COMMISSION OF THE EUROPEAN COMMUNITIES

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COMMISSION STAFF WORKING PAPER

REPORT OF
THE SCIENTIFIC, TECHNICAL AND ECONOMIC
COMMITTEE FOR FISHERIES

STECF opinion on the REPORT OF THE FIRST MEETING OF THE SUBGROUP ON BY-CATCHES OF TURTLES IN THE EU LONGLINE FISHERIES. (SGRST/SGFEN 05-01)

November, 2005

STECF opinion expressed during plenary meeting held in Brussels, in November 2005
Plenary Meeting

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BY-CATCH OF SEA TURTLES IN EU LONG LINE FISHERIES.

STECF was asked the following:

To review, comment as appropriate and endorse the report prepared by SGRST/SGFEN 05-01 (4-8 July 2005) on this matter, which (a) summarised EU drifting long-line fisheries, (b) assessed the known by-catch of turtles, (c) reviewed data from national rescue centres and (d) assessed knowledge on effectiveness of mitigation measures.

STECF observations and comments

STECF reviewed the report prepared by SGRST/SGFEN 05-01, noting that to collate most of the available information on these issues was a significant task which was further hampered by the unavailability of some experts to attend the meeting As a consequence, most of the information provided by the SGRST/SGFEN report were related to the Mediterranean Sea, resulting in an incomplete and regionalized overview of the EU drifting long-line fleets activities and their turtle by-catch. It is desirable that scientists with a good knowledge of drifting long-line fisheries in distant waters should be convened to fill the existing gaps in our knowledge of these fisheries.

STECF notes that several EU drifting long-line vessels usually fish in areas where important concentration of marine turtle species are known to occur.

STECF notes that worldwide, seven marine turtle species, Loggerhead (*Caretta caretta)*, Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricate*), Kemp´s Ridley (*Lepidochelys kempi*), Olive Ridley (*Lepidochelys olivacea*), Flatback (*Natator depressus*) and Leatherback (*Dermochelys coriacea*), are likely to be impacted by the EU drifting long-line fleets..

STECF further notes the difficulties encountered in obtaining good descriptions of the EU drifting long-line fleets operating that currently operate in the various fisheries worldwide. A major problem is the inability to obtain information on multipurpose licences that exist in several EU Member States. A similar problem also exists even in international fishery commissions such as ICCAT, where a register of vessels has been already established, but where there is no obligation to specify the fishing gear used. The present EU Data Collection Regulation (EC Reg. 1543/2000) is inadequate to provide this type of information by *metier*. As a result, SGRST/SGFEN was unable to provide a general figure of the EU drifting long-line fleet as a whole, although information from some EU countries, where data has been obtained from specific research projects was relatively comprehensive.

STECF notes that the SGRST/SGRN report provides a useful list of bilateral drifting long-line agreements between the EU and several other countries for the Atlantic Ocean, the Indian Ocean and the Pacific Ocean. At the same time, STECF shares the concern by SGRST/SGFEN regarding the fact that no data and information from such fisheries was available to the sub-group.

STECF notes that the information collated by the Sub-group indicates the large variability of the by-catch rates of marine turtles by sea area and time. However, since the available information not extensive, together with the scant information about the life cycle of the most frequent turtle species encountered, the scope to clearly identify the likely "hot spots" for marine turtle by-catch is rather limited.

On this last issue, STECF notes that of the 18 research projects carried out in various EU countries, most of the research effort (11+1) was concentrated in the Mediterranean Sea, the majority of the EU funded projects were co-funded by DG Environment (7), while only one was co-funded by DG FISH. This may explain the limited attention given to the fisheries concerned and the limited spatial coverage of some projects. In addition, while several research projects are still on-going, SGRST/SGFEN found that some experiments on mitigation approaches have been conducted with inappropriate methodologies and as a consequence, their results are not conclusive with regard to their utility and potential effectiveness in mitigating turtle by-catch in the long-line fisheries (e.g.: bait colour, lures, etc.).

STECF notes that although information at present is incomplete, several stranding networks and rescue centres are active in EU countries. These activities should be able to provide useful additional information on marine turtles, particularly on the incidental effects of various fishing gears, including surface drifting long-lines. Rescue centres are a very good source of detailed information about the possibility for a turtle to survive after hooking. Rescue centres are also able to increase the survival rate of hooked marine turtles, but their effects on the turtle populations as a whole, are unknown.

Regarding trials on mitigation approaches by using circle hooks, the US investigations in the Pacific and the western Atlantic have suggested that the use G-shaped hooks (= circle hooks) above a certain size reduce the by-catches compared to by-catches in fisheries using the traditional Jj-shaped hooks. On basis of the results from the Grand Bank trials, FAO concluded in 2004 that: *"(the use of) circle hooks reduce catches of sea turtles (compared to J-hooks)"*.

However, it also appears that the hook-shape and size based mitigation effects do not seem to be the same for all marine turtle species. Furthermore, the bait species and size also appear to have an influence the by-catch. Another broad overview, recently concluded that the overall effect of circle hooks in reducing by-catch is largely limited to the soft-shelled leatherback turtle.

The main conclusions of the available knowledge on these issues, examined by SGRST/SGFEN, are the followings:

1. circle hooks reduce the catch rate of leatherback turtles and hard-shelled turtles, but the effect of bait type and size has not been evaluated.
2. mostly because of mouth size, catch rates of hard-shelled turtles is probably reduced by large hooks, i.e. it is the size of the hooks rather than the shape which influences the by-catch rate of hard-shelled turtles.
3. Experiments have been limited so far only to a very few fisheries and target species; the extrapolation of these preliminary results to all pelagic drifting long-line fisheries is not appropriate.
4. The are indications from experiments that changing from J to Circle hooks may in some instances increase the by-catch of some shark species.

The available data about the effects of different bait species and their size are confounded by the effects of different hook size and design. However, from the experiments in the northwest Atlantic, it seems that when using J-hooks switching from using squid to mackerel as bait, reduces the by-catch of both loggerheads and leatherbacks in pelagic drifting long-lines. Change in bait type could affect some specific fisheries. The bait size is another important factor to be taken into account, but this information is often not available.

STECF notes that its previous opinion on the use of different circle hooks and baits, reported on SEC(2005)369, is still valid and the consideration reported there can be retained.

Trials on mitigation approaches using circle hooks or by setting lines deeper in the water column are currently ongoing. However STECF shares the view of SGRST/SGFEN's, that further research is still required to better assess the biological and economical effects of a change in fishing technique or fishing strategy on either target species or other species like sharks.

STECF Recommendations

Due to the importance of the drifting long-line fisheries for the EU fishery, STECF makes the following **recommendations:**

In view of the implementation of an ecosystem approach to fishery management, the revised Data Collection Regulation, should include the mandatory collection of by-catch data on marine turtles (and other protected species) by observers on board.

In future, drifting long-line fisheries should be properly described according to a more appropriate fleet segmentation is required in the revised Data Collection Regulation; basic data on fleets, by gear type and area, should be collected and available for use by STECF or other appropriate bodies.

CPUE data from the drifting long-line fishery in all oceans should be collected according to international standards (e.g. ICCAT methodologies); therefore, the EC Data Collection Regulation should be adapted accordingly.

EU drifting long-line fleets fishing under EU Bilateral Agreements worldwide, should provide information about their fishing activities and the turtle (and other species) by-catch. Their activity should be properly monitored by on-board observersd, particularly during at least the first year of activity in a newly exploited area. This information should be made available to STECF when necessary.

Co-operation among EU scientist working on marine turtle conservation and fisheries should be encouraged, with the purpose to standardised data collection, by using agreed protocols. Participation of EU experts in international commissions dealing with these issues should be also encouraged and supported.

Co-funded EC projects and activities dealing with the drifting long-line fishery and the marine turtle by-catch should provide data when specifically requested by STECF, even in a provisional format. These projects should be conducted following scientific methodologies and properly taking into account the scientific literature.

Data from turtle rescue centres should be annually reported to EU Member States and made available to the EC when necessary.

Further monitoring of EU drifting long-line fisheries worldwide is needed to better assess marine turtle by-catch and population mortality. Research should be carried out over large areas and for consecutive years, in an attempt to identify areas and periods when by-catch rates are significant.

Research on possible mitigation measures regarding marine turtle by-catch in drifting long-line fisheries targeting various species, directly tested at sea, should be further encouraged. Such research should involve collaboration between different countries and cover large geographical areas. Research data should provide a comprehensive overview of the catch, including all fish and other species, and detailed technological descriptions of the fishing gears used, setting procedures, hook type and size, and bait type and size.

Research on marine turtle population dynamics, including migrations, concentrations and genetics should be encouraged and these data should be made available to STECF when necessary.

ANNEX REPORT OF THE SUBGROUP ON BY-CATCHES OF TURTLES IN THE EU LONGLINE FISHERIES. (SGRST/SGFEN 05-01)

COMMISSION OF THE EUROPEAN COMMUNITIES

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REPORT OF THE FIRST MEETING OF THE SUBGROUP
ON BY-CATCHES OF TURTLES IN THE EU LONGLINE FISHERIES.
(SGRST/SGFEN 05-01)
OF THE SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

DRIFTING LONGLINE FISHERIES AND THEIR TURTLE BY-CATCHES: BIOLOGICAL AND ECOLOGICAL ISSUES, OVERVIEW OF THE PROBLEMS AND MITIGATION APPROACHES

Brussels, 4-8 July 2005

This report has been evaluated and endorsed by the Scientific, Technical and Economic Committee for Fisheries (STECF) in its plenary session of 7-11 November 2005

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1 INTRODUCTION

The increasing longline fisheries among EU fleets have possibly resulted in increasing by-catches of sea turtles as well.

At the STECF Plenary in November 2004 a paper on mitigation methods for by-catches of sea turtles in pelagic longline fisheries for tuna and swordfish in the NW Atlantic was evaluated (STECF report, Nov. 2004: Evaluation of the effect of circle hooks. - Ref. US. '*Experiments in the western Atlantic northeast distant waters to evaluate sea turtle mitigation measures in the pelagic longline fishery')*

As a first step, STECF recommended that a working group be convened with the objective of compiling a comprehensive overview of the marine turtle by-catch problem related to EU longline fisheries, in particular in the various areas covered by Community fleets. This group should compile all published data from various oceans and fisheries with the purpose of identifying 'hot-spots' where this problem is or may be significant. The main purpose of such WG is to compile the available quantitative data necessary on which to base future mitigation measures.

Where scientific information was not yet available or insufficient or not robust, the sub-group has been asked to provide its expert judgement.

This work, together with other sources of information already available to the Commission, should thoroughly inform Commission's future management proposals for the Community fisheries.

1.1 TERMS OF REFERENCE

The meeting was held in Brussels (4-8 July 2005). In its terms of reference, supplied by the STECF, the SGRST/SGFEN was asked to:

1. Review/identification of EU longline (LL) fleets where by-catches of sea turtles have been observed:

    a. Atlantic fisheries: Pelagic longlines for tuna and tuna like species (including specific CPUE data for target species and marine turtles).
    b. Mediterranean fisheries: All longline pelagic fisheries (including specific CPUE data for target species and marine turtles).
    c. EU longline fisheries in other distant waters (including specific CPUE data for target species and marine turtles).

2. Overview of the available (quantitative) data on by-catch of turtles in EU waters or in other areas where EU pelagic longline fleets are active by fishery, area and season.
3. Overview of the percentage of hooked marine turtles over the total recovered in national turtle rescue centres (if available).
4. Overview of mitigation method/approaches with special reference to recent EU projects and US papers.

1.2 PARTICIPANTS

The participants are listed below:

1.2.1 STECF Members

CAMIÑAS Juan Antonio
DI NATALE Antonio (chair)
MUNCH-PETERSEN Sten

1.2.2 Invited experts

BLASDALE Tom
CASALE Paolo
CALVO Angel
DEFLORIO Michele
GIACOMA Cristina

GONCALVES Joao
KAPANTAGAKIS Argyris
MARGARITOULIS Dimitris
PINNEGAR John

1.2.3 STECF Secretariat

ALTHOFF Wiking (EC Commission - JRC)
ASTUDILLO Armando (EC Commission – DG Fishery)
BIAGI Franco (EC Commission – DG Fishery)
SHEPERD Iain (EC Commission - JRC)
WEISSENBERGER Jean (EC Commission – DG Fishery)

1.3 PRELIMINARY OVERVIEW

SGRN/SGFEN notes that participation was mostly composed by experts dealing with Mediterranean and Atlantic areas; experts working in other oceans were invited but it was not possible for them to attend, due to an overlap with various scientific workshops elsewhere in the world and due to commitments required by the EC Data Collection Regulations.

In addition, some experts responsible for important national networks within Europe did not attend the meeting even though they were invited to participate. This absence is particularly unfortunate since some of these networks (in the Mediterranean) have been taking care of marine turtles for many decades and their representatives would presumably be able to provide long time series of data.

It is quite clear that the by-catch problem in pelagic longline fisheries is only a part of a larger problem concerning the impact of various types of fisheries and other human activities on marine turtles. All turtle species are protected under international conventions (including CITES, Berne, Bonn, Barcelona, etc.) and also within the EC Habitat Directive, which also makes the monitoring of these species mandatory for the member states (MS).

A general overview of the problems related to the by-catch of marine turtles in the pelagic longline fisheries in the various oceans where the EU fleets are operating, was provided to the meeting, along with major research findings concerning the biological and behavioural characteristics of marine turtles.

The complexity of the current situation is highlighted, particularly the high cost required to carry out properly designed observer programmes, able to collect the basic data needed to better assess the by-catch problem and to provide the field information that could be used to help to mitigate potential impacts.

1.4 OVERVIEW OF THE RESEARCH IN THE EU COUNTRIES ON THE BY-CATCH OF MARINE TURTLES IN PELAGIC LONGLINES.

According to the information available to SGRN/SGFEN, only a small number of research projects have been carried out so far to better understand the by-catch (including marine turtles) related to pelagic longline activities in the various areas where EU fleets are active.

According to the information provided during the meeting (Table 1-1), most of the projects have been conducted in the Mediterranean Sea.

Table 1-1. Research projects dealing with turtle by-catch carried out in EU countries.

Project Name	Contracting Institution	Main funding Institution and Partners	Area of the Project	Duration	Main Objectives
Reduction of the impact of the by-catch of Loggerhead sea turtles in drifting longlines. LIFE02NAT/E/8610	SEC and IEO, Spain	EC DG Environment, and Spanish Administrations	Alboran sea and contiguous Atlantic and Mediterranean waters (Murcia-Portugal borders)	2003-2006	Identify the Spanish fleets catching turtles in the area Evaluate the turtles captures by fleet and year period Propose mitigation measures Involve the fisherman in the solutions Countries involved: Spain
Turtles bycatch in the Spanish Mediterranean drifting longline Fleet	IEO, Spain	IEO Málaga,	Western Mediterranean	yearly	Evaluate the total turtles bycatch of the Spanish drifting longline fleet in the Mediterranean. Country involved: Spain
Collaborative UK Marine Mammal & Marine Turtle Strandings Project	Natural History Museum (NHM), UK; Zoological Society of London (ZSL)	UK Department for Environment, Food & Rural Affairs (Defra)	UK and Eire	yearly	Produce annual report on UK & Eire Marine Turtle Strandings & Sightings Countries involved: UK (England, Wales, Scotland, Northern Ireland) & Republic of Ireland Marine Environmental Monitoring (MEM), manages 'TURTLE' a UK & Eire database holding both records of sightings and strandings of marine turtles dating back to 1748 (www.strandings.com), contact: rodpenrose@cix.co.uk.

"Urgent conservation measures for *Caretta caretta* in the Pelagie islands" (LIFE99 NAT/IT/006271)	Regional Province of Agrigento-Sicily Italy	EC DG Environment, Italian Ministry for Environment and Territory Protection, Province Agrigento, CTS, Hydrosphera, IATA-CNR Firenze, Politecnico Milano, University of Torino, Riserva Naturale di Lampedusa	Strait of Sicily (Mediterranean Sea)	2000-2003	Local (Pelagie) Action plan of *Caretta caretta*, Guidelines of the Rescue center in Linosa, Experiments to mitigate longline and bait attractiveness for sea turtles, Involve the fisherman in the rescue activities Pelagie nesting beaches protection Country involved: Italy
"Reduction of the impact of human activity on *Caretta* and *Tursiops* and their conservation in Sicily" (LIFE03 NAT/IT/000163),	Regional Province of Agrigento-Sicily Italy	EC DG Environment, Italian Ministry for Environment and Territory Protection, Province of Agrigento-, CTS, Legambiente, University of Torino, AGCI Pesca, Telespazio	Strait of Sicily and South-western coasts of Sicily	2003-2007	Evaluate Pelagie (Sicily) fisheries impact on sea-turtles and dolphins by fleet and year period, Evaluate mitigation measures by changing longline devices (bait attractiveness and hook depth), Propose mitigation measures and awareness raising activities aimed at local fishermen, tourists and local administrations Improvements to the existing rescue centre and create a new one on the Sicilian coast. Pelagie nesting beaches protection Country involved: Italy

"TARTANET – A network for the conservation of sea turtles in Italy" (LIFE04 NAT/IT/000187),	Dipartimento Conservazione Natura (Roma), CTS, Rome, Italy	EC DG Environment, Italian Ministry for Environment and Territory Protection, Province of Agrigento CTS, Lega Ambiente, University of Torino, AGCI Pesca, Legapesca, Università di Siena– Fondazione Cetacea,	Italian coasts	2004-2008	Establish a national network of Rescue Centers, Adoption of common procedures, Activation of a central data base run by the Italian Ministry for Environment and Territory Protection, Evaluate mitigation measures by changing fishing devices (longlines hook depth, bait attractiveness, circle hooks) and Turtle excluder devices on trawlers Involve the fisherman in the solutions Pelagie nesting beaches protection Country involved: Italy
Field Trials to Evaluate Loggerhead Sea Turtle (*Caretta caretta*). By-catches in Longline Fishing Gear: a Test of Circle Hooks in a Mediterranean Swordfish Fishery	Dip. Biologia Animale e dell'Uomo, University of Torino, Italy	U.S. Department of Commerce – NOAA- NMFS AGCI Pesca,	Strait of Sicily and South-western coasts of Sicily	2005-2006	Evaluate mitigation measures: circle hooks. Countries involved: Italy and US
Assessing marine turtle by-catch in European drifting longline and trawl fisheries. (98/008)	Bioinsight – Villeurbane (F)	EC DG Fishery (co-funded) Department of Animal Health, University of Bari – IEO, Malaga – ARCHELON, Ithavik,	Greece, Italy and Spain (Mediterranean)	1999-2000	Assessment of the turtle by-catch in pelagic longline fisheries and in trawl fisheries. Assessment of direct mortality rates, CPUE and total estimated catch per gear, area and season. Countries involved: Greece, Italy and Spain
Impact of the drifting longline fishery on large pelagic and by-catch species in the central Mediterranean Sea (prog. 4A71)	WWF-Italia (Roma) and Aquastudio Research Institute – Messina- Italy (scientific responsible)	Italian Ministry of Agriculture and Forestry Policies	Southern Italian waters	1998-1999	Assessing in details the effects of various types of pelagic longlines on all the species. To compare CPUE data by gear type, area and season. Country involved: Italy
Pelagic drifting gears used in the adult swordfish (Xiphias gladius) fishery: comparative assessment of their functionality, catch capability, global impact and economy of the system and its re-conversion to other activities.	Aquastudio Reserarch Institute – Messina (Italy)	Italian Ministry of Merchant Marine IREPA	Italian waters – Central Mediterranean	1990-1991	Assessing the impact of driftnets and pelagic longline fisheries on the various species, with particular regards to protected species and socio-economic aspects. Definition of the technological features. CPUE and CPU data. Country involved: Italy

The environmental effects of fisheries in the Mediterranean.	MRRAG-Imperial College-London -UK	EC DG Environment, MRRAG, Ministry of the Environment of Portugal, Aquastudio	Mediterranean EC Countries	1990	Assessing the impact of the various types of fishing gears used by the Mediterranean fisheries on all the marine resources, by reviewing all the available literature information. Countries involved: Italy, Portugal, Germany, UK, Eire, France, The Nederlands, Belgium. Spain, Denmark.
Incidental catches of Loggerhead turtles, *Caretta caretta*, in swordfish longliners in the Ionian Sea, Greece	MEDASSET – Athens - Greece	MEDASSET	Greek Ionian Waters	1989	Descriptive research on the marine turtle-longline interaction. Country involved: Greece
Pilot project for the improvement of selectivity in pelagic longlines used in large pelagic fisheries in the seas around Puglia. .	Department of Animal Health and Well-being, University of Bari, Italy	P.O.R. Regione Puglia 2000-2006	Italian waters of the South Adriatic Sea and North Ionian Sea	Accepted but not started yet	Evaluation of two experimental longlines targeting swordfish and albacore in the view of the reduction of the undersize swordfish catches and incidental catches of sensible species (e.g. marine turtles, sharks, birds, etc.). Assessment of the economic sustainability of using the experimental longlines in comparison to the gears actually used. Country involved: Italy
Pilot action on experimental fishery in international waters in the Indo-Pacific Ocean near Solomon Islands, Kiribati and New Zealand.	IEO La Coruna (Spain)	Segretaria General de Pesca, Spain, IFOP	Indian Pacific Ocean	2004-2005	Pelagic longline fishing trials with observers on board Country involved: Spain
Behaviour, ecology and conservation of pelagic stage loggerhead sea turtles, Caretta caretta. (Life 96Nat/P/3019).	University of Madeira.-Portugal	EC DG Environment; CITMA –; Funchal Munic. Museum; Madeira Nat. Park.	Madeiran waters	1996-1999	To find areas of large turtle concentrations in Madeiran waters; develop continuous monitoring techniques (satellite telemetry); rise public awareness, specially fishermen about conservation of turtles; recover injured turtles-, propose management guidelines and new areas for Natura-2000 network. Country involved: Portugal

Maré: Integrated management of coastal and marine protected areas in the Azores (Life Nat B4 – 3200/98 – 509)	- Dept. Ocean. Fisheries (DOP), Univ. Azores - Portugal	EC DG Environment; DRA – Environm. Board and DRP – Fisheries Board (Azorean Goverment).	Azorean waters	1998-2003	Nautical abundance surveys, record accidental catches, rise public awareness, specially fishermen, concerning conservation of marine turtles. Country involved: Portugal
Sea turtle by catch longline experiment.	- IMAR-Centre Univ. Azores (DOP); - ACCSTR, Univ. Florida.	NOAA/NMFS (US)	Azorean waters	1998-2004	Record by-catches of sea turtles in the longline driftingfishery targeting swordfish and test the effect of different types of circular hooks on the fishery target species and bycatches. Countries involved: Portugal and USA
Diving behaviour of juvenile loggerhead sea turtles (*Caretta caretta*) and its relation to deep-sea longline fishing, in Madeiran Waters. (PDCTM-POCTI/P/MAR/15248/1999)	University of Madeira, Portugal	EU structural funds, Portuguese Science Foundation FCT	Madeira Exclusive Economic Area	2000-2005	Determine juvenile pelagic turtle free-ranging diving behaviour through accoustic telemetry and datalogging. Determine longline time-depth profiles with dataloggers Correlate both informations to determine main interaction depths
Trophic ecology and population structure of juvenile, pelagic stage loggerhead sea turtles (*Caretta caretta*) in the North Atlantic Ocean (PraxisPOCTI/P/BIA/11310/1998)	University of Madeira, Portugal	EU structural funds, Portuguese Science Foundation FCT, Universuity of Azores, University of Algrave, University of Florida	Madeira Exclusive Economic Area	1999-2003	Determine population composition and trophic status of pelagic turtles off Madeira and Azores
Lucky project: acoustic telemetry of wild loggerheads and one loggerhead held in captivity (Lucky).	National Environ. Res. Instit. (NERI_DK); -- Danish Aquarium (DA); - Dept. Ocean. Fisheries (DOP), Univ. Azores.	Danish Aquarium, Shell-DK, TV-2DK	Azores and N Atlantic	2004-2005	Diving behaviour and tracking by satellite telemetry of several wild loggerhead turtles and one kept in captivity during 5 years Countries involved: Portugal and Denmark

1.5 OVERVIEW OF MARINE TURTLE SPECIES AND DISTRIBUTION

Originating in the Jurassic, marine turtles include two extant families, *Cheloniidae* and *Dermochelyidae*. The living species appear in a period from the beginning of the Eocene and the Pleistocene, 60-10 million years ago. Actually the species distribution is mainly tropical and sub tropical and only the reproduction occurs at land. Marine turtles are species with very different life cycles, distribution ranges and different behaviours.

1.5.1 *Caretta caretta*, Loggerhead Turtle

This species frequents tropical, subtropical and temperate waters of the Atlantic, Indian and Pacific oceans. Major nesting sites are found in the western Pacific, western and eastern Atlantic, Mediterranean Sea, Indian Ocean. At sea, trans-oceanic migrations of this species have been documented across northern Pacific and northern Atlantic, with a contingent from the western Atlantic foraging in the Azores, Madeira and in the Mediterranean. This species is basically carnivorous and for this reason it is a common by-catch turtle in drifting longlines. It is listed as Endangered in the Red Data List of the World Conservation Union (IUCN).
Relevant interaction with pelagic longline is documented in the eastern and central Pacific, Gulf of Mexico, north and south Atlantic, western and central Mediterranean.

1.5.2 *Chelonia mydas*, Green Turtle

Green turtle is a cosmopolitan species with a wide tropical and subtropical distribution. Their geographical limits are inside the isotherms of 20°C and their migratory movements are under those limits, according to the different seasons of the year. Its nesting areas are found in both sides of the Pacific, Atlantic Ocean, Indian Ocean and in the Mediterranean Sea. The east Pacific populations are characterized by a different color and are referred to as “black turtle”. It is mainly a coastal species that forms aggregations in shallow waters, abundant in sea grasses. It is basically herbivorous but can feed upon animal preys in young ages (for this reason some green turtles are caught by baited hooks of drifting longline). No trans-oceanic migrations like those of *Caretta caretta* are documented, with the exception of the one between Brazil and Ascension Island in the Atlantic. It is listed as Endangered in the Red Data List of the World Conservation Union (IUCN), with the exception of the Mediterranean population which is listed as Critically Endangered.
Relevant interaction with pelagic longline is documented in the Indian Ocean, as well as in the eastern and central Pacific Ocean.

1.5.3 *Eretmochelys imbricata*, Hawksbill Turtle

This species is solitary or forms small groups, occupying wide areas around almost all the tropical rocky and coral coasts. Their distribution area is limited by the parallels 25° North and 35° South, even if individuals can be found in various areas, including the Mediterranean. It is the most coastal species and lives in habitats with abundant sponges (it predominantly feeds upon sponges), coral reefs and meadows of marine vegetation. Its nesting areas are found in both sides of the Pacific, Atlantic, and Indian Oceans. It is listed as Critically Endangered in the Red Data List of the World Conservation Union (IUCN).
Relevant interaction with pelagic longline is documented in the Indian and eastern Pacific Ocean.

1.5.4 *Lepidochelys kempi,* Kemp´s Ridley Turtle

This species has a restricted geographical distribution even if individuals can be found in various areas, including the Mediterranean. The majority of adults occur in the Gulf of Mexico, where the only major nesting area of the species is found. However, the juvenile part of the population seems to wander throughout tropical and temperate coastal areas of the northwestern Atlantic Ocean. It is listed as Critically Endangered in the Red Data List of the World Conservation Union (IUCN).

1.5.5 *Lepidochelys olivacea*, Olive Ridley Turtle

This species is currently the most abundant. It occurs in tropical and subtropical waters around the world, although some individuals are occasionally found in temperate seas. Major nesting areas are found in the eastern Pacific, Indian and Atlantic Oceans. This species has the particular habit of nesting in large aggregations (known as “arribadas”) of thousands individuals. It is listed as Endangered in the Red Data List of the World Conservation Union (IUCN).
Relevant interaction with pelagic longline is documented in the eastern and in the central northern Pacific.

1.5.6 *Natator depressus*, Flatback Turtle

This turtle is an endemic inhabitant of the waters of northern Australia and in the seas of Timor, Arafura and Coral. Generally it is located in shallow waters of the coral reef areas and neighbouring islands as Papua New Guinea, Java, Timor, etc.; however, it reproduces only in northern Australia. Post-hatchlings and juveniles do not have a wide dispersal phase unlike other sea turtles. *N. depressus* dwells in shallow waters where it feeds upon benthic preys. It is listed as Data Deficient in the Red Data List of the World Conservation Union (IUCN).

1.5.7 *Dermochelys coriacea*, Leatherback Turtle

Thanks to its large size, the leatherback turtle is more adapted to endure low temperatures than other turtle species. Its geographical range is therefore extended to higher latitudes than the other species and in all the oceans. Adults are mainly found in the open ocean It undertakes very long migrations, crossing the oceans. Major nesting sites are found in the eastern Pacific, Indian and Atlantic Oceans. It is listed as Critically Endangered in the Red Data List of the World Conservation Union (IUCN).

Relevant interaction with pelagic longline is documented in the eastern and central Pacific, north and south Atlantic, Indian Ocean.

2 OVERVIEW OF THE EU LONGLINE FISHERIES CONCERNED

2.1 EU PELAGIC LONGLINE FLEETS

One of the greatest problems facing the WG was the difficulty of obtaining reliable figures for the EU pelagic longline fleets and their distribution in the various areas concerned. All EU fishing vessels are registered but the current segmentation does not allow easy access to the type of information required by the WG. This was largely due to the fact that many of the longliners have a multipurpose licence, without a clear specification of the permissible gears that can be used throughout the year.Consequently, it is almost impossible to know how many vessels use the pelagic longline gear in any given year, season or geographical area.

Furthermore, not all the licences include a distinction between pelagic and bottom set longlines. Several vessels, particularly those of small or medium size, change their fishing gear several times during the same year, according to the particular fishing strategies, economic incentives, quotas and the weather.

Some EU fleets are listed in the ICCAT register; however, this register is limited to vessels over 24 m and only those fishing for tuna and tuna-like species in the Atlantic and the Mediterranean. There is no clear separation able to provide a list of longliners, due to the same structural problems described above..

For all these reasons, SGRST/SGFEN decided to try to find better information where available from national or EC programmes, even if incomplete, taking advantage of the presence of several experts having a good knowledge of specific projects already carried in various EU countries, providing a rough assessment of the scale of the fleets, particularly for the most important fishing fleets using longlines.

Another information source was the list of bilateral fisheries agreements and the IFREMER review of these in 1999. Bilateral fisheries agreements between the European Union and third countries establish the general framework for the access of Community fleets to the waters of these countries. A protocol attached to each lays down the specific conditions (technical, financial, type of resources, etc.) for implementation of the agreement. The European Commission, acting on a brief approved by the Council of Ministers, negotiates fisheries agreements with third countries on behalf of the Community.

These bilateral agreements have been used by SGRST/SGFEN to better understand the activity of the various EU longline fleets operating elsewhere in the world and they are reported in the relevant paragraphs for the geographical area concerned.

2.1.1 Atlantic Ocean EU pelagic longline fisheries

EU fleets fishing with pelagic longlines in the North Atlantic mostly target swordfish and tuna-like species, but also pelagic sharks. Most of the available data concern the central Atlantic Ocean and not the North Sea or the Baltic Sea where pelagic longline fisheries are thought to be of little importance, at least as regards to the by-catch of sea turtles.

The data given below were made available during the meeting.

2.1.1.1 France

No information was available to SGRST/SGFEN.

A French longline fishery is known to have existed in the 1980s and 1990s, targeting porbeagle (*Lamna nasus*) and other shark species in the Bay of Biscay and Celtic Sea. Most vessels operated out of La Rochelle (see Lallemand-Lemoine 1991).

2.1.1.2 Portugal

According to the information provided to SGRST/SGFEN, the Portuguese pelagic longline fleet consisted of 79 vessels in 2003 (Table 2-1).

Table 2-1. Portuguese fleet registered for 2003 in ICCAT database.

Type of boat	No. of boats
< 50 GRT (<20 m)	61
51-200 GRT (ca. 20-30 m)	15
>200 GRT (>30 m)	3

It was not possible to assess the number of drifting longline boats operating in Madeiran waters. However, around the Azorean EEZ (part of ICES area Xa2) there are now 3 main fleets operating: regional, mainland and Spanish. (Table 2-2).

Table 2-2. Drifting longline fleet operating in area X (source: Fisheries Sub-secretary office – Azorean Autonomous Government).

Fleet	2001	2002	2003	2004 [c]	2005
Regional (14<x<24 m) (>6 nM)	12 (4) [a]	12 (4) [a]	13 (6) [a]	15 (6) [a]	17 (5) [a]
Mainland (>24 m) (>6 or 12 nM)	0	27	28	33	55
Spanish (>24 m) (>100 nM)	0	0	0	111 [b]	108 [b]

a) From the fishing permits issued only (a few) effectively used the permit.
b) Some of these licences correspond to boats without permits to fish in Spanish fishing grounds.
c) In 2004 the Azorean EEZ was opened to the European fleet between the 100-200 nM, which before was closed to them.

The hook for the drifting longline fishery in the Azores has the minimum size of 30 mm (measured from the barb perpendicular to the hook shank) – Regulation no. 101/2002, October 24). Thus measures correspond more or less to the J type hook nº 9/0. This presents an interesting legal problem, as the larger circular hooks have a smaller distance on that specific measure, and thus are illegal in the Azores.

Two main types of fishing gear are usually used by the Azorean and Portuguese mainland drifting longline boats, targeting swordfish and blue shark (Ferreira 2005):

1) Spanish model: the main line is in multifilament cable (ø 4 mm), stored in a box. Monofilament branch lines (ø 1.8 mm), 10-14 m in length, are suspended on the main cable with snaps, at 45 m intervals. Hooks (*J* type –straight 9/0, Mustad #76800) are attached to the free end of the branch line. The final part of the branch line (30 cm) is normally an iron string (ø 2 mm). Between every 8 branch lines,a buoy is deployed with a variable cable length (6-14 m) that will set the fishing gear at a chosen depth. Between every 4 sets of small buys (32 hooks), a larger buoy is deployed, to which an acoustic transmitter is attached. The fishing depth (depths at which the hooks are placed) varies from ca. 15 to 50 m. Light sticks are not used by the regional and national fleet. To operate this gear the normal crew number is 15 fishermen.
2) American model: similar to the previous one, but the mainline in made of monofilament and it is stored in a winch. The crew required to operate this gear is smaller (only 7 fisherman). For this reason, this gear is becoming the more popular nowadays.

The number of hooks deployed varies from 800 in small boats (<15 m) to 1200-1500 in medium-sized boats (<25 m), and up to 2500 in even larger boats (>25 m), depending on the sea conditions. Thus the total length of the longline can vary from 36 km to 112 km depending on the number of hooks deployed.

The most usual bait is mackerel (*Scomber japonicus*) but some boats also use squid as bait, or shark meat.

The gear is deployed 1-2 before sunset.and typically the gear stays in water all the night. The hauling (retrieval) starts at sunrise and normally takes twice the time of deployment.

Small vessels operate in short campaigns (1-2 days), but larger vessels (>20 m) with freezing capabilities can stay at sea for a month or more.

Small boats normally operate from May/June to December targeting swordfish, but larger boast operated all the year round shifting the target species from swordfish to blue shark.

Off the waters surrounding Madeira Island a deep pelagic drifting longline method is used tragetting black-scabbardfish *Aphanopus carbo* (Merret & Haedrich 1997; Reis *et al.* 2001). It is the main longline fishing method, only one vessel targeted swordfish during 2001. According to information from the Madeiran Regional Fisheries Service the Madeirean longline fleet counted in 1999 34 boats (with more than 10 landings), all less than 25m in length. For this fishery lines are set between 700 and 1300 m depth (Dellinger & Ferreira 2005). Longline length, the number of hooks used and the fishing distance from Madeira increased during the past years, but not the number of boats. The number of hooks varies between 4000-7000 of sizes no. 5, 7 or 8 attached 3 m apart from each other. Main bait is cephalopod stripes, but fish is used as well. One longline capture cycle takes usually slightly less than a day. Small boats stay at sea 1-2 days while the larger ones with freezing capability stay up to 14 or more days. Fishing distances from Madeira Island can be between 3nm up to well over 100 nm.

2.1.1.3 Spain

2.1.1.3.1 SPANISH NORTH ATLANTIC PELAGIC LONGLINE FISHERY

Spain is the EU country with the highest number of drifting longline fishing vessels operating in the North Atlantic Ocean. This fleet operates in international waters under ICCAT regulation and fisheries agreements such as those with Cape Verde, Senegal, Guinea- Bissau, Guinea and Gabon.

This fleet, primarily in the Galician ports of Vigo and La Guardia, is composed of 67 longliners with an average GRT of 128, and an average of 329 Kw per vessel. In recent years there have been shifts in fleet distributions, including movement of some vessels to the South Atlantic and out of the Atlantic (Figure 2-1), as well as changes in operating procedures to opportunistically target tuna and/or other species, taking advantage of market conditions and higher relative catch rates for swordfish.

A large part of the fishing effort is not only directed towards swordfish or tunas, but also on sharks, an additional target species for this fleet in recent years. The most important bilateral fishing agreement between Spain and another nation state is that with Cape Verde, where the greatest number of Spanish pelagic longliners are now authorised to operate. According to the most up-to-date information, there are 39 Spanish pelagic longliners with a total GRT of 4,630 (varying from 31 to 267 each). However, in recent years there has been a progressive reduction of the total EU pelagic longliners operating in this area.

The Spanish Northern Atlantic fleet continues to operate primarily north of 15ºN and some years has reached as far west as 55ºW in pursuit of its target species which has been changing over the last few years.

In recent years there has also been a change in the type of longline gear used. A large part of the fleet has adopted the "Florida style" longline, equipped with light-sticks and other elements, which replaced the traditional "Spanish" type multifilament longline. With the new gear, it is possible to attain higher catch rates (per hook set) compared to those obtained using the traditional one. Lines are set 2 hours before sunset, and hauled during the night, 6 hours after setting.

2.1.1.3.2 SPANISH SOUTH ATLANTIC PELAGIC LONGLINE FISHERY

Some of the Spanish drifting longliners formerly operating in the North Atlantic have now moved to the South Atlantic. These vessels are usually bigger than those which have continued operating in the North Atlantic.

Catch rates of swordfish are much higher in some statistical rectangles than in other both in the North and South Atlantic. High catch rates are recorded in a more or less continuous zone in the tropicsdown to around 15º S. The highest catch rates both in number and weight, are usually found in regions of the SW Atlantic (W of 15ºW) reaching as far south as 30º-35º S.

As has been observed in earlier studies, there are noteworthy differences between the SW and SE areas with much greater catch rates being observed in the SW areas (Figure 2-1 and Figure 2-2).

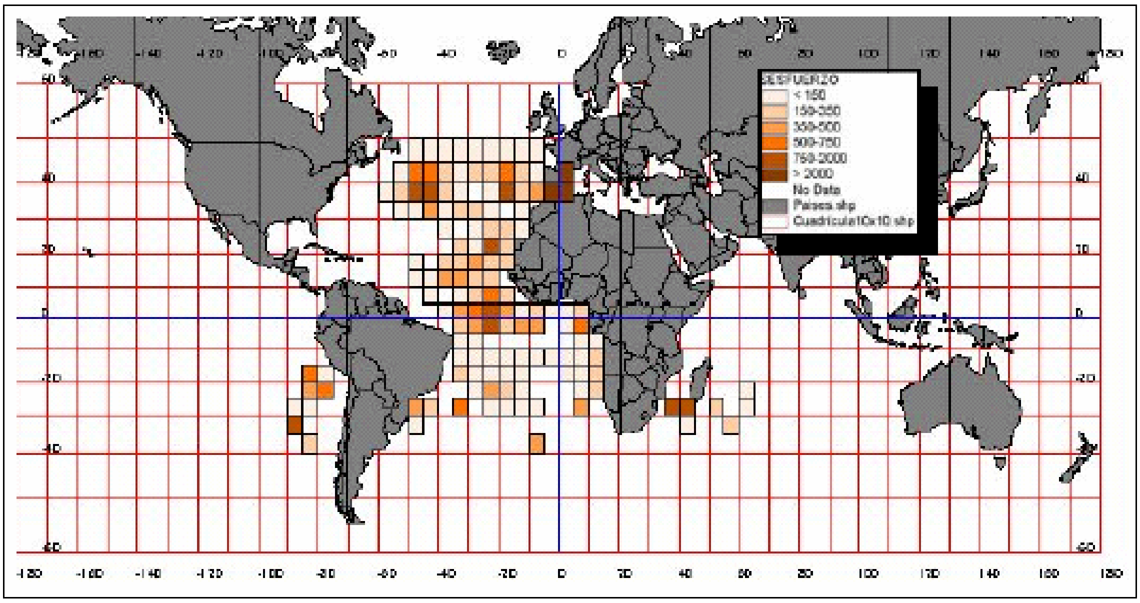

Figure 2-1. Nominal effort in thousands of hooks carried out by the Spanish drifting longline fleet in the year 2000 (from Mejuto *et al.* 2003).

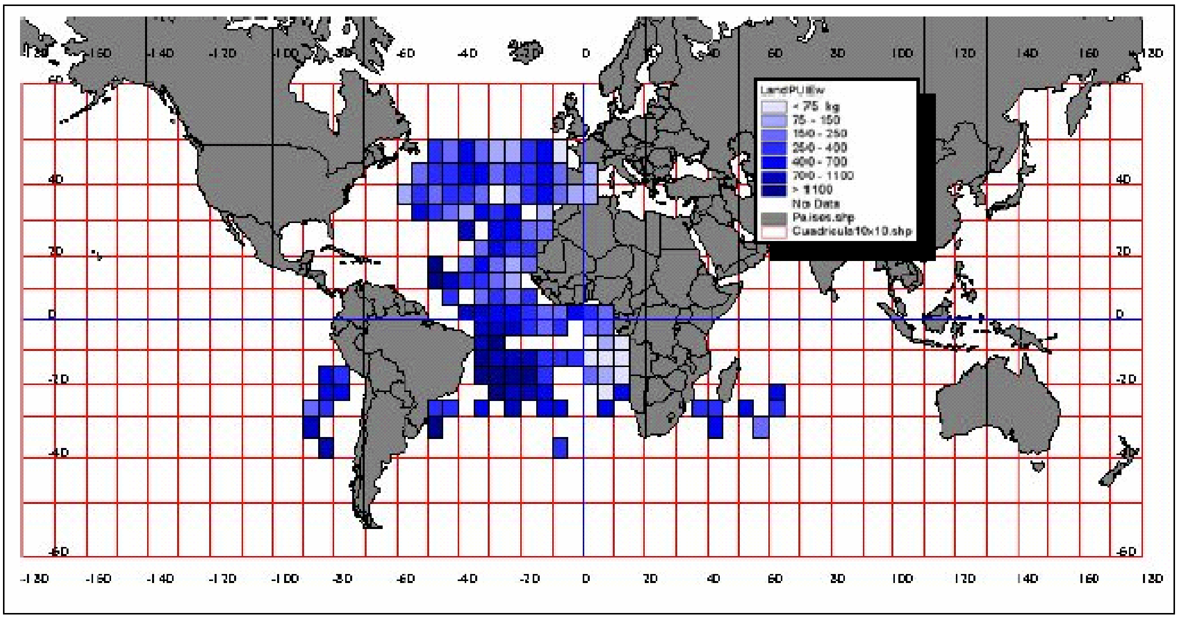

Figure 2-2. CPUE (in kg RW) of swordfish per thousand hooks set by the Spanish drifting longline fleet in the year 2000 (from Mejuto *et al.* 2003).

2.1.1.4 UK and Ireland

Very little longlining is carried out by UK and Irish vessels at present. However, an experimental fishery operated recently off the Irish coast, as a possible alternative to driftnetting. One leatherback was caught and released during trials (F Guilfoyle pers. comm. in Pierpoint 2000).

There are currently 21 UK longline vessels fishing in the Channel, Western Approaches and Celtic Sea (ICES areas VIId, e, g, h and j).

Eleven of these vessels are larger than 10 metres, of which only six are currently active, spending more than 30 days at sea each year. There are a further ten vessels that are smaller than 10 m. Only one of these vessels fishes for more than 30 days each year. The total number of days at sea for the whole fleet in 2003 was 1867.

The main ports that these vessels land into are included in Figure 2-3. Most landings are into the French port of Lorient.

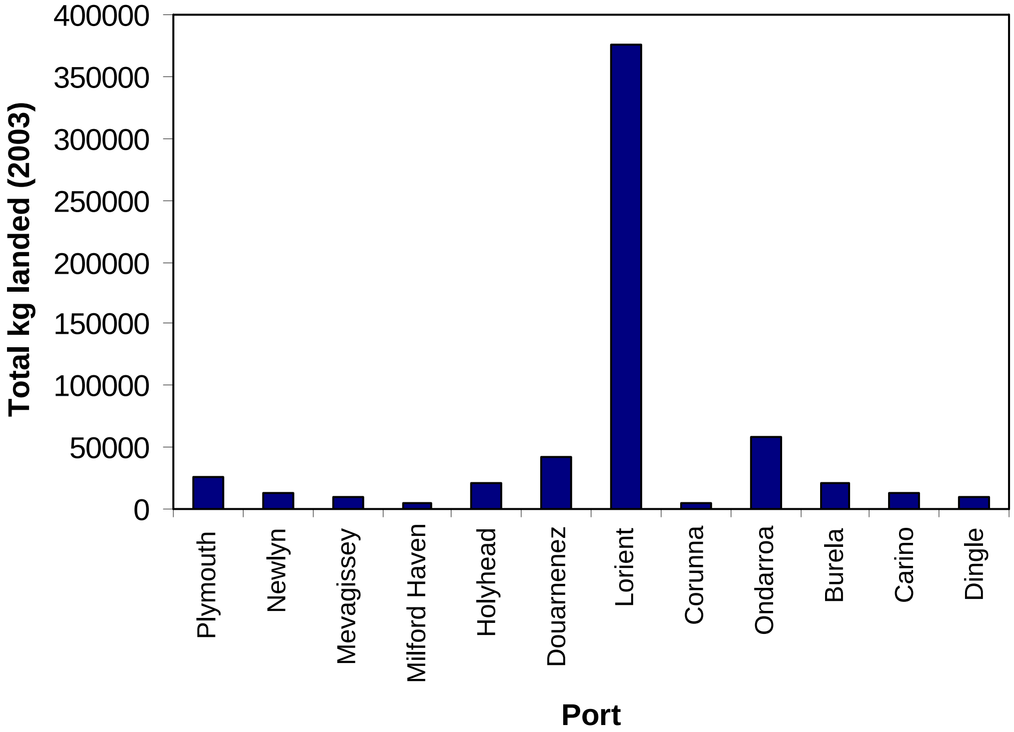

Figure 2-3. Total landings (in kgs) at UK and French ports by the UK (England and Wales) longline fleet fishing in the Channel, Western Approaches and Celtic Sea (ICES areas VIId, e, g, h and j).

The main species landed are indicted in Figure 2-4. The catch is composed mainly conger eel, with ling, hake, skate, spurdog and sharks also being important target species.

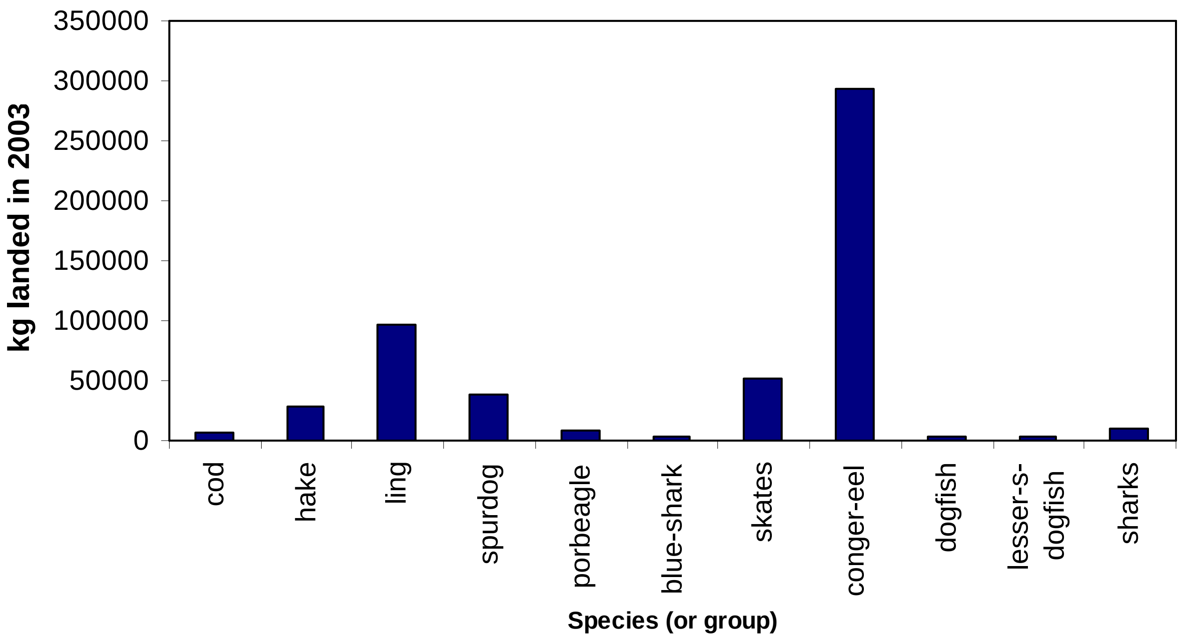

Figure 2-4. Total landings (in kgs) by species, in the UK (England and Wales) longline fleet fishing in the Channel, Western Approaches and Celtic Sea (ICES areas VIId, e, g, h and j).

There is also small deepwater longline fishery involving UK registered vessels, although the number of vessels is small (<10) (P. A. Large, personal communication). These vessels land catches into Scotland, Northern Ireland and Spain.

2.1.1.5 Bilateral agreements

Several bilateral agreements have been signed to allow EU fleets to carry out fishing activities in various Atlantic areas. The relevant ones are reported in Table 2-3, which also lists the number of pelagic longline vessels. Additional information is also available for the period 1993-1997 from the IFREMER review of bilateral agreements in 1999.

Table 2-3. Inventory of bilateral fisheries agreements between the EC (EU nations) and soutern Atlantic nation states in 2005

Country	Period	Number of Vessels	Detailed Breakdown
Cape-Verde	01/07/2004-30/06/2005	630 gross registered tonnes for bottom longliners and 37 seiners, 62 drifting longliners and 18 pole-and-line tuna vessels	Bottom longliners: Portugal – max 630 GRT or 4 vessels Tuna seiners: France 19 vessels, Spain 18 vessels Drifting longliners: Spain 52 vessels, Portugal 10 vessels Pole & Line: France 6 vessels, Spain 10 vessels, Portugal 2 vessels.
Côte d'Ivoire	01/07/2004-30/06/2007	1 300 gross registered tonnes for demersal species and 34 seiners, 11 drifting longliners and 3 pole-and-line vessels for tuna fishing	Tuna seiners: France 17 vessels, Spain 17 vessels Drifting longliners: Spain 6 vessels, Portugal 5 vessels Pole & Line: France 3 vessels
Equatorial Guinea*	1997-2001	Tuna 30 seiners 8 pole-and-line vessels 30 drifting longliners	Tuna seiners: France 19 vessels, Spain 10 vessels, Italy 1 vessel Drifting longline/pole & line: France 8 vessels, Spain 25 vessels, Portugal 4 vessels
Gabon	03/12/2001-02/12/2005	Trawlers: 1 200 grt/month, averaged yearly 38 tuna seiners 26 drifting longliners	Tuna seiners: France 20 vessels, Spain 18 vessels Drifting longliners: Spain 20 vessels, Portugal 6 vessels
Guinea	01/01/2004-31/12/2008	Tuna 34 seiners 14 pole-and-line vessels 9 drifting longliners	Tuna seiners: France 17 vessels, Spain 17 vessels Pole & Line: France 7 vessels, Spain 7 vessels Drifting longliners: Spain 8 vessels, Portugal 1 vessel
Gambia*	1993 1996	Was limited to 23 seiners and 7 pole & line vessels for tuna fishing	No details available

Guinea-Bissau	16/06/2001-15/06/2006	2001-2004, Tuna Seiners: 40 Pole-and-line/Longliners: 36 2004-2006, Tuna Seiners: 40 Pole-and-line/Longliners: 30	Tuna seiners: France 19 vessels, Spain 20 vessels, Italy 1 vessel Drifting longline/pole & line: France 5 vessels, Spain 21 vessels, Portugal 4 vessels
Mauritania	01/01/2004-31/12/2006	Tuna: 35 freezer seiners and 14 drifting longliners	Tuna seiners: France 18 vessels, Spain 18 vessels Drifting longline/pole & line: France 8 vessels, Spain 20-21 vessels, Portugal 3 vessels
São Tomé and Principe	01/06/2002-31/05/2005	Tuna : 38 seiners 25 drifting longliners 2 pole-and-line vessels	Tuna seiners: France 18 vessels, Spain 18 vessels Drifting longliners: Spain 20 vessels, Portugal 5 vessel Pole & Line: Portugal 2 vessels
Senegal	01/07/2002 30/06/2006	Tuna fishing Seiners: 39 vessels Pole-and-line: 16 vessels Longliners: 23 vessels	Tuna seiners: France 18 vessels, Spain 21 vessels Drifting longliners: Spain 20 vessels, Portugal 3 vessel Pole & Line: Portugal 3 vessels, Spain 20 vessels

NB: protocols with Gambia and Equatorial Guinea were not renewed upon their expiry.
From http://europa.eu.int/comm/fisheries/doc_et_publ/factsheets/facts/en/pcp4_2.htm.

Spanish and French vessels make up the majority of the *tuna fleet* that operates under the bilateral agreements in the South Atlantic. Most of these two fleets consist of seiners. There is also a lesser number of Italian and Portuguese pole-and-line and long-liner vessels (see Table 2-4). There are around 50 Spanish tuna seiners (51 in 1993 compared with 43 in 1997 with an average engine capacity of 2 652 kw and GRT of 1 746). These are registered in Berméo, Santander, Vigo and Cádiz. Spain fishes under all of the agreements, its fleet composition varying by country (long-liners, pole-and-line, seiners). France had a fleet of 31 tuna seiners under four different owners for its 1997 tuna operations (compared with 35 in 1993), with an average engine capacity of 2 688 kw and average GRT of 1 419. Over 95% of its vessels were based in Concarneau in Brittany, this fleet divides its activities between the Atlantic and Indian Oceans.

A fleet of Spanish and Portuguese *long-liners* measuring between 20 and 25m in length, operate mainly in the Moroccan EEZ catching hake and silver scabbardfish, species that are in great demand in the Portuguese market. Two-thirds of the 120 vessels are Spanish.

Table 2-4. Inventory of tuna licences (longline and pole & line) issued during the period 1993-1997 (from IFREMER 1999).

Fleet type	Third countries	1993	1994	1995	1996	1997	Average for period 1993-97
Long-liners	Senegal	6	6	6	6	21	9
	Guinea	0	0	6	8	13	5
	Madagascar	0	3	12	12	11	8
	Mauritius	0	0	0	1	1	n.s.
	Seychelles	0	0	0	3	12	3
	Sao Tomé and Príncipe	0	0	0	22	25	9
	Angola	2	2	5	8	11	6
	Ivory Coast	0	0	0	0	14	3
	Cape Verde	7	2	15	18	26	14
Pole-and-line vessels and long-liners	Mauritania	9	9	9	16	28	14
Pole-and-line vessels	Ivory Coast	2	2	3	5	1	3
	Cape Verde	0	0	0	0	9	2
	Senegal	7	9	9	9	11	9
	Guinea	1	3	0	10	10	5
	Guinea-Bissau	8	8	11	13	33	15
	Seychelles	2	6	8	1	1	4
	Mauritania	9	9	9	16	28	14
Total all countries		44	50	84	132	227	107

*: For Morocco long-liners and pole-and-line vessels are included under other southern agreement licences in Table 28
** No Italian seiners before that date in the period under study
Source: Licence survey from files from DGXIV. IFREMER/CEMARE/CEP 1999.

2.1.2 Mediterranean EU longline fishing fleets

2.1.2.1 Cyprus

The large pelagic fishing fleet in 1995 (the last data available from the FAO) comprised 25-30 longline vessels on average 15-16 m long,.

The pelagic fishery is seasonal (April-October), concentrating mainly on swordfish fishing and utilizing locally built wooden vessels, equipped with diesel engines of 80/160 hp. Both main line and snoods are used. Licences are limited to 50 vessels. The main species caught are swordfish, bluefin tuna, albacore, tuna-like species, dolphinfish and sharks. Recent gear modifications have resulted in a marked increase in CPUE (GFCM-ICCAT WG. Report, Malta, April 2002).

According to the information available on the ICCAT data base, only 1 pelagic longline vessel over 24 m is actually registered but according to the level of catch reported to ICCAT and the general information reported to previous meetings, the pelagic longline fleet is more numerous, including small and medium-sized vessels. No further data have been made available to SGRST/SGFEN.

2.1.2.2 France

No data have been made available to SGRST/SGFEN.

2.1.2.3 Greece

The drifting longline fleet in Greece has always been considered part of the artisanal fishing fleet segment. These vessels were allowed to use drifting longlines but also other gears of the artisanal fishery. This regime changed from 2002 when a special drifting longline license was introduced. The life time of such a license was limited to one calendar year. Additionally, a closed period for al drifting longline activities is imposed from 1991. The closed period extends from the beginning of October to the end of January.

Pelagic longlines were not specifically distinguished in historical statistics until 2002. After that year longline vessels were officially characterized by an annual license issued by the Greek Ministry of Agricultural Development and Food. In this way, the size of the pelagic longline fleet changes from year to year as more or fewer licences are issued. In the year 2004, the number of vessels with a pelagic longline license was 565. A total of 455 vessels were below 12 m, 65 vessels were between 12 t and 15 m and 33 vessels were above 15 m. Although 565 vessels have been registered to have a drifting longline license, only 217 have been observed to be active in 2004.

Drifting long-lines in Greece mainly target swordfish but they are also employed for the albacore fishery which is, however, limited to certain areas (mainly Central Aegean Sea) during the autumn months. Blue fin tuna is a secondary target species.

A regular monitoring program for the entire Greek fishing fleet has been conducted since 1995 through the application of Council Regulation 109/94 and 493/96. Since no specific pelagic longline fleet segment has been specified in the above mentioned Regulations, there are no effort data for drifting longline vessels. After 2002, through the application of Council Regulations 1543/00 and 1639/01, an effort and landings monitoring program was introduced for pelagic long-lines. Additionally, on-board observations for the drifting longline fishery have been conducted on an *ad hoc* basis in the framework of several research studies.

2.1.2.4 Italy

The pelagic longline fishery has a long history in Italy. A first good description can be found in the XVII century. The most important technological development in this fishery is linked to the introduction of engines and artificial fibres, late in 1940 andearly 1950s. This technology made the longlines longer and able to operate offshore.

By the 1960s it was possible to recognize several distinct longline types targetting swordfish, bluefin tuna, albacore, bonito, dolphin fish and pelagic sharks. The major gear differences were the total main line length, the hook size, the depth and the fishing season.

The fleet is not well defined in terms of number of vessels, because several small and medium size vessels operate under a multi-purpose licence and are able to carry out several fishing activities during the same year. According to a very rough estimate, the Italian pelagic longline fleet might be around 1,200 vessels. A more detailed splitting by gear type is difficult, even though some data have been collected by previous research projects. Detailed descriptions of some pelagic longline fleets in various southern Italian regions are also available from various project reports.

The Italian pelagic longline fleet includes vessels between 5 to over 30 m length, with some employing longline gear in an exclusive way, while most of the fleet use this gear as well as many others, sometimes for a very short period.

The vessel characteristics are likely to affect the fishing strategy, especially for the larger boats that can stay at sea for weeks before landing catches. Smaller vessels operate in coastal areas on a daily basis.

The relevant characteristics of the various longline types are reported in Table 2-5 but personal adaptations are common place among longline fishermen.

The most technologically advanced pelagic longline is the bluefin tuna type (LL BFT), developed for the first time in 1963 in Sicily, adopting the Japanese technology. This first bluefin tuna longline had a main line between 3 to 15 km long, branch lines every 35 m with a length of 4 m and J hooks (No. 0 in Mustad old catalogue), fishing between 30 to 60 m in spring time. The use of this gear was eventually exported to Puglia in 1970 and then to Sardinia in 1978.

The fishery takes places from late March to early July, with a peak in May-June and small variations from year to year, according to the oceanographic conditions.

The swordfish longline (LL SWO) is a well developed gear, used for over two centuries, and now existing in several distinct types, according to each fisherman's experience.

The swordfish fishery in coastal areas operates with lighter gears, and in the past, smaller longlines with small hooks were used illegally to catch juvenile swordfish.

The longline fishery targeting swordfish operates all the year round, but the normal fishing season is from late February to December, with peaks in summer.

The swordfish longline is shot in the evening and gear retrieval begins during the first hours of the new day, starting with the last hook put at sea, taking 6 to 9 hours, depending on the gear length, sea conditions and quantity of fish caught. Therefore, the first hook can stay underwater for about 12 hours, whereas the last one only remains in place for one to two hours.

In recent times, some vessels have begun to use a modified longline for swordfish, called "American type", deployed at a greater depth, with hooks placed below 100 m and using lightsticks of various colours.

The Italian longline used for the albacore fishery is a smaller gears, but quite similar to the small longline used for juvenile swordfish.

The fishery was originally operated primarily in areas close to the southern part of Italy, however in some past years a longline fishing was also reported in the Ligurian Sea. From the last part of the '90s, the albacore fishery cover new fishing grounds off the northern African coast and now most of the catches are coming from these areas.

The albacore longline (LL ALB) is shot at night and retrieval begins after sunrise, starting from the last hook put at sea. The first hook can remain underwater for 7 to 10 hours, whereas the last one is left at sea sometimes for only one hour.

There are usually two fishing seasons: one between late February and early May and the second from September to November. Small quantities of albacore are already reported in the swordfish longlines as an occasional by-catch.

Table 2-5. Italian longline types used in the Mediterranean fisheries.

GEAR	LL BFT	LL BFT JAP	LL SWO	LL ALB
Main line length (km)	50-100	60-100	02-90	02->50
Main line diameter (cm) or code	0,8	0,8	no.150-180 or 1,8 mm	no.130 or 1.2-.15 mm
Total number of hooks	1250-2500	1500-2500	100-3000	200-3000
Branch line length (m)	20-50	30-55	6-50	2-6
Branch line diameter (mm) or code	3-6	4-6	<1.6	0.8-1 mm or no.060-070
Distance between branch lines (m)	40-50	40-50	30-50	11-20
No. branch lines between two float lines	4	4	3-5	6-7
Distance between two floats (m)	200-250	200-250	84-250	60-150
Float line length (m)	10-13	10-30	3-70	3-40
Size of the hook (old Mustad catalogue)	00-0 (Mustad) or 4.5, 4.6, 4.7 o 4.8 (Japanese type)	00-0 Mustad (between 9 to 10 cm high)	0-1-2-3-4-5 Mustad (between 9 to 5 cm high)	6-7-8 Mustad (between 4 to 2 cm high)
Hook type	J (long or short)	J (long or short)	J (long or short)	J (short)
Hook material	steel	steel	steel	steel
Bait species (and gr)	*Scomber scomber* and *Scomber japonicus* (200-300), *Loligo* sp. (200-250)	*Scomber scomber* and *Scomber japonicus* (200-300), squids (200-250)	*Scomber scomber* and *Scomber japonicus* (100-300), squids (50-250), *Alosa fallax* (50-200), *Sardina pilchardus*.	*Sardina pilchardus* (25-40), *Sardinella aurita*.
Lightsticks by hooks	used by some vessels for the deep-water fishery	none	used by some vessels for the deep-water fishery	none
Float type	plastic buoys	plastic buoys	plastic buoys, bottles or balls	plastic bottles or balls
Reflectors float type	yes, every 2 to 4 km	yes, every 2 to 4 km	sometimes, every 5 to 10 km	sometimes, every 5 to 10 km
Main line characteristics	polyamyde multifilament	polyamyde multifilament	nylon monofilament or polyamyde multifilament	nylon monofilament
Branch line characteristics	nylon monofilament, polyamyde multifilament or partially steel wire covered by nylon	nylon monofilament, polyamyde multifilament or partially steel wire covered by nylon	nylon monofilament	nylon monofilament

Float line characteristics	polyamyde multifilament	polyamyde multifilament	nylon monofilament or polyamyde multifilament	nylon monofilament

All Italian drifting longline gears show a good selectivity in term of target species: the data available from an observer on board programme carried out in 1998 and 1999 (Guglielmi & Di Natale, 2000) show an average catch rate in number of specimens of 67.8% for swordfish and 80.8% for albacore, in the respective longline types, while the data available for bluefin tuna longline are very poor, even if this latter gear is considered the most selective, due to both hook and bait size.

2.1.2.5 Malta

According to the information available on the ICCAT data base, 3 pelagic longline vessels over 24 m are registered, but it is anticipated that smaller vessels are fishing in Malta, engaged in the swordfish fishery. No data have been made available to SGRST/SGFEN as concerns smaller longline vessels.

2.1.2.6 Portugal

No data have been made available to SGRST/SGFEN for the vessels reported to operate in the Mediterranean Sea with pelagic longlines.

2.1.2.7 Spain

About 70 fishing ports are distributed along the Spanish Mediterranean Peninsula, Balearic Islands and North African Spanish cities (Figure 2-5). The drifting longline fishery is one of the new fishing activities that has been developed during the last century. The Spanish Mediterranean drifting longline fleet includes 73 licence fishing boats (BOE 09/11/99, Table 2-6) operating from 22 controlled base ports. The most important base ports by number of vessels are Águilas: 11%, Garrucha: 10 % and Carboneras: 36% (Table 2-6 and Figure 2-6). The number of landing ports with operative longliners in any given year is difficult to quantify due to the dynamics of the fleet, the large area and the number of fishing ports along Spanish coast.

The engine power of boats ranges from 15 to 480 HP, vessel length ranges from 4.3 to 24 metres and GRT from 1.27 to 116.94 t. The fleet has been classified into two groups according to GRT, length, fishing effort and fishing days:

Small boats from 4 to 12 meters length fish about 1-2 days near the coast. The GRT for this category ranges from 1.27 to 19.3 GRT. These boats periodically change fishing gear (longline, nets, pots) adapting their activity to species abundance and weather conditions.

Bigger boats, from 12 meters length, spend from 5 to 10 days at sea usually over a large area outside the continental shelf. These boats are between 7.2 and 116.94 GRT. Part of the fleet makes temporal gear modifications during the year according to the presence of target species (swordfish, albacore and bluefin tuna).

These vessels are equipped with a winch to retrieve the line and baskets for gear. Most of the boats are equipped with GPS, radar and echo sounder. Small boats usually work with at least 2 fishermen, rarely 5. The bigger boats work with 8-10 fishermen (12 maximum) depending of season, type of gear and catches.

The fishing area is delimited by longitude 42ºN and 36ºN and latitude 04ºW and 05ºE, although more eastern areas have been fished in recent years (Figure 2-6). The waters around Balearic Islands are the main fishing ground during summer season.

The Spanish drifting longline fishery operate throughout the year targeting swordfish. The maximum effort occurs in summer months depending mostly on target species abundance. Many factors affect fishing activities, resulting in variation in total effort per month and year.

Spanish legislation regulates longline activity in the Mediterranean waters. Vessels with a full or seasonal license are recorded in a national register. Boats licensed to operate drifting longlines are not permitted to use any other type of gear at the same time. Vessels are permitted to operate for 20 fishing days (sets) per month and 12 months per year.

Table 2-6. Number of drifting longline boats by fishing port. (Sampled ports are in bold letter).

Fishing Port	Province	Drifting longliners	%
Altea	Alicante	1	1
Campello	Alicante	2	3
Santa Pola	Alicante	1	1
Jávea	**Alicante**	**1**	**1**
Roquetas de Mar	Almería	2	3
Carboneras	**Almería**	**26**	**36**
Garrucha	**Almería**	**7**	**10**
Adra	Almería	2	3
Almería	Almería	1	1
Vilanova i la Geltrú	Barcelona	2	3
Blanes	Barcelona	5	7
Algeciras	Cádiz	2	3
Benicarló	Castellón	1	1
Castellón	Castellón	2	3
Peníscola	Castellón	1	1
Vinaroz	Castellón	1	1
Llança	Girona	2	3
Motril	**Granada**	**1**	**1**
Porto Colom	Mallorca	1	1
Águilas	**Murcia**	**8**	**11**
Cartagena	**Murcia**	**3**	**4**
San Pedro del Pinatar	Murcia	1	1
Total		**73**	100

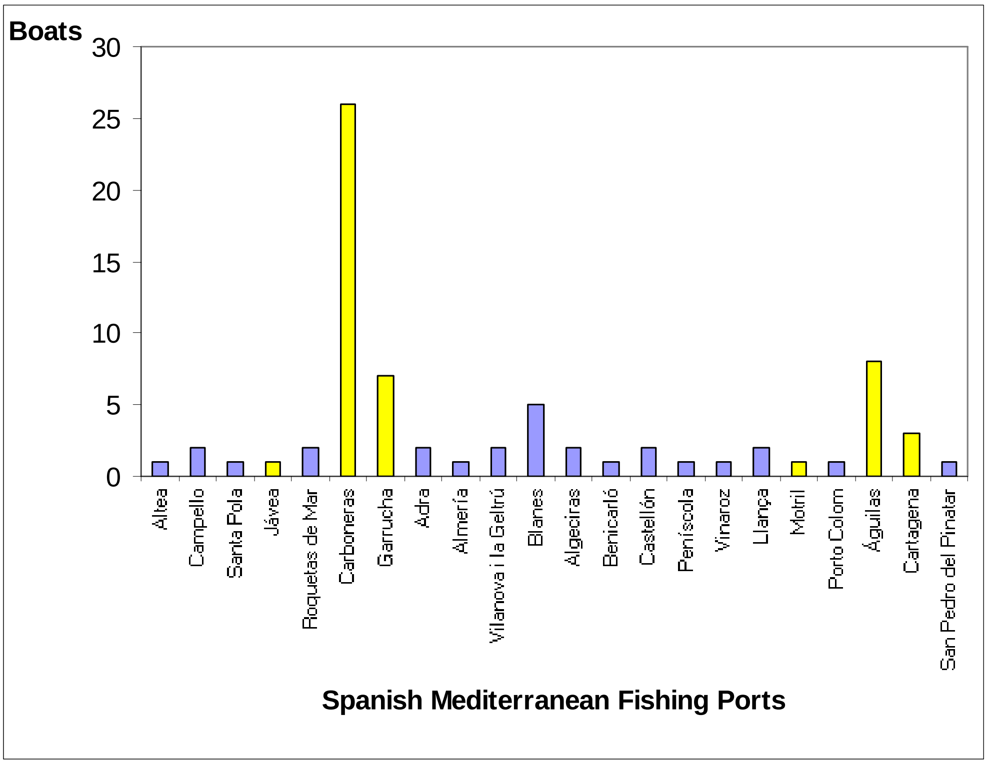

Figure 2-5. Distribution of drifting longline boats by fishing port. Yellow colour indicates the sampling ports in Spanish program.

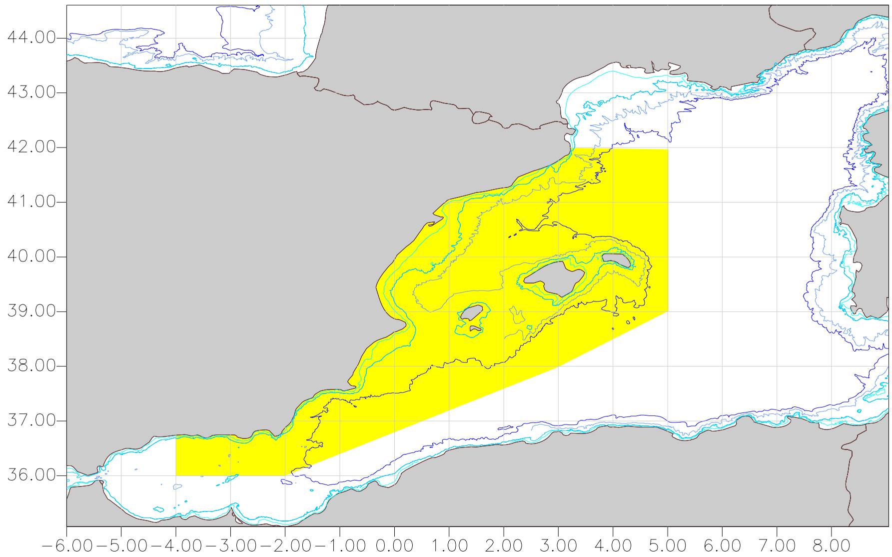

Figure 2-6. Fishing area of Spanish drifting longline fleet during 1999 and 2000 (grid 1ºx1º)

The main gear used to target swordfish (LLHB) is called 'marrajera' by fishermen. Three other types of gear are used and have the same basic structure but with modifications to allow temporary targeting of albacore (LLALB) and bluefin tuna (LLJAP). A semi-pelagic gear (LLPB) is also used for fishing swordfish, and is called 'piedrabola'. Characteristics of the fishing gears are presented in Table 2-7, and Figure 2-8 shows schematically a standard longline generally used by observed Spanish boats.

The use of light sticks by the Spanish fishermen started in 2000. Hook characteristics differ according to the gear and target species (Figure 2-7). Table 2-8 presents the hooks size (length and width). More variation exists in hook size for vessels targetting for swordfish than those targetting for albacore (the smallest).

Table 2-7. Technical characteristics of the drifting longline gears used by the Spanish observed boats.

Gear	LLHB	LLPB	LLALB	LLJAP
Main line lenght (km)	14-72	21-32	75	54-75
Main line diameter (mm)	1.8-2.0	2	1.8	4.0-7.0
Total number of hooks	2990 (500-4672)	1575 (750-2200)	3556(1300-5000)	1394 (500-2100)
Branch lines length (m)	6.3-10.8	4.5-5.4	7.2	21.6-43.2
Branch lines diameter (mm)	1.3-1.6	1.5	0.8	2.5-3.0
Distance between branch lines (m)	14.4-27	14.4-16.2	14.4	21.6-43.2
N° branch line between two float lines	8-15.	30-33	8-11.	4-6.
Distance between two floats (m)	194-504	432	194	108-216
Float line length (m)	2.7-7.2	108-360	6.3	14.4-25.2
Size of hook(*)	1, 2 and 3	1, 2	6, 7	0.2, 0.4
Hook material	Steel			
Bait	Sardinella aurita, Scomber scombrus, S. japonicus, Lepidopus caudatus, Scombresox saurus, Shortfin squids	Scomber scombrus, S. japonicus, Lepidopus caudatus, Shortfin squids	Sardina pilchardus, Scomber japonicus	Scomber scombrus, S. japonicus, Shortfin squids
Lightsticks by hooks	Not always used. 1 lightstick (yellow light) each 3 to 20 hooks.	Not used	Not used	Not always used. 1 lightstick (blue light) each 3 to 5 hooks.
Float type	Plastic balls and bottles			
Reflector floats type	Standard: radar reflector with intermittent battery light			No light
Main, branch and float line characteristics	Trasparent monofilament nylon			Main line: rope

Table 2-8. Characteristics of hooks of the drifting longline gears used by the Spanish observed boats.

Gear	Hook number	Length (mm)	Width (mm)
LLHB	1	89.5	30.9
	2	80.6	27.5
	3	71.4	24.8
LLJAP	02	73.3	28.7
	04	66.0	25.4
LLALB	6	37.1	15.0
	7	43.6	15.8

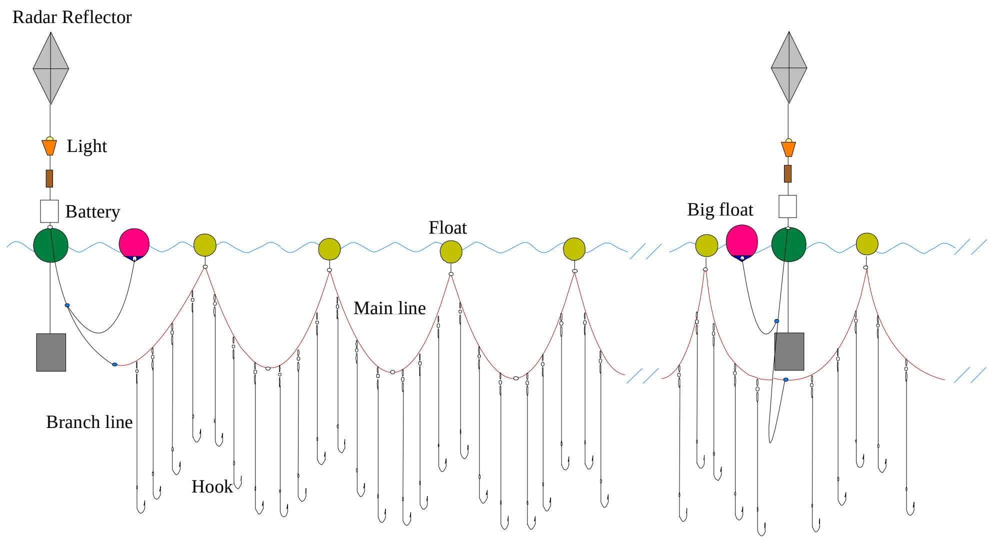

Figure 2-7. Scheme of standard longline generally used by Spanish observed boats.

Figure 2-8. Relative size of the hooks used in different Spanish longline gears.

2.1.3 Indian Ocean pelagic longline fishery

2.1.3.1 France

No data have been made available to SGRST/SGFEN.

2.1.3.2 Portugal

No data have been made available to SGRST/SGFEN.

2.1.3.3 Spain

According to a report from García -Cortés & Mejuto (2000), the Spanish drifting longline fleet began fishing in the Indian Ocean at the end of 1993 when 3 vessels set out to conduct a prospecting survey on the swordfish (*Xiphias gladius)* in the SE Indian Ocean . This prospecting activity continued throughout the first few months of 1994 with the addition of two more vessels. These vessels later left the Indian Ocean, with only sporadic trips in later years. Starting in 1998, there was an increase in the number of vessels which would alternate their fishery activity between the Indian and other oceans.Two vessels began operating in the Indian Ocean on a permanent basis. During year 2000, a total of 6 Spanish drifting longliners were fishing in the Indian Ocean in addition to alternating their activities with other oceans. From the outset of its activity, in addition to the main target species *Xiphias gladius* (SWO), the Spanish drifting longline fleet had been catching other species such as billfish, tuna and pelagic sharks, the latter being of great importance, both because of their abundance as well as their increasing economic worth.

A total number of 10 Spanish vessels carried out fishing activity in the Indian Ocean (10º-30º S/30º-70ºE) during year 2001. Eight boats were fishing seasonally, alternating their fishing operations between the Indian and other oceans. The vessels ranged from 27 to 42 meters in length and their technical characteristics averaged 210 TRB and 693 HP.

The gear used at the beginning of the fishing activity was the “traditional” Spanish longline style, but since 2001 the boats have been changing to the “american” style longline, a slightly modified version of the “Florida style” longline. The mean number of hooks used per set was 1151, more than reported in the standard Florida Style gear and considerably fewer than the number of hooks used in the “traditional” Spanish longline.

2.1.3.4 Bilateral agreements

Several bilateral agreements have been signed to allow EU fleets to carry out fishing activities in various Indian Ocean areas. The relevant ones are reported in Table 2-9, which also lists the number of pelagic longline vessels. Additional information is also available for the period 1993-1997 from the IFREMER review of bilateral agreements in 1999.

Table 2-9. Inventory of bilateral fisheries agreements between the EC (EU nations) and Indian Ocean nation states in 2005.

Country	Period	Number of Vessels	Detailed Breakdown
Comoros	The current protocol has been extended from 28/02/2004-31/12/2004. A new protocol (01/01/2005-31/12/2010) is currently being considered for adoption by the Council	40 seiners 25 drifting longliners	Tuna seiners: France 21 vessels, Spain 18 vessels, Italy 1 vessel Drifting longliners: Spain 20 vessels, Portugal 5 vessel
Madagascar	01/01/2004-31/12/2006	40 seiners 40 drifting longliners	Tuna seiners: France 16 vessels, Spain 22 vessels, Italy 2 vessels Drifting longliners: Spain 24 vessels, Portugal 6 vessel, France 10 vessels
Mauritius	03/12/2003-02/12/2007	41 seiners and 49 drifting longliners. Line fishing is set at 25 grt/month, averaged yearly	Tuna seiners: France 16 vessels, Spain 22 vessels, Italy 2 vessels, UK 1 vessel Drifting longliners: Spain 19 vessels, Portugal 7 vessel, France 23 vessels
Seychelles	18/01/2002-17/01/2005 A new protocol (18/01/2005-17/01/2011) is currently being considered for adoption by the Council	Seiners: 40 Drifting longliners: 27	Tuna seiners: Spain 18 vessels, France 20 vessels, Italy 1 vessel, UK 1 vessel Drifting longliners: Spain 15 vessels, Portugal 7 vessel, France 5 vessels

2.1.4 Pacific Ocean pelagic longline fishery

No data were made available to SGRN/SGFEN, even though pelagic longline fishing activity is known to be carried out by some EU fleets, in international watersand in the EEZs of Kiribati and the Salomon Islands.

2.1.4.1 Bilateral agreements

Several bilateral agreements have been signed to allow EU fleets to carry out fishing activities in various Pacific Ocean areas. The relevant ones are reported in Table 2-10, which also lists the number of pelagic longline vessels. Additional information is also available for the period 1993-1997 from the IFREMER review of bilateral agreements in 1999.

Table 2-10. Inventory of bilateral fisheries agreements between the EC (EU nations) and Pacific Ocean nation states in 2005

Country	Period	Number of Vessels	Detailed Breakdown
Kiribati	16/09/2003- 15/09/2006	1st year Seiners: 6 Drifting longliners: 12 Following years Seiners: 4 Drifting longliners: 12	No details available (Vessels from France, Spain & Portugal)
Salomon Islands	01/01/2005- 31/12/2007	Purse seiners: 40 Longliners: 10	No details available

2.2 CATCHES

According to the data and information available in section 2.1, it is very apparent that it is difficult to get a reliable figure of the catches obtained by the EU pelagic longline fleets. Most of the catches are reported within the segment of the national fleet concerned, sometimes without a separation by gear.

Furthermore, it is almost impossible to obtain a total figure of the EU pelagic longline catches by country or area, except for the few rare cases.

To provide an idea of the size of catches that might be related to the use of pelagic longline, SGRST/SGFEN decided to provide a copy of the ICCAT catch table from 1978 to 2002 (Table 2-11), concerning the most important large pelagic species in the Atlantic Ocean and the Mediterranean Sea. The table reports the total catch per species and area, the reported longline catch and the total catch by each of the EU countries.

It is important to note that the catches reported for each EU country are not divided by gear type, also that there is a lack of homogeneity in the national reports.

Table 2-11. ICCAT catches by species and geographical area. Total catches in tonnes by longlines only and by EC countries

Spp.	Area		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
YFT	AT.E	Total Catches	134044	127517	130961	155818	165001	165373	113949	156547	146535	144428	135219	161322	192456	163848	160492	158338	168170	149112	150624	136481	147471	141651	132366
YFT	AT.E	Longline	11290	6777	12508	7986	10456	6040	8092	9444	3684	4481	7511	6385	7640	5502	3903	4107	8503	7955	8567	5964	8036	7495	8436
YFT	AT.W	Total Catches	14798	13359	13163	17704	26290	39666	37481	42365	31751	27680	30284	32807	27095	32640	32895	37230	46335	34047	30682	29609	28044	28980	30184
YFT	AT.W	Longline	9572	9277	6735	11323	9926	6969	8503	9743	12407	9990	14736	13033	13215	9410	11777	9925	9463	8833	8737	8823	8795	11596	11465
YFT	AT.E	EC- Spain	33636	40083	38759	51428	54164	51946	40049	66874	61878	66093	50167	61649	68603	53464	49902	40403	40612	38278	34879	24550	31337	19947	24681
YFT	AT.E	EC- France	55192	47776	54372	55085	45717	40470	7946	12304	17756	17491	21323	30807	45684	34840	33964	36064	35468	29567	33819	29966	30739	31246	29789
YFT	AT.E	EC- Portugal	125	185	77	208	981	1333	1527	36	295	278	188	182	179	328	195	128	126	231	288	176	267	178	194
YFT	AT.E	Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	255	54	16	0	55	151	223	97	25	36
YFT	AT.E	Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	332	0	0	0	0	0	0	0	0	0
YFT	AT.E	Poland	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YFT	AT.E	UK-St. Helena	37	69	55	59	97	59	80	72	82	93	98	100	92	100	166	171	150	181	151	109	181	116	136
YFT	AT.W	EC- Spain	2029	1052	0	0	0	1957	3976	1000	0	0	1	3	2	1462	1314	989	7	4	36	34	46	30	171
YFT	AT.W	EC- France	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YFT	AT.W	EC- Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YFT	AT.W	Neth. Antil.	173	173	173	173	173	173	173	150	150	160	170	170	170	150	160	170	155	140	130	130	130	130	130
YFT	AT.W	UK-Bermuda	12	26	35	21	22	10	11	42	44	25	23	22	15	17	42	58	44	44	67	55	53	59	31
BET	Atlantic	Total Catches	52693	45975	63596	67753	73493	59384	71052	78215	65396	55976	65796	78068	84337	94795	97758	110060	129507	123155	119114	105647	109887	121177	102349
BET	Atlantic	Longline	28796	27560	41677	41608	51805	33757	43303	52595	39942	35570	47758	58389	56537	61556	62359	62871	78296	74816	74900	68251	71825	76513	70902
BET	Atlantic	EC- Spain	2300	2300	1385	711	521	421	447	239	171	190	151	87	62	34	56	36	7	7	5	0	0	0	0
BET	Atlantic	EC- France	6849	5419	8430	10010	9332	8794	13617	10340	10884	8875	8475	8263	10355	14705	14656	16782	22096	17849	15393	12513	7115	13739	11250
BET	Atlantic	EC- Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BET	Atlantic	EC- Portugal	5350	3483	3706	3086	1861	4075	4354	6457	7428	5036	2818	5295	6233	5718	5796	5616	3099	9662	5810	5437	6334	3313	1498
BET	Atlantic	Poland	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BET	Atlantic	UK-St. Helena	22	8	9	14	23	14	19	0	0	5	1	1	3	3	10	6	6	10	10	12	17	6	8
SKJ	AT.E	Total Catches	100885	83119	98774	107941	122368	102669	91230	78441	90021	90402	116226	89738	112549	169771	122660	147708	134486	129390	114557	109373	116796	134165	109463
SKJ	AT.E	Longline	0	0	0	22	2	62	22	6	19	6	4	9	0	5	3	2	10	3	7	47	85	42	48
SKJ	AT.W	Total Catches	7176	6565	12573	23073	32520	31839	35596	40272	32151	24164	23736	26382	26110	33404	30155	33221	29949	21859	27561	31718	29079	27306	29295
SKJ	AT.W	Longline	2	1	1	9	23	8	25	24	8	6	9	25	23	33	29	20	16	33	19	18	14	9	12
SKJ	AT.E	EC- Spain	25066	18748	26384	35458	38016	28934	46659	35100	41992	33076	47643	35300	47834	79908	53319	63660	50538	51594	38538	38513	36008	44520	37226
SKJ	AT.E	EC- France	25903	18602	25767	26926	31132	29727	12994	13645	13045	17114	16504	15211	17099	33271	21890	33735	32779	25188	23107	17023	18382	20344	18183
SKJ	AT.E	EC- Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
SKJ	AT.E	EC- Portugal	4584	3074	1954	2825	5530	1113	3974	2409	5446	8420	14257	7725	3987	8059	7477	5651	7528	4996	8297	4399	4544	1810	1302
SKJ	AT.E	Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	0	0	0	0	0	0	0	0
SKJ	AT.E	Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	92	0	0	0	0	0	0	0	0	0
SKJ	AT.E	Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	221	0	0	0	0	0	0	0	0	0
SKJ	AT.E	UK-St. Helena	21	76	70	112	271	103	85	62	139	139	158	397	171	24	16	65	55	115	86	294	298	13	64
SKJ	AT.W	EC- Spain	2031	1052	0	0	0	209	2610	500	0	0	0	0	0	1592	1120	397	0	0	0	0	0	1	1
SKJ	AT.W	EC- France	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SKJ	AT.W	EC- Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
SKJ	AT.W	Neth. Antil.	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	45	40	35	30	30	30	30	30
ALB	AT.N	Total Catches	50047	51365	38707	34531	42673	51490	41829	40826	47554	38115	33878	32070	36557	27938	30815	38063	35036	38295	28780	28988	25587	34840	33754
ALB	AT.S	Total Catches	23169	22628	22930	24040	29672	14918	14599	31097	37288	40630	30107	27212	28714	25866	35918	32516	34733	27231	27898	27802	30487	27553	29259
ALB	MEDIT.	Total Catches	590	833	500	1500	1272	1235	3414	4129	3712	3993	4063	4060	1896	2378	2202	2130	1349	1587	3125	2541	2698	4851	5577
ALB	AT.N	Longline	14157	12207	9451	9819	13206	16863	19709	17413	21232	7296	3013	2228	2683	5304	3103	7020	7196	4776	4620	4044	3875	6621	6606
ALB	AT.S	Longline	22806	21843	20671	20426	25255	11941	9834	22672	29815	30964	21828	19407	21590	21859	26519	23650	24224	19718	20472	19447	19699	20588	22275
ALB	MEDIT.	Longline	150	0	0	0	0	0	226	375	150	161	168	165	624	523	442	402	350	87	366	348	194	417	2800
ALB	AT.N	EC- Spain	25404	29630	25202	20819	25478	29557	15685	20672	24387	28206	27557	25424	25792	17233	18176	18380	16998	20197	16323	17294	13286	15364	15965
ALB	AT.N	EC-France	10400	9320	3955	2929	2855	2391	2797	1860	1200	1921	2805	4050	3300	4123	6924	6293	5934	5304	4694	4618	3711	7189	6019
ALB	AT.N	EC-Ireland	0	0	0	0	0	0	0	0	0	0	0	0	40	60	451	1946	2534	918	874	1913	3750	4858	3464
ALB	AT.N	EC-Portugal	85	149	79	442	321	1778	775	657	498	433	184	169	3185	709	1638	3385	974	6470	1634	395	91	324	278
ALB	AT.N	EC-UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	499	613	196	49	33	117	343	15
ALB	AT.N	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2
ALB	AT.S	EC- Spain	0	0	0	889	106	295	307	155	200	807	185	0	0	280	1943	783	831	457	184	256	193	1027	282
ALB	AT.S	EC-France	40	172	457	912	947	372	7	18	35	100	0	0	0	50	449	564	129	82	190	38	40	13	23
ALB	AT.S	EC-Portugal	0	0	0	0	0	0	741	1357	1029	899	1153	557	732	81	184	483	1185	655	494	256	124	232	486
ALB	AT.S	UK-St. Helena	12	2	4	7	11	7	9	0	0	2	1	1	1	5	28	38	5	82	47	18	1	1	58
ALB	MEDIT.	Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
ALB	MEDIT.	EC- Spain	0	0	0	900	572	535	1331	531	0	0	3	0	84	547	227	290	218	475	404	380	126	284	152
ALB	MEDIT.	EC-France	0	0	0	0	0	0	141	250	20	60	31	31	121	140	11	64	23	3	0	5	5	0	0
ALB	MEDIT.	EC-Greece	0	0	0	0	0	0	0	0	484	500	500	500	500	500	500	1	1	0	952	741	1152	2005	1786
ALB	MEDIT.	EC-Italy	590	833	500	600	700	700	1942	3348	3208	3433	3529	3529	1191	1191	1464	1275	1107	1109	1769	1414	1414	2561	3630
ALB	MEDIT.	Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	4
BFT	AT.E + MED	Total Catches	14645	12223	14103	13845	22375	21660	24425	21962	19051	18196	24117	20951	23247	26428	31897	34268	46471	47290	50762	46758	39097	32454	33752
BFT	AT.W	Total Catches	5763	6255	5801	5771	1445	2542	2292	2685	2322	2592	3011	2867	2798	2992	2115	2311	2106	2426	2401	2230	2591	2662	2665
BFT	AT.E + MED	Longline	912	970	1255	917	4255	3606	2734	1763	1448	1703	2396	1974	2522	6066	6416	5059	9224	12867	12959	10206	7049	6484	7052
BFT	AT.W	Longline	3217	3691	3972	3879	363	829	835	1245	764	1134	1373	678	739	895	674	696	539	466	528	382	764	914	859
BFT	AT.E + MED	Cyprus	0	0	10	10	10	10	10	10	10	10	10	10	10	10	10	14	10	10	10	10	21	31	61
BFT	AT.E + MED	EC-Denmark	2	1	0	3	0	0	1	2	1	0	0	0	0	0	0	37	0	0	0	0	1	0	0
BFT	AT.E + MED	EC-Spain	4190	3656	2468	2601	3813	5257	7547	5090	3577	3654	5995	5210	5379	3664	4532	7096	5878	8426	8762	8047	5800	5363	6246
BFT	AT.E + MED	EC-France	2320	1853	1961	2503	5028	4060	4202	5920	3838	4863	6504	4894	5223	5185	8270	8094	12179	10329	9690	8470	7713	6741	7321
BFT	AT.E + MED	EC-Germany	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BFT	AT.E + MED	EC-Greece	0	0	0	0	5	0	0	11	131	156	159	182	201	175	447	439	886	1004	874	1217	286	248	622
BFT	AT.E + MED	EC-Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	21	52	22
BFT	AT.E + MED	EC-Italy	4983	4020	6272	6017	6658	5865	7140	7199	7576	4607	4201	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3279	3845
BFT	AT.E + MED	EC-Portugal	56	35	24	17	41	174	34	29	193	163	48	3	27	395	358	208	668	481	473	749	377	487	502
BFT	AT.E + MED	EC-Sweden	2	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BFT	AT.E + MED	EC-UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	12	0
BFT	AT.E + MED	Malta	26	23	24	32	40	31	21	21	41	36	24	29	81	105	80	251	572	587	399	393	407	447	376
BFT	AT.W	France-Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
BFT	AT.W	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1

BUM	AT.N	Total Catches	976	897	1085	1296	1650	1214	1378	1566	1069	836	909	1540	1943	1411	1086	1057	1510	1446	1742	1711	1489	1248	999
BUM	AT.S	Total Catches	530	504	619	567	884	749	1252	1623	789	1085	1690	2530	2378	2580	1750	1798	2303	2230	2607	3073	2299	2430	2335
BUM	AT.N	Longline	553	480	643	792	1162	809	920	1223	695	327	415	1009	1597	981	629	600	1065	925	1266	1227	950	752	642
BUM	AT.S	Longline	526	490	498	430	822	533	975	1362	661	964	1530	2017	1958	2280	1473	1415	1643	1565	1991	2250	1517	1524	1485
BUM	AT.N	EC-Spain	0	0	0	0	0	0	3	4	1	0	8	7	2	1	7	7	6	1	22	5	6	3	25
BUM	AT.N	EC-Portugal	0	0	0	0	1	2	1	8	12	8	2	1	1	4	2	15	11	10	7	3	47	8	15
BUM	AT.N	UK-Bermuda	5	2	4	1	2	7	8	9	11	6	8	15	17	18	19	11	15	15	15	3	5	1	2
BUM	AT.S	EC-Spain	0	0	0	0	0	0	0	0	0	0	0	15	0	6	23	18	21	38	88	71	82	109	116
BUM	AT.S	EC-Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
BUM	UNCL	EC-Fr. & Es.	136	126	144	169	174	167	118	122	135	132	137	144	199	137	116	146	133	126	96	82	80	83	79
WHM	AT.N	Total Catches	423	482	521	750	605	1280	653	860	905	587406	368	393	235	610	565	657	617	628	407	385	382	350	290
WHM	AT.S	Total Catches	522	534	428	460	463	461	525	844	680	879	921	1409	1196	1343	817	946	1297	951	1073	676	676	634	579
WHM	AT.N	Longline	317	370	403	671	548	1196	570	788	812	433	167	234	251	105	466	436	528	451	514	316	333	301	282
WHM	AT.S	Longline	520	530	419	340	442	308	471	825	654	870	832	1333	1152	1320	803	923	1295	945	660	589	552	623	570
WHM	UNCL	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
WHM	AT.N	EC-Spain	0	0	0	0	0	0	9	14	0	0	61	12	4	8	18	15	25	10	75	71	65	88	118
WHM	AT.N	UK-Bermuda	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
WHM	AT.S	EC-Spain	0	0	0	0	0	0	0	0	0	0	1	1	0	9	4	8	0	18	32	3	4	45	68
SAI	AT.E	Total Catches	2547	3256	2099	2131	2876	3687	2492	2328	2105	2566	2064	1664	2314	1482	1706	2473	1206	1559	1927	1292	995	1209	1004
SAI	AT.W	Total Catches	795	903	907	1056	1119	1196	1221	1093	1281	1171	1294	1065	1225	1197	1339	1450	1265	1256	1162	1107	1860	1115	1291
SAI	AT.E	Landings	114	83	151	202	309	270	224	148	140	112	126	152	153	57	51	523	178	240	164	213	198	265	165
SAI	AT.W	Landings	279	378	360	408	471	320	512	506	489	451	558	417	382	241	371	657	552	386	346	226	1031	452	766
SAI	AT.E	EC-Spain	0	0	0	0	10	0	4	7	9	0	28	14	0	9	2	30	7	13	25	26	18	19	8
SAI	AT.E	EC-Fr. & Es.	405	375	432	504	521	499	354	364	403	394	408	432	595	174	150	182	160	128	97	110	138	131	98
SAI	AT.E	EC-Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	53	11
SAI	AT.W	EC-Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	5	3	36	3	15	20	6	14
SAI	AT.W	EC-Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
SPF	AT.E	Total Catches	254	235	270	316	326	312	222	228	252	247	256	270	373	107	92	120	134	107	85	99	111	144	103
SPF	AT.W	Total Catches	0	0	0	0	0	0	0	0	54	75	10	7	1	0	0	65	2	10	8	1	9	33	74
SPF	AT.E	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	36	29	26	31	25	63	43
SPF	AT.W	Longline	0	0	0	0	0	0	0	0	54	75	10	7	1	0	0	65	2	4	5	1	9	33	74
SPF	AT.E	EC-Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	3	1	1	1	30	14
SPF	AT.E	EC-Fr. & Es.	254	235	270	316	326	312	222	228	252	247	256	270	373	107	92	112	98	78	59	68	86	81	60
SPF	AT.W	EC-Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	22	50
SWO	AT.N	Total Catches	11835	11937	13558	11180	13215	14527	12791	14383	18486	20236	19513	17250	15672	14934	15394	16717	15475	16844	15172	12997	12195	11590	11421
SWO	AT.S	Total Catches	2766	3294	5323	3975	6447	5402	9139	9586	5894	6030	12956	16848	17124	13713	13633	15942	19629	21780	18152	18435	13835	15306	15508
SWO	MEDIT.	Total Catches	5958	5547	6579	6813	6343	6896	13666	15292	16765	18320	20365	17762	12441	11997	14726	13265	16082	12430	12053	14693	14369	13700	15570
SWO	AT.N	Longline	11123	11177	12831	10549	13019	14023	12664	14240	18269	20022	18927	15348	14026	14208	14288	15641	14309	15765	13787	12186	10783	10449	9642
SWO	AT.S	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	215	383	408	708	526	562	439	476	525	1119
SWO	MEDIT.	Longline	5046	4877	5115	5418	5770	6313	6749	6493	7505	8007	9476	7065	7184	7393	7648	7377	8985	6084	5884	5389	6496	6098	6961
SWO	AT.N	EC-Spain	3622	2582	3810	4014	4554	7100	6315	7441	9719	11135	9799	6648	6386	6633	6672	6598	6185	6953	5547	5140	4079	3993	4595
SWO	AT.N	EC-France	0	0	5	4	0	0	1	4	4	0	0	0	75	75	75	95	46	84	97	164	110	104	122
SWO	AT.N	EC-Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	132	81	35
SWO	AT.N	EC-Italy	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWO	AT.N	EC-Portugal	17	29	15	13	11	9	14	22	468	994	617	300	475	773	542	1961	1599	1617	1703	903	773	777	732
SWO	AT.N	EC-UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	5	11	0	2	1
SWO	AT.N	Poland	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWO	AT.N	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	5	3	3
SWO	AT.S	EC-Spain	0	0	0	0	0	0	0	0	66	0	4393	7725	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758	6388
SWO	AT.S	EC-Fr. & Es.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
SWO	AT.S	EC-Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	380	389	441	384	381	392
SWO	AT.S	UK-St. Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWO	MEDIT.	Cyprus	82	98	72	78	103	28	63	71	154	84	121	139	173	162	73	116	159	89	40	51	61	92	82
SWO	MEDIT.	EC-Spain	720	800	750	1120	900	1322	1245	1227	1337	1134	1762	1337	1523	1171	822	1358	1503	1379	1186	1264	1443	906	1436
SWO	MEDIT.	EC-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWO	MEDIT.	EC-Greece	0	0	0	91	773	772	1081	1036	1714	1303	1008	1120	1344	1904	1456	1568	2520	974	1237	750	1650	1520	1960
SWO	MEDIT.	EC-Italy	4506	3930	4143	3823	2939	3026	9360	10863	11413	12325	13010	13009	5524	4789	7595	6330	7765	6725	5286	6104	6104	6312	7515
SWO	MEDIT.	EC-Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
SWO	MEDIT.	Malta	136	151	222	192	177	59	94	172	144	163	233	122	135	129	85	91	47	72	72	100	153	187	175

LEGEND: **YFT** Atlantic yellowfin tuna; **BET** Atlantic bigeye tuna; **SKY** Atlantic skipjack tuna; **ALB** Atlantic albacore; **BFT** Atlantic bluefin tuna; **BUM** Atlantic blue marlin; **WHM** Atlantic white marlin; **SAI** Atlantic sailfish; **SPP** Atlantic spearfish; **SWO** Atlantic swordfish

2.3 WG REMARKS

1. Although information at present is insufficient, the WG considers that EU longline fleets are fishing in waters (Mediterranean, Atlantic, Indian Ocean and the Pacific) where turtle by-catch is known to occurs.
2. The EU longline fleet is rather heterogeneous, from small artisanal vessels to large industrial vessels with processing facilities.
3. Most of the information on longline fleets presented in this chapter is only from EU countries in the Mediterranean Sea.
4. Information on the EU longline fleets in distant waters and the Atlantic is only available for a few of the countries known to operate in these waters (see the list of bilateral EU agreements).
5. Often the fleets are multipurpose fleets, and it is therefore not possible to extract specific information on the number of vessels engaged in pelagic longline fisheries, the longline effort and corresponding turtle by-catch.
6. The EU pelagic longline fleet is likely to have different components varying from year to year, or by season or month.

3 OVERVIEW OF THE QUANTITATIVE BY-CATCH DATA ON TURTLES BY THE EU PELAGIC LONGLINE FLEETS

Marine turtles face a range of threats, both at nesting colonies and in the wider marine environment. Anthropogenic threats include: incidental capture in fishing equipment; beach development and nesting habitat destruction; disorientation of hatchlings by beachfront lighting; direct take; nest destruction by beach vehicles; dredging; ingestion of plastics or other marine debris; boat collision; and oil spills (Plotkin 1995).

The incidental capture of marine turtles in longline fishing gear is generally accepted to be a significant factor contributing to the decline of sea turtle populations in both the Pacific and Atlantic Oceans (Heppell *et al.* 1999; NMFS 2001). Pelagic stage juvenile hard-shelled turtles e.g. loggerhead turtles are generally hooked in the mouth, which presumably results from them actively biting the baited hook, whereas leatherback turtles are most often entangled.

3.1 ATLANTIC OCEAN

Substantial bycatch has been documented in NW Atlantic pelagic longline fisheries (e.g. Witzell 1984, 1996, 1999). The estimated annual bycatch for the US Atlantic pelagic longline fleet from 1992-98, ranged 664 to 3136 turtles (Johnson *et al.* 1999; Yeung 1999). Loggerheads and leatherbacks accounted for 52% and 42% of observed animals respectively (Johnson *et al.* 1999). Most bycatch in the US pelagic longline fishery occurs south and east of the Grand Banks with a disproportionate number of turtles captured in only a few sets (Hoey 1997). In 1995 for example, many turtles were caught on longlines set within a decaying warm-core ring of the Gulf Stream. There were multiple recaptures of some individuals. The National Oceanic and Atmospheric Administration are considering the adoption of time/area closures to reduce bycatch (NOAA 1999).

3.1.1 France

No data have been made available for SGRST/SGFEN.

3.1.2 Ireland

There are additional accounts of turtle bycatch in an experimental longline fishery in Irish waters (F Guilfoyle, Aberdeen University, pers. comm.; D Rihan, Bord Iascaigh Mhara, pers. comm.). No data were available however, for Spanish vessels, which operate the largest longline fleet in the NE Atlantic, mostly targeting swordfish (see section 2.1.1.2).

3.1.3 Portugal

Loggerhead turtles from south-eastern U.S.A. nesting beaches migrate after hatchling and are sighted at the juvenile pelagic state at Azores and Madeira Islands (Bolten *et al.* 1998) where they remain some time within the Portuguese EEZ (Dellinger 2000). Deepwater fishing activities based in mainly in Madeira, targeting *Aphanopus carbo* (black scabardfish), impact the juvenile loggerheads. Turtle mean CPUE for 1997 was 0.028±0.070 turtles per thousand hooks (Encarnação 1998), and peaked in July August (Ferreira 2001). Dellinger and Encarnação (2000) estimated an annual take of over 500 turtles by this activity. Turtle mortality was nearly 100% which indicated that turtles take the bait during setting and are drowned by the line. This large mortality is the main difference to other longline fisheries that set their gear much closer to the surface.

Incidental by-catch of turtles has been reported for longline fisheries in the Azores. The loggerhead bycatch in 1998, based on 151 sets (from May to December) observed on a longline boat using J hooks ("Ancora 17/0") baited with mackerel or squid, caught 60 loggerhead turtles, ranging from 41.3 to 65.4 cm (CCL- curved carapace length), but 15 of these turtles were not brought on board and thus not adequately measured, as they were released by cutting the line. The mean CPUE of loggerheads (no./1000 hooks) increased from May (0.04) to a maximum in July (0.79), decreased until September (nearly 0.2), increasing again in October (almost 0.5) and decreased afterwards to December, attaining low values (almost 0.2). The average CPUE for that year was 0.27. For these 60 turtles, 54 were hooked in the mouth (90%), 3 in the esophagus (5%), 1 in the eye, 1 in the flipper and 1 undetermined (1.7% each). Only, one of those turtles was dead, another was weak, but recovered and all the others were active (Bjorndal & Bolten 1999; Ferreira *et al.* 2001).

More detailed data on the by-catch species in this fishery is available for some years. For instance, in 2000, drifting longlines targeting swordfish captured at least 147 loggerhead turtles and 4 leatherbacks (Table 3-1).

The mortality of turtles in the area likely increased after 2004, as new longliners from the Portuguese and Spanish mainland are now fishing in the area for the first time (Table 2.1).

The list of by-catch species in the drifting longline fishery in the Azorean waters is very incomplete, based on only one boat in and for 2 years (Table 3-1)., All experimental campaigns carried out after 2000 used circular hooks that are not generally used by fisherman.

Table 3-1. List of target species and by catches from the commercial drifting longline fishery in Azorean waters based in the use of J hooks (1998 – from Ferreira, 1999; 2000 – unpublished data, from "sea turtle by catch longline experiment"). CPUE in nº of individual/1000 hooks. A – 3 months (April-May and August) 1998. B – 6 months (July to December) 2000.

		A – 1998		B – 2000		Average
Latin Name	Common Name	**N**	**CPUE**	**N**	**CPUE**	**CPUE**
Osteichthyes:		hooks =	88420	hooks =	93000	
Xiphias gladius	**Swordfish**	410	4.637	723	7.774	6.206
Alepisaurus spp.	**Lancetfish**	32	0.362	23	0.247	0.305
Thunnus alalunga	**Albacore**	1	0.011	4	0.043	0.027
Thunnus thynnus	**Atlantic bluefin tuna**	1	0.011		0.000	0.006
Coryphaena hippurus	**Common dolphin fish**	7	0.079	7	0.075	0.077
Thunnus obesus	**Bigeye tuna**	4	0.045	5	0.054	0.050
Ruvettus pretiosus	**Oilfish**	2	0.023	3	0.032	0.027
Lepidocybium flavobrunneum	**Escolar**	4	0.045	8	0.086	0.066
Mola mola	**Ocean sunfish**	2	0.023	13	0.140	0.081
Masturus lanceolatus	**Sharp-tailed sunfish**		0.000	5	0.054	0.027
Thunnus albacares	**Yellowfin tuna**		0.000	1	0.011	0.005
Katsuwonus pelamis	**Skipjack tuna**		0.000	1	0.011	0.005
Tetrapturus pfluegeri	**Longbill spearfish**	5	0.057	8	0.086	0.071
Taractes cf. *rubescens*	**Dark-pomfret**	1	0.011	2	0.022	0.016
Lepidopus caudatos	**Silver scabbard fish**	1	0.011		0.000	0.006
Chondrichthyes:						
Prionace glauca	**Blue shark**	1945	21.997	1340	14.409	18.203
Isurus oxyrinchus	**Mako shark**	18	0.204	38	0.409	0.306
Alopias superciliosus	**Bigeye thresher shark**	3	0.034	13	0.140	0.087
Alopias vulpinuis	**Common thresher shark**	1	0.011		0.000	0.006
Dasyatis violácea	**Pelagic stingray**	4	0.045	4	0.043	0.044
Sphyrna zygaena	**Hammer head shark**		0.000	1	0.011	0.005
Carcharhinus galapagensis	**Galapagos shark**	1	0.011	1	0.011	0.011
Heptranchias perlo	**Sharpnose sevengill**		0.000	1	0.011	0.005
Galeorinus galeus	**Tope shark**		0.000	8	0.086	0.043
Galeocerdo cuvier	**Tiger shark**	1	0.011		0.000	0.006
Reptilia:						
Caretta caretta	**Logger head turtle**	10	0.113	147	1.581	0.847
Dermochelys coriacea	**Leatherback turtle**	1	0.011	4	0.043	0.027
Others:						
Todarodes sagittatus	**Flying squid**	1	0.011		0.000	0.006

3.1.4 SPAIN

No data have been made available for SGRST/SGFEN.

3.1.5 UK

No data have been made available for SGRST/SGFEN.

3.2 MEDITERRANEAN SEA

3.2.1 Cyprus

It has been estimated that over 500 turtles are caught each year in Cyprus (Godley *et al.* 1998) mainly in gillnets and longlines. A survey based on interviews with artisanal fishermen (using both nets and longlines) in northern Cyprus yielded an estimated by-catch of 4 turtles per boat and year (Godley *et al.* 1998). Even though 90% of the specimens were reported as having been caught alive, an unknown fraction of them could have been killed on board as fishermen perceive turtles as a nuisance. The authors of the report suggest that green turtles could possibly account for a significant proportion of turtles caught.

3.2.2 France

A recent revision of the "thonnaille" fishing for Bluefin tuna off the Gulf of Lions and in the Liguria Sea showed incidental captures of *Caretta caretta* in unknown numbers (STECF 2001). Information on incidental turtles capture in artisanal gears, bottom trawls, and other artisanal gears (drifting longline, trammel nets and gillnets) is available from literature (Laurent 1991; Laurent *et al.* 1996).

Delaugerre (1987) reported a mortality rate of 94.4% for *Caretta caretta* specimens caught in Corsica by trammel nets placed at depths >60 m. A mortality of 53.7% out of 149 turtles was estimated for turtles caught at a depth less than 50 m. (Lauren 1991, in Gerosa and Casale 1999). Stranded loggerheads on the coasts of France are uncommon: about ten juvenile loggerheads and some leatherback are observed annually (Lescure, 1997). According to this author, loggerheads are mainly captured with trammel nets and bottom trawl; information on turtles captures with drifting longline or tuna purse-seiners are not available. Leatherback strandings and sightings on the French Mediterranean coast have been summarized by Oliver (1986). Most observations of by-catch in this species have involved entanglement in nets or ropes.

No total estimates of turtle by-catch are available for the French drifting longline fleet.

3.2.3 Greece

According to Laurent *et al.* (2001), incidental catch and mortality of marine turtles is of grave concern in Greece.

During the first monitoring effort (1999-2000) of the EMTP Project (Laurent *et al.* 2001), 255 swordfish longline operations ('sets') were monitored using on board observers. The observations were conducted in two of the most significant ports for the Greek pelagic longline fishing fleet. The monitoring in 1999 covered the Strait of Kythira between Crete and Peloponissos, while the monitoring in 2000 covered the entire Aegean Sea and Ionian Sea. Figure 3-1 shows the spatial distribution of the sampled drifting longline efforts.

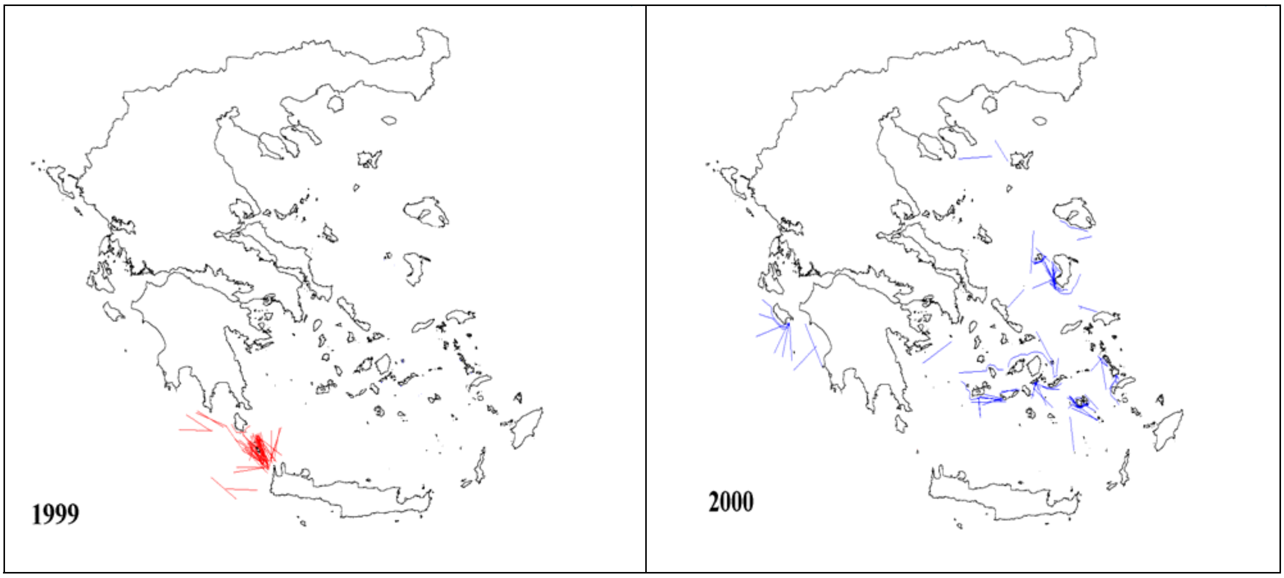

Figure 3-1. Spatial distribution of the sampled drifting longline effort.

Data collected by the monitoring programme has focused on the following parameters:

- Technical characteristics of the gears
- Fishing depth and temperature of the water
- Fishing effort
- Morphometric characteristics of the sea turtles
- Hooking time of the sea turtles caught.

Over 255 trips were observed during the two years of monitoring (1999-2000). A total of 23 sea turtles were captured. 22 of them were *Caretta caretta* and one *Dermochelys coriacea.* Table 3-2 shows the capture distribution by vessel length class. In 2000, in the swordfish fishery, turtle catch rates (number of turtle catch per 1,000 hooks) were estimated at 0.30±0.17 (95%CI) in Greece. Direct mortality; *i.e.* proportion of turtles found dead, was estimated at 4.3% (N=23 longline-caught turtles).

Table 3-2. Sea turtles by-catch in the 326 observed sets in Greece.

		Vessels < 15 m		
	No of sampled vessels	Total Observed effort (10^3 hooks)	Captured turtles	Dead
1999	5	23,23	1	0
2000	7	46,95	1	1
		Vessels > 15 m		
	No of sampled vessels	Total Observed effort (10^3 hooks)	Captured turtles	Dead
1999	1	35,26	4	0
2000	4	25,42	17	0
2004	11	46,5	8	0

The turtles caught in the two years of observations were medium- and large size loggerhead. Most of the turtles were caught in Ionian Sea (13 over 23) and in particular close to the Island of Zakynthos, which is a well-known reproduction area. 70% of the captured turtles were released with a hook deep in the digestive track. There was a single *Dermochelys coriacea* caught in the area of the Cyclades Islands. The turtle was entangled by the flipper and not hooked in the mouth.

The average length of the turtles (Straight Minimum Carapace Length) was 59.2 cm for the year 1999 and 490 mm for the year 2000. It has been observed that 83% of the turtles caught were hooked on a hook carrying a light stick, while 12% were hooked on the hook next to a light stick. The only turtle that was captured dead was hooked next to a shark. It is suspected that the death of the turtle was caused by the weight of the dead shark tightrning the line. Only one turtle was hooked on a hook timer. The registered hooking time was 18 hours and 9 minutes. Although the fishing depth was 30 m, the turtle was able to reach the surface and breathe normally. All turtles captured alive were in relative good condition. 70% of the turtles were hooked deep in the oesophagus while 30% were hooked in the mouth and the hook could be easily removed. All interviewed fishers declared that they release the turtles either after cutting the line or after removing the hook when possible.

During a second period of observations, it was monitored the fishing effort of 65 swordfish longlines and 6 albacore longlines In 2004, monitoring was carried out aboard drifting longlines vessels larger than 15 m. The monitored parameters were:

1) Technical characteristics of the gears
2) Fishing effort
3) Number of captured sea turtles

During the longline fishery targeting on swordfish (46.540 hooks totally) a total of 8 sea turtle captures were recorded, all alive. All sea turtles were recorded from May to September. During the longline fishery targeting on albacore (4.800 hooks totally) there was not any capture of sea-turtles.

The CPUE estimations for turtle by-catch is shown on Table 3-3.

Table 3-3. Turtles CPUE estimations for Greek drifting longline (LL) fisheries in 1999, 2000 and 2004.

Year	Fishery	Number of Hooks observed	CPUE Loggerhead	CPUE Leatherback
1999	LL-Swordfish	70.170	0.0706	0
2000	LL-Swordfish	60.680	0.2802	0.0165
2004	LL-Swordfish	46.540	0.1719	0
2004	LL-Albacore	4.800	0.0000	0

A previous study addressing the by-catch of turtles by the swordfish longline fleet based at Kefalonia, and operating mainly in the Central and South Ionian Sea, from 1989 to 1995, showed that each vessel caught an average of 7.7 loggerhead turtles every year (Panou *et al.* 1999). Loggerhead turtles are also taken on longlines in the Ionian Sea (Panou *et al.* 1992). Although nesting season in that area coincides with the peak of the swordfish fishery, 77% of individuals caught were immature, highlighting the vulnerability of juvenile animals to fishing (though Salter, 1995 alternatively suggests that this fact could reflect the capture of adults by driftnets, but this fact is not mentioned in any Mediterranean study). Extrapolating these data to the total professional Greek longline fleet in the Ionian Sea (which accounts for more than 50% of total Greek fishing effort in western Greece), an estimated figure of 280 turtles caught per year is obtained. This figure is different to the most recent estimations (Table 3-4). Laurent *et al.* (1996) compiled estimations from Panou *et al.* (1993, 1996), assessing 80 loggerhead captured annually by the Kefalonian fleet and unknown numbers in the Agean and Crete longline fisheries. The difference between the two figures, besides of the different years taken into account, is due to the fact that the data provided at the meeting (Kapantagakis, *pers. com.)* are deriving from an observer on board programme, carried out with the same protocol in several years and on a large range of vessels, while the data provided by Panou *et al.* (1993 and 1996) were obtained only from the area around Kefalonia and extrapolated to the whole Greek fishery.

Table 3-4. Estimations of average total sea turtles captures for LL fisheries in Greece between 1999 to 2004.

Year	Fishery	Total Captures Loggerhead	Total Captures Leatherback
1999	LL-Swordfish	835	0
2000	LL-Swordfish	3.181	58
2004	LL-Swordfish	207	0
2004	LL-Albacore	0	0

3.2.4 Italy

Turtles are very common in Italian waters migrating from the eastern to the western Mediterranean basin and *vice versa* through the Straits of Messina and the Strait of Sicily (Argano and Baldari 1983; Margaritoulis 1988; Argano *et al.* 1992; Bentivegna 2002). The two corridors are characterized by intense fishing (Bentivegna 2002), but pelagic longlines are mostly active in the Strait of Sicily.

Results from an on-board observer programme (De Florio *et al.* 2005) showed a total of 233 marine turtles (81 in 1999, 151 in 2000 and 1 in 2001) captured in drifting longline fisheries:

94 loggerhead (*C. caretta*) were caught in the northern Ionian Sea, 27 in 1999 (23 caught by longlines and 4 by drift nets) and 67 in 2000 (64 caught by longlines and 3 by drift nets);
134 marine turtles (132 loggerhead and 2 green turtle) were caught in the southern Ionian Sea: 53 loggerhead and 1 green turtle in 1999, 78 loggerhead and 1 green turtle in 2000, and 1 loggerhead in 2001;
5 loggerhead were caught in the southern Tyrrhenian Sea in 2000.

The total by-catch of marine turtles and effort by area and gear in 1999-2000, are as follows (Table 3-5):

Table 3-5. Total bycatch of marine turtles by area and gear.

Northern Ionian Sea, 1999

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
SWO-LL	11	91	146.3	**0.08**	**0.12**
ALB-LL	12	39	90.5	**0.13**	**0.31**
TOTAL	**23**	**130**			
gear	*No. marine turtle*	*N.o sets*	*E (x 1000 m)*	*CPUE (No.)*	*catch/set*
GILL	3	29	289.0	**0.01**	**0.10**
ALB-GLL	1	6	43.2	**0.02**	**0.17**
TOTAL	**4**	**35**			

Northern Ionian Sea, 2000

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
SWO-LL	19	54	87.8	**0.22**	**0.35**
ALB-LL	45	32	89.5	**0.50**	**1.41**
TOTAL	**64**	**86**			
gear	*No. marine turtle*	*No. Sets*	*E (x 1000 m)*	*CPUE (No.)*	*catch/set*
GILL	3	42	333.2	**0.01**	**0.07**
TOTAL	**3**	**42**			

Southern Ionian Sea, 1999

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
SWO-LL	54	109	131.6	**0.41**	**0.50**
TOTAL	**54**	**109**			

Southern Ionian Sea, 2000

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
SWO-LL	51	57	71.8	**0.71**	**0.89**
ALB-LL	28	50	143.5	**0.20**	**0.56**
TOTAL	**79**	**107**			

Southern Ionian Sea, 2001

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
ALB-LL	1	4	10.0	**0.10**	**0.25**
TOTAL	**1**	**4**			

Southern Tyrrhenian Sea, 2000

gear	*No. marine turtle*	*No. sets*	*E (x 1000 hook)*	*CPUE (No.)*	*catch/set*
SWO-LL	5	7	8.5	**0.59**	**0.71**
TOTAL	**5**	**7**			

SWO-LL = swordfish longline, ALB-LL = Albacore longline, GILL = driftnet

In the Northern Ionian Sea, in both years, the percentage of turtles captured with the same gear was always lower than that recorded in the Southern Ionian Sea. The highest catch was registered between May and October, but this is likely to be a result of the greater fishing effort during this period.

The mean carapace length of loggerheads was 40.9 cm (SD = 10.3; range = 19.0-77.5; n = 188). Among these turtles, only three were large specimens (CSCL ≥ 70 cm) and they were captured by swordfish longlines (LL-SWO). Sea turtles caught by LL-SWO (mean = 43.8 cm; SD = 11.3; n = 115) were significantly larger ($p<0.01$) than those captured by albacore longlines (LL-ALB) (mean = 37.2 cm; SD = 7.4; n = 83) (Figure 3-2). The size difference was largely due to the bigger hook sizes used in the swordfish longline. In both investigated areas of the Ionian Sea, almost all individuals were juveniles or sub-adults, and therefore immature, with a low proportion of adults. In fact, only five (3%) of the measured individuals caught by LL-SWO could be considered adults as they were larger than 65 cm CSCL (Aguilar *et al.* 1995; Margaritoulis 1982).

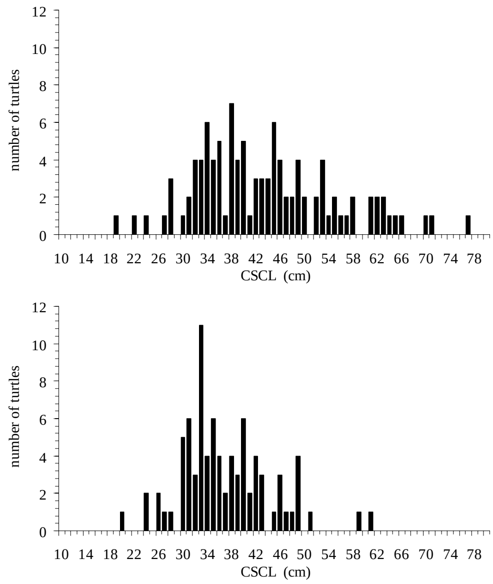

Figure 3-2. Length (CSCL) frequency distributions of loggerheads caught in the Ionian Sea during the observations carried out in 1999 and 2000. Top) Swordfish longline (n = 105); bottom) Albacore longline (n = 83).

The information herein was provided in the framework of the EMTP European project 98/008 and therefore they are not representative of the longline fishery in all Italian fishing areas.

In order to compare catch rates obtained during the EMTP 98/008 European project and other studies (Table 3-6), only sea turtles caught by LL-SWO (swordfish fishery) are considered since, with the exception of historical data collected in the northern Ionian Sea, no data regarding LL-ALB (albacore fisheries) are available in the literature. The overall sea turtle catch rate in the investigated area was significantly lower than that reported elsewhere in the western Mediterranean during the 1986-1995 period (0.27 vs 1.44; $p<0.001$) and 1991 (0.27 vs 4.47; $p<0.001$). The occurrence of a higher concentration of sea turtles in the western basin of the Mediterranean Sea is due to the entrance of specimens from the Atlantic Ocean via the Strait of Gibraltar throughout the year, as well as by the movements of sea turtles coming from the eastern and central Mediterranean, especially during spring and summer. Moreover, the western Mediterranean is also characterised by the presence of sea turtles that move towards the eastern warmer waters along the northern African coast during autumn, where it is know that a wintering areas exists.

The sea turtle catch rate obtained in this study for the northern Ionian Sea, from both LL-SWO and LL-ALB, is higher than that recorded in the same area from 1978 to 1981 (0.27 vs 0.06; $p<0.001$). This difference could be due to the fact that the historical catch rates were underestimated because they were obtained from the captains of vessels, who were not always available or willing to provide detailed information on their fishing activities.

During 2002 a total of 9 loggerhead turtles (*Caretta caretta*) catches were recorded during onboard observations in the Strait of Sicily, for 10 fishing sets (Table 3.7). During July-August observers were deployed twice on 5 vessels with average length of 12m. Mean swordfish longline length was 50km (min 20, max 60), mean hook number 900 (min 800, max 1500), *Scomber* spp. or *Alosa fallax* were used as bait, hook mean size 7 (min 5, max 9). Turtle capture rate per 1000 hooks was 1.0 animal; 1 was dead and 2 badly injured.

A short study was carried out at the beginning of the 1990s (Di Natale *et al.* 1992) on swordfish longlines in the Southern Tyrrhenian Sea and in the Strait of Sicily. The CPUE (related to 1,000 hooks) over 25 fishing setsobserved on board was 0.077 for loggerhead turtle and 0.026 for leatherback turtle.

Another study was carried out in 1999-2000, with onboard scientific observers (Guglielmi & Di Natale 2000). The area taken into account included the Southern Tyrrhenian Sea, the Western Ionian Sea, the Southern Adriatic Sea and the Southern Mediterranean Sea, with trials on swordfish longlines (LL SWO), bluefin tuna longlines (BFT LL) and albacore longlines (ALB LL). A complete data set for all the species reported during the commercial fishing trials is included in the study report. Table 3-8 shows only the data concerning marine turtles. CPUE is related to 1,000 hooks effort, while CPU is the number of catches in each single fishing day per vessel.

Table 3-6. Catch rates for sea turtles from pelagic longlines from this study and previous studies (from EMPT project, limited to Mediterranean data).

Area	# of turtles caught	Effort (x1000 hooks)	CPUE (n)	Source
	Swordfish longline			
EMTP project				
Northern Ionian Sea (1999-2000)	30	234.1	0.13	Deflorio *et al.* 2005
Southern Ionian Sea (1999-2000)	85	190.4	0.45	Deflorio *et al.* 2005
Overall	115	424.5	0.27	Deflorio *et al.* 2005
Other studies				
Northern Ionian Sea (1978-1981)	101	1743.5	0.06	De Metrio *et al.* 1983
Western Mediterranean (1986-1995)	44173	30600.8	1.44	Camiñas 1997
Western Mediterranean (1991)	367	82.2	4.47	Argano *et al.* 1992
	Albacore longline			
EMTP project				
Northern Ionian Sea (1999-2000)	57	180.0	0.32	Deflorio *et al.* 2005
Southern Ionian Sea (1999-2000)	28	143.5	0.20	Deflorio *et al.* 2005
Overall	85	323.5	0.27	Deflorio *et al.* 2005
Other studies				
Northern Ionian Sea (1978-1981)	695	4811.1	0.14	De Metrio *et al.* 1983

Table 3-7. Status of Loggerhead turtles in drifting longline by-catch as reported by EMTP project for the Straits of Sicily during 2002.

Number of turtles recorded	Number dead	Freed after line cutting	Returned to rescue center	De-hooked on Vessels
9	1	1	1	6

Table 3-8. Marine turtles caught during the 1998-99 longline commercial fishing trials observed in the Central Mediterranean area (Guglielmi & Di Natale 2000).

Species	1998									1999								
	LL SWO			LL ALB			TOTAL 1998			LL SWO			LL BFT			TOTAL 1999		
	n	CPUE	CPU	n	CPUE	CPU	n	CPUE	CPU	n	CPUE	CPU	n	CPUE	CPU	n	CPUE	CPU
Caretta caretta	10	0,230	0,278	57	1,738	8,143	67	0,879	0,023	9	0,089	0,106	6	2,143	2,000	15	0,145	0,170
Dermochelys coriacea	1	0,023	0,023				1	0,013	1,558	2	0,020	0,024				2	0,019	0,023

Between the two years considered and including all the gear types, the average CPUE was 0.456 for the Loggerhead turtle and 0.017 for the Leatherback turtle, while the CPU was 0.626 and 0.023 respectively.

In the same study, differences among areas are quite evident (Table 3-9), showing a cumulative higher catch rate in the Southern Mediterranean sea (CPUE = 0.906) with a peak in July (CPUE = 6.555).

As concern the loggerhead turtle, the highest average catch rate was also in the Southern Mediterranean Sea (CPUE = 2) with a peak in July (CPUE = 6.555) in 1998. It was evident that the longline had intercepted a massive migration course during that period. The higest daily catch rate was recorded in one day in July (CPUE = 40.7).

As regards the Leatherback turtle, the highest average catch rate was reported in the Central-Southern Tyrrhenian sea (CPUE = 0.063) in 1999, but the highest peak was in May 1988 in the Southern Mediterranean sea (CPUE = 0.1).

No total estimates of turtle by-catch are available for the Italian drifting longline fleet.

Table 3-9. CPUE data on marine turtle by-catch in observed longline fishing activities in various central Mediterranean areas in 1988 and 1999 (Guglielmi & Di Natale 2000).

	1998					1998					1998					
month	***Caretta caretta***					***Dermochelys coriacea***					**TOTAL TURTLES**					
	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	%
APRIL				0	0				0	0				0	0	0,00
MAY				0,4	0,4				0,1	0,1				0,5	0,5	6,91
JUNE																
JULY				6,555	6,555				0	0				6,555	6,555	90,58
AUGUST	0	0		0	0	0	0		0	0	0	0		0	0	0,00
SEPTEMBER	0	0	0,333	0,2	0,182	0	0	0	0	0	0	0	0,333	0,2	0,182	2,51
OCTOBER																
NOVEMBER																
DECEMBER																
AVERAGE	0	0	0,333	2	0,879	0	0	0	0,031	0,011	0	0	0,333	2,031	1,535	100,00
	1999					**1999**					**1999**					
month	***Caretta caretta***					***Dermochelys coriacea***					**TOTAL TURTLES**					
	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	%
APRIL				0	0				0	0				0	0	0,00
MAY		0		0,286	0,25		0		0,071	0,063		0		0,357	0,063	4,31
JUNE		0		2	1,2		0		0	0		0		2	1,2	82,02
JULY		0			0		0			0		0			0	0,00
AUGUST	0,167	0		0	0,05	0	0		0	0	0,167	0		0	0,05	3,42
SEPTEMBER	1			0	0,5	0			0	0	1			0	0,05	3,42
OCTOBER	0			0,063	0,05	0,25			0	0,05	0,5			0,063	0,1	6,84
NOVEMBER				0	0				0	0				0	0	0,00
DECEMBER																
AVERAGE	0,438	0		0,208	0,205	0,063	0		0,019	0,023	1,667	0		0,226	0,228	100
	TOTAL 1998-99					**TOTAL 1998-99**					**TOTALE 1998-99**					
month	***Caretta caretta***					***Dermochelys coriacea***					**TOTAL TURTLES**					
	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	C.S. Tyrrhenian Sea	W Ionian Sea	S Adriatic Sea	S Mediterranean Sea	MEAN CPUE	%
APRIL				0	0				0	0				0	0	0,00
MAY		0		0,333	0,308		0		0,083	0,077		0		0,417	0,385	6,22
JUNE		0		2	1,2		0		0	0		0		2	1,2	19,39
JULY		0		6,555	4,214		0		0	0		0		6,555	4,214	68,09
AUGUST	0,143	0		0	0,032	0	0		0	0	0,143	0		0	0,032	0,52
SEPTEMBER	0,857	0	0,333	0,091	0,348	0	0	0	0	0	0,857	0	0,333	0,091	0,348	5,62
OCTOBER	0			0,063	0,05	0,25	0		0	0,05	0,25	0		0,063	0,01	0,16
NOVEMBER				0	0				0	0				0	0	0,00
DECEMBER																
AVERAGE	0,389	0	0,333	0,882	0,634	0,056	0	0	0,024	0,023	0,444	0	0,333	0,906	0,657	100

3.2.5 Malta

Gramentz (1989) reports 1500-2000 loggerhead captured annually in Maltese longlines, mostly immature. Groombridge (1990) report between 1000-3000 turtles annually captured by longlines, nets and other gears, both as target and accidentally, estimating 500-600 turtles deaths in Malta each year

Longline fishing activity is reported to be increasing around Malta in the most recent years, but no recent estimates are available.

3.2.6 Portugal

Some driftinglongline vessels are known to operate in the Mediterranean. No data have been made available for SGRST/SGFEN.

3.2.7 Spain

From the early 80's onwards many different studies and research project on the Spanish fisheries have demonstrated the potential impact of driftinglonglines on marine turtles in the western Mediterranean.

A study referring to the Spanish longline fleet targeting swordfish in the South Western Mediterranean (up to 60-80 vessels in the summer months, in the early 1990's) suggested that turtle by-catch in this region was high (Aguilar *et al.* 1995). Rates as high as 6.5-9.8 turtles per day and boat were recorded during 1990 and 1991, suggesting an estimated total catch ranging from 22,000 to 35,000 individuals each year. Estimates of total catches by the Spanish longline fleet in the Mediterranean for the period 1988-1996 range from 1,953 individuals in 1993 to 23,888 in 1990 (Camiñas 1997b). It is important to note that individuals caught by the Spanish longline fleet have two different origins: Atlantic individuals entering the Mediterranean during the spring, and others belonging to the Central and Eastern Mediterranean breeding populations. Both groups migrate into the Western Mediterranean feeding grounds in spring and summer (Camiñas 1997a, b).

From 1985-1995 IEO (Instituto Español de Oceanografía) maintained a turtle sampling scheme in Mediterranean ports where tuna and swordfish are landed. In addition, daily queries were made to the drifting longline skippers in Alicante from 1985 to 1986 in order to estimate the effort by boat, the gear characteristics, the total captures and the number of turtles discarded. From the Alicante data and the total effort by month for the Spanish drifting longline fishing fleet for swordfish in the Mediterranean the number of captured turtles by month has been estimated. Results are presented in Table 3-10 and Figure 3-3 (Camiñas 1996).

Table 3-10. Extrapolation of total loggerhead by-catch in the Spanish Mediteranean drifting longline fisheries.

MONTH	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
I	8	0	0	23	15	10	0	9	0	3
II	13	2	2	9	5	0	5	0	3	0
III	22	47	10	29	0	17	12	0	36	5
IV	37	297	53	165	31	9	0	16	13	12
V	711	1289	511	988	405	140	152	109	153	116
VI	1481	6723	1647	5857	3108	427	34	67	221	921
VII	7049	5428	2995	4537	9048	6825	496	598	2885	2844
VIII	5996	3720	12748	1325	7689	3594	947	850	1013	6770
IX	583	1260	1204	941	2573	1653	278	242	874	2667
X	149	51	726	1374	863	194	53	43	114	971
XI	77	38	85	67	130	63	7	11	51	274
XII	112	2	5	24	20	8	6	7	0	10
TOTAL	16237	18216	19987	15339	23886	12940	1990	1953	5364	11673

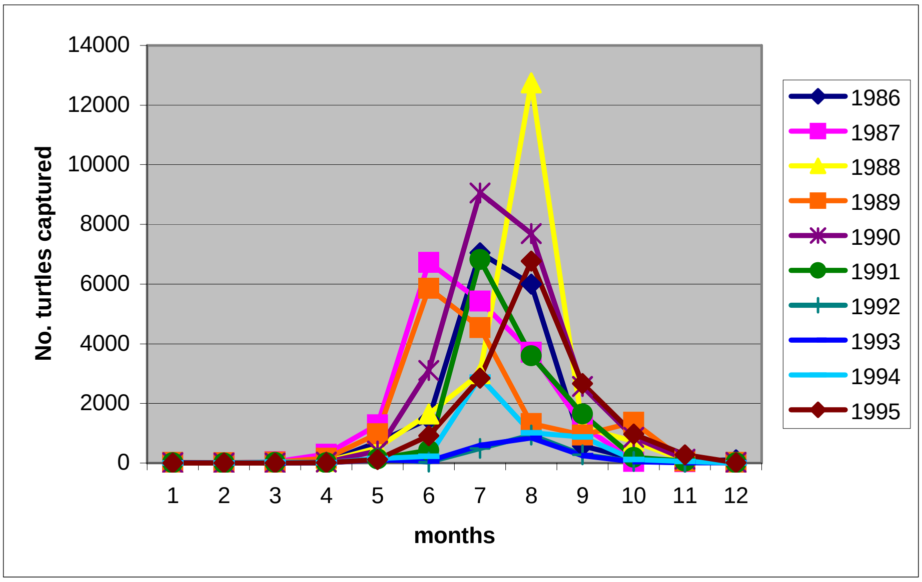

Figure 3-3. Monthly distribution of captured loggerhead by the Spanish driftinglongline fleet.

As well as interviewing fishing skippers, IEO have instigated an extensive onboard observer programme, monitoring the Spanish longline fleet fishing for tuna and tuna-like species. Based on the IEO onboard programme, Table 3-11 gives observed captures of loggerhead turtles during the period 1999 to 2004 (Camiñas Baez & Valeriaz 2005).

Table 3-11. Total Loggerhead by-catch on observerd drifting longline trips by IEO in the years 1999-2004 (Camiñas *et al.* 2005).

Year	LL Albacore (boats >12 m)			LL Bluefin		LL Bluefin (with Roller)		LL Swordfish (boats <12 m)			LL Swordfish (boats >12 m)		LL Swordfish (with Roller)	
Quarter	2nd	3rd	4th	2nd	3rd	2nd	3rd	2nd	3rd	4th	3rd	4th	3rd	4th
1999	-	270	23	0	-	-	-	-	43	-	89	73	-	-
2000	61	-	-	391	-	-	-	5	0	-	1038	30	-	-
2001	-	-	-	195	91	-	-	51	22	0	235	48	-	-
2002	-	-	-	26	0	-	-	-	-	-	64	10	-	-
2003	-	-	-	39	2	17	7	-	-	-	245	1	7	7
2004	-	-	-	2	-	29	1	-	4	0	4	0	247	103

A total 1546 fishing operations were observed, representing 3,825,292 hooks. Sea turtles direct mortality was analysed by gear and fleet strata as presented in Table 3-12.

Table 3-12– Loggerhead mortality on observed drifting longline fishing operation by the Spanish fleet

Year	LL Albacore		LL Bluefin		LL Bluefin (with Roller)		LL Swordfish (boats <12 m)		LL Swordfish (boats >12 m)		LL Swordfish (with Roller)	
	O	Lg D	O	Lg D	O	Lg D	O	Lg D	O	Lg D	O	Lg D
1999	64	4	14	0	0		21	0	180	0	0	
2000	7	1	148	13	0		15	0	242	8	0	
2001	0		37	0	0		74	2	143	1	0	
2002	0		30	0	0		0		115	0	0	
2003	0		23	0	12	0	0		87	0	56	0
2004	0		14	0	19	1	35	0	33	0	155	15

O: Observed operations; Lg D: Loggerhead captured dead. Source: Camiñas *et al.* 2005.

The percentage of direct mortality varies between 0.54 % in the fleet fishing for swordfish with the traditional gear and 4.24% in the fleet targeting swordfish with the recently introduced “American roller”. Intermediate values were observed in the fleet targeting bluefin tuna (3.23%).

Results from the European Union EMT Project (Camiñas and Valeiras 2001 in Laurent *et al.*, 2001) are summarised as follows.

A total of 2127 marine turtle catches were recorded during the whole period of onboard observations. During 1999, 498 loggerhead turtles (*Caretta caretta*) and 1 leatherback turtle (*Dermochelys coriacea*) were captured in 291 monitored fishing sets. In 2000, a total of 1627 loggerhead turtles and 1 leatherback turtle were captured incidentally in 507 sets.

In 1999, a total of 21 sets were observed on stratum A (small) vessels. All the sets observed correspond to the swordfish longline gears (LLSWO) and a total of 43 turtles (loggerhead) were captured. The catch rate was 1.37 turtles per 1000 hooks and all the turtles were released alive. In 2000 the observed effort on fleet A (small vessels <12 m) was similar to that in 1999 (20 sets). Nevertheless, the number of turtles captured was much lower (only 5 turtles).

A total of 270 sets were observed in 1999 and 487 in 2000 corresponding to the fleet stratum B (large vessels >12 m). The highest catch rate for both years was for albacore gear: 4.65 and 8.71 turtles/1000 hooks, respectively. Two leatherback turtles were caught in drifting longline sets for swordfish (fleet stratum B). Captures occurred in August in both years. Catch rate was very low (0.001 and 0.002/1000 hooks respectively). It is important to note that the recently used gear ‘Piedrabola’ (LL-PB) did not capture turtles during the observation period (23 sets observed in 1999 and 2000).

A total of 27 loggerhead turtle were directly killed in 798 fishing sets (3.4% of total turtle catches). The direct mortality rate was for LL-BFT (bluefin tuna longlines) in 2000 (0.58 dead loggerhead turtles by unit effort of 1000 hooks). In monitored sets in 1999, 11 dead turtles were observed, possibly due to smaller sample size. The direct mortality for LL-ALB (albacore longlines) in 2000 was 0.57 but the set sample size for this gear was just 7 sets. In 1999, a sample of 63 LL-ALB sets resulted in a rate of 0.01 dead loggerhead turtles per 1000 hooks.

Geographic distribution of loggerhead captures occur in a broad area from Creus Cape near the French border to 4º W in the north Alboran Sea. The main concentration area, is around the Balearic Islands, north Balearic Sea and eastern region off Cape Palos. Loggerhead turtles (*Caretta caretta*) are captured all around the year with maximum catch from May to September (Figure 3-4) (Camiñas 1986; 1988; 1996; 1997; Camiñas *et al.* 1992; Camiñas & De la Serna 1995).

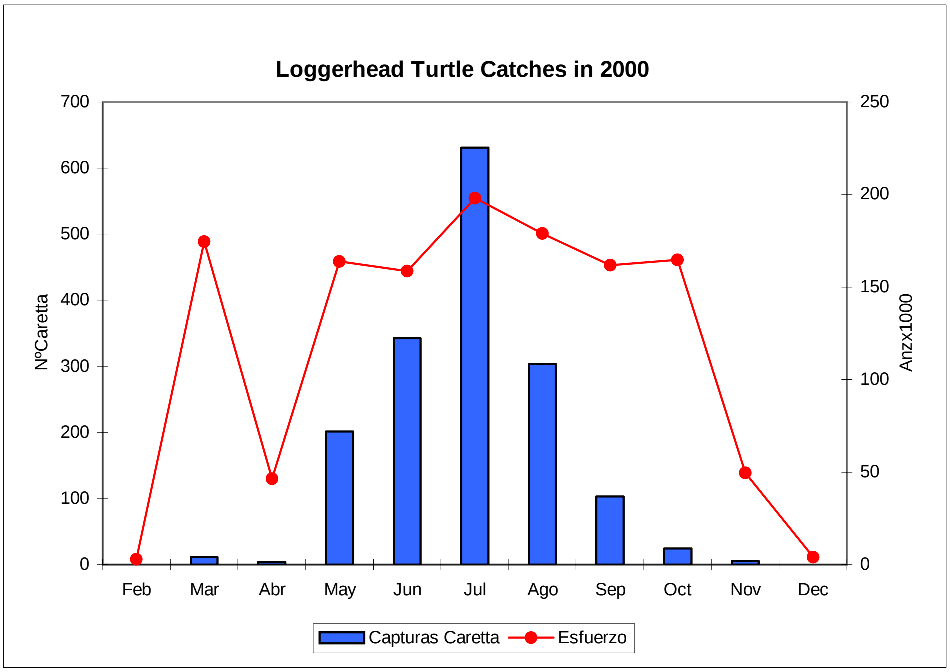

Figure 3-4. Spanish driftinglongline fishing effort (1000s of hooks) in the Mediterranean and the total number of loggerhead captured by month (Camiñas 2002).

Table 3-13 presents, by gear and year, the minimum, maximum and median carapace length of the turtles caught (SCL - straight carapace length). The minimum SCL for LL-ALB (Albacore longline) was 17.2 cm, for LL-SWO (swordfish longline) the minimum SCL was 31.0 cm, and the minimum SCL for the LL-BFT (Bluefin longline) was 36.1 cm (only 2000 data). Maximum SCL size for LL-JAP was 72.3 cm. LL-SWO caught turtles of a maximum size of 71.1 (in 2000) and the maximum for the LL-ALB was 63.7 cm (in 1999). These differences could be due to different gears fishing at different depths with different hooks sizes used for different target species (i.e. albacore, swordfish and bluefin tuna). A correlation between the turtle's size and the gear type as shows in Figure 3.5 was noted during the experiment. In general, the albacore longline capture the smaller turtles, the swordfish longline the medium sizes and the bluefin gear (fishing at deeper waters) the biggest ones.

In 1999 there were that two apparent size modes for the two gear used (LSWO and LLALB) (Figure 3-5) In Figure 3-6, corresponding to the year 2000, capture sizes of turtles from the three gears (LL-SWO, LL-ALB, LL-BFT) are presented. Again, the smallest loggerheads were captured by LL-ALB and biggest, by the LL-BFT. (Figure 3-6)

When a turtles was not boarded, observers estimated the size class of each specimen (in 5 cm categories). Using this information, Figure 3-7 was constructed, where we compare the measured size distribution with estimated sizes. This figure shows a theoretical size distribution of *Caretta* at sea affected by the Spanish driftinglongline gears. The 80 cm size class that appeas in the estimates do not appear in thsampled size group, but represent an important percentage of longlines captures.

It was observed that the mode size in the sampled group is representative of the total (measured and not) , but the biggest turtles (bigger than 75 cm carapace length and not measured onboard) captured by longline do not appear in the sizes sampled (Figure 3-7).

Table 3-13. Minimum straight carapace length (MSCL) of measured (onboard) loggerhead turtles by the two different gears used (LLALB= Albacore longline, LLSWO= Swordfish longline).

MSCL (mm)	Median	Maximum	Minimum
LLALB	331	637	172
LLSWO	492	671	279
Total 1999	417	671	172
MSCL (mm)	Median	Maximum	Minimum
LLALB	334	490	220
LLJAP	548	723	361
LLSWO	495	711	310
Total 2000	515	723	220

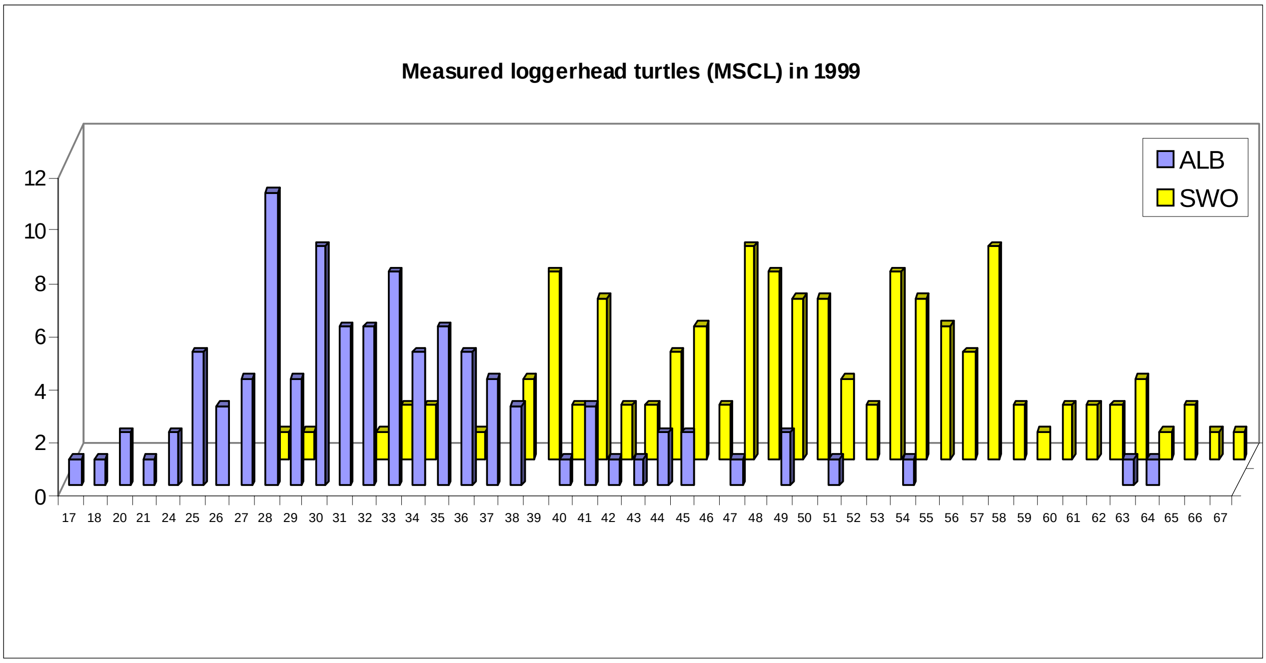

Figure 3-5. Size distribution of the *C. caretta* captured by the albacore longline (blue) and swordfish longline (yellow) in 1999.

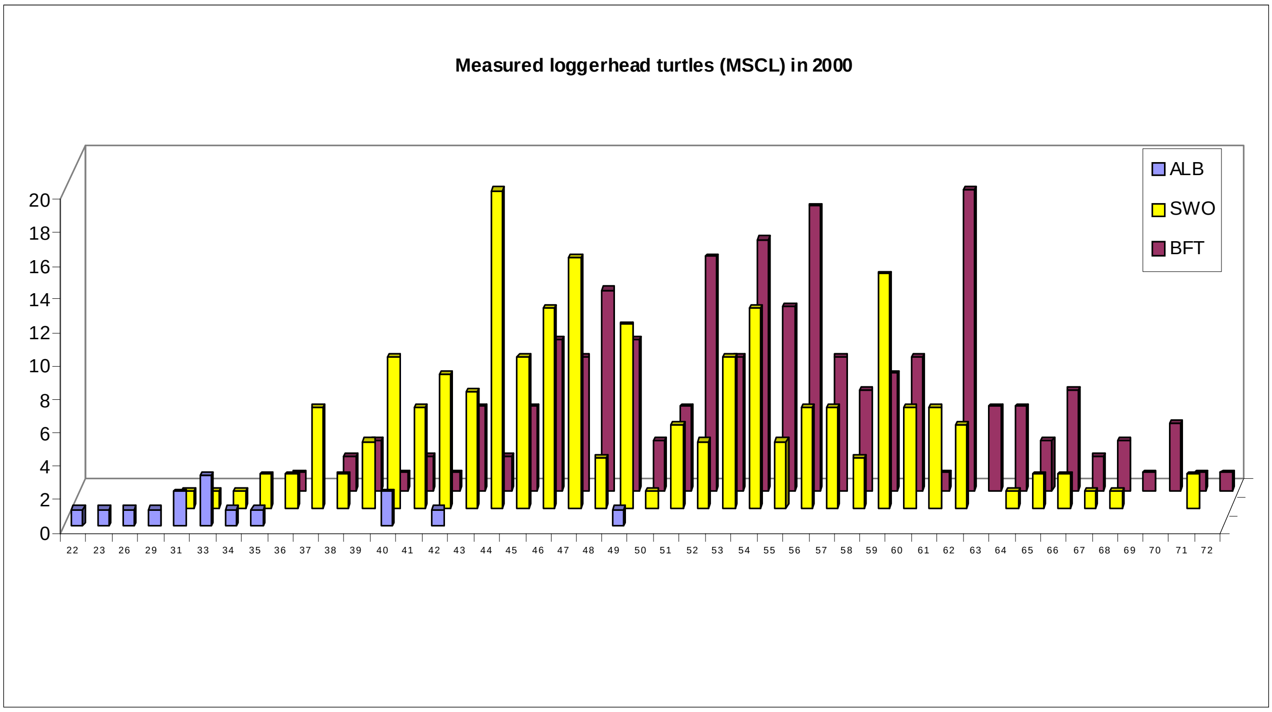

Figure 3-6. Size distribution of the *C. caretta* captured by the Albacore longline (blue), swordfish longline (yellow) and bluefin (purple) in 2000.

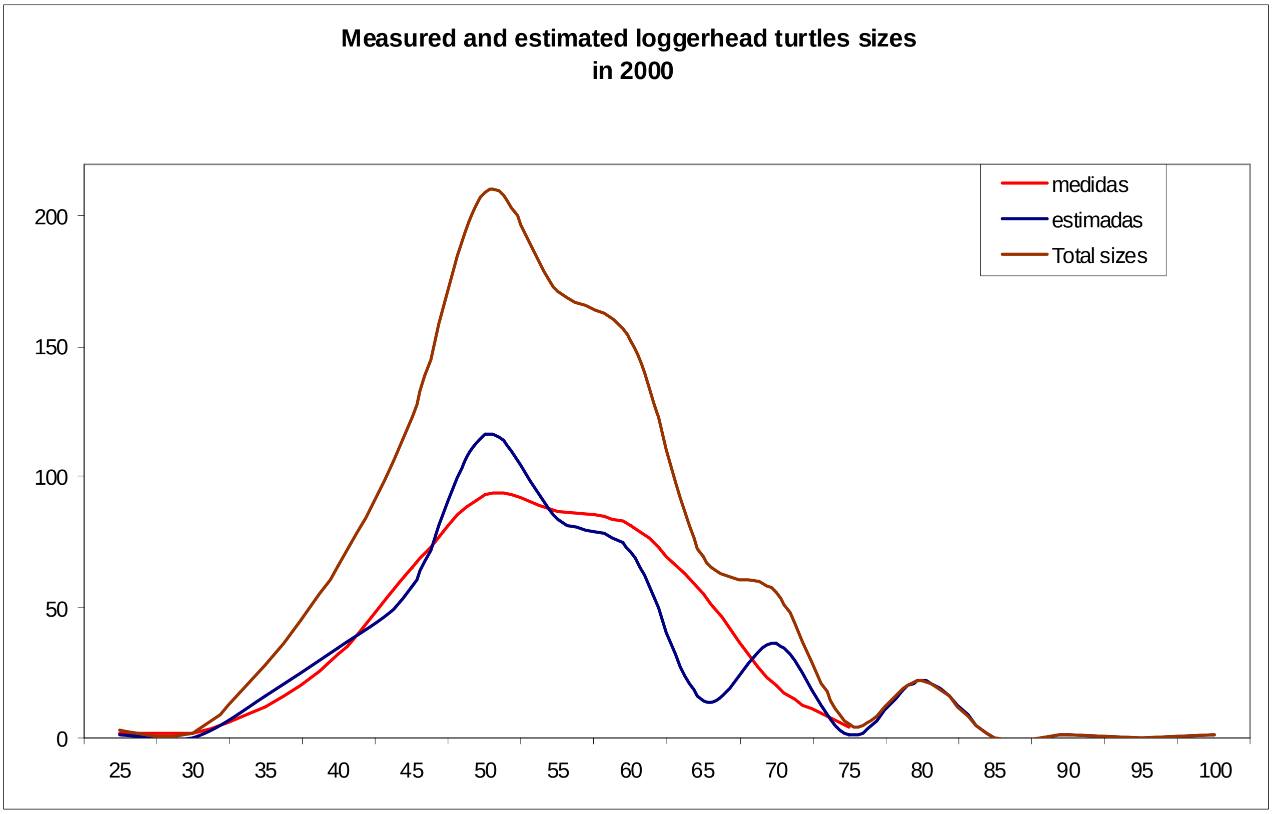

Figure 3-7. Measured and estimated carapace size of the loggerhead captured (on board or not) by the Spanish drifting longline vessels in the Mediterranean in 2000.

3.2.8 Summary tables from EMTP project 1999-2000

Table 3-14. Turtle catch rates (CPUE = number of turtle catch per 1000 hooks) with 95% confidence intervals for year, calendar quarter, boat size (B = >12m, S = <12m) and fishing areas in swordfish drifting longline fisheries operating in Greece, Italy and Spain.

Year/Quarter		Boat size	Greece	Italy		Spain
				north Ionian Sea	*south Ionian Sea*	
1999	quarter 1	S	/	/	/	/
		B	/	/	/	/
	quarter 2	S	/	0.23 ± 0.23 (8)	0.21 ± 0.41 (6)	/
		B	/	/	/	0 (1)
	quarter 3	S	0.04 ± 0.08 (62)	0.06 ± 0.04 (78)	0.40 ± 0.23 (60)	1.37 ± 0.63 (21)
		B	0.08 ± 0.08 (71)	/	/	0.40 ± 0.26 (81)
	quarter 4	S	/	0 (5)	0.15 ± 0.15 (36)	/
		B	/	/	/	0.22± 0.10 (99)
	total	S	0.04 ± 0.08 (62)	0.08 ± 0.04 (91)	0.29 ± 0.03 (102)	1.37 ± 0.63 (21)
		B	0.08 ± 0.08 (71)	/	/	0.29 ± 0.19 (182)
2000	quarter 1	S	/	/	/	/
		B	/	/	/	0.06 ± 0.03 (51)
	quarter 2	S	/	/	0.73 ± 0.19 (35)	0.49 ± 0.51 (7)
		B	/	/	/	0.80 ± 1.07 (31)
	quarter 3	S	0.06 ± 0.08 (86)	0.24 ± 0.14 (48)	0.68 ± 0.24 (22)	0 (8)
		B	0.63 ± 0.39 (36)	/	/	2.04 ± 0.68 (165)
	quarter 4	S	/	0 (6)	/	/
		B	/	/	/	0.14 ± 0.09 (77)
	total	S	0.06 ± 0.08 (86)	0.22 ± 0.12 (54)	0.71 ± 0.14 (57)	0.20 ± 0.17 (15)
		B	0.63 ± 0.39 (36)	/	/	1.15 ± 0.73 (324)

Table 3-15. Turtle catch rates (CPUE = number of turtle caught per 1000 hooks) with 95% confidence intervals for year and calendar quarter and fishing areas in albacore (LL-ALB) and bluefin tuna (LL-BFT) longline drifting longline fisheries operating in Italy and Spain.

Year/Quarter		Italy		Spain	
		north Ionian Sea	***south Ionian Sea***	***LL ALB***	***LL BFT***
1999	quarter 1	/	/	/	/
	quarter 2	/	/	/	0 (11)
	quarter 3	0.22 ± 0.39 (4)	/	1.28 ± 0.56 (48)	/
	quarter 4	0.12 ± 0.08 (35)	/	0.33 ± 0.37 (15)	/
	total	**0.13 ± 0.08 (39)**	**/**	**1.05 ± 1.47 (63)**	**0 (11)**
2000	quarter 1	/	/	/	/
	quarter 2	/	/	3.27 ± 4.03 (7)	1.74 ± 0.99 (148)
	quarter 3	/	0.26 ± 0.11 (14)	/	/
	quarter 4	0.50 ± 0.19 (32)	0.17 ± 0.06 (36)	/	/
	total	**0.50 ± 0.19 (32)**	**0.20 ± 0.06 (50)**	**3.27 ± 4.03 (7)**	**1.74 ± 0.99 (148)**

Table 3-16. Summary table on catch-per-unit-effort of turtles in EC drifting longline fleets, by geographic area and country.

COUNTRY	AREA	SUB-AREA	FISHERY	YEAR	MONTH	No. HOOKS OBSERVED	CPUE TARGET SPECIES1	CPUE LOGGERHEAD	CPUE LEATHERBACK	CPUE GREEN TURTLE	CPUE OTHER TURTLES	CPUE N.D. TURTLES	reference
ITALY	MED	C MED	* LL SWO	1978		491000		0.05					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL ALB	1978		1578800		0.14					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL SWO	1979		454700		0.10					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL ALB	1979		973900		0.32					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL SWO	1980		542300		0.02					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL ALB	1980		1359500		0.08					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL SWO	1981		255500		0.08					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL ALB	1981		898900		0.06					De Metrio *et al.* 1983
ITALY	MED	C MED	* LL SWO	1999	May	3400		0.29					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999	June	9400		0.21					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999	July	49800		0.08					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999	August	52000		0.04					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999	September	24400		0.08					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999	October	7300		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	1999		146300	4.03	0.08					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	June	4800		0.21					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	July	14100		0.92					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	August	26100		0.46		0.04			Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	September	25600		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	October	26300		0.27					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	November	11500		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999	December	10200		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	1999		118600	5.27	0.28		0.01			Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	1999	September	9200		0.22					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	1999	October	36000		0.19					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	1999	November	38400		0.08					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	1999	December	6900		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	1999		90500	9.13	0.13					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	2000	July	17400		0.57					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	2000	August	46400		0.15					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	2000	September	15900		0.13					Laurent *et al.* 2001

ITALY	MED	C MED	* LL SWO	2000	November	400		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	2000	December	7700		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	* LL SWO	2000		87800	5.06	0.22					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	2000	May	21400		0.79					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	2000	June	22400		0.67					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	2000	July	16600		0.60					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	2000	August	11300		0.80					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL SWO	2000		71800	2.73	0.71					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	2000	October	57500		0.71					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	2000	November	25000		0.16					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	2000	December	7000		0.00					Laurent *et al.* 2001
ITALY	MED	C MED	* LL ALB	2000		89500	9.23	0.50					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL ALB	2000	September	38000		0.26					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL ALB	2000	October	52500		0.19					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL ALB	2000	November	47000		0.13		0.02			Laurent *et al.* 2001
ITALY	MED	C MED	§ LL ALB	2000	December	6000		0.17					Laurent *et al.* 2001
ITALY	MED	C MED	§ LL ALB	2000		143500	4.72	0.19		0.01			Laurent *et al.* 2001
SPAIN	IND	E IND	LL SWO	2003	Jun-Oct	111300	22.73	0	0	0	0,009**	0	Prospecting survey IEO, 2003.
ITALY	MED	C MED	LL SWO	1991	May-Jul	39083	5.501	0.077	0.026				Di Natale *et al.* 1993
ITALY	MED	C MED	LL SWO	1998	Apr-Sep	43,414	12,369	0,230	0,023			0.25	Guglielmi & Di Natale 2000
ITALY	MED	C MED	LL ALB	1998	Apr-Sep	32,800	72,226	1.738	0				Guglielmi & Di Natale 2000
ITALY	MED	C MED	LL SWO	1999	Apr-Nov	100,745	5.549	0,089	0,020			0.11	Guglielmi & Di Natale 2000
ITALY	MED	C MED	LL BFT	1999	Jun	2,800	2.143	2.143	0				Guglielmi & Di Natale 2000
Grecce	MED	CE MED	# DLL-SW	1999		70,170		0.0713	0	0	0	0	Laurent *et al.* 2001, EMTP
Grecce	MED	CE MED	# D£LL-SW	2000		60,680		0.2802	0.0165	0	0	0	
Grecce	MED	CE MED	# DLL-SW	2004		46,540	192.51	0.1719	0	0	0	0	National Fishery Data Collection System - Report 2004 (G. Tserpes, A. Kapantagakis)
Grecce	MED	CE MED	# DLL-ALB	2004		4,800	55.51	0.0000	0	0	0	0	National Fishery Data Collection System - Report 2004 (G. Tserpes, A. Kapantagakis)
ITALY	MED	W MED	LLALB	1999		15360		1.05					Camiñas &Valeiras 2001
ITALY	MED	W MED	LLBF	1999		14000		0.00					Camiñas &Valeiras 2001
ITALY	MED	W MED	LLSWO	1999		612832		0.33					Camiñas &Valeiras 2001

* North Ionian Sea (Gulf of Taranto), § South Ionian Sea, **Olive ridley, ♣ 3.09 in the CS Mediterranean , # Aegean and Ionian Seas

3.3 INDIAN & PACIFIC OCEANS

No data have been made available for SGRST/SGFEN.

3.4 WG REMARKS

1. Although information at present is insufficient and related only to some EU fleets, the WG considers that the EU longline fleets are fishing in waters (Mediterranean, Atlantic, Indian ocean and the Pacific) where turtle by-catch is occurs at different catch rates.
2. Most of the information on longline fleets presented in this chapter is only from EU countries in the Mediterranean Sea.
3. Information on the EU longline fleets in distant waters and the Atlantic is only available for few countries and does not cover all these waters (see the list of bilateral EU agreements).
4. Often the fleets are multipurpose fleets, and it is therefore not possible to extract specific information on the number of vessels engaged in pelagic longline fisheries, the longline effort and corresponding estimated turtle by-catch.
5. In the best possible case, it is possible to provide only a rough estimation of the marine turtle by-catch related to EU fishing fleets only in areas were specific monitoring programmes are or have been active.
6. The Loggerhead turtle (*Caretta caretta*) appears to be the most affected turtle species by the drifting longline fishing activities in the Mediterranean and in the Atlantic, but catch rates are quite variable and observer programmes have not been conducted continuously over the previous years.
7. The period between June and July shows the higher catch rates of Loggerhead turtle; anomalous high catch rates encountered in the Southern Mediterranean sea in 1998 seem related to a migratory movement in that area in July, but data on Loggerhead migratory courses and periods are not available.
8. The catch rate of Leatherback turtle (*Dermochelys coriacea*) is less variable, ranging from 0.013 to 0.019 in at least two Mediterranean areas. The portion of the Atlantic population of this species entering into the Mediterranean Sea is unknown. The few Atlantic catch rate data available range from 0.011 to 0.043. No catch rates are available for any other sea where EC fleets are active.
9. The catch rate of Green turtle (*Chelonia mydas*) is also very low (0.01) and reported for a few Mediterranean areas, confirming the limited distribution of this species, which is known to be mostly present in the Eastern Mediterranean. No catch rates are available for any other sea where EC fleets are active.
10. According to the fishing gear and fishing operations details provided above, it is unclear how the hook size and type could affect the turtle catch rate. At the same time, it seems more clear that a deeper position of the hook in the water column can reduce the turtle by-catch, but this information should be matched with a corresponding CPUE for the target species to provide a proper figure to be used for fishery management purposes.

4 DATA FROM MARINE TURTLE NETWORKS AND RESCUE CENTRES

Several national or local stranding networks already exist in various EU countries and some of them have operated for a considerable amount of time. The data collected by these networks might help to better understand the problem of how human activities interact with marine turtles. Such programmes can sometimes provide useful data on the percentage of turtles which are found hooked or entangled in lines, either dead or alive.

A number of marine turtle rescue Centres are already active in various EU countries, taking care of live turtles that are brought there. Data from these centres might provide detailed information about the effects of hooks and line on marine turtle welfare and survival.

Only data from a few national networks or rescue Centres have been made available to SGRST/SGFEN.

4.1 BELGIUM

In Belgium research into sea birds and marine mammals that end up the nation's beaches is coordinated by the Royal Belgian Institute of Natural Sciences (through it's Management Unit of the North Sea Mathematical Models - MUMM). Only three turtles (all *D. coriacea*) have been recorded, one stranded on 19th December 2000, one in September 1998 and one in December 1988. Two of these animals are thought to have been hit by ships propellers.

4.2 FRANCE

Twenty-seven years (1979-2005) of turtle stranding and sighting records have been collated for the French Atlantic Coast by Duguy and his co-workers (Duguy 1987, 1988, 1991, 1993, Duguy et al. 1998) by Martin (2003) in her assessment of the temporal occurrence of Leatherback turtles in the Bay of Biscay.

These records, include both live and dead animals, and originate from sea patrols of the French national police, recreational vessels, local fishermen, local councils, members of the general public and volunteers of the sea mammal stranding network (CNEMM, since 1972). Data collection was historically centralized at the Natural History Museum of La Rochelle, and subsequently at the Aquarium of La Rochelle. La Rochelle is also the geographical base of observers on board. Surveys at sea were carried out for many years, usually within about 10 miles off the French coast, and generally from June until September. Most of the records that resulted from the observres surveys were centered around 46°N-1.5°W, in an area of the Bay of Biscay called the 'Pertuis Charentais'(about 90% of the observations made at sea). Brongersma (1972) also reported live turtle sightings in the Bay of Biscay area covering the period for the period 1919-1969, including 84 records from the French Atlantic coast.

Table 4-1. Incidences of sightings, strandings and captures for the French Atlantic coast (1979-2000) (redrawn from Martin 2003).

	Live or Dead	Number of records
Sightings	Live	878
	Dead	27
Strandings	Live	4
	Dead	283
Captures	Live	39
	Dead	14
	Unknown	4
Total		1249

From the publications of Duguy and co-workers, a total of 1249 records for the Atlantic coast of France were gathered (Table 4-1). For all areas, captures in fishing gear were relatively sporadic (N = 57 in the period 1979-2000), and have been examined by Duguy *et al.* (1998). Most leatherback turtle (*Demochelys coriacea*) deaths associated with fisheries in the Bay of Biscay, are thought to have involved pelagic trawl nets or entanglement in buoy ropes (Table 4-2). There are only two records of leatherback turtles caught on fishing lines (one on a longline or 'palangre'). Ingestion of plastic bags and the resulting stomach lesions, is thought to be another major threat to leatherback turtles in the region. These authors also report a loggerhead turtle (*Caretta carretta*) found with monofilament fishing line wrapped around it's head.

Table 4-2. Mode of capture in 82 leatherback turtles found on the French Atlantic coast (from Duguy *et al.* 1998).

Trawl net	Pelagic-trawl	Gill-net	Net (type unspecified)	Longline (palangre)	Buoy/anchor rope	Line	Fishing gear (unspecified)
6	10	5	19	1	28	1	12

Annual incidences of leatherback turtles in the Bay of Biscay were relatively low from 1979 until the mid 1990s, but greatly increased thereafter (Figure 4-1). There was a sharp increase in the annual incidences of live sightings from 1996 to 2000 (with a maximum of 177 records in 1997). With regards to dead strandings, annual incidences were relatively low between 1979 and 1994 (with a maximum of 10 records in 1993), whilst annual incidences showed a remarkable increase from 1995 to 2000 (with a maximum of 55 records in 1995).

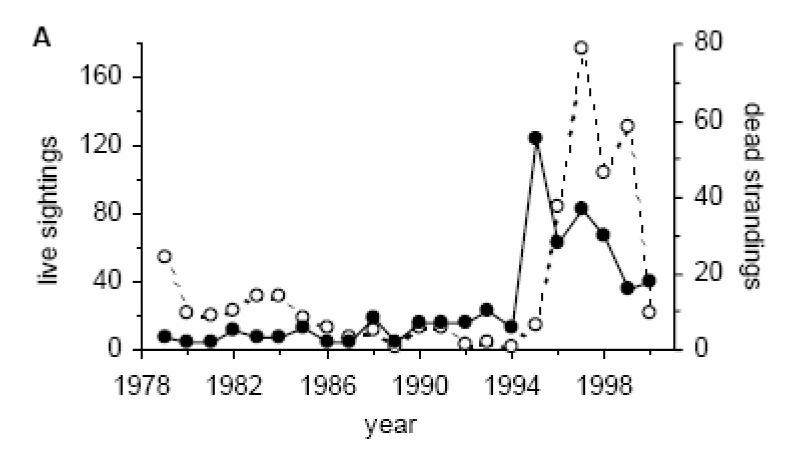

Figure 4-1. The incidences of leatherback turtles in the Bay of Biscay (1979-2000). (A) The annual incidences of live sightings (O and primary y-axis) and dead strandings (• and secondary y-axis) (taken from Martin 2003).

Cumulated monthly totals (1979-2000, Figure 4-2) showed a clear and strong seasonal pattern, with more than 90% of live sightings occurring between August and September (range: May until November). In contrast, records of dead strandings spread over most of the year, with 88% of dead turtles being found between August and January. There was a clear time lag of two months between the peak of live sightings and that for of dead strandings.

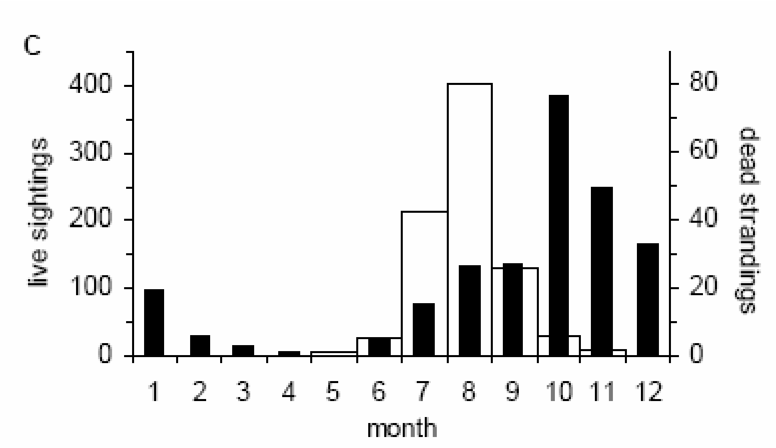

Figure 4-2. The patterns of occurrence (cumulated monthly records, 1979-2000) for live sightings (open bars and primary y-axis) and dead strandings (solid bars and secondary y-axis) of leatherback turtles in the Bay of Biscay (taken from Martin 2003).

Brongersma (1972) noticed significant variability in annual incidences of leatherback turtles in European waters, and a gradual increase in the number of records since the beginning of the 20th century (1900-1970), as well as a 'sudden' and 'tremendous' increase in the number of records for 1950-1970. Inter-annual variability may be explained by annual variations in the absolute abundance of turtles visiting the area, and also by other factors profoundly affecting recording efforts such as war (Brongersma 1972).

It seems likely that there has been an increase in the absolute abundance of turtles visiting the Bay of Biscay and UK/Eire waters in recent years (Martin 2003), although the influence of biological factors (e.g. prey density) and physical factors (e.g. sea-surface temperatures, SSTs) on their abundance is not yet well understood. A correlation between the presence/absence of Leatherback turtles in northern Atlantic European waters and SSTs was hypothesised by Brongersma (1972), who noted that live turtles were only observed in waters warmer than about 11°C. He assumed that turtles would die in colder SSTs. More recent work suggests however, that the Leatherback turtle is a facultative endotherm that would be capable of maintaining a core temperature around 25°C even in waters of about 5-7°C (Frair *et al.* 1972, Davenport *et al.* 1990; Holland *et al.* 1990; Paladino *et al.* 1990).

4.3 GREECE

ARCHELON, the Sea Turtle Protection Society of Greece has operated a Sea Turtle Rescue Centre (STRC) in Glyfada, close to Athen, since 1994. The STRC is the base of a nationwide stranding network, through which sea turtle strandings are reported and stored in a data base. Live turtles (injured or weak) are admitted to the Centre for medical care and recovery.

Between 1994 and 2000, 226 injured turtles were admitted to the Centre. Of these, about 34% had head trauma, 24% suffered from hook ingestion, 22% from entanglement in fishing lines and nets, and 20% from other causes. In total, about 80% were thought to suffer injuries incurred through interaction with fisheries (Panagopoulos *et al.* 2003).

Since 1999, a more detailed examination protocol (e.g. more frequent radiographs) provided better data about the cause of injury. According to this improved protocol, from a total of 295 turtles admitted to the Centre in the period 1999-2004 it was estimated that 124 (42.0%) were injured through interaction with longline fisheries (by ingestion of hook/fishing line or entanglement in fishing line). Of these 124 turtles, 70 (56%) were released after rehabilitation, 52 (42%) died and 2 (2%) are still recovering in the Centre (30 June 2005) (Margaritoulis and Panagopoulou, in preparation).

It should be noted that turtle strandings represent only a small amount of the actual mortalities at sea (Epperly *et al.* 1996); therefore the reported admissions to the Rescue Centre do not reflect the total number of injuries caused by longlines.

4.4 ITALY

Data collected between 1981-2004 by five independent stranding monitoring programs in Italy, were analyzed to provide evidence of anthropogenic impacts (Casale *et al.*, in press). . 9.4% of these specimens (n=839) were reported to have evidence of interaction with longline. Since the above programmes had not been established with this goal in mind, collected data may have been incomplete as far as anthropogenic evidence is concerned, and this figure is to be considered as an underestimation.

Data from another national network, supported by Centro Studi Cetacei (CSC) from 1985 to the present, have not made available to SGRST/SGFEN, even if annual detailed information is provided within the CSC Annual National Reports (published in *Atti Soc. It. Sci. Nat. Museo Civ.Stor. Nat. Milano*).

Partial data have been provided only for the Campania region (Flegra Bentivegna, *pers.com.*), related to the turtle rescue centre at the Zoological Station "A. Dohrn" in Naples from 1994 to 2004, acting within the national network of Centro Studi Cetacei (Table 4-3).

Table 4-3. Loggerhead turtles rescued by the Zoological Station "A. Dohrn" in Naples, directly related to drifting longline fishery in the period 1994-2004.

	month													
	1	2	3	4	5	6	7	8	9	10	11	12	total	% died
Number of specimens	0	1	1	0	3	4	3	7	3	2	3	1	28	53.6

Data collected at the WWF's sea turtle rescue center in Lampedusa Island (central southern Mediterranean) were analyzed to provide insights of mortality factors induced by interaction with longline (Freggi & Casale, in press).

In the period 2001-2002 data were collected on 230 *Caretta caretta* specimens incidentally caught by longliners from Lampedusa Island. The position of the hook in the body was: mouth (32.6%), higher oesophagus (part of the hook visible; 33.9%), lower oesophagus or deeper (hook not visible; 33.0%), limb (0.4%).

The fate of a sub-sample of turtles with hooks deep in the body and kept under observation (n=21) provided an estimate of the mortality rate (33.3%) induced by hooks only (not considering branchlines).

Observations of both turtles captured by longliners and those found drifting afloat show that while lethal hooks perforate blood vessels or the digestive tract, e.g. the stomach, usually in the short period, lethal branchlines act more in the long period, because they cause compression and invagination of the intestinal tract, eventually breaking it or, disabling digestive functions, debilitating the specimens to death. It seems that turtles released with even relatively short branchline tracts might experience high mortality, if they survive the hook.

Another set of data is available from the marine turtle rescue center at the Genoa Aquarium (Claudia Gili, *pers. com.).* This centre provides information from the Ligurian Sea, a northern Mediterranean area where marine turtles are usually less prevelent and where the pelagic longline pressure is lower compared with the southern areas. Table 4-4 shows the data from 1993 to the present. According to these data, 30.5% of the rescued turtles had hooks or lines; their mortality was 16.7%. Most of the turtles which are released by this center are tagged.

A third data set is available from the Hydrosfera rescue Center in the Linosa Island, acting within the recent LIFE projects. Linosa is in the Strait of Sicily, an important area for the Mediterranean loggerhead. The data for the years 2000 to 2002 are reported in the Table 4-5. No data have been made available for more recent years.

Table 4-4. Marine turtles rescued by the rescue center of the Genoa Aquarium since 1993 to the present.

YEAR	Total rescued turtles	turtles with hooks or lines				
	no.	rescued	%	released	still recovering	% survival rate
1993	1	0	0			
1994	4	2	50,0	2		100,0
1995	3	0	0			
1996	2	0	0			
1997	9	3	33,3	2		66,7
1998	6	1	16,7	1		100,0
1999	2	0	0			
2000	1	0	0			
2001	9	5	55,6	5		100,0
2002	4	2	50,0	2		100,0
2003	7	1	14,3	0		0,0
2004	9	4	44,4	1	2	75,0
2005	2	0	0			
TOTAL	59	18	30,5	13	2	83,3

Table 4-5. Turtles rescued by the rescue center of Linosa Island between 2000 to 2002.

Linosa Rescue Center	**Year**	**a** No. rescued turtles	**b** No. turtles with hook	**c** No. turtles with 1 hook	**d** No. turtles with 2 hooks	**e** No. turtles with 3 hooks	**f** No. turtles with >3 hooks	**g** No. turtles with line only	**h** No. turtles without hook	**i** No. turtles with hook or line arrived dead	**l** No. turtles without hook or line arrived dead	**m** No. turtles dead after arrival	**n** No. turtles defecating hooks
-	2000	158	128	121	6	1	0	0	30	0	0	6	1
	2001	88	80	73	6	1	0	0	8	0	0	3	1
	2002	60	41	39	1	1	0	0	19	0	0	5	0
%			B/a	C/b	D/b	E/b	E/d	G/b	H/a	I/b	L/b	M/a-i-l	N(b-i-l)
	2000		81,0	0,95	0,05	0,01	0	0	19,0			3,8	0,01
	2001		90,9	0,91	0,08	0,01	0	0	9,1			3,4	0,01
	2002		68,3	0,95	0,02	0,02	0	0	31,7			8,3	0,0
TOTAL													

4.5 PORTUGAL

In mainland Portugal there are several stranding networks and coast watch campaigns (e.g. Geota, reports available from 1998-2003), however these do not typically collate stranding records of turtles. A report (Aquário Vasco da Gama), mentions that 8 loggerheads and 1 leatherback were found dead during 1998.

A stranding programme that is being carried out in the Azores by the Environmental Board (RACA), predominently collects cetacean data. However, a few turtle strandings are reported every year (2-3), as well as live turtles entangled in lost fishing gear (cables, ropes, nets), (1-2 every year).

In Madeira a cetacean stranding network is known to be operating, but no data was available on turtle strandings. The Madeira University Turtle Project collects data on strandings, entanglements and accidental captures since 1994. They also run a small rescue centre without specific funding. By large most strandings are longline victims released by the fishermen, since no turtles can be kept onboard by law. Other recorded causes of strandings by importance are entanglements and oil pollution. An average of 20 turtles are taken in each year (T. Dellinger, pers.com.).

There is only one national rescue centre in Portugal, located in Albufeira - Algarve ("Zoomarine: Porto de Abrigo – Reabilitação de Espécies Marinhas"), with the capacity to handle a maximum of 10 turtles a time. Based on the experience gained in the last 4 years, between 20-25 marine turtles (mainly loggerheads and green) are admitted annually to this centre, from which 10-15 remain alive and are able to be rehabilitated. Around 12 turtles are released annually. Almost all of these turtle came from net fisheries, and almost none from the longline fishery (Élio Vicente*, pers. com.*).

4.6 SPAIN

In 2002 the Spanish Herpetological Association (AHE) in collaboration with IEO updated the Spanish Marine Turtles Data Base in agreement with the Ministry of Environment. The original AHE Data Base included bibliographic and observations data (stranding and at sea observations) for these marine reptiles from 1887 to 2001. An updating of the data base was carried out in 2002. The Spanish Institute for Oceanography (IEO) and the Spanish Cetacean Society (SEC) are responsible for coordinating this new version. Research Institutes, Universities, Recovery Centres, NGOs and individuals working on marine turtles were the main contributors. The data base grouped the turtles considering: a) turtles observed alive at sea and, b) turtles captured by fishermen and moved to a recovery centre. Stranded turtles are also included. The data base in 2002 (Camiñas 2002) included a total 8886 records for the five species found in Spanish waters: 8.291records of *C. caretta*; 552 of *D. coriacea*; 30 of *Ch. mydas*; 7 of *E. imbricata* and 6 corresponding to *L.kempii*. A new updating procedure is in process in 2005 under the IEO coordination.

In 1998 the SEC (Spanish Cetacean Society) completed a document compiling the existing information on turtles stranding in the Spanish coasts, with the exclusion of Canary Islands. The species included were Loggerhead (*Caretta caretta*), Green turtle (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*). According to the information for the Mediterranean Spanish Autonomous regions (Table 4-6), the stranding percentages were as follow:

Table 4-6. Total number and percentages of marine turtles stranded in the Spanish Mediterranean (from Cañadas *et al.* 2000).

Species	Baleares	Cataluña	Valencia	Murcia	Ceuta	Andalucía
Total number of turtles	85	106	75	20	n.a.	65
C. caretta	93.7	98.5	97	-	70	90
Ch. mydas	2	1,5	1	-	-	-
D. coriacea	2	-	2	-	20	10
E. imbricata	2	-	-	-	-	-
Unidentified	-	-	-	-	10	-

The total number of stranded marine turtles in Spain by species and regions (Mediterranean and Atlantic) is reported in Table 4-7 and Figure 4-3.

Table 4-7. Number and % of stranded turtles (all the species together) in Spain compiled by the SEC in 1998.

Autonomous Region	Nº	%	Regional %
País Vasco	6	1.22	**Atlantic** 28.36
Cantabria	42	8.57	
Asturias	31	6.33	
Galicia	60	12.24	
Andalucía	65	13.27	**Mediterranean** 71.64
Murcia	20	4.08	
Valencia	75	15.31	
Cataluña	106	21.63	
Baleares	85	17.35	
Total strandings	490	100	

Based on the Spanish stranding data, SEC had provided Figure 4-3.

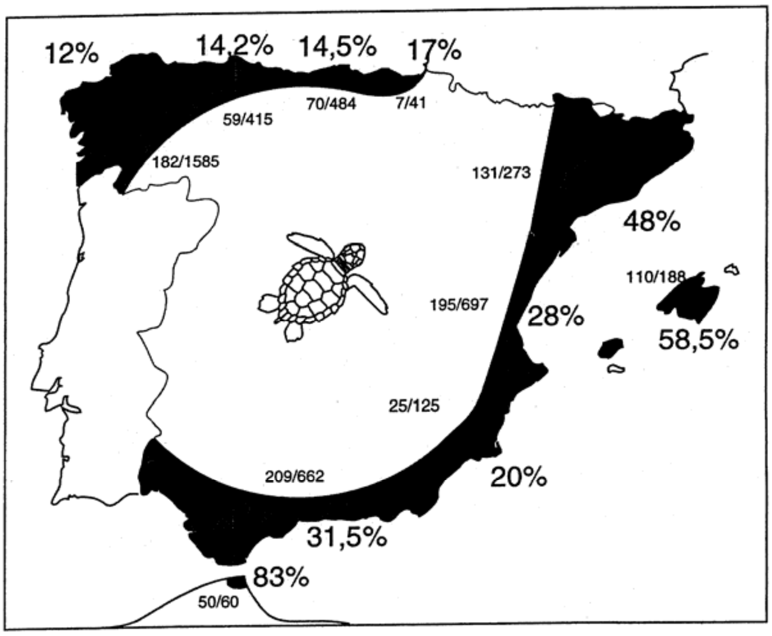

Figure 4-3. Percentage distribution for the stranded marine turtles in Spain (Cañadas *et al.* 2000)

4.7 UK AND IRELAND

Records of sightings and strandings of live and dead marine turtles in the UK and Ireland are assembled each year, as part of the "Collaborative UK Marine Mammal & Marine Turtle Strandings Project" (Penrose 2005). The 'TURTLE' database currently holds 1049 records of marine turtles in UK and Irish waters (recorded during the period 1748-2005) and includes in excess of 154 records of turtle bycatch (Pierpoint 2000).

Sightings and strandings by species and area in the period 1984-2004 are shown in Table 4-8, while the distribution of sightings and strandings in 2004 is shown in Figure 4-4.

Table 4-8. Sightings and strandings of live and dead marine turtles included in the UK & Ireland 'TURTLE' database (1984-2004).

Country	GT	HB	KR	LBT	LOG	UNI
England	1	0	4	239	25	32
Scotland	2	0	0	128	24	25
Eire	0	0	0	102	31	1
Wales	0	0	2	75	5	7
Channel Islands	1	0	0	0	2	1
N. Ireland	0	0	0	1	0	1
Total	4	0	6	545	87	67

GT = Green turtle, HB = Hawksbill turtle, KR = Kemp's ridley turtle, LBT = Leatherback turtle, LOG = Loggerhead turtle,UNI = Unidentified turtle.

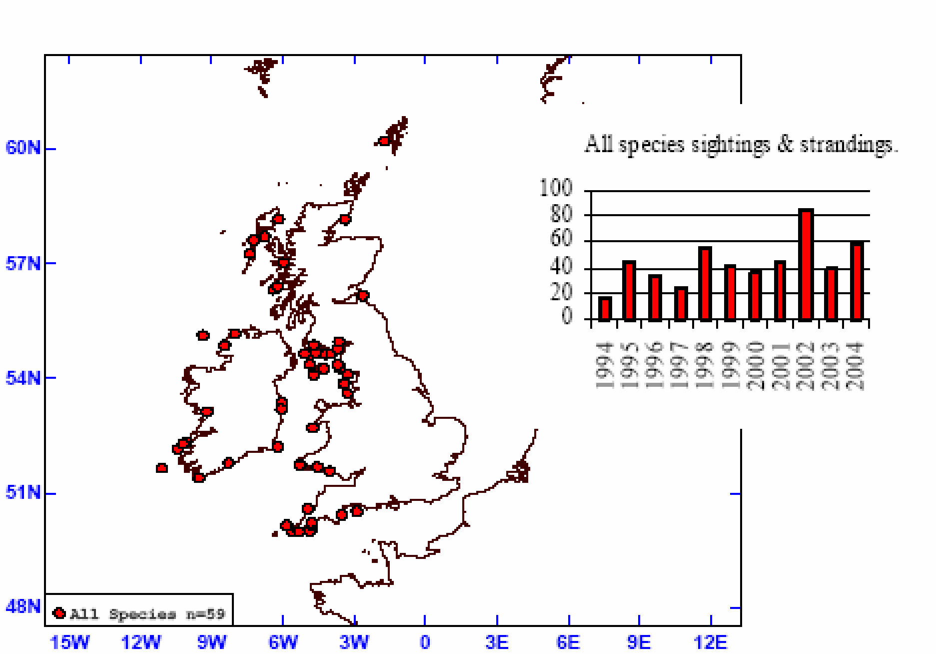

Figure 4-4. Turtle sightings & strandings in UK and Ireland in 2004 (from Penrose 2005).

Significant numbers of leatherbacks are recorded each year in June, July, August and September. Figure 4-5 indicates the monthly average of sightings and strandings covering the period 1994-2004. The graph clearly shows an increase in numbers through the summer months. These observations agree with results from long-term tracking of individuals using electronic data-storage tags (Hays *et al.* 2004), which also indicate that turtles tend to dive deeper during summer months, presumably in search of food. Stranding and sighting records for the hard-shell species are more sporadic throughout the year.

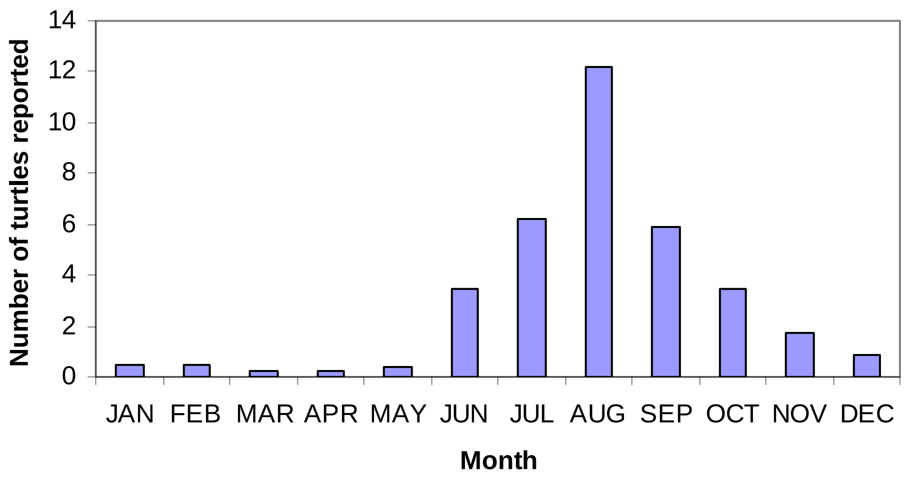

Figure 4-5. Monthly average of leatherback turtle sightings and strandings covering the period 1994-2004 (redrawn from Penrose 2005).

Most records of turtle bycatch or capture in British and Irish waters refer to leatherback turtles. Of 154 capture records, 129 are of leatherbacks (94% of records identified to species). There are a small number of by-catch records for other species (Pierpoint 2000).

The method of capture assigned to records of all species is shown in Table 4-9. In 50 cases leatherbacks were found entangled in rope, usually buoy ropes used in pot fisheries for crustaceans or whelk. This mode of capture therefore represents 58.3% of leatherback bycatch records for which gear type was specified. There are a further 30 records of entanglement (35.7%) in net fisheries (including driftnets, pelagic and demersal trawls, set nets and purse seines). There are three records of entrapment by hook and line (3.6%): two of which were commercial longlines, the third that of a recreational fisherman.

Table 4-9. Methods of incidental and deliberate capture of turtles in UK and Irish waters 1748-1999 (taken from the UK 'TURTLE' strandings database; Pierpoint 2000).

Gear Type	Leatherback	Loggerhead	Kemp Ridley	Hawksbill	Unidentified
Entanglement in pot/creel ropes	50				1
Nets	11	3	1	1	1
Purse-seine / ring net	2	1			
Trawl nets	8				
Drift nets	9				1
Hook & line (recreational)	1				1
Longline (cod)	1				
Longline (shark)	1				
Anti-submarine net	1				
Entanglement in anchor warp	1				
Not specified	45	5	1		10
Deliberate capture					
Harpoon	1				
Not specified	1				
Suspected bycatch					
Entanglement in pot/creel ropes	2				
Herring nets	2				

Turtle by-catch was reported from pelagic tuna driftnet fisheries which formely operate in the south-west of the region. Goujon *et al.* (1993) estimate that 30 and 100 turtles, mainly leatherbacks, were caught by the French fleet in 1992 and 1993 respectively. The capture rate ranged from 0.33 to 1.0 turtles per 10,000 tuna. SMRU in 1996 recorded a by-catch of eight leatherback turtles in 62 net hauls observed on UK vessels in 1995: a capture rate of 8.0 leatherbacks per 10,000 tuna. Fishing effort by UK vessels in 1995 was approximately 25 times less that that of the French fleet in both 1992 and 1993. Mortality in the English study was 25%. By-catch is also reported for Irish driftnet vessels (E. Rogan pers. comm.). There were six turtles taken in 125 net hauls in 1996 and recorded mortality was 17%. No turtles were caught in 18 hauls observed in 1998.

Very little longlining is carried out by UK and Irish vessels at present. However, an experimental fishery operated recently off the Irish coast, as a possible alternative to driftnetting. One leatherback was caught and released during trials (F Guilfoyle pers. comm. in Pierpoint 2000). Vessels of the Spanish Atlantic longline fleet target swordfish and tuna in approximately the same waters that French, Irish and English driftnetters operate.

The fate of 83 leatherback turtles incidentally captured since 1980 is shown in

Table 4-10. Overall, at least 43 of 83 by-caught leatherback turtles (52%) were found alive and 32 (38.5%) were released. Recorded mortality was 30 animals (46% of 65 leatherbacks for which mortality and released data were recorded). There are no data regarding post-release mortality. Other causes of turtle mortality in UK waters (e.g. contaminants) are discussed in Godley *et al.* (1998).

Table 4-10. Incidental capture of leatherback turtles 1980-1999: total found alive, total found dead, and if found alive: numbers released and numbers which died later (redrawn from Penrose 2005).

Gear Type	Total records	Found dead	Found alive	Not known	Found alive		
					Released	Died later	Not known
Ropes	36	18	17	1	11	4	1
'Nets'	6	2	4		3	1	
Bottom set nets	1		1		1		
Trawl nets	5		5		5		
Drift nets	8	2	6		6		
Non-fishing gear	2		2		2		
Not specified	25		8	17	4	3	1
Total	83	22	43	18	32	8	3

4.8 WG REMARKS

1. Although information at present is incomplete, it is evident that several stranding networks and rescue centres are active in EU countries.
2. These activities are able to provide useful additional information on marine turtles, particularly on the incidence of various fishing gears, including drifting longlines. Rescue centres are a very good source of detailed information about the possibility for a turtle to survive after hooking. Survival rates are quite different among centres and these discrepancies should need further investigations.
3. Rescue centres are able to increase the survival rate of hooked marine turtles, but their effects on the total population might be minimal.

5 AREAS WHERE HIGH INTERFERENCE IS REPORTED BY EU PELAGIC LONGLINE FLEETS

The WG reviewed the available information on geographic areas (fishing areas) where the marine turtles have high incidence and EU pelagic longline fisheries affect different turtle species and turtle sizes (ages) in different geographic areas depending on the pelagic life stage and migrations (for feeding, mating or nesting). The mortality of adult and large juvenile turtles is tought likely to affect populations more than mortality of small juveniles and hatchlings (e.g. Crouse *et al.* 1987).

5.1 ATLANTIC OCEAN

Information on captures and stranding reports from UK and Eire, France, Portugal and south Spain was available during the meeting. Although specific data on captures by all the EU drifting longline fleets operating in NE Atlantic were not available, information on stranded turtles indicate that significant numbers of leatherbacks are recorded each year in June, July, August and September in the Bay of Biscay, UK and Eire, (Martin 2003; Penrose 2005). Stranding and sighting records for the hard-shell species are more sporadic throughout the year although loggerheads are widely observed in the area.

In France, mainland Portugal and Spain a number of leatherbacks strand every year, although mortality associated with the longline fishery is not well defined.

Information from Azores and Madeira underline the importance of these islands as foraging areas for juvenile loggerheads belonging to the American populations (Bolten *et al.* 1998). Turtles tagged at Madeira have been recently found to nest at Cape Verde Islands, underlining the possibility that Madeiran waters might be used at different times by American and Cape-Verde populations (Dellinger, *pers. com.*). A satellite telemetry study with turtles captured off Madeira Island showed that pelagic loggerhead habitat goes all the way from North of the Cape Verde Island, Mauritania, Moroco and Canary Islands up to far north and northwest of the Azores (Dellinger 2000).

Information on turtles' captures by the EU fleets fishing with drifting longlines in the central, north and south Atlantic was not available. However, interactions with other longline fleets in these areas are documented (e.g. Balestra *et al.* 2003; Watson *et al.* 2004; Lewison *et al.* 2004).

A more comprehensive data set and more observed fishing trips in various areas are necessary to understand if it is possible to define some reliable "hot spots" in this ocean. Lewison *et al.* (2004) argues that the central South Atlantic should be considered a 'hot-spot' due largely to heavy fishing by China, Equatorial Guinea and several Central American fleets (i.e. Belize, Honduras, Panama).

5.2 MEDITERRANEAN SEA

Direct mortality in the pelagic longlines of Greece, Italy and Spain differ, according to the various type of gears and year periods (Laurent *et al.* 2001) with the highest catch rate in the Spanish fishery and the lowest in the Greek fleet, but also a notable a high peak in some southern Mediterranean areas. Figure 5-1 to Figure 5-6 and Figure 5-7 to Figure 5-9 illustrate some areas in Spain and Italy where turtle captures were investigated in 1999 and 2000; respectively. Figure 5-10 shows those reported in 2000 in Greece.

Taking this information into consideration, the Strait of Gibraltar and the Strait of Sicily should be considered as relevant large hot-spot areas (Figure 5-6 and Figure 5-9). In the western Mediterranean, a large proportion of the captured loggerheads are of western Atlantic origin (confirmed by genetic studies) and the remaining part come from the eastern Mediterranean (Laurent *et al.*, 1998).

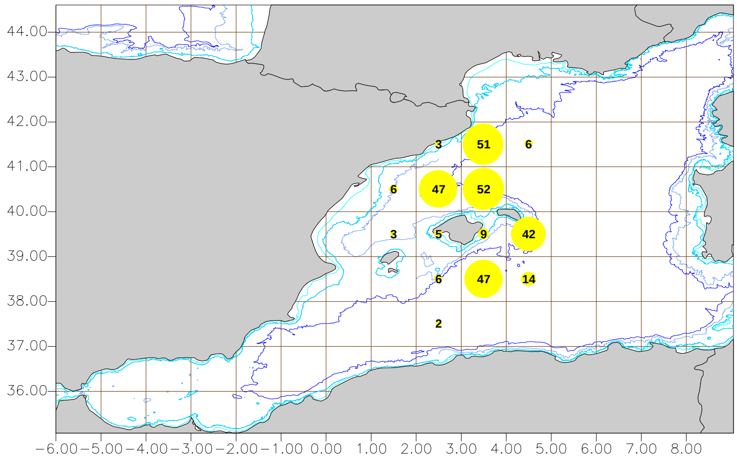

Figure 5-1. Geographical distribution of marine turtle catches (number of turtles) in albacore longline in Alboran Sea and Gibraltar area, the western Mediterranean in 1999.

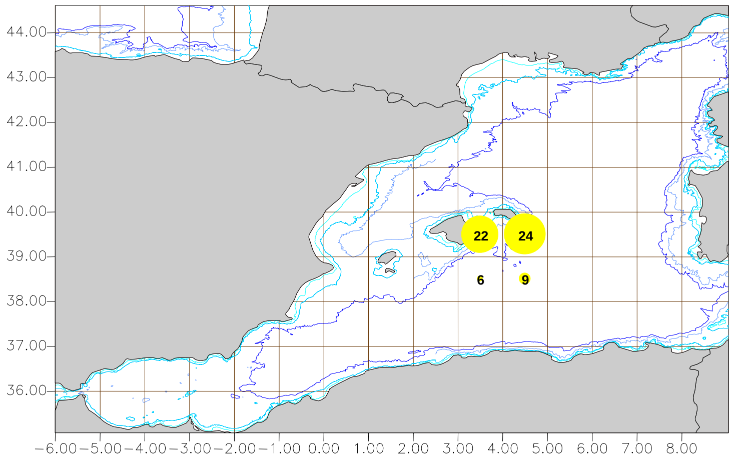

Figure 5-2. Geographical distribution of marine turtle catches (number of turtles) in albacore longline in Alboran Sea and Gibraltar area, the western Mediterranean in 2000.

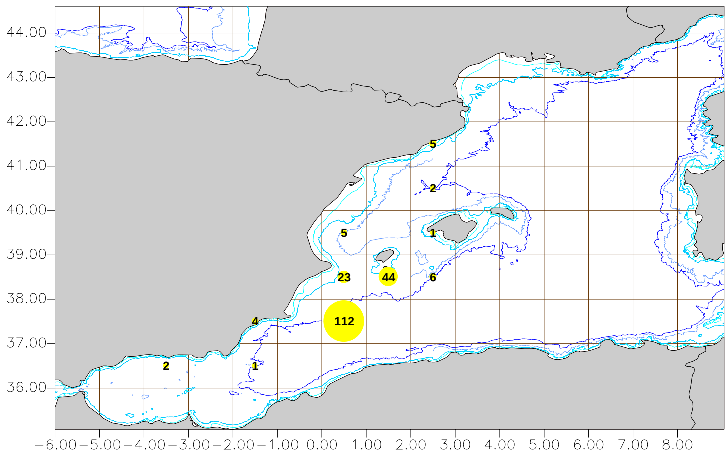

Figure 5-3. Geographical distribution of marine turtle catches (number of turtles) in swordfish longline in Alboran Sea and Gibraltar area, in the western Mediterranean 1999.

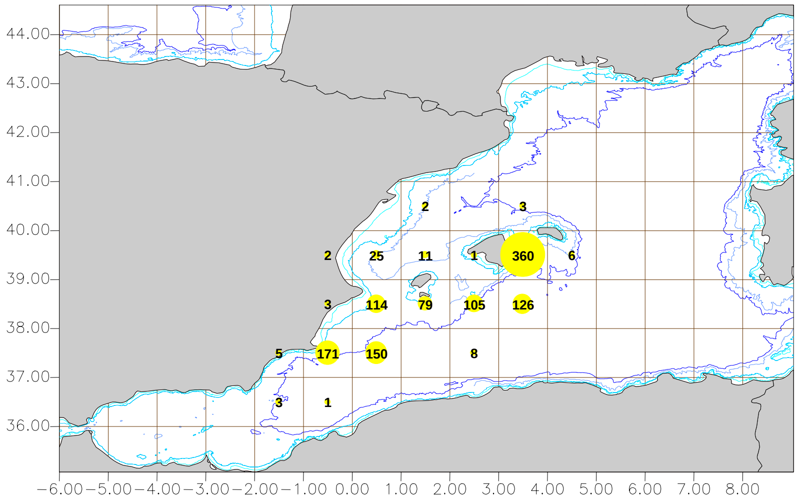

Figure 5-4. Geographical distribution of marine turtle catches (number of turtles) in swordfish longline in 2000.

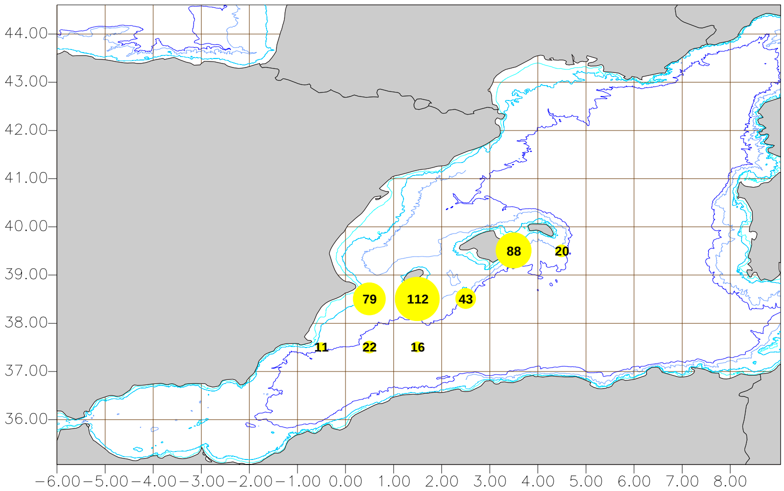

Figure 5-5. Geographical distribution of marine turtle catches (number of turtles) in bluefin tuna longline in 2000.

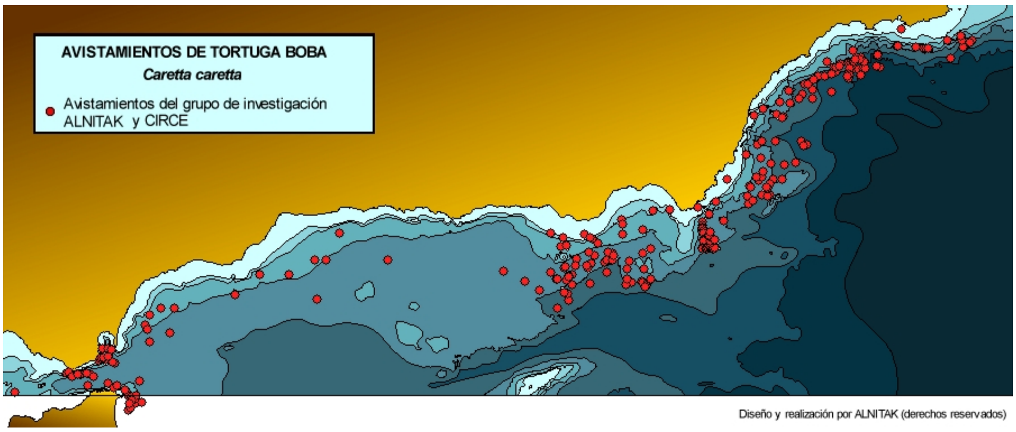

Figure 5-6. Turtles observations at sea in Alboran sea and Strait of Gibraltar areas (Cañadas *et al.* 2000).

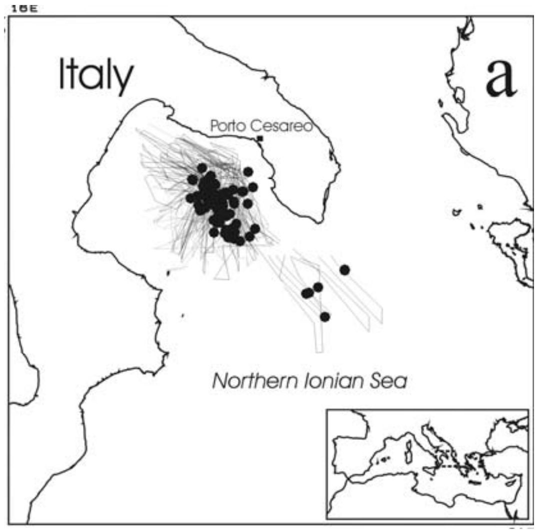

Figure 5-7. Spatial distribution of both swordfish and albacore longline fishing sets (lines) and recovery points of loggerheads (-) and green turtles (+) observed off Italian coasts.

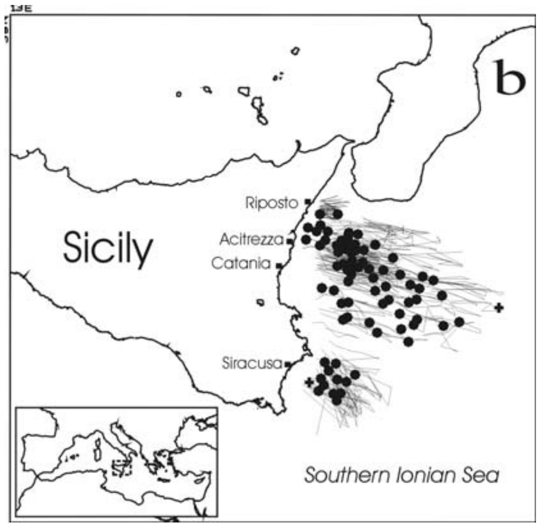

Figure 5-8. Spatial distribution of both swordfish and albacore longline fishing sets (lines) and recovery points of loggerheads (-) and green turtles (+) observed off Italian coasts.

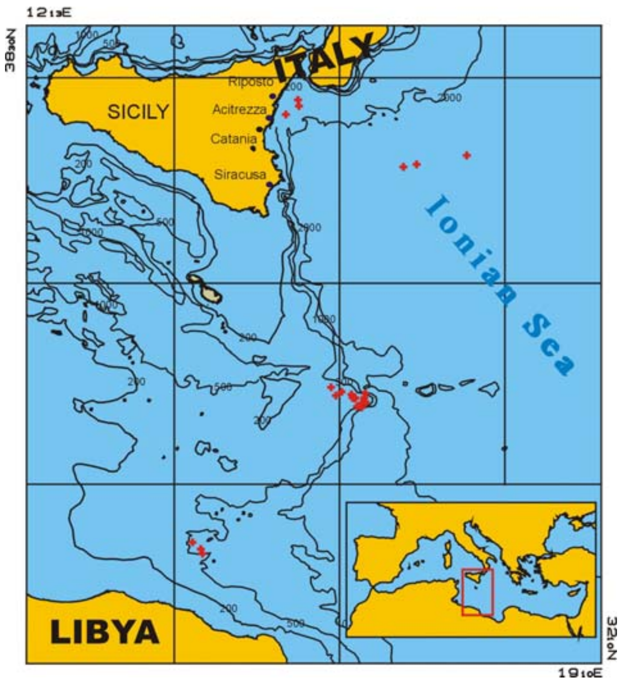

Figure 5-9. Geographical distribution of the marine turtles caught by Italian longliners in the southern Ionian Sea (A2) during 1999.

Figure 5-10. Spatial distribution of captured turtles in the year 2000 in Greece (17 *Caretta caretta* and 1 *Dermochelys coriacea*).

Information from other EU Mediterranean countries in the region using pelagic longline was not available during the meeting.

Information about migratory concentrations are also quite poor, due to the limited number of turtles tagged with satellite tags. Variability from year to year is known and periods when loggerhead turtles show oriented and coordinated movements are known to possibly coincide with climatic and oceanographic factors.

A much more detailed observer coverage of the various fleets and periods is necessary to better define Mediterranean "hot spots" to be used for fishery management purposes.

5.3 INDIAN OCEAN

Generally, information on incidences with the longline fleet from this area is poor when existing. Concerning EU fleets little information is available, except for the pelagic longline fleet based in Reunion Island, where captures of *Dermochelys coriacea, Eretmochelys imbricate* and *Chelonia mydas* are reported (Campbell 2004). In addition to the EU pelagic longline fleet, there is evidence of captures by the Australian fleet (Campbell 2004).

Due to the lack of data, it is difficult to define "hot spots" in the Indian Ocean, even if it is likely to have several, due to the presence of various nesting areas and migratory movements and aggregation.

5.4 PACIFIC OCEAN

No information is available on direct captures by EU longline fleets. However, interactions between pelagic longlines (e.g.: USA, Australia, Costa Rica, Ecuador, Japan, New Zealand) and turtles are important in the area (e.g. Skillman & Kleiber 1998; Arauz *et al.* 2000; Lewison *et al.* 2004; Largacha *et al.* 2005).

The identification of "hot spots" appears quite difficult, due to the very low observers coverage of the many fleets fishing in this huge area.

Lewison *et al.* (2004) argues that there are two major 'hot-spots' in the Pacific, one in the central Pacific area south of Kiribati (where some Spanish and Portuguese vessels are known to operate), and one in the region between Indonesia and the Philippines. Although the data used by Lewison *et al.* from the Pacific Ocean are not nation specific, global landings suggest that Japan and Taiwan are primary fleets in this region. Indonesian fleets also report significant longline landings (45 000 MT per year), likely from artisanal fisheries in the same area (Lewison *et al.* 2004).

5.5 WG REMARKS

1. Information about specific "hot spots" is very insufficient, due to the low reseach effort carried out so far on this issue.
2. The situation in the Atlantic Ocean needs further data and investigation. Leatherback turtle seem more present in NE Atlantic in summer and early fall, raising the attention on that part of the ocean. Juvenile loggerhead turtles concentrate in mid-Atlantic, but much more detailed data are needed.
3. According to the available information, several "hot spots" are present in the Mediterranean sea, but their relevance is variable over time and space, according to environmental factors and possibly turtles behavioural features. Some high catch rates indicate the possible presence of migratory concentrations or migration courses, but information on this issue is very scarce.
4. Hot spots in other oceans (Red Sea, Indian Ocean, Pacific Ocean) where EU longline fleets are active do certainly exists, but information is poor or lacking, due to the absence of any reported observer coverage.
5. Although information at present is insufficient, the WG considers that the EU longline fleets are fishing in waters (Mediterranean, Atlantic, Indian ocean and the Pacific) where turtle by-catch is known to occurs.
6. The EU longline fleet is rather heterogeneous, from small artisanal vessels to large industrial vessels with processing facilities.
7. Most of the information on longline fleets presented in this chapter is only from EU countries in the Mediterranean Sea.
8. Information on the EU longline fleets in distant waters and in the Atlantic is only available for a few fleets and do not cover all these Oceans (see the list of bilateral EU agreements).
9. The EU fleets are often multipurpose fleets, and it is therefore not possible to extract specific information on the number of vessels engaged in pelagic longline fisheries, the longline effort and corresponding turtle by-catch.
10. The EU pelagic longline fleet is likely to have different components varying from year to year, or by season or month, according to fishing strategies and to the possibility to shift from one gear to the other.
11. In the best possible case, it is possible to provide only a rough estimation of the fishing effort related to EU fishing fleets only in areas were specific monitoring programmes are active.

6 OVERVIEW OF MITIGATION METHODS OR APPROACHES

This overview is mainly based on reports of studies and investigations covering mainly the north Atlantic (Garrison 2003; Bolten *et al.* 2004; Watson *et al.* 2004, 2005), the eastern Pacific (Largacha *et al.* 2005), and also on the review by Gilman *et al* (2005), and by Casale (2005). Recent EC LIFE projects on this issues have been also reviewed.

Below are described what the WG considers important factors regarding mitigation measures for the longline by-catches of marine turtles. These include:

1. The influence of hook design and size on (by-) catch rates
2. Choice and size of bait
3. Soak time of hooks
4. Depth of the gear setting
5. Mortality of caught turtles
6. Handling of caught turtles by the fishermen

When evaluating mitigation methods aiming at reducing the mortality of turtles as by-catch in pelagic longline fisheries it is important to distinguish between:

1. Catch Rate, i.e. the number of turtles captured
2. Mortality Rate, the number (fraction) of turtles dying when captured.

6.1 HOOK DESIGN AND SIZE AND (BY-) CATCH RATES

A small number of studies have evaluated the effectiveness of changing hook type from conventional "J" hooks to circle hooks as a possible mitigating measure to reduce turtle bycatch. Circle hooks have the point of the hook turned inwards towards the shank and the gap between the point and the shank is smaller than in "J" hooks.

Experiments conduced by NOAA in the U.S.A. Northeast Distant Water swordfish fishery in 2002 and 2003 (Watson *et al.* 2005), see Table 6-1, compared turtle catch rates using 18/0 offset, 18/0 non-offset and 20/0 offset circle hooks baited with mackerel or squid with conventional 25 degree offset 9/0 (4.1 cm wide) J hooks with squid bait used as a control. The results are summarised in table 6.1 and showed significant reductions in CPUE of both loggerhead and leatherback turtles. In these studies, the use of circle hooks with squid bait reduced swordfish CPUE by 29% but increased Bigeye tuna CPUE by 20%.

Table 6-1. Results of NOAA studies comparing circle hooks to a control of 9/0 J hook baited with squid. (CI=Confidence Interval).

Species	Control		Treatment		Catch Rate	
	Hook	Bait	Hook	Bait		CI
C. caretta	J 9/0	Squid	C 18/0	Mackerel	-90%	70-97%
C. caretta	J 9/0	Squid	C 18/0	Squid	-86%	73-93%
C. caretta	J 9/0	Squid	J 9/0	Mackerel	-71%	42-86%
D. coriacea	J 9/0	Squid	C 18/0	Mackerel	-65%	36-81%
D. coriacea	J 9/0	Squid	C 18/0	Squid	-57%	34-72%
D. coriacea	J 9/0	Squid	J 9/0	Mackerel	-66%	37-81%

It should be noted that the circle hooks used by Watson *et al* were considerably larger (5.7 cm width) than the control J hooks (4.1 cm width) and therefore the increased hook size rather than the shape could at least partly account for the reduction in turtle catch rates; furthermore, information about the bait size is lacking. The investigations by Watson *et al.* (2005) indicate, that the use of circle hooks with a width of >5.1cm significantly reduced the incidence of loggerhead turtles attempting to swallow baited hooks, see Table 6-2. For leatherbacks, however, this reduction does not seem to be pronounced. The results from the longline experiments in the Gulf of Mexico 2001-02 (Garrison 2003) indicate similar characteristics of the relation between hook type (and size) and the by-catch rates of turtles.

Table 6-2. Position of hooking in loggerheads (Watson *et al.* 2005).

Hook	% of hooks		Number observations
	Mouth	Deeper	
J	31.2	68.8	80
C 18/0	72.7	27.3	11

Studies in the Azores longline swordfish and blue shark fishery (Bolten and Bjorndal 2003) found no significant difference in the number of loggerhead turtles caught using 16/0 circle hooks, 18/0 circle hooks, and 9/0 J hooks baited with squid bait. This experiment, however, had a relatively small sample size (88,150 hooks) and a small number of loggerheads (44) were captured, and so the results must be treated with caution.

As well as reducing hooking rates, it has also been shown that circle hooks in some circumstances reduce the incidence of turtles swallowing the hooks versus being hooked in the mouth (Table 6-2).

These results are supported by the Azores studies in which Bolten *et al.* (2004) reported that with the smaller 16/0 circle hooks, 8% of turtles ingest the hook vs. 53% with J hook.

It is frequently asserted that deep hooking increases post-release mortality although there is at present no scientific evidence to support this. Indeed, it is possible that, where the hook is not removed prior to release, mouth hooking may result in greater mortality by impairing feeding and other behaviour.

The conclusions that can be drawn from the above listed research are that;

1. Large circle hooks (>5.1 cm) reduce hooking rate of loggerhead turtles relative to smaller “J” hooks
2. Large circle hooks reduce the incidence rate of loggerhead turtles becoming hooked internally, possibly as a result of their inability to ingest larger hooks.
3. Circle hooks reduce hooking rates of leatherback turtles, possibly as a result of the different hook shape reducing the incidence of foul-hooking.
4. It has not been statistically demonstrated, that small circle hooks (<5.1 cm) reduce turtle capture rates and more research is needed in this area.
5. Further research is also needed to determine post release mortality rates for internally and externally hooked turtles.

6.2 CHOICE OF BAIT

Research by Watson *et al* in the USA Northeast Distant Water swordfish fishery and by Garrison (2003) in the Gulf of Mexico) looked at the effect of different baits on turtle bycatch, however, the results were, in many cases, confounded by the effects of different hook size and design. Use of blue dyed squid showed no significant effect on turtle captures. Use of mackerel bait on 9/0 ”J” hooks produced a significant reduction in CPUE of 71% for loggerhead 66% for leatherbacks compared with squid bait on the same type of hooks. Use of mackerel bait increased swordfish catches by 63% but reduced bigeye tuna catches by 81%.

It is likely that the size of the bait as well as the species influences the levels of turtle by-catch. No data on bait size are available. Since the target of the fishery influences the choice of bait as well as of hook type, this is an important issue to consider regarding mitigation measures for by-catch of turtles.

6.3 SOAK TIME

The investigations by Watson *et al* (2004) indicate that loggerhead cpue increases with increased daylight hook soak time. This would imply that loggerhead interaction with longline gear in the NW Atlantic is a daytime interaction.

6.4 HOOK DEPTH (DEPTH OF THE GEAR SETTING)

Hard shell turtles in the oceanic stage (i.e when they are captured by drifting longlines) are epipelagic and do not often dive to great depths. For instance, *Caretta caretta* has been observed to spend 90% of their time at less than 40 m from the surface, while *Lepidochelys olivacea* 60% (Polovina *et al.*, 2004) are found at depths less than 100 m. Free ranging juvenile pelagic loggerhead turtles are capable of diving to depths below 200 m, but usually stay in the upper 30m (Dellinger 2000; Dellinger & Ferreira 2005) Main interaction depth are the upper 20m of the water column (Dellinger & Ferreira 2005). However, even when longlines are set at depths greater than the dive range of turtles, the time spent within these upper 20 m is determining for the byctach rate as seen with the Madeiran black-scabbardfish fishery (Dellinger & Ferreira 2005).

On this basis, hooks deeper then 40 m or deeper then 100 m are very promising to reduce turtle catch rate, and some preliminary results show that this might be economically compatible for fishermen in some areas (see Gilman *et al.* 2005 for a review). For instance, in the South Pacific promising results have been obtained in some long line fisheries for tuna and tuna like fish around New Caledonia. When the main line with baited hooks was set at depths > 100 m the reported catch rates of tuna increased, while that of turtle by-catches decreased (see www.smartgear.org).

Leatherbacks, however, are reported to dive deeper, down to 1,000 m or more in some areas (Eckert 1983, in: Eckert 1995), although they spent most of the time at less than 100 m (Hays *et al.* 2004).

This solution might be adopted in some areas and fisheries, but it is likely not to be valid in all areas, fisheries or seasons where EU fleets operate. Fishing trials would be useful to better define fisheries and areas where this technical solution can be adopted to mitigate the turtles by-catch in pelagic longline fisheries.

6.5 HANDLING OF CAUGHT TURTLES BY THE FISHERMEN

While fishermen cannot manage the by-catch rate without changing the fishing activity (e.g. area, gear, time), they can intervene to reduce the mortality of turtles which have been caught. Usually fishermen minimise the trouble in releasing the turtles simply by cutting the line with the hook, leaving the hook and the branch-line (often a long tract) attached to the animal. This line is a cause of morality, both as a consequence of subsequent entanglement and by internal damage if ingested, even for relatively short tracts (e.g. Freggi and Casale, in press). However, removing the hook increases the survival chances of the turtle, and fishermen can play a fundamental role in reducing post-release mortality. As a minimum they should cut the branch-line as close as possible to the turtle's mouth, but it is best if they completely remove the hook, if it is accessible. However, this requires more time, effort and skills. In order to have fishermen intervene in these ways, specific awareness projects are required, providing them with basic guidelines and instructions (e.g. Gerosa & Aureggi 2001).

6.6 FISHERY INDUCED MORTALITY

The level of turtle mortality once captured is considered one of the key issues for this WG in relation to STECF recommendations in 2004. However it appears that the available data are insufficient to properly quantify mortality by hook type and different ways of capture.

Studies in the Northwest Atlantic (Watson *et al.* 2004, 2005) and in the Azores (Bolten *et al.* 2004) have demonstrated that the use of circle hooks results in reduced incidence of turtles ingesting hooks and branch-line material. This has been assumed to equate to lower levels of post-release mortality, however, Casale (2005) summarised the available evidence:

1. On the basis of satellite tracking, Polovina *et al.* (2000) and Parker *et al.* (in press) reported no significant difference in distance traveled and travel speed between deeply and lightly hooked turtles. Moreover, lightly hooked specimens were unhooked before release, so they probably performed better than if they had hooks still in place.
2. Epperly *et al.* (2003) state: "For those tags transmitting, turtles that ingested the hook showed the same bimodal depth distribution as entangled/lightly hooked turtles".
3. On the basis of necropsies, Work and Balazs (2002) suggest that "deep or light hooking may not be a satisfactory criteria for the short-term survival".

It is important to note that the human factor (fishermen removing hooks from the turtle's mouth) is not relevant here, because in the first two studies turtles captured by a hook in the mouth were released after removing the hook.

So, at present, the assumption that deep-hooked turtles suffer greater mortality has no scientific basis. Moreover, the problem is more complex than deep vs. light (mouth) hooking, because Circle and J hooks have a different shape that directly influences the engagement, and it seems unlikely that they induce the same mortality rate even if in the same body position.

A few estimates of post-release mortality for different hooking positions are available:

6.6.1 Mouth hooked with J hooks

Parker *et al.* (in press) used satellite tracking to assess the fate of turtles released after removing the hook from the mouth. Under these circumstances (only hook injury, hook not in place) a possible mortality of 21% was observed (n=19; Parker *et al.*, in press; CI95%: 6-46%). However, because of confounding factors, satellite tracking is not a reliable method to investigate mortality (Chaloupka *et al.* 2004). The presence of the hook in the mouth in the studied individuals is an important factor as it cannot be considered a realistic scenario that all fishermen (whatever the fishery and country they belong to) remove all hooks from all turtle mouths. So, in order to estimate the actual mortality of sea turtles with a J hook in the mouth on the average, no-treatment mortality should be investigated. Projects on post-release mortality which use de-hooked turtles will only provide the minimum possible mortality rate, applicable only on that (small) part of turtles which hopefully will be de-hooked by fishermen during normal operations.

6.6.2 Internally hooked with J hooks

34% (n=32; Aguilar *et al.*, 1995; CI95%: 19-53%). Captivity. Possible underestimation due to treatments.

33% n=21; Freggi and Casale, in press; CI95%: 15-57%). Captivity. Possible underestimation due to treatments.

35% (n=31; Parker *et al.*, in press; CI95%: 19-55%). Satellite tracking. Possible slight overestimation due to technical failures. However, because of confounding factors, satellite tracking is not a reliable method to investigate mortality (Chaloupka *et al.* 2004).

6.6.3 Mouth hooked with circle hooks

No data have been made available to SGRST/SGFEN.

6.6.4 Internally (ingested) hooked with circle hooks

No data have been made available to SGRST/SGFEN.. Mortality rates were only available for deeply ingested J hooks.

6.6.5 Conclusion

In conclusion, with the available information, it is not possible to know whether or not circle hooks induce a lower, higher, or the same mortality rate then J hooks.

6.7 RESEARCH IN EU WATERS.

6.7.1 Italian investigations

In order to reduce incidental catches of loggerhead turtles in the drifting longline fishery for swordfish in the Mediterranean, several investigations on mitigation methods have been conducted in recent years, some of which are ongoing, mostly funded by the EC LIFE projects. They focus on the possibility of:

1. Utilizing turtle specific deterrent
2. reducing attractiveness of the bait to turtles
3. reducing attractiveness of the gears: characteristics of floats

4. reducing encounter probability: hook depth
5. reducing hook ingestion: hook size and shape
6. increasing hook defecation

Experimental programs investigating the applicability of the above mentioned mitigation measures were conducted during the summer in 2001 and 2002 by University of Torino within the framework of EU-Life Project "Urgent conservation measures for *Caretta caretta* around the Pelagie islands".

6.7.1.1 Turtle specific deterrent

Experiments were carried out on 4 juveniles and 7 sub-adults loggerhead turtles in open tanks at the Cattolica (Rimini) "Delphynursery". Turtles were exposed to sound playback at different frequencies and their behavioural responses observed.

At frequencies between 50 and 400 Hz, some avoidance behaviour was observed with the maximum level of avoidance at (20%) 50Hz. "Neutral" behaviour, turtles reacting to the sound but not moving towards or away from its source, was observed between 50 and 700 Hz with highest levels (40%) between 50 and 100 Hz. The most frequent behaviour at all frequencies was "no response" and at frequencies above 700 Hz, no response was observed in any of the tests. Although these behavioural responses to sound playback were observed in early tests, the turtles very quickly became accustomed to the signal after which they no longer displayed avoidance behaviour.

This results, even if based on a small sample, together with the increased level of acoustic pollution in the Mediterranean did not encourage continuation of this type of experiments, and no more experiments on turtle specific deterrent have been conducted or are planned at present, but the detailed results have not be made available at this meeting.

6.7.1.2 Bait attractiveness

The effect of bait colours (yellow, red and blue) and bait odour was tested with experiments carried on with 27 loggerheads (22 immature and 5 adults) in open tanks.

6.7.1.2.1 BAIT COLOUR

It was observed that juveniles react to baits colour differently with respect to sub-adults and furthermore, sub-adults show sharp individual differences.

As the reaction to different colours (Figure 6-1) depends strongly on individual age as well as other factors, such as smell, it does not seems worthwhile to continue this kind of tests although positive result have been obtained in 3 sets of experiments in the USA. Moreover, this is unlikely to be adopted as a mitigation measure, also because of problems associated with absorbance of colours with the depth. These experiments were conducted within the confines of shallow pools where there was very little light attenuation.

6.7.1.2.2 BAIT ODOUR

Further experiments aimed at testing the effect of "prey" odours on bait attractiveness independently of colours were carried out in open tanks on a sample of 27 specimens (22 immature individuals and 5 adults: 3 males and 2 females). The aim was to evaluate the effect of the mackerel odour coupled with an odourless squid-like yellow lure (12 cm long) (Figure 6-2) in eliciting approaching and biting behaviour. Turtles were presented with either (a) artificial lures without mackerel, (b) artificial lure with a small piece of mackerel, or (c) simultaneously with artificial lures with and without a mackerel.

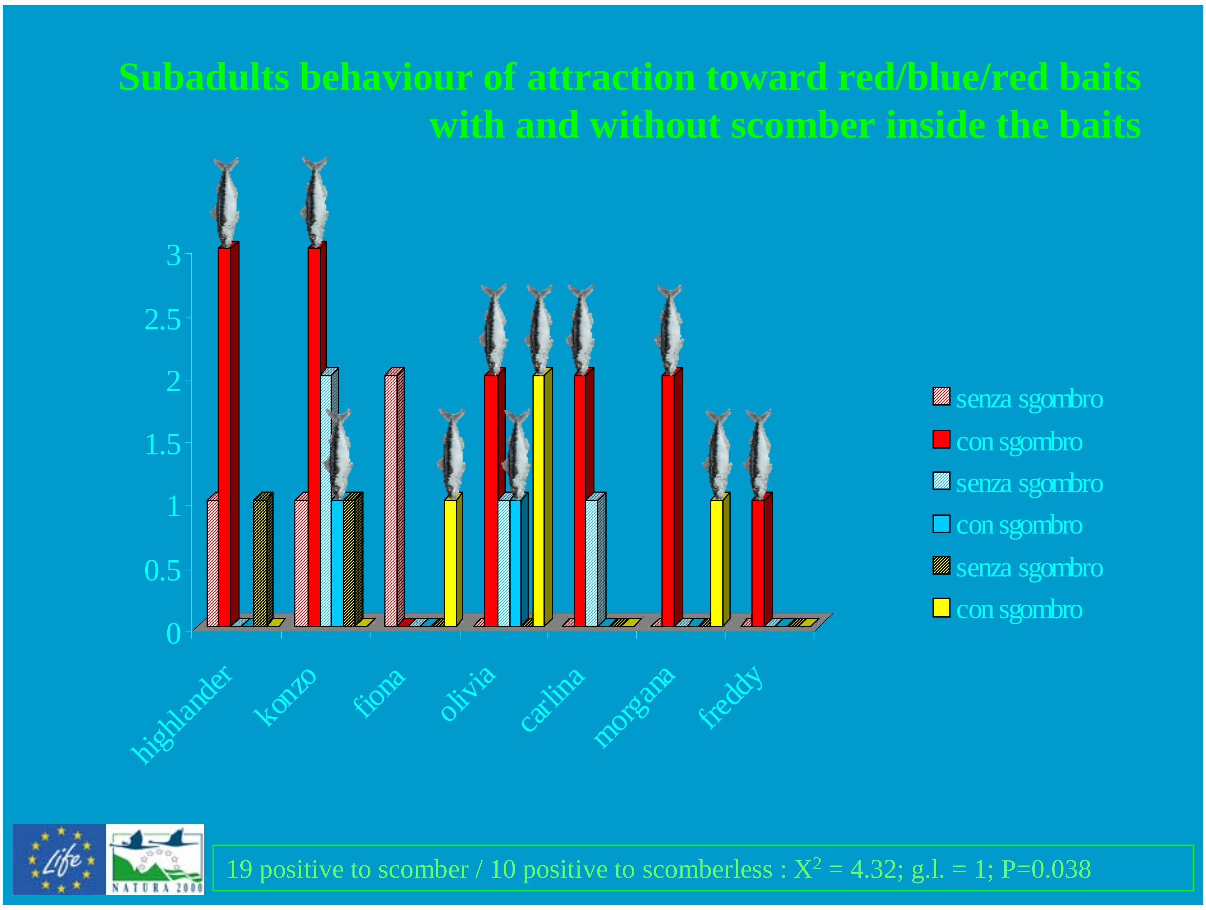

Figure 6-1. Responses of loggerhead turtles to different coloured artificial baits with and without mackerel inside.

Figure 6-2. Lure used in bait odour response experiments.

Table 6-3. Responses of loggerhead turtles to lures with and without mackerel hidden inside.

	total frequency of response			
	No interest	Non-specific change of behaviour	attraction	Bite
Test a. two lures without mackerel	96	66	13	14
Test b. two lures each with a small piece of mackerel	51	96	46	55
Test c. one lure with mackerel and one without, tested simultaneously	48	57	47	55

Table 6-3 shows total frequencies of "no interest", "non-specific change in behaviour", "attraction" and "bite" behaviours observed during all experiments run. Mackerel odour caused a significant decrease (47%) in the behaviour pattern of ignoring the lure while it nearly tripled the frequency of bites and other behaviours showing attraction to the lure, irrespective of the presence of one (situation c) or two (situation b) lures having Mackerel odour (Pearson Chi-square = 56.917, DF = 4, $p<0.005$).

All turtles showed non-specific change in behaviour and/or attraction toward lures having mackerel odour. Results show that 19 out of 27 turtles bit the lure with mackerel odour, only 8 bit the odourless lures, and 9 never bit a lure, either with or without mackerel. The number of bites aimed at lures having mackerel odour was significantly higher than that elicited by the odourless lure (Wilcoxon test Z = -3.649, $p<0.001$). All biting individuals bit mackerel-containing lures more frequently. The only exception was one adult male (out of 27 specimens), which bit the odourless lure only once and never bit the mackerel-associated lure. These results are supported by the outcome of choice tests (situation c test), where 100% of the turtles bit the lure having mackerel odour, even if it was set only 10 cm apart from the odourless one (19/0, binomial test $p<0.001$).

The results clearly showed that, for all turtles tested, mackerel odour was an important cue for selecting between lures. A small piece of mackerel is enough to make a lure attractive as well as to make the turtle's biting behaviour more frequent. Odourless lures, therefore, seem promising with respect to the aim of reducing by-catches of *Caretta caretta*.

6.7.1.2.3 AT SEA EXPERIMENTS

In order to evaluate their acceptability to commercial fishermen, odourless lures were tested at sea in the Strait of Sicily thanks to the co-operation of local fishermen.

Table 6-4. Preliminary results of at-sea trials on artificial lures. Xg = *Xiphias gladius* (swordfish), Tb = *Tetrapturus belone* (spearfish), S = *Sarda sarda* (bonito); Cc = *Caretta caretta* (loggerhead sea turtle); Mm = *Mola mola* (sunfish), D spp. = *Dasyatis* spp. (stingrays).

	n° Xg	n° Tb	n° S	n° Cc	n° Mm
per 1000 hooks with fish baits	4.92	0.31	0.20	0.20	0.10
per 1000 hooks with artificial baits	0.35	0.35	0.00	0.00	0.00

Table 6-4 presents peliminary results obtained during 14 fishing trips made in the Straits of Sicily from 2002 to 2004 in the months of July and August. The number of target species specimens and the number of by-catch species specimens (CPUE) is given per 1000 hooks.

The artificial lures tested not only drastically decreased the number of by-catches, but also reduced the catch of *Xiphias gladius* and *Sarda sarda*. More experimental fishing trials are in progress within the framework of the project "Reduction of the impact of human activity on *Caretta* and *Tursiops* and their conservation in Sicily" (LIFE03 NAT/IT/000163).

6.7.1.3 Attractiveness of the gears: characteristics of floats

Experiments to evaluate the potential effect of white or luminous floats on sea turtles were carried out with 4 juveniles and 7 sub-adults in open tanks. Responses to the floats were evaluated by measuring the time each turtle spent in the area near or far from the float, lit or unlit. No significant difference was observed between the two experimental conditions.Results suggest that turtles are neither attracted nor repelled by white floats, whether luminous or non-luminous. However the WG remarked that conditions in a two metre deep tank may not be comparable with at-sea conditions. No more experiments are being carried out at the moment

6.7.1.4 Reducing encounter probability: hook depth

Previous results suggest open the possibility that higher turtle by-catch occurs near floats not as a consequence of the float *per se* but of the fact that hooks near the floats are less deep than the other hooks of the same line.

Preliminary experimental tests were run by University of Torino and AGCI in the Strait of Sicily to evaluate the effect of different hook depth on sea turtle by-catches. Early indications are that most sea-turtle by-catches happened when hook are set between 10 and 15 m deep, however, more data are needed to confirm this. This approach seems one of the most promising but differences among fisheries and target species are to be seriously taken into account for a better evaluation of this mitigation technique.

6.7.1.5 Other ongoing Italian research

Experimental fishing sets are in progress in the Strait of Sicily to verify the effectiveness of circle hooks in reducing *Caretta caretta* by-catches and mortality and to assess the probability that hooks have been defecated. This research is being carried out under the framework of the following projects: “Reduction of the impact of human activity on *Caretta* and *Tursiops* and their conservation in Sicily” (LIFE03 NAT/IT/000163) “TARTANET – A network for the conservation of sea turtles in Italy” (LIFE04 NAT/IT/000187), and Field Trials to Evaluate Loggerhead Sea Turtle (*Caretta caretta*) By-catches in Longline Fishing Gear: a Test of Circle Hooks in a Mediterranean Swordfish Fishery.

6.7.2 Spanish Mediterranean experiments with mitigation measures

6.7.2.1 The background problems

The Spanish drifting longline fishery is characterised by heterogeneity of the gears used. This fishery targets mainly swordfish with a traditional gear described in section 2.1.1.3. The fishery is conducted throughout the year with peak catches during summer. There are significant by-catches of various shark species and marine turtles, mainly loggerheads. In general, the highest catches are taken from July to November due to the recruiting swordfish in the western Mediterranean, the main fishing area for this fleet. The impact on juvenile swordfish is considered an important problem in this fishery.

Another important problem in this fishery is the incidental by-catches of loggerheads. IEO investigations show that turtles by-catches in drifting longlines mainly occur during June-September, a period when loggerheads from the eastern Mediterranean and Atlantic stocks concentrate around Balearic Island for feeding. Because of the concentrations of both fish and turtles as well as the ability of the turtles to feed on the baited hooks, the result is a large number of loggerheads being captured or even killed by the longlines.

6.7.2.2 The purpose of the project

The current activity is based on a pilot project of 6 months duration, having an experimental drifting longline fishery in the Mediterranean carried out by 6 commercial fishing vessels from Carboneras. The project is funded by the Spanish Secretaria de Pesca (SGPM). The aim of the project is to:

1. Reduce the capture of juveniles swordfish and other species such as sharks
2. Reduce the longline by-catches of marine turtles
3. Increase the knowledge of the spatial distribution of swordfish in relation to recruitment areas and areas with concentration of adults.

4. Analyse the catches by the traditional Spanish drifting longline, and the catches by modified (experimental) gears regarding hooks type and size, bait type and size, fishing depth, fishing time (soaking time) and others parameters.

All relevant information/data on catch and by-catch are collected during fishing trips by onboard scientific observers from the IEO "large pelagics" research team. Project activities begin in July 2005 and the first results are expected to be presented to SGPM in the beginning of 2006.

6.7.3 Portuguese experiments with mitigation measures

At Madeira, one important mitigation measure might be to stop discarding bait to the sea. This conditions turtles to follow boats, increasing the incidental capture rate when lines are set. The byctach rate of turtles from the black-scabbardfish fishery at Madeira shows this since the time-depth window available for turtles to get the bait is very small, given the great depth that lines are set. (T. Dellinger, pers. com.)

6.7.4 Comments

The effectiveness of experiments carried out in pools is quite limited in most of the cases. The importance of physical factors (light penetration and colour absorbance, currents, oceanographic factors, etc.) of at-sea conditions is to be seriously taken into consideration in reading the in-pool results of the experiments, particularly those on colour and odour, but also the isolation of a single turtle in a captive environment is another important factor as concerns behavioural observations.

Several experiments on the effects of artificial baits, odour, etc. have been conducted in the past by EU scientists and those trials should be properly considered with the purpose to avoid useless duplication of efforts and costs.

6.8 CONCLUSIONS ON MITIGATION APPROACHES

Effective methods for mitigation of the incidental by-catch of sea turtles in drifting longline fisheries (for tuna and tuna-like species) have been and are currently being investigated both in EU fisheries and non-EU fisheries. Hitherto focus has mainly been put on hook design.

6.8.1 Hook type and by-catch rate

US investigations in the Pacific and the western Atlantic have suggested that the use G-shaped hooks (= circle hooks) above a certain size reduce the by-catches compared to by-catches in fisheries using the traditional J-shaped hooks. On basis of the results from the Grand Bank trials (Watson et al. 2003, 2004, see above) FAO concluded in 2004 that: *"(the use of) circle hooks reduce catches of sea turtles (compared to J-hooks)"* (TC: STCF/2004/DMA.2).

However, it also appears from Watson (2004) and Gilman *et al.* (2005), (see the preceding chapter), that the hook-shape and size based mitigation effects do not seem to be the same for all marine turtle species. Furthermore, the bait species and size seemingly also influence the by-catch.

Casale (2005) further scrutinised the available data presented by Watson et al. (2003, 2004). From this it appears that the overall effect of the circle hooks in reducing by-catch is largely limited to the soft-shelled leatherback turtle.

There is scientific evidence that replacing J shaped hooks with circle hooks can reduce the catch-rate of the leatherback turtle (*Dermochelys coriacea*) in longline fisheries. However, for other marine turtle species, e.g. "hard-shelled" marine turtles such as loggerhead (*Caretta caretta*),) the studies carried out by NOAA in the Atlantic strongly suggest that catch rate of these species is rather affected by hook size and bait (probably because of its size too), and not so much by hook shape. The main conclusions from the data presented in this document are the following:

1. circle hooks reduce the catch rate of leatherback turtles only and not of hard-shelled turtles.
2. catch rates of hard-shelled turtles is reduced by large hooks, i.e. it is the size of the hooks rather than the shape which influences the by-catch rate of hard-shelled turtles.
3. the available data do not give any indication that circle hooks (shape factor) can reduce the longline catches of hard-shelled sea turtles.

4. Experiments have been limited so far only to a very few fisheries and target species; the extrapolation of these preliminary results to all drifting longline fisheries is not appropriate.

Thus the main conclusion drawn by this WG on the influence of hook type/design and size is that for soft-shelled turtles, i.e. leatherbacks, there is evidence of reduced by-catches with circle hooks, while for hard-shelled turtles they are hook and bait size rather than shape that influences catch rate.

In areas where the impact of longline catches of leatherback turtles is not an issue, as in the Mediterranean Sea, there seems to be no strong basis for introducing circle hooks as an effective mitigation measure to reduce by-catches of marine turtles.

6.8.2 Bait species

The available data the effects of different bait species are confounded by the effects of different hook size and design. However, from the experiments by Watson *et al.* (2005) in the northwest Atlantic, it seems that when using J-hooks switching from squid to mackerel as bait reduces the by-catch of both loggerheads and leatherbacks in drifting longlines. The bait size is another important factor to be taken into account, but this information is often not available.

6.8.3 The influence of the hook type and bait on the catch of target species and unwanted by-catch of bony fish and sharks

When considering hook design as a mitigation measure one should keep in mind the effects on catch rates for target species (fish) and by-catch of fish. The available data (Wilson 2004) indicate that, in a given fishery and area, circle hooks (compared to J-shaped hooks):

1. Decrease the catch of swordfish
2. Increase the catch of bigeye tuna
3. Increase the catch of bluefin tuna
4. Do not affect the catch of blue sharks

Furthermore, if the change of hook type is associated with a change of bait, from squid to mackerel, then these changes might have the following effects:

1. Increase the catch of swordfish
2. Decrease the catch of bigeye tuna
3. Increase the catch of bluefin tuna
4. Decrease the catch of blue sharks

Nothing is said about the bait size.

Thus, according to the results reported for this specific fishery, the consequences of the hook type to target species and the other sea turtles should be considered regarding introduction of mitigation measures.

6.8.4 Mortality of turtles caught in longline fisheries

The other important issue considering protective measures of marine turtles is the mortality of the turtles caught in the longline fisheries and how to reduce this mortality after capture.

The mortality of turtles caught may roughly be grouped into A) external hooking/entangled in the lines, B) hooked in the mouth, C) hooks and line ingested. ´

6.8.4.1 External hooking/entanglement in lines

The mortality by external hooking/entanglement in lines is probably only significant for the softshelled leatherbacks (*Dermochelys*) and mainly caused by subsequent entanglement in the line attached to the hook. For the hard-shelled turtles this particular mortality is probably negligible compared to the other causes of mortality.

6.8.4.2 Hooking in the mouth

The real magnitude of this mortality component is unknown. The figures available at present are probably underestimated, because the fishermen or the observers are known to have removed the hooks from the caught animals. This holds for both types of hooks.

6.8.4.3 Ingested hooks

A few estimates of mortality from ingestion of J-shaped hooks are available (around 35% mortality). There are no data for circle hooks, and therefore no estimates of mortality rates from ingestion of circle hooks. The effect of circle hooks (compared to J-hooks) on the mortality rate of hard-shelled turtles is still unknown. Even negative effects cannot be excluded. In addition to ingestion of the hook often considerable amounts of hook line is also ingested.

Therefore, with the available information at present, it is not possible to determine whether circle hooks induce a significantly different overall mortality rate (lower or higher), than J shaped hooks.

6.8.5 Previous STECF opinion

STECF, in its Plenary Meeting in November 2004, was requested to review and comment as appropriate the report " Experiments in the Western Atlantic Northeast Distant Waters to evaluate sea turtles mitigation measures in the drifting longline fishery. Report on experiments conducted in 2001-2003. February 4, 2004. Report of the National Marine Fisheries Service, NOAA, U.S. Department of Commerce, by Watson, J.W., Foster, D.G., Epperly, S.P., Shah, A.K..

In reviewing the above mentioned report, STECF decided to take into consideration also other reports by the same principal Author, among which one very recently produced (Watson *et al.* 2004), and reports by other Authors working on the same subject, with the purpose to provide more informed comments on this issue, with the purpose to suggest possible improvements in the existing drifting longline practices for the Community fleets.

Here following there are the STECF final comments, which are shared by the SGRST and which are also useful to better assess the problems.

1. Circle hooks might be a promising solution in several drifting longline activities to mitigate the impact on marine turtles, but no data are available at the moment on smaller size hooks required in several drifting longline fisheries for species smaller than large fish.
2. Bait size, as well as hook size, might affect the hooking rate for several species, including loggerhead turtles, but no data are available on bait size, even if Watson *et al.* 2003, reported a bait weight for mackerel up to 500 gr.
3. According to these problems, there is the need to better evaluate, in a comparative manner and using not only a good experimental design but also a proper observer's reporting, the true impact of "J" hook types and circle hook types of various sizes (baited in a comparable manner) on marine turtles, target species and other by-catch components. These data are not fully available at the moment, neither from the experiments examined nor from most of previous trials.
4. The rationale for rule making option to require 16/0 circle hooks in tuna direct drifting longline fishery to mitigate sea turtle mortality (Watson *et al.* 2004) is a useful document and a good summary of all the existing comparative data for NW Atlantic and the Gulf of Mexico, providing a large overview of the existing knowledge and the expected fishery changes, even in terms of catches for the main target species. Even there, in some cases there are no sufficient data, while the by-catch of other species, including sharks or other commercial species, is simply not considered.
5. The identification of the most relevant migration areas and season for several important marine turtle species (loggerhead, leatherback, green) is one of the key factor to better manage the drifting longline fishing activity, because a time/area closure might help to mitigate the problem when it reach critical peaks.

7 SUMMARY OF GENERAL COMMENTS AND REMARKS

7.1 MARINE TURTLES CONCERNED

Seven marine turtle species, Loggerhead (*Caretta caretta)*, Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricate*), Kemp´s Ridley (*Lepidochelys kempi*), Olive Ridley (*Lepidochelys olivacea*), Flatback (*Natator depressus*) and Leatherback (*Dermochelys coriacea*) can be affected by the EU fleets fishing in different oceans.

7.2 OVERVIEW OF THE EU LONGLINE FISHERIES CONCERNED

- The EU drifting longline fleet is rather heterogeneous, from small artisanal vessels to large industrial vessels with processing facilities. This fleet is likely to have different components varying from year to year, or by season or month. Often the fleets are multipurpose fleets, and it is therefore not possible to extract specific information on the number of vessels engaged in pelagic longline fisheries, the longline effort and corresponding turtle by-catch.
- Although information at present is insufficient, the EU drifting longline fleets are fishing in waters where turtle by-catch is known to occur and particularly in the Mediterranean, Atlantic, Indian and the Pacific oceans.
- Most of the information on longline fleets presented in this chapter is only from EU countries in the Mediterranean Sea. Information on the EU longline fleets in distant waters and the Atlantic is only available for a few of the countries known to operate in these waters (see the list of bilateral EU agreements).

7.3 OVERVIEW OF THE QUANTITATIVE BY-CATCH DATA ON TURTLES BY THE EU PELAGIC LONGLINE FLEETS.

- Most of the information on longline fleets analyzed was mainly from EU countries in the Mediterranean Sea. In the best possible case, it is possible to provide only a rough estimation of the marine turtle by-catch related to EU fleets fishing with drifting longline only in areas were specific monitoring programmes are or have been active.
- The Loggerhead turtle (*Caretta caretta*) appears to be the most affected turtle species by the drifting longline fishing activities in the Mediterranean and in the Atlantic, but catch rates are quite variable (0-6.6). The period between June and July shows the higher catch rates of Loggerhead turtle although anomalous high daily catch rates (40.7) were encountered in the Southern Mediterranean sea in 1998.
- The catch rate of Green turtle (*Chelonia mydas*) is also very low (0.01) and reported for a few Mediterranean areas, which is known to be mostly restricted in the Eastern Mediterranean. No catch rates are available for any other sea where EC fleets are active.
- The catch rate of Leatherback turtle (*Dermochelys coriacea*) is less variable, ranging from 0.013 to 0.019 in at least two Mediterranean areas. The portion of the Atlantic population of this species in the Mediterranean Sea is unknown. The few Atlantic catch rate data available range from 0.011 to 0.043. No catch rates are available for any other sea where EC fleets are active within the Leatherback range.

7.4 DATA FROM MARINE TURTLE NETWORKS AND RESCUE CENTRES

- Although at present information is incomplete, several stranding networks and rescue centres are active in EU countries in both Atlantic and Mediterranean regions.

- Some rescue centres activities can provide useful additional information on marine turtles, particularly on the incidence of various fishing gears, including drifting longlines.
- When marine turtles with hooks inside the digestive are maintained in rescue centres detailed information about the possibility for a turtle to survive after hooking could be obtained. Survival rates are quite different among centres and these discrepancies should need further investigations.
- Rescue centres are able to increase the survival rate of hooked marine turtles, but their effects on the total population might be minimal.

7.5 AREAS WHERE HIGH INTERFERENCE IS REPORTED BY EU PELAGIC LONGLINE FLEETS (HOT SPOTS)

- Information about specific "hot spots" is very insufficient, due to the low research effort carried out so far on this issue. According the SG the situation in the Atlantic Ocean needs further data and investigation. Leatherback turtle seem more present in NE Atlantic in summer and early fall, raising the attention on that part of the ocean. Juvenile loggerhead turtles concentrate in mid-Atlantic islands, but much more detailed data are needed.
- According to the available information, several "hot spots" are present in the Mediterranean sea, but their relevance is variable over time and space, according to environmental factors and possibly turtles behavioral features (mainly reproduction, feeding, resting and migrations). Some high catch rates could indicate migratory concentrations or migration courses, but information on this issue is insufficient.
- Hot spots in other oceans (Indian Ocean, Pacific Ocean) where EU longline fleets are active do certainly exist, but information is poor or lacking, due to the absence of any reported observer coverage.

7.6 MITIGATION METHODS OR APPROACHES

The STECF considers important factors regarding mitigation measures for the longline by-catches of marine turtles. These include:

1. The influence of hook design and size on (by-) catch rates
2. Choice and size of bait
3. Soak time of hooks
4. Depth of the gear setting
5. Mortality of caught turtles
6. Handling of caught turtles by the fishermen

When evaluating mitigation methods aiming at reducing the mortality of turtles as by-catch in pelagic longline fisheries it is important to distinguish between:

a. Catch Rate, i.e. the number of turtles captured
b. Mortality Rate, the number (fraction) of turtles dying when captured.
c. Delayed Mortality Rate, as the number of turtles dying because the hooks or lines after been released alive.

Effective methods for mitigation of the incidental by-catch of sea turtles in drifting longline fisheries (for tuna and tuna-like species) have been and are currently being investigated both in EU fisheries and non-EU fisheries. Hitherto focus has mainly been put on hook design.

7.6.1 Hook type and by-catch rate

Investigations in the Pacific and the western Atlantic US fisheries using non-offset and offset circle hooks suggest that the use circle hooks above a certain size reduce the by-catches compared to by-catches in fisheries using the traditional J-shaped hooks. However, it also appears that the hook-shape and size based mitigation effects do not seem to be the same for all marine turtle species. Furthermore, the bait species and size seemingly also influence the by-catch.

There is scientific evidence that replacing J shaped hooks with circle hooks in certain regions can reduce the catch-rate of the leatherback turtle (*Dermochelys coriacea*) in longline fisheries. However, for other marine turtle species, e.g. "hard-shelled" marine turtles such as Loggerhead (*Caretta caretta*),) the studies carried out by US-NOAA in the Atlantic suggest that catch rate of these species is rather affected by hook size and bait and not so much by hook shape. In areas where the impact of longline catches of leatherback turtles is not an issue, as in the Mediterranean Sea, there seems to be no strong basis for introducing circle hooks as an effective mitigation measure to reduce by-catches of marine turtles.

According to the fishing gear and fishing operations reviewed by the SGRST/SGFEN, it is unclear how the hook size and type could affect the turtle catch rate. At the same time, it seems clearer that a deeper position of the hook in the water column can reduce the turtle by-catch, but this information should be matched with a corresponding CPUE for the target species to provide a proper figure to be used for fishery management purposes.

SGRST/SGFEN notes that the previous STECF opinion on the use of different circle hooks and baits, reported on SEC(2005)369, is still valid and the consideration reported there can be retained.

7.6.2 Bait species

The available data the effects of different bait species are confounded by the effects of different hook size and design. However, from the experiments by Watson *et al.* (2005) in the northwest Atlantic, it seems that when using J-hooks switching from squid to mackerel as bait reduces the by-catch of both loggerheads and leatherbacks in drifting longlines. The bait size is another important factor to be taken into account, but this information is often not available.

7.6.3 The influence of the hook type and bait on the catch of target species and unwanted by-catch of bony fish and sharks

When considering hook design as a mitigation measure one should keep in mind the effects on catch rates for target species (fish) and by-catch of fish. The available data indicate that (Wilson, 2004), in a given fishery and area, circle hooks (compared to J-shaped hooks):

- Decrease the catch of swordfish
- Increase the catch of bigeye tuna
- Increase the catch of bluefin tuna
- Do not affect the catch of blue sharks

Furthermore, if the change of hook type is associated with a change of bait, from squid to mackerel, then these changes might have the following effects:

- Increase the catch of swordfish
- Decrease the catch of bigeye tuna
- Increase the catch of bluefin tuna
- Decrease the catch of blue sharks

Nothing is said about the bait size.

Thus, according to the results reported for this specific fishery, the consequences of the hook type to target species and the sea turtles should be considered regarding introduction of mitigation measures.

7.6.4 Mortality causes of turtles caught in longline fisheries

The other important issue considering protective measures of marine turtles is the mortality causes of the turtles caught or entangled in the longline gears (direct mortality) and how to reduce this mortality after capture.

The direct mortality cause of turtles caught may roughly be grouped into A) external hooking/entangled in the lines, B) hooked in the mouth, C) hooks and line ingested.

The mortality by external hooking/entanglement in lines is probably only significant for the softshelled leatherbacks (*Dermochelys*) and mainly caused by subsequent entanglement in the line attached to the hook. For the hard-shelled turtles this particular mortality is probably negligible compared to the other causes of mortality, although is dependent of the depth where the hooks are deployed and the possibility for breathing.

The real magnitude of hooking in the mouth mortality component is unknown. The figures available at present could be underestimated, because the fishermen or the observers could removed the hooks from the caught animals. This holds for both types of hooks.

A few estimates of mortality from ingestion of J-shaped hooks are available (around 35% mortality). There are no data for circle hooks. The effect of circle hooks (compared to J-hooks) on the mortality rate of hard-shelled turtles is still unknown. In addition to ingestion of the hook, often considerable amounts of hook line is also ingested. Therefore, with the available information at present, it is not possible to determine whether circle hooks induce a significantly different overall mortality rate (lower or higher), than J shaped hooks.

SGRST/SGFEN notes that the previous STECF opinion on the use of different circle hooks and baits, reported on SEC(2005)369, is still valid and the consideration reported there can be retained.

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