOC.ECON	Socio-economic variables
TIME.DAY	Time: Day or night
TIME.MOON	Time: Moon phase
TIME.SEAS	Time: Season/trimestre/month
TIME.YEAR	Time: Year

2.2.4 Design of the RESULTS table for versatility

Given the many types of results available for by-catch, the RESULTS table must be versatile. Fields in the RESULTS table are listed in figure 2.2.1.3. They were designed to allow storage of

- Time series. The ResYearIncrement field stores time values measured in years from the start year of the group of results, itself stored in the RESULTGROUPS table as the field, RgrpStartYear. Use of this field was described in §2.2.2.
- Measures of many sorts. The measure is identified precisely in the field, ResMeasure. A name is entered from the drop-down list shown in figure 2.2.4.1. The measures themselves are grouped to allow searching for groups of related measures. These are shown in figure 2.2.4.2 taken from refMEASURES. The value of the measure is stored in the ResValue field.
- Units of many sorts. The unit is identified in the field ResUnits. These are listed in figure 2.2.4.3 taken from refUNITS. Each unit has a conversion factor which differs from 1 if it is not a standard metric unit. The name of the standard unit also has a field for use when units are converted. Units help to define the measure. For example 'Fishing: discards' is a quantity if units are N or kg, but is a rate if units are N/1000 hooks.
- Qualifications describing the measured values: by species (ResSpecies), gender (ResGender), and whether or not the animal(s) was (were) discarded alive (ResAlive).
- The numbers of animals contributing to the RESULT record (ResNfish). This last field serves to indicate the reliability of averages or other summary statistics, and can also be used for storing length or age compositions. It should not be used when the measure itself is a number because it would not then be printed out in the same field as other results.
- The record number of the first record for a certain animal (ResAnimal#). This is intended to allow different records referring to the same animal to be correlated.

In practice, few of the measures stored in the RESULTS table need qualification by variables other than ResSpecies, ResGender, ResAlive and ResNfish. If they do, a common reason is because the conditions of fishing have been manipulated in some way for experimental reasons. In that case, the results are not typical of by-catch taken by vessels operating normally and they should therefore be excluded from the RESULTS table in case they mislead. Publications reporting this type of research may, nevertheless, be located using the 'Co-variables' keyword stored in the PUBLICATIONS table.

Few results for individual animals came forward during the project. The arrangement for relating multiple results to the same animal using ResAnimal# seemed therefore to be satisfactory since vectors can easily be created from data retrievals using a spreadsheet. The alternative would be to have an additional ANIMALS table in the database allowing storage of vectors for each one but that complication did not seem warranted.

Figure 2.2.4.1 By-catch database; measures used in the RESULTS table. See also fig. 2.2.4.2

Measure#	Measure id	Measure	Measure group
4	AGE	Biol: Age: individual fish	3
29	Amat	Biol: Age@maturity	6
40	LCC	Biol: Length: carapace over shell	1
13	CLKL	Biol: Length: cleiteron to keel	1
9	CFL	Biol: Length: curved fork	1
11	CPFFL	Biol: Length: curved pectoral fin to fork	1
38	L.DISK	Biol: Length: disk width	1
15	INT-DR	Biol: Length: inter dorsal	1
2	LD1	Biol: Length: lower jaw to 1st dorsal fin	1
6	LJFL	Biol: Length: lower jaw to fork	1
14	OPKEEL	Biol: Length: opercule to keel	1
10	PAL	Biol: Length: pectoral fin to anus	1
7	EYF	Biol: Length: posterior edge of eye sockedt to fork	1
67	PreAnFin	Biol: Length: pre-anal fin length	1
1	FL	Biol: Length: snout to fork	1
32	FL0	Biol: Length: to fork	1
12	TLE	Biol: Length: total	1
44	Lunspec	Biol: Length: unspecified measure	1
49	LvBLk	Biol: Length: von Bertalanffy K	1
48	Linf	Biol: Length: von Bertalanffy L infinity	1
50	LvBLt0	Biol: Length: von Bertalanffy t0	1
26	LJFLmat	Biol: Length@maturity, lower jaw to fork	6
23	FLmat	Biol: Length@maturity, snout to fork	6
33	AGC	Biol: LengthWeight: allometric growth coeff.	1
34	AGP	Biol: LengthWeight: allometric growth power	1
66	B.R.gest	Biol: Repro: gestation period	
47	GSI	Biol: Repro: gonad-somatic index	6
64	B.R.Juv	Biol: Repro: juveniles per adult	6
57	R.mat	Biol: Repro: mature	6
58	R.spawn	Biol: Repro: spawned or spent	6
63	B.stom.con	Biol: Stomach contents	9
68	B.stom.ind	Biol: Stomach contents, individuals eaten	9
59	B.stom	Biol: stomachs empty	9
3	WGT	Biol: Weight: fresh fish	2
16	HGTW	Biol: Weight: head and gutted fish	2
37	DvFW	Biol: Weight: ratio dressed to total fin weight	2
36	RvFW	Biol: Weight: ratio round to total fin weight	2
56	C.AlAl	Fishing: Catch: alive alongside	4
27	C.NY	Fishing: Catch: number, total	4
19	C.FAD	Fishing: Catch: occurrence, FAD	4
20	C.FS	Fishing: Catch: occurrence, free school	4
18	CPUE.ST	Fishing: Catch: per unit effort, standardized	4
24	CPUE.UN	Fishing: Catch: per unit effort, unstandardized	4
61	C.prop+Tr	Fishing: Catch: positive trips	4
17	PresAbs	Fishing: Catch: Presence-absence	4
55	C.FADunass	Fishing: Catch: ratio FAD assoc: unassociated	4
54	C.ShDp	Fishing: Catch: ratio shallow:deep	4
21	C.WT	Fishing: Catch: weight, total	4
35	C.JUV.DIS	Fishing: Discard of juveniles	4
39	C.DIS	Fishing: Discards	4
45	C.DIS.S	Fishing: Discards, survival of	4
53	G.distr	Geographic: distribution	8
65	G.tempMin	Geographic: low temperature boundary	8
30	Foverlap	Geographic: Range overlap with fishery	8
31	G.sight	Geographic: sighted	8
46	G.SPUE	Geographic: sightings per unit effort	8
62	POP.abun	Population: abundance	7
42	Atl%	Population: Atlantic/Elsewhere	7
41	NbreedPrs	Population: breeding pairs	7
43	CONstatus	Population: conservation status	7
60	POP.mkrc	Population: mark-recapture	7
28	M	Population: natural mortality rate	7
51	POP.r	Population: rate of increase, productivity	7
52	POP.sus	Population: susceptibility (PSA analysis)	7

Figure 2.2.4.2 By-catch database; groupings used for the measures shown in fig. 2.2.4.1

MeasureGroup#	MGname	MGkeyword
1	Length	Biological
2	Weight	Biological
3	Age	Biological
4	Catch	Fishing
6	Reproduction	Biological
7	Population	Population
8	Geographic	Geographic
9	Trophic	Biological

Figure 2.2.4.3 By-catch database; units variously used for the measures shown in fig. 2.2.4.1

Unit#	Units	UnitName	UnitConvFact	UnitStandard
19	%	percent	1	%
20	% by N	percent by number	1	% by N
28	% by Wt	percent by weight	1	% by Wt
10	% of sets	percent of sets	1	% of sets
15	/yr	per year	1	/yr
35	°C	degrees Centigrade	1	°C
1	cm	centimetres	1	cm
7	day	days	1	day
27	ft	foot	0.307	m
26	g	gramme	0.001	kg
6	hr	hours	1	hr
3	kg	kilograms	1	kg
21	kg/1000 hks	kg per 1000 hooks	1	kg/1000 hks
32	kg/set	kg/set	1	kg/set
33	kg/trip	kg/trip	1	kg/trip
4	lb	pounds	0.4536	kg
2	m	metres	1	m
25	mm	millimetres	0.1	cm
23	month	months	0.08333	yr
17	N	number	1	N
8	N/1000 hks	Number per 1000 hooks	1	N/1000 hks
18	N/day	Number per day	1	N/day
34	N/month	Number per month	0.08333	N/yr
14	N/vessel	number per vessel	1	N/vessel
13	N/yr	number per year	1	N/yr
9	no unit	no unit	1	no unit
30	Prob	probability	1	Prob
24	qtr	quarter	0.25	yr
16	rank(1lo,3hi)	rank(1=low,3=high)	1	rank(1lo,3hi)
11	rel. unit	relative units	1	rel. unit
29	sights/day	sightings/day	1	sights/day
12	t	metric tonnes	1	t
31	t/set	tonnes/set	0.001	kg/set
36	t/yr	tonnes/year	1	t/yr
22	Threat	Crit.end=1, endang=2,vuln=3, near-threatened=4	1	Threat
5	yr	years	1	yr

2.3 Data entry

A strength of the MS Access system is its flexibility for designing forms for manipulating records. Data entry forms were developed for all of the major data tables in the by-catch database. Drop-down menus are used to standardise the values put into fields and prevent typing errors and variable spellings. The forms are all split horizontally or vertically to show existing records in the form of a data sheet. These can be checked to see what information is already present in the table or to find a particular record, select it and edit it. The datasheets can be freely scrolled and sorted, and columns frozen for this purpose. MS Access automatically stores typing entered by the user in a field of a form after the cursor is moved on to a new field, so there are no buttons to actively store each record. A record that is started in error can usually be abandoned with any fields already stored by pressing [Esc].

The recommended way to start data entry is by double-clicking the form 'addByCatchRESULTS', see figure 2.3.1. A new RESULTGROUPS record is created and a unique number assigned automatically by Access. The user is then asked to fill the Project and Publication fields. Values may be selected from drop-down lists or, if the required values are not already present in the database, a nearby button is clicked to bring up the appropriate entry form for these types of record. See figures 2.3.2 and 2.3.4. The same system is used on the subordinate forms to supplement the drop-down lists of people (figure 2.3.3) and countries (not shown). Each form is closed when all new records have been added, and the user is taken back to the previous form. The new values will often now be visible in the drop-down lists but, if not, the [Refresh records] button on the Access ribbon is clicked.

More than one RESULTGROUPS record is linked with each publication or project whenever there is more than one group of results associated, e.g. if the publication reports measures on by-catches taken in different regions, at different time periods, or with different gear types. Clicking the button 'New result group, same header' will bring up a copy of the header record with a new RESULTGROUPS record number. It is only necessary to edit the one or two field values that change between groups. The records for different RESULTGROUPS of one publication or project may not be stored close together in the table. To find the different groups of results associated with one project or publication in adjacent rows, sort the data sheet on the project or publication fields.

Data for PUBLICATIONS or PROJECTS can also be entered without having to start with the addByCatchRESULTS form. The addPUBLICATIONS and addPROJECTS forms can be used directly by double-clicking on them. Note, however, that PUBLICATIONS that are not associated with RESULTGROUPS can only be retrieved with bibliographic criteria or keywords; they cannot be retrieved by searching for geographic regions, time periods, species, gear groups or other fields that are stored in the RESULTGROUPS table. This may be satisfactory for general review papers for example.

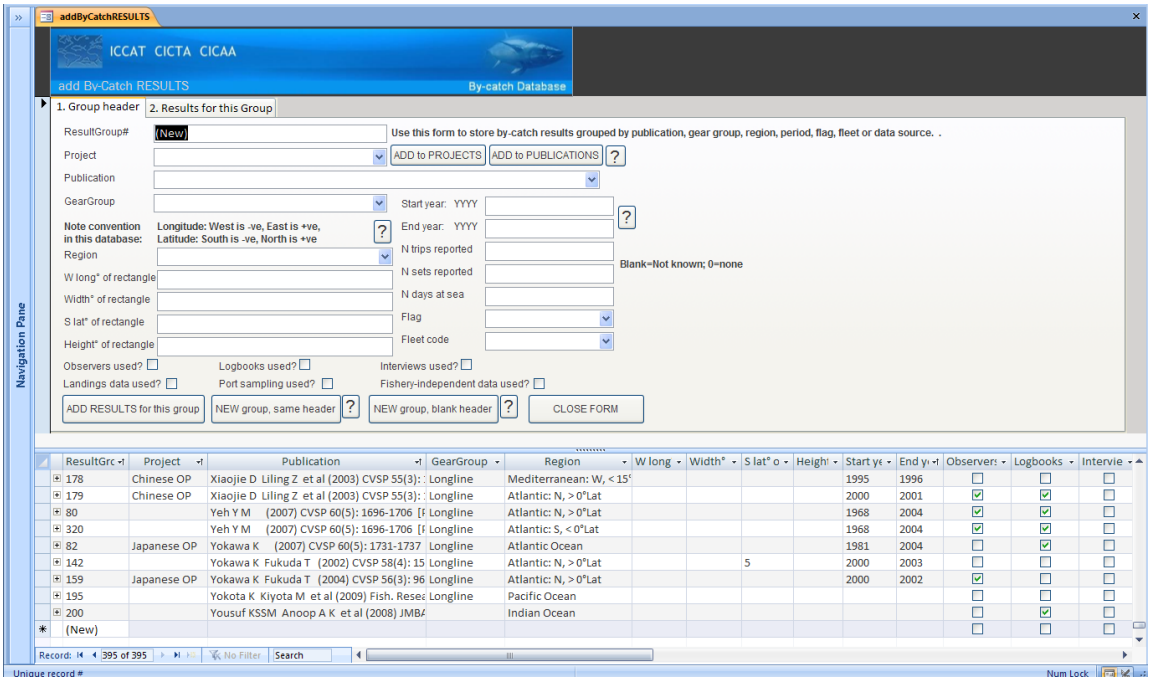
Any of the fields on these forms may be left blank if the information is not available to fill them. The convention used in this database is that blank = no information. However, blank fields are not selected during retrievals, meaning that the chances of the record being found successfully during searching are diminished. The entry 0 (zero) is treated as valid information, unlike a blank field.

Forms were not developed for most of the reference tables, e.g. for species codes, gear groups, etc. They should only occasionally require supplementing or altering which is done by typing directly into

the MS Access data sheet. Users are asked to take care that reference values are spelt perfectly and do not have overlapping or vague meanings that would degrade the retrieval accuracy of the database.

Figure 2.3.1 By-catch database; data entry split form for by-catch results. Lower part shows existing records for sorting and scrolling. Down arrows in small blue boxes show drop-down lists. Question marks provide local help. Labelled buttons enable addition of projects or publications, repetition of the header record to create a new group, creation of a new, blank header record, and closure of the form. Tabs are at the top left under the banner. (a) Tab 1, Group header, here unfilled; (b) Tab 2, Results for the group, in this case a time series for Atlantic blue marlin.

a) Tab 1



b) Tab 2

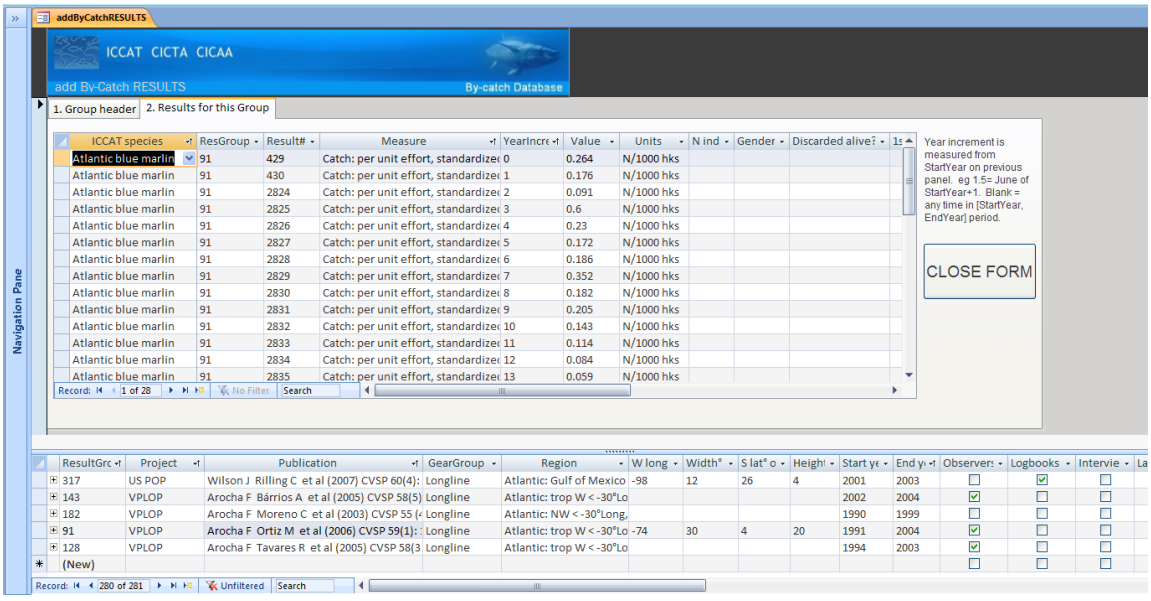
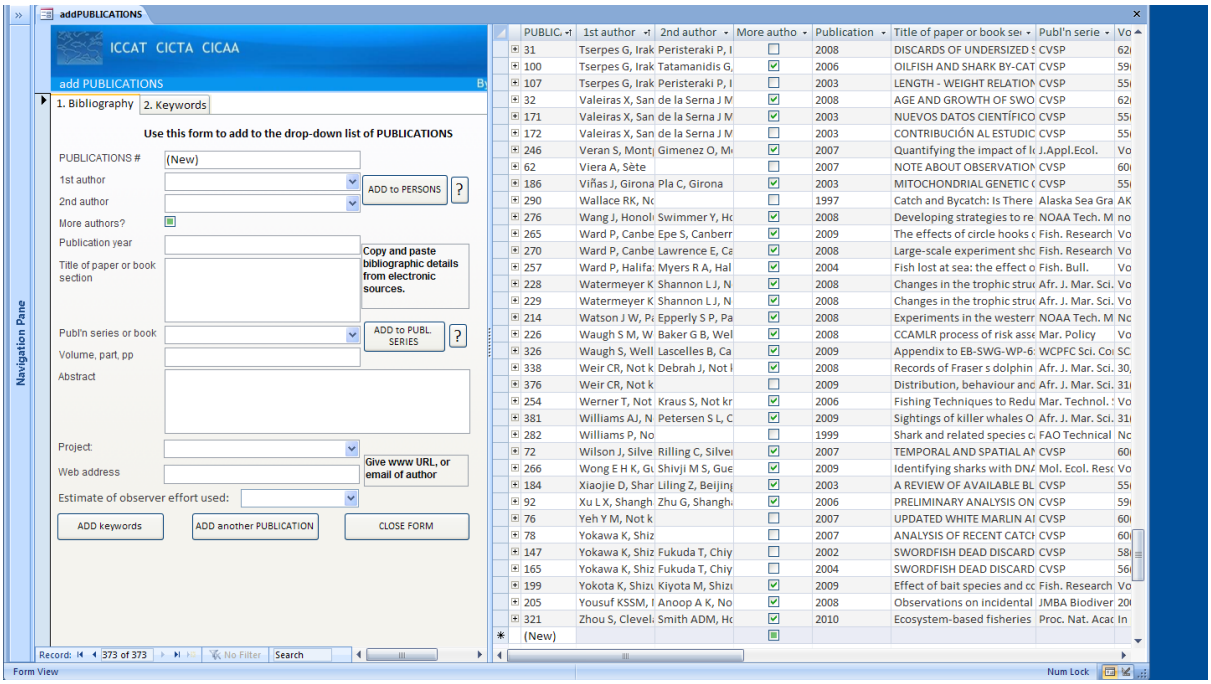


Figure 2.3.2 By-catch database; data entry split form for publications. Right side shows existing records for sorting and scrolling. Labelled buttons enable addition of persons or publication series, and easy transfer to the Keywords tab. Other details as in fig. 2.3.1. (a) Tab 1, Bibliographic form, here unfilled; (b) Tab 2, Keywords form, here with example data.

a) Tab 1



b) Tab 2

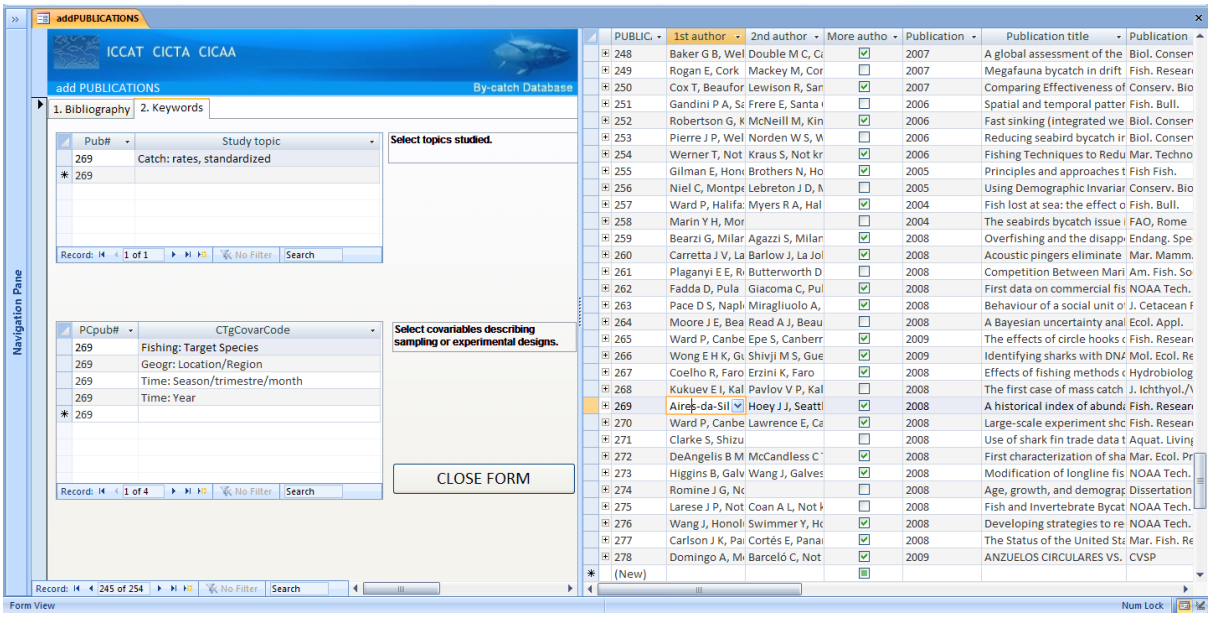


Figure 2.3.3 By-catch database; data entry split form for persons. Right side shows existing records for sorting and scrolling. Other details as in fig. 2.3.1.

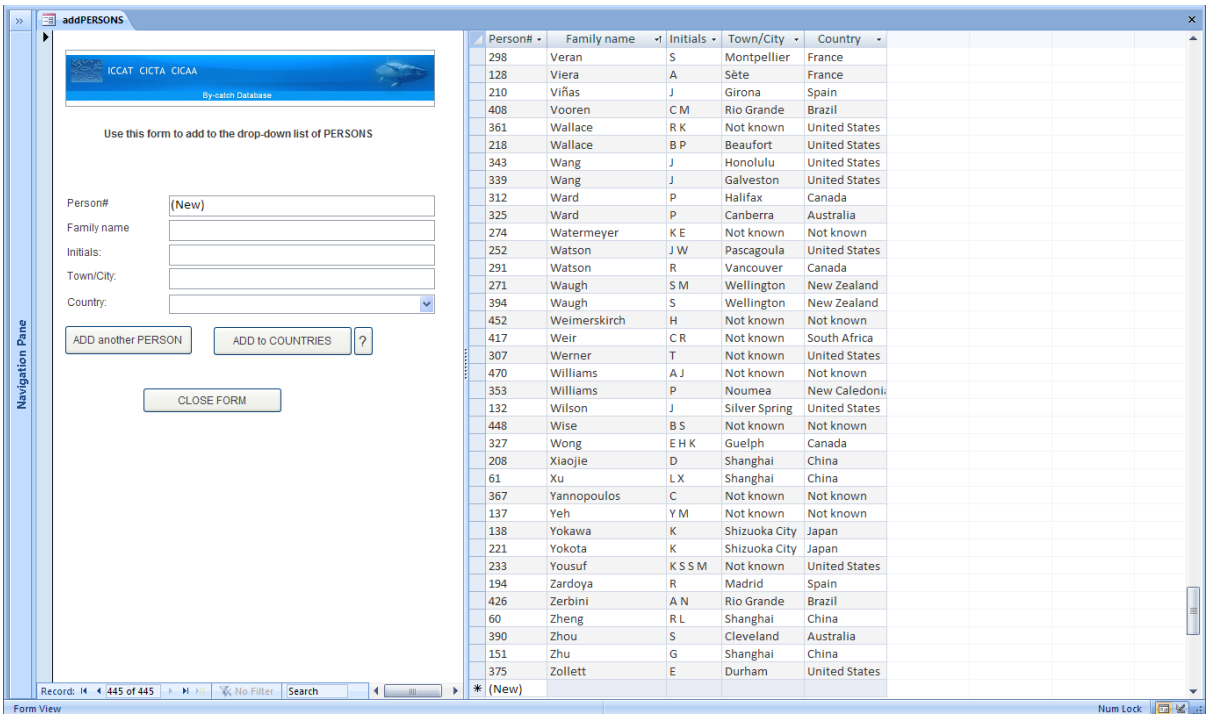
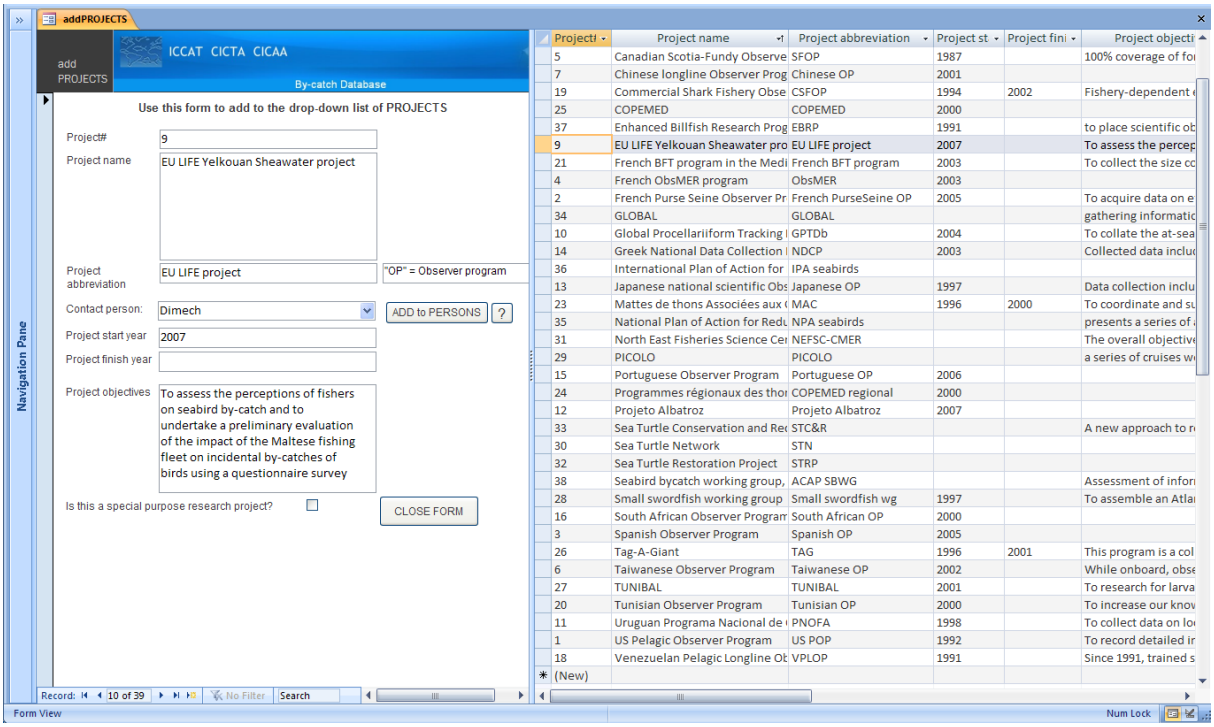


Figure 2.3.4 By-catch database; data entry split form for projects. Right side shows existing records for sorting and scrolling. Other details as in fig. 2.3.1. Record 9 is selected here.



2.4 Data retrievals

Access allows users to write their own 'queries' for retrievals of data records complying with given criteria. However, many will find general-purpose retrieval forms more convenient. Two were written for the By-catch database: one retrieves PUBLICATIONS, the other retrieves RESULTS; in both cases they must conform with criteria set by the user. Instructions for use are included in the database. The following is a brief summary.

Note: For security reasons, Access 2007 will not let you run retrievals (written in Visual Basic) unless 'macros are enabled', and the By-catch database may therefore cease to function at the opening screen (illustrated with an albatross). Users are required to (1) "Trust" the signature on the database, i.e. FishWorldScience Ltd, and (2) store the database in a "trusted" folder. Both involve the Access "Trust Center" available via the coloured Microsoft Office button (top left of screen), then Access options (bottom right of resulting window). Fuller details are given in the ReadMe file distributed with the signed database.

2.4.1 Retrieving by-catch publications

The form for retrieving publications is shown in figure 2.4.1.1. It retrieves all PUBLICATIONS and associated RESULTGROUPS records that comply with the criteria set. Output is in the form of a formatted Access report. Notes: (i) If a wide year range is chosen and no other criteria are set, the complete table of publications will be retrieved (which wastes time). (ii) Very restrictive criteria will yield no publications. (iii) PUBLICATIONS associated with more than one RESULTGROUPS record will be repeated for each RESULTGROUPS record. This is because each is likely to show a difference, e.g. a different region, gear group, or species.

Only a year range must be set on the PUBLICATIONS retrieval form. The default range includes publication dates from 1900 to the present year, i.e. all available papers in the database. The geographic region is chosen from named regions. The user should check the radio button to indicate whether publications referring to all overlapping regions, or only enclosed regions should be retrieved. This is explained more fully in §2.2.2.

The animals of interest can be selected by specifying a single species. Typing in the start of the English name, if known, will bring up the rest of the name. If it is not known, the drop-down box reveals all species in alphabetical order of scientific names. This arrangement is useful if one knows the English or the scientific name but not both. Animals of interest can also be selected by specifying a group from the drop-down box to the right.

Keywords may be selected in the 'Study topic' and 'Co-variables' box if required. The flag of the fishing fleet may also be set as a retrieval criterion.

The last box on the retrieval form allows users to insert fragments of the bibliographic string including parts of the names of the first two authors, the publication year in brackets, the name of

the journal, or the volume and pages. No quotes are used. Note that accented letters must also be accented in the search string.

An example of a retrieved publication for yellow-nosed albatross is shown in figure 2.4.1.2. The most recent publications are shown first. Output includes bibliographic information in bold, the title underlined, the abstract, a web or email address for obtaining the publication, details from the RESULTGROUPS record including region, gear group, the years spanned by results, the PROJECT, the flag of the fleet, all assigned values of keywords, and all species reported on.

Microsoft designed Access reports to be printed directly. Saving them to a file in the format shown is less straightforward. For figure 2.4.1.2, the [Print Screen] key on the computer was used to save screen images to the clipboard. These can then be pasted into a word-processing package. Alternatively, Access reports can be printed using a '.pdf printer' that can be freely downloaded from the internet. It installs itself into the list of available printers but creates .pdf files rather than a printed image.

2.4.2 Retrieving by-catch results

The form for retrieving by-catch results is shown in figure 2.4.2.1. It retrieves all RESULTGROUPS and associated RESULTS that comply with the criteria set. A bibliographic reference and project names are also included in the output. Output is in the form of a datasheet that can be selected [click in top left corner], then copied and pasted into Excel for editing and further processing.

A year range must be set on the RESULTS retrieval form. It restricts retrieval of records according to the date associated with each. A wide default range is shown when the form is first loaded. The radio buttons on the right allow reduction of the number of RESULTS records retrieved by specifying that all periods associated with results must be enclosed within the year-range set. This is explained more fully in §2.2.2.

The region is chosen by specifying a search rectangle with longitude and latitude degrees, remembering to set degrees west and degrees south as negative values, as is the convention in this database. The diagrammatic globe on the right of the form may be helpful for approximating large regions. The user should check the radio button to indicate whether publications for all overlapping regions, or only those for enclosed regions should be retrieved. This is explained more fully in §2.2.2.

The animals of interest can be selected by specifying a single species, or a group, as for the showPUBLICATIONS form (§2.4.1). Similarly, the type of measure, the gear group, flag, and data sources may be specified if required. If not, all records meeting the time and regional criteria will be retrieved.

An example of retrieved results for the sandbar shark is shown split into 3 panels in figure 2.4.2.2. Some records may appear repetitive but a search along the line of each should reveal that at least one of the fields is different in every record.

Figure 2.4.1.1 By-catch database; retrieval form for PUBLICATIONS. Years are default values.

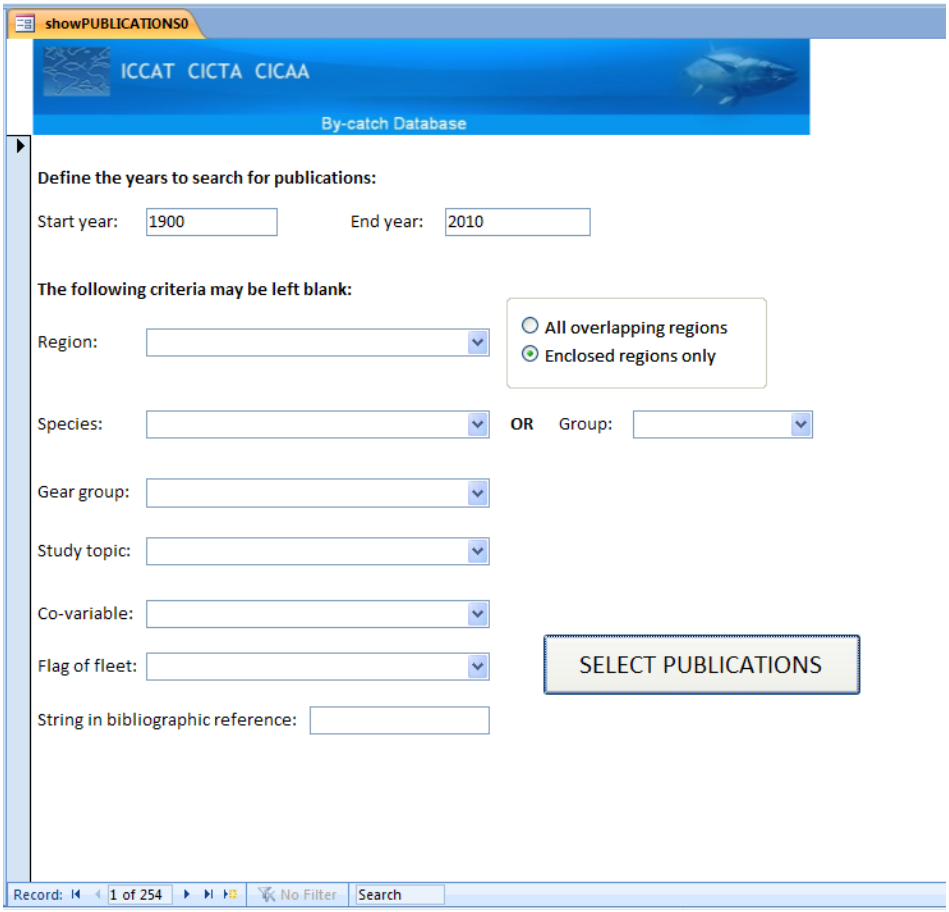
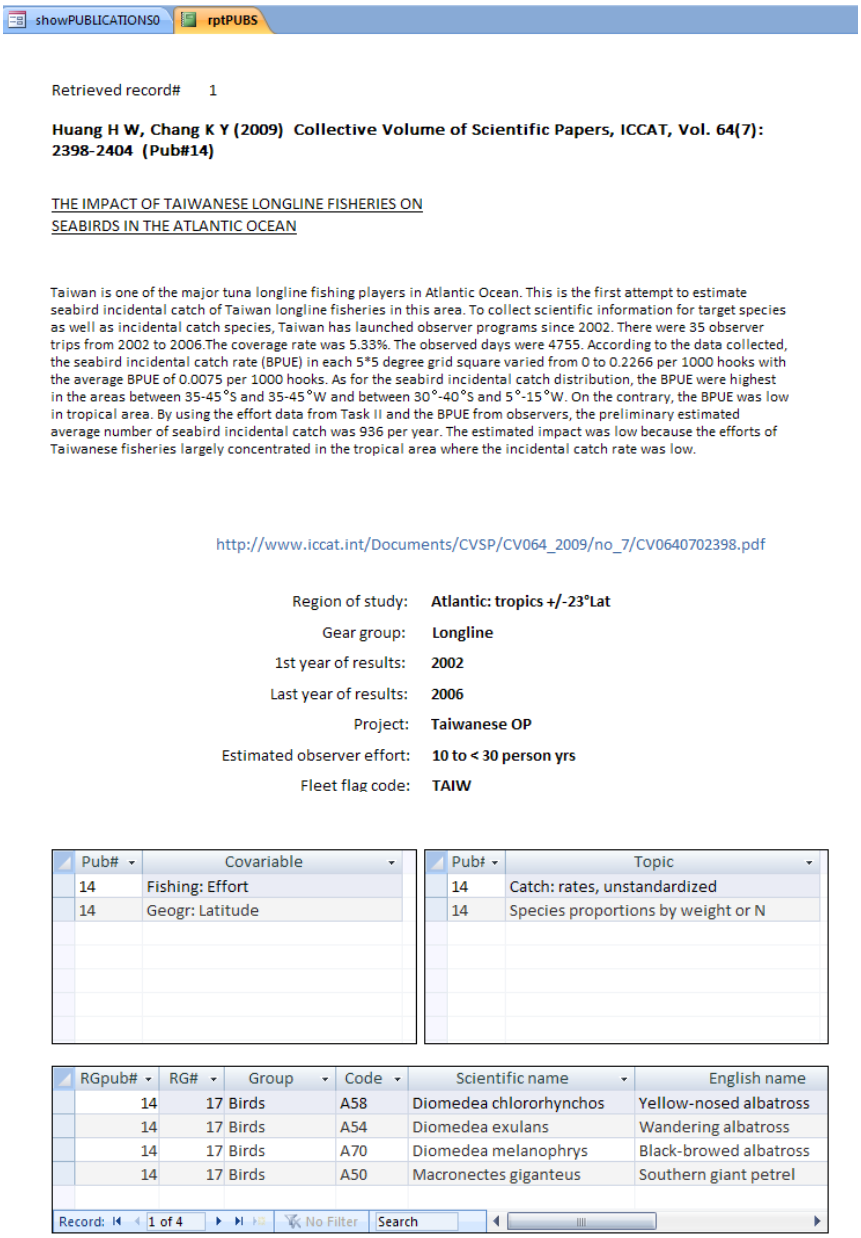


Figure 2.4.1.2 By-catch database; example of a report on PUBLICATIONS with results for the yellow-nosed albatross, 1st output record.



showPUBLICATIONS0 rptPUBS

Retrieved record# 1

Huang H W, Chang K Y (2009) Collective Volume of Scientific Papers, ICCAT, Vol. 64(7): 2398-2404 (Pub#14)

THE IMPACT OF TAIWANESE LONGLINE FISHERIES ON SEABIRDS IN THE ATLANTIC OCEAN

Taiwan is one of the major tuna longline fishing players in Atlantic Ocean. This is the first attempt to estimate seabird incidental catch of Taiwan longline fisheries in this area. To collect scientific information for target species as well as incidental catch species, Taiwan has launched observer programs since 2002. There were 35 observer trips from 2002 to 2006.The coverage rate was 5.33%. The observed days were 4755. According to the data collected, the seabird incidental catch rate (BPUE) in each 5*5 degree grid square varied from 0 to 0.2266 per 1000 hooks with the average BPUE of 0.0075 per 1000 hooks. As for the seabird incidental catch distribution, the BPUE were highest in the areas between 35-45°S and 35-45°W and between 30°-40°S and 5°-15°W. On the contrary, the BPUE was low in tropical area. By using the effort data from Task II and the BPUE from observers, the preliminary estimated average number of seabird incidental catch was 936 per year. The estimated impact was low because the efforts of Taiwanese fisheries largely concentrated in the tropical area where the incidental catch rate was low.

http://www.iccat.int/Documents/CVSP/CV064_2009/no_7/CV0640702398.pdf

Region of study:	**Atlantic: tropics +/-23°Lat**
Gear group:	**Longline**
1st year of results:	**2002**
Last year of results:	**2006**
Project:	**Taiwanese OP**
Estimated observer effort:	**10 to < 30 person yrs**
Fleet flag code:	**TAIW**

Pub#	Covariable
14	Fishing: Effort
14	Geogr: Latitude

Pub#	Topic
14	Catch: rates, unstandardized
14	Species proportions by weight or N

RGpub#	RG#	Group	Code	Scientific name	English name
14	17	Birds	A58	Diomedea chlororhynchos	Yellow-nosed albatross
14	17	Birds	A54	Diomedea exulans	Wandering albatross
14	17	Birds	A70	Diomedea melanophrys	Black-browed albatross
14	17	Birds	A50	Macronectes giganteus	Southern giant petrel

Record: 1 of 4 No Filter Search

Figure 2.4.2.1 By-catch database; retrieval form for RESULTS with period and rectangle criteria set.

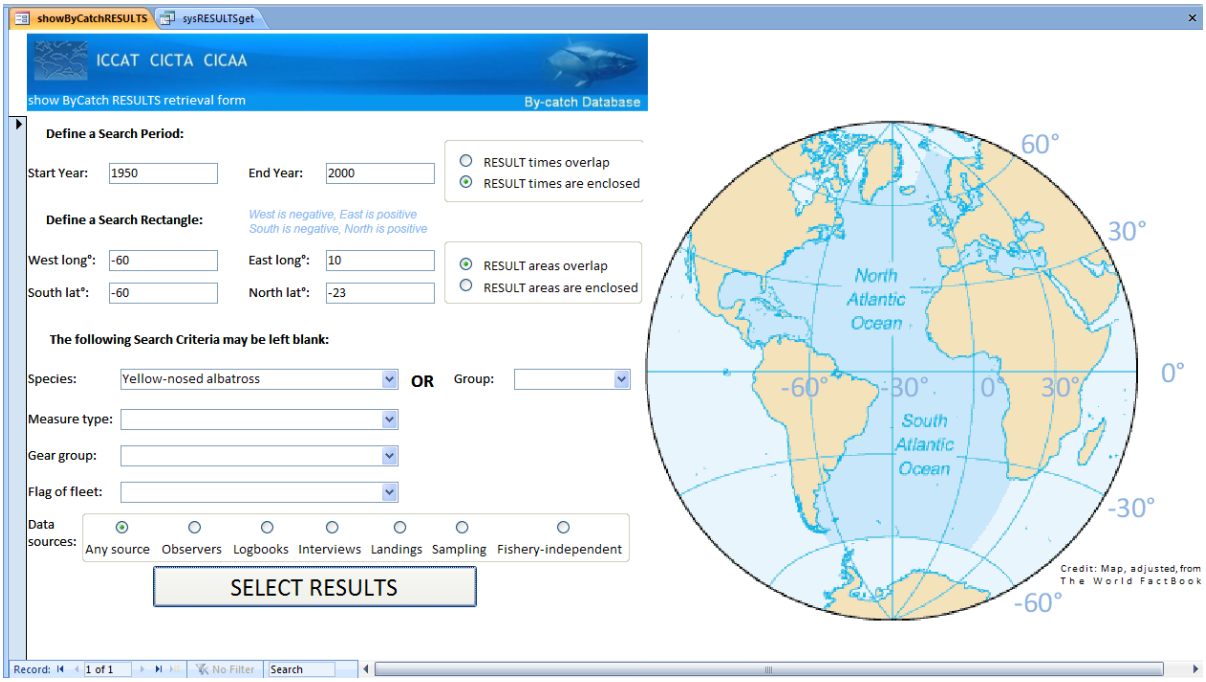


Figure 2.4.2.2 By-catch database; example of an output datasheet with results of all types for the sandbar shark caught anywhere. The long output records were subdivided into 3 panels to fit this page. Note the length distributions for male and females utilising the Nfish field. There was no information on the fate of the sharks, field DiscdAlive. The codes for Flag and Fleet are standard ICCAT codes.

showByCatchRESULTS | sysRESULTSget

ResultGroup	Result#	ProjAbbrev	Publication	GearGrp	Region	WestLong	EastLong	SouthLat	NorthLat	StartDate
73	287		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
99	468	PNOFA	Mora O Domir	LL	Atlantic: SW, < -30°Long, < 0°Lat	-60	-30	66	132	1998
108	664	CSFOP	Cortés E Neer	VS	Atlantic Ocean	-95	15	-66	66	1994
146	899	US POP	Beerkircher L F	LL	Atlantic: NW < -30°Long, > 0°Lat	-95	-30	0	66	1992
20	1631	Spanish OP	Mejuto J García	LL	Atlantic + Mediterranean	-60	15	-66	66	1997
73	2252		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2253		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2254		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2255		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2256		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2257		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2258		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2259		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2260		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2261		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
73	2262		Hazin F H V Ol	LL	Atlantic: trop W < -30°Long, +/-23°Lat	-35	-34	-10	-7	1994
108	3381	CSFOP	Cortés E Neer	VS	Atlantic Ocean	-95	15	-66	66	1994
(New)	(New)									

EndDate	ICCAT speci	SciName	SpGroup	Gender	Measure	MeasureGrp	ObsvdValue	Units
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	155	cm
2004	CCP	Carcharhinus plumbeus	Elasmobranchs		Catch: Presence-absence	Catching	1	no unit
2002	CCP	Carcharhinus plumbeus	Elasmobranchs		Weight: ratio dressed to total fin weight	Weight	5.34	%
2002	CCP	Carcharhinus plumbeus	Elasmobranchs		Catch: Presence-absence	Catching	1	no unit
2006	CCP	Carcharhinus plumbeus	Elasmobranchs		Catch: weight, total	Catching		kg
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	165	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	175	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	185	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	195	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	M	Length: total	Length	205	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	155	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	165	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	175	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	185	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	195	cm
1996	CCP	Carcharhinus plumbeus	Elasmobranchs	F	Length: total	Length	205	cm
2002	CCP	Carcharhinus plumbeus	Elasmobranchs		Weight: ratio round to total fin weight	Weight	2.55	%

N fish	Disc'd alive?	Animal	TripsObsvd	SetsObsvd	D@Sobsvd	ObsvrsUsed	LogBksUsed	InterviewsU	LandingsUse	PortSampUs	FisheryInde	Flag	Fleet
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
			43	918	1175	☐	☐	☐	☐	☐	☑	URY	042UY00
39						☑	☐	☑	☑	☐	☑	UNCL	999--99
						☑	☐	☑	☐	☐	☐	USA	025US01
						☑	☐	☑	☑	☑	☐	EC.ESP	021ES03
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
2						☐	☑	☐	☐	☐	☐	BRA	003BR01
3						☐	☑	☐	☐	☐	☐	BRA	003BR01
5						☐	☑	☐	☐	☐	☐	BRA	003BR01
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
0						☐	☑	☐	☐	☐	☐	BRA	003BR01
6						☐	☑	☐	☐	☐	☐	BRA	003BR01
10						☐	☑	☐	☐	☐	☐	BRA	003BR01
67						☑	☐	☑	☑	☐	☑	UNCL	999--99
						▣	▣	▣	▣	▣	▣		

2.5 Choice of publications and results for input to the By-catch database

Reports in the ICCAT Collective Volumes of Scientific Papers (CVSP) published from 2009 backwards were examined and those of potential interest to studies of by-catch or biology archived in the by-catch database. The many papers on stock assessment, management, and related issues concerning the principal target species were mostly excluded since they are not included in the term 'by-catch' and, for the most part, can be retrieved with the existing ICCAT Bibliographic database using the 'species' filter. However, the choice of papers for the by-catch database was not straightforward because some species may be targeted on some occasions but not on others, depending on regulations, gear, fishing method etc.. Where there was doubt, papers were mostly included, particularly those of biological interest.

Abstracts and summary information about relevant papers presented in the Aquatic Sciences and Fisheries Abstracts (ASFA) were also examined and many of direct relevance to oceanic fishery by-catches included in the By-catch database. They do not all refer to the Atlantic. ASFA is copyrighted by the Food and Agriculture Organization, Rome, so permission to cut and paste information was sought. A copy of the reply is attached at Annex 3. It was taken as acceptance of continuing use of ASFA for feeding the By-catch database. ASFA proved to be a rich source of useful papers, particularly those written by authors outside the ICCAT community of scientists. Other papers for inclusion in the By-catch database were sought in the contents lists of journals presented on the internet.

Many publications and reports include results suitable for transcribing into the By-catch database, especially those in the CVSP series because they frequently report original measurements made at sea. Many were added to the database. Exceptions were results given with inadequate descriptive information, those whose reliability was questionable – as with some cited results, and results of fishing under specially manipulated conditions. Large tables were mostly not transcribed unless all of the data were clearly relevant to by-catch research. Instead, a selection of values was taken, or a single RESULTS record was created showing the measure presented in the table but with the value left blank. This was intended as a keyword to alert users to the existence of the type of measure without giving excessive processing time to one publication. The results available for adding to the database were limited when publications could only be accessed as abstracts, as on ASFA and many journal web pages.

Frequently, some fairly unusual by-catch species are reported caught but without any measures being taken from them. They were assigned the measure ‘Presence/absence’ as a keyword to alert users to the report of the species.

Reported results were heterogeneous with regard to species, the exact type of measure made, the units, precision, region, time period, gear, etc. For this reason, no attempt was made to accumulate, total, or otherwise process results quantitatively within the By-catch database. That task seems more appropriate for scientists who inspect the data, select what they want, then process them thoughtfully in a spreadsheet or statistical package.

Table 2.5.1 summarises the types of information that were stored in the database during the project.

Lastly, despite taking much care with the transcribing of results, there can be no guarantee that no mistakes were made. All users finding results of interest must check them against original sources

before use, and all distributed versions of the By-catch database should have a prominent 'health warning' to this effect.

Table 2.5.1 Summary of types of information found and stored in the By-catch database during the by-catch project. The totals are approximate; e.g. the animal groupings may include 'unidentified' treated as a species.

Item	Number of records	Of which:
Countries	159	
Journal titles	61	
Species codes with results	269	Birds: 39
		Elasmobranchs: 77
		Invertebrates: 1
		Mammals: 38
		Teleosts (not tunas): 70
		Tunas: 36
		Turtles: 6
Authors	444	
Projects	39	
Publications	372	1991: 1
		1996: 2
		1997: 11
		1999: 2
		2000: 1
		2001: 3
		2002: 4
		2003: 32
		2004: 12
		2005: 44
		2006: 27
		2007: 53
		2008: 104
		2009: 45
		2010: 31
ResultGroups	394	
Results	4505	Age results: 26
		Catches and CPUEs: 3129
		Geographic results: 111
		Lengths: 956
		Population results: 179
		Reproductive measures: 33
		Trophic results: 15
		Weights: 51
		Birds: 427
		Elasmobranchs: 1546
		Invertebrates: 1
		Mammals: 111
		Teleosts (not tunas): 319
		Tunas: 1692
		Turtles: 401

2.6 Future of the By-catch database

Assuming that the delivered By-catch database proves to be useful and acceptable to ICCAT scientists, thought must be given to how it will be kept current and made available to users.

Loading the publications and results onto the database is a time-consuming task for a scientist who was not an author of the publication. Important details such as dates, region, fishing gear, etc. may be obscure within the texts and some may be absent altogether. Consequently, papers have to be studied with care. The task of entering publications and associated results would be easier for one of the authors familiar with the work. In the case of ICCAT CVSP papers, a form containing the keywords, measure types, and other fields as tick lists could be sent to the first author on acceptance. Those returning the form completed should find their paper included in the By-catch database since this requires only a few minutes when all the information is to hand. Possibly, authors of papers in other publications would respond to an invitation to fill the form also since having the paper in the database could enlarge readership.

The location of the database is a relevant consideration. The easiest option would be to distribute it by email (as a signed, compacted file), or on a CD, preferably with periodic updates, possibly provided by the Secretariat. A more difficult option would be to put the data tables onto the ICCAT central server, and re-engineer data entry and retrieval systems so that they can be operated over the internet. The clear advantages are that permitted scientists could load their own data, and everyone would have access to them. The By-catch database could then become a valuable communicative resource for ocean fisheries science.

Task 3: Obtaining observer data

Interact with National Scientists leading National Observer Programs to obtain relevant national observer data and develop appropriate rules for their use. An inventory of past and current observer programmes should be developed as part of 1, above. The contractor will act as an intermediary between the Secretariat and National programs to obtain observer program databases and develop confidentiality agreements, as appropriate.

3.1 Introduction

Observer data relating to non-target species currently do not have to be reported to the ICCAT Secretariat though data relating to a limited number of by-catch species are sometimes reported as part of the ICCAT Task II Catch and Effort (T2CE) reporting system. This project represented a new effort to gain resources of by-catch data. As already discussed in the Introduction to this report (§1), there can often be substantial administrative or legal hindrances to reporting by-catches to ICCAT. Partly for this reason, ICCAT's Sub-committee on Statistics drafted rules and procedures for the protection of confidential data. These are available as Appendix 10 of the report of the meeting of the Standing Committee on Research and Statistics held in Madrid, October 2009.

3.2 Inventory of past and current observer programmes

A preliminary list of observer programmes was kindly provided to the contractor by the Secretariat. It is shown in table 3.1. A list of 36 observer and other research programmes found by the contractor on looking through CVSP reports from 2008 back to 2003, and through ASFA lists after querying for "by-catch", is shown in table 3.2. Brief objectives and the centre of co-ordination for the project are included.

3.3 Requests for observer data

A formal request for observer data on by-catch species was written. Since confidentiality of observer data is often an issue, the message included the generalised draft confidentiality rules prepared by the ICCAT Sub-committee on Statistics, as well as the confidentiality clause from the contract between ICCAT and this contractor. The formal request (excluding the lengthy confidentiality documents) is shown in Annex 3. Most of these requests were sent out by email on 16 March 2010 except where stated. See table 3.3.

Concerning the obtaining of observer data, one ICCAT scientist stated that his country's observer data were currently not available for legal reasons but that these were being investigated with the aim of supplying data before the end of the project. Spain and China acknowledged the request and also considered the possibilities for sending data. Portugal advised that available data were already sent to ICCAT.

One new submission of by-catch data resulted from the requests. It came from the French Bluefin tuna programme in the Mediterranean Sea, courtesy of J-M Fromentin. Selected results were archived on the By-catch database. A retrieval of them is shown in table 3.4

Table 3.1. Preliminary inventory of observer projects supplied by ICCAT Secretariat.

Reported by	Flag of vessels:	Year updated	Fleet/Gear	Target Species:	Range of vessel size	Years of operation of the program	Season of operation	% vessels/trips with observer	% of total effort in the fishery with observer
Chinese Taipei	Chinese Taipei	2008	Pelagic Longline	BET-ALB	24-50M	2002-2008		3-8%	
EC-Ireland	EC-Ireland	2006	Mid water	ALB	20 - 40 m	8	July - October		
USA	USA	2008	Pelagic	SWO-BET-	less than 49	1992-present	All year	1.2-6.6%	2.2-13.9%
Iceland	Japanese	2005	Pelagic	BFT	379-409 GRT	1996-2005	August-Nov	100%	100%
Russian Federation	Russian Federation	2006	Pelagic Longline	SWO-BET-YFT-ALB-SHK		1965-1991, 2005, 2006	all year round		
Russian Federation	Russian Federation	2007	Purse seine	YFT-TUN	50-85 m	1973-2000, 2006, 2007	all year round		
JAPAN	JAPAN	2007	Pelagic Longline	BET-YFT-BFT	45 - 55 m in LOA	13(1995-), 1995 and 1996 are	All year round, but mostly June-January	4-7%	
TURKEY	TURKEY	2007	Purse seine	BFT	17.3-62 m	2003-2006	May-June	5.2-10.7%	
Mexico	Mexico	2007	Pelagic	YFT	13-25 m	1994-2008	All year	100%	100%
Venezuela	Venezuela	2008	Pelagic	SWO-BET-		1991-2008	All year	8.1-19.7%	6.2-36.4%
EU-France	EU-France	2003	France PS Med	BFT	27-34 m	2003	01/05/2003 au	5.25%	35%
EC_GREECE	EC_GREECE	2008	Pelagic	SWO	12m to 20m	2004 to 2006	February to	3.2-4.7%	0.59-0.89%
Uruguay	Uruguay	2008	Pelagic	SWO, YFT,	15-55	1998-2007	All year	4-39%	5-65%
Canada	Canada	2008	Pelagic Longline	SWO, BET, YFT, BFT,	45-100 feet	1980-2008	Tuna-fall, SWO summer/fall, SHK-	5-25%	
Mexico	Mexico	2007	Pelagic	YFT	13-25 t.	1994-2008	All year	100%	100%

Table 3.2. Inventory of observer programmes and research projects prepared by the contractor from reports in the ICCAT CVSP series from 2003 to 2008 and from Aquatic Sciences and Fisheries Abstracts. Blank fields indicate unavailable information. Panel 1 of 2.

Project	Start	Objectives	Coordination
US POP	1992	To record detailed information on catch, effort, gear configuration, fishing locations, etc. The mission of the program is to accurately quantify finfish catch and by-catch amounts and to quantify marine mammal, sea turtle, and sea birds incidental mortality	Miami, United States
French PurseSeine OP	2005	To acquire data on effort strategy, species composition and quantities of by-catch and discard in the purse seine fisheries of the Indian and Atlantic Oceans	Not known, Not known
Spanish OP	2005		A Coruña, Spain
ObsMER	2003		Sète, France
SFOP	1987	100% coverage of foreign fisheries in the Canadian zone, allowing accurate determinations of nominal catch and bycatch. SFOP coverage of domestic longline vessels is on the order of 5%.	Dartmouth, Canada
Taiwanese OP	2002	While onboard, observers shall record the following information, (1) Basic information of the vessels: the vessel's name, tonnage, vessel length, number of crew, the type of communication system, etc. (2) Daily fishing activities information: gear characteristics	Not known, Not known
Chinese OP	2001		Shanghai, China
PNOBF	2006		Monteiro Recife, Brazil
EU LIFE project	2007	To assess the perceptions of fishers on seabird by-catch and to undertake a preliminary evaluation of the impact of the Maltese fishing fleet on incidental by-catches of birds using a questionnaire survey	Marsaxlokk, Malta
GPTDb	2004	To collate the at-sea distribution of seabird species in the ICCAT area, and to analyse the spatial and temporal overlap between seabird distribution and ICCAT longline fishing effort.	Not known, Not known
PNOFA	1998	To collect data on local environmental conditions, details of fishing operations and catch by species (target, by-catch, discards and lost catch).	Rocha, Uruguay
Projeto Albatroz	2007		Santos-SP, Brazil
Japanese OP	1997	Data collection includes vessel attributes, gear configuration, species identification, biological sampling and various measurements on all catches.	Shizuoka City, Japan
NDCP	2003	Collected data include information on fishing	Iraklion, Greece
Portuguese OP	2006		Olhão, Portugal
South African OP	2000		Cape Town, South Africa
Birdlife & WWF			Not known, Not known

Table 3.2. **(Panel 2 of 2)** Inventory of observer programmes and research projects.

Project	Start	Objectives	Coordination
VPLOP	1991	Since 1991, trained scientific observers have recorded detailed information on gear characteristics, fishing operations as well morphometric and biological information from a sub-sample of the Venezuelan longline pelagic vessels (Arocha & Marcano, 2001).	Cumaná, Venezuela
CSFOP	1994	Fishery-dependent estimates of the fin-to-carcass weight ratio were developed	Panama City, United States
Tunisian OP	2000	To increase our knowledge about the by-catch specific composition of the Tunisian traps and purse seine	Salammbô, Tunisia
French BFT program	2003	To collect the size composition of BFT catches by a French purse seiner.	Sète, France
Bigeye Tuna program	1999	To coordinate research activities on bigeye tuna (Thunnus obesus) in the Atlantic Ocean. The mayor objective was to clarify the stock structure of bigeye tuna and to study the impact of the fisheries on the stocks.	Madrid, Spain
MAC	1996	To coordinate and support a catch, effort, and biological sampling program for Maltese dolphin fish (Coryphaena hippurus)	Sète, France
COPEMED regional	2000		Tangier, Morocco
TAG	1996	This program is a collaboration between scientists from Stanford University, the Monterey Bay Aquarium and the National Marine Fisheries Service. To date 560 electronic tags have been deployed on Atlantic bluefin tuna at four locations in feeding regions	Pacific Grove, United States
TUNIBAL	2001	To research for larval sampling and the characterisation of bluefin's spawning habitat in the Central Atlantic and around the Balearic archipelago.	Olhão, Portugal
Small swordfish wg	1997	To assemble an Atlantic -wide data base consisting of catch (numbers of fish) and effort records by 5o squares and quarter with effort in hooks and numbers of swordfish separated in undersized (< 125 cm) and larger than undersized (>= 125 cm).	Miami, United States
PICOLO		A series of cruises were carried out in the SSA (Gulf of Guinea) to study the physical environmental features and the living organisms (acoustics, trawling).	Sète, France
STN			Rome, Italy
NEFSC-CMER		The overall objective is development of devices or techniques that make fishing gear repulsive (or at least less attractive) to sea turtles but that are undetectable by the targeted fish species.	Gloucester Point, United States
STRP			Not known, Costa Rica
STC&R		A new approach to reducing incidental capture of sea turtles in U.S. commercial and recreational fisheries based on evaluating sea turtle bycatch across gear types and relying heavily upon involvement of stakeholders (e.g., fishing industry, non-government)	Woods Hole, United States
GLOBAL		gathering information about fisheries, fishing effort and by-catch in the Eastern Pacific. The project is not limited to investigating only sea turtle by-catch, but also looks at marine mammals and sea birds.	Beaufort, United States
IPA seabirds			Honolulu, United States
EBRP	1991	To place scientific observers on Venezuelan longliners targeting tuna and swordfish	Cumaná, Venezuela

Table 3.3. Progress in requesting by-catch data and observer forms from ICCAT scientists.

Request sent to	Observer program	Acknowledged?	Outcome
G Diaz	US Pelagic	Yes	Confidentiality problems; investigating
A Delgado J Ariz	Spanish	Yes	Forms & instructions received
H Murua	Spanish tropical purse seiners, AZTI	Project co-ordinated with French which is acknowledged	Forms & instructions received from P Chavance (below)
P Chavance	French tropical purse seiners	Yes	Forms & instructions received
J-M Fromentin	2003 BFT study	Yes	Data set received
E Cortes	US Coastal	Yes	Referred to others for approvals
A Hattour	Tunisian	Wrong address	
E Chassot	French purse seiners	Yes	Investigating availability of data
X Dai	Chinese longliners	Yes	Investigating availability of data
H Holzhausen	Namibian	No	
Felipe Carvalho	Brazilian longliners	No	
F Arocha	Venezuelan longliners	No	
A Domingo	Uruguyan	No	
H-W Huang	Taiwanese longline	No	
S Petersen	Seabird & turtle studies	No	
P Mancini	Project Albatroz	No	
M Santos	Portuguese	Yes	Observer data already sent to ICCAT
Y Senba	Japanese longline	Yes	Need permission
P Peristeraki	Greek swordfish	No	
M Fowler	Canadian Scotia-Fundy	Yes	Industry survey database details received

Table 3.4. French Bluefin tuna observer programme in the Mediterranean Sea: selected results after archiving in, and retrieval from the By-catch database.

StartDate	T species	SciName	SpGroup	Measure	ObsvdValue	Units	N fish	Disc'd alive?
2003.33	MOX	Mola mola	Teleosts	Catch: number, total	1	N		y
2003.36	SWO	Xiphias gladius	Tunas	Length: unspecified measure	142	cm	1	n
2003.36	TTL	Caretta caretta	Turtles	Length: carapace over shell	70	cm	1	y
2003.36	SKJ	Katsuwonus pelamis	Tunas	Length: unspecified measure	66	cm	20	n
2003.364	SKJ	Katsuwonus pelamis	Tunas	Length: unspecified measure	70	cm	33	n
2003.364	ALB	Thunnus alalunga	Tunas	Length: unspecified measure	75	cm	1	n
2003.364	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	2	N		n
2003.364	TTL	Caretta caretta	Turtles	Length: carapace over shell	70	cm	1	y
2003.378	TTL	Caretta caretta	Turtles	Length: carapace over shell	50	cm	1	y
2003.405	SKJ	Katsuwonus pelamis	Tunas	Weight: fresh fish	6.25	kg	128	n
2003.414	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	2	N		n
2003.419	ALB	Thunnus alalunga	Tunas	Length: unspecified measure	67	cm	2	n
2003.455	TTL	Caretta caretta	Turtles	Length: carapace over shell	45	cm	1	y
2003.701	MOX	Mola mola	Teleosts	Length: unspecified measure	80	cm	1	n
2003.707	MOX	Mola mola	Teleosts	Length: unspecified measure	80	cm	1	n
2003.707	MOX	Mola mola	Teleosts	Length: unspecified measure	70	cm	1	n
2003.707	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	1	N		n
2003.707	MOX	Mola mola	Teleosts	Length: unspecified measure	80	cm	2	n
2003.709	SWO	Xiphias gladius	Tunas	Length: unspecified measure	220	cm	1	n
2003.709	SWO	Xiphias gladius	Tunas	Length: unspecified measure	55	cm	3	y
2003.709	SWO	Xiphias gladius	Tunas	Length: unspecified measure	50	cm	2	n
2003.709	MOX	Mola mola	Teleosts	Length: unspecified measure	50	cm	1	y
2003.71	SWO	Xiphias gladius	Tunas	Length: unspecified measure	55	cm	2	n
2003.71	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	1	N		n
2003.71	DST	Stenella coeruleoalba	Mammals	Length: unspecified measure	200	cm	1	n
2003.71	DST	Stenella coeruleoalba	Mammals	Length: unspecified measure	150	cm	1	n
2003.71	DST	Stenella coeruleoalba	Mammals	Length: unspecified measure	100	cm	1	n
2003.71	DST	Stenella coeruleoalba	Mammals	Catch: number, total	6	N		y
2003.734	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	5	N		y
2003.742	SWO	Xiphias gladius	Tunas	Length: unspecified measure	50	cm	1	n
2003.742	DOL	Coryphaena hippurus	Teleosts	Length: unspecified measure	50	cm	15	n
2003.688	SWO	Xiphias gladius	Tunas	Length: unspecified measure	70	cm	1	n
2003.688	SWO	Xiphias gladius	Tunas	Length: unspecified measure	60	cm	1	n
2003.688	MOX	Mola mola	Teleosts	Length: unspecified measure	100	cm	1	n
2003.701	MOX	Mola mola	Teleosts	Length: unspecified measure	55	cm	1	n
2003.704	MOX	Mola mola	Teleosts	Length: unspecified measure	80	cm	1	n
2003.704	MOX	Mola mola	Teleosts	Length: unspecified measure	62	cm	1	n
2003.704	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	1	N		n
2003.707	MOX	Mola mola	Teleosts	Catch: number, total	3	N		n
2003.704	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	4	N		n
2003.71	MOX	Mola mola	Teleosts	Catch: number, total	6	N		n
2003.71	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	5	N		n
2003.712	MOX	Mola mola	Teleosts	Catch: number, total	5	N		n
2003.712	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	2	N		n
2003.712	MOX	Mola mola	Teleosts	Catch: number, total	2	N		n
2003.734	MOX	Mola mola	Teleosts	Catch: number, total	3	N		n
2003.734	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	1	N		n
2003.738	MOX	Mola mola	Teleosts	Catch: number, total	2	N		n
2003.738	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	3	N		n
2003.738	SWO	Xiphias gladius	Tunas	Length: unspecified measure	65	N	1	n
2003.745	MOX	Mola mola	Teleosts	Catch: number, total	2	N		y
2003.745	PLS	Dasyatis violacea	Elasmobranchs	Catch: number, total	2	N		y
2003.745	SWO	Xiphias gladius	Tunas	Length: unspecified measure	92	cm	1	n
2003.738	SWO	Xiphias gladius	Tunas	Length: unspecified measure	80	cm	1	n
2003.384	BLT	Auxis rochei	Tunas	Length: unspecified measure	41	cm	55	n
2003.384	BLT	Auxis rochei	Tunas	Weight: fresh fish	2.09	kg	55	n
2003.384	SWO	Xiphias gladius	Tunas	Length: unspecified measure	122	cm	1	n
2003.384	SWO	Xiphias gladius	Tunas	Weight: fresh fish	9	kg	1	n
2003.397	SWO	Xiphias gladius	Tunas	Length: unspecified measure	115	cm	1	n
2003.397	SWO	Xiphias gladius	Tunas	Weight: fresh fish	9	kg	1	n
2003.397	ALB	Thunnus alalunga	Tunas	Length: unspecified measure	70	cm	1	n
2003.449	ALB	Thunnus alalunga	Tunas	Length: unspecified measure	73	cm	1	n

Task 4: Development of specific by-catch data collection forms and protocols

Develop specific by-catch data collection forms and protocols that will help to ensure future data collection quality and quantity (beyond what is already available in the ICCAT manual, e.g. adding species ID sheets for observer data collection forms, etc.). These forms and protocols would need to be adopted by the SCRS.

4.1 Introduction

Observer programs are already in place for ICCAT fishing vessels, see tables 3.1 and 3.2, but many are primarily directed towards assessment of the targeted, commercial species being caught. The recording of by-catch may or may not be carried out consistently. Consequently, confidence in estimated rates of by-catch over the ICCAT area is low for many species.

A new by-catch monitoring protocol for ICCAT should implement a systematic and uniform approach to sampling and reporting whenever possible. Then the core of results is not influenced by the interests and scheduling of individual observers, and there should be high confidence that certain, pre-specified by-catch events will be reported if they occurred during periods of observation. Of course, observers have to rest sometimes and cannot be in two places on a ship at one time. Therefore the protocol may have to include an element of catch sampling, e.g. allocating one watch period to processing target species, another to by-catch.

Developing the details of a scientific by-catch protocol for ICCAT is particularly challenging because of

(1) the extensive and diverse geographic area of the Commission's jurisdiction – the Atlantic Ocean and the Mediterranean Sea,

(2) the many types of vessels and nationalities fishing there, and

(3) the large numbers of potential by-catch species – more than 300 from five vertebrate groups – cartilaginous fish (Elasmobranchs), bony fish (Teleosts), birds, reptiles and mammals.

These challenges suggest that a new by-catch protocol, if it is to be robust and successful throughout the ICCAT area, is likely to be simple to apply and to have a small number of well-understood objectives. For some CPCs, these objectives would be less than what they already do; for others, they would be enhancements.

This section of the report firstly reviews and comments upon possible objectives, existing schemes, and proposals by others for by-catch monitoring. Proposals are then made for a by-catch monitoring protocol and associated reporting forms and species identification sheets in accordance with Task 4. The proposals were prepared independently and should not be construed as official policy of ICCAT. Recommendations for minimal monitoring of by-catch drawn up by ICCAT's Sub-committee on Ecosystems (SCECO) after discussion of a draft of this report are shown in Annex 6.

4.2 Candidate objectives for by-catch monitoring

By-catch results can be analysed and presented in many different ways. Some commonly suggested candidate objectives for by-catch monitoring are listed below with arguments in favour and against.

i. To enumerate "trophy" by-catch species, i.e. those of most interest to the public, such as dolphins, turtles, and albatrosses. Results are useful for reassuring markets by declaring low by-catch rates per unit of fish product, e.g. “dolphin-friendly” tuna. Other goals may be to check whether species are declining towards extinction, and to permit design of better ways of preventing their capture and death. However, lower profile, non-trophy species may be more threatened by fishing and perform more important roles within the ecosystem.

ii. To enumerate *all* untargeted species being caught. This objective for ICCAT would require high levels of taxonomic competence among observers across all national fleets. Taxonomic problems have been reported for groundfish surveys in the North Sea where a team of qualified fisheries scientists is present on each survey vessel (Daan, 2001). Taxonomic problems in the Atlantic could be more problematic because of the higher species diversity, solo working by the observer and, perhaps, poor availability of taxonomic training and good field guides in the observer’s language.

iii. To enumerate a selection of untargeted species caught. A selection of species for monitoring could easily omit some species found later to be important. It also calls for selection criteria that are likely to be hard to choose and apply objectively. Rarity in the by-catch is not necessarily a good criterion since it may only indicate low vulnerability to the fishery. Rarity supported by the broader deliberations of the International Union for the Conservation of Nature (IUCN) on risks of extinction (‘Critically endangered’, ‘Endangered’, ‘Vulnerable’, ‘Near threatened’) is of more value. Nevertheless, there are other species for which a decline from 'common' to 'less common' in by-catches may be relevant ecologically if the species performs an important trophic function in the pelagic ecosystem.

iv. To collect CPUE data for population assessments of the type carried out for commercially targeted species. Knowledge about the dynamics of a population would obviously be helpful for deciding the importance of fishing-related deaths. However, although methods of assessment based on CPUE alone are available (Mesnil *et al.*, 2009) they are relative, fishery-independent, and some require age data. CPUEs observed on commercial fishing vessels are likely to be affected by “technical creep”, i.e. increasing catching powers over time and, in the opposite direction, by by-catch mitigation measures. If stock assessments of some kind are contemplated for by-catch species, they should therefore be considered as crude indices only, e.g. estimating just 3-levels for a stock (low, mid, or high).

v. To collect CPUE data for spatial analysis. Spatial variability of CPUE adds the information from two spatial dimensions to a stock assessment and can be much more informative biologically. One may expect that technical creep within each year of observation is relatively unimportant, but it is still necessary to assume that catchability does not vary spatially. Spatial analyses might also be useful for allocating observers to fishing trips. Allowance should be made for the effects of varying observed fishing effort on precision in each geographic sub-region. A review of spatial statistics applicable to fisheries data was given by Woillez et al. (2009).

vi. To collect CPUE data for assessment of ecological risks posed by ICCAT fisheries. Risk assessment methods (Francis and Shotton, 1997, Hobday *et al.*, 2007) take a broader, more qualitative approach to the effects of fishing than single-species stock assessments, and have already been applied within ICCAT (Arrizabalaga *et al.*, 2009, Cortès *et al.*, 2009). Ecological risk assessments seem highly appropriate in the ICCAT context, given the large number of by-catch species being reported upon. Hobday *et al*.'s 3-staged method is valuable because it guides attention towards the species and processes most at risk from fishing, thus preventing the research work from growing without limit. Another benefit of risk assessment is that it stimulates a search for all kinds of biological information on the species of concern. The By-catch database should be useful for this.

4.3 Existing forms and protocols for by-catch

Various protocols and sets of reporting forms for observers became available to the contractor, some submitted personally by ICCAT scientists. They are reviewed below briefly in the context of by-catch. Although the review is not comprehensive, several good ideas come forward. Concerning by-catch species being reported upon, table 4, put at the end of this section because of its length, is a comparative presentation of lists of reportable species within ICCAT, organised by vertebrate group and with species sorted by their conservation status according to the International Union for the Conservation of Nature (IUCN), the so-called 'Red List'. Note: the ICCAT species codes shown are not always the same as the codes used nationally.

4.3.1 ICCAT

ICCAT forms for reporting by-catch currently consist of the "Task II: Catch and effort statistics" form, numbered ST03-T2CE and available by downloading from www.iccat.int as part of the ICCAT manual. Species other than the 12 main targeted tuna, swordfish, and shark species are reported voluntarily as weights or numbers landed or discarded by adding extra columns to the spreadsheet form. The quantities are totals for 5° squares in the case of longlines, and 1° squares for other gears. Each row of data may represent one or more sets within the square. Fishing effort is reported using one or two types of unit. The form allows reporting whether sets were on a free school (FSC) or on a fish-aggregating device (FAD). ICCAT 3-letter codes for 123 species are included with the electronic form. The list of species is shown alongside others in Table 4.

Additionally, form ST04-T2SZ is used to report the size (length or weight) composition of a sample of fish, one form per species, one line per (size class x maturity) combination, where maturity is recorded as Male, Female, Unknown, and Immature. Form ST05-CAS is similarly used to report size composition but as specifically estimated for the total catch in a 5° square. This form is used for the 6 main target species only (bluefin, albacore, yellowfin, bigeye, skipjack and swordfish).

The ICCAT forms enable by-catch reporting by species but are not conducive to it. The required species codes must be looked up one-by-one, special columns must be added to ST03-T2CE for each species, and observers may prefer to record by-catch by set, leaving a computer to collate the results into 5° or 1° squares. Recording of lengths and maturities might be discouraged by the lack of special boxes for each species. Additionally, there is no place to record whether the species was alive or dead after processing or whether any by-catch mitigation measures were being taken.

Besides forms, ICCAT also publishes a field manual on the web site. Section 4.10 of it deals generally with observer programmes but does not propose a list of priority species or measurements for by-catch. This implies that scientific analyses of by-catch data are handicapped by

a) uncertainties over whether the lack of a result for a species represents lack of occurrence in the by-catch or inconsistent observations, and

b) varying approaches to observations and measurements.

4.3.2 United States Pelagic Observer Program

The United States Pelagic Observer Program (POP) has operated since 1992 mainly on longliners operating in the northwest Atlantic. Protocols and observer forms are described by Diaz *et al.* (2009). The mission of the POP is to accurately quantify finfish catch and by-catch amounts and to quantify incidental mortal and injuries to marine mammals, sea turtles, and sea birds. The POP also collects biological data for fish, as well as detailed information on fishing gear and effort, and meteorological and oceanographic conditions. Observer coverage varies between 6 and 9% of sets over the fleet but 100% of sets are covered on each observed trip. The carrying of an observer by a selected vessel is mandatory.

Data are recorded for approximately 108 species and groups. The US POP list is shown alongside others in Table 4. Recorded variables include status of by-catch (alive, damaged, dead, etc.), the condition and sizes of released fish, plus the number of interactions and fate of seabirds, marine mammals, and sea turtles. Figure 4.3.2.1 shows the many details recorded for incidental catches of marine mammals. A special manual and form for turtles is available at http://www.sefsc.noaa.gov/seaturtlefisheriesobservers.jsp . [The form is copy-protected so is not reproduced here.] The manual includes an identification guide, advice on resuscitation, tagging, and measurements.

The US POP data, along with those from other ICCAT countries, have been applied in an Ecological Risk Assessment for pelagic sharks by Cortès *et al.* (2009).

MARINE MAMMAL INCIDENTAL TAKE FORM January, 2007

OBSERVER/TRIP ID _____ HAUL # _____

YEAR (MM/DD/YYYY) _____ TIME (24 hr) _____

LOCATION OF TAKE

LATITUDE _____ deg _____ min N / S LONGITUDE _____ deg _____ min W

SPECIMEN NUMBER (BY TRIP) _____ SPECIMEN FIELD NUMBER _____

SPECIES IDENTIFICATION

____ Short-finned pilot whale	____ Long-finned pilot whale	____ Unid. pilot whale
____ Risso's dolphin	____ Atlantic spotted dolphin	____ Pantropical spotted dolphin
____ Bottlenose dolphin	____ Common dolphin	____ Unid. dolphin
____ Cuvier's beaked whale	____ Unid. beaked whale	____ Pygmy sperm whale
____ Unid. marine mammal	Other _____	

Diagnostic features _____

Confidence Level of Species ID ____ Good ____ Fair ____ Poor

Photos Taken? Y / N Number of photos taken _____

HOOKING OF MARINE MAMMAL

Was animal hooked? Y / N / Unknown (If No, skip to next section) No. of gangions to next float _____

Location Internal: Hook visible? Y / N ___ Visible to insertion point ____ Partial hook ____ Not visible

Location in Mouth: ____ Upper ____ Lower ____ Side ____ Swallowed ___ Unknown

External: ____ Front Flipper ____ Dorsal fin ____ Body ____ Head / Neck ____ Tail

____ Other/Unknown (explain) _____

Was hook removed from animal? Y / N / Unknown

If No, was line intentionally cut? Y / N Amount of line left trailing (in ft) _____

ENTANGLEMENT OF MARINE MAMMAL

Was animal entangled? Y / N / Unknown

Entanglement Location (check all that apply)____ Front Flipper ____ Head / Neck ____ Tail/Flukes

____ Body ____ Mouth ____ Other _____

Gear involved: ____ Hook ____ Mainline ____ Gangion/Leader ____ Dropline/Floatline ____ Float

Was gear removed from animal? Y / N / Partial / Unknown

If No, amount of line left on animal (in ft)? _____ Were wraps cut? Y / N / Partial / Unknown

DESCRIPTION OF GEAR REMOVAL PROCEDURE / GEAR REMAINING (Use addtl. sheet as necessary)

_____

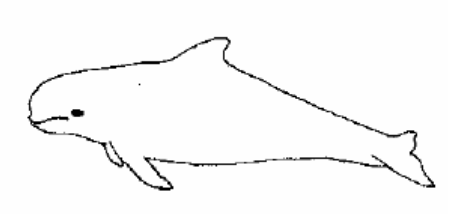
_____

_____

_____

Figure 4.3.2.1 United States Pelagic Observer Program: form for recording by-catch of a marine mammal, taken from Diaz *et al*. (2009). 1st panel of 2.

SKETCH OF ANIMAL SHOWING WHERE GEAR WAS HOOKED OR ENTANGLED ON BODY
(Include other identifying or unusual marks as appropriate)



CONDITION OF MARINE MAMMAL UPON RELEASE

____ Alive, swam away normally ____ Alive, swam abnormally ____ Dead

Description of animal's behavior/condition upon release (use addtl. sheets as necessary) _____

_____

_____

_____

_____

WAS ANIMAL BOARDED? Y / N If No, approx. length of animal (ft): _____

If yes, complete the following. If full necropsy performed, use separate necropsy data sheet.

Total length (tip of rostrum to fluke notch, in cm): _____ Straight / Curved / Estimated

Sex: M / F / Unknown Disposition of Carcass: _____

Additional comments: _____

BIOPSY SAMPLES TAKEN? Y / N / Attempted (unsuccessful)

If yes, itemize samples: _____

PRESENCE OF OTHER MARINE MAMMALS AT TIME OF CAPTURE

Were other marine mammals present at time of capture? Y / Did not look / Looked but did not see

Number of other marine mammals present (record all three) _____ MIN _____ MAX _____ BEST GUESS

Same species as animal captured? Y / N / Unknown Species ID if different _____

Approximate distance from vessel (in ft) _____

DETERRENCE/AVOIDANCE

Were actions taken to deter or avoid animals? Y / N / Unknown

Describe (use addtl. sheets as necessary; indicate whether actions taken before, during, or after interaction)

_____

_____

_____

Debriefed: Y / N Debriefed by:_____ Date: _____

Figure 4.3.2.1 2nd panel of 2.

4.3.3 European observer programmes for tropical tuna purse seiners

The manual and forms used by observers on French seiners for tropical tunas was received from P. Chavance, IRD, and for Spanish seiners from A. Delgado de Molina, Centro Oceanográfico de Canarias. Other European Community countries use similar forms in their own language. Observers are required on vessels by European regulation 1543/2000. Coverage by the French is for 10% of the fleet in the Atlantic (and Indian) Ocean.

Forms are provided for recording travelling and searching by the seiner, as well as for the details of each seine shot and catches of the target species. Form C2 is used for samples of by-catch species. A copy is shown in figure 4.3.3.1. The species, length, weight, sex, and references to any photographs taken are recorded for each individual in the by-catch of each set. The form illustrates the appropriate length measurement to be made for each type of animal (except birds).

The manual recommends that observers give by-catch species the maximum chance of survival if possible by returning them to the water even without identifying or measuring them. They can instead be photographed alongside a measuring scale. Observers are required to give priority for measuring to by-catch species along with discarded tuna species, swordfish, billfish, shortfin mako, blue sharks, porbeagles, and the dogfish shark family. The manual lists species or group codes for approximately 9 billfish, 42 elasmobranchs, 52 other types of fish, 6 species of turtle, and 28 marine mammals. This is a total of almost 140 species or taxonomic groups but birds are not included. The list of species is shown alongside others in Table 4.

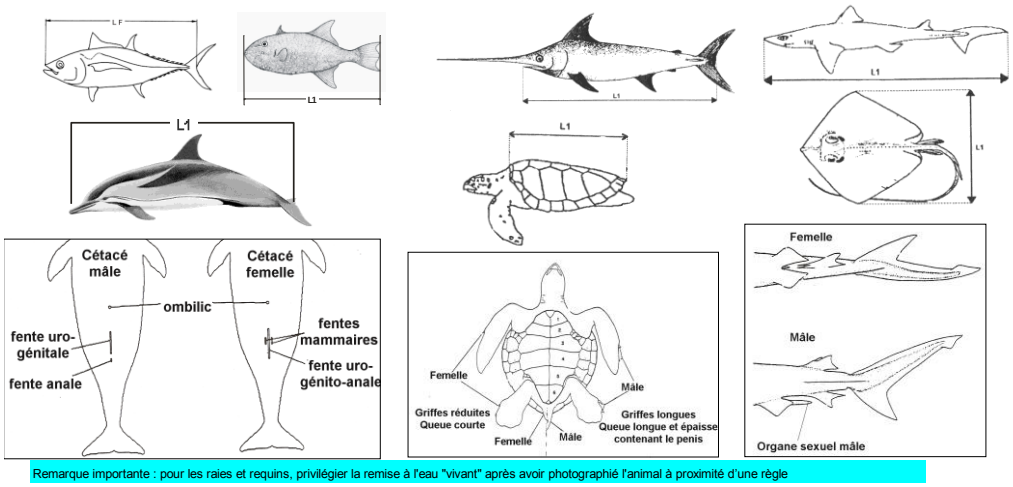
Figure 4.3.3.1 French observer program for tropical tuna purse seiners. Copy of form C2 used for recording details of by-catch species.

Programme national de collecte des données de base (France) **Formulaire C2**

Version 2.2 juil 2009

Echantillonnage des espèces associées

Formulaire échantillon n°:	**Calée n°:**	**Date :**	**Nom de l'observateur :**
Formulaire route n°:	**Ligne route n° :**	**Nom du bateau :**	**Bateau n°:**



Remarque importante : pour les raies et requins, privilégier la remise à l'eau "vivant" après avoir photographié l'animal à proximité d'une règle

	Espèce	L1	Sexe	Photo n°	Poids en kg
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

	Espèce	L1	Sexe	Photo n°	Poids en kg
23					
24					
25					
26					
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4.3.4 Indian Ocean Tuna Commission (IOTC)

Resolution 10/04 of the IOTC deals with a regional observer programme for Indian Ocean fisheries. Much of this document is procedural. Of relevance to this report are the following clauses:

1. The objective of the IOTC observer scheme shall be to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area.

10. Observers shall:
(a) Record and report fishing activities, verify positions of the vessel;
(b) Observe and estimate catches as far as possible with a view to identifying catch composition and monitoring discards, by-catches and size frequency;
(c) Record the gear type, mesh size and attachments employed by the master;
(d) Collect information to enable the cross-checking entries made to the logbooks (species composition and quantities, live and processed weight and location, where available); and
(e) Carry out such scientific work (for example, collecting samples), as requested by the IOTC Scientific Committee

The resolution comes into force on 1 July 2010 and a target of 5% coverage of fishing operations has been set.

As is to be expected for a legal document, the instructions to observers are general. This implies that scientific analyses of by-catch data are handicapped by the same problems as mentioned above for ICCAT (4.3.1). There is also no explicit mention of the need to report by-catch per unit of observed fishing effort, or to report on any by-catch mitigation measures being taken. More specific instructions will presumably follow the implementation date.

4.3.5 Western and Central Pacific Fisheries Commission

The document 'Conservation and management measure 2007—01' established a regional observer programme (ROP) in the west and central Pacific in 2007. The objectives are:

4. The objectives of the Commission ROP shall be to collect verified catch data, other scientific data, and additional information related to the fishery from the Convention Area and to monitor the implementation of the conservation and management measures adopted by the Commission.

The functions of observers are in paragraph 6, part of which is below:

6. The functions of observers operating under the Commission ROP shall include collecting catch data and other scientific data, monitoring the implementation of the conservation and management measures adopted by the Commission and any additional information related to the fishery that may be approved by the Commission. . .

More detail of information to be reported by observers is given in WCPFC/ IWG-ROP2-2008/11 'Minimum data standards, WCPFC Regional Observer Programme', dated July 2008 and, judging from a web search at the time of writing, still only available as a draft. Among many standard fields, the following are of interest for by-catch studies.

- Use of wire traces (relevant for sharks)
- Line hauling and shooting speeds (relevant for birds)

- Presence of automatic bait thrower, automatic branch line attachment, Tori pole, bird curtain, weighted branch lines, etc. (relevant for birds)
- Hook size and type (relevant for turtles)
- Disposal method for offal (relevant for birds)

Information required on catch includes species code, length, gender, fate, and condition but it is not clear how many species this applies to. Also specified are species of retained and discarded catch. Table 6 of the document refers to interactions with "Species of special interest" including marine reptiles, mammals, and seabirds. Length, gender, and condition should be recorded for species taken on deck. For other interactions with fishing, the vessel's activity, a description of the interaction, the number of animals involved and the effects on their condition should be reported.

Table 8 of the document requires observers to give opinions on whether, among other matters, the vessel

- recorded positions accurately,
- recorded retained and discarded target species accurately
- recorded by-catch species and discards accurately.

Further information on WCPFC observer objectives as recommended by the WCPFC Scientific Committee is given by Black et al. (Black A, Small C, Sullivan B (2007) 'Recording seabird bycatch in longline observer programs' WCPFC-SC3-EB SWG/WP-6.). According to these authors, five high-priority objectives recommended for the regional observer program are:

- To record the species, fate (retained or discarded) and condition at capture and release (e.g. alive, barely alive, dead etc) of the catch of target and non-target species; depredation effects; and interactions with other non-target species including species of special interest (i.e. sharks, marine reptiles, marine mammals and seabirds);
- To collect data to allow the standardisation of fishing effort, such as gear and vessel attributes, fishing strategies, the depths of longline hooks, FAD use and setting activities of purse seiners, and other factors affecting fishing power;
- To sample the length and other relevant measurements of target and non-target species;
- To sample other biological parameters, such as gender, stomach contents, hard parts (e.g. otoliths, first dorsal bone), tissue samples and collect data to determine relationships between length and weight, and processed weight and whole weight;
- To record information on mitigation measures utilised and their effectiveness.

These WCPFC objectives do not pin down the by-catch species to be reported on, nor which sampling to apply to each.

4.3.6 Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

CCAMLR provides detailed electronic forms to their observers. The forms and a Scientific Observers' Manual (as well as practical advice to fishers to help them reduce by-catches) are available from http://www.ccamlr.org/pu/e/sc/obs/logbooks.htm . One form is designed for observing longline fishing, another for trawling. Seining, trolling and pole and line fishing, as carried out in the ICCAT region, do not have equivalent CCAMLR forms. The introduction to the CCAMLR Manual states that the objective of the observer programme is

to gather and validate scientific information essential for assessing the status of populations of Antarctic marine living resources and for assessing the impact of fishing on those populations and populations of related and dependent species. The Scheme is applied equally to harvesting and research vessels.

Another document, the 'CCAMLR scheme of International scientific observation' (February 2000), states in Annex 1 the tasks to be undertaken by scientific observers. They include

(i) record details of the vessel's operation (e.g. partition of time between searching, fishing, transit etc., and details of hauls);
(ii) take samples of catches to determine biological characteristics;
(iii) record biological data by species caught;
(iv) record by-catches, their quantity and other biological data;
(v) record entanglement and incidental mortality of birds and mammals;
(vi) record the procedure by which declared catch weight is measured and collect data relating to the conversion factor between green weight and final product in the event that catch is recorded on the basis of weight of processed product;

Other CCAMLR documents presented in the Manual specify research priorities. These include

- observations of by-catch (including birds and seals),
- monitoring of total incidental mortality of seabirds by species, sex, and age,
- assessment of seabird mortality per unit of fishing effort and relative vulnerability of different species,
- evaluation of the efficiency of mitigation measures.

Detailed lists of data collection and sampling requirements are also present in CCAMLR documents. Notable among these are (a) recording details of the movements of birds and mammals, both migratory and in relation to the fishing gear; and (b) that two observers should be present on each vessel in order to monitor by-catch of seabirds. CCAMLR's electronic longline form has 15 panels for completion by observers, including panels for Tori streamer lines, seabird activity, marine mammal interactions with the fishing gear, seabird and marine mammal by-catch, species representing vulnerable marine ecosystems (VME), biological data collection, estimation of weight conversion factors, waste disposal, sightings of potentially illegal fishing vessels, and tagging information. A list of species relevant to CCAMLR includes 178 species and taxonomic groups. [This is not shown comparatively in table 4 because several of the species would not be found in the ICCAT area.]

4.3.7 Inter-American Tropical Tuna Commission (IATTC)

The IATTC covers the eastern Pacific Ocean. Documents can be found at http://www.iattc.org . A "Tuna-Dolphin Program" has had considerable success in reducing by-catch of dolphins by purse seiners. Catches per set have reduced from more than 8 individuals per set in the 1980s to almost zero from 2000. This has been achieved by observers, 'Dolphin Mortality Limits' assigned to individual vessels, and changes to fishing practices and gear. Additionally, contracting parties and co-operating non-parties (CPCs) have agreed (Resolution C-07-03) to implement the FAO Guidelines to reduce mortality and injury of turtles together with adjustments to fishing practices with purse seines and longlines. They have also agreed (Resolution C-05-01) to take steps to reduce incidental catches of seabirds taking into account the FAO International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries, and to conserve and manage shark stocks in accordance with the FAO International Plan of Action for the Conservation and Management of Sharks (Resolution C-05-03).

4.3.8 Birdlife International

Birdlife International, a conservation organisation based in the UK, has submitted detailed working papers to several RFMOs recommending data collection protocols for reporting seabird by-catches of longline fisheries, e.g. http://www.iattc.org/pdffiles2/iattc-bycatch-rates-birdlife.pdf and EB WP-6 document.pdf at http://www.wcpfc.int/taxonomy/term/114/all. Their papers make numerous constructive suggestions for monitoring by-catches of seabirds, some of which are summarised below:

1. The main objectives for recording seabird by-catch are to quantify mortalities, to understand contributing factors, to allow scaled-up estimates of total mortalities for the fishery, and to assess the effectiveness of mitigation measures.
2. Observers must set aside time to observe hooks as they are brought aboard; otherwise many birds will be missed due to dropping off the hook, release by the crew, etc. Substantial variability in catch rates is typical. By-catch rates should be recorded as birds per 1000 hooks as observed, not as fished.
3. Fish sampling and the need for sleep may mean that an observer cannot observe all hooks being brought aboard. The haul should then be randomly sampled, either by time or by section of the longline.
4. By-catch rates of the rarer species are usually low and therefore most difficult to monitor accurately, yet these species are the most important for conservation of biodiversity.
5. Seabird carcases should be preserved and returned to port to confirm identification (since many species are difficult to distinguish). Alternatively, photographs of the upper and lower body and bill may be sufficient.
6. Seabird by-catch rates can be standardised by estimating seabird abundance in the vicinity of the fishing vessel. A record of seabird by-catch mitigation measures, e.g. Tori lines, weighted hooks, shooting after dark, is also important.

4.4 Contractor's comments on reviews

4.4.1 The benefits of a simple by-catch protocol

A feature of some existing, documented by-catch monitoring protocols is the high level of detail that observers are required to report. However, the completeness and accuracy of reporting could depend on personal motivation, training, the level of competing duties such as the monitoring of targeted species, overall catch rates, as well as on the conditions at sea. Provision of high levels of training for observers across all fleets operating in the ICCAT region appears to be particularly difficult because of geographic and linguistic constraints. Some RFMOs, e.g. CCAMLR, require that two observers be present on a vessel so as to complete all duties. This also might be difficult for ICCAT CPCs to achieve.

Many of the benefits of highly detailed reporting are lost if reports are patchy or inaccurate. The opposite approach, aiming for consistent reporting of a limited suite of simple observations, has several arguments favouring it in the ICCAT context:

(i) Monitoring of by-catch alongside existing monitoring of target species is more feasible without additional observers.
(ii) Observers have more time for observing hauls, and identifying species or taxonomic groups.

(iii) Scientific analysis is relatively straightforward and opens the way to routine, e.g. annual presentations of results. This would be helpful politically as well as for motivating observers.
(iv) Data collection forms and a protocol would be relatively easy to translate into different languages.
(v) Gradual enhancement of a simple by-catch programme in the light of experience is easier than repair of a complicated programme and is less likely to make inconsistencies in the core data.
(vi) Statistically, datasets having more variables than observed records, or nearly so, are referred to as 'over-determined'. Models for different subsets of variables are then correlated for purely algebraic reasons leading to mutual support of what may be fallacious hypotheses. Put another way, it is best to prioritise variables on practical grounds prior to sampling and then to model the results consistently with that choice.
(vii) CPCs remain free to implement and resource more elaborate by-catch protocols for their own research.

4.4.2 Should by-catch CPUEs be standardised for local abundances?

BirdLife International proposed that CPUEs for seabirds should be standardised for the abundance of seabirds in the vicinity of fishing operations. Counting seabirds near a vessel is feasible approximately, assuming that observers can identify the flying birds accurately, but counting prior to capture is not feasible for most other types of by-catch living less visibly in the water. Therefore reporting of standardised CPUEs for seabirds to ICCAT would make them different from other groups.

Additionally, a question can be asked about the purpose of estimating by-catch rates of seabirds standardised for local abundances. Standardised CPUEs allow better comparisons of the overall lethality of different vessels, gears and mitigating measures in operation. On the other hand, they provide a false estimate of the absolute numbers of birds being killed by fishing operations. To see this, imagine that vessel A has 100 seabirds following it, and vessel B has 10 seabirds. Both fish 1000 hooks and catch 10 birds. Unstandardised CPUE is 10 birds per 1000 hooks in both cases, but the standardised CPUE for vessel A is 0.1 birds per 1000 hooks per bird in the air, and for vessel B is 1.0 per 1000 hooks (cancelling 'birds' from the units), a tenfold difference.

Knowledge of the numbers killed, and consistency of reporting among different animal groups seem more important in the context of ICCAT than comparisons among fishing vessels. On the other hand, observers should observe a sample of fishing operations, especially hauling, so as not to miss by-catch that is lost from the gear or discarded by the crew, and it would not be hard for them to estimate seabird abundances on, say, a geometric scale at the same time. This thinking is used in the following proposals (§4.5.1).

4.4.3 Allocation of an observer's time during a trip

Another point coming from the review is that observers' time should be explicitly allocated to the different components of the catch, i.e. targeted fish, non-targeted fish and elasmobranchs, reptiles, mammals, and birds. A fixed split between targeted fish and by-catch is needed when both are present to prevent an observer giving too much attention to one component or the other. One rational approach to the by-catch component is then to allocate time in approximate proportion to the numbers of animals in each zoological group. A routine with randomised sequencing of tasks

seems ideal. The purpose is to avoid favouring one component of the by-catch, e.g. interesting mammals or turtles, at the expense of other, possibly just-as-important components, thereby degrading overall data quality.

4.5 Proposed by-catch protocol and sampling forms for ICCAT

The contractor's independent proposals for a by-catch monitoring protocol drawn up as a partial response to task 4 of the by-catch contract are given in this section in *large italics*. Readers are reminded that the proposals have no official status.

The first requirement of a protocol is objectives. Several examples are given in the review above (§4.3). Those put forward by Birdlife International (§4.3.8) are commendably succinct and verifiable. It is only necessary to broaden them beyond seabirds. For example (with suggested embellishments in brackets):

The objectives for by-catch monitoring by sea-going observers in the ICCAT area are

1. To quantify mortalities of all types of untargeted species (paying special attention to those on the IUCN Red List, and those with significant ecological roles).
2. To understand (and explain) the contributing factors.
3. To make scaled-up estimates of total mortalities for (each type of) fishery.
4. To assess the effectiveness of by-catch mitigation measures (recommending improved and new systems when possible).
5. (To support research on by-catch species and their ecological roles as resources permit.)

The contractor's six proposals for meeting these objectives follow with a short justification below each. It is assumed that details of vessel and gear, fishing effort, use of fish aggregating devices (FADs), locations, times, weather and sea state are all being recorded accurately and routinely by observers. See for example, extracts from the resolution of the IOTC presented in section 4.3.4 above. This information is necessary for any catch monitoring programme and would often be important for processing by-catch data, e.g. to extrapolate observed results to estimates for the fishing trip or fleet. Proposals below refer only to the special requirements of by-catch monitoring.

Two categories of by-catch information are suggested for reporting. One, proposal 3, is for regular reporting of quantitative data to ICCAT to meet proposed objective 1. The other, proposal 4, relates to more detailed set-by-set, partly qualitative information that seems less suitable for regular transmission to ICCAT but which would be helpful for local management and occasional review by ICCAT as a contribution to proposed objective 4.

Following the general proposals, two data collection forms are suggested for use by observers in accordance with the proposals.

4.5.1 General proposals for an ICCAT by-catch protocol

1. *Observers should monitor an agreed list of 100-200 species whenever they occur as by-catch, provided that working conditions and safety considerations allow. The list of priority species should be distributed to all observer groups together with suitable, non-technical identification guides. Confusable species, difficult to distinguish at sea, should be grouped, also by agreement to encourage consistent reporting.*

The contractor did not attempt to recommend a list of by-catch species and groups to be monitored. Table 4 (at the end of this section) may be of assistance if ICCAT scientists tackle the task. It shows 27 species of seabird, 60 species of elasmobranch, 4 species of marine mammal, 5 species of teleost, and 6 species of sea turtle that are classified as 'near threatened' or more at risk of extinction by the IUCN. For conservation of biodiversity therefore, there are at least 102 species to include on an ICCAT priority list. The panels for elasmobranchs in table 4 also show (last column) recommendations of Prof. Nick Dulvy, Chair of Marine Biodiversity and Conservation, Simon Fraser University. He recommends a further 9 species of shark and ray not covered by the IUCN classifications. His letter of advice is shown in Annex 4. Many other species are rare as a result of fishing though they have not been classified as 'at risk' by IUCN because of inadequate information and a cautious attitude to raising alarms (Dulvy and Forrest, 2010). Typically, they are high-level predators (Myers and Worm, 2003), loss of which may be altering the trophic structure of pelagic ecosystems (Pauly *et al.*, 1998, Pauly and Watson, 2005, Casini *et al.*, 2008, Daskalov, 2008). Perhaps another 50 to 100 species could be added to the priority list if ICCAT scientists consider that the trophic aspect is also sufficiently important to justify ongoing monitoring of the relevant species.

The size of the list may, however, have to be restricted so that there can be agreement that all ICCAT observers will be trained to identify every species, or group of confusable species, on the list. A shared reference system for taxonomic identification should be available to all. Suggestions for achieving this are in §4.6.

2. *Observers should assign 50% of their working time to monitoring setting, hauling and by-catch, and 50% to monitoring target species whenever substantial quantities of both categories are caught.*

The value, 50%, is arbitrary and negotiable. Reasons for observing fishing operations are given under proposal 5 below. Possibly, less time is needed to observe operations with purse seines or baitboats than with longlines. The important point is that a split of working time should be agreed as guidance for observers.

3. *The taxonomic identities, numbers, and fate (dead and dying, or discarded and likely to live) of by-catch species together with measures of the associated fishing*

effort should be monitored for each observed set. The results, aggregated for agreed regions and periods, should be reported to ICCAT annually. Fishing effort and by-catch that was not observed should be excluded from the reports.

Quick processing of by-catch species at sea after identifying them is needed because the identifications alone may require much effort and this crucial aspect should not be compromised. If necessary, photographs or preserved specimens should taken for expert examination after the voyage. Numbers and fate are usually easy measures to make, report, and present. They also clearly contribute to knowledge about the effects of fishing on a species. Adding other measures typically made for target species, such as weights, lengths, maturity stage, manner of capture and so on is not recommended for an ICCAT protocol because it could sometimes distract observers from the basic task of identifying and enumerating by-catch species. Extra tasks might, however, be carried out for the purposes of special research programmes when adequate resources are supplied.

Proposal 3 specifically refers to observed effort because including the effort of hauls that were not sampled for by-catch would bias estimated CPUEs downwards.

4. Observers should also record:
(i) the total time spent observing the setting and hauling of gear;
(ii) any interactions of the gear seen with marine animals;
(iii) approximate assessments of abundances of seabirds and marine mammals observed to be vulnerable to fishing operations;
(iv) the effectiveness of by-catch mitigation measures seen operating; and
(v) environmental or other factors that may affect by-catch rates.
This information is intended firstly for national assessments of fishing procedures and by-catch mitigating measures. The assessments should also be available for reporting to ICCAT by-catch reviewing committees as required.

Observers should watch setting and hauling of the gear to learn whether fishing practices or environmental factors are increasing by-catches. For example, purse seines may be set around dolphins or turtles, and longline sets may leave bait at the surface for unnecessarily long times, or may occur in bright light when bait is most visible to seabirds. The effectiveness of by-catch mitigating measures can also be assessed by observing fishing operations. If animals, particularly seabirds and dolphins, are being caught during setting or hauling their abundance nearby is also relevant. This information can be used to standardise by-catch CPUE estimates if required for comparisons of the lethality of specific fishing operations. Simple rank-type abundances, repeated at intervals, are probably sufficient (e.g. as powers of ten: 0, 1 to 9, 10 to 99, 100 upwards). Watching hauling has additional importance for registering by-catch that escapes or is released and discarded.

The set-by-set, partly qualitative information collected under proposal 4 would be bulky and difficult to summarise in a spatial grid for example. Therefore, rather than transmitting it regularly to ICCAT, it should initially be considered nationally with the aim of reducing the environmental effects of local fishing vessels directly so far as practically possible. Later, observations and managerial actions could

be summarised for appropriate ICCAT meetings, e.g. those considering by-catch mitigating measures. Publicising environmental improvements should be encouraged to serve as good examples for the industry and to promote consumer confidence in the fish products.

5. *ICCAT should decide a regular sub-division of the ICCAT area that will be suitable for the systematic collection, analysis, and display of by-catch data and associated fishing effort. By-catch rates per unit of fishing effort should be regularly published using this grid.*

Ideally for simplest spatial analysis, the sub-division would use a regular grid, e.g. 5x5° squares, though the patchiness of fishing may dictate that irregular grid-cells are necessary. The size of the cells should be a compromise between smallness for geographic definition, and largeness to ensure that enough fishing effort will be observed annually in every cell to estimate CPUEs with reasonable precision. Possibly, different sizes of cell may be necessary for the different types of gear, e.g. longlines and purse seines, reflecting the different levels of effort and different by-catch species for each. However, use of different grids for different by-catch species seems undesirable because of the additional complexity. How to publish grids of results for many species would have to be decided. Possibly, selected species of most public interest could be published graphically, leaving results for other species as data files available for downloading from the ICCAT web site.

Several benefits could follow from spatial presentations of by-catch data. Distributions could be compared with distributions of fishing effort and of the species themselves (if known) to assess the degree of overlap, the conservation risk, and to see whether diversion of effort to other regions or seasons might reduce by-catch effectively. Spatial distributions might inform about the efficiencies of by-catch mitigation measures, and the relative abundances of populations, depending on what assumptions are acceptable. Consumer confidence in tuna products might benefit from accessible presentations of by-catch results on the web, particularly if improved care for the environment can be seen from them.

6. By-catch data should also be put towards regularly updated ecological risk assessments encompassing all monitored species (so far as practicable) with the intention of identifying any critical, fishery-related factors that might cause loss of biodiversity or de-stabilisation of pelagic ecosystems of the Atlantic.

Ecological risk assessments are recommended in preference to single-species stock assessments for by-catch because they are more consistent with a broadly based, ecosystem approach to monitoring effects of the fishery, and they identify and focus on the species of most concern. The risk assessments should be aimed at recommending mitigating measures and new research to address gaps in knowledge, as appropriate.

4.5.2 Form for setting or hauling the gear

The 'setting or hauling' form, shown in figure 4.5.2.1, is suggested for implementation of proposal 4 (§4.5.1). A feature of the form is the 'low, medium, or high' and ranked scales for some measures. This is intended to assist standardised computer processing across many CPCs. Completed forms

could be archived nationally by CPCs for periodic assessment of their own fisheries with respect to by-catches, and for advising ICCAT when requested. Regular submission of the setting or hauling forms to ICCAT is not suggested because of the large volumes of partly qualitative data involved.

Observation of all shots and hauls may not be necessary. If possible, the choice of shots and hauls to be observed should be scheduled randomly to minimise bias. Similarly, if the whole shot or haul cannot be observed, randomly selected periods should be monitored.

The heading fields are intended to link the form unambiguously with whatever form is being used to record the gear, co-ordinates, and shooting details of the set. There is then no need to repeat all of those details. The observer records the start and finish time of each observed period, the effectiveness of any by-catch mitigating measures seen in operation, and the abundances of visible animals such as birds and dolphins that appear at risk of being caught during the shooting operation. Observed effort, e.g. in thousands of hooks, is recorded for each of the observed periods during hauling. Any observed catches that are released or lost should be recorded on the By-catch form (§4.5.3) together with their fate, dead or likely to live. These data are thus stored alongside those for by-catch found when the haul has finished and the total catch is examined in detail. Approximate light levels and wind strength are recorded for each observed period since both can affect the CPUE for some species, notably seabirds. Finally, a box on the form allows the observer to comment generally on fishing techniques with respect to by-catch.

Figure 4.5.2.1 Proposal for a basic 'setting or hauling' form featuring standardised, ranked measures for easy processing at ICCAT. The form could be elaborated in many ways for specific fisheries and by-catch mitigating measures (BMM) provided that the distinction between fished and observed effort is retained.

Setting or Hauling form

Header fields to link with other forms where times, location, and fished effort of this set are given.

Ship and voyage identifiers:

Set identifier:

Observer identifier:

By-catch grid cell (if known):

By-catch mitigating measures (BMM):
BMM1 =
BMM2 =
BMM3 =

	Set or Haul?	Date	Time (GMT)
Start operation:			

Note: Take start and finish times from ship's log if not witnessed

Observations

Observed periods		Effort*	Are by-catch mitigating measures effective?			Abundances in fishing zone (circle range)			Conditions (0=zero, Low, Mid, Hi)	
		Unit=								
Start time	End time		BMM1	BMM2	BMM3	Mammals	Type of mammal	Seabirds	Light	Wind
			Yes Mid No	Yes Mid No	Yes Mid No	0, 1-3, 4-9, 10-30		0, 1-9, 10-99, 100-999	0 L M H	0 L M H
			Yes Mid No	Yes Mid No	Yes Mid No	0, 1-3, 4-9, 10-30		0, 1-9, 10-99, 100-999	0 L M H	0 L M H
			Yes Mid No	Yes Mid No	Yes Mid No	0, 1-3, 4-9, 10-30		0, 1-9, 10-99, 100-999	0 L M H	0 L M H
			Yes Mid No	Yes Mid No	Yes Mid No	0, 1-3, 4-9, 10-30		0, 1-9, 10-99, 100-999	0 L M H	0 L M H
			Yes Mid No	Yes Mid No	Yes Mid No	0, 1-3, 4-9, 10-30		0, 1-9, 10-99, 100-999	0 L M H	0 L M H

	Date	Time (GMT)
Finish operation:		

Comments on fishing technique in relation to by-catch:

*Only for hauling

4.5.3 Form for by-catch

This form is intended both for collecting basic by-catch and associated effort data at sea then, subsequently, for reporting them to ICCAT. Many CPCs already have forms that collect the suggested data fields as well as many others needed for specific fisheries or supplementary objectives. Here, it is suggested that one form having at least the basic fields would initially be completed for each haul of by-catch. Forms would then be assigned to by-catch grid cells (Proposal 5, §4.5.1) based on longitude and latitude of the set. The same form with a header identifying the grid cell could then be used by the CPC for sending these aggregated data to ICCAT. ICCAT would have the task of aggregating the forms from all CPCs for each taxon, by-catch grid cell, and major gear group. The by-catch database prepared for Tasks 1 and 2 of this contract is designed to store such measures for specified rectangular areas.

A paper version of the by-catch form should list the commonest species expected in by-catches by the gear in use and for the region being fished. This would save observers much, error-prone looking up and writing of scientific names and 3-letter ICCAT codes. The rarer species cannot all be included on a paper form unless it is several pages long. Therefore the names and codes of sporadically occurring species have to be written carefully onto the form by the observer. For each species in the by-catch, a line on the form is used to record the numbers caught but returned to the sea alive, the numbers killed, and any reference numbers for photographs taken or specimens saved for better identification. The proposed by-catch form is shown in figure 4.5.3.1.

An electronic version of the by-catch form issued to observers on a rugged portable computer would be easier to use since it would be possible to list all species likely to be encountered in a spreadsheet, thus minimising looking up and error-prone transcription work. Each species could also be linked to species identification sheets of the type prepared for this contract (see below §4.6) to help confirm identification.

Figure 4.5.3.1 Proposal for a basic by-catch form. Many CPCs already have more elaborate versions. Common species expected in each group could be printed on a paper version of this form to minimise transcription work. Rarer species would be written below, in empty rows, by hand. An electronic version of the form could show all species from the priority list, as well as links to identification sheets.

By-catch recording form							
Header fields to link with other forms where times, location, and fished effort of this set are given.							
Ship and voyage identifiers							
Set identifier							
Gear group							
Observer identifier							
Date and time of observations							
By-catch grid cell (if known):							
				Units			
Fishing effort producing this by-catch:							
Seabirds							
ICCAT code	**Scientific name**	**National name**	**N back in sea alive**	**Numbers killed**	**Ref. #s for photos**	**Ref. #s for specimens**	**Notes**
Mammals							
ICCAT code	**Scientific name**	**National name**	**N back in sea alive**	**Numbers killed**	**Ref. #s for photos**	**Ref. #s for specimens**	**Notes**
Turtles							
ICCAT code	**Scientific name**	**National name**	**N back in sea alive**	**Numbers killed**	**Ref. #s for photos**	**Ref. #s for specimens**	**Notes**
Elasmobranchs							
ICCAT code	**Scientific name**	**National name**	**N back in sea alive**	**Numbers killed**	**Ref. #s for photos**	**Ref. #s for specimens**	**Notes**
Teleosts							
ICCAT code	**Scientific name**	**National name**	**N back in sea alive**	**Numbers killed**	**Ref. #s for photos**	**Ref. #s for specimens**	**Notes**

4.6 Species identification sheets

Several good field guides written in English exist for the identification of fish, sharks, seabirds, and mammals found in the Atlantic and Mediterranean (Lythgoe and Lythgoe, 1991, Proctor and Lynch, 2005, Shirihai and Jarrett, 2006, Onley and Scofield, 2007). Other guides are available from the Food and Agriculture Organization (FAO, http://www.fao.org/icatalog/search/result.asp?subcat_id=49), Fishbase, Wikipedia and elsewhere on the web. The facilities for non-English speakers to identify by-catch species are not known by the contractor but may not be so good in some countries. Furthermore, a problem of standardisation can arise when different observers use different guide books in different languages for identifications. Even if all species are well identified, different scientific names and codes may be used, and confusable species put together into different groups. Ideally, a common set of guides will be available across the ICCAT region, as suggested in the wording of Task 4 of this contract (". . . e.g. adding species ID sheets for observer data collection forms . . . ") .

For these reasons, the contractor prepared species identification sheets designed to show essential diagnostic features, full-grown size, the national and scientific names, the ICCAT code, an indication of geographic distribution, the IUCN threat status, credits and sources of further information. The format of the sheets, with the minimum of text, is meant to be easy to translate into different languages. The A4 landscape presentation could be suitable for paper sheets in a ring binder, or for display on a laptop computer. The sheets are deliberately in black and white with colours merely labelled. This is to allow the full set of sheets to be fairly easily transmitted electronically and printed, as well as being usable in poor light. Furthermore, suitable colour illustrations were not available for many species, and several species show variable colours which fade after death. Confusable species are also listed on the sheets. These might form a basis for grouping hard-to-distinguish species together if required.

119 species identification sheets were prepared, including

- 8 albatrosses, 1 gannet, 3 petrels and 4 shearwaters among the birds,
- 62 species of sharks and rays,
- 17 teleost fish,
- 6 marine turtles, and
- 18 dolphins and whales among marine mammals

Many, but not all, of these species are listed as vulnerable to extinction by the International Union for the Conservation of Nature (IUCN). As explained in the Introduction of this report, resources for this work became available because other project resources were not being used. However, preparation of sheets for all of the 300 or so species that may be caught by tuna and shark fishing vessels in the Atlantic or Mediterranean could not be achieved during the project with these resources.

Taxonomic descriptions and illustrations published in the works listed above were used but most notably the FAO species identification guides for elasmobranchs and teleosts, "Albatrosses, petrels and shearwaters of the world" by Onley and Schofield (2007, Helm Field Guides, London), and "Whales, dolphins and seals" by Shirihai and Jarrett (2006, A & C Black, London). [Mention of these references is not intended to suggest that the many others available might be inferior.] A possible

collaboration between ICCAT and FAO for identifying by-catch of tuna fisheries is under consideration. Some images that were used are in the public domain (e.g. on Wikipedia) but this still leaves some restrictions, e.g. if ICCAT wishes to put its own copyright on the sheets. For other images, copyright holders were written to and several positive replies received. See Annex 5. A few require fees. One solution to copyright problems would be if ICCAT scientists could provide good copyright-free images for tracing. The images should preferably show front, back, and side profiles with close-ups of small diagnostic features. The many "pretty" photographs available on the internet are seldom useful for identifications unfortunately.

Three examples of prepared species identification sheets are shown in figures 4.6.1-3. It was necessary to reduce the sizes of the sheets and to experiment with different file types to get the clearest presentations in this report. The full set of 119 sheets is available as .pdf files from the ICCAT Secretariat. A short, accompanying 'readme' text encourages users of the sheets to advise the contractor of any adjustments to the sheets that may seem necessary.

Figure 4.6.1 Species identification sheet for the black-browed albatross as proposed for use by ICCAT fisheries observers.

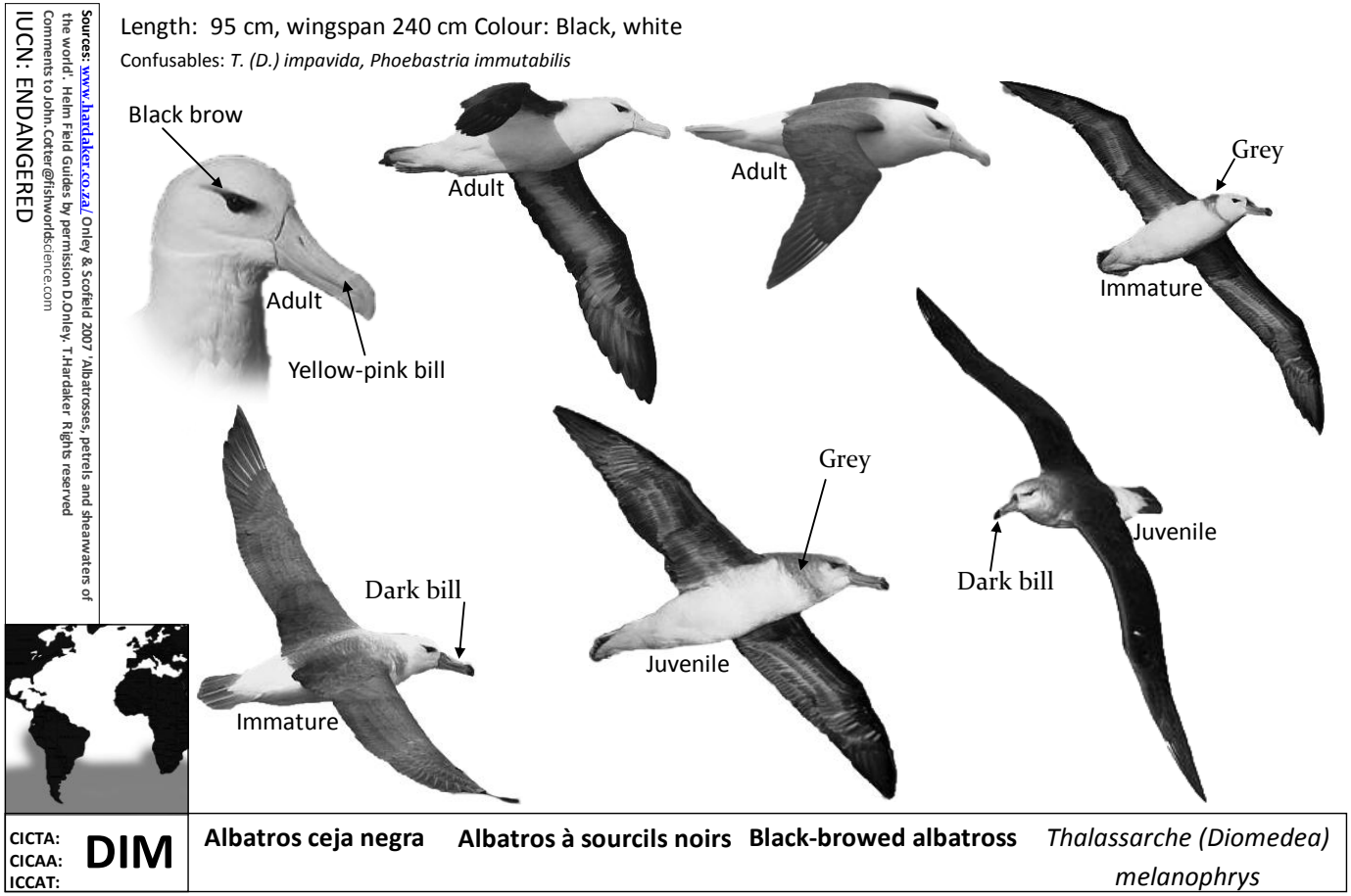
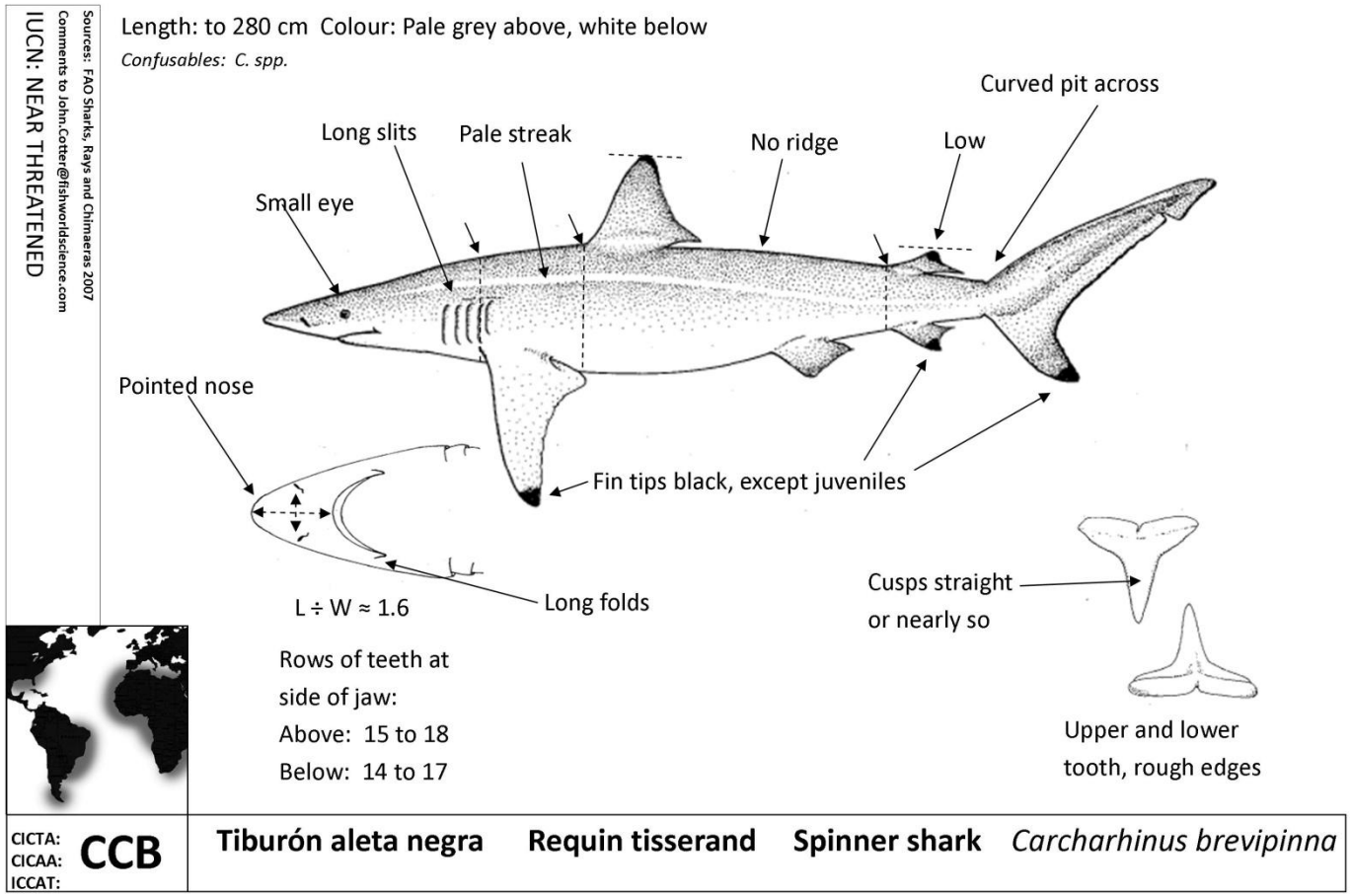


Figure 4.6.2 Species identification sheet for the spinner shark as proposed for use by ICCAT fisheries observers.



igure 4.6.3 Species identification sheet for the Kemp's ridley turtle as proposed for use by ICCAT fisheries observers.

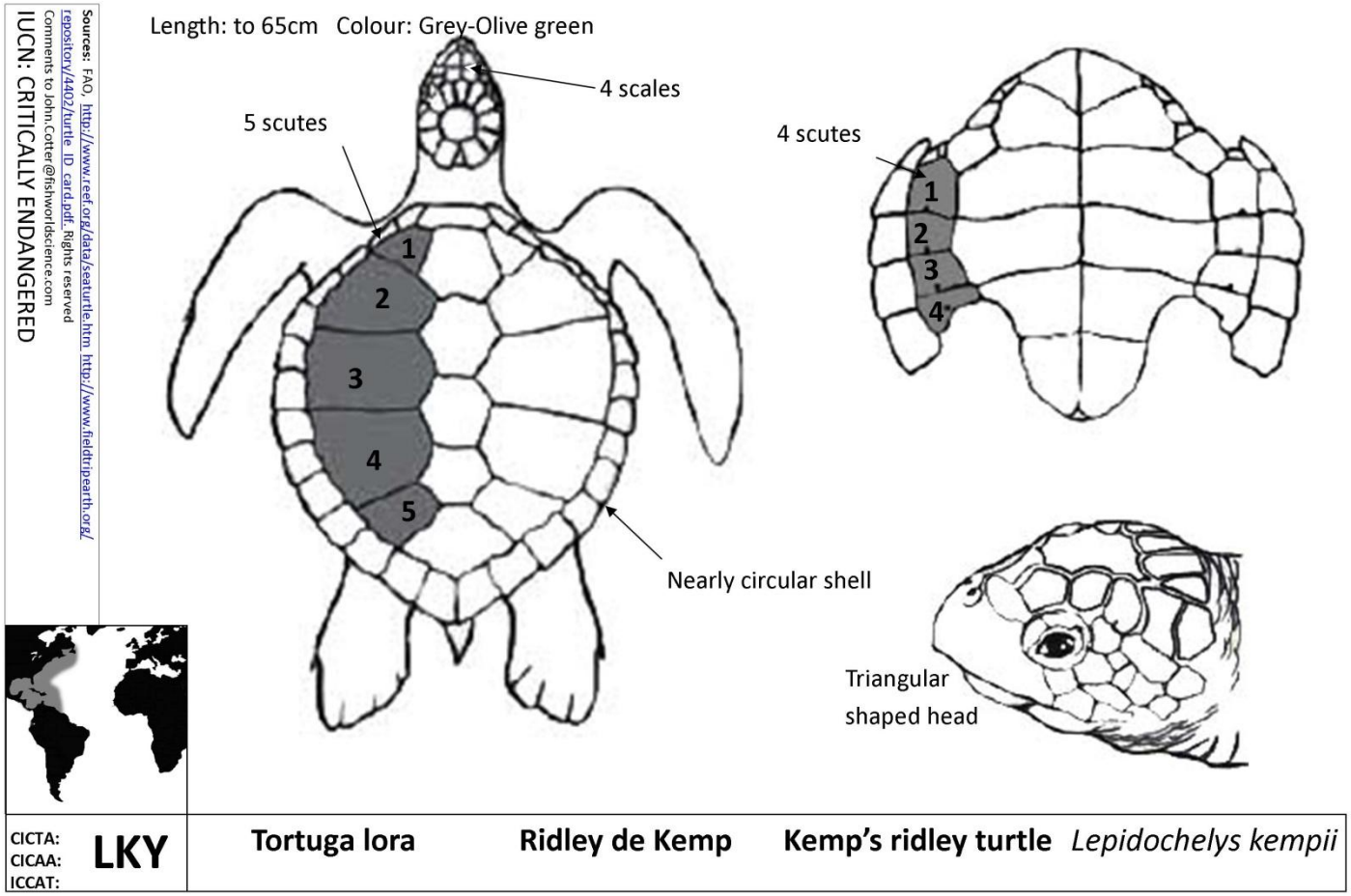


Table 4 Lists of species sorted by vertebrate group and declared IUCN status (if available). Rows were taken from ICCAT lists supplemented by by-catch species referred to in recent papers (>2004) in the ICCAT Collective Volume of Scientific Papers series (coded A01, A02,..., B01... but replaced with FAO 3A codes if available). French, US pelagic observer program (POP), and ICCAT columns indicate species to which those authorities have assigned codes for reporting purposes. The panels for Elasmobranchs have an extra column showing recommendations for monitoring provided by Nicholas Dulvy, Professor of Marine Biodiversity and Conservation, Simon Fraser University, Canada. See also Annex 4.

Turtles

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
TTL	Turtles	Caretta caretta	Loggerhead turtle	Endangered	✓	✓	
TUG	Turtles	Chelonia mydas	Green turtle	Endangered	✓	✓	
DKK	Turtles	Dermochelys coriacea	Leatherback turtle	Crit. Endangered	✓	✓	
TTH	Turtles	Eretmochelys imbricata	Hawksbill turtle	Crit. Endangered	✓	✓	
LKY	Turtles	Lepidochelys kempii	Kemps Ridley turtle	Crit. Endangered	✓	✓	
LKV	Turtles	Lepidochelys olivacea	Olive Ridley turtle	Vulnerable	✓		

Marine mammals

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
A71	Mammals	Arctocephalus sp.	Fur seals				
MIW	Mammals	Balaenoptera acutorostrata	Minke whale		✓		
SIW	Mammals	Balaenoptera borealis	Sei whale	Endangered	✓		
BRW	Mammals	Balaenoptera edeni	Bryde's whale	Data Deficient	✓		
FIW	Mammals	Balaenoptera physalus	Fin whale	Endangered	✓		
DCO	Mammals	Delphinus delphis	Common dolphin		✓	✓	
EUG	Mammals	Eubalaena glacialis	Northern right whale	Endangered			
B12	Mammals	Eubalena australis	Southern right whale				
SHW	Mammals	Globicephala macrorhynchus	Shortfin pilot whale	Data Deficient	✓	✓	
PIW	Mammals	Globicephala melas	Pilot whale	Data Deficient	✓	✓	
DRR	Mammals	Grampus griseus	Risso's dolphin		✓	✓	
PYW	Mammals	Kogia breviceps	Pygmy sperm whale	Data Deficient	✓	✓	
DWH	Mammals	Lagenorhynchus acutus	Atlantic whiteside dolphin				
HUW	Mammals	Megaptera novaeangliae	Humpback whale				
MEP	Mammals	Mesoplodon sp.	Beaked whales				
KIW	Mammals	Orcinus orca	Killer whale	Data Deficient	✓	✓	
A72	Mammals	Otaria flavescens	Sea lion				
PHR	Mammals	Phocoena phocoena	Harbour porpoise				
SPW	Mammals	Physeter macrocephalus	Sperm whale	Vulnerable	✓		
FAW	Mammals	Pseudorca crassidens	False killer whale	Data Deficient	✓		
DPN	Mammals	Stenella attenuata	Pantropical spotted dolphin		✓	✓	
DCL	Mammals	Stenella clymene	Shortsnouted spinner dolphin	Data Deficient	✓	✓	
DST	Mammals	Stenella coeruleoalba	Striped dolphin		✓	✓	
DSA	Mammals	Stenella frontalis	Atlantic spotted dolphin	Data Deficient	✓	✓	
DSI	Mammals	Stenella longirostris	Spinner dolphin	Data Deficient	✓		
A59	Mammals	Stenella plagiodon	Atlantic spotted dolphin	Data Deficient			
RTD	Mammals	Steno bredanensis	Rough-toothed dolphin		✓		
DBO	Mammals	Tursiops truncatus	Bottlenose dolphin		✓	✓	
BCW	Mammals	Ziphius cavirostris	Goosebeaked whale		✓		

Table 4 continued. Seabirds

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
A32	Birds	Calonectris diomedea	Cory's shearwater			✓	
A31	Birds	Calonectris edwardsii	Cape Verde Shearwater	Near Threatened			
A35	Birds	Catharacta skua	Great skua				
A30	Birds	Daption capense	Cape petrel				
DCR	Birds	Diomedea chlororhynchos	Atl. yellow-nosed albatross	Endangered			
A53	Birds	Diomedea dabbenena	Tristan albatross	Crit. Endangered			
DIP	Birds	Diomedea epomophora	Southern royal albatross	Vulnerable			
DIX	Birds	Diomedea exulans	Wandering albatross	Vulnerable			
DIM	Birds	Diomedea melanophrys	Black-browed albatross	Endangered			
A45	Birds	Diomedea sanfordi	Northern royal albatross	Endangered			
B07	Birds	Fratercula arctica	Atlantic puffin				
A42	Birds	Fulmarus glacialis	Northern fulmar				
A49	Birds	Fulmarus glacialoides	Southern fulmar				
A39	Birds	Larus argentatus	Herring gull			✓	
A41	Birds	Larus atricilla	Laughing gull				
A23	Birds	Larus audouinni	Audouin's gull	Near Threatened			
A57	Birds	Larus cachinnans	Yellow-legged gull				
A33	Birds	Larus marinus	Great black-backed gull				
A50	Birds	Macronectes giganteus	Southern giant petrel				
A44	Birds	Macronectes halli	Northern giant petrel				
A43	Birds	Morus bassanus	Northern gannet			✓	
A29	Birds	Morus capensis	Cape gannet	Vulnerable			
B03	Birds	Phoebastria albatrus	Short-tailed albatross	Vulnerable			
B02	Birds	Phoebastria nigripes	Black-footed albatross	Endangered			
PHU	Birds	Phoebetria fusca	Sooty albatross	Endangered			
A87	Birds	Phoebetria palpebrata	Light-mantled albatross	Near Threatened			
A55	Birds	Procellaria aequinoctialis	White-chinned petrel	Vulnerable			
A37	Birds	Procellaria cinerea	Grey petrel	Near Threatened			
A52	Birds	Procellaria conspicillata	Spectacled petrel	Vulnerable			
A74	Birds	Pterodroma arminjoniana	Trindade petrel	Vulnerable			
A26	Birds	Pterodroma cahow	Bermuda petrel	Endangered			
A28	Birds	Pterodroma hasitata	Black-capped petrel	Endangered			
PDM	Birds	Pterodroma macroptera	Great-winged petrel				
PFC	Birds	Puffinus carneipes	Flesh-footed shearwater				
PUG	Birds	Puffinus gravis	Great shearwater			✓	
A48	Birds	Puffinus griseus	Sooty shearwater	Near Threatened			
A24	Birds	Puffinus lherminieri	Audubon's shearwater				
A25	Birds	Puffinus mauritanicus	Balearic shearwater	Crit. Endangered			
B06	Birds	Puffinus puffinus	Manx shearwater				
A56	Birds	Puffinus yelkoan	Yelkouan shearwater	Near Threatened			
A40	Birds	Thalassarche carteri	Indian yellow-nosed albatross	Endangered			
DCU	Birds	Thalassarche cauta	Shy albatross	Near Threatened			
A38	Birds	Thalassarche chrysostoma	Grey-headed albatross	Vulnerable			
A27	Birds	Thalassarche melanophrys	Black-browed albatross	Endangered			
B05	Birds	Thalassarche steadi	White-capped albatross	Near Threatened			

Table 4 continued. Elasmobranchs, panel 1 of 3

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT	Dulvy recom
PTH	Elasmobr.	Alopias pelagicus	Pelagic thresher	Vulnerable	✓		✓	✓
THR	Elasmobr.	Alopias sp.	Thresher sharks		✓	✓	✓	
BTH	Elasmobr.	Alopias superciliosus	Bigeye thresher	Vulnerable	✓	✓	✓	
ALV	Elasmobr.	Alopias vulpinus	Thresher	Vulnerable	✓	✓	✓	✓
AVO	Elasmobr.	Anoplagonus inermis	Smooth alligatorfish					
API	Elasmobr.	Apristurus sp.	Deep-water catsharks				✓	
RSK	Elasmobr.	Carcharhinidae	Requiem sharks				✓	
CVX	Elasmobr.	Carcharhiniformes	Ground sharks		✓		✓	
CCN	Elasmobr.	Carcharhinus acronotus	Blacknose shark	Near Threatened		✓	✓	
ALS	Elasmobr.	Carcharhinus albimarginatus	Silvertip shark	Near Threatened			✓	✓
CCA	Elasmobr.	Carcharhinus altimus	Bignose shark	Data Deficient		✓	✓	✓
BRO	Elasmobr.	Carcharhinus brachyurus	Copper shark	Near Threatened			✓	✓
CCB	Elasmobr.	Carcharhinus brevipinna	Spinner shark	Near Threatened		✓	✓	✓
FAL	Elasmobr.	Carcharhinus falciformis	Silky shark	Near Threatened	✓	✓	✓	✓
CCG	Elasmobr.	Carcharhinus galapagensis	Galapagos shark	Near Threatened				✓
CCO	Elasmobr.	Carcharhinus isodon	Finetooth shark			✓	✓	✓
CCE	Elasmobr.	Carcharhinus leucas	Bull shark	Near Threatened		✓	✓	✓
CCL	Elasmobr.	Carcharhinus limbatus	Blacktip shark	Near Threatened		✓	✓	✓
OCS	Elasmobr.	Carcharhinus longimanus	Oceanic whitetip shark	Vulnerable	✓	✓	✓	✓
CCM	Elasmobr.	Carcharhinus macloti	Hardnose shark	Near Threatened			✓	
BLR	Elasmobr.	Carcharhinus melanopterus	Blacktip reef shark	Near Threatened			✓	
DUS	Elasmobr.	Carcharhinus obscurus	Dusky shark	Vulnerable		✓	✓	✓
CCV	Elasmobr.	Carcharhinus perezi	Caribbean reef shark	Near Threatened		✓		✓
CCP	Elasmobr.	Carcharhinus plumbeus	Sandbar shark	Vulnerable		✓	✓	✓
CCR	Elasmobr.	Carcharhinus porosus	Smalltail shark	Data Deficient			✓	
CCI	Elasmobr.	Carcharhinus sealei	Blackspot shark	Near Threatened			✓	
CCS	Elasmobr.	Carcharhinus signatus	Night shark	Vulnerable		✓	✓	✓
CCT	Elasmobr.	Carcharias taurus	Sand tiger shark	Vulnerable			✓	
WSH	Elasmobr.	Carcharodon carcharias	Great white shark	Vulnerable	✓		✓	✓
GUP	Elasmobr.	Centrophorus granulosus	Gulper shark	Vulnerable			✓	
CPL	Elasmobr.	Centrophorus lusitanicus	Lowfin gulper shark	Vulnerable			✓	
GUQ	Elasmobr.	Centrophorus squamosus	Leafscale gulper shark	Vulnerable			✓	
CPU	Elasmobr.	Centrophorus uyato	Little gulper shark	Data Deficient			✓	
CFB	Elasmobr.	Centroscyllium fabricii	Black dogfish				✓	
CYO	Elasmobr.	Centroscymnus coelolepis	Portuguese dogfish	Near Threatened			✓	
CYP	Elasmobr.	Centroscymnus crepidater	Longnose velvet dogfish				✓	
CYY	Elasmobr.	Centroscymnus cryptacanthus	Shortnose velvet dogfish				✓	
BSK	Elasmobr.	Cetorhinus maximus	Basking shark	Vulnerable	✓		✓	✓
HXC	Elasmobr.	Chlamydoselachus anguineus	Frill shark	Near Threatened				
SCK	Elasmobr.	Dalatias licha	Kitefin shark	Near Threatened			✓	
A83	Elasmobr.	Dasyatidae	Stingrays		✓			
RDA	Elasmobr.	Dasyatis americana	Southern stingray	Data Deficient				
RDC	Elasmobr.	Dasyatis centroura	Roughtail stingray					
PLS	Elasmobr.	Dasyatis violacea	Pelagic stingray	Data Deficient	✓			
DCA	Elasmobr.	Deania calcea	Birdbeak dogfish				✓	
DNA	Elasmobr.	Deania sp.	Deania dogfishes				✓	
SHB	Elasmobr.	Echinorhinus brucus	Bramble shark	Data Deficient			✓	
ETR	Elasmobr.	Etmopterus princeps	Great lanternshark	Data Deficient			✓	
ETP	Elasmobr.	Etmopterus pusillus	Smooth lanternshark				✓	
SHL	Elasmobr.	Etmopterus sp.	Lanternsharks		✓		✓	
ETX	Elasmobr.	Etmopterus spinax	Velvet belly				✓	
TIG	Elasmobr.	Galeocerdo cuvier	Tiger shark	Near Threatened	✓	✓	✓	✓
GAG	Elasmobr.	Galeorhinus galeus	Tope shark	Vulnerable			✓	✓
B09	Elasmobr.	Galeus atlanticus	Atlantic catshark	Near Threatened				

Table 4 continued. Elasmobranchs, panel 2 of 3

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT	commer
SHO	Elasmobr.	Galeus melastomus	Blackmouth catshark				✓	
GAU	Elasmobr.	Galeus sp.	Crest-tail catsharks				✓	
GNC	Elasmobr.	Ginglymostoma cirratum	Nurse shark	Data Deficient			✓	
GNG	Elasmobr.	Ginglymostoma sp.	Nurse sharks				✓	
HXT	Elasmobr.	Heptranchias perlo	Sharpnose sevengill shark	Near Threatened				
SBL	Elasmobr.	Hexanchus griseus	Bluntnose sixgill shark	Near Threatened			✓	
ISB	Elasmobr.	Isistius brasiliensis	Cookiecutter shark		✓	✓		
SMA	Elasmobr.	Isurus oxyrinchus	Shortfin mako	Vulnerable	✓	✓	✓	✓
LMA	Elasmobr.	Isurus paucus	Longfin mako	Vulnerable		✓	✓	✓
MAK	Elasmobr.	Isurus sp.	Mako sharks			✓	✓	
LMT	Elasmobr.	Lamiopsis temmincki	Broadfin shark	Endangered			✓	
LMD	Elasmobr.	Lamna ditropis	Salmon shark				✓	✓
POR	Elasmobr.	Lamna nasus	Porbeagle	Vulnerable		✓	✓	✓
MSK	Elasmobr.	Lamnidae	Mackerel sharks,porbeagles		✓		✓	
RJF	Elasmobr.	Leucoraja fullonica	Shagreen ray	Near Threatened				
RMB	Elasmobr.	Manta birostris	Manta ray	Near Threatened	✓			
LMP	Elasmobr.	Megachasma pelagios	Megamouth shark	Data Deficient	✓			
RMH	Elasmobr.	Mobula hypostoma	Ray sp.	Data Deficient				
A86	Elasmobr.	Mobula japanica	Mobula japanica	Near Threatened				
A01	Elasmobr.	Mobula lucasana	Ray sp.	Near Threatened				
RMM	Elasmobr.	Mobula mobular	Devil ray	Endangered	✓			✓
A82	Elasmobr.	Mobula tarapacana	Chilean devil ray	Data Deficient				✓
A94	Elasmobr.	Mobulidae	Devil rays			✓		
SDS	Elasmobr.	Mustelus asterias	Starry smooth-hound				✓	
CTI	Elasmobr.	Mustelus canis	Dusky smooth-hound	Near Threatened		✓		
CTK	Elasmobr.	Mustelus henlei	Brown smooth-hound				✓	
MTR	Elasmobr.	Mustelus morrisi	Narrowfin smooth-hound	Data Deficient				
SMD	Elasmobr.	Mustelus mustelus	Smooth-hound	Vulnerable			✓	
SDP	Elasmobr.	Mustelus schmitti	Narrownose smooth-hound	Endangered			✓	
SDV	Elasmobr.	Mustelus sp.	Smooth-hounds				✓	
MYL	Elasmobr.	Myliobatis aquila	Common eagle ray	Data Deficient	✓			
NGB	Elasmobr.	Negaprion brevirostris	Lemon shark	Near Threatened			✓	
NTC	Elasmobr.	Notorynchus cepedianus	Broadnose sevengill shark	Data Deficient			✓	
LOO	Elasmobr.	Odontaspis ferox	Smalltooth sand shark	Vulnerable				✓
ODH	Elasmobr.	Odontaspis noronhai	Smalltooth sand tiger	Data Deficient				✓
OXY	Elasmobr.	Oxynotus centrina	Angular roughshark	Vulnerable			✓	
OXN	Elasmobr.	Oxynotus paradoxus	Sailfin roughshark	Data Deficient			✓	
A90	Elasmobr.	Paragaleus pectoralis	Paragaleus pectoralis	Data Deficient				
BSH	Elasmobr.	Prionace glauca	Blue shark	Near Threatened	✓	✓	✓	✓
PCH	Elasmobr.	Pseudocarcharias kamoharai	Crocodile shark	Near Threatened		✓		✓
PTM	Elasmobr.	Pseudotriakis microdon	False catshark	Data Deficient			✓	
MPO	Elasmobr.	Pteromylaeus bovinus	Bull ray	Data Deficient				
A73	Elasmobr.	Pteroplatytrygon violacea	Pelagic stingray			✓		✓
RFL	Elasmobr.	Raja straeleni	Spotted skate	Data Deficient				
RHN	Elasmobr.	Rhincodon typus	Whale shark	Vulnerable	✓		✓	✓
A02	Elasmobr.	Rhinoptera sp.	Cownose ray		✓		✓	
A89	Elasmobr.	Rhizoprionodon acutus	Sharp-nosed shark					
RHR	Elasmobr.	Rhizoprionodon porosus	Caribbean sharpnose shark					
RHZ	Elasmobr.	Rhizoprionodon sp.	Sharpnose sharks				✓	
RHT	Elasmobr.	Rhizoprionodon terraenovae	Atlantic sharpnose shark			✓	✓	
SAU	Elasmobr.	Scomberesox saurus	Atlantic saury					
SCL	Elasmobr.	Scyliorhinidae	Catsharks, nursehounds				✓	
SYC	Elasmobr.	Scyliorhinus canicula	Small-spotted catshark				✓	
SYT	Elasmobr.	Scyliorhinus stellaris	Nursehound	Near Threatened			✓	
SYO	Elasmobr.	Scymnodon obscurus	Smallmouth knifetooth dogfish				✓	
SYR	Elasmobr.	Scymnodon ringens	Knifetooth dogfish	Data Deficient			✓	

Table 4 continued. Elasmobranchs, panel 3 of 3

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT	commer
GSK	Elasmobr.	Somniosus microcephalus	Greenland shark	Near Threatened		✓	✓	
SOR	Elasmobr.	Somniosus rostratus	Little sleeper shark	Data Deficient			✓	
SPV	Elasmobr.	Sphyrna couardi	Hammerhead shark					✓
SPL	Elasmobr.	Sphyrna lewini	Scalloped hammerhead	Endangered	✓	✓	✓	✓
SPK	Elasmobr.	Sphyrna mokarran	Great hammerhead	Endangered	✓	✓	✓	✓
SPJ	Elasmobr.	Sphyrna tiburo	Bonnethead				✓	✓
SPZ	Elasmobr.	Sphyrna zygaena	Smooth hammerhead	Vulnerable	✓	✓	✓	✓
SPN	Elasmobr.	Sphyrnidae	Hammerhead sharks		✓	✓	✓	
DGX	Elasmobr.	Squalidae	Dogfish sharks			✓	✓	
QUL	Elasmobr.	Squaliolus laticaudus	Spined pygmy shark					
DGS	Elasmobr.	Squalus acanthias	Picked dogfish	Vulnerable		✓	✓	
QUB	Elasmobr.	Squalus blainvielli	Longnose spurdog	Data Deficient				
QUC	Elasmobr.	Squalus cubensis	Cuban dogfish	Data Deficient				
DOP	Elasmobr.	Squalus megalops	Shortnose spurdog	Data Deficient			✓	
SUA	Elasmobr.	Squatina aculeata	Sawback angelshark	Crit. Endangered				
SUT	Elasmobr.	Squatina oculata	Smoothback angelshark	Endangered				
AGN	Elasmobr.	Squatina squatina	Angelshark	Crit. Endangered			✓	
ASK	Elasmobr.	Squatinidae	Angelsharks, sand devils				✓	
TTO	Elasmobr.	Torpedo nobiliana	Torpedo ray	Data Deficient				✓
LES	Elasmobr.	Triakis semifasciata	Leopard shark				✓	
SSQ	Elasmobr.	Zameus squamulosus	Velvet dogfish	Data Deficient				

Table 4 continued. Teleosts & tunas, panel 1 of 3

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
AJS	Teleosts	Abalistes stellatus	Starry triggerfish		✓	✓	
WAH	Tunas	Acanthocybium solandri	Wahoo		✓		✓
ALO	Teleosts	Alepisaurus brevirostris	Shortnose lancetfish				
ALX	Teleosts	Alepisaurus ferox	Longnose lancetfish				
ALI	Teleosts	Alepisaurus sp.	Lancet fish			✓	
SLT	Tunas	Allothunnus fallai	Slender tuna				✓
A04	Teleosts	Alutera punctata	Alutera punctata				
ALM	Teleosts	Aluterus monoceros	Unicorn leatherjacket		✓		
ALN	Teleosts	Aluterus scriptus	Scrawled filefish				
BSF	Teleosts	Aphanopus carbo	black scabbardfish				
BLT	Tunas	Auxis rochei	Bullet tuna				✓
FRI	Tunas	Auxis thazard	Frigate tuna				✓
TRG	Teleosts	Balistes carolinensis	Grey triggerfish		✓		
A06	Teleosts	Balistes punctatus	Bluespotted triggerfish		✓		
TRI	Teleosts	Balistidae	Triggerfishes		✓		
GAR	Teleosts	Belone belone	Needlefish				
BES	Teleosts	Belonidae	Needlefishes		✓		
POA	Teleosts	Brama brama	Atlantic pomfret				
A07	Teleosts	Brama raii	Pomfret				
A78	Teleosts	Bramidae	Pomfrets		✓	✓	
VAD	Teleosts	Campogramma glaycos	Vadigo				
CNT	Teleosts	Canthidermis maculatus	Rough triggerfish		✓		
B28	Teleosts	Canthidermis sufflamen	Ocean triggerfish				
RUB	Teleosts	Caranx crysos	Blue runner		✓		
CVJ	Teleosts	Caranx hippos	Crevalle jack				
CXS	Teleosts	Caranx sexfasciatus	Bigeye trevally				
NXL	Teleosts	Caranx latus	Horse-eye jack				
CEO	Teleosts	Centrolophus niger	Black ruff				
CFW	Teleosts	Coryphaena equiselis	Pompano dolphin fish		✓		
DOL	Teleosts	Coryphaena hippurus	Dolphin fish		✓		
UBB	Teleosts	Cubiceps baxteri	Black fathead				
UBU	Teleosts	Cubiceps pauciradiatus	Bigeye cigarfish			✓	
LEB	Tunas	Cybiosarda elegans	Leaping bonito				
DIY	Teleosts	Diodon hystrix	Porcupinefish		✓		
TOP	Teleosts	Dissostichus eleginoides	Patagonian Toothfish				
ECN	Teleosts	Echeneidae	Remoras		✓	✓	
RRU	Teleosts	Elagatis bipinnulata	Rainbow runner		✓	✓	
ANE	Teleosts	Engraulis encrasicolus	European anchovy				
GPX	Teleosts	Epinephelus sp.	Groupers				
A09	Teleosts	Euleptorhamphus velox	Flying halfbeak		✓		
KAW	Tunas	Euthynnus affinis	Kawakawa				
LTA	Tunas	Euthynnus alletteratus	Little tunny			✓	✓
BKJ	Tunas	Euthynnus lineatus	Black skipjack				
FLY	Teleosts	Exocoetidae	Flying fishes		✓		
COD	Teleosts	Gadus morhua	Cod	Vulnerable			
BUK	Tunas	Gasterochisma melampus	Butterfly kingfish				
GES	Teleosts	Gempylus serpens	Snake mackerel				
SHM	Tunas	Grammatorcynus bicarinatus	Shark mackerel				
DBM	Tunas	Grammatorcynus bilineatus	Double-lined mackerel				
DOT	Tunas	Gymnosarda unicolor	Dogtooth tuna				
A11	Teleosts	Hippocampus guttulatus	Common seahorse	Data Deficient			
HDR	Teleosts	Hirundichthys rondeleti	Blackwing flyingfish				
BIL	Tunas	Istiophoridae	Billfishes			✓	✓
SAI	Tunas	Istiophorus albicans	Atlantic sailfish		✓	✓	✓
SFA	Tunas	Istiophorus platypterus	Indo-Pacific sailfish		✓		
SKJ	Tunas	Katsuwonus pelamis	Skipjack tuna			✓	✓
A12	Teleosts	Kyphosus sectator	Bermuda chub		✓		

Table 4 continued. Teleosts & tunas, panel 2 of 3

Code	Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
KYP	Teleosts	Kyphosus sp.	Sea chubbs		✓		
A64	Teleosts	Labotes surinamensis	Atlantic tripletail				
LGH	Teleosts	Lagocephalus lagocephalus	Oceanic pufferfish				
LAG	Teleosts	Lampris guttatus	Opah		✓	✓	
LEC	Teleosts	Lepidocybium flavobrunneum	Escolar			✓	
SFS	Teleosts	Lepidopus caudatus	Silver scabbardfish				
LEE	Teleosts	Lichia amia	Leerfish				
LOB	Teleosts	Lobotes surinamensis	Tripletail		✓	✓	
ANG	Teleosts	Lophius americanus	Goosefish				
MON	Teleosts	Lophius piscatorius	Monk fish				
LVM	Teleosts	Luvarus imperialis	Luvar				
RTX	Teleosts	Macrouridae	Rat-tails				
BLM	Tunas	Makaira indica	Black marlin		✓		✓
BLZ	Tunas	Makaira mazara	Indo-Pacific blue marlin				
BUM	Tunas	Makaira nigricans	Atlantic blue marlin		✓	✓	✓
MRW	Teleosts	Masturus lanceolatus	Sharp-tail sunfish		✓	✓	
MOX	Teleosts	Mola mola	Ocean sunfish		✓	✓	
MOP	Teleosts	Mola sp.	Sunfishes			✓	
BLI	Teleosts	Molva dypterygia	Blue ling				
MMH	Teleosts	Muraena helena	Muray eel				
NAU	Teleosts	Naucrates ductor	Pilotfish		✓		
NEN	Teleosts	Nesiarchus nasutus	Black gemfish				
A14	Teleosts	Ophichthidae	Eels				
BOP	Tunas	Orcynopsis unicolor	Plain bonito				✓
RPG	Teleosts	Pagrus pagrus	Common sea bream	Endangered			
HTL	Teleosts	Phtheirichthys lineatus	Slender suckerfish		✓		
WRF	Teleosts	Polyprion americanus	Stone bass	Data Deficient			
A93	Teleosts	Polyprion moeone	Bass grouper				
BLU	Teleosts	Pomatomus saltatrix	Bluefish			✓	
TRZ	Teleosts	Pseudocaranx dentex	Guelly jack				
A15	Teleosts	Pseudotolithis sp.	Cassava fishes				
CBA	Teleosts	Rachycentron canadum	Cobia				
RZV	Teleosts	Ranzania laevis	Slender mora				
REL	Teleosts	Regalecus glesne	Oarfish				
A16	Teleosts	Remora osteochir	Marlin sucker				
REO	Teleosts	Remora remora	Remora remora		✓		
RRL	Teleosts	Remorina albescens	White suckerfish		✓		
OIL	Teleosts	Ruvettus pretiosus	Oilfish		✓	✓	
BAU	Tunas	Sarda australis	Australian bonito				
BEP	Tunas	Sarda chiliensis	Eastern Pacific bonito				
BIP	Tunas	Sarda orientalis	Striped bonito				
BON	Tunas	Sarda sarda	Atlantic bonito		✓	✓	✓
A17	Teleosts	Schedophilus medusophagus	Blackfishes				
HDV	Teleosts	Schedophilus ovalis	Imperial blackfish				
RDM	Teleosts	Sciaenops ocellatus	Red drum				
MAS	Teleosts	Scomber japonicus	Chub mackerel			✓	
MAC	Teleosts	Scomber scombrus	Atlantic mackerel		✓		
SER	Teleosts	Scomberomorus brasiliensis	Serra Spanish mackerel				
BRS	Tunas	Scomberomorus brasiliensis	Serra Spanish mackerel				✓
KGM	Tunas	Scomberomorus cavalla	King mackerel			✓	✓
COM	Tunas	Scomberomorus commerson	Narrow-barred Spanish mackerel				
MOS	Tunas	Scomberomorus concolor	Monterey Spanish mackerel	Endangered			
GUT	Tunas	Scomberomorus guttatus	Indo-Pacific king mackerel				
KOS	Tunas	Scomberomorus koreanus	Korean seerfish				
STS	Tunas	Scomberomorus lineolatus	Streaked seerfish				
SSM	Tunas	Scomberomorus maculatus	Atlantic Spanish mackerel				✓
PAP	Tunas	Scomberomorus multiradiatus	Papuan seerfish				
ASM	Tunas	Scomberomorus munroi	Australian spotted mackerel				
NPH	Tunas	Scomberomorus niphonius	Japanese Spanish mackerel				

Table 4 continued. Teleosts & tunas, panel 3 of 3

Group	Sci Name	English	IUCN status	French	US PoP	ICCAT
Tunas	Scomberomorus plurilineatus	Kanadi kingfish				
Tunas	Scomberomorus queenslandicus	Queensland school mackerel				
Tunas	Scomberomorus regalis	Cero				✓
Tunas	Scomberomorus semifasciatus	Broad-barred king mackerel				
Tunas	Scomberomorus sierra	Pacific sierra				
Tunas	Scomberomorus sinensis	Chinese seerfish				
Tunas	Scomberomorus sp.	Seerfishes				✓
Tunas	Scomberomorus tritor	West African Spanish mackerel		✓		✓
Teleosts	Seriola dumerili	Greater amberjack				
Teleosts	Seriola lalandi	Yellowtail				
Teleosts	Seriola rivoliana	Longfin yellowtail		✓		
Teleosts	Seriola sp.	Amberjack				
Teleosts	Serranidae	Seabasses		✓		
Teleosts	Sphyraena barracuda	Barracuda		✓		
Teleosts	Sphyraenidae	Barracudas			✓	
Teleosts	Spinax niger	Velvet belly				
Teleosts	Taractes asper	Rough pomfret				
Teleosts	Taractes rubescens	Dagger pomfret				
Teleosts	Taractichthys longipinnis	Big scale pomphret				
Teleosts	Taractichthys steindachneri	Sickle pomfret				
Teleosts	Tetraodontidae	Puffer fishes				
Tunas	Tetrapturus albidus	Atlantic white marlin		✓	✓	✓
Tunas	Tetrapturus angustirostris	Shortbill spearfish		✓		
Tunas	Tetrapturus audax	Striped marlin		✓		
Tunas	Tetrapturus belone	Mediterranean spearfish				
Tunas	Tetrapturus georgii	Roundscale spearfish			✓	
Tunas	Tetrapturus pfluegeri	Longbill spearfish		✓	✓	✓
Tunas	Thunnus alalunga	Albacore	Data Deficient		✓	✓
Tunas	Thunnus albacares	Yellowfin tuna			✓	✓
Tunas	Thunnus atlanticus	Blackfin tuna			✓	✓
Tunas	Thunnus maccoyii	Southern bluefin tuna	Crit. Endangered			✓
Tunas	Thunnus obesus	Bigeye tuna	Vulnerable		✓	✓
Tunas	Thunnus thynnus	Northern bluefin tuna	Data Deficient		✓	✓
Tunas	Thunnus tonggol	Longtail tuna				
Teleosts	Trachipteridae	Ribbonfishes			✓	
Teleosts	Trachipterus arcticus	Deal fish				
Teleosts	Trachipterus ishikawae	Slender oarfish				
Teleosts	Trachurus mediterraneus	Mediter. horse mackerel				
Teleosts	Trichiuridae	Snake mackerals			✓	
Teleosts	Uraspis secunda	Uraspis secunda		✓		
Tunas	Xiphias gladius	Swordfish	Data Deficient	✓	✓	✓

5. Concluding remarks

In conclusion, the deliverables from this project are thought to leave ICCAT better able to find the information already published on by-catch, in a good position for implementing a standardised, low-level by-catch monitoring programme across the ICCAT area, and better able to store and retrieve those results flexibly for studies of by-catch mitigating measures and ecological changes linked with fishing.

The following additional, concluding remarks are also offered.

The By-catch database requires feeding with bibliographic data and scientific results from reports and publications. This is detailed, painstaking work that may not happen unless either, someone is paid to do it or, those who have an interest in seeing their work made available to a wider readership do it themselves. This suggests that the database could grow fastest and attain highest value as a research resource if it is made available on the web so that authors can add the details of their own publications in the manor of a 'Wiki', e.g. Wikipedia which grows through users' contributions. The simplest way to achieve this would be for authors who have passed security tests to have access to the input forms directly. Possibly, an editor should scan new additions periodically to check them for consistent use of keywords, variable names, etc. Transfer of the existing stand-alone PC system to one located on a server with an interface on the web would, however, require significant programming resources.

Judging from responses to requests for observer data under Task 3, some national observer groups require compulsion by ICCAT before they are likely to get permission or resources to publicise the by-catches taken on their nation's fishing vessels. A requirement for partially aggregated data that would be mixed with those from other CPCs before publication could ease the problem because (a) it maintains anonymity and (b) the observer groups should then receive the resources to do the job. Keeping the observers' tasks simple and focussed means that they are more likely to be carried out effectively. Possibly in 3 years, ICCAT could have a valuable resource of systematically collected numbers of each significant by-catch species caught per unit of fishing effort for different types of fishery conducted by most or all CPCs. Bias due to oversight of the difference between observed and fished fishing effort when calculating CPUE for observed by-catch should be minimal. There could also be a bigger central resource of documented experience with by-catch mitigating measures.

CPUE data have well known limitations but CPUEs for by-catch can still be very helpful for guiding fisheries towards sustainability. Overlap between a species and the fishery is one aspect that can be dealt with readily if adjustments are needed. Injection of other information, as in an ecological risk assessment, provides another important avenue of research. Valuable external information could include IUCN deliberations, ecological knowledge, e.g. concerning food webs, population abundances (as available for land-breeding animals, for example), life history data, migrational information, stock assessments for commercial species, and so on.

More publication of by-catch information has potential for improving the public image of tuna fisheries and the RFMOs that manage them. At present, many research publications, e.g. in the ICCAT Collective Volume of Scientific Papers, reveal the strong, international interests and positive

approaches to conservation problems resulting from by-catches of tuna fisheries. However, most of these papers are too technical to catch the eye of the news media or the critical public. Regular, carefully formatted publications of standardised by-catch data could achieve more, especially if they allow improved conservation of by-catch species to be visible, as with the IATTC achievements in reducing dolphin by-catch rates (§4.3.7).

Annex 1: Report of meeting at ICCAT Secretariat, Madrid, 18 February 2010.

Final: 5 March 2010

Topic: Progress and t.o.r. for the Short-term By-catch Co-ordination contract.

Present

Haritz Arrizabalaga, Chair of Sub-committee on Ecosystems
Victor Restrepo, ICCAT (intermittent presence)
Pilar Pallarés, ICCAT
Carlos Palma, ICCAT
Laurie Kell, ICCAT
John Cotter, FishWorld Science (FWS) Ltd, Lowestoft, UK (Contractor) – Rapporteur for meeting.

Background

The meeting was called by JC to present progress on the contract and to clarify directions for future work. He realised that the meeting could not speak for ICCAT committees. The 6-month project has 5 tasks and ends on 3 June 2010.

Special actions arising

1. JC to send HA a copy of the meta-database operable in MS Access 2003 (Done 19 Feb).

2. HA to try it out and report any problems or suggestions to JC (Done 23 Feb). Others to do similarly if they have not already tried the system.

3. HA and PP to correct or confirm the list of species that need not be considered as by-catch under Task 1 and Task 2 (Done 5 March).

4. The ICCAT Secretariat (CP and PP) will revise the geographical strata considered under Task 1.

5. The ICCAT Secretariat and HA to provide any suggestions for by-catch keywords.

Task 1

Research and document potential sources of by-catch information such as, and not limited to, peer-review publications, reports, working documents, etc. The contractor must prepare a meta-database that identifies the sources, the types of information, the species, the temporal/spatial strata covered, the gears, etc.

Progress: A meta-database written in MS Access 2007 and containing more than 100 references drawn from the Collective Volume of Scientific Papers (2009 to 2005) was distributed for assessment prior to the meeting together with a short explanatory report.

Discussions: The meeting advised the contractor:

- The submitted design of the meta-database was broadly suitable for the intended task, subject to comments given below.

- For the purpose of the meta-database, "by-catch" means any unintended catch. Thus the meta-database should include references to assessed species when referred to as by-catch (depending on the target).

- The meta-database should include references to unpublished monitoring by observer programmes, citing them as "Unpublished" but making use of the INSTITUTES table as the source for these monitoring programmes. This would serve for Task 3, below, which refers to an inventory of past and current observer programmes.

- The meta-database should include a field to identify the ICCAT fleets that are being reported upon.

- The way in which the by-catch meta-database would be used to collect and publish information has not yet been decided by SCRS. For the present, the contractor was only expected to develop the database structure in Access and to populate it with as much relevant by-catch information as possible, taken from CVSP, ASFA, and open literature papers, before the contracted period ends.

Task 2

Development and feed a by-catch database that includes information on catch, catch rates and biological information as detailed as possible (by country, area, gear, year, season, etc.). This task is complementary to Task 1. The contractor must develop a database with available species-specific information. This is a long-term endeavor and it is not expected that in a six-month period the contractor will enter all existing information. However, substantial progress must be made and focus must be on priority species identified by the SCRS Sub-Committee on Ecosystems.

Progress: JC knew of only two by-catch datasets available to him at the time:

- the 'T2CE' dataset published on the ICCAT website (a standard extraction of the ICCAT official Task-II catch and effort data reported by ICCAT member states). This dataset holds catch (in number and weight) and effort data for about 30 species and groups of species taken from stated, but variable rectangles and time periods, plus

- the 'POPcatch' set which holds biological data, species by species, for many species caught by the US longline fleet.

By re-forming table structures downloaded from the ICCAT web site, the T2CE set was built into the By-catch meta-database so as to permit retrievals for catches of any species in the region of a square of chosen size and location anywhere in the Atlantic. Time series for each fleet fishing in the chosen rectangle are output. A simple retrieval in this form was demonstrated. A CD that includes the T2CE set was distributed at the meeting (being too large to email). No developments for the POPcatch set had yet been begun.

Discussions:

The Group noted that the type of querying facilities developed under task 2 by the contractor are already embedded in the ICCAT database system. The T2CE data available from the ICCAT web site is a simplified front end, adopted by the SCRS and mainly used by ICCAT member states to check their own reported data. Therefore the development of new database structures with similar functionality under Task 2 may not be worthwhile. On the other hand, this could depend on what new by-catch data come forward during the project.

"Priority species" in the wording of task 2 above refers to species for which no data are submitted to ICCAT, i.e. mammals, sea birds, turtles, some sharks and teleosts. Thus task 2 refers to a smaller set of species than task 1.

Concerning "available species-specific information" in Task 2, this refers partly to catch rates found by observer programmes. The POPcatch set is an example of observer data collected. It also refers to catch rates obtained by researchers or values read from tables or measurable graphics presented in reports. It was noted that such results must often be heavily qualified, e.g. "nominal CPUE when fishing in a certain way, at a particular time and place", and that a risk of misunderstandings exists when results are presented without the associated methods and caveats given in the source papers. Nevertheless, the benefits were thought to outweigh these considerations. Reporting of catch rates of many by-catch species (in particular, sea birds and sea turtles) to ICCAT is not yet mandatory but requests are, nevertheless, being made by the Commission and others for information on total removals by tuna fisheries, on by-catch species compositions, and on whether these animals are likely to be retained on board or discarded alive or dead. If few data are found to exist, this is still a useful result because it might stimulate more by-catch monitoring.

Additionally, the words "available species-specific information" also refer to species-based biological data per individual, eg. length, weight, other biometric measures, sex, collected under some observer programs and linked to the respective fishing operational parameters like gear, fishing date, geographical position. Such data are important for inclusion in the Task 2 database whatever format (SCRS documents, annual report, etc.) they have. The overall objective is to assess the total removals, species composition, size composition, and disposition (fate: dead or alive). The contractor should focus on populating a simple database using aggregated data associated with reports identified under Task 1. Fields of primary interest include year, month, gear, gear type (hook type), country, species, catch, effort, size, fate.

Task 3

Interact with National Scientists leading National Observer Programs to obtain relevant national observer data and develop appropriate rules for their use. An inventory of past and current observer programmes should be developed as part of 1, above. The contractor will act as an intermediary between the Secretariat and National programs to obtain observer program databases and develop confidentiality agreements, as appropriate.

Progress: None by the contractor. An inventory, possibly incomplete, of 16 observer programmes had kindly been supplied to the contractor before the meeting by PP.

Discussions: The meeting noted that the Secretariat had, for years, been asking ICCAT countries to supply catch and effort data for by-catch species but with patchy success. Concerning the Task 3

words "develop appropriate rules for the use" (above), these primarily refer to the confidentiality of data. SCRS 2009 had drafted a confidentiality agreement for use in these circumstances.

It was **agreed** that the contractor's work under Task 3 was to identify research groups and monitoring agencies who generated potentially useful observer data on by-catch species. These groups would mostly be suggested by the reports being processed for Task 1. The lead author should be invited to submit data to FWS (for ICCAT) with a chosen degree of aggregation. A draft confidentiality agreement, based on that recently prepared by SCRS, would also be sent for possible use. The contractor should take any data received before the end of the contract and, subject to the concluded confidentiality agreement, either (1) archive them with others in the database being developed under Task 2 or, if appropriate, (2) submit them to the Secretariat's IT team for inclusion with the T2CE data set or others held by ICCAT.

Task 4.

Develop specific by-catch data collection forms and protocols that will help to ensure future data collection quality and quantity (beyond what is already available in the ICCAT manual, e.g. adding species ID sheets for observer data collection forms, etc.). These forms and protocols would need to be adopted by the SCRS.

Progress: None.

Discussions: The meeting was told that cases had arisen recently where a research group had collected by-catch data but had not submitted them to ICCAT because the format for doing so was undecided. It was **agreed** that the contractor, not being practically experienced in tuna fisheries or their by-catches, should draft proposals for data collection forms and protocols for submission to appropriate specialists in the ICCAT community with an invitation to comment upon and improve the designs. The Group considered that the current ICCAT forms (available at: www.iccat.int/Forms/ST01-06_en.rar) for collecting fisheries data, and the respective formats and protocols should be used as a basis for the drafting of the by-catch data collection forms. The data collection protocols and forms need to be gear specific (e.g. purse vs longline) and make use of species ID sheets. Interaction with the SC Statistics during progress on Task 4 will be worthwhile to get additional guidance.

Task 5

Reporting: It was **agreed** that the formal Interim Report should be prepared to take into account the contractor's initial practical implementation of the work agreed in this meeting report. The final report of the project should bring together the deliverables of the 4 tasks for consideration by the Sub-Committee on Ecosystems at their meeting in Madrid from 31 May to 4 June 2010 where the contractor should make a presentation. JC **agreed** to make adjustments to the project deliverables in the light of comments by the Sub-Committee in the month following their meeting. This would accord with wording on this aspect in Annex 1 of the existing contract.

Annex 2: Emailed letter used to request by-catch data, observer forms and protocols from national scientists.

Dear -------,

FishWorld Science (FWS) Ltd is contracted to ICCAT to co-ordinate by-catch data for tuna fisheries. This is a request for any data or documents relating to the observer program that you wrote about recently in the article: ---------- Collect. Vol. Sci. Pap. ICCAT, ----------.

Two tasks in the contract explain this request:

1. "To interact with national scientists leading national observer programmes to obtain relevant observer data . . . . The contractor will act as an intermediary between the Secretariat and national programs to obtain observer program databases and develop confidentiality agreements, as appropriate."

2. "To develop specific by-catch data collection forms and protocols that will help to ensure future data collection quality and quantity (beyond what is already available in the ICCAT manual, e.g. by adding species ID sheets for observer data collection forms, etc). These forms and protocols would need to be adopted by the SCRS."

Concerning task (1), you or your colleagues may know of observer data not yet submitted to ICCAT because they are not required or because no formats for submission are available. Information about marine mammals, turtles, and seabirds is of particular interest as well as information about sharks, fish, and invertebrates. I would be happy to receive such data unprocessed or aggregated, on paper or electronically, as you wish. The data will be put into a by-catch database that I am developing for the purpose.

Concerning task (2), any data-collection forms, protocols, identification sheets or other practical documents that I receive in time will be put into a review of such documents that I am preparing before suggesting developments in accordance with the task.

Confidentiality of data may be an issue. I attach draft rules for the protection of data compiled by ICCAT as recently recommended by the Sub-Committee on Statistics which may be adaptable for your needs. I also attach a copy of clause 18 of the contract between this company and ICCAT which currently enforces strict confidentiality when FWS Ltd is handling by-catch data.

Contributions are needed in time to prepare a report for the Sub-Committee on Ecosystems meeting at the end of May this year.
Thank you for your time.
Yours sincerely,
John Cotter
Director
FishWorld Science Ltd
Lowestoft
United Kingdom NR33 7LH
email: john.cotter@phonecoop.coop

Annex 3: Copy of email received from Aquatic Sciences and Fisheries Abstracts concerning copyright

From: Pepe, Richard (FIPS) [mailto:Richard.Pepe@fao.org]
Sent: Wednesday, March 17, 2010 11:15 AM
To: Pilar Pallares
Cc: Grainger, Richard (FIPS); Laurie.Kell@iccat.int
Subject: RE: ASFA copyright

Dear Pillar,

1. The Agreement between FAO and the ASFA publisher (ProQuest, ex CSA) contains the **paragraph 5.3.1.1** which deals with the use of ASFA records in web site databases (I assume from your e-mail below that this is what you want to do). You can do it, BUT there are a few restrictions (see first Excerpt from Publishing Agreement below)

2. Also, the Agreement between FAO and the ASFA publisher (ProQuest, ex CSA) contains the **paragraph 9.2** which gives special mention to the input (records) submitted to the ASFA database, by an ASFA Partner - it appears that this input belongs to you without restrictions at all times and in all places.

3. In addition, the Agreement between FAO and the ASFA publisher (ProQuest, ex CSA) contains the **paragraph 5.3.2** as regards using the database to create/distribute short bibliographies to your users either once off or as part of an ongoing SDI service (**S**elective **D**issemination of **I**nformation).

1) paragraph 5.3.1.1

.....

EXCERPT from: ***PUBLISHING AGREEMENT between FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS and PROQUEST LLC***

5.3.1.1 Limited Use of records from ASFA Database in specialized web-based data bases*. Occasionally, FAO, other U.N. Organizations participating in ASFA and/or ASFA Partners are mandated to host small, subject specific web-based databases. ProQuest shall authorize the use in these databases of up to 20% of records originated/downloaded from ASFA. In such cases the ASFA Partner: 1) may not charge users for accessing the database;*

2) must keep the total number of records in the database from exceeding 25,000
3) will provide user statistics to ProQuest, if requested;
4) will acknowledge ProQuest and the other ASFA Partners for use of their records.ProQuest has the right to revisit all such arrangements if it's determined that any of suchdatabases is responsible for the erosion of ProQuest's customer base.

.....

Regarding the "acknowledgment" statement mentioned in the above paragraph (which should appear somewhere on your web page or site)

It should read something like:
Some records are from the Aquatic Sciences and Fisheries Abstracts (ASFA) database.
ASFA is the cooperative effort of all the ASFA Partners, and the database is made available in ProQuest under an
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on behalf of the ASFA Partners.

.....

2) paragraph 9.2
This Paragraph is regarding the records submitted to ASFA database by ICCAT (i.e your input). As you can see from the "Excerpt below" - with these records you are, of course, free do use them anywhere and in anyway .

.....
EXCERPT from: *PUBLISHING AGREEMENT between FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS and PROQUEST LLC*
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.....

3) paragraph 5.3.2 . Note item -C below is saying that you can extract records from the database (up to 1% of total daatbase) to create a selected bibliography for distribution to your users.

Item-d, is saying you can do the same thing on an on-going basis as part of an SDI service.

EXCERPT from: *PUBLISHING AGREEMENT between FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS and PROQUEST LLC*

5.3.2 Use of ASFA Database in Machine-Readable Form by Partners other than FAO and other UN Organizations

a) Each such Partner can use the ASFA database in its computer systems at one geographic location determined by the Partner (see 5.7.2a) for the fulfillment of its mandate;

b) Each such Partner set forth in Exhibit-E receiving a complimentary copy of the ASFA magnetic tape ....

c) Each such Partner can use the ASFA database to reproduce and distribute to the non-profit sector within their country or, in the case of international organizations, within their jurisdictional domain, multiple copies of selected output from the ASFA database, not representing a substantial part of ASFA (*i.e.,* no more than one percent (1%)) without the prior permission from ProQuest; and

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Regards,

Richard Pepe
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Annex 4: Monitoring of elasmobranchs.

Letter from Nicholas Dulvy, Professor of Marine Biodiversity and Conservation, Simon Fraser University.

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May 17th, 2010

Dr John Cotter
Director
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Lowestoft NR33 7LH
United Kingdom

Dear Dr Cotter:

RE: Advice on ICCAT observer protocol Chondrichthyan species list

Thank you for the opportunity to contribute to the International Commission for the Conservation of Atlantic Tunas draft protocol for observer monitoring. I have attached a list of species that we would recommend prioritizing for inclusion in such a monitoring protocol. Our priority list of 38 species was produced with consultation from the following IUCN SSG members: Alen Soldo, Gabriel Morey, Fabrizio Serena, John Carlson and Lucy Harrison.

The IUCN assesses species according to the IUCN Red List Categories and Criteria. Species assigned one of the threatened categories (Vulnerable, Endangered or Critically Endangered) are likely to face an elevated risk of extinction and are likely to be fished beyond MSY and other related target reference points[i].

We prioritized all pelagic species likely to be captured in longline or purse seine gears irrespective of threat status, and included those that are likely to be caught in high seas and near coastal fisheries for tunas and billfishes. There are a number of reasons for taking this precautionary approach[ii]. First, oceanic pelagic sharks are one of the most threatened guilds of vertebrates. Second, there is increasing evidence that sharks are targeted for their increasingly valuable flesh as tuna and billfish populations decline. Third, the much of the international trade in shark fins sources fins from sharks caught as bycatch in tuna and billfish fisheries. Generally all available shark fins are used, irrespective of species identity. Fourth, as far as we are aware there is no species-specific catch monitoring of chondrichthyan bycatch that could be used to monitor their status.

If you have any further queries please do not hesitate to contact us.
Yours sincerely,

Nicholas Dulvy and on behalf the co-chair Andres Domingo

Promoting the sustainable use, wise management and conservation of all sharks, rays and chimaeras

[i] Dulvy, N.K., Jennings, S.J., Goodwin, N.B., Grant, A. & Reynolds, J.D. (2005) Comparison of threat and exploitation status in Northeast Atlantic marine populations. *Journal of Applied Ecology*, **42**, 883-891.

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These documents are available to download from: www.iucnssg.org/index.php/reports_and_publications

Please see list on next page

Appendix 1. Sharks and ray species proposed for consideration for inclusion in ICCAT bycatch monitoring protocol

Latin name	Common name	Threat status
Alopias superciliosus	Bigeye thresher	Vulnerable
Alopias vulpinus	Thresher	Vulnerable
Carcharhinus albimarginatus	Silvertip shark	Near Threatened
Carcharhinus brachyurus	Bronze whaler	Near Threatened
Carcharhinus altimus	Bignose shark	Data Deficient
Carcharhinus brevipinna	Spinner shark	Near Threatened
Carcharhinus falciformis	Silky shark	Near Threatened
Carcharhinus galapagensis	Galapagos shark	Near Threatened
Carcharhinus isodon	Finetooth shark	Least Concern
Carcharhinus leucas	Bull shark	Near Threatened
Carcharhinus limbatus	Blacktip shark	Near Threatened
Carcharhinus longimanus	Oceanic whitetip shark	Vulnerable
Carcharhinus obscurus	Dusky shark	Vulnerable
Carcharhinus perezi	Caribbean reef shark	Near Threatened
Carcharhinus plumbeus	Sandbar shark	Vulnerable
Carcharhinus signatus	Night shark	Vulnerable
Carcharodon carcharias	Great white shark	Vulnerable
Cetorhinus maximus	Basking shark	Vulnerable
Galeocerdo cuvier	Tiger shark	Near Threatened
Galeorhinus galeus	Tope shark	Vulnerable
Isurus oxyrinchus	Shortfin mako	Vulnerable
Isurus paucus	Longfin mako	Vulnerable
Lamna ditropis	Salmon shark	Least Concern
Lamna nasus	Porbeagle	Vulnerable
Mobula mobular	Devil ray	Endangered
Mobula tarapacana	Chilean devil ray	Data Deficient
Odontaspis ferox	Smalltooth sand shark	Vulnerable
Odontaspis noronhai	Smalltooth sand tiger	Data Deficient
Prionace glauca	Blue shark	Near Threatened
Pseudocarcharias kamoharai	Crocodile shark	Near Threatened
Pteroplatytrygon violacea	Pelagic stingray	Least Concern
Rhincodon typus	Whale shark	Vulnerable
Sphyrna couardi	Whitefin hammerhead	Not Evaluated
Sphyrna lewini	Scalloped hammerhead	Endangered
Sphyrna mokarran	Great hammerhead	Endangered
Sphyrna tiburo	Bonnethead	Least Concern
Sphyrna zygaena	Smooth hammerhead	Vulnerable
Torpedo nobiliana	Torpedo ray	Data Deficient

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Annex 5: Copyright for photographs of species

The table below summarises communications with copyright holders for pictures considered for development of species identification sheets as part of Task 4 of this project. The 'condition' refers to that requested by the copyright holder if the photograph is used. 'Copy?' records a request to see a final copy of ID sheets using the photographs.

Species	© holder	OK'ed ?	Condition, URL	Copy ?
Cape petrel	Samuel Blanc	Yes	Picture : © Samuel Blanc / www.sblanc.com	Yes
Northern fulmar	Andreas Trepte	Yes	http://www.flickr.com/photos/30394895@N00/3344356623/	No
Black-capped Petrel	Arlington James	Yes	http://www.fws.gov/birds/waterbirds/petrel/	Yes
Albatrosses, whales	Trevor Hardaker	Yes	©Trevor hardaker http://www.hardaker.co.za/ Also: http://www.zestforbirds.co.za/	Yes
Hammerheads	George H. Burgess	Yes	http://www.flmnh.ufl.edu/fish and gburgess@flmnh.ufl.edu	No
Leatherback turtle	Andy Bystrom	Yes	http://costaricanconservationnetwork.wordpress.com/2009/09/15/piles-of-support-for-leatherback-national-park/	No
Hawksbill turtle	Tom Doeppner	Yes	© Thomas W. Doeppner	No
Teleost	D Ross Robertson	Yes	© D Ross Robertson www.stri.org/sftep No uses apart from ICCAT species ID	No
Whale	Joni Lawrence	Yes	www.marinebio.org	No
Sea turtles	Seaturtle Canada	Yes	©Seaturtle Canada and acknowledgement Contact: Kathleen Martin. www.seaturtle.ca.	No
Fur Seal	Phillip Colla	$185 not paid	www.oceanlight.com	No
Risso's dolphin	Uko Gorter	Yes	Uko Gorter, www.ukogorter.com No uses apart from ICCAT species ID	No

Annex 6: Recommendations of the Sub-committee on Ecosystems (2010) for minimal collection of data on by-catch from fisheries conducted in the ICCAT region

Introduction and objectives

Recognizing the vulnerability of many marine species to fisheries conducted in the Atlantic and Mediterranean regions overseen by the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Sub-committee on Ecosystems, at their meeting in Madrid from 31 May to 4 June, agreed to recommend to the Commission that by-catches should be monitored regularly by fisheries observers to the minimal standards described in this document. The primary objective is:

> *To characterize the amount, composition (species and sizes) and disposition or fate of the by-catch in ICCAT fisheries.*

Other important objectives are

> *To understand the factors contributing to by-catch;*
>
> *To estimate the effect of the by-catch on the populations; and*
>
> *To estimate the effectiveness of by-catch mitigation measures that are used.*

Method

In order to meet the primary objective, observers should record details for *every* species of the by-catch on a form (linking to locations and dates of fishing) as follows:

1. Species identification. Aids for correct and consistent identifications are listed at the end of this document. Species that cannot be identified at sea should be photographed, as necessary, from above, below, and from one side, with supplementary close-up photos to show details of teeth, fin rays, scales or other diagnostic features of the animal group. Alternatively (or as well), dead specimens should be preserved for later identification. Photos and specimens must be linked with the haul giving rise to them using an appropriate referencing system. When possible, unwanted by-catch should be returned to the sea alive.

2. ICCAT 3-letter codes. These may differ from codes used nationally. Codes referring to groups of two or more species should not be used.

3. Numbers and/or weight (in kilogrammes) of each species of by-catch. Quantities for each haul may be estimated from randomized sampling of the catch when it is large.

4. An indication of sizes, e.g. a length frequency distribution for multi-modal distributions, or a mean and range for uni-modal distributions. These may also be estimated from randomized sampling when catches are large. For consistency, the following length measurements should be reported to ICCAT for different types of animals:

    a. Birds: (i) body length from tip of beak to end of tail feathers, and (ii) stretched wingspan.

    b. Turtles: curved shell length.

c. Fish and sharks: lower jaw to fork of tail, or to the extremity of the tail when there is no fork.

d. Skates and rays: width of disc.

e. Mammals: total length.

Observers routinely using other, different length measures should estimate conversion factors and report only the converted estimates to ICCAT. Measurements should be made to the nearest centimetre (cm) below the actual length, and reported in cms.

5. The fate of each individual – whether kept on board, discarded dead, or released alive.

6. The fishing effort that gave rise to the observed by-catch. To clarify: the observed effort will be smaller than the total fished effort if by-catch from some of the fishing operations was not processed by the observer.

7. The total fished effort and gear for the observed trip (to enable raising of by-catch estimates).

A policy should be in place within each fishery for assisting observers to split their working time when catches include large quantities of both target and by-catch species. The split may depend on the objectives of each observer program and the nature of the fishery.

In order to meet the other objectives of by-catch monitoring, observers are encouraged to record additional notes during the trip on factors thought to be contributing to by-catch, details of the fishing methods and gear relevant to by-catch species, and the effectiveness of by-catch mitigating measures being used.

Reporting to ICCAT

By-catch data should be reported to ICCAT with other results being reported under the ICCAT Task II (catch and effort) rules. It is necessary to distinguish Task II logbook data from Task II observer data. Task II data are mostly reported after aggregation to 5° rectangles by season or year. The same level of aggregation is also appropriate for observer data. The ICCAT Secretariat should aggregate results from different countries within each rectangle and time period before publication of summarizing statistics.

Aids for consistent identification of Atlantic and Mediterranean species

The following list is not intended to be comprehensive or to provide endorsements.

1. Species identification sheets, one per species, are available from the ICCAT Secretariat as .pdf files. The sheets illustrate the principle diagnostic features of each species in a standard, black and white format with a minimum of technical labelling. More than 120 by-catch species, including seabirds, turtles, marine mammals, sharks, rays, and fish have been so described.

2. Species Identification Publications available from the Food and Agriculture Organization (FAO) of the United Nations at http://www.fao.org/icatalog/search/result.asp?subcat_id=49. [Some of these guides are in French and Spanish.] In particular guides for the Eastern Central Atlantic, Western Central Atlantic, the Mediterranean and Black Sea, Namibia and Morocco are relevant.

These guides provide authoritative taxonomic descriptions of each species, principally fish, sharks and rays.

3. The Fishbase website at www.fishbase.org provides information including diagnostic features for fish, sharks and rays.

4. Wikipedia at http://en.wikipedia.org/wiki/Main_Page provides information on all types of marine animals.

5. Robins, C.R., Ray, G.C., Douglass, J., and Freund, R. (1986). A field guide to Atlantic coast fishes, North America. The Peterson Field Guide Series, Houghton Mifflin Company, Boston, USA, 354 pp.

6. Onley, D., and Scofield, P. (2007). Field guide to the albatrosses, petrels and shearwaters of the world. Christopher Helm, London, 240 pp.

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